AUTHENTIC RESTORATION PRODUCT

CHRYSLER CORPORATION

SERVICE MANUAL

1998
RAM TRUCK
1500 - 3500

To order the special service tools used and illustrated, please refer to the instructions on inside back cover.

CHRYSLER CORPORATION

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FOREWORD

The information contained in this service manual has been prepared for the professional automotive technician involved in daily repair operations. This manual does not cover theory of operation, which is addressed in service training material. Information describing the operation and use of standard and optional equipment is included in the Owner's Manual provided with the vehicle.

Information in this manual is divided into groups. These groups contain general information, diagnosis, testing, adjustments, removal, installation, disassembly, and assembly procedures for the systems and components. To assist in locating a group title page, use the Group Tab Locator on the following page. The solid bar after the group title is aligned to a solid tab on the first page of each group. The first page of the group has a contents section that lists major topics within the group. If you are not sure which Group contains the information you need, look up the Component/System in the alphabetical index located in the rear of this manual.

A Service Manual Comment form is included at the rear of this manual. Use the form to provide Chrysler Corporation with your comments and suggestions.

Tightening torques are provided as a specific value throughout this manual. This value represents the midpoint of the acceptable engineering torque range for a given fastener application. These torque values are intended for use in service assembly and installation procedures using the correct OEM fasteners. When replacing fasteners, always use the same type (part number) fastener as removed.

Chrysler Corporation reserves the right to change testing procedures, specifications, diagnosis, repair methods, or vehicle wiring at any time without prior notice or incurring obligation.

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GROUP TAB LOCATOR

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INTRODUCTION

CONTENTS

GENERAL INFORMATION

VEHICLE IDENTIFICATION NUMBER

The Vehicle Identification Number (VIN) plate is located on the lower windshield fence near the left A-pillar (Fig. 1). The VIN contains 17 characters that provide data concerning the vehicle. Refer to the VIN decoding chart to determine the identification of a vehicle.

The Vehicle Identification Number is also imprinted on the:

- Body Code Plate.
- Equipment Identification Plate.
- Vehicle Safety Certification Label.
- Frame rail.

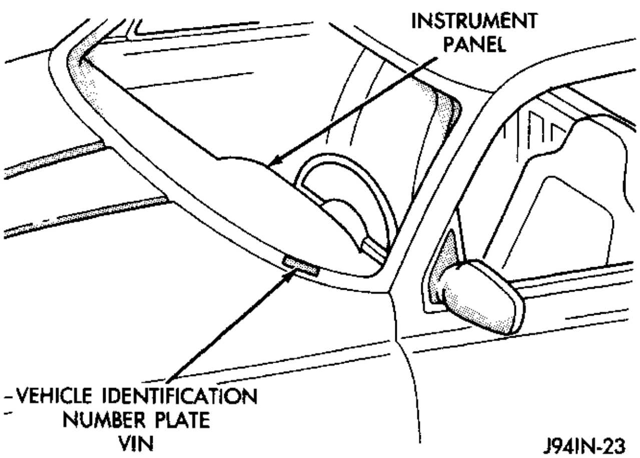

Fig. 1 Vehicle Identification Number (VIN) Location

To protect the consumer from theft and possible fraud the manufacturer is required to include a Check Digit at the ninth position of the Vehicle Identification Number. The check digit is used by the manufacturer and government agencies to verify the authenticity of the vehicle and official documentation. The formula to use the check digit is not released to the general public.

VEHICLE SAFETY CERTIFICATION LABEL

A certification label is attached to the left side B-pillar (Fig. 2). The label certifies that the vehicle conforms to Federal Motor Vehicle Safety Standards (FMVSS). The label also lists the:

- Month and year of vehicle manufacture.
- Gross Vehicle Weight Rating (GVWR). The gross front and rear axle weight ratings (GAWR's) are based on a minimum rim size and maximum cold tire inflation pressure.
- Vehicle Identification Number (VIN).
- Type of vehicle.
- Type of rear wheels.
- Bar code.
- Paint Code.
- Month, Day and Hour (MDH) of final assembly.

BODY CODE PLATE

The Body Code Plate (Fig. 3) is located on the floor pan under the passenger seat or attached to the front face of the radiator closure panel. There are seven lines of information on the body code plate. Lines 5, 6, and 7 are not used to define service information. Information reads from left to right, starting with line 4 in the center of the plate to line 1 at the bottom of the plate.

The last code imprinted on a vehicle code plate will be followed by the imprinted word END. When two vehicle code plates are required, the last available spaces on the first plate will be imprinted with the letters CTD (for continued).

When a second vehicle code plate is necessary, the first four spaces on each row will not be used because of the plate overlap.

GENERAL INFORMATION (Continued)

POSITION	INTERPRETATION	CODE = DESCRIPTION
1	Country of Origin	1 = United States 3 = Mexico
2	Make	B = Dodge
3	Vehicle Type	4 = Multipurpose Passenger 5 = Bus 6 = Incomplete 7 = Truck
4	Gross Vehicle Weight Rating	H = 6001-7000 J = 7001-8000 K = 8001-9000 L = 9001-10,000 M = 10,001-14,000 W = Hydraulic Brakes
5	Vehicle Line	C = Ram Cab Chassis/Ram Pick Up (4x2) F = Ram Cab Chassis/Ram Pick Up (4x4)
6	Series	1 = 1500 2 = 2500 3 = 3500
7	Body Style	2 = Club Cab 3 = Quad Cab 6 = Conventional Cab/Cab Chassis
8	Engine	D = 5.9L 6cyl. Diesel W = 8.0L 10 cyl. MPI X = 3.9L 6 cyl. MPI Y = 5.2L 8 cyl. MPI Z = 5.9L 8 cyl. MPI-LDC 5 = 5.9L 8cyl. MPI-HDC
9	Check Digit	
10	Model Year	W = 1998
11	Plant Location	J = St. Louis North S = Dodge City G = Saltillo M = Lago Alberto Assembly
12 thru 17	Vehicle Build Sequence	

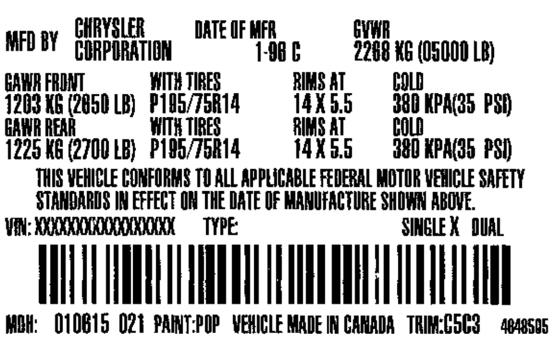

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Fig. 2 Vehicle Safety Certification Label—Typical

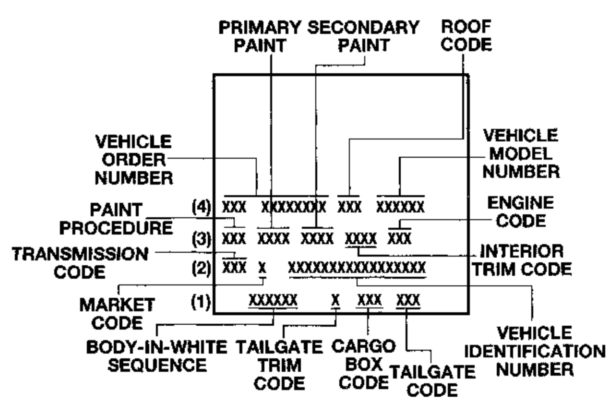

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Fig. 3 Body Code Plate

GENERAL INFORMATION (Continued)

BODY CODE PLATE—LINE 4

DIGITS 1 THROUGH 12
Vehicle Order Number

DIGITS 13, 14, AND 15
Open Space

DIGITS 16, 17, AND 18
Car Line Shell
- BR1 = 1500 4 X 2
- BE1 = 1500 4 X 2
- BR6 = 1500 4 X 4
- BE6 = 1500 4 X 4
- BR2 = 2500 4 X 2
- BE2 = 2500 4 X 2
- BR7 = 2500 4 X 4
- BE7 = 2500 4 X 4
- BR3 = 3500 4 X 2
- BE3 = 3500 4 X 2
- BR8 = 3500 4 X 4
- BE8 = 3500 4 X 4

DIGIT 19
Price Class
- L = Ram Truck (All)

DIGITS 20 AND 21
Body Type
- 31 = Ram Truck Club Cab (138.7 in. Wheel Base)
- 32 = Ram Truck Club Cab (154.7 in. Wheel Base)
- 33 = Ram Truck Quad Cab (138.7 in. Wheel Base)
- 34 = Ram Truck Quad Cab (154.7 in. Wheel Base)
- 61 = Ram Truck (118.7 in. Wheel Base)
- 62 = Ram Truck (134.7 in. Wheel Base)
- 63 = Ram Truck Cab Chassis (138.7 in. Wheel Base)
- 64 = Ram Truck Cab Chassis (162.7 in. Wheel Base)

BODY CODE PLATE—LINE 3

DIGITS 1,2, AND 3
Paint Procedure

DIGIT 4
Open Space

DIGITS 5 THROUGH 8
Primary Paint
Refer to Group 23, Body for color codes.

DIGIT 9
Open Space

DIGITS 10 THROUGH 13
Secondary Paint

DIGIT 14
Open Space

DIGITS 15 THROUGH 18
Interior Trim Code

DIGIT 19
Open Space

DIGITS 20, 21, AND 22
Engine Code
- EHC = 3.9 L 6 cyl. MPI Gasoline
- ELF = 5.2 L 8 cyl. MPI Gasoline
- ELN = 5.2 L 8 cyl. (CNG)
- EML = 5.9 L 8 cyl. MPI Gasoline
- EMM = 5.9 L 8 cyl. MPI Gasoline (Heavy Duty)
- ETB = 5.9 L 6 cyl. Turbo Diesel
- EWA = 8.0 L 10 cyl. MPI Gasoline

BODY CODE PLATE—LINE 2

DIGITS 1, 2, AND 3
Transmission Codes
- DGP = 4–speed Automatic (47RE)
- DGT = 4–speed Automatic (46RE)
- DGK = 4–speed Automatic (42RE)
- DDP = 5–speed Manual (NVG-4500)
- DDX = 5–speed Manual (NVG-4500 Heavy Duty)
- DDC = 5–speed Manual (NVG-3500)
- DEE = 6–speed Manual (NVG-5600)

DIGIT 4
Open Space

DIGIT 5
Market Code
- B = International
- C = Canada
- M = Mexico
- U = United States

DIGIT 6
Open Space

DIGITS 7 THROUGH 23
Vehicle Identification Number (VIN)
Refer to Vehicle Identification Number (VIN) paragraph for proper breakdown of VIN code.

BODY CODE PLATE—LINE 1

DIGITS 1 THROUGH 6
Body-in-white assembly sequence.

DIGIT 7
Open Space

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GENERAL INFORMATION (Continued)

DIGIT 8

Tailgate trim code.

DIGIT 9

Open Space

DIGITS 10 THROUGH 12

Cargo box code
- XBS = Sweptline

DIGIT 13

Open Space

DIGITS 14 THROUGH 16

Tailgate code
- MWD = Plain Tailgate

EQUIPMENT IDENTIFICATION PLATE

The Equipment Identification Plate (Fig. 4) is located at the left, front of the inner hood panel. The plate lists information concerning the vehicle as follows:

- The model.
- The wheelbase.
- The VIN (Vehicle Identification Number).
- The T.O.N. (order number).
- The optional and special equipment installed on the vehicle.

Refer to the information listed on the plate when ordering replacement parts.

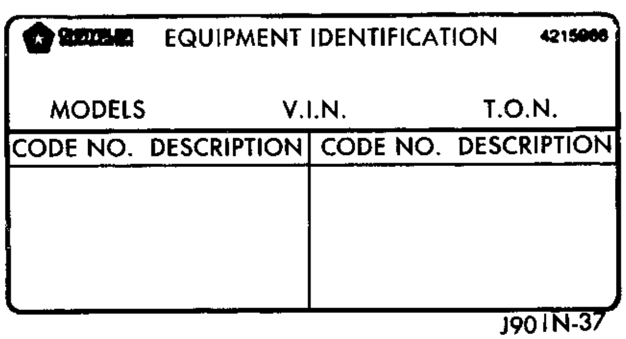

Fig. 4 Equipment Identification Plate

VEHICLE DIMENSIONS

The Vehicle Dimensions chart provides the dimensions for each type of Ram Truck. To determine model designation, refer to line 4 of the Body Code Plate.

EXTERIOR DIMENSIONS

MODEL: BE1L31

Wheel Base	138.2 in. (3509.2 mm.)
Track: Front	66.9 in. (1699.3 mm.)
Track: Rear	66.9 in. (1699.3 mm.)
Length	224.1 in. (5693.4 mm.)
Width	79.3 in. (2015.2 mm.)
Height	72.1 in. (1831.9 mm.)

MODEL: BE1L32

Wheel Base	154.1 in. (3915.0 mm.)
Track: Front	66.9 in. (1699.3 mm.)
Track: Rear	66.9 in. (1699.3 mm.)
Length	244.1 in. (2015.2 mm.)
Width	79.3 in. (2015.2 mm.)
Height	71.7 in. (1823.3 mm.)

MODEL: BE1L33

Wheel Base	138.2 in. (3509.2 mm.)
Track: Front	66.9 in. (1699.3 mm.)
Track: Rear	66.9 in. (1699.3 mm.)
Length	224.1 in. (5693.4 mm.)
Width	79.3 in. (2015.2 mm.)
Height	72.1 in. (1831.9 mm.)

MODEL: BE1L34

Wheel Base	154.1 in. (3915.0 mm.)
Track: Front	66.9 in. (1699.3 mm.)
Track: Rear	66.9 in. (1699.3 mm.)
Length	244.1 in. (2015.2 mm.)
Width	79.3 in. (2015.2 mm.)
Height	71.9 in. (1825.0 mm.)

MODEL: BR1L61

Wheel Base	118.2 in. (3001.2 mm.)
Track: Front	66.9 in. (1699.3 mm.)
Track: Rear	66.9 in. (1699.3 mm.)
Length	204.1 in. (5185.4 mm.)
Width	79.3 in. (2015.2 mm.)
Height	72.2 in. (1835.2 mm.)

MODEL: BR1L62

Wheel Base	134.2 in. (3407.6 mm.)
Track: Front	66.9 in. (1699.3 mm.)
Track: Rear	66.9 in. (1699.3 mm.)
Length	224.1 in. (5693.4 mm.)
Width	79.3 in. (2015.2 mm.)
Height	72.0 in. (1830.0 mm.)

MODEL: BE6L31

Wheel Base	138.5 in. (3518.2 mm.)
Track: Front	68.6 in. (1742.4 mm.)
Track: Rear	66.9 in. (1699.3 mm.)
Length	224.1 in. (5693.4 mm.)
Width	79.3 in. (2015.2 mm.)
Height	75.3 in. (1914.1 mm.)

MODEL: BE6L32

Wheel Base	154.1 in. (3915.0 mm.)
Track: Front	68.6 in. (1742.4 mm.)
Track: Rear	66.9 in. (1699.3 mm.)
Length	244.1 in. (6201.4 mm.)
Width	79.3 in. (2015.2 mm.)
Height	74.7 in. (1898.0 mm.)

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GENERAL INFORMATION (Continued)

MODEL: BE6L33
Wheel Base . . . . .138.5 in. (3518.2 mm.)
Track: Front . . . . .68.6 in. (1742.4 mm.)
Track: Rear . . . . .66.9 in. (1699.3 mm.)
Length. . . . . .224.1 in. (5693.4 mm.)
Width .79.3 in. (2015.2 mm.)
Height. . . . . .75.4 in. (1914.1 mm.)

MODEL: BE6L34
Wheel Base . . . . .154.1 in. (3915.0 mm.)
Track: Front . . . . .68.9 in. (1742.4 mm.)
Track: Rear . . . . .66.9 in. (1699.3 mm.)
Length. . . . . .244.1 in. (6201.4 mm.)
Width .79.3 in. (2015.2 mm.)
Height. . . . . .74.7 in. (1897.4 mm.)

MODEL: BR6L61
Wheel Base . . . . .118.5 in. (3010.6 mm.)
Track: Front . . . . .68.6 in. (1742.4 mm.)
Track: Rear . . . . .66.9 in. (1699.3 mm.)
Length. . . . . .204.1 in. (5185.4 mm.)
Width .79.3 in. (2015.2 mm.)
Height. . . . . .75.0 in. (1907.3 mm.)

MODEL: BR6L62
Wheel Base . . . . .134.5 in. (3416.6 mm.)
Track: Front . . . . .68.6 in. (1742.4 mm.)
Track: Rear . . . . .66.9 in. (1699.3 mm.)
Length. . . . . .224.1 in. (5693.4 mm.)
Width .79.3 in. (2015.2 mm.)
Height. . . . . .75.4 in. (1916.3 mm.)

MODEL: BE2L31
Wheel Base . . . . .138.6 in. (3520.4 mm.)
Track: Front . . . . .68.6 in. (1742.4 mm.)
Track: Rear . . . . .68.0 in. (1727.2 mm.)
Length. . . . . .224.1 in. (5693.4 mm.)
Width .79.3 in. (2015.2 mm.)
Height. . . . . .72.7 in. (1847.7 mm.)

MODEL: BE2L32
Wheel Base . . . . .154.6 in. (3926.8 mm.)
Track: Front . . . . .68.6 in. (1742.4 mm.)
Track: Rear . . . . .68.0 in. (1727.2 mm.)
Length. . . . . .244.1 in. (6201.4 mm.)
Width .79.3 in. (2015.2 mm.)
Height. . . . . .72.5 in. (1842.9 mm.)

MODEL: BE2L33
Wheel Base . . . . .138.6 in. (3520.4 mm.)
Track: Front . . . . .68.6 in. (1742.4 mm.)
Track: Rear . . . . .68.0 in. (1727.2 mm.)
Length. . . . . .224.1 in. (5693.4 mm.)
Width .79.3 in. (2015.2 mm.)
Height. . . . . .72.7 in. (1847.7 mm.)

MODEL: BE2L34
Wheel Base . . . . .154.6 in. (3926.8 mm.)
Track: Front . . . . .68.6 in. (1742.4 mm.)
Track: Rear . . . . .68.0 in. (1727.2 mm.)
Length. . . . . .244.1 in. (6201.4 mm.)
Width .79.3 in. (2015.2 mm.)
Height. . . . . .72.6 in. (1842.9 mm.)

MODEL: BR2L62
Wheel Base . . . . .134.6 in. (3418.8 mm.)
Track: Front . . . . .68.6 in. (1742.4 mm.)
Track: Rear . . . . .66.9 in. (1699.3 mm.)
Length. . . . . .224.1 in. (5693.4 mm.)
Width .79.3 in. (2015.2 mm.)
Height. . . . . .75.4 in. (1916.3 mm.)

MODEL: BE7L31
Wheel Base . . . . .138.7 in. (3522.6 mm.)
Track: Front . . . . .69.7 in. (1771.8 mm.)
Track: Rear . . . . .68.0 in. (1727.2 mm.)
Length. . . . . .224.1 in. (5693.4 mm.)
Width .79.3 in. (2015.2 mm.)
Height. . . . . .77.9 in. (1958.1 mm.)

MODEL: BE7L32
Wheel Base . . . . .154.7 in. (3929.0 mm.)
Track: Front . . . . .69.7 in. (1771.8 mm.)
Track: Rear . . . . .68.0 in. (1727.2 mm.)
Length. . . . . .244.1 in. (6201.4 mm.)
Width .79.3 in. (2015.2 mm.)
Height. . . . . .76.8 in. (1952.9 mm.)

MODEL: BE7L33
Wheel Base . . . . .138.7 in. (3522.6 mm.)
Track: Front . . . . .69.8 in. (1771.8 mm.)
Track: Rear . . . . .68.0 in. (1727.2 mm.)
Length. . . . . .224.1 in. (5693.4 mm.)
Width .79.3 in. (2015.2 mm.)
Height. . . . . .77.1 in. (1958.1 mm.)

MODEL: BE7L34
Wheel Base . . . . .154.7 in. (3929.0 mm.)
Track: Front . . . . .69.8 in. (1771.8 mm.)
Track: Rear . . . . .68.0 in. (1727.2 mm.)
Length. . . . . .244.1 in. (6201.4 mm.)
Width .79.3 in. (2015.2 mm.)
Height. . . . . .76.9 in. (1952.9 mm.)

MODEL: BR7L62
Wheel Base . . . . .134.7 in. (3421.0 mm.)
Track: Front . . . . .69.7 in. (1771.8 mm.)
Track: Rear . . . . .68.0 in. (1727.2 mm.)
Length. . . . . .224.1 in. (5693.4 mm.)
Width .79.3 in. (2015.2 mm.)
Height. . . . . .76.9 in. (1955.0 mm.)

GENERAL INFORMATION (Continued)

MODEL: BE3L32
Wheel Base . . . . .154.2 in. (3917.5 mm.)
Track: Front . . . . .69.7 in. (1771.8 mm.)
Track: Rear . . . . .73.0 in. (1854.2 mm.)
Length. . . . . .244.1 in. (6201.4 mm.)
Width .93.5 in. (2375.5 mm.)
Height. . . . . .72.9 in. (1852.0 mm.)

MODEL: BE3L34
Wheel Base . . . . .154.2 in. (3917.5 mm.)
Track: Front . . . . .69.8 in. (1771.8 mm.)
Track: Rear . . . . .102.2 in. (2594.7 mm.)
Length. . . . . .244.1 in. (6201.4 mm.)
Width .79.3 in. (2015.2 mm.)
Height. . . . . .72.9 in. (1852.0 mm.)

MODEL: BR3L62
Wheel Base . . . . .134.2 in. (3409.5 mm.)
Track: Front . . . . .69.7 in. (1771.8 mm.)
Track: Rear . . . . .73.0 in. (1854.2 mm.)
Length. . . . . .224.1 in. (5693.4 mm.)
Width .79.3 in. (2015.2 mm.)
Height. . . . . .72.9 in. (1853.3 mm.)

MODEL: BR3L63
Wheel Base . . . . .138.6 in. (3521.1 mm.)
Track: Front . . . . .69.8 in. (1771.8 mm.)
Track: Rear . . . . .73.0 in. (1854.2 mm.)
Length. . . . . .220.0 in. (5587.4 mm.)
Width .79.3 in. (2015.2 mm.)
Height. . . . . .77.1 in. (1957.1 mm.)

MODEL: BR3L64
Wheel Base . . . . .162.6 in. (4130.7 mm.)
Track: Front . . . . .69.8 in. (1771.8 mm.)
Track: Rear . . . . .73.0 in. (1854.2 mm.)
Length. . . . . .244.0 in. (6197.0 mm.)
Width .79.3 in. (2015.2 mm.)
Height. . . . . .76.9 in. (1952.8 mm.)

MODEL: BE8L32
Wheel Base . . . . .154.6 in. (3927.5 mm.)
Track: Front . . . . .69.7 in. (1771.8 mm.)
Track: Rear . . . . .73.0 in. (1854.2 mm.)
Length. . . . . .244.1 in. (6201.4 mm.)
Width .93.5 in. (2375.5 mm.)
Height. . . . . .77.0 in. (1956.1 mm.)

MODEL: BR8L63
Wheel Base . . . . .138.6 in. (3521.1 mm.)
Track: Front . . . . .69.8 in. (1771.8 mm.)
Track: Rear . . . . .73.0 in. (1854.2 mm.)
Length. . . . . .220.0 in. (5587.4 mm.)
Width .79.3 in. (2015.2 mm.)
Height. . . . . .77.1 in. (1957.1 mm.)

MODEL: BR8L64
Wheel Base . . . . .162.6 in. (4130.7 mm.)
Track: Front . . . . .69.8 in. (1771.8 mm.)
Track: Rear . . . . .73.0 in. (1854.2 mm.)
Length. . . . . .244.0 in. (6197.0 mm.)
Width .79.3 in. (2015.2 mm.)
Height. . . . . .76.9 in. (1954.4 mm.)

MODEL: BE8L34
Wheel Base . . . . .154.6 in. (3927.5 mm.)
Track: Front . . . . .69.8 in. (1771.8 mm.)
Track: Rear . . . . .102.2 in. (2594.7 mm.)
Length. . . . . .244.1 in. (6201.4 mm.)
Width .79.3 in. (2015.2 mm.)
Height. . . . . .77.0 in. (1956.1 mm.)

MODEL: BR8L62
Wheel Base . . . . .134.7 in. (3420.9 mm.)
Track: Front . . . . .69.7 in. (1771.8 mm.)
Track: Rear . . . . .73.0 in. (1854.2 mm.)
Length. . . . . .224.1 in. (5693.4 mm.)
Width .79.3 in. (2015.2 mm.)
Height. . . . . .77.4 in. (1966.3 mm.)

INTERIOR DIMENSIONS

Head Room-Front . . . . .40.1 in. (1017.7 mm.)
Head Room-Front (Quad/Club Cab) . . . . .40.4 in. (1025.7 mm.)
Head Room-Rear (Quad/Club Cab) . . . . .39.3 in. (999.3 mm.)
Leg-Front . . . . .41.0 in. (1041.2 mm.)
Leg-Rear (Quad/Club Cab) . . . . .33.2 in. (843.5 mm.)
Shoulder-Front . . . . .66.5 in. (1688.2 mm.)
Shoulder-Rear (Quad/Club Cab) . . . . .67.2 in. (1706.8 mm.)
Hip-Front . . . . .63.6 in. (1616.0 mm.)
Hip-Rear (Quad/Club Cab) . . . .65.1 in. (1652.5 mm.)

INTERNATIONAL VEHICLE CONTROL AND DISPLAY SYMBOLS

INTERNATIONAL VEHICLE CONTROL AND DISPLAY SYMBOLS

The graphic symbols illustrated in the following chart (Fig. 5) are used to identify various instrument controls. The symbols correspond to the controls and displays that are located on the instrument panel.

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GENERAL INFORMATION (Continued)

INTERNATIONAL CONTROL AND DISPLAY SYMBOLS

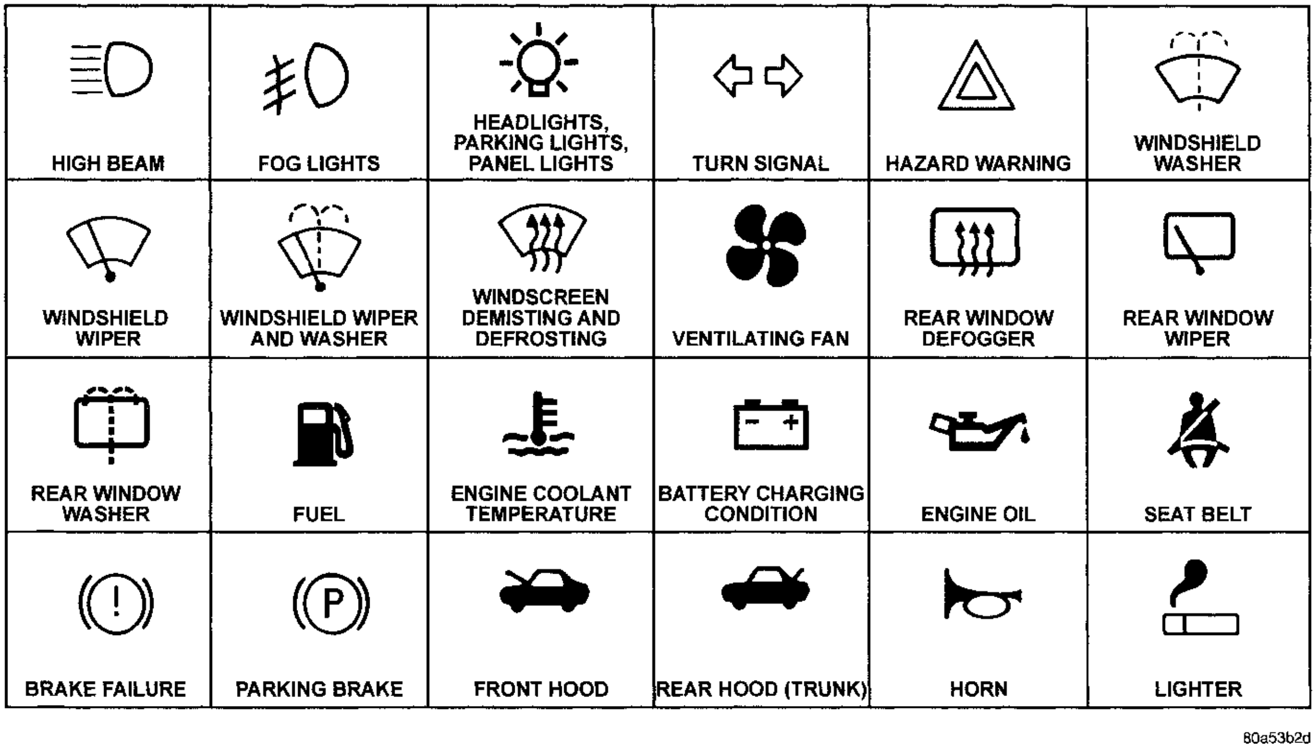


Fig. 5

FASTENER IDENTIFICATION

FASTENER IDENTIFICATION

THREAD IDENTIFICATION

SAE and metric bolt/nut threads are not the same. The difference is described in the Thread Notation chart (Fig. 6).

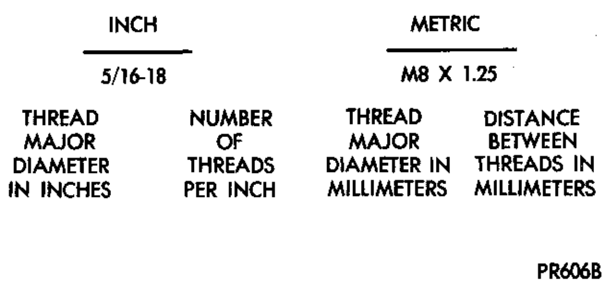


Fig. 6 Thread Notation—SAE and Metric

GRADE/CLASS IDENTIFICATION

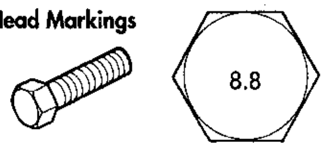
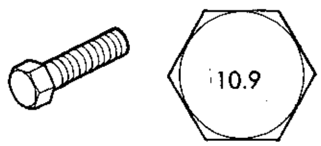
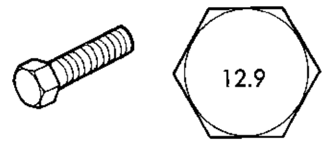
The SAE bolt strength grades range from grade 2 to grade 8. The higher the grade number, the greater the bolt strength. Identification is determined by the line marks on the top of each bolt head. The actual bolt strength grade corresponds to the number of line marks plus 2. The most commonly used metric bolt strength classes are 9.8 and 12.9. The metric strength class identification number is imprinted on the head of the bolt. The higher the class number, the greater the bolt strength. Some metric nuts are imprinted with a single-digit strength class on the nut face. Refer to the Fastener Identification and Fastener Strength Charts.

Mopar AUTHENTIC RESTORATION PRODUCT

GENERAL INFORMATION (Continued)

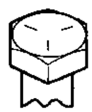
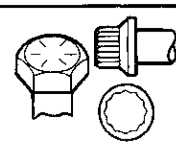
FASTENER IDENTIFICATION

Bolt Markings and Torque - Metric

Commercial Steel Class	8.8	10.9	12.9
Bolt Head Markings			

Body Size	Torque				Torque				Torque			
Diam.	Cast Iron		Aluminum		Cast Iron		Aluminum		Cast Iron		Aluminum	
mm	N•m	ft-lb	N•m	ft-lb	N•m	ft-lb	N•m	ft-lb	N•m	ft-lb	N•m	ft-lb
6	9	5	7	4	14	9	11	7	14	9	11	7
7	14	9	11	7	18	14	14	11	23	18	18	14
8	25	18	18	14	32	23	25	18	36	27	28	21
10	40	30	30	25	60	45	45	35	70	50	55	40
12	70	55	55	40	105	75	80	60	125	95	100	75
14	115	85	90	65	160	120	125	95	195	145	150	110
16	180	130	140	100	240	175	190	135	290	210	220	165
18	230	170	180	135	320	240	250	185	400	290	310	230

Bolt Markings and Torque Values - U.S. Customary

SAE Grade Number	5	8
Bolt Head Markings These are all SAE Grade 5 (3) line 		

Body Size	Bolt Torque - Grade 5 Bolt				Bolt Torque - Grade 8 Bolt			
	Cast Iron		Aluminum		Cast Iron		Aluminum	
	N•m	ft-lb	N•m	ft-lb	N•m	ft-lb	N•m	ft-lb
1/4 - 20	9	7	8	6	15	11	12	9
- 28	12	9	9	7	18	13	14	10
5/16 - 18	20	15	16	12	30	22	24	18
- 24	23	17	19	14	33	24	25	19
3/8 - 16	40	30	25	20	55	40	40	30
- 24	40	30	35	25	60	45	45	35
7/16 - 14	60	45	45	35	90	65	65	50
- 20	65	50	55	40	95	70	75	55
1/2 - 13	95	70	75	55	130	95	100	75
- 20	100	75	80	60	150	110	120	90
9/16 - 12	135	100	110	80	190	140	150	110
- 18	150	110	115	85	210	155	170	125
5/8 - 11	180	135	150	110	255	190	205	150
- 18	210	155	160	120	290	215	230	170
3/4 - 10	325	240	255	190	460	340	365	270
- 16	365	270	285	210	515	380	410	300
7/8 - 9	490	360	380	280	745	550	600	440
- 14	530	390	420	310	825	610	660	490
1 - 8	720	530	570	420	1100	820	890	660
- 14	800	590	650	480	1200	890	960	710

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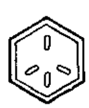
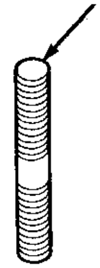
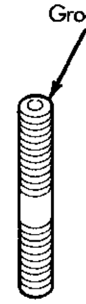
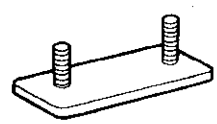
Mopar AUTHENTIC RESTORATION PRODUCT

GENERAL INFORMATION (Continued)

FASTENER STRENGTH

HOW TO DETERMINE BOLT STRENGTH

	Mark	Class
Hexagon head bolt	 Bolt head No. 4 — 5 — 6 — 7 — 8 — 9 — 10 — 11 —	4T 5T 6T 7T 8T 9T 10T 11T
	 No mark	4T
Hexagon flange bolt w/washer hexagon bolt	 No mark	4T
Hexagon head bolt	 Two protruding lines	5T
Hexagon flange bolt w/washer hexagon bolt	 Two protruding lines	6T
Hexagon head bolt	 Three protruding lines	7T
Hexagon head bolt	 Four protruding lines	8T

	Mark	Class
Stud bolt	No mark 	4T
	Grooved 	6T
Welded bolt		4T

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GENERAL INFORMATION (Continued)

FASTENER USAGE

WARNING: USE OF AN INCORRECT FASTENER MAY RESULT IN COMPONENT DAMAGE OR PERSONAL INJURY.

Figure art, specifications and torque references in this Service Manual are identified in metric and SAE format.

During any maintenance or repair procedures, it is important to salvage all fasteners (nuts, bolts, etc.) for reassembly. If the fastener is not salvageable, a fastener of equivalent specification must be used.

THREADED HOLE REPAIR

Most stripped threaded holes can be repaired using a Helicoil®. Follow the manufactures recommendations for application and repair procedures.

METRIC SYSTEM

WARNING: USE OF AN INCORRECT FASTENER MAY RESULT IN COMPONENT DAMAGE OR PERSONAL INJURY.

Figure art, specifications and torque references in this Service Manual are identified in metric and SAE format.

During any maintenance or repair procedures, it is important to salvage metric fasteners (nuts, bolts, etc.) for reassembly. If the fastener is not salvageable, a fastener of equivalent specification should be used.

The metric system is based on quantities of one, ten, one hundred, one thousand and one million (Fig. 7).

Mega	- (M) Million	Deci	- (D) Tenth
Kilo	- (K) Thousand	Centi	- (C) Hundreth
Milli	- (m) Thousandth		

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Fig. 7 Metric Prefixes

The following chart will assist in converting metric units to equivalent English and SAE units, or vise versa.

Refer to the Conversion Chart to convert torque values listed in metric Newton- meters (N·m). Also, use the chart to convert between millimeters (mm) and inches (in.)

TORQUE REFERENCES

Individual Torque Charts appear at the end of many Groups. Refer to the Standard Torque Specifications Chart for torque references not listed in the individual torque charts.

CONVERSION FORMULAS AND EQUIVALENT VALUES

Multiply	By	To Get	Multiply	By	To Get
in-lbs	x 0.11298	= Newton-Meters (N•m)	N•m	x 8.851	= in-lbs
ft-lbs	x 1.3558	= Newton-Meters (N•m)	N•m	x 0.7376	= ft-lbs
Inches Hg (60°F)	x 3.377	= Kilopascals (kPa)	kPa	x 0.2961	= Inches Hg
psi	x 6.895	= Kilopascals (kPa)	kPa	x 0.145	= psi
Inches	x 25.4	= Millimeters (mm)	mm	x 0.03937	= Inches
Feet	x 0.3048	= Meters (M)	M	x 3.281	= Feet
Yards	x 0.9144	= Meters (M)	M	x 1.0936	= Yards
Miles	x 1.6093	= Kilometers (Km)	Km	x 0.6214	= Miles
mph	x 1.6093	= Kilometers/Hr. (Km/h)	Km/h	x 0.6214	= mph
Feet/Sec.	x 0.3048	= Meters/Sec. (M/S)	M/S	x 3.281	= Feet/Sec.
Kilometers/Hr.	x 0.27778	= Meters/Sec. (M/S)	M/S	x 3.600	= Kilometers/Hr.
mph	x 0.4470	= Meters/Sec. (M/S)	M/S	x 2.237	= mph

COMMON METRIC EQUIVALENTS

1 Inch = 25 Millimeters	1 Cubic Inch = 16 Cubic Centimeters
1 Foot = 0.3 Meter	1 Cubic Foot = 0.03 Cubic Meter
1 Yard = 0.9 Meter	1 Cubic Yard = 0.8 Cubic Meter
1 Mile = 1.6 Kilometers	

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Mopar AUTHENTIC RESTORATION PRODUCT

GENERAL INFORMATION (Continued)

METRIC CONVERSION

in-lbs to N•m

in-lb	N•m	in-lb	N•m	in-lb	N•m	in-lb	N•m	in-lb	N•m
2	.2260	42	4.7453	82	9.2646	122	13.7839	162	18.3032
4	.4519	44	4.9713	84	9.4906	124	14.0099	164	18.5292
6	.6779	46	5.1972	86	9.7165	126	14.2359	166	18.7552
8	.9039	48	5.4232	88	9.9425	128	14.4618	168	18.9811
10	1.1298	50	5.6492	90	10.1685	130	14.6878	170	19.2071
12	1.3558	52	5.8751	92	10.3944	132	14.9138	172	19.4331
14	1.5818	54	6.1011	94	10.6204	134	15.1397	174	19.6590
16	1.8077	56	6.3270	96	10.8464	136	15.3657	176	19.8850
18	2.0337	58	6.5530	98	11.0723	138	15.5917	178	20.1110
20	2.2597	60	6.7790	100	11.2983	140	15.8176	180	20.3369
22	2.4856	62	7.0049	102	11.5243	142	16.0436	182	20.5629
24	2.7116	64	7.2309	104	11.7502	144	16.2696	184	20.7889
26	2.9376	66	7.4569	106	11.9762	146	16.4955	186	21.0148
28	3.1635	68	7.6828	108	12.2022	148	16.7215	188	21.2408
30	3.3895	70	7.9088	110	12.4281	150	16.9475	190	21.4668
32	3.6155	72	8.1348	112	12.6541	152	17.1734	192	21.6927
34	3.8414	74	8.3607	114	12.8801	154	17.3994	194	21.9187
36	4.0674	76	8.5867	116	13.1060	156	17.6253	196	22.1447
38	4.2934	78	8.8127	118	13.3320	158	17.8513	198	22.3706
40	4.5193	80	9.0386	120	13.5580	160	18.0773	200	22.5966

N•m to in-lbs

N•m	in-lb	N•m	in-lb	N•m	in-lb	N•m	in-lb	N•m	in-lb
.2	1.7702	4.2	37.1747	8.2	72.5792	12.2	107.9837	16.2	143.3882
.4	3.5404	4.4	38.9449	8.4	74.3494	12.4	109.7539	16.4	145.1584
.6	5.3107	4.6	40.7152	8.6	76.1197	12.6	111.5242	16.6	146.9287
.8	7.0809	4.8	42.4854	8.8	77.8899	12.8	113.2944	16.8	148.6989
1	8.8511	5	44.2556	9	79.6601	13	115.0646	17	150.4691
1.2	10.6213	5.2	46.0258	9.2	81.4303	13.2	116.8348	17.2	152.2393
1.4	12.3916	5.4	47.7961	9.4	83.2006	13.4	118.6051	17.4	154.0096
1.6	14.1618	5.6	49.5663	9.6	84.9708	13.6	120.3753	17.6	155.7798
1.8	15.9320	5.8	51.3365	9.8	86.7410	13.8	122.1455	17.8	157.5500
2	17.7022	6	53.1067	10	88.5112	14	123.9157	18	159.3202
2.2	19.4725	6.2	54.8770	10.2	90.2815	14.2	125.6860	18.5	163.7458
2.4	21.2427	6.4	56.6472	10.4	92.0517	14.4	127.4562	19	168.1714
2.6	23.0129	6.6	58.4174	10.6	93.8219	14.6	129.2264	19.5	172.5970
2.8	24.7831	6.8	60.1876	10.8	95.5921	14.8	130.9966	20	177.0225
3	26.5534	7	61.9579	11	97.3624	15	132.7669	20.5	181.4480
3.2	28.3236	7.2	63.7281	11.2	99.1326	15.2	134.5371	21	185.8736
3.4	30.0938	7.4	65.4983	11.4	100.9028	15.4	136.3073	22	194.7247
3.6	31.8640	7.6	67.2685	11.6	102.6730	15.6	138.0775	23	203.5759
3.8	33.6342	7.8	69.0388	11.8	104.4433	15.8	139.8478	24	212.4270
4	35.4045	8	70.8090	12	106.2135	16	141.6180	25	221.2781

ft-lbs to N•m

ft-lb	N•m	ft-lb	N•m	ft-lb	N•m	ft-lb	N•m	ft-lb	N•m
1	1.3558	21	28.4722	41	55.5885	61	82.7049	81	109.8212
2	2.7116	22	29.8280	42	56.9444	62	84.0607	82	111.1770
3	4.0675	23	31.1838	43	58.3002	63	85.4165	83	112.5328
4	5.4233	24	32.5396	44	59.6560	64	86.7723	84	113.8888
5	6.7791	25	33.8954	45	61.0118	65	88.1281	85	115.2446
6	8.1349	26	35.2513	46	62.3676	66	89.4840	86	116.6004
7	9.4907	27	36.6071	47	63.7234	67	90.8398	87	117.9562
8	10.8465	28	37.9629	48	65.0793	68	92.1956	88	119.3120
9	12.2024	29	39.3187	49	66.4351	69	93.5514	89	120.6678
10	13.5582	30	40.6745	50	67.7909	70	94.9073	90	122.0236
11	14.9140	31	42.0304	51	69.1467	71	96.2631	91	123.3794
12	16.2698	32	43.3862	52	70.5025	72	97.6189	92	124.7352
13	17.6256	33	44.7420	53	71.8583	73	98.9747	93	126.0910
14	18.9815	34	46.0978	54	73.2142	74	100.3316	94	127.4468
15	20.3373	35	47.4536	55	74.5700	75	101.6862	95	128.8026
16	21.6931	36	48.8094	56	75.9258	76	103.0422	96	130.1586
17	23.0489	37	50.1653	57	77.2816	77	104.3980	97	131.5144
18	24.4047	38	51.5211	58	78.6374	78	105.7538	98	132.8702
19	25.7605	39	52.8769	59	79.9933	79	107.1196	99	134.2260
20	27.1164	40	54.2327	60	81.3491	80	108.4654	100	135.5820

N•m to ft-lbs

N•m	ft-lb	N•m	ft-lb	N•m	ft-lb	N•m	ft-lb	N•m	ft-lb
1	.7376	21	15.9888	41	30.2400	61	44.9913	81	59.7425
2	1.4751	22	16.2264	42	30.9776	62	45.7289	82	60.4801
3	2.2127	23	16.9639	43	31.7152	63	46.4664	83	61.2177
4	2.9502	24	17.7015	44	32.4527	64	47.2040	84	61.9552
5	3.6878	25	18.4391	45	33.1903	65	47.9415	85	62.6928
6	4.4254	26	19.1766	46	33.9279	66	48.6791	86	63.4303
7	5.1629	27	19.9142	47	34.6654	67	49.4167	87	64.1679
8	5.9005	28	20.6517	48	35.4030	68	50.1542	88	64.9545
9	6.6381	29	21.3893	49	36.1405	69	50.8918	89	65.6430
10	7.3756	30	22.1269	50	36.8781	70	51.6293	90	66.3806
11	8.1132	31	22.8644	51	37.6157	71	52.3669	91	67.1181
12	8.8507	32	23.6020	52	38.3532	72	53.1045	92	67.8557
13	9.5883	33	24.3395	53	39.0908	73	53.8420	93	68.5933
14	10.3259	34	25.0771	54	39.8284	74	54.5720	94	69.3308
15	11.0634	35	25.8147	55	40.5659	75	55.3172	95	70.0684
16	11.8010	36	26.5522	56	41.3035	76	56.0547	96	70.8060
17	12.5386	37	27.2898	57	42.0410	77	56.7923	97	71.5435
18	13.2761	38	28.0274	58	42.7786	78	57.5298	98	72.2811
19	14.0137	39	28.7649	59	43.5162	79	58.2674	99	73.0187
20	14.7512	40	29.5025	60	44.2537	80	59.0050	100	73.7562

in. to mm

in.	mm	in.	mm	in.	mm	in.	mm	in.	mm
.01	.254	.21	5.334	.41	10.414	.61	15.494	.81	20.574
.02	.508	.22	5.588	.42	10.668	.62	15.748	.82	20.828
.03	.762	.23	5.842	.43	10.922	.63	16.002	.83	21.082
.04	1.016	.24	6.096	.44	11.176	.64	16.256	.84	21.336
.05	1.270	.25	6.350	.45	11.430	.65	16.510	.85	21.590
.06	1.524	.26	6.604	.46	11.684	.66	16.764	.86	21.844
.07	1.778	.27	6.858	.47	11.938	.67	17.018	.87	22.098
.08	2.032	.28	7.112	.48	12.192	.68	17.272	.88	22.352
.09	2.286	.29	7.366	.49	12.446	.69	17.526	.89	22.606
.10	2.540	.30	7.620	.50	12.700	.70	17.780	.90	22.860
.11	2.794	.31	7.874	.51	12.954	.71	18.034	.91	23.114
.12	3.048	.32	8.128	.52	13.208	.72	18.288	.92	23.368
.13	3.302	.33	8.382	.53	13.462	.73	18.542	.93	23.622
.14	3.556	.34	8.636	.54	13.716	.74	18.796	.94	23.876
.15	3.810	.35	8.890	.55	13.970	.75	19.050	.95	24.130
.16	4.064	.36	9.144	.56	14.224	.76	19.304	.96	24.384
.17	3.318	.37	9.398	.57	14.478	.77	19.558	.97	24.638
.18	4.572	.38	9.652	.58	14.732	.78	19.812	.98	24.892
.19	4.826	.39	9.906	.59	14.986	.79	20.066	.99	25.146
.20	5.080	.40	10.160	.60	15.240	.80	20.320	1.00	25.400

mm to in.

mm	in.	mm	in.	mm	in.	mm	in.	mm	in.
.01	.00039	.21	.00827	.41	.01614	.61	.02402	.81	.03189
.02	.00079	.22	.00866	.42	.01654	.62	.02441	.82	.03228
.03	.00118	.23	.00906	.43	.01693	.63	.02480	.83	.03268
.04	.00157	.24	.00945	.44	.01732	.64	.02520	.84	.03307
.05	.00197	.25	.00984	.45	.01772	.65	.02559	.85	.03346
.06	.00236	.26	.01024	.46	.01811	.66	.02598	.86	.03386
.07	.00276	.27	.01063	.47	.01850	.67	.02638	.87	.03425
.08	.00315	.28	.01102	.48	.01890	.68	.02677	.88	.03465
.09	.00354	.29	.01142	.49	.01929	.69	.02717	.89	.03504
.10	.00394	.30	.01181	.50	.01969	.70	.02756	.90	.03543
.11	.00433	.31	.01220	.51	.02008	.71	.02795	.91	.03583
.12	.00472	.32	.01260	.52	.02047	.72	.02835	.92	.03622
.13	.00512	.33	.01299	.53	.02087	.73	.02874	.93	.03661
.14	.00551	.34	.01339	.54	.02126	.74	.02913	.94	.03701
.15	.00591	.35	.01378	.55	.02165	.75	.02953	.95	.03740
.16	.00630	.36	.01417	.56	.02205	.76	.02992	.96	.03780
.17	.00669	.37	.01457	.57	.02244	.77	.03032	.97	.03819
.18	.00709	.38	.01496	.58	.02283	.78	.03071	.98	.03858
.19	.00748	.39	.01535	.59	.02323	.79	.03110	.99	.03898
.20	.00787	.40	.01575	.60	.02362	.80	.03150	1.00	.03937

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GENERAL INFORMATION (Continued)

TORQUE SPECIFICATIONS

SPECIFIED TORQUE FOR STANDARD BOLTS

Class	Diameter mm	Pitch mm	Specified torque					
			Hexagon head bolt			Hexagon flange bolt		
			N•m	kgf-cm	ft-lbf	N•m	kgf-cm	ft-lbf
4T	6	1	5	55	48 in.-lbf	6	60	52 in.-lbf
	8	1.25	12.5	130	9	14	145	10
	10	1.25	26	260	19	29	290	21
	12	1.25	47	480	35	53	540	39
	14	1.5	74	760	55	84	850	61
	16	1.5	115	1,150	83	—	—	—
5T	6	1	6.5	65	56 in.-lbf	7.5	75	65 in.-lbf
	8	1.25	15.5	160	12	17.5	175	13
	10	1.25	32	330	24	36	360	26
	12	1.25	59	600	43	65	670	48
	14	1.5	91	930	67	100	1,050	76
	16	1.5	140	1,400	101	—	—	—
6T	6	1	8	80	69 in.-lbf	9	90	78 in.-lbf
	8	1.25	19	195	14	21	210	15
	10	1.25	39	400	29	44	440	32
	12	1.25	71	730	53	80	810	59
	14	1.5	110	1,100	80	125	1,250	90
	16	1.5	170	1,750	127	—	—	—
7T	6	1	10.5	110	8	12	120	9
	8	1.25	25	260	19	28	290	21
	10	1.25	52	530	38	58	590	43
	12	1.25	95	970	70	105	1,050	76
	14	1.5	145	1,500	108	165	1,700	123
	16	1.5	230	2,300	166	—	—	—
8T	8	1.25	29	300	22	33	330	24
	10	1.25	61	620	45	68	690	50
	12	1.25	110	1,100	80	120	1,250	90
9T	8	1.25	34	340	25	37	380	27
	10	1.25	70	710	51	78	790	57
	12	1.25	125	1,300	94	140	1,450	105
10T	8	1.25	38	390	28	42	430	31
	10	1.25	78	800	58	88	890	64
	12	1.25	140	1,450	105	155	1,600	116
11T	8	1.25	42	430	31	47	480	35
	10	1.25	87	890	64	97	990	72
	12	1.25	155	1,600	116	175	1,800	130

Mopar AUTHENTIC RESTORATION PRODUCT

LUBRICATION AND MAINTENANCE

CONTENTS

GENERAL INFORMATION

INDEX

GENERAL INFORMATION

INTRODUCTION

Service and maintenance procedures for components and systems listed in Schedule – A or B can be found by using the Group Tab Locator index at the front of this manual. If it is not clear which group contains the information needed, refer to the index at the back of this manual.

There are two maintenance schedules that show proper service based on the conditions that the vehicle is subjected to.

Schedule – **A**, lists scheduled maintenance to be performed when the vehicle is used for general transportation.

Schedule – **B**, lists maintenance intervals for vehicles that are operated under the conditions listed at the beginning of the Maintenance Schedule section.

Use the schedule that best describes your driving conditions.

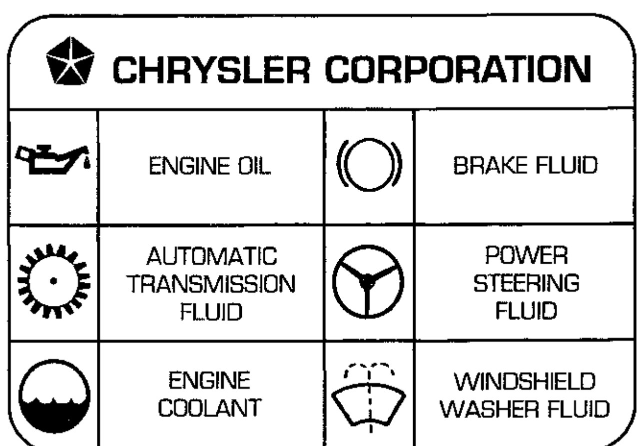
Where time and mileage are listed, follow the interval that occurs first.

PARTS AND LUBRICANT RECOMMENDATIONS

When service is required, Chrysler Corporation recommends that only Mopar® brand parts, lubricants and chemicals be used. Mopar provides the best engineered products for servicing Chrysler Corporation vehicles.

INTERNATIONAL SYMBOLS

Chrysler Corporation uses international symbols to identify engine compartment lubricant and fluid inspection and fill locations (Fig. 1).



9500-1

Fig. 1 International Symbols

GENERAL INFORMATION (Continued)

CLASSIFICATION OF LUBRICANTS

Only lubricants that are endorsed by the following organization should be used to service a Chrysler Corporation vehicle.

- Society of Automotive Engineers (SAE)
- American Petroleum Institute (API) (Fig. 2)
- National Lubricating Grease Institute (NLGI) (Fig. 3)

Fig. 2 API Symbol

GASOLINE ENGINE OIL

SAE VISCOSITY RATING INDICATES ENGINE OIL VISCOSITY

An SAE viscosity grade is used to specify the viscosity of engine oil. SAE 30 specifies a single viscosity engine oil. Engine oils also have multiple viscosities. These are specified with a dual SAE viscosity grade which indicates the cold-to-hot temperature viscosity range.

- SAE 30 = single grade engine oil.
- SAE 10W-30 = multiple grade engine oil.

API QUALITY CLASSIFICATION

The API Service Grade specifies the type of performance the engine oil is intended to provide. The API Service Grade specifications also apply to energy conserving engine oils.

Use engine oils that are API Service Certified. 5W-30 and 10W-30 MOPAR engine oils conform to specifications.

Refer to Group 9, Engine for gasoline engine oil specification.

DIESEL ENGINE OIL

ENGINE OIL QUALITY

Use only oils conforming to API Quality CE, or CE/SG. A sulfated ash limit is specified for lubrication oil used in Cummins engines. Oils with a high ash content may produce deposits on valves that can progress to guttering and valve burning. A maximum sulfated ash content of 1.85 mass % is recommended for all oil used in the engine.

Refer to Group 9, Engine for diesel engine oil specification.

GEAR LUBRICANTS

SAE ratings also apply to multiple grade gear lubricants. In addition, API classification defines the lubricants usage.

LUBRICANTS AND GREASES

Lubricating grease is rated for quality and usage by the NLGI. All approved products have the NLGI symbol (Fig. 3) on the label. At the bottom NLGI symbol is the usage and quality identification letters. Wheel bearing lubricant is identified by the letter "G". Chassis lubricant is identified by the latter "L". The letter following the usage letter indicates the quality of the lubricant. The following symbols indicate the highest quality.

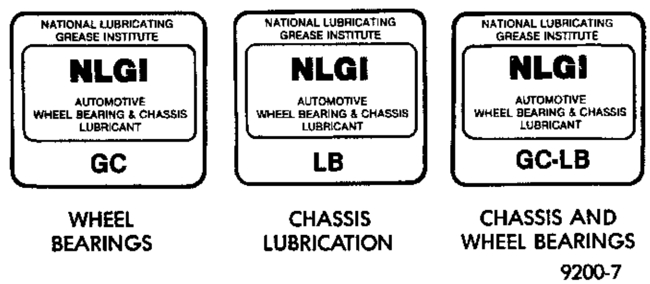


Fig. 3 NLGI Symbol

FLUID CAPACITIES

FUEL TANK

119 inch wheel base	98 L (26 gal.)
135 inch wheel base	98 L (26 gal.)
All others	132 L (35 gal.)

ENGINE OIL W/FILTER CHANGE

3.9L	3.8 L (4.0 qts.)
5.2L & 5.9L Gasoline	4.7 L (5.0 qts.)
5.9L Diesel	10.4 L (11.0 qts.)
8.0 L	6.6 L (7.0 qts.)

ENGINE OIL W/O FILTER CHANGE

3.9L	3.3 L (3.5 qts.)
5.2L & 5.9L Gasoline	4.3 L (4.5 qts.)
5.9L Diesel*	
8.0L*	

*Oil filter must be changed with every oil change.

COOLING SYSTEM

3.9L	19 L (20 qts.)
5.2L	19 L (20 qts.)
5.9L Gas	19 L (20 qts.)
5.9L Diesel	24.5 L (26.0 qts.)
8.0L	22.7 L (24.0 qts.)

Mopar AUTHENTIC RESTORATION PRODUCT

GENERAL INFORMATION (Continued)

AUTOMATIC TRANSMISSION

Dry fill capacity*

42RE .8.0-10.4 L (17-22 pts.)
46RE . . . . .9-11 L (19-23 pts.)
47RE . . . . .14-16 L (29-33 pts.)

*Depending on type and size of internal cooler, length and inside diameter of cooler lines, or use of an auxiliary cooler, these figures may vary. Refer to Group 21, Transmission for proper fluid fill procedure.

MANUAL TRANSMISSION

NV3500 . . . . .2.0 L (4.2 pts.)
NV4500 . . . . .3.8 L (8.0 pts.)
NV4500 HD. .3.8 L (8.0 pts.)
NV5600 . . . . .4.5 L (9.5 pts.)

TRANSFER CASE

NV231 HD. . . . . .1.2 L (2.5 pts.)
NV241 . . . . .2.7 L (5.0 pts.)
NV241 HD. . . . . .3.5 L (6.5 pts.)
NV241 HD W/PTO . . . . .4.9 L (9.0 pts.)

POWER TAKE OFF ADAPTER

NV021 . . . . .2.1 L (4.6 pts.)

FRONT AXLE

216-FBI . . . . .2.3 L (4.8 pts.)
248-FBI . . . . .3.6 L (7.6 pts.)

REAR AXLE

9-1/4 inch. . . . . .2.3 L (4.9 pts.)
248-RBI . . . . .3.0 L (6.3 pts.)
267-RBI . . . . .3.3 L (7.0 pts.)
286-RBI (2WD) . . . . .3.2 L (6.8 pts.)
286-RBI (4WD) . . . . .4.8 L (10.1 pts.)

REAR AXLE—LIMITED SLIP DIFFERENTIAL

248-RBI . . . . .3.0 L (6.3 pts.*)
267-RBI . . . . .3.3 L (7.0 pts.*)
286-RBI (2WD) . . . . .3.2 L (6.8 pts.*)
286-RBI (4WD). . . . . .4.8 L (10.1 pts.**)

* Include 0.05 L (0.25 pts.) friction modifier.
** Include 0.19 L (0.4 pts.) friction modifier.

POWER STEERING

All . . . . .1.3 L (2.7 pts.)

Mopar AUTHENTIC RESTORATION PRODUCT

MAINTENANCE SCHEDULES—LIGHT DUTY VEHICLES

INDEX

GENERAL INFORMATION

INTRODUCTION

The following is a list of Maintenance Schedules for Light Duty Cycle vehicles (1500 and 2500 Models Except 8.0L).

There are two maintenance schedules that show proper service based on the conditions that the vehicle is subjected to. Use the schedule that best describes these conditions.

Schedule—**A**, lists all the scheduled maintenance to be performed under "normal" operating conditions for Light Duty vehicles.

Schedule—**B**, lists maintenance recommended for Light Duty vehicles operated under the following conditions:

- Frequent short trip driving less than 5 miles (8 km)
- Frequent driving in dusty conditions
- Frequent trailer towing
- Extensive idling
- More than 50% of your driving is at sustained high speeds during hot weather, above 90°F (32°C)

Where time and mileage are listed, follow the interval that occurs first.

EMISSION CONTROL SYSTEM MAINTENANCE

The scheduled emission maintenance listed in **bold type** on the Maintenance Schedules, must be done at the mileage specified to assure the continued proper functioning of the emission control system. These, and all other maintenance services included in this manual, should be done to provide the best vehicle performance and reliability. More frequent maintenance may be needed for vehicles in severe operating conditions such as dusty areas and very short trip driving.

UNSCHEDULED INSPECTION

At Each Stop For Fuel

- Check engine oil level and add as required.
- Check windshield washer solvent and add as required.
- Clean windshield and wiper blades as required.

Once A Month

- Check tire pressure and look for unusual wear or damage.
- Inspect battery and clean and tighten terminals as required.
- Check fluid levels of coolant reservoir, brake master cylinder, power steering, and transmission and add as needed.
- Check all lights and all other electrical items for correct operation.
- Inspect and clean wiper blades. Replace if required.

At Each Oil Change

- Inspect exhaust system.
- Inspect brake hoses.
- Adjust rear brakes.
- Rotate the tires at each oil change interval shown on Schedule—A (7,500 Miles) or every other interval shown on Schedule—B (6,000 Miles).
- Check engine coolant level, hoses, and clamps.
- If your mileage is less than 7,500 miles (12 000 km) yearly, replace the engine oil filter at each oil change.
- Lubricate steering linkage.

LIGHT DUTY SCHEDULE—A

7,500 Miles (12 000 km) or at 6 months

- Change engine oil.
- Adjust rear brakes.

15,000 Miles (24 000 km) or at 12 months

- Change engine oil.
- Replace engine oil filter.
- Adjust rear brakes.

22,500 Miles (36 000 km) or at 18 months

- Change engine oil.
- Inspect front wheel bearings. Clean and repack, if required (4x2).
- Inspect brake linings.
- Adjust rear brakes.

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GENERAL INFORMATION (Continued)

30,000 Miles (48 000 km) or at 24 months

- Change engine oil.
- Change engine oil filter.
- **Replace engine air cleaner element.**
- **Replace spark plugs.**
- Adjust rear brakes.

37,500 Miles (60 000 km) or at 30 months

- Change engine oil.
- Drain and refill automatic transmission fluid. Replace filter and adjust bands.
- Drain and refill transfer case fluid.
- Adjust rear brakes.

45,000 Miles (72 000 km) or at 36 months

- Change engine oil.
- Replace engine oil filter.
- Inspect front wheel bearings. Clean and repack, if required (4x2).
- Inspect brake linings.
- Flush and replace engine coolant at 36 months regardless of mileage.
- Adjust rear brakes.

52,500 Miles (84 000 km) or at 42 months

- Change engine oil.
- Flush and replace engine coolant, if not done at 36 months.
- Adjust rear brakes.

60,000 Miles (96 000 km) or at 48 months

- Change engine oil.
- Replace engine oil filter.
- **Replace engine air cleaner element.**
- **Replace ignition cables.**
- **Check PCV valve and replace as necessary.***
- **Replace spark plugs.**
- Adjust rear brakes.

67,500 Miles (108 000 km) or at 54 months

- Change engine oil.
- Inspect front wheel bearings. Clean and repack, if required (4x2).
- Inspect brake linings.
- Adjust rear brakes.

75,000 Miles (120 000 km) or at 60 months

- Change engine oil.
- Replace engine oil filter.
- Drain and refill automatic transmission fluid. Replace filter and adjust bands.
- Drain and refill transfer case fluid.
- Flush and replace engine coolant if it has been 30,000 miles (48 000 km) or 24 months since last change.
- Adjust rear brakes.

82,500 Miles (132 000 km) or at 66 months

- Change engine oil.
- Flush and replace engine coolant if it has been 30,000 miles (48 000 km) or 24 months since last change.
- Adjust rear brakes.

90,000 Miles (144 000 km) or at 72 months

- Change engine oil.
- Replace engine oil filter.
- **Replace engine air cleaner element.**
- **Replace spark plugs.**
- Inspect front wheel bearings. Clean and repack, if required (4x2).
- Inspect brake linings.
- Adjust rear brakes.

97,500 Miles (156 000 km) or at 78 months

- Change engine oil.
- Adjust rear brakes.

105,000 Miles (168 000 km) or at 84 months

- Change engine oil.
- Replace engine oil filter.
- Flush and replace engine coolant if it has been 30,000 miles (48 000 km) or 24 months since last change.
- Adjust rear brakes.

112,500 Miles (180 000 km) or at 90 months

- Change engine oil.
- Inspect front wheel bearings. Clean and repack, if required (4x2).
- Drain and refill automatic transmission fluid. Replace filter and adjust bands.
- Drain and refill transfer case fluid.
- Inspect brake linings.
- Flush and replace engine coolant if it has been 30,000 miles (48 000 km) or 24 months since last change.
- Adjust rear brakes.

120,000 Miles (192 000 km) or at 96 months

- Change engine oil.
- Replace engine oil filter.
- **Replace engine air cleaner element.**
- **Replace ignition cables.**
- **Check PCV valve and replace as necessary.***
- **Replace spark plugs.**
- Adjust rear brakes.

*This maintenance is recommended by Chrysler to the customer but it is not required to maintain warranty on the PCV valve.

GENERAL INFORMATION (Continued)

LIGHT DUTY SCHEDULE—B

3,000 Miles (5 000 km)
- Change engine oil.
- Adjust rear brakes.

6,000 Miles (10 000 km)
- Change engine oil.
- Replace engine oil filter.
- Adjust rear brakes.

9,000 Miles (14 000 km)
- Change engine oil.
- Adjust rear brakes.

12,000 Miles (19 000 km)
- Change engine oil.
- Replace engine oil filter.
- Drain and refill automatic transmission fluid. Replace filter and adjust bands.**
- Change rear axle fluid.
- Change front axle fluid (4x4).
- Inspect brake linings.
- Adjust rear brakes.

15,000 Miles (24 000 km)
- Change engine oil.
- **Inspect engine air cleaner element, replace as necessary.**
- Adjust rear brakes.

18,000 Miles (29 000 km)
- Change engine oil.
- Replace engine oil filter.
- Adjust rear brakes.

21,000 Miles (34 000 km)
- Change engine oil.
- Inspect front wheel bearings. Clean and repack, if required (4x2)
- Adjust rear brakes.

24,000 Miles (38 000 km)
- Change engine oil.
- Replace engine oil filter.
- Drain and refill automatic transmission fluid. Replace filter and adjust bands.
- Change rear axle fluid.
- Change front axle fluid (4x4).
- Inspect brake linings.
- Adjust rear brakes.

27,000 Miles (43 C00 km)
- Change engine oil.
- Adjust rear brakes.

30,000 Miles (48 000 km)
- Change engine oil.
- Replace engine oil filter.
- **Replace engine air cleaner element.**
- **Inspect PCV valve, replace as necessary.***
- **Replace spark plugs.**
- Adjust rear brakes.

33,000 Miles (53 000 km)
- Change engine oil.
- Adjust rear brakes.

36,000 Miles (58 000 km)
- Change engine oil.
- Replace engine oil filter.
- Drain and refill automatic transmission fluid. Replace filter and adjust bands.**
- Drain and refill transfer case fluid.
- Change rear axle fluid.
- Change front axle fluid (4x4).
- Inspect brake linings.
- Adjust rear brakes.

39,000 Miles (62 000 km)
- Change engine oil.
- Adjust rear brakes.

42,000 Miles (67 000 km)
- Change engine oil.
- Replace engine oil filter.
- Inspect front wheel bearing. Clean and repack, if required (4x2).
- Adjust rear brakes.

45,000 Miles (72 000 km)
- Change engine oil.
- **Inspect engine air cleaner element, replace as necessary.**
- Adjust rear brakes.

48,000 Miles (77 000 km)
- Change engine oil.
- Replace engine oil filter.
- Drain and refill automatic transmission fluid. Replace filter and adjust bands.
- Change rear axle fluid.
- Change front axle fluid (4x4).
- Inspect brake linings.
- Adjust rear brakes.

51,000 Miles (82 000 km)
- Change engine oil.
- Flush and replace engine coolant.
- Adjust rear brakes.

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GENERAL INFORMATION (Continued)

54,000 Miles (86 000 km)
- Change engine oil.
- Replace engine oil filter.
- Adjust rear brakes.

57,000 Miles (91 000 km)
- Change engine oil.
- Adjust rear brakes.

60,000 Miles (96 000 km)
- Change engine oil.
- Replace engine oil filter.
- **Replace engine air cleaner element.**
- **Replace ignition cables.**
- **Inspect PCV valve and replace as necessary.***
- **Replace spark plugs.**
- Drain and refill automatic transmission fluid. Replace filter and adjust bands.**
- Change rear axle fluid.
- Change front axle fluid (4x4).
- Inspect brake linings.
- Adjust rear brakes.

63,000 Miles (101 000 km)
- Change engine oil.
- Inspect front wheel bearings. Clean and repack, if required (4x2)
- Adjust rear brakes.

66,000 Miles (106 000 km)
- Change engine oil.
- Replace engine oil filter.
- Adjust rear brakes.

69,000 Miles (110 000 km)
- Change engine oil.
- Adjust rear brakes.

72,000 Miles (115 000 km)
- Change engine oil.
- Replace engine oil filter.
- Drain and refill automatic transmission fluid. Replace filter and adjust bands.
- Drain and refill transfer case fluid.
- Change rear axle fluid.
- Change front axle fluid (4x4).
- Inspect brake linings.
- Adjust rear brakes.

75,000 Miles (120 000 km)
- Change engine oil.
- **Inspect engine air cleaner element, replace as necessary.**
- Adjust rear brakes.

78,000 Miles (125 000 km)
- Change engine oil.
- Replace engine oil filter.
- Adjust rear brakes.

81,000 Miles (130 000 km)
- Change engine oil.
- Flush and replace engine coolant.
- Adjust rear brakes.

84,000 Miles (134 000 km)
- Change engine oil.
- Replace engine oil filter.
- Drain and refill automatic transmission fluid. Replace filter and adjust bands.**
- Change rear axle fluid.
- Change front axle fluid (4x4).
- Inspect front wheel bearings. Clean and repack if required (4x2).
- Inspect brake linings.
- Adjust rear brakes.

87,000 Miles (139 000 km)
- Change engine oil.
- Adjust rear brakes.

90,000 Miles (144 000 km)
- Change engine oil.
- Replace engine oil filter.
- **Replace engine air cleaner element.**
- **Inspect PCV valve, replace as necessary.***
- **Replace spark plugs.**
- Adjust rear brakes.

93,000 Miles (149 000 km)
- Change engine oil.
- Adjust rear brakes.

96,000 Miles (154 000 km)
- Change engine oil
- Replace engine oil filter.
- Drain and refill automatic transmission fluid. Replace filter and adjust bands.
- Change rear axle fluid.
- Change front axle fluid (4x4).
- Inspect brake linings.
- Adjust rear brakes.

99,000 Miles (158 000 km)
- Change engine oil.
- Adjust rear brakes.

102,000 Miles (163 000 km)
- Change engine oil.
- Replace engine oil filter.
- Adjust rear brakes.

GENERAL INFORMATION (Continued)

105,000 Miles (168 000 km)

- Change engine oil.
- **Inspect engine air cleaner element, replace as necessary.**
- Inspect front wheel bearings. Clean and repack if required (4x2).
- Adjust rear brakes.

108,000 Miles (173 000 km)

- Change engine oil.
- Replace engine oil filter.
- Drain and refill automatic transmission fluid. Replace filter and adjust bands.**
- Drain and refill transfer case fluid.
- Change rear axle fluid.
- Change front axle fluid (4x4).
- Inspect brake linings.
- Adjust rear brakes.

111,000 Miles (178 000 km)

- Change engine oil.
- Flush and replace engine coolant.
- Adjust rear brakes.

114,000 Miles (182 000 km)

- Change engine oil.
- Replace engine oil filter.
- Adjust rear brakes.

117,000 Miles (187 000 km)

- Change engine oil.
- Adjust rear brakes.

120,000 Miles (192 000 km)

- Check engine oil.
- Replace engine oil filter.
- **Replace engine air cleaner element.**
- **Replace ignitions cables.**
- **Check PCV valve and replace as necessary.***
- **Replace spark plugs.**
- Drain and refill automatic transmission fluid. Replace filter and adjust bands.
- Change rear axle fluid.
- Change front axle fluid (4x4).
- Inspect brake linings.
- Adjust rear brakes.

*This maintenance is recommended by Chrysler to the customer but it is not required to maintain warranty on the PCV valve.

**Off-the-highway operation, trailer towing, snow plowing, or prolonged operation with heavy loading, especially in hot weather require the more frequent transmission service indicated with a ** in Schedule—B. Perform these services if the vehicle is operated under these conditions.

Inspection and service should also be performed anytime a malfunction is observed or suspected.

Mopar AUTHENTIC RESTORATION PRODUCT

MAINTENANCE SCHEDULES—MEDIUM DUTY VEHICLES

INDEX

GENERAL INFORMATION

INTRODUCTION

The following is a list of Maintenance Schedules for Medium Duty Cycle vehicles (8.0L 2500 and 3500 Models — California Only).

There are two maintenance schedules that show proper service based on the conditions that the vehicle is subjected to. Use the schedule that best describes these conditions.

Schedule—**A**, lists all the scheduled maintenance to be performed under normal operating conditions for Medium Duty vehicles.

Schedule—**B**, lists maintenance recommended for Medium Duty vehicles operated under the following conditions:

- Frequent short trip driving less than 5 miles (8 km)
- Frequent driving in dusty conditions
- Frequent trailer towing
- Extensive idling
- More than 50% of your driving is at sustained high speeds during hot weather, above 90°F (32°C)

Where time and mileage are listed, follow the interval that occurs first.

EMISSION CONTROL SYSTEM MAINTENANCE

The scheduled emission maintenance listed in **bold type** on the Maintenance Schedules, must be done at the mileage specified to assure the continued proper functioning of the emission control system. These, and all other maintenance services included in this manual, should be done to provide the best vehicle performance and reliability. More frequent maintenance may be needed for vehicles in severe operating conditions such as dusty areas and very short trip driving.

UNSCHEDULED INSPECTION

At Each Stop For Fuel

- Check engine oil level and add as required.
- Check windshield washer solvent and add as required.
- Clean windshield and wiper blades as required.

Once A Month

- Check tire pressure and look for unusual wear or damage.
- Inspect battery and clean and tighten terminals as required.
- Check fluid levels of coolant reservoir, brake master cylinder, power steering, and transmission and add as needed.
- Check all lights and all other electrical items for correct operation.
- Inspect and clean wiper. Replace if required.

At Each Oil Change

- Inspect exhaust system.
- Inspect brake hoses.
- Adjust rear brakes.
- Rotate the tires at each oil change interval shown on Schedule—A (7,500 Miles) or every other interval shown on Schedule—B (6,000 Miles).
- Check engine coolant level, hoses, and clamps.
- Lubricate steering linkage.

MEDIUM DUTY SCHEDULE—A

6,000 miles (10 000 km) or at 6 months

- Replace engine oil and filter.
- Adjust rear brakes.

12,000 Miles (19 000 km) or at 12 months

- Replace engine oil and filter.
- Adjust rear brakes.

18,000 Miles (29 000 km) or at 18 months

- Replace engine oil and filter.
- Inspect brake linings.
- Adjust rear brakes.

24,000 Miles (38 000 km) or at 24 months

- Replace engine oil and filter.
- Drain and refill automatic transmission fluid. Replace filter and adjust bands.
- Inspect front wheel bearings. Clean and repack, if required (4x2).
- Adjust rear brakes.

GENERAL INFORMATION (Continued)

30,000 Miles (48 000 km) or at 30 months

- Replace engine oil and filter.
- **Replace engine air cleaner element.**
- **Replace spark plugs.**
- Adjust rear brakes.

36,000 Miles (58 000 km) or at 36 months

- Replace engine oil and filter.
- Drain and refill transfer case fluid.
- Inspect brake linings
- Flush and replace engine coolant at 36 months, regardless of mileage.
- Adjust rear brakes.

42,000 Miles (67 000 km) or at 42 months

- Replace engine oil and filter.
- Adjust rear brakes.

48,000 Miles (77 000 km) or at 48 months

- Replace engine oil and filter.
- Drain and refill automatic transmission fluid. Replace filter and adjust bands.
- Inspect front wheel bearings. Clean and repack, if required (4x2).
- Flush and replace engine coolant if not done at 36 months.
- Adjust rear brakes.

54,000 Miles (86 000 km) or at 54 months

- Replace engine oil and filter.
- Inspect brake linings.
- Adjust rear brakes.

60,000 Miles (96 000 km) or at 60 months

- Replace engine oil and filter.
- **Replace engine air cleaner element.**
- **Replace ignition cables.**
- **Replace spark plugs.**
- Flush and replace engine coolant if it has been 30,000 miles (48 000 km) or 24 months since last change.
- Adjust rear brakes.

66,000 Miles (106 000 km) or at 66 months

- Replace engine oil and filter.
- Adjust rear brakes.

72,000 Miles (115 000 km) or at 72 months

- Replace engine oil and filter.
- Drain and refill automatic transmission fluid. Replace filter and adjust bands.
- Drain and refill transfer case fluid.
- Inspect front wheel bearings. Clean and repack, if required (4x2).
- Inspect brake linings.
- Adjust rear brakes.

78,000 Miles (125 000 km) or at 78 months

- Replace engine oil and filter.
- Flush and replace engine coolant if it has been 30,000 miles (48 000 km) or 24 months since last change.
- Adjust rear brakes.

84,000 Miles (134 000 km) or at 84 months

- Replace engine oil and filter.
- Flush and replace engine coolant if it has been 30,000 miles (48 000 km) or 24 months since last change.
- Adjust rear brakes.

90,000 Miles (144 000 km) or at 90 months

- Replace engine oil and filter.
- **Replace engine air cleaner element.**
- **Replace spark plugs.**
- Inspect brake linings.
- Adjust rear brakes.

96,000 Miles (154 000 km) or at 96 months

- Replace engine oil and filter.
- Drain and refill automatic transmission fluid. Replace filter and adjust bands.
- Inspect front wheel bearings. Clean and repack, if required (4x2).
- Adjust rear brakes.

102,000 Miles (163 000 km) or at 102 months

- Replace engine oil and filter.
- Adjust rear brakes.

108,000 Miles (173 000 km) or at 108 months

- Replace engine oil and filter.
- Drain and refill transfer case fluid.
- Inspect brake linings.
- Flush and replace engine coolant if it has been 30,000 miles (48 000 km) or 24 months since last change.
- Adjust rear brakes.

114,000 Miles (183 000 km) or at 114 months

- Replace engine oil and filter.
- Adjust rear brakes.

120,000 Miles (192 000 km) or at 120 months

- Replace engine oil and filter.
- **Replace engine air cleaner element.**
- **Replace ignition cables.**
- **Replace spark plugs.**
- Drain and refill automatic transmission fluid. Replace filter and adjust bands.
- Inspect front wheel bearings. Clean and repack, if required (4x2).
- Adjust rear brakes.

Mopar AUTHENTIC RESTORATION PRODUCT

GENERAL INFORMATION (Continued)

MEDIUM DUTY SCHEDULE—B

3,000 Miles (5 000 km)
- Replace engine oil and filter.
- Adjust rear brakes.

6,000 Miles (10 000 km)
- Replace engine oil and filter.
- Adjust rear brakes.

9,000 Miles (14 000 km)
- Replace engine oil and filter.
- Adjust rear brakes.

12,000 Miles (19 000 km)
- Replace engine oil and filter.
- Drain and refill automatic transmission fluid. Replace filter and adjust bands.*
- Change rear axle fluid.
- Change front axle fluid (4x4).
- Inspect brake linings.
- Adjust rear brakes.

15,000 Miles (24 000 km)
- Replace engine oil and filter.
- **Inspect engine air cleaner element, replace as necessary.**
- Adjust rear brakes.

18,000 Miles (29 000 km)
- Replace engine oil and filter.
- Adjust rear brakes.

21,000 Miles (29 000 km)
- Replace engine oil and filter.
- Adjust rear brakes.

24,000 Miles (38 000 km)
- Replace engine oil and filter.
- Drain and refill automatic transmission fluid. Replace filter and adjust bands.
- Inspect front wheel bearings. Clean and repack, if required (4x2).
- Change rear axle fluid.
- Change front axle fluid (4x4).
- Inspect brake linings.
- Adjust rear brakes.

27,000 Miles (43 000 km)
- Replace engine oil and filter.
- Adjust rear brakes.

30,000 Miles (48 000 km)
- Replace engine oil and filter.
- **Replace engine air cleaner element.**
- **Replace spark plugs.**
- Adjust rear brakes.

33,000 Miles (53 000 km)
- Replace engine oil and filter.
- Adjust rear brakes.

36,000 Miles (58 000 km)
- Replace engine oil and filter.
- Drain and refill automatic transmission fluid. Replace filter and adjust bands.*
- Drain and refill transfer case fluid.
- Change rear axle fluid.
- Change front axle fluid (4x4).
- Inspect brake linings.
- Adjust rear brakes.

39,000 Miles (62 000 km)
- Replace engine oil and filter.
- Adjust rear brakes.

42,000 Miles (67 000 km)
- Replace engine oil and filter.
- Adjust rear brakes.

45,000 Miles (72 000 km)
- Replace engine oil and filter.
- **Inspect engine air cleaner element, replace as necessary.**
- Adjust rear brakes.

48,000 Miles (77 000 km)
- Replace engine oil and filter.
- Drain and refill automatic transmission fluid. Replace filter and adjust bands.
- Inspect front wheel bearings. Clean and repack, if required (4x2).
- Change rear axle fluid.
- Change front axle fluid (4x4).
- Inspect brake linings.
- Flush and replace engine coolant.
- Adjust rear brakes.

51,000 Miles (82 000 km)
- Replace engine oil and filter.
- Adjust rear brakes.

54,000 Miles (86 000 km)
- Replace engine oil and filter.
- Adjust rear brakes.

57,000 Miles (91 000 km)
- Replace engine oil and filter.
- Adjust rear brakes.

60,000 Miles (96 000 km)
- Replace engine oil and filter.
- **Replace engine air cleaner element.**
- **Replace ignition cables.**
- **Replace spark plugs.**

AUTHENTIC RESTORATION PRODUCT

GENERAL INFORMATION (Continued)

- Drain and refill automatic transmission fluid. Replace filter and adjust bands.*
- Change rear axle fluid.
- Change front axle fluid (4x4).
- Inspect brake linings.
- Adjust rear brakes.

63,000 Miles (101 000 km)

- Replace engine oil and filter.
- Adjust rear brakes.

66,000 Miles (106 000 km)

- Replace engine oil and filter.
- Adjust rear brakes.

69,000 Miles (110 000 km)

- Replace engine oil and filter.
- Adjust rear brakes.

72,000 Miles (115 000 km)

- Replace engine oil and filter.
- Drain and refill automatic transmission fluid. Replace filter and adjust bands.
- Drain and refill transfer case fluid.
- Inspect front wheel bearings. Clean and repack, if required (4x2).
- Change rear axle fluid.
- Change front axle fluid (4x4).
- Inspect brake linings.
- Adjust rear brakes.

75,000 Miles (120 000 km)

- Replace engine oil and filter.
- **Inspect engine air cleaner element, replace as necessary.**
- Adjust rear brakes.

78,000 Miles (125 000 km)

- Replace engine oil and filter.
- Flush and replace engine coolant.
- Adjust rear brakes.

81,000 Miles (130 000 km)

- Replace engine oil and filter.
- Adjust rear brakes.

84,000 Miles (134 000 km)

- Replace engine oil and filter.
- Drain and refill automatic transmission fluid. Replace filter and adjust bands.*
- Change rear axle fluid.
- Change front axle fluid (4x4).
- Inspect brake linings.
- Adjust rear brakes.

87,000 Miles (139 000 km)

- Replace engine oil and filter.
- Adjust rear brakes.

90,000 Miles (144 000 km)

- Replace engine oil and filter.
- **Replace engine air cleaner element.**
- **Replace spark plugs.**
- Adjust rear brakes.

93,000 Miles (149 000 km)

- Replace engine oil and filter.
- Adjust rear brakes.

96,000 Miles (154 000 km)

- Replace engine oil and filter.
- Drain and refill automatic transmission fluid. Replace filter and adjust bands.
- Inspect front wheel bearings. Clean and repack, if required (4x2).
- Change rear axle fluid.
- Change front axle fluid (4x4).
- Inspect brake linings.
- Adjust rear brakes.

99,000 Miles (156 000 km)

- Replace engine oil and filter.
- Adjust rear brakes.

102,000 Miles (163 000 km)

- Replace engine oil and filter.
- Adjust rear brakes.

105,000 Miles (168 000 km)

- Replace engine oil and filter.
- **Inspect engine air cleaner element, replace as necessary.**
- Adjust rear brakes.

108,000 Miles (173 000 km)

- Replace engine oil and filter.
- Drain and refill automatic transmission fluid. Replace filter and adjust bands.*
- Drain and refill transfer case fluid.
- Change rear axle fluid.
- Change front axle fluid (4x4).
- Inspect brake linings.
- Flush and replace engine coolant.
- Adjust rear brakes.

111,000 Miles (178 000 km)

- Replace engine oil and filter.
- Adjust rear brakes.

114,000 Miles (183 000 km)

- Replace engine oil and filter.
- Adjust rear brakes.

AUTHENTIC RESTORATION PRODUCT Mopar

GENERAL INFORMATION (Continued)

117,000 Miles (187 000 km)

- Replace engine oil and filter.
- Adjust rear brakes.

120,000 Miles (192 000 km)

- Replace engine oil and filter.
- **Replace engine air cleaner element.**
- **Replace ignition cables.**
- **Replace spark plugs.**
- Drain and refill automatic transmission fluid. Replace filter and adjust bands.
- Change rear axle fluid.
- Change front axle fluid (4x4).
- Inspect brake linings.
- Adjust rear brakes.

*Off-the-highway operation, trailer towing snow plowing, prolonged operation with heavy loading, especially in hot weather require the more frequent transmission service indicated with a * in Schedule—B. Perform these services if the vehicle is operated under these conditions.

Mopar AUTHENTIC RESTORATION PRODUCT

MAINTENANCE SCHEDULES—HEAVY DUTY VEHICLES

INDEX

GENERAL INFORMATION

INTRODUCTION

The following is a list of Maintenance Schedules for Heavy Duty Cycle vehicles (Federal Only – 2500 8.0L HD and 3500 5.9L & 8.0L Models).

There are two maintenance schedules that show proper service based on the conditions that the vehicle is subjected to. Use the schedule that best describes these conditions.

Schedule—**A**, lists all the scheduled maintenance to be performed under normal operating conditions for Heavy Duty vehicles.

Schedule—**B**, lists maintenance recommended for Heavy Duty vehicles operated under the following conditions:

- Frequent short trip driving less than 5 miles (8 km)
- Frequent driving in dusty conditions
- Frequent trailer towing
- Extensive idling
- More than 50% of your driving is at sustained high speeds during hot weather, above 90°F (32°C)

Where time and mileage are listed, follow the interval that occurs first.

EMISSION CONTROL SYSTEM MAINTENANCE

The schedule emission maintenance listed in **bold type** on the following schedules, must be done at the mileage specified to assure the continued proper functioning of the emission control system. These, and all other maintenance services included in this manual, should be done to provide the best vehicle performance and reliability. More frequent maintenance may be needed for vehicles in severe operating conditions such as dusty areas and very short trip driving.

UNSCHEDULED INSPECTION

At Each Stop For Fuel

- Check engine oil level and add as required.
- Check windshield washer solvent and add as

indshield and wiper blades as required.

Once A Month

- Check tire pressure and look for unusual wear or damage.
- Inspect battery and clean and tighten terminals as required.
- Check fluid levels of coolant reservoir, brake master cylinder, power steering, and transmission and add as needed.
- Check all lights and all other electrical items for correct operation.
- Inspect and clean wiper blades. Replace if required.

At Each Oil Change

- Inspect exhaust system.
- Inspect brake hoses.
- Adjust rear brakes.
- Rotate the tires at each oil change interval shown on Schedule—A (6000 Miles) or every other interval shown on Schedule—B (6,000 Miles).
- Check engine coolant level, hoses, and clamps.
- If your mileage is less than 6000 miles (9 600 km) yearly, replace the engine oil filter at each oil change.
- Lubricate steering linkage.
- Replace engine oil filter at every oil change (8.0L only).

HEAVY DUTY SCHEDULE—A

6,000 miles (10 000 km) or at 6 months

- Change engine oil.
- Replace engine oil filter (8.0L only).
- Adjust rear brakes.

12,000 Miles (19 000 km) or at 12 months

- Change engine oil.
- Replace engine oil filter.
- Adjust rear brakes.

18,000 Miles (29 000 km) or at 18 months

- Change engine oil.
- Replace engine oil filter (8.0L only).
- Inspect brake linings
- Adjust rear brakes.

AUTHENTIC RESTORATION PRODUCT

GENERAL INFORMATION (Continued)

24,000 Miles (38 000 km) or at 24 months

- Change engine oil.
- Replace engine oil filter.
- **Replace engine air cleaner element and air pump filter.**
- Clean and relubricate crankcase inlet air filter (5.9L).
- Drain and refill automatic transmission fluid. Replace filter and adjust bands.
- Inspect front wheel bearings. Clean and repack, if required (4x2).
- Adjust rear brakes.

30,000 Miles (48 000 km) or at 30 months

- Change engine oil.
- Replace engine oil filter (8.0L only).
- **Replace spark plugs.**
- Adjust rear brakes.

36,000 Miles (58 000 km) or at 36 months

- Change engine oil.
- Replace engine oil filter.
- Drain and refill transfer case fluid.
- Inspect brake linings.
- Flush and replace engine coolant at 36 months, regardless of mileage.
- Adjust rear brakes.

42,000 Miles (67 000 km) or at 42 months

- Change engine oil.
- Replace engine oil filter (8.0L only).
- Adjust rear brakes.

48,000 Miles (77 000 km) or at 48 months)

- Change engine oil.
- Replace engine oil filter.
- **Replace engine air cleaner element and air pump filter.**
- Drain and refill automatic transmission fluid. Replace filter and adjust bands.
- Clean and relubricate crankcase inlet air cleaner element (5.9L only).
- Inspect front wheel bearings. Clean and repack, if required (4x2).
- Flush and replace engine coolant if not done at 36 months.
- Adjust rear brakes.

54,000 Miles (86 000 km) or at 54 months

- Change engine oil.
- Replace engine oil filter (8.0L only).
- Inspect brake linings.
- Adjust rear brakes.

60,000 Miles (96 000 km) or at 60 months

- Change engine oil.
- Replace engine oil filter.
- **Replace ignition cables.**
- **Replace PCV valve (5.9L).***
- **Replace distributor cap and rotor (5.9L only).**
- **Replace spark plugs.**
- Clean EGR air passages (5.9L if equipped).*
- Replace EGR valve (5.9L if equipped).*
- Flush and replace engine coolant if it has been 30,000 miles (48 000 km) or 24 months since last change.
- Adjust rear brakes.

66,000 Miles (106 000 km) or at 66 months

- Change engine oil.
- Replace engine oil filter (8.0L only).
- Adjust rear brakes.

72,000 Miles (115 000 km) or at 72 months

- Change engine oil.
- Replace engine oil filter.
- **Replace engine air cleaner element and air pump filter.**
- Drain and refill automatic transmission fluid. Replace filter and adjust bands.
- Clean and relubricate crankcase inlet air cleaner element (5.9L only).
- Drain and refill transfer case fluid.
- Inspect front wheel bearings. Clean and repack, if required (4x2).
- Inspect brake linings.
- Adjust rear brakes.

78,000 Miles (125 000 km) or at 78 months

- Change engine oil.
- Replace engine oil filter (8.0L only).
- Flush and replace engine coolant if it has been 30,000 miles (48 000 km) or 24 months since last change.
- Adjust rear brakes.

82,500 Miles (132 000 km) or at 82 months

- Replace oxygen sensor (5.9L only).*

84,000 Miles (134 000 km) or at 84 months

- Change engine oil.
- Replace engine oil filter.
- Flush and replace engine coolant if it has been 30,000 miles (48 000 km) or 24 months since last change.
- Adjust rear brakes.

90,000 Miles (144 000 km) or at 90 months

- Change engine oil.
- Replace engine oil filter (8.0L only).
- Replace spark plugs.
- Inspect brake linings.
- Adjust rear brakes.

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GENERAL INFORMATION (Continued)

96,000 Miles (154 000 km) or at 96 months

- Change engine oil.
- Replace engine oil filter.
- **Replace engine air cleaner element and air pump filter.**
- Drain and refill automatic transmission fluid. Replace filter and adjust bands.
- Clean and relubricate crankcase inlet air cleaner element (5.9L only).
- Inspect front wheel bearings. Clean and repack, if required (4x2).
- Adjust rear brakes.

102,000 Miles (163 000 km) or at 102 months

- Change engine oil.
- Replace engine oil filter (8.0L only).
- Adjust rear brakes.

108,000 Miles (173 000 km) or at 108 months

- Change engine oil.
- Replace engine oil filter.
- Drain and refill transfer case fluid.
- Inspect brake linings.
- Flush and replace engine coolant if it has been 30,000 miles (48 000 km) or 24 months since last change.
- Adjust rear brakes.

*Requires Service Reminder Indicator Light. If so equipped, these parts are to be replaced at the indicated mileage or when the service reminder indicator light remains on continuously with the key in the "ON" position, whichever occurs first.

HEAVY DUTY SCHEDULE—B

3,000 Miles (5 000 km)

- Change engine oil.
- Replace engine oil filter (8.0L only).
- Adjust rear brakes.

6,000 Miles (10 000 km)

- Change engine oil.
- Replace engine oil filter.
- Adjust rear brakes.

9,000 Miles (14 000 km)

- Change engine oil.
- Replace engine oil filter (8.0L only).
- Adjust rear brakes.

12,000 Miles (19 000 km)

- Change engine oil.
- Replace engine oil filter.
- **Inspect engine air cleaner element and air p filter, replace as necessary.**
- and relubricate crankcase inlet air filter
- Drain and refill automatic transmission fluid. Replace filter and adjust bands.**
- Change rear axle fluid.
- Change front axle fluid (4x4).
- Inspect brake linings.
- Adjust rear brakes.

15,000 Miles (24 000 km)

- Change engine oil.
- Replace engine oil filter (8.0L only).
- Adjust rear brakes.

18,000 Miles (29 000 km)

- Change engine oil.
- Replace engine oil filter.
- Adjust rear brakes.

21,000 Miles (34 000 km)

- Change engine oil.
- Replace engine oil filter (8.0L only).
- Adjust rear brakes.

24,000 Miles (38 000 km)

- Change engine oil
- Replace engine oil filter.
- **Replace engine air cleaner element and air pump filter.**
- Drain and refill automatic transmission fluid. Replace filter and adjust bands.
- Change rear axle fluid.
- Change front axle fluid (4x4).
- Clean and relubricate crankcase inlet air cleaner element (5.9L only).
- Inspect front wheel bearings. Clean and repack, if required (4x2).
- Inspect brake linings.
- Adjust rear brakes.

27,000 Miles (43 000 km)

- Change engine oil.
- Replace engine oil filter (8.0L only).
- Adjust rear brakes.

30,000 Miles (48 000 km)

- Change engine oil.
- Replace engine oil filter.
- **Inspect PCV valve, replace as necessary (5.9L).**
- **Replace spark plugs.**
- Adjust rear brakes.

33,000 Miles (53 000 km)

- Change engine oil.
- Replace engine oil filter (8.0L only).
- Adjust rear brakes.

AUTHENTIC RESTORATION PRODUCT

GENERAL INFORMATION (Continued)

36,000 Miles (58 000 km)
- Change engine oil.
- Replace engine oil filter.
- **Inspect engine air cleaner element and air pump filter, replace as necessary.**
- Drain and refill automatic transmission fluid. Replace filter and adjust bands.**
- Drain and refill transfer case.
- Change rear axle fluid.
- Change front axle fluid (4x4).
- Inspect brake linings.
- Adjust rear brakes.

39,000 Miles (62 000 km)
- Change engine oil.
- Replace engine oil filter (8.0L only).
- Adjust rear brakes.

42,000 Miles (67 000 km)
- Change engine oil.
- Replace engine oil filter.
- Adjust rear brakes.

45,000 Miles (72 000 km)
- Change engine oil.
- Replace engine oil filter (8.0L only).
- Adjust rear brakes.

48,000 Miles (77 000 km)
- Change engine oil.
- Replace engine oil filter.
- **Replace engine air cleaner element and air pump filter.**
- Drain and refill automatic transmission fluid. Replace filter and adjust bands.
- Change rear axle fluid.
- Change front axle fluid (4x4).
- Clean and relubricate crankcase inlet air cleaner element (5.9L only).
- Inspect front wheel bearings. Clean and repack, if required (4x2).
- Inspect brake linings.
- Flush and replace engine coolant.
- Adjust rear brakes.

51,000 Miles (82 000 km)
- Change engine oil.
- Replace engine oil filter (8.0L only).
- Adjust rear brakes.

54,000 Miles (86 000 km)
- Change engine oil.
- Replace engine oil filter.
- Adjust rear brakes.

57,000 Miles (91 000 km)
- Change engine oil.
- Replace engine oil filter (8.0L only).
- Adjust rear brakes.

60,000 Miles (96 000 km)
- Change engine oil.
- Replace engine oil filter.
- **Inspect engine air cleaner element and air pump filter, replace as necessary.**
- **Replace PCV valve (5.9L).***
- **Replace distributor cap and rotor (5.9L).**
- **Replace ignition cables.**
- **Replace spark plugs.**
- Clean EGR passages (5.9L if equipped).*
- Replace EGR valve (5.9L if equipped).*
- Drain and refill automatic transmission fluid. Replace filter and adjust bands.**
- Change rear axle fluid.
- Change front axle fluid (4x4).
- Inspect brake linings.
- Adjust rear brakes.

63,000 Miles (101 000 km)
- Change engine oil.
- Replace engine oil filter (8.0L only).
- Adjust rear brakes.

66,000 Miles (106 000 km)
- Change engine oil.
- Replace engine oil filter.
- Adjust rear brakes.

69,000 Miles (110 000 km)
- Change engine oil.
- Replace engine oil filter (8.0L only).
- Adjust rear brakes.

72, 000 Miles (115 000 km)
- Change engine oil.
- Replace engine oil filter.
- **Replace engine air cleaner element and air pump filter.**
- Clean and relubricate crankcase inlet air filter (5.9L).
- Drain and refill automatic transmission fluid. Replace filter and adjust bands.
- Drain and refill transfer case fluid.
- Change rear axle fluid.
- Change front axle fluid (4x4).
- Inspect front wheel bearings. Clean and repack, if required (4x2).
- Inspect brake linings.
- Adjust rear brakes.

Mopar AUTHENTIC RESTORATION PRODUCT

GENERAL INFORMATION (Continued)

75,000 Miles (120 000 km)
- Change engine oil.
- Replace engine oil filter (8.0L only).
- Adjust rear brakes.

78,000 Miles (125 000 km)
- Change engine oil.
- Replace engine oil filter.
- Flush and replace engine coolant.
- Adjust rear brakes.

81,000 Miles (130 000 km)
- Change engine oil.
- Replace engine oil filter (8.0L only).
- Adjust rear brakes.

82,500 Miles (132 000 km)
- Replace oxygen sensor (5.9L only).*

84,000 Miles (134 000 km)
- Change engine oil.
- Replace engine oil filter.
- **Inspect engine air cleaner element and air pump filter, replace as necessary.**
- Drain and refill automatic transmission fluid. Replace filter and adjust bands.**
- Change rear axle fluid.
- Change front axle fluid (4x4).
- Inspect brake linings.
- Adjust rear brakes.

87,000 Miles (139 000 km)
- Change engine oil.
- Replace engine oil filter (8.0L only).
- Adjust rear brakes.

90,000 Miles (144 000 km)
- Change engine oil.
- Replace engine oil filter.
- **Inspect PCV valve, replace as necessary (5.9L).**
- **Replace spark plugs.**
- Adjust rear brakes.

93,000 Miles (149 000 km)
- Change engine oil.
- Replace engine oil filter (8.0L only).
- Adjust rear brakes.

96,000 Miles (154 000 km)
- Change engine oil.
- Replace engine oil filter.
- **Replace engine air cleaner element and air pump filter.**
- Drain and refill automatic transmission fluid. Replace filter and adjust bands.
- Change rear axle fluid.
- Change front axle fluid (4x4).
- Clean and relubricate crankcase inlet air cleaner element (5.9L only).
- Inspect front wheel bearings. Clean and repack, if required (4x2).
- Inspect brake linings.
- Adjust rear brakes.

99,000 Miles (156 000 km)
- Change engine oil.
- Replace engine oil filter (8.0L only).
- Adjust rear brakes.

102,000 Miles (163 000 km)
- Change engine oil.
- Replace engine oil filter.
- Adjust rear brakes.

105,000 Miles (168 000 km)
- Change engine oil.
- Replace engine oil filter (8.0L only).
- Adjust rear brakes.

108,000 Miles (173 000 km)
- Change engine oil.
- Replace engine oil filter.
- **Inspect engine air cleaner element and air pump filter, replace as necessary.**
- Drain and refill automatic transmission fluid. Replace filter and adjust bands.**
- Drain and refill transfer case fluid.
- Change rear axle fluid.
- Change front axle fluid (4x4).
- Inspect brake linings.
- Flush and replace engine coolant.
- Adjust rear brakes.

*Requires Service Reminder Indicator Light. If so equipped, these parts are to be replaced at the indicated mileage or when the service reminder indicator light remains on continuously with the key in the ON position, whichever occurs first.

**Off-the-highway operation, trailer towing, snow plowing, prolonged operation with heavy loading, especially in hot weather require the more frequent transmission service indicated with a ** in Schedule—B. Perform these services if the vehicle is operated under these conditions.

Inspection and service should also be performed anytime a malfunction is observed or suspected.

Mopar AUTHENTIC RESTORATION PRODUCT

MAINTENANCE SCHEDULES—DIESEL ENGINE VEHICLES

INDEX

GENERAL INFORMATION

INTRODUCTION

The following is a list of Maintenance Schedules for Diesel Engine equipped vehicles.

There are two maintenance schedules that show proper service based on the conditions that the vehicle is subjected to. Use the schedule that best describes these conditions.

Schedule—**A**, lists all the scheduled maintenance to be performed under normal operating conditions for Diesel Engine equipped vehicles.

Schedule—**B**, lists maintenance recommended for Diesel Engine equipped vehicles operated under the following conditions:

- Frequent short trip driving less than 5 miles (8 km)
- Frequent driving in dusty conditions
- Frequent trailer towing
- Extensive idling
- More than 50% of your driving is at sustained high speeds during hot weather, above 90°F (32°C)

Where time and mileage are listed, follow the interval that occurs first.

UNSCHEDULED INSPECTION

At Each Stop For Fuel

- Check engine oil level, add as required.
- Check windshield washer solvent and add if required.
- Clean windshield and wiper blades as required.

Once A Month

- Check tire pressure and look for unusual wear or damage.
- Inspect battery and clean and tighten terminals as required.
- Check fluid levels of coolant reservoir, brake master cylinder, power steering, and transmission. Add fluid as required.
- Check all lights and all other electrical items for correct operation.
- Drain water from fuel filter.
- **Check Filter Minder®. Replace filter if necessary.**
- Inspect and clean wiper blades. Replace if required.

At Each Oil Change

- Inspect exhaust system.
- Inspect brake hoses.
- Adjust rear brakes.
- Rotate the tires at each oil change interval shown, 6,000 miles (9 600 km) on Schedule —A or every other interval shown on Schedule—B.
- Check engine coolant level, hoses, and clamps.
- Lubricate steering linkage.

SCHEDULE—A

6,000 Miles (10 000 km) or at 6 months

- Change engine oil and filter.
- Adjust rear brakes.

12,000 Miles (19 000 km) or at 12 months

- Change engine oil and filter.
- Inspect water pump weep hole for blockage.
- Replace fuel filter and clean strainer.
- Adjust rear brakes.

18,000 Miles (29 000 km) or at 18 months

- Change engine oil and filter.
- inspect drive belts, replace as necessary.
- Inspect brake linings.
- Adjust rear brakes.

24,000 Miles (38 000 km) or at 24 months

- Change engine oil and filter.
- Adjust valve lash clearance.
- Inspect fan hub.
- Inspect damper.
- Inspect water pump weep hole for blockage.
- Replace fuel filter and clean strainer.
- Drain and refill automatic transmission fluid. Replace filter and adjust bands.
- Inspect front wheel bearings. Clean and repack, if required (4x2).
- Adjust rear brakes.

GENERAL INFORMATION (Continued)

30,000 Miles (48 000 km) or at 30 months

- Change engine oil and filter.
- Adjust rear brakes.

36,000 Miles (58 000 km) or at 36 months

- Change engine oil and filter.
- Inspect drive belts, replace as necessary.
- Inspect water pump weep hole for blockage.
- Replace fuel filter and clean strainer.
- Drain and refill transfer case fluid.
- Inspect brake linings.
- Flush and replace engine coolant at 36 months, regardless of mileage.
- Adjust rear brakes.

42,000 Miles (67 000 km) or at 42 months

- Change engine oil and filter.
- Adjust rear brakes.

48,000 Miles (77 000 km) or at 48 months

- Change engine oil and filter.
- Adjust valve lash clearance.
- Inspect intake air temperature sensor, clean or replace as necessary (California only).*
- Drain and refill automatic transmission fluid. Replace filter and adjust bands.
- Inspect fan hub.
- Inspect damper.
- Inspect front wheel bearings. Clean and repack, if required (4x2).
- Inspect water pump weep hole for blockage.
- Replace fuel filter and clean strainer.
- Flush and replace engine coolant if not done at 36 months.
- Adjust rear brakes.

54,000 Miles (86 000 km) or at 54 months

- Change engine oil and filter.
- Inspect drive belts, replace as necessary.
- Inspect brake linings.
- Adjust rear brakes.

60,000 Miles (96 000 km) or at 60 months

- Change engine oil and filter.
- Inspect water pump weep hole for blockage.
- Replace fuel filter and clean strainer.
- Flush and replace engine coolant if it has been 30,000 miles (48 000 km) or 24 months since last change.
- Adjust rear brakes.

66,000 Miles (106 000 km) or at 66 months

- Change engine oil and filter.
- Adjust rear brakes.

72,000 Miles (115 000 km) or at 72 months

- Change engine oil and filter.
- Inspect drive belts, replace as required.
- Drain and refill automatic transmission fluid. Replace filter and adjust bands.
- Drain and refill transfer case fluid.
- Adjust valve lash clearance.
- Inspect fan hub.
- Inspect damper.
- Inspect water pump weep hole for blockage.
- Replace fuel filter and clean strainer.
- Inspect front wheel bearings. Clean and repack, if required (4x2).
- Inspect brake linings.
- Adjust rear brakes.

78,000 Miles (125 000 km) or at 78 months

- Change engine oil and filter.
- Flush and replace engine coolant if it has been 30,000 miles (48 000 km) or 24 months since last change.
- Adjust rear brakes.

84,000 Miles (134 000 km) or at 84 months

- Change engine oil and filter.
- Inspect water pump weep hole for blockage.
- Replace fuel filter and clean strainer.
- Flush and replace engine coolant if it has been 30,000 miles (48 000 km) or 24 months since last change.
- Adjust rear brakes.

90,000 Miles (144 000 km)

- Change engine oil and filter.
- Inspect drive belts, replace if necessary.
- Inspect brake linings.
- Adjust rear brakes.

96,000 Miles (154 000 km) or at 96 months

- Change engine oil and filter.
- Adjust valve lash clearance.
- Inspect intake air temperature sensor, clean or replace as necessary (California only).*
- Drain and refill automatic transmission fluid. Replace filter and adjust bands.
- Inspect fan hub.
- Inspect damper.
- Inspect front wheel bearings. Clean and repack, if required (4x2).
- Inspect water pump weep hole for blockage.
- Replace fuel filter and clean strainer.
- Adjust rear brakes.

102,000 Miles (163 000 km) or at 102 months

- Change engine oil and filter.
- Adjust rear brakes.

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GENERAL INFORMATION (Continued)

108,000 Miles (173 000 km) or at 108 months
- Change engine oil and filter.
- Inspect drive belts, replace as necessary.
- Inspect water pump weep hole for blockage.
- Replace fuel filter and clean strainer.
- Drain and refill transfer case fluid.
- Inspect brake linings.
- Flush and replace engine coolant if it has been 30,000 miles (48 000 km) or 24 months since last change.
- Adjust rear brakes.

*Refer to engine's data plate. This maintenance is required for engines labeled "FAMILY: VCE359D6D1AK".

SCHEDULE—B

3,000 Miles (5 000 km)
- Change engine oil and filter.
- Adjust rear brakes.

6,000 Miles (10 000 km)
- Change engine oil and filter.
- Replace fuel filter and clean strainer.
- Adjust rear brakes.

9,000 Miles (14 000 km)
- Change engine oil and filter.
- Adjust rear brakes.

12,000 Miles (19 000 km)
- Change engine oil and filter.
- Inspect water pump weep hole for blockage.
- Replace fuel filter and clean strainer.
- Drain and refill automatic transmission fluid. Replace filter and adjust bands.
- Change rear axle fluid.
- Change front axle fluid (4x4).
- Inspect brake linings.
- Adjust rear brakes.

15,000 Miles (24 000 km)
- Change engine oil and filter.
- Adjust rear brakes.

18,000 Miles (29 000 km)
- Change engine oil and filter.
- Inspect drive belts, replace as necessary.
- Replace fuel filter and clean strainer.
- Adjust rear brakes.

21,000 Miles (34 000 km)
- Change engine oil and filter.
- Adjust rear brakes.

24,000 Miles (38 000 km)
- Change engine oil and filter.
- Adjust valve lash clearance.
- Inspect fan hub.
- Inspect damper.
- Inspect water pump weep hole for blockage.
- Replace fuel filter and clean strainer.
- Drain and refill automatic transmission fluid. Replace filter and adjust bands.
- Change rear axle fluid.
- Change front axle fluid (4x4).
- Inspect front wheel bearings. Clean and repack, if required (4x2).
- Inspect brake linings.
- Adjust rear brakes.

27,000 Miles (43 000 km)
- Change engine oil and filter.
- Adjust rear brakes.

30,000 Miles (48 000 km)
- Change engine oil and filter.
- Replace fuel filter and clean strainer.
- Adjust rear brakes.

33,000 Miles (53 000 km)
- Change engine oil and filter.
- Adjust rear brakes.

36,000 Miles (58 000 km)
- Change engine oil and filter.
- Inspect drive belts, replace as necessary.
- Inspect water pump weep hole for blockage.
- Replace fuel filter and cleaner strainer.
- Drain and refill automatic transmission fluid. Replace filter and adjust bands.
- Drain and refill transfer case fluid.
- Change rear axle fluid.
- Change front axle fluid (4x4).
- Inspect brake linings.
- Adjust rear brakes.

39,000 Miles (62,000 km)
- Change engine oil and filter.
- Adjust rear brakes.

42,000 Miles (67 000 km)
- Change engine oil and filter.
- Replace fuel filter and clean strainer.
- Adjust rear brakes.

45,000 Miles (72 000 km)
- Change engine oil and filter.
- Adjust rear brakes.

GENERAL INFORMATION (Continued)

48,000 Miles (77 000 km)

- Change engine oil and filter.
- Adjust valve lash clearance.
- Inspect intake air temperature sensor, clean or replace as necessary (California only).*
- Inspect fan hub.
- Inspect damper.
- Inspect water pump weep hole for blockage.
- Replace fuel filter and clean strainer.
- Drain and refill automatic transmission fluid. Replace filter and adjust bands.
- Change rear axle fluid.
- Change front axle fluid (4x4).
- Inspect front wheel bearings. Clean and repack if required (4x2).
- Inspect brake linings.
- Flush and replace engine coolant.
- Adjust rear brakes.

51,000 Miles (82 000 km)

- Change engine oil and filter.
- Adjust rear brakes.

54,000 Miles (86 000 km)

- Change engine oil and filter.
- Inspect drive belts, replace as necessary.
- Replace fuel filter and clean strainer.
- Adjust rear brakes.

57,000 Miles (91 000 km)

- Change engine oil and filter.
- Adjust rear brakes.

60,000 Miles (96 000 km)

- Change engine oil and filter.
- Inspect water pump weep hole for blockage.
- Replace fuel filter and clean strainer.
- Drain and refill automatic transmission fluid. Replace filter and adjust bands.
- Change rear axle fluid.
- Change front axle fluid (4x4).
- Inspect brake linings.
- Adjust rear brakes.

63,000 Miles (101 000 km)

- Change engine oil and filter.
- Adjust rear brakes.

66,000 Miles (106 000 km)

- Change engine oil and filter.
- Replace fuel filter and clean strainer.
- Adjust rear brakes.

69,000 Miles (110 000 km)

- Change engine oil and filter.
- Adjust rear brakes.

72,000 Miles (115 000 km)

- Change engine oil and filter.
- Inspect drive belts, replace as necessary.
- Adjust valve lash clearance.
- Inspect fan hub.
- Inspect damper.
- Inspect water pump weep hole for blockage.
- Replace fuel filter and clean strainer.
- Drain and refill automatic transmission fluid. Replace filter and adjust bands.
- Drain and refill transfer case fluid.
- Change rear axle fluid.
- Change front axle fluid (4x4).
- Inspect front wheel bearings. Clean and repack if required (4x2).
- Inspect brake linings.
- Adjust rear brakes.

75,000 Miles (120 000 km)

- Change engine oil and filter.
- Adjust rear brakes.

78,000 Miles (125 000 km)

- Change engine oil and filter.
- Flush and replace engine coolant.
- Replace fuel filter and clean strainer.
- Adjust rear brakes.

81,000 Miles (130 000 km)

- Change engine oil and filter.
- Adjust rear brakes.

84,000 Miles (134 000 km)

- Change engine oil and filter.
- Inspect water pump weep hole for blockage.
- Replace fuel filter and clean strainer.
- Drain and refill automatic transmission fluid. Replace filter and adjust bands.
- Change rear axle fluid.
- Change front axle fluid (4x4).
- Inspect brake linings.
- Adjust rear brakes.

87,000 Miles (139 000 km)

- Change engine oil and filter.
- Adjust rear brakes.

90,000 Miles (144 000 km)

- Change engine oil and filter.
- Inspect drive belts, replace as necessary.
- Replace fuel filter and clean strainer.
- Adjust rear brakes.

93,000 Miles (149 000 km)

- Change engine oil and filter.
- Adjust rear brakes.

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GENERAL INFORMATION (Continued)

96,000 Miles (154 000 km)

- Change engine oil and filter.
- Adjust valve lash clearance.
- Inspect intake air temperature sensor, clean or replace as necessary (California only).*
- Inspect fan hub.
- Inspect damper.
- Inspect water pump weep hole for blockage.
- Replace fuel filter and clean strainer.
- Drain and refill automatic transmission fluid. Replace filter and adjust bands.
- Change rear axle fluid.
- Change front axle fluid (4x4).
- Inspect front wheel bearings. Clean and repack if required (4x2).
- Inspect brake linings.
- Adjust rear brakes.

99,000 Miles (158 000 km)

- Change engine oil and filter.
- Adjust rear brakes.

102,000 Miles (163 000 km)

- Change engine oil and filter.
- Replace fuel filter and clean strainer.
- Adjust rear brakes.

105,000 Miles (168 000 km)

- Change engine oil and filter.
- Adjust rear brakes.

108,000 Miles (173 000 km)

- Change engine oil and filter.
- Clean engine air filter canister.
- Inspect drive belts, replace as necessary.
- Inspect water pump weep hole for blockage.
- Replace fuel filter and clean strainer.
- Drain and refill automatic transmission fluid. Replace filter and adjust bands.
- Drain and refill transfer case fluid.
- Change rear axle fluid.
- Change front axle fluid (4x4).
- Inspect brake linings.
- Flush and replace engine coolant.
- Adjust rear brakes.

*Refer to engine's data plate. This maintenance is required for engines labeled "FAMILY: VCE359D6D1AK".

JUMP STARTING, TOWING AND HOISTING

INDEX

SERVICE PROCEDURES

JUMP STARTING PROCEDURE

WARNING: REVIEW ALL SAFETY PRECAUTIONS AND WARNINGS IN GROUP 8A, BATTERY/STARTING/CHARGING SYSTEMS DIAGNOSTICS. DO NOT JUMP START A FROZEN BATTERY, PERSONAL INJURY CAN RESULT. DO NOT JUMP START WHEN MAINTENANCE FREE BATTERY INDICATOR DOT IS YELLOW OR BRIGHT COLOR. DO NOT JUMP START A VEHICLE WHEN THE BATTERY FLUID IS BELOW THE TOP OF LEAD PLATES. DO NOT ALLOW JUMPER CABLE CLAMPS TO TOUCH EACH OTHER WHEN CONNECTED TO A BOOSTER SOURCE. DO NOT USE OPEN FLAME NEAR BATTERY. REMOVE METALLIC JEWELRY WORN ON HANDS OR WRISTS TO AVOID INJURY BY ACCIDENTAL ARCING OF BATTERY CURRENT. WHEN USING A HIGH OUTPUT BOOSTING DEVICE, DO NOT ALLOW BATTERY VOLTAGE TO EXCEED 16 VOLTS. REFER TO INSTRUCTIONS PROVIDED WITH DEVICE BEING USED.

CAUTION: When using another vehicle as a booster, do not allow vehicles to touch. Electrical systems can be damaged on either vehicle.

TO JUMP START A DISABLED VEHICLE:

(1) Raise hood on disabled vehicle and visually inspect engine compartment for:

- Battery cable clamp condition, clean if necessary.
- Frozen battery.
- Yellow or bright color test indicator, if equipped.
- Low battery fluid level.
- Generator drive belt condition and tension.
- Fuel fumes or leakage, correct if necessary.

CAUTION: If the cause of starting problem on disabled vehicle is severe, damage to booster vehicle charging system can result.

(2) When using another vehicle as a booster source, park the booster vehicle within cable reach. Turn off all accessories, set the parking brake, place the automatic transmission in PARK or the manual transmission in NEUTRAL and turn the ignition OFF.

(3) On disabled vehicle, place gear selector in park or neutral and set park brake. Turn off all accessories.

(4) Connect jumper cables to booster battery. RED clamp to positive terminal (+). BLACK clamp to negative terminal (-). DO NOT allow clamps at opposite end of cables to touch, electrical arc will result. Review all warnings in this procedure.

(5) On disabled vehicle, connect RED jumper cable clamp to positive (+) terminal. Connect BLACK jumper cable clamp to engine ground as close to the ground cable attaching point as possible (Fig. 1) and (Fig. 2).

(6) Start the engine in the vehicle which has the booster battery, let the engine idle a few minutes, then start the engine in the vehicle with the discharged battery.

CAUTION: Do not crank starter motor on disabled vehicle for more than 15 seconds, starter will overheat and could fail.

(7) Allow battery in disabled vehicle to charge to at least 12.4 volts (75% charge) before attempting to start engine. If engine does not start within 15 seconds, stop cranking engine and allow starter to cool (15 min.), before cranking again.

DISCONNECT CABLE CLAMPS AS FOLLOWS:

- Disconnect BLACK cable clamp from engine ground on disabled vehicle.
- When using a Booster vehicle, disconnect BLACK cable clamp from battery negative terminal. Disconnect RED cable clamp from battery positive terminal.
- Disconnect RED cable clamp from battery positive terminal on disabled vehicle.

TOWING RECOMMENDATIONS

A vehicle equipped with SAE approved sling-type towing equipment can be used to tow all vehicles.

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SERVICE PROCEDURES (Continued)

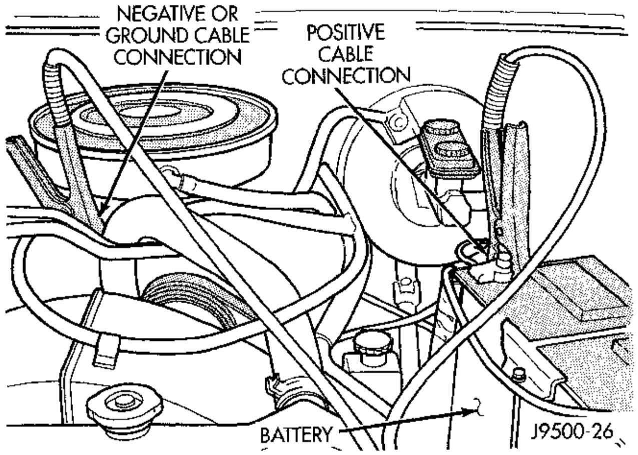

Fig. 1 Jumper Cable Clamp Connections—Gas Engine

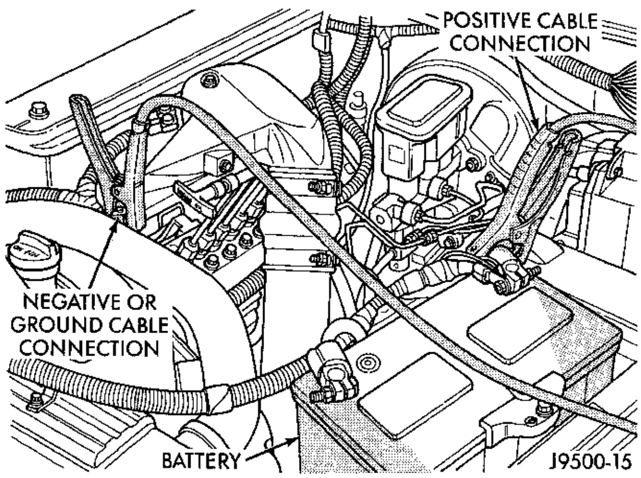

Fig. 2 Jumper Cable Clamp Connections—Diesel Engine

When towing a 4WD vehicle using a wheel-lift towing device, use tow dollies under the opposite end of the vehicle. A vehicle with flat-bed device can also be used to transport a disabled vehicle (Fig. 3).

A wooden crossbeam may be required for proper connection when using the sling-type, front-end towing method.

SAFETY PRECAUTIONS

CAUTION: The following safety precautions must be observed when towing a vehicle:

- Secure loose and protruding parts.
- Always use a safety chain system that is independent of the lifting and towing equipment.
- Do not allow towing equipment to contact the disabled vehicle's fuel tank.
- Do not allow anyone under the disabled vehicle while it is lifted by the towing device.

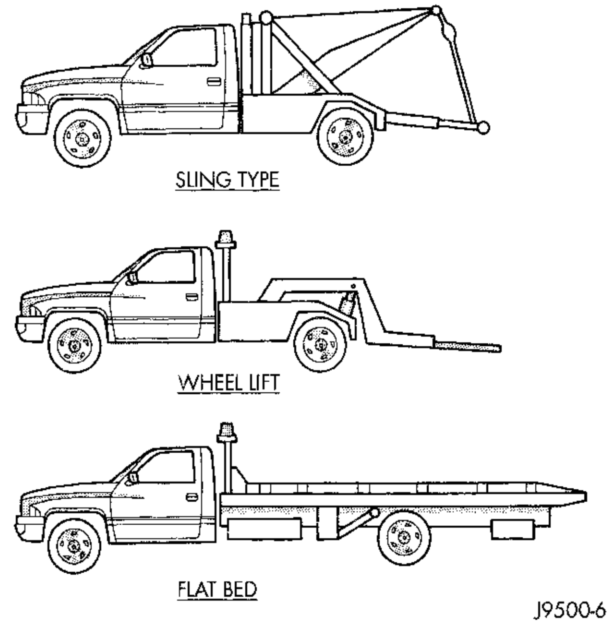

Fig. 3 Tow Vehicles With Approved Equipment

- Do not allow passengers to ride in a vehicle being towed.
- Always observe state and local laws regarding towing regulations.
- Do not tow a vehicle in a manner that could jeopardize the safety of the operator, pedestrians or other motorists.
- Do not attach tow chains, T-hooks, J-hooks, or a tow sling to a bumper, steering linkage, drive shafts or a non-reinforced frame hole.
- Do not tow a heavily loaded vehicle. Damage to the cab, cargo box or frame may result. Use a flatbed device to transport a loaded vehicle.

GROUND CLEARANCE

CAUTION: If vehicle is towed with wheels removed, install lug nuts to retain brake drums or rotors.

A towed vehicle should be raised until lifted wheels are a minimum 100 mm (4 in) from the ground. Be sure there is adequate ground clearance at the opposite end of the vehicle, especially when towing over rough terrain or steep rises in the road. If necessary, remove the wheels from the lifted end of the vehicle and lower the vehicle closer to the ground, to increase the ground clearance at the opposite end of the vehicle. Install lug nuts on wheel attaching studs to retain brake drums or rotors.

SERVICE PROCEDURES (Continued)

RAMP ANGLE

If a vehicle with flat-bed towing equipment is used, the approach ramp angle should not exceed 15 degrees.

TOWING WHEN KEYS ARE NOT AVAILABLE

When the vehicle is locked and keys are not available, use a flat bed hauler. A Wheel-lift or Sling-type device can be used on 4WD vehicles provided **all the wheels are lifted off the ground using tow dollies.**

TWO-WHEEL-DRIVE VEHICLE TOWING

Chrysler Corporation recommends that a vehicle be towed with the rear end lifted, whenever possible.

WARNING: WHEN TOWING A DISABLED VEHICLE AND THE DRIVE WHEELS ARE SECURED IN A WHEEL LIFT OR TOW DOLLIES, ENSURE THE TRANSMISSION IS IN THE PARK POSITION (AUTOMATIC TRANSMISSION) OR A FORWARD DRIVE GEAR (MANUAL TRANSMISSION).

TOWING-REAR END LIFTED

CAUTION: Do not use steering column lock to secure steering wheel during towing operation.

- Unlock steering column and secure steering wheel in straight ahead position with a clamp device designed for towing.
- Verify that steering components are in good condition.

TOWING-FRONT END LIFTED

CAUTION: Many vehicles are equipped with air dams, spoilers, and/or ground effect panels. To avoid component damage, a wheel-lift towing vehicle or a flat-bed hauling vehicle is recommended.

If a two-wheel-drive vehicle cannot be towed with the rear wheels lifted, it can be towed with the front wheels lifted with the transmission in the neutral position.

TWO WHEEL DRIVE—AUTOMATIC TRANSMISSION

Provided the transmission is operable, tow only in **NEUTRAL** at speeds not to exceed 30 mph (50 km/h) and distances less than 15 miles (25km/h).

If the vehicle is to be towed more than 15 miles, the propeller shaft should be disconnected or place tow dollies under rear wheels.

TWO WHEEL DRIVE—MANUAL TRANSMISSION

To reduce the possible damage of transmission components, the propeller shaft must be removed or place tow dollies under the rear wheels before towing.

FOUR-WHEEL-DRIVE VEHICLE TOWING

Chrysler Corporation recommends that a vehicle be transported on a flat-bed device. A Wheel-lift or Sling-type device can be used provided **all the wheels are lifted off the ground using tow dollies.**

WARNING: WHEN TOWING A DISABLED VEHICLE AND THE DRIVE WHEELS ARE SECURED IN A WHEEL LIFT OR TOW DOLLIES, ENSURE THE TRANSMISSION IS IN THE PARK POSITION (AUTOMATIC TRANSMISSION) OR A FORWARD DRIVE GEAR (MANUAL TRANSMISSION).

CAUTION: Many vehicles are equipped with air dams, spoilers, and/or ground effect panels. To avoid component damage, a wheel-lift towing vehicle or a flat-bed hauling vehicle is recommended.

HOISTING RECOMMENDATIONS

Refer to the Owner's Manual for emergency vehicle lifting procedures.

WARNING: THE HOISTING AND JACK LIFTING POINTS PROVIDED ARE FOR A COMPLETE VEHICLE. WHEN A CHASSIS OR DRIVETRAIN COMPONENT IS REMOVED FROM A VEHICLE, THE CENTER OF GRAVITY IS ALTERED MAKING SOME HOISTING CONDITIONS UNSTABLE. PROPERLY SUPPORT (Fig. 4) OR SECURE VEHICLE TO HOISTING DEVICE WHEN THESE CONDITIONS EXIST.

FLOOR JACK

When properly positioned, a floor jack can be used to lift a vehicle (Fig. 5). Support the vehicle in the raised position with jack stands at the front and rear ends of the frame rails.

CAUTION: Do not lift vehicle with a floor jack positioned under:

- **An axle tube.**
- **A body side sill.**
- **A steering linkage component.**
- **A drive shaft.**
- **The engine or transmission oil pan.**
- **The fuel tank.**
- **A front suspension arm.**

AUTHENTIC RESTORATION

SERVICE PROCEDURES (Continued)

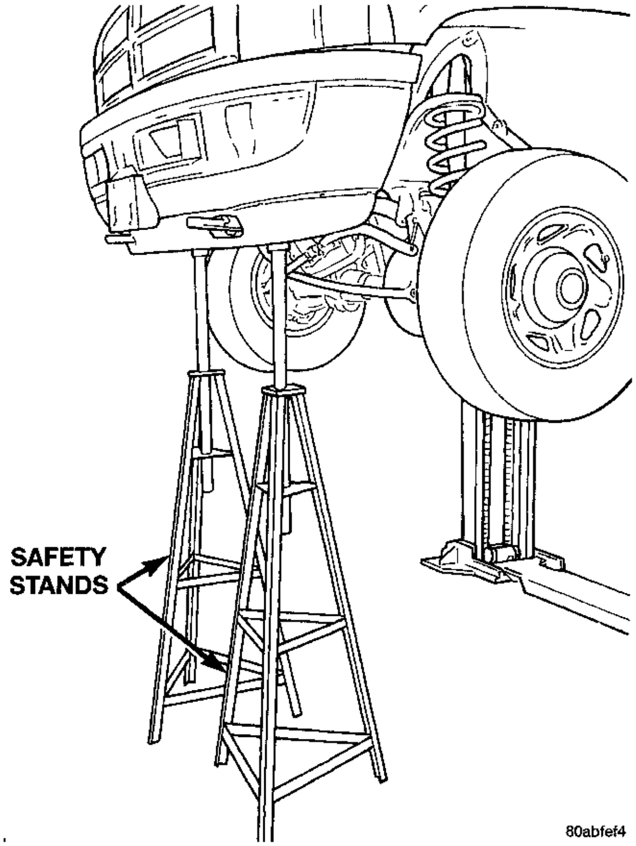

Fig. 4 Safety Stands

NOTE: Use the correct frame rail lifting locations only (Fig. 5).

HOIST

A vehicle can be lifted with:

- A single-post, frame-contact hoist.
- A twin-post, chassis hoist.
- A ramp-type, drive-on hoist.

NOTE: When a frame-contact type hoist is used, verify that the lifting pads are positioned properly (Fig. 5). The forward lifting pads should be positioned a minimum of 5 inches forward of the crossmember bolt access holes (Fig. 6).

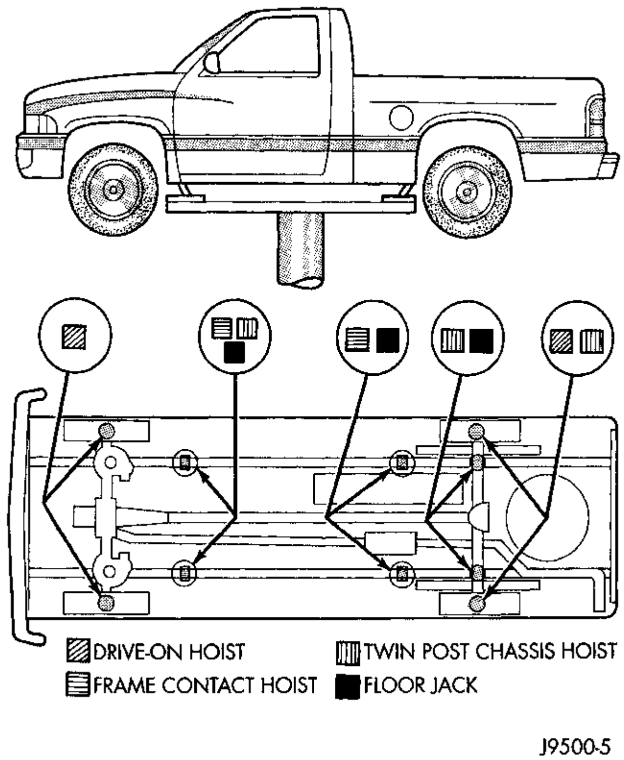

Fig. 5 Vehicle Lifting Locations

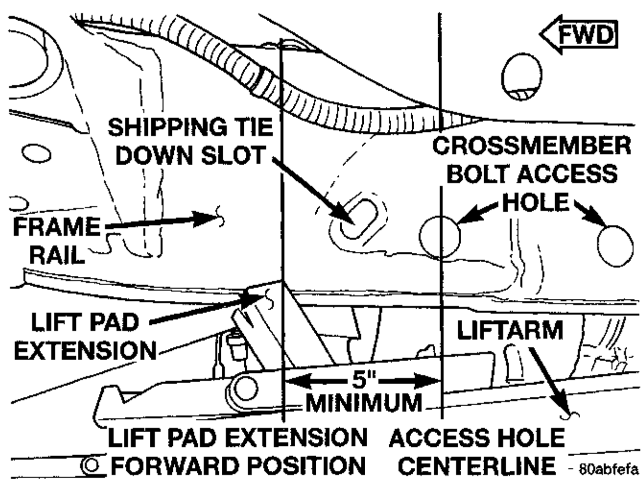

Fig. 6 Front Lift Pad Location

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SUSPENSION

CONTENTS

WHEEL ALIGNMENT

INDEX

DESCRIPTION AND OPERATION

WHEEL ALIGNMENT

Wheel alignment involves the correct positioning of the wheel in relation to the vehicle. The positioning is accomplished through suspension and steering linkage adjustments. An alignment is considered essential for efficient steering, good directional stability and to minimize tire wear. The most important measurements of an alignment are caster, camber and toe position (Fig. 1) and (Fig. 2).

• **CASTER** is the forward or rearward tilt of the steering knuckle from vertical. Tilting the top of the knuckle rearward provides positive caster. Tilting the top of the knuckle forward provides negative caster. Caster is a directional stability angle which enables the front wheels to return to a straight ahead position after turns.

• **CAMBER** is the inward or outward tilt of the wheel relative to the center of the vehicle. Tilting the top of the wheel inward provides negative camber. Tilting the top of the wheel outward provides positive camber. Incorrect camber will cause wear on the inside or outside edge of the tire.

• **WHEEL TOE POSITION** is the difference between the leading inside edges and trailing inside edges of the front tires. Incorrect wheel toe position is the most common cause of unstable steering and uneven tire wear. The wheel toe position is the **final** front wheel alignment adjustment.

CAUTION: Do not attempt to modify any suspension or steering components by heating and bending.

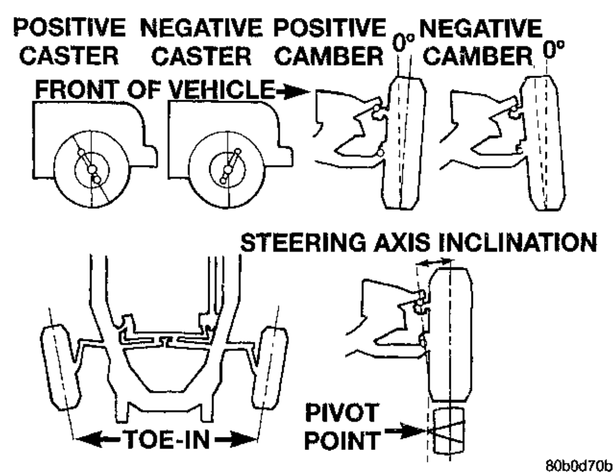

Fig. 1 Alignment Angles IFS

DESCRIPTION AND OPERATION (Continued)

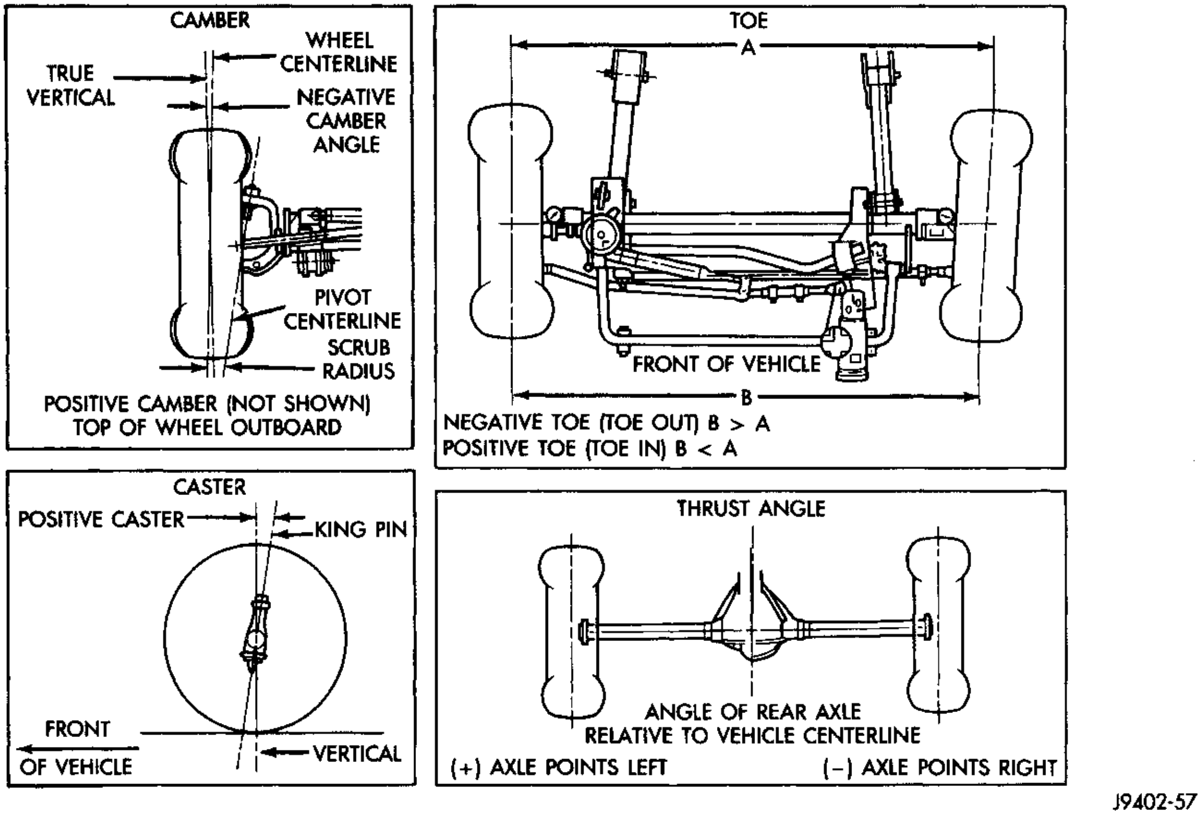

Fig. 2 Alignment Angles Link/Coil

DIAGNOSIS AND TESTING

PRE-ALIGNMENT

Before starting wheel alignment, the following inspection and necessary corrections must be completed. Refer to Suspension and Steering System Diagnosis Chart for additional information.

(1) Inspect tires for size, air pressure and tread wear.

(2) Inspect front wheel bearings for wear.

(3) Inspect front wheels for excessive radial or lateral runout and balance.

(4) Inspect ball studs, linkage pivot points and steering gear for looseness, roughness or binding.

(5) Inspect suspension components for wear and noise.

SERVICE PROCEDURES

ALIGNMENT IFS SUSPENSION

Before each alignment reading the vehicle should be jounced (rear first, then front). Grasp each bumper at the center and jounce the vehicle up and down several times. Always release the bumper in the down position. **Set the front end alignment to specifications while the vehicle is in its NORMALLY LOADED CONDITION.**

Camber and caster angle adjustments involve changing the position of the upper suspension arm pivot bar (Fig. 3). Refer to the Alignment Specification Chart for the correct setting.

CASTER: Move the rear position of the pivot bar in or out. This will change the caster angle significantly and camber angle only slightly. To retain camber move the forward pivot very slightly in the opposite direction.

NOTE: For example, to increase a positive caster angle, move the rear position of the pivot bar inward (toward the engine). Move the front of pivot bar outward (away from the engine) slightly until the original camber angle is obtained.

SUSPENSION AND STEERING SYSTEM DIAGNOSIS

CONDITION	POSSIBLE CAUSES	CORRECTION
FRONT END NOISE	1. Loose or worn wheel bearings. 2. Loose or worn steering or suspension components.	1. Adjust or replace wheel bearings. 2. Tighten or replace components as necessary.
EXCESSIVE PLAY IN STEERING	1. Loose or worn wheel bearings. 2. Loose or worn steering or suspension components. 3. Loose or worn steering gear.	1. Adjust or replace wheel bearings. 2. Tighten or replace components as necessary. 3. Adjust or replace steering gear.
FRONT WHEELS SHIMMY	1. Loose or worn wheel bearings. 2. Loose or worn steering or suspension components. 3. Tires worn or out of balance. 4. Alignment.	1. Adjust or replace wheel bearings. 2. Tighten or replace components as necessary. 3. Replace or balance tires. 4. Align vehicle to specifications.
VEHICLE INSTABILITY	1. Loose or worn wheel bearings. 2. Loose or worn steering or suspension components. 3. Tire pressure. 4. Alignment.	1. Adjust or replace wheel bearings. 2. Tighten or replace components as necessary. 3. Adjust tire pressure. 4. Align vehicle to specifications.
EXCESSIVE STEERING EFFORT	1. Loose or worn steering gear. 2. Column coupler binding. 3. Tire pressure. 4. Alignment.	1. Adjust or replace steering gear. 2. Replace coupler. 3. Adjust tire pressure. 4. Align vehicle to specifications.
VEHICLE PULLS TO ONE SIDE	1. Tire pressure. 2. Alignment. 3. Loose or worn steering or suspension components 4. Radial tire lead. 5. Brake pull. 6. Weak or broken spring.	1. Adjust tire pressure. 2. Align vehicle to specifications. 3. Tighten or replace components as necessary. 4. Rotate or replace tire as necessary. 5. Repair brake as necessary. 6. Replace spring.

SERVICE PROCEDURES (Continued)

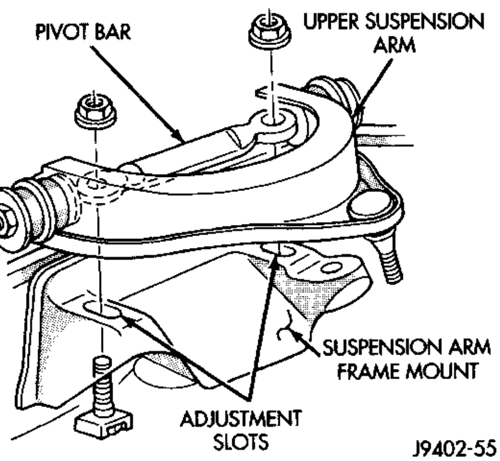

Fig. 3 Caster Camber Adjustment Location

CAMBER: Move the forward position of the pivot bar in or out. This will change the camber angle significantly and caster angle only slightly. The camber angle should be adjusted as close as possible to the **preferred service specification**. After adjustment is made tighten pivot bar nuts to specifications.

TOE POSITION: The wheel toe position adjustment should be the final adjustment.

(1) Start the engine and turn wheels both ways before straightening the wheels. Center and secure the steering wheel and turn off engine.

(2) Loosen the tie rod adjustment sleeve clamp bolts/nuts.

NOTE: Each front wheel should be adjusted for one-half of the total toe position specification. This will ensure the steering wheel will be centered when the wheels are positioned straight-ahead.

(3) Adjust the wheel toe position by turning the tie rod adjustment sleeves as necessary.

ALIGNMENT LINK/COIL SUSPENSION

Before each alignment reading the vehicle should be jounced (rear first, then front). Grasp each bumper at the center and jounce the vehicle up and down several times. Always release the bumper in the down position. **Set the front end alignment to specifications while the vehicle is in its NORMALLY LOADED CONDITION.**

CAMBER: The wheel camber angle is preset and is not adjustable.

CASTER: Check the caster of the front axle for correct angle. Be sure the axle is not bent or twisted. Road test the vehicle and make left and right turn. Observe the steering wheel return-to-center position. Low caster will cause poor steering wheel returnability.

Caster can be adjusted by rotating the cams on the lower suspension arm (Fig. 4). Refer to the Alignment Specification for the correct setting.

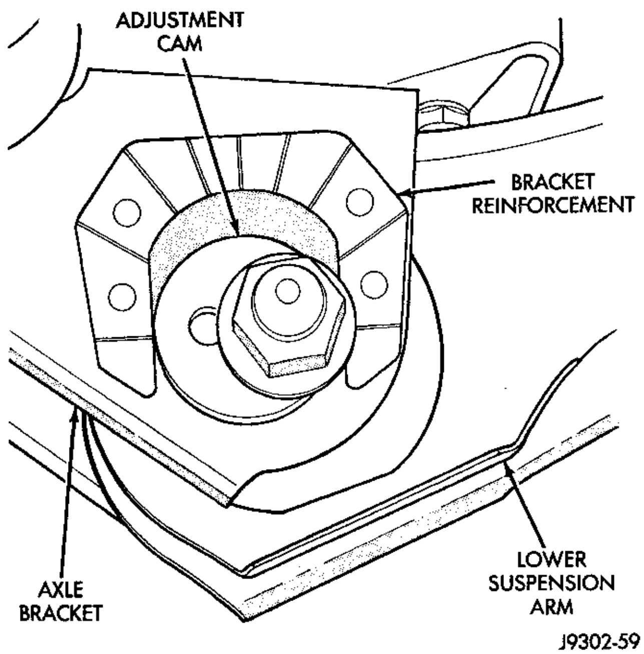

Fig. 4 Cam Adjuster

TOE POSITION: The wheel toe position adjustment should be the final adjustment.

(1) Start the engine and turn wheels both ways before straightening the wheels. Center and Secure the steering wheel and turn off engine.

(2) Loosen the adjustment sleeve clamp bolts.

CAUTION: Do not loosen/move alignment bar or alignment bar clamp (Fig. 5). The bar is used as a locator for the adjuster clamps.

(3) Adjust the right wheel toe position with the drag link (Fig. 5). Turn the sleeve until the right wheel is at the correct TOE-IN position. Position clamp bolts to their original position and tighten to specifications. **Make sure the toe setting does not change during clamp tightening.**

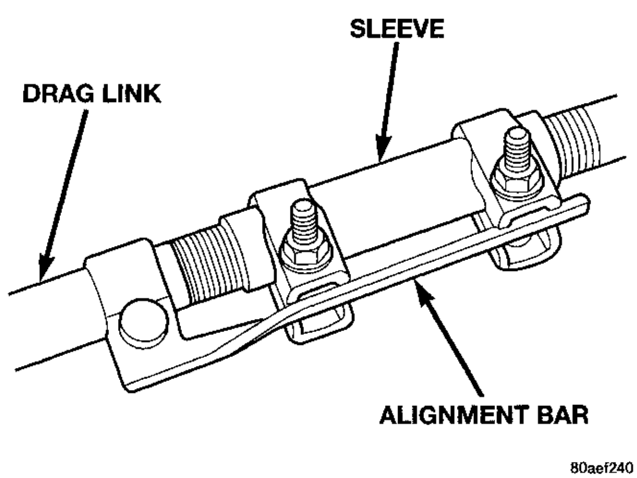

Fig. 5 Alignment Bar/Drag Link Adjustment

AUTHENTIC RESTORATION PRODUCT

SERVICE PROCEDURES (Continued)

(4) Adjust left wheel toe position with tie rod at left knuckle. Turn the sleeve until the left wheel is at the correct TOE-IN position. Position clamp bolts to their original position and tighten to specifications. **Make sure the toe setting does not change during clamp tightening.**

(5) Verify the right toe setting.

CAB-CHASSIS CASTER CORRECTION MEASUREMENT

NOTE: To determine the correct caster alignment angle for Cab-Chassis vehicles the following procedure must be performed.

NOTE: 4x2 11000 GVW has a solid front axle and uses a 4x4 frame.

(1) Take a height measurement to the center of the front gauge hole in the frame. Take another measurement to the center of the rear spring hanger bolt (Fig. 6). Take these measurements on both sides of the vehicle.

(2) Subtract the front measurement from the rear measurement and use the average between the right and left side. Use this number (caster correlation valve) with the Corrected Caster Chart to obtain the preferred caster angle.

CORRECTED CASTER CHART-CAB CHASSIS

Caster Correlation Value (inches)	4x2 8800 lb. GVW 134.7 in. wheel base	4x4 8800 lb. GVW 4x2 & 4x4 11000 lb. GVW 134.7 & 138.7 in. wheel base	4x2 & 4x4 11000 lb. GVW 162.7 in. wheel base
	Caster ± 1 deg.	Caster ± 1 deg.	Caster ± 1 deg.
−5.00	4.27°	3.77°	3.81°
−4.75	4.39°	3.89°	3.91°
−4.50	4.51°	4.01°	4.01°
−4.25	4.64°	4.14°	4.11°
−4.00	4.76°	4.26°	4.21°
−3.75	4.88°	4.38°	4.31°
−3.50	5.00°	4.50°	4.41°
−3.25	5.12°	4.62°	4.51°
−3.00	5.25°	4.75°	4.61°
−2.75	5.37°	4.87°	4.71°
−2.50	5.49°	4.99°	4.81°
−2.25	5.61°	5.11°	4.91°
−2.00	5.74°	5.24°	5.01°
−1.75	5.86°	5.36°	5.11°
−1.50	5.98°	5.48°	5.21°
−1.25	6.10°	5.60°	5.31°
−1.00	6.23°	5.73°	5.41°
−0.75	6.33°	5.83°	5.51°
−0.50	6.47°	5.97°	5.61°
−0.25	6.59°	6.09°	5.71°
0.00	6.71°	6.21°	5.81°

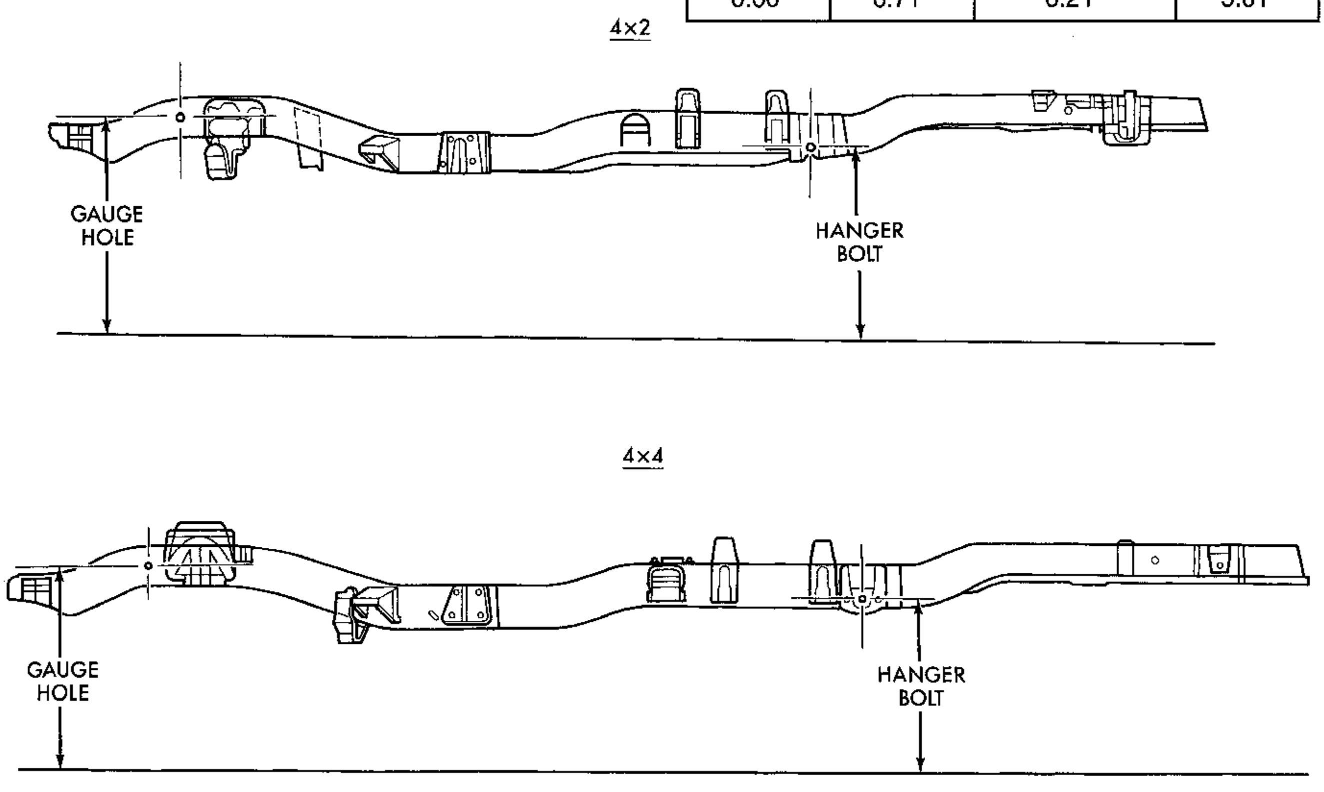

Fig. 6 Chassis Measurement

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SPECIFICATIONS

ALIGNMENT

4 x 2 & 4 x 4	GROSS VEHICLE WEIGHT lbs.	WHEEL BASE inches	PREFERRED CASTER ± 1.00°	PREFERRED CAMBER ± 0.50°
4 x 2	6,010	118.7	3.40°	0.50°
4 x 2	6,400	118.7	3.40°	0.50°
4 x 2	6,010	134.7	3.60°	0.50°
4 x 2	6,400	134.7	3.60°	0.50°
4 x 2	6,400	138.7	3.70°	0.50°
4 x 2	6,400	154.7	3.85°	0.50°
4 x 2	7,500	134.7	3.55°	0.50°
4 x 2	8,800	134.7	3.45°	0.50°
4 x 2	8,800	138.7	3.50°	0.50°
4 x 2	8,800	154.7	3.65°	0.50°
4 x 2	10,500	134.7	3.25°	0.50°
4 x 2	10,500	154.7	3.45°	0.50°
4 x 4	6,400	118.7	3.10	Not Set
4 x 4	6,400	134.7	3.25	Not Set
4 x 4	6,400/6,600	138.7	3.40	Not Set
4 x 4	6,400/6,600	154.7	3.55	Not Set
4 x 4	7,500	134.7	3.00	Not Set
4 x 4	8,800	134.7	3.10	Not Set
4 x 4	8,800	138.7	3.15	Not Set
4 x 4	8,800	154.7	3.25	Not Set
4 x 4	10,500	134.7	2.90	Not Set
4 x 4	10,500	154.7	3.00	Not Set
CAB-CHASSIS VEHICLES				
4 x 2 / 4 x 4	8,800	134.7	Caster	Not Set
*4 x 2 / 4 x 4	11,000	138.7	Correction	Not Set
*4 x 2 / 4 x 4	11,000	162.7	Measurement	Not Set
Preferred Total Toe-In 0.10° (± 0.10°) Preferred Cross Caster 0° (± 0.5°) Preferred Cross Camber 0° (± 0.5°) Thrust Angle 0° (± 0.4°)				

NOTE: *4 x 2 11,000 GVW has a solid front axle with link/coil suspension system.

Mopar AUTHENTIC RESTORATION PRODUCT

FRONT SUSPENSION (IFS)

INDEX

DESCRIPTION AND OPERATION

INDEPENDENT FRONT SUSPENSION (IFS)

The IFS suspension is comprised of (Fig. 1) and (Fig. 2);

- Shock absorbers
- Coil springs
- Upper and lower suspension arms
- Stabilizer bar

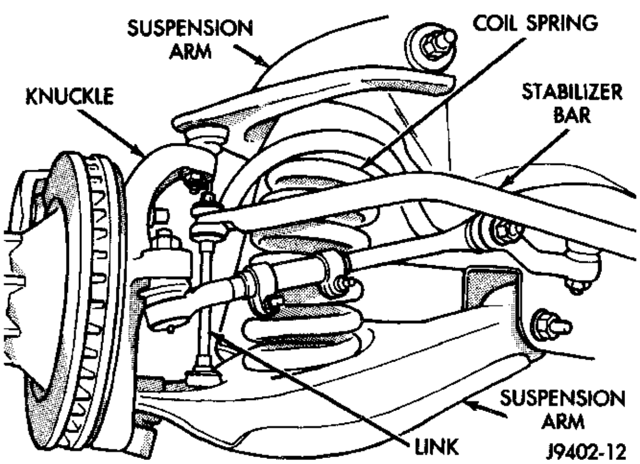

Fig. 1 Independent Front Suspension

Shock Absorbers: The shock absorbers dampen jounce and rebound of the vehicle over various road conditions. Shocks are mounted on the bottom to the lower suspension arms. The top of the shock mounts on frame brackets using grommets.

Coil Springs: The coil springs control ride quality and maintain proper ride height. The springs mount between the lower suspension arm and the front cross member spring seat. A rubber isolator seats on top off the spring to help prevent noise.

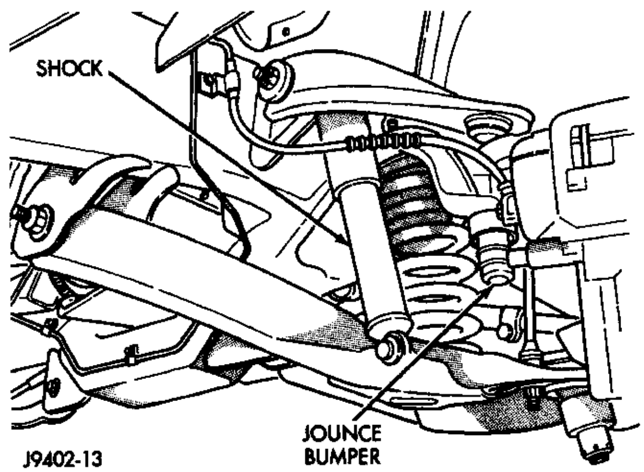

Fig. 2 Independent Front Suspension

Suspension Arms: The suspension arms have replaceable ball studs which are pressed into the arms. Bushings located inboard are not replaceable. The upper arm has a pivot bar which mounts on a frame bracket. The bracket has slotted holes this allows the arm to be adjusted for caster and camber. The suspension arm travel (jounce or rebound) is limited through the use of urethane bumpers.

Stabilizer Bar: The stabilizer bar is used to minimize vehicle front sway during turns. The spring steel bar helps to control the vehicle body in relationship to the suspension. The bar extends across the front underside of the chassis and mounts on the frame rails. Links connected the bar to the lower suspension arms. Stabilizer bar mounts are isolated by

AUTHENTIC RESTORATION PRODUCT

DESCRIPTION AND OPERATION (Continued)

rubber bushings. Links are isolated with rubber grommet.

CAUTION: Components attached with a nut and cotter pin must be torqued to specification. Then if the slot in the nut does not line up with the cotter pin hole, tighten nut until it is aligned. Never loosen the nut to align the cotter pin hole.

CAUTION: Suspension components with rubber/urethane bushings (except stabilizer bar) should be tightened with the vehicle at normal ride height. It is important to have the springs supporting the weight of the vehicle when the fasteners are torqued. If springs are not at their normal ride position, vehicle ride comfort could be affected and premature bushing wear may occur.

NOTE: Periodic lubrication of the front suspension/steering system components may be required. Rubber bushings must never be lubricated. Refer to Group 0, Lubrication And Maintenance for the recommended maintenance schedule.

DIAGNOSIS AND TESTING

LOWER BALL JOINT

(1) Raise the front of the vehicle. Place safety floor stands under both lower suspension arms as far outboard as possible. Lower the vehicle to allow the stands to support some or all of the vehicle weight.

NOTE: The upper suspension arms must not contact the rebound bumpers.

(2) Remove the tire and wheel assembly.
(3) Mount a dial indicator solidly under the lower suspension arm.
(4) Position indicator plunger against the bottom of the steering knuckle lower ball joint boss.

NOTE: The dial Indicator plunger must be perpendicular to the machined surface of the steering knuckle lower ball joint boss.

(5) Position a pry bar over the top of the upper suspension arm and under the pivot bar of the upper suspension arm. Pry down on the upper suspension arm and then zero the dial indicator.
(6) Reposition the pry bar under the upper suspension arm and on top of the frame rail. Pry up on the upper suspension arm and record the dial indicator reading.
(7) If the travel exceeds 0.8 mm (0.030 in.) replace the ball joint.

UPPER BALL JOINT

(1) Position a floor jack under the lower suspension arm. Raise the wheel and allow the tire to lightly contact the floor (vehicle weight relieved from the tire).
(2) Mount a dial indicator solidly on the upper suspension arm.
(3) Position the indicator plunger against the upper ball stud boss of the steering knuckle.
(4) Grasp the top of the tire and apply force in and out. Look for movement at the ball joint between the upper suspension arm and steering knuckle.
(5) If lateral movement is greater than 0.8 mm (0.030 in.), replace the ball joint.

SHOCK DIAGNOSIS

A knocking or rattling noise from a shock absorber may be caused by movement between mounting bushings and metal brackets or attaching components. These noises can usually be stopped by tightening the attaching nuts. If the noise persists, inspect for damaged and worn bushings, and attaching components. Repair as necessary if any of these conditions exist.

A squeaking noise from the shock absorber may be caused by the hydraulic valving and may be intermittent. This condition is not repairable and the shock absorber must be replaced.

The shock absorbers are not refillable or adjustable. If a malfunction occurs, the shock absorber must be replaced. To test a shock absorber, hold it in an upright position and force the piston in and out of the cylinder four or five times. The action throughout each stroke should be smooth and even.

The shock absorber bushings do not require any type of lubrication. Do not attempt to stop bushing noise by lubricating them. Grease and mineral oil-base lubricants will deteriorate the bushing.

REMOVAL AND INSTALLATION

SHOCK ABSORBER

REMOVAL

(1) Raise and support vehicle.
(2) Remove shock upper nut and remove retainer and grommet.
(3) Remove lower mounting bolt from suspension arm and remove shock (Fig. 3).

AUTHENTIC RESTORATION

REMOVAL AND INSTALLATION (Continued)

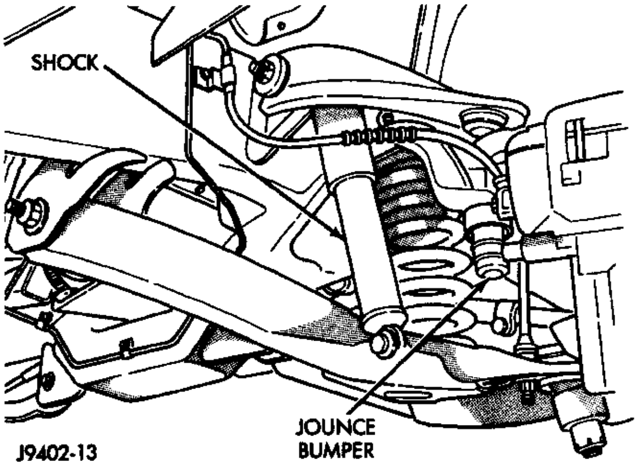

Fig. 3 Shock Absorber

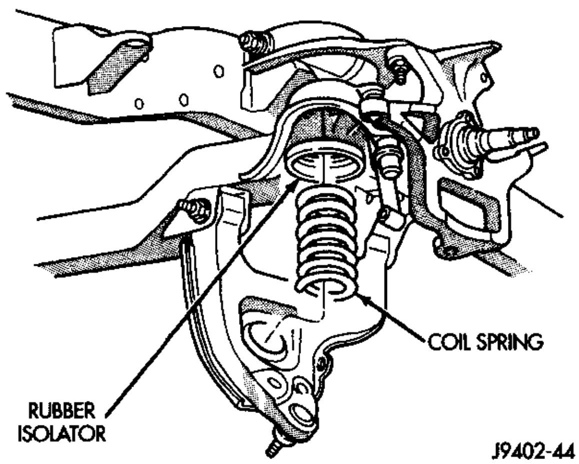

Fig. 4 Coil Spring

INSTALLATION

(1) Extend shock fully, install retainer and grommet on top of shock absorber. Check grommets and retainer for wear.

(2) Guide shock up through upper suspension arm bracket. Install top grommet, retainer and nut. Tighten nut to 47 N·m (35 ft. lbs.).

(3) Align bottom end of shock into lower suspension arm and install mounting bolt. Tighten bolt to 142 N·m (105 ft. lbs.).

(4) Remove support and lower vehicle.

COIL SPRINGS

REMOVAL

(1) Raise and support vehicle.

(2) Remove tire and wheel assembly.

(3) Remove brake caliper assembly and rotor refer to Group 5 Brakes.

(4) Disconnect tie rod from steering knuckle.

(5) Disconnect stabilizer bar link from lower suspension arm.

(6) Support lower suspension arm outboard end with jack. Place jack under arm in front of shock mount.

(7) Remove cotter pin and nut from lower ball joint. Separate ball joint with remover C-4150A.

(8) Remove lower shock bolt from suspension arm.

(9) Lower jack and suspension arm until spring tension is relieved. Remove spring and rubber isolator (Fig. 4).

INSTALLATION

(1) Install rubber isolator on top of spring. Position spring into upper spring seat and lower suspension arm.

(2) Raise suspension arm with jack and position shock into suspension arm mount. Install shock bolt and tighten to 135 N·m (100 ft. lbs.).

(3) Install steering knuckle on lower ball joint. Install lower ball joint nut and tighten to:
- LD: 129 N·m (95 ft. lbs.)
- HD: 136 N·m (110 ft. lbs.)

(4) Replace cotter pin and remove jack.

(5) Install stabilizer bar link on lower suspension arm. Install grommet, retainer and nut and tighten to 37 N·m (27 ft. lbs.).

(6) Install tie rod on steering knuckle and tighten nut to 88 N·m (65 ft. lbs.).

(7) Install brake caliper assembly and rotor, refer to Group 5 Brakes.

(8) Install tire and wheel assembly.

(9) Remove support and lower vehicle.

STEERING KNUCKLE

REMOVAL

(1) Raise and support vehicle.

(2) Remove wheel and tire assembly. Remove the brake caliper, refer to Group 5 Brakes.

(3) Remove the wheel hub and bearing assembly from the spindle. Refer to Wheel Hub and Bearings service removal.

(4) Remove the cotter pin and nut from the tie-rod end and disconnect tie rod.

(5) Remove the cotter pins and nuts from the upper and lower ball joints. Separate upper ball joint from knuckle with remover MD-990635. Separate lower ball joint with remover C-4150A and remove knuckle.

INSTALLATION

(1) Position knuckle on ball joints and install ball joint nuts.

(2) Tighten upper ball joint nut to 81 N·m (60 ft. lbs.) and install cotter pin.

(3) Tighten lower ball joint nut to:
- LD: 129 N·m (95 ft. lbs.)

REMOVAL AND INSTALLATION (Continued)

- HD: 149 N·m (110 ft. lbs.)

(4) Install cotter pin.

(5) Install the brake rotor hub and bearing assembly on spindle. Refer to Wheel Hub and Bearings service installation.

(6) Install the brake caliper, refer to Group 5 Brakes.

(7) Install wheel and tire assembly.

(8) Remove support and lower vehicle.

LOWER SUSPENSION ARM

REMOVAL

(1) Raise and support vehicle.

(2) Follow procedure under Coil Spring Removal.

(3) Remove bolts mounting suspension arm to crossmember and remove arm.

INSTALLATION

(1) Position suspension arm on crossmember and install bolts and nuts snug.

(2) Follow procedure under Coil Spring Installation.

(3) Remove support and lower vehicle.

(4) Tighten suspension arm crossmember nuts to 196 N·m (145 ft. lbs.).

UPPER SUSPENSION ARM

REMOVAL

(1) Raise and support vehicle.

(2) Remove tire and wheel assembly.

(3) Support lower suspension arm at outboard end with jack stand.

(4) Remove upper ball joint cotter pin and nut.

(5) Separate ball joint from knuckle with remover MB-990635.

(6) Remove pivot bar bolts from upper suspension arm bracket and remove arm from vehicle (Fig. 5).

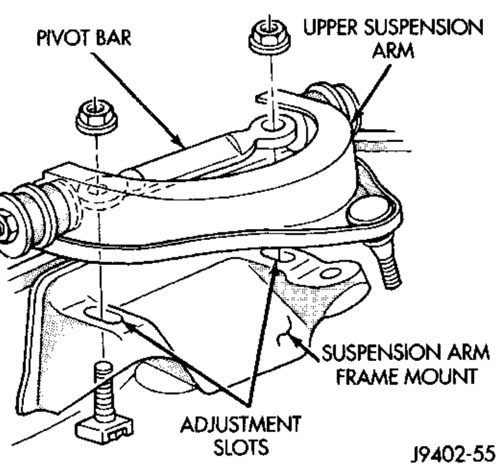

Fig. 5 Upper Suspension Arm

INSTALLATION

(1) Position upper suspension arm on bracket and install pivot bar bolts. Tighten to 203 N·m (150 ft. lbs.).

(2) Install ball joint in knuckle. Install nut and tighten to 81 N·m (60 ft. lbs.) and replacement cotter pin.

(3) Remove jack from lower suspension arm.

(4) Install tire and wheel assembly.

(5) Remove support and lower vehicle.

(6) Align front suspension.

STABILIZER BAR

REMOVAL

(1) Raise and support the vehicle.

(2) Disconnect the link from lower suspension arm and stabilizer bar (Fig. 6).

(3) Disconnect the stabilizer bar clamps from the frame rails. Remove the stabilizer bar.

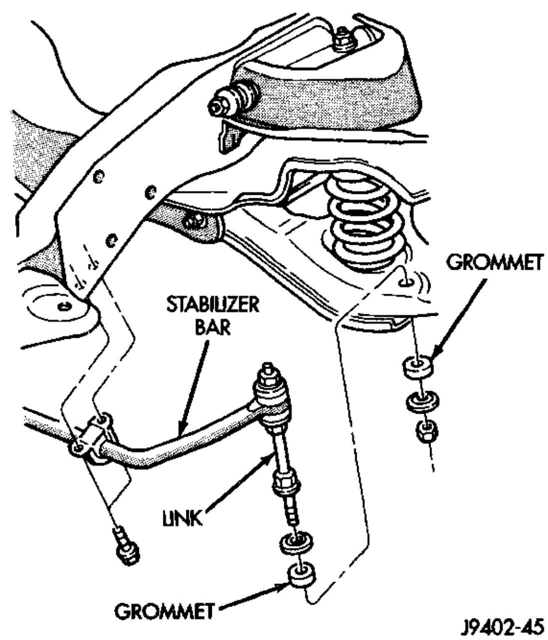

Fig. 6 STABILIZER BAR

INSTALLATION

(1) Position the stabilizer bar on the frame rail and install the clamps and bolts. Ensure the bar is centered with equal spacing on both sides. Tighten the bolts to 54 N·m (40 ft. lbs.).

(2) Install links on stabilizer bar and lower suspension arm. Install grommets, retainers and nuts. Tighten nuts to 37 N·m (27 ft. lbs.).

(3) Remove the supports and lower the vehicle.

AUTHENTIC RESTORATION PRODUCT

REMOVAL AND INSTALLATION (Continued)

WHEEL BEARINGS

REMOVAL
(1) Raise and support the vehicle.
(2) Remove the wheel and tire assembly.
(3) Remove disc brake caliper from steering knuckle. Refer to Group 5 Brakes.
(4) Remove the dust cap, cotter pin, and hub nut from spindle.
(5) Carefully slide the hub/rotor from spindle.
(6) Remove the seal and inner wheel bearing from the hub/rotor.
(7) Remove inner bearing races from hub/rotor with a pin punch if bearings are going to be replaced.

INSTALLATION
(1) Install the new bearing cup(s) with an appropriate installation tool.
(2) Apply a coating of MOPAR Wheel Bearing Grease or equivalent lubricant to inner surface area of hub/rotor. Install inner wheel bearing and seal in the hub/rotor.
(3) Inspect bearing and seal contact surfaces on spindle for burrs and/or roughness.
(4) Remove all rough contact surfaces from spindle. Apply a coating of lubricant.
(5) Carefully slide the hub/rotor onto spindle. Install outer wheel bearing, washer and retaining nut.

NOTE: Use care to prevent inner wheel bearing and seal from contacting spindle threads during installation.

(6) Tighten the nut to 41-54 N·m (30-40 ft. lbs.) torque to preload bearing while rotating the hub/rotor. Stop hub/rotor and loosen nut to completely release bearing preload torque. Tighten the nut finger-tight and install the nut lock. Install a new cotter pin.
(7) The adjustment (above) should have 0.001 to 0.003 inch (0.254 to 0.0762 mm) end play.
(8) Clean the dust cap and apply a coating lubricant to the internal surface. **Do not fill the dust cap with lubricant.** Install the cap.
(9) Install disc brake caliper, refer to Group 5 Brakes.
(10) Install the wheel and tire assembly.

WHEEL STUDS

REMOVAL
(1) Remove wheel and tire assembly.
(2) Remove disc brake rotor, refer Group 5 Brakes.
(3) Place rotor on flat surface and drive studs out of the with a hammer and punch.

INSTALLATION
(1) Turn the rotor over and place in a vise.
(2) Drive new studs into the rotor with hammer and punch.
(3) Install rotor, refer to Group 5 Brakes.
(4) Install wheel and tire assembly.

DISASSEMBLY AND ASSEMBLY

LOWER BALL JOINT

NOTE: If the ball joint is tack welded to the suspension arm, the suspension arm must be replaced.

DISASSEMBLY
(1) Remove lower suspension arm.
(2) Position special tool on lower suspension arm and press out ball joint (Fig. 7).

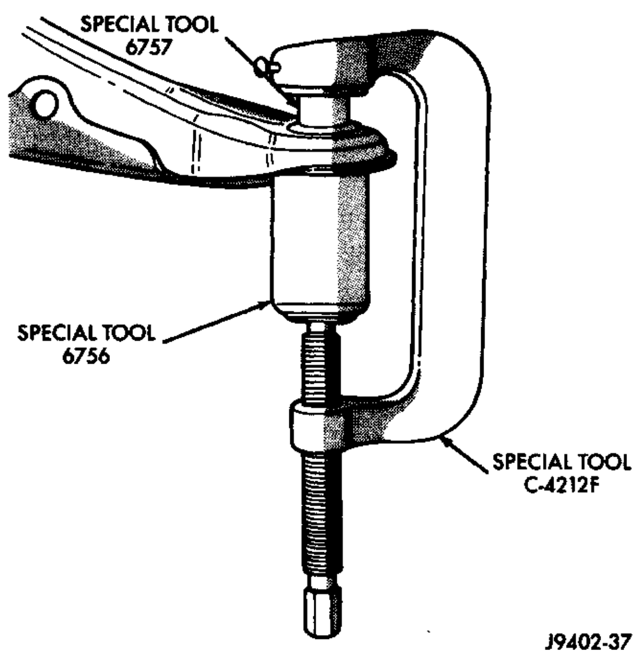

Fig. 7 Lower Ball Joint Removal

ASSEMBLY
(1) Press replacement ball joint into the lower suspension arm bore with special tools (Fig. 8).
(2) Install lower suspension arm.

UPPER BALL JOINT

DISASSEMBLY
(1) Remove the upper suspension arm.
(2) Position special tools on upper suspension arm and press ball joint out of arm (Fig. 9).

ASSEMBLY
(1) Press ball joint into upper suspension arm with special tools (Fig. 10).
(2) Install the upper suspension arm.

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DISASSEMBLY AND ASSEMBLY (Continued)

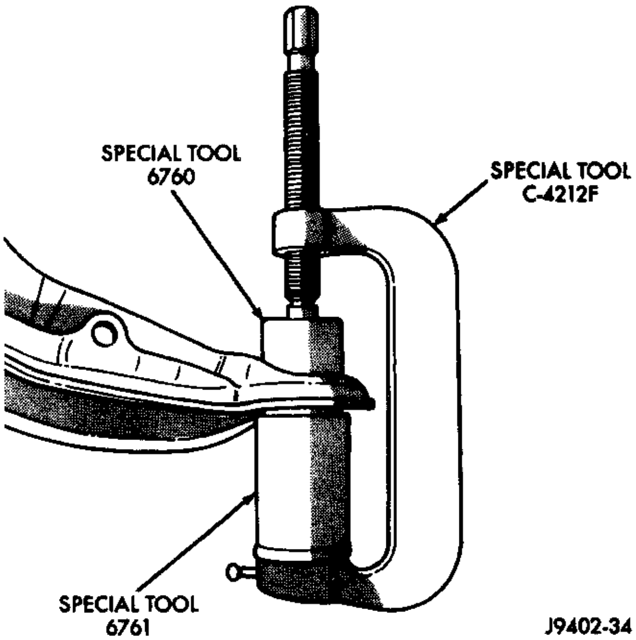


Fig. 8 Lower Ball Joint Installation

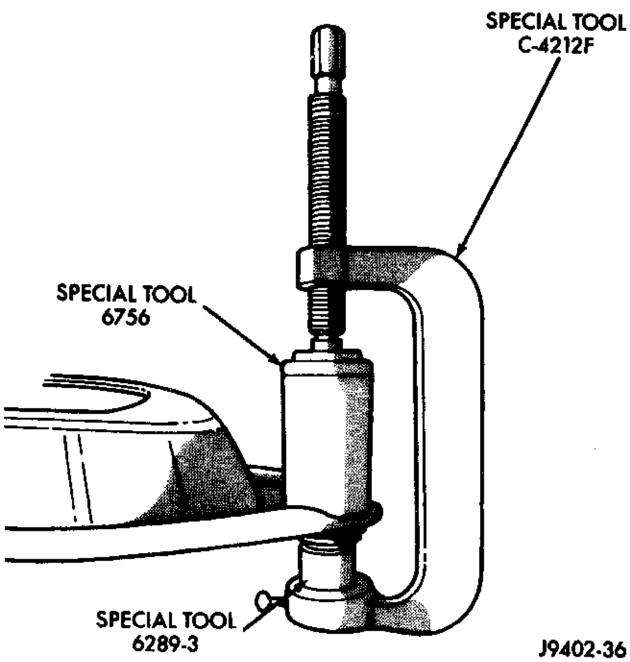


Fig. 9 Upper Ball Joint Removal

CLEANING AND INSPECTION

WHEEL BEARINGS

NOTE: Bearing and races must be replaced as a set if worn or damaged.

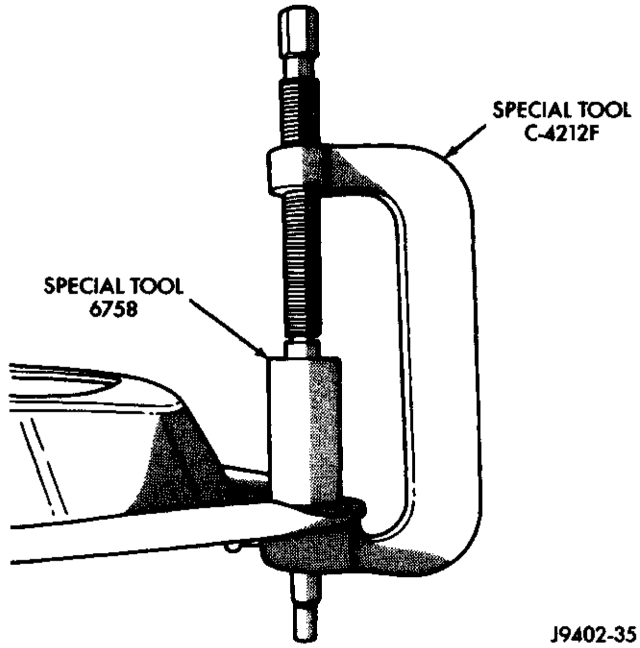


Fig. 10 Upper Ball Joint Installation

(1) Thoroughly clean the interior of hub/rotor.
(2) Clean the bearings with solvent and towel dry.
(3) After cleaning, apply engine oil to each bearing.
(4) Rotate each bearing slowly while applying downward force. Examine the rollers for pitting and roughness, replace bearing if worn or defective.
(5) Remove the engine oil from each bearing. Pack each bearing with multi-purpose NLGI, grade 2, EP-type lubricant (or an equivalent lubricant).

NOTE: Ensure that lubricant is forced into all the cavities between the bearing cage and rollers.

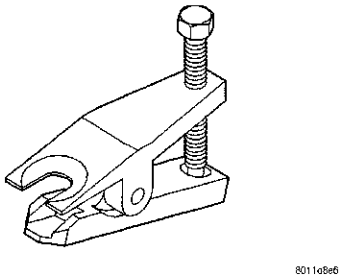
SPECIFICATIONS

TORQUE CHART

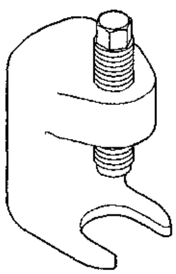
DESCRIPTION	TORQUE
Shock Absorber	
Upper Nut	47 N·m (35 ft. lbs.)
Lower Bolt	142 N·m (105 ft. lbs.)
Lower Suspension Arm	
Frame Nuts	197 N·m (145 ft. lbs.)
LD Ball Joint Nut	129 N·m (95 ft. lbs.)
HD Ball Joint Nut	149 N·m (110 ft. lbs.)
Upper Suspension Arm	
Pivot Bar Nuts	203 N·m (150 ft. lbs.)
Ball Joint Nut	81 N·m (60 ft. lbs.)
Stabilizer Bar	
Clamp Bolt	54 N·m (40 ft. lbs.)
Link Nuts	37 N·m (27 ft. lbs.)

SPECIAL TOOLS

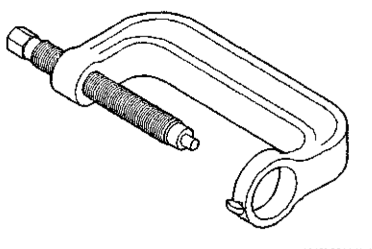
IFS FRONT SUSPENSION



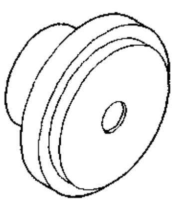
Remover, Tie Rod End MB-990635



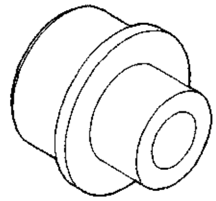
Remover, Lower Ball Joint C-4150A



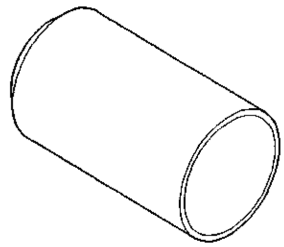
Press Ball Joint Remover/Installer C-4212F



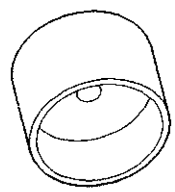
Remover, Ball Joint 6757



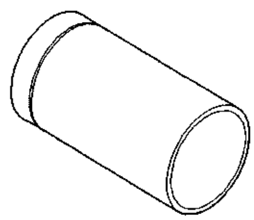
Remover, Ball Joint 6289–3



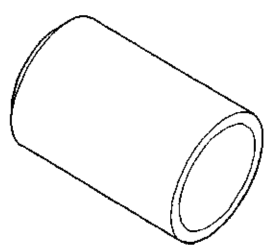
Receiver, Ball Joint 6756



Receiver, Ball Joint 6760



Installer, Ball Joint 6758



Installer, Ball Joint 6761

FRONT SUSPENSION LINK/COIL

INDEX

DESCRIPTION AND OPERATION

FRONT SUSPENSION LINK/COIL

The Ram Truck Link/coil suspension allows each wheel to adapt to different road surfaces. The suspension is comprised of (Fig. 1):

- Shock absorbers
- Coil springs
- Upper and lower suspension arms
- Stabilizer bar
- Track bar

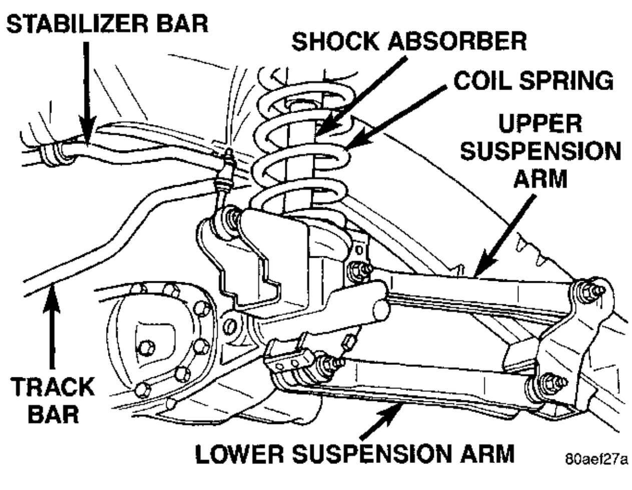


Fig. 1 Link/Coil Suspension

Shock Absorbers: The shock absorbers dampen the jounce and rebound of the vehicle over various road conditions. Shocks are mounted inside the springs and attached at the top to brackets with grommets. These brackets are bolted on the frame with three studs on a ring. The shock is mounted at the bottom of the axle below the spring seat.

Coil Springs: The coil springs control ride quality and maintain proper ride height. The springs use a rubber isolators between the frame bracket and spring. The isolators help prevent road noise. The bottom of the spring sits on a seat mounted to the axle.

Suspension Arms: The upper and lower suspension arms use bushings to isolate road noise. The suspension arms are bolted to the frame and axle through the rubber bushings. The lower suspension arm uses cam bolts at the axle to allow for caster and pinion angle adjustment. The suspension arm travel (jounce or rebound) is limited through the use of urethane bumpers.

Stabilizer Bar: The stabilizer bar is used to minimize vehicle front sway during turns. The spring steel bar helps to control the vehicle body in relationship to the suspension. The bar extends across the front underside of the chassis and connects to the frame rails. Links are connected from the bar to the axle brackets. Stabilizer bar mounts are isolated by teflon lined rubber bushings.

Track Bar: The track bar is used to control front axle side-to-side movement. The bar is attached to a frame rail bracket with a ball stud and is isolated with a bushing at the axle bracket.

Steering Knuckles: The steering knuckles pivot on replaceable ball studs attached to the axle tube yokes.

CAUTION: Components attached with a nut and cotter pin must be torqued to specification. Then if the slot in the nut does not line up with the cotter pin hole, tighten nut until it is aligned. Never loosen the nut to align the cotter pin hole.

AUTHENTIC RESTORATION PRODUCTS

DESCRIPTION AND OPERATION (Continued)

CAUTION: Suspension components with rubber bushings (except stabilizer bar) should be tightened with the vehicle at normal height. It is important to have the springs supporting the weight of the vehicle when the fasteners are torqued. If springs are not at their normal ride position, vehicle ride comfort could be affected and premature bushing wear may occur.

NOTE: Periodic lubrication of the front suspension (steering) system components is required. Rubber bushings must never be lubricated. Refer to Group 0, Lubrication And Maintenance for the recommended maintenance schedule.

DIAGNOSIS AND TESTING

SHOCK DIAGNOSIS

A knocking or rattling noise from a shock absorber may be caused by movement between mounting bushings and metal brackets or attaching components. These noises can usually be stopped by tightening the attaching nuts. If the noise persists, inspect for damaged and worn bushings, and attaching components. Repair as necessary if any of these conditions exist.

A squeaking noise from the shock absorber may be caused by the hydraulic valving and may be intermittent. This condition is not repairable and the shock absorber must be replaced.

The shock absorbers are not refillable or adjustable. If a malfunction occurs, the shock absorber must be replaced. To test a shock absorber, hold it in an upright position and force the piston in and out of the cylinder four or five times. The action throughout each stroke should be smooth and even.

The shock absorber bushings do not require any type of lubrication. Do not attempt to stop bushing noise by lubricating them. Grease and mineral oil-base lubricants will deteriorate the bushing.

TRACK BAR

(1) Turn the front wheel 90° to the left of center.

(2) Mount a dial indicator to the left frame rail in front of the track bar ball joint (Fig. 2).

(3) Position the dial indicator plunger on the ball joint end cap next to the grease fitting and zero the indicator.

NOTE: Dial indicator plunger must be perpendicular to the ball joint end cap.

(4) Turn the front wheel 180° to the right and record the dial indicator reading. Repeat this step three times and record all readings.

(5) If any of the readings exceed 2.03 mm (0.080 in) replace the track bar.

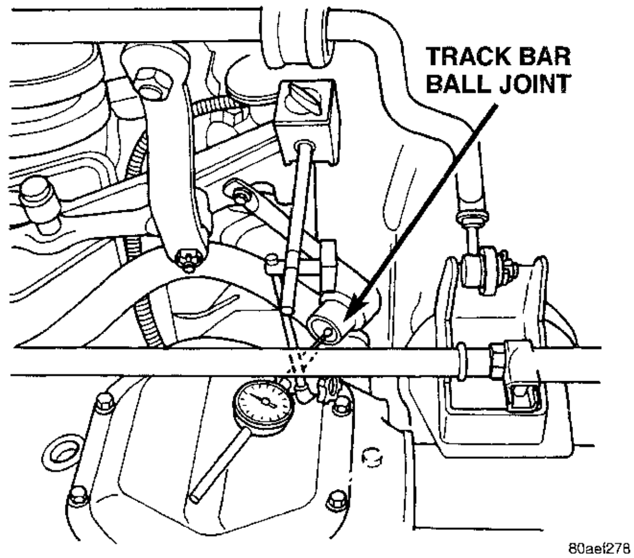


Fig. 2 Dial Indicator Location

REMOVAL AND INSTALLATION

SHOCK ABSORBER

REMOVAL

(1) Remove the nut, retainer and grommet from the upper stud in the engine compartment.

(2) Remove three nuts from the upper shock bracket (Fig. 3).

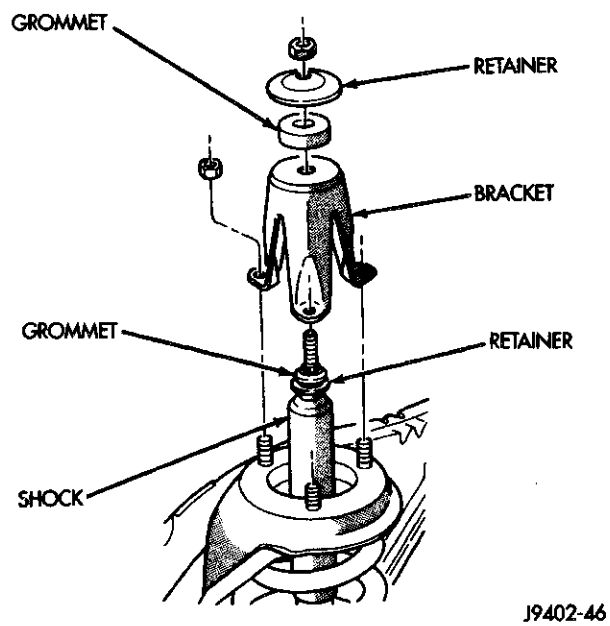


Fig. 3 Shock Absorber and Bracket

REMOVAL AND INSTALLATION (Continued)

(3) Remove the lower bolt from the axle bracket (Fig. 4). Remove the shock absorber from engine compartment.

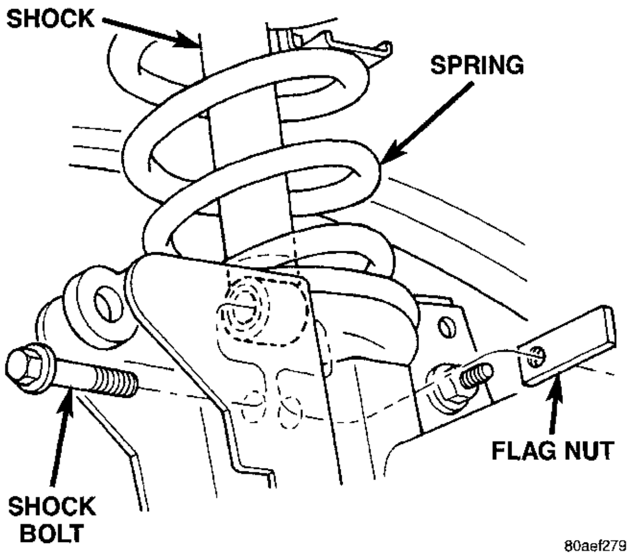


Fig. 4 Shock Absorber Axle Mount

INSTALLATION

(1) Position the lower retainer and grommet on the upper stud. Insert the shock absorber through the spring from engine compartment.

(2) Install the lower bolt and tighten to 135 N·m (100 ft. lbs.).

(3) Install the upper shock bracket and three nuts. Tighten nuts to 75 N·m (55 ft. lbs.).

(4) Install upper grommet and retainer. Install upper shock nut and tighten to 47 N·m (35 ft. lbs).

COIL SPRING

REMOVAL

(1) Raise and support the vehicle. Position a hydraulic jack under the axle to support it.

(2) Paint or scribe alignment marks on lower suspension arm cam adjusters and axle bracket for installation reference.

(3) Remove the upper suspension arm and loosen lower suspension arm bolts.

(4) Mark and disconnect the front propeller shaft from the axle 4x4 models.

(5) Disconnect the track bar from the frame rail bracket.

(6) Disconnect the drag link from pitman arm.

(7) Disconnect the stabilizer bar link and shock absorber from the axle.

(8) Lower the axle until the spring is free from the upper mount. Remove the coil spring.

INSTALLATION

(1) Position the coil spring on the axle pad.

(2) Raise the axle into position until the spring seats in the upper mount.

(3) Connect the stabilizer bar links and shock absorbers to the axle bracket. Connect the track bar to the frame rail bracket.

(4) Install the upper suspension arm.

(5) Install the front propeller shaft to the axle 4x4 model.

(6) Install drag link to pitman arm and tighten nut to specifications. Install new cotter pin.

(7) Remove the supports and lower the vehicle.

(8) Tighten the following suspension components to specifications:

- Link to stabilizer bar nut.
- Lower shock bolt.
- Track bar bolt at axle shaft tube bracket.
- Upper suspension arm nut at axle bracket.
- Upper suspension nut at frame bracket.
- Align lower suspension arm reference marks and tighten cam nut.
- Lower suspension nut at frame bracket.

STEERING KNUCKLE

For service procedures on the steering knuckle and ball joints refer to Group 3 Differentials And Driveline.

LOWER SUSPENSION ARM

REMOVAL

(1) Raise and support the vehicle.

(2) Paint or scribe alignment marks on the cam adjusters and suspension arm for installation reference (Fig. 5).

(3) Remove the lower suspension arm nut, cam and cam bolt from the axle.

(4) Remove the nut and bolt from the frame rail bracket and remove the lower suspension arm (Fig. 6).

INSTALLATION

(1) Position the lower suspension arm at the axle bracket and frame rail bracket.

(2) Install the rear bolt and finger tighten the nut.

(3) Install the cam bolt, cam and nut in the axle and align the reference marks.

(4) Remove support and lower the vehicle.

(5) Tighten cam nut at the axle bracket to 129 N·m (95 ft. lbs.). Tighten rear nut at the frame bracket to 176 N·m (130 ft. lbs.).

UPPER SUSPENSION ARM

REMOVAL

(1) Raise and support the vehicle.

(2) Remove the upper suspension arm nut and bolt at the axle bracket (Fig. 6).

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REMOVAL AND INSTALLATION (Continued)

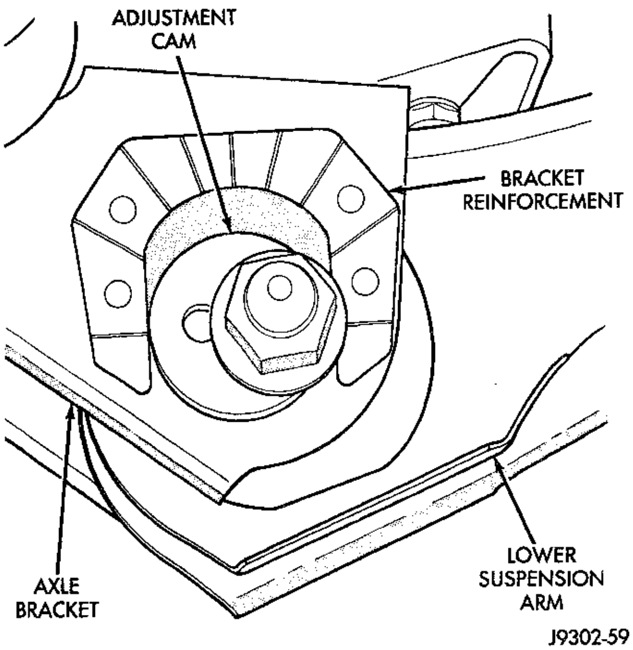

Fig. 5 Cam Adjuster

(3) Remove the nut and bolt at the frame rail and remove the upper suspension arm.

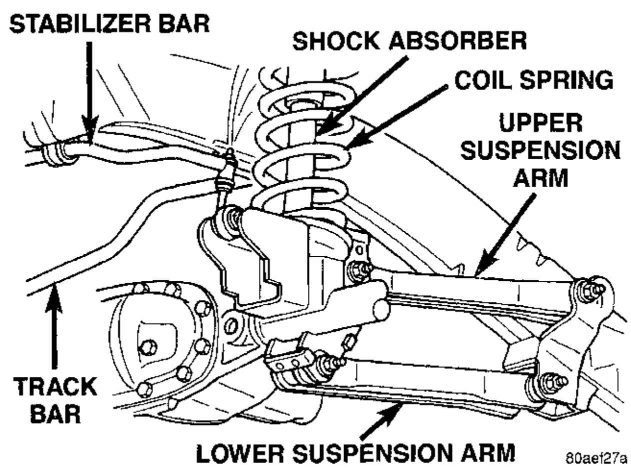

Fig. 6 Upper and Lower Suspension Arm

INSTALLATION

(1) Position the upper suspension arm at the axle and frame rail.

(2) Install the bolts and finger tighten the nuts.

(3) Remove the supports and lower the vehicle.

(4) Tighten nut at the axle bracket to 121 N·m (89 ft. lbs.). Tighten nut at frame bracket to 115 N·m (85 ft. lbs.).

STABILIZER BAR

REMOVAL

(1) Raise and support the vehicle.

(2) Hold the link shafts with a wrench and remove the nuts (Fig. 7).

(3) Remove the retainers and grommets from the stabilizer bar links.

(4) Remove the stabilizer bar link cotter pins and nuts from the axle brackets.

(5) Remove the links from the axle brackets with Puller C-3894-A (Fig. 8).

(6) Remove the stabilizer bar clamps from the frame rails and remove the stabilizer bar.

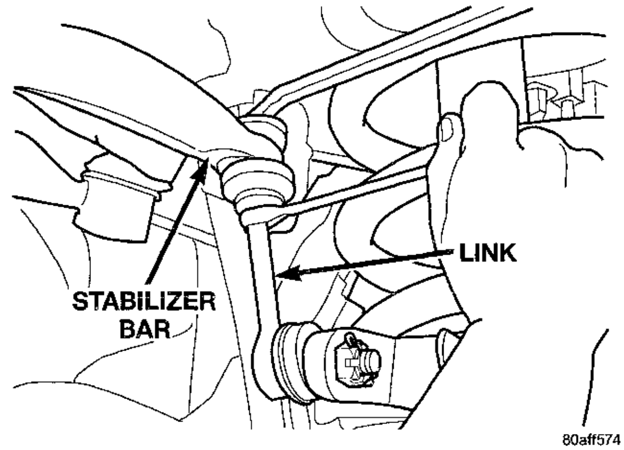

Fig. 7 Stabilizer Bar

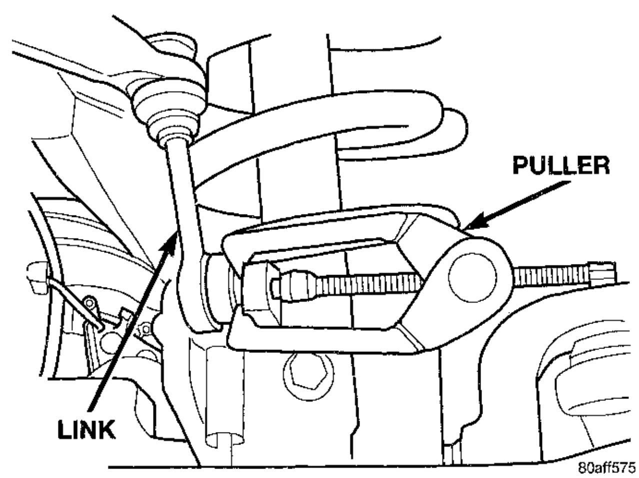

Fig. 8 Stabilizer Link

INSTALLATION

(1) Position the stabilizer bar on the frame rail and install the clamps and bolts. Ensure the bar is centered with equal spacing on both sides. Tighten the bolts to 54 N·m (40 ft. lbs.).

(2) Install links to the axle bracket and tighten nut to 68 N·m (50 ft. lbs.).

(3) Install links, retainers, grommets and nuts to the stabilizer bar (Fig. 7). Hold the link shaft with a wrench and tighten the nuts to 37 N·m (27 ft. lbs.).

(4) Remove the supports and lower the vehicle.

REMOVAL AND INSTALLATION (Continued)

TRACK BAR

REMOVAL

(1) Raise and support the vehicle.

(2) Remove the cotter pin and nut from the ball stud end at the frame rail bracket (Fig. 9).

(3) Remove ball stud from bracket with Puller C-4150A (Fig. 10).

(4) Remove the bolt and flag nut from the axle bracket and remove the track bar (Fig. 9).

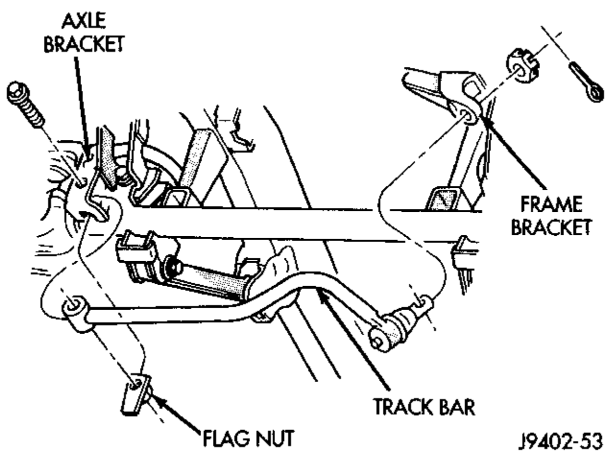

Fig. 9 Track Bar

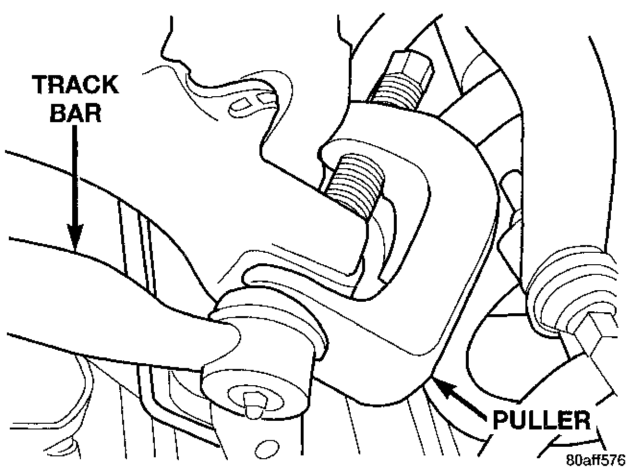

Fig. 10 Track Bar Puller

INSTALLATION

(1) Install the track bar at axle tube bracket. Loosely install the retaining bolt and flag nut.

(2) Pry the axle assembly over to install the track bar at the frame rail bracket.

(3) Install the retaining nut on the stud. Tighten the ball stud nut to 95 N·m (70 ft. lbs.). Install a new cotter pin.

(4) Remove the supports and lower the vehicle.

(5) Tighten the bolt at the axle tube bracket to 176 N·m (130 ft. lbs.).

HUB/BEARING WITH 5 STUDS

REMOVAL

(1) Raise and support the vehicle.

(2) Remove wheel and tire assembly.

(3) Remove brake caliper and rotor, refer to Group 5 Brakes.

(4) Remove ABS sensor if equipped, refer to Group 5 Brakes.

(5) Remove cotter pin and axle hub nut.

(6) Remove hub/bearing mounting bolts (Fig. 11).

(7) Remove hub/bearing, brake shield and spacer from steering knuckle.

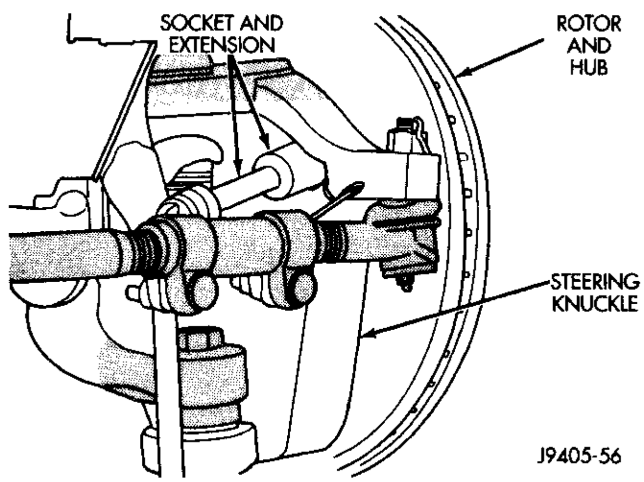

Fig. 11 Hub/Bearing Mounting Bolts

INSTALLATION

(1) Apply liberal quantity of anti-seize compound to splines of front drive shaft.

(2) Insert two rearmost, top and bottom rotor hub bolts in steering knuckle. Insert bolts through back side of knuckle so they extend out front face as shown.

(3) Position hub spacer (Fig. 12) and brake shield (Fig. 13) on bolts just installed in knuckle.

(4) Align rotor hub with drive shaft and start shaft into rotor hub splines.

(5) Align bolt holes in hub bearing flange with bolts installed in knuckle. Then thread bolts into bearing flange far enough to hold assembly in place.

(6) Install remaining bolts. Tighten hub bearing bolts to 170 N·m (125 ft. lbs.).

(7) Install washer and hub nut and tighten to 237 N·m (175 ft. lbs.).

(8) Install new cotter pin in hub nut. Tighten nut as needed to align cotter pin hole in shaft with opening in nut.

(9) Install brake caliper and ABS wheel speed sensor if equipped.

(10) Install wheel and tire assemblies.

(11) Remove support and lower the vehicle.

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REMOVAL AND INSTALLATION (Continued)

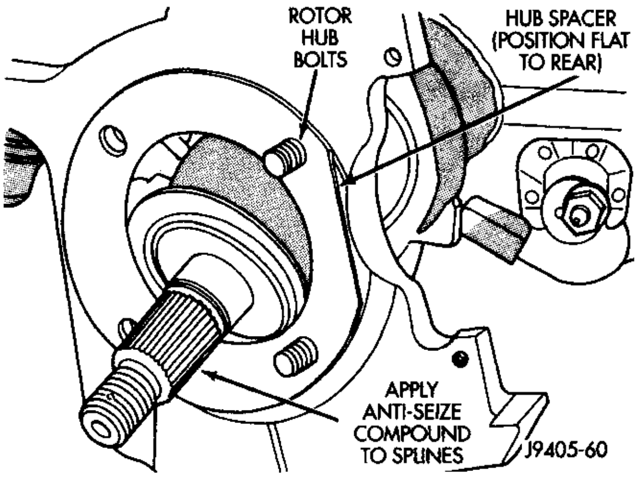


Fig. 12 Hub Spacer

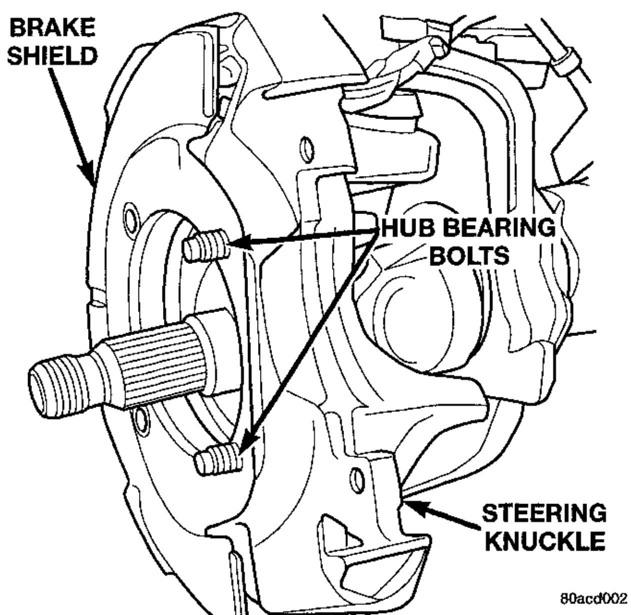


Fig. 13 Brake Shield

(12) Apply brakes several times to seat brake shoes and caliper piston. Do not move vehicle until firm brake pedal is obtained.

HUB/BEARING WITH 8 STUDS

REMOVAL

(1) Raise and support vehicle.
(2) Remove wheel and tire assembly.
(3) Remove hub extension mounting nuts and remove the extension from the rotor if equipped (Fig. 14).
(4) Remove brake caliper.
(5) Remove the cotter pin and hub nut from the axle shaft (Fig. 15).

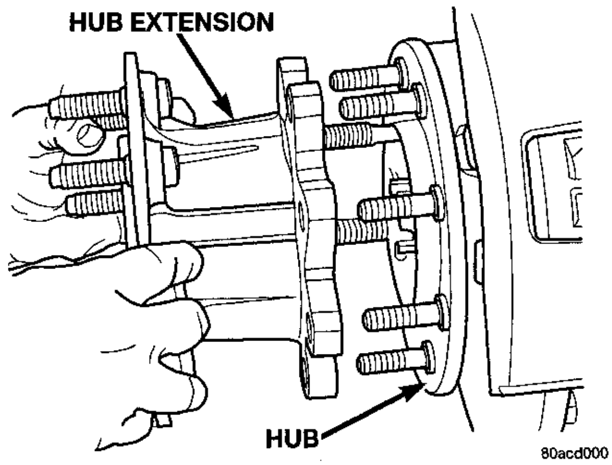


Fig. 14 Hub Extension

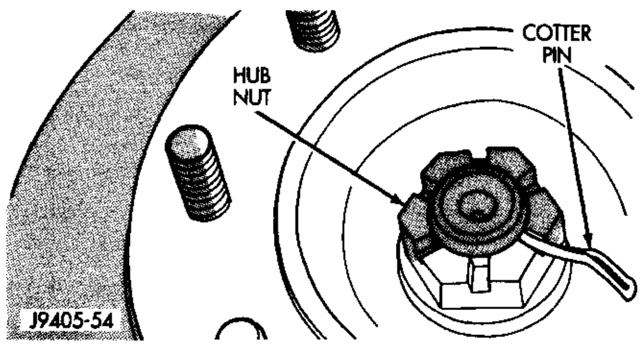


Fig. 15 Hub Nut Cotter Pin

(6) Disconnect the ABS wheel speed sensor wire from under the hood. Remove sensor wire from the frame and steering knuckle if equipped.
(7) Remove hub/bearing mounting bolts from inboard side of steering knuckle (Fig. 16).

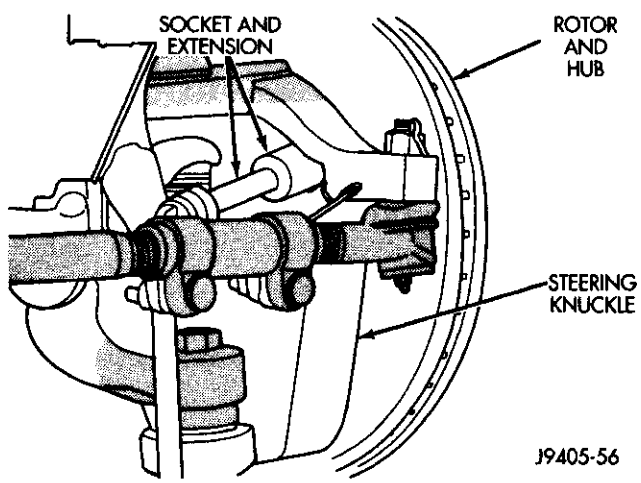


Fig. 16 Hub/Bearing Mounting Bolts

(8) Remove rotor hub/bearing assembly (Fig. 17), brake shield and spacer from the steering knuckle.

REMOVAL AND INSTALLATION (Continued)

NOTE: If rotor hub assembly will not come out of the knuckle, use Puller C-844 with extra Puller Leg C-844-1 (Fig. 18) to remove the assembly.

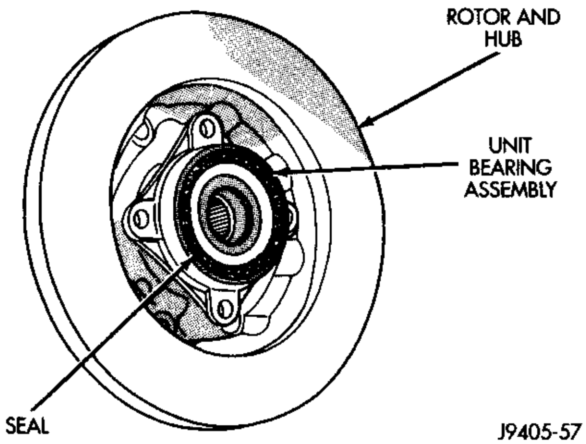


Fig. 17 Rotor Hub/Bearing Assembly

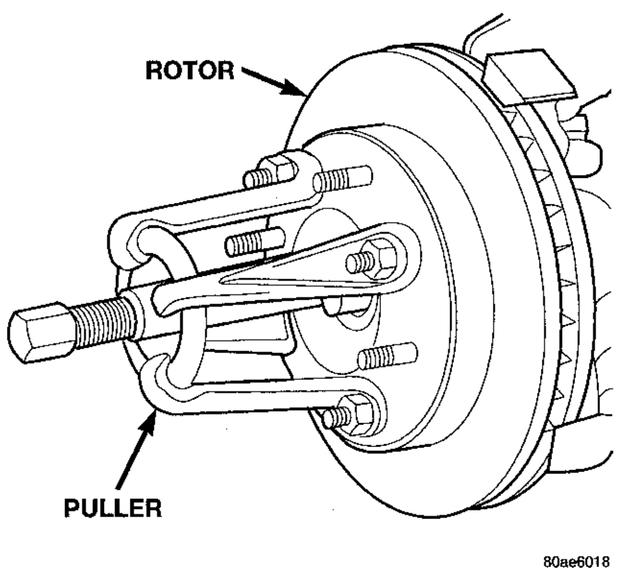


Fig. 18 Rotor Hub/Bearing Removal

(9) Press out the wheel studs/hub extension studs and separate the rotor from the hub (Fig. 19).

(10) Remove the wheel speed sensor (Fig. 20) from the hub bearing if equipped.

INSTALLATION

(1) Install the wheel speed sensor in the hub bearing if equipped.

(2) Position rotor on the hub/bearing.

(3) Press wheel studs/hub extension studs through the back side of the rotor and through the hub bearing flange (Fig. 21).

(4) Apply liberal quantity of anti-seize compound to splines of front drive shaft.

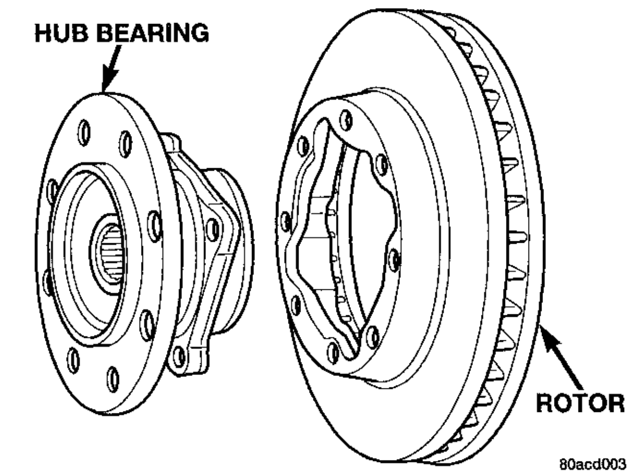


Fig. 19 Rotor And Hub/Bearing

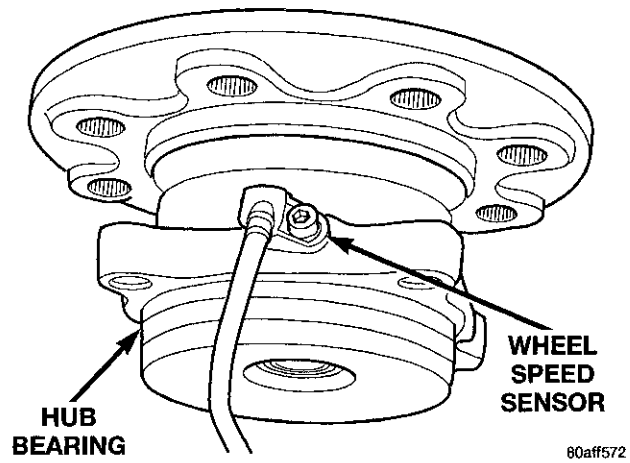


Fig. 20 Wheel Speed Sensor

(5) Insert two rearmost, top and bottom rotor hub bolts in steering knuckle. Insert bolts through back side of knuckle so they extend out front face as shown.

(6) Position hub spacer (Fig. 22) and brake shield (Fig. 23) on bolts just installed in knuckle.

NOTE: If the vehicle is equipped with a wheel speed sensor the brake shield must be positioned on the hub bearing (Fig. 24).

(7) Align rotor hub with drive shaft and start shaft into rotor hub splines.

NOTE: Position wheel speed sensor wire at the top of the knuckle if equipped.

(8) Align bolt holes in hub bearing flange with bolts installed in knuckle. Then thread bolts into bearing flange far enough to hold assembly in place.

(9) Install remaining bolts. Tighten hub/bearing bolts to 170 N·m (125 ft. labs.

AUTHENTIC RESTORATION PRODUCT

REMOVAL AND INSTALLATION (Continued)

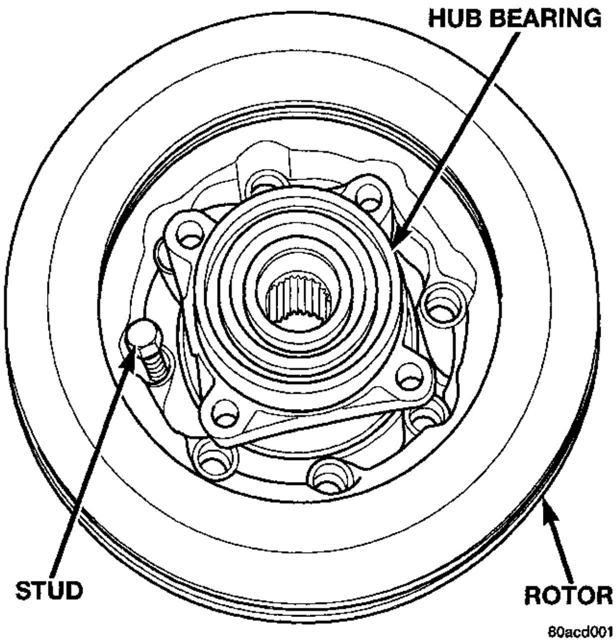


Fig. 21 Rotor, Hub/Bearing And Stud

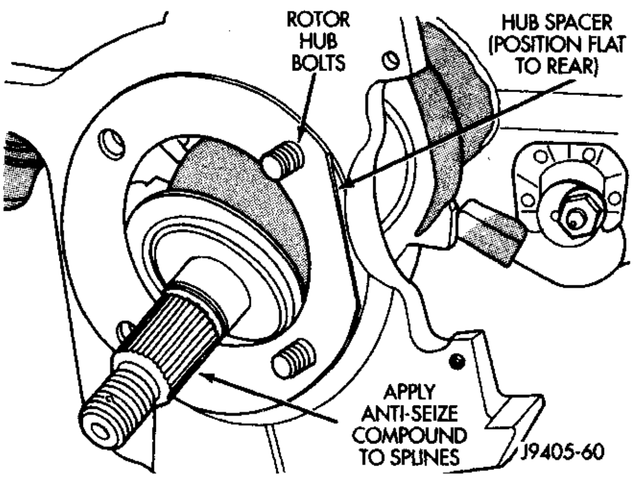


Fig. 22 Hub Spacer

(10) Install washer and hub nut and tighten to 237 N·m (175 ft. lbs.).

(11) Install new cotter pin in hub nut. Tighten nut as needed to align cotter pin hole in shaft with opening in nut.

(12) Install brake caliper.

(13) Install sensor wire to the steering knuckle and frame and if equipped. Connect the wheel speed sensor wire under the hood.

(14) Install wheel and tire assemblies.

(15) Remove support and lower the vehicle.

(16) Apply brakes several times to seat brake shoes and caliper piston. Do not move vehicle until firm brake pedal is obtained.

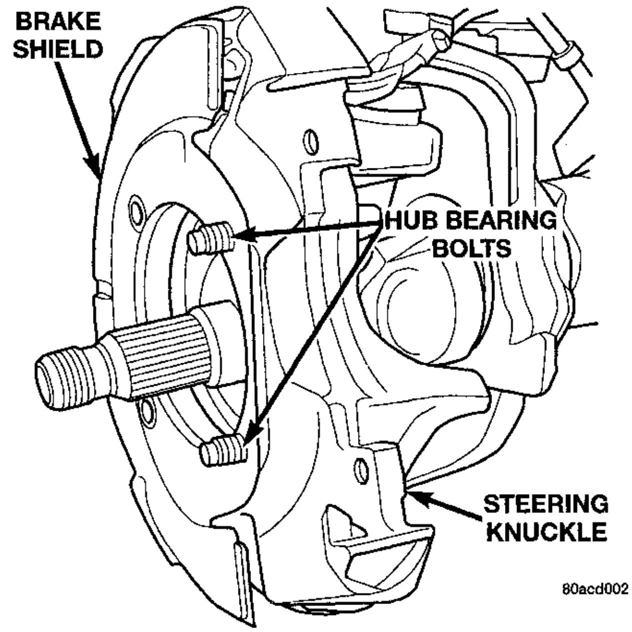


Fig. 23 Brake Shield

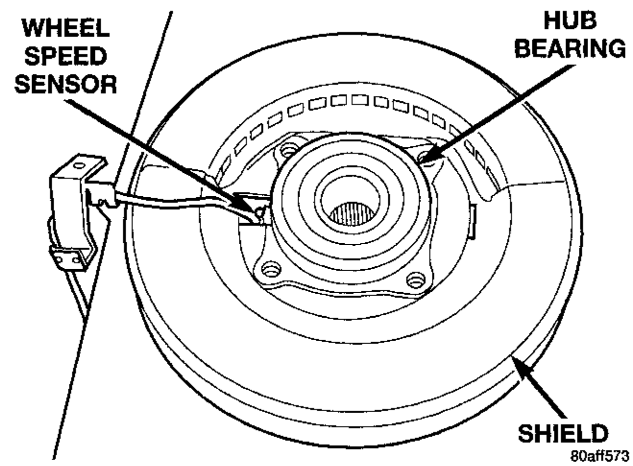


Fig. 24 Brake Shield With Wheel Speed Sensor

WHEEL MOUNTING STUDS

REMOVAL

(1) Raise and support vehicle.

(2) Remove wheel and tire assembly.

(3) Remove brake caliper and rotor, refer to Group 5 Brakes for procedure.

(4) Remove stud from hub with Remover C-4150A (Fig. 25).

INSTALLATION

(1) Install new stud into hub flange.

(2) Install three washers onto stud, then install lug nut with the flat side of the nut against the washers.

REMOVAL AND INSTALLATION (Continued)

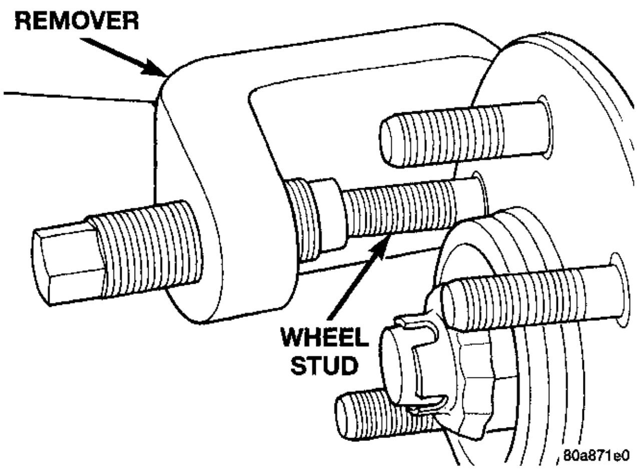


Fig. 25 Wheel Stud Removal

(3) Tighten lug nut until the stud is pulled into the hub flange. Verify that the stud is properly seated into the flange.

(4) Remove lug nut and washers.

(5) Install the brake rotor and caliper, refer to Group 5 Brakes for procedure.

(6) Install wheel and tire assembly, use new lug nut on stud or studs that were replaced.

(7) Remove support and lower vehicle.

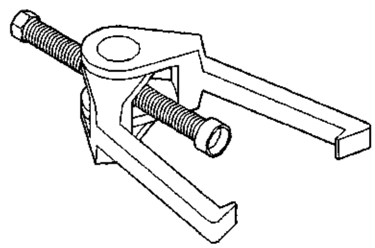
SPECIFICATIONS

TORQUE CHART

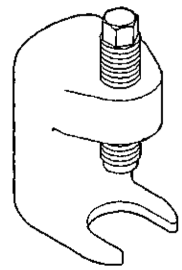
DESCRIPTION	TORQUE
Shock Absorber	
Upper Nut	47 N·m (35 ft. lbs.)
Lower Bolt	135 N·m (100 ft. lbs.)
Bracket	75 N·m (55 ft. lbs.)
Suspension Arm Lower	
Axle Nut	129 N·m (95 ft. lbs.)
Frame Nut	176 N·m (130 ft. lbs.)
Suspension Arm Upper	
Axle Nut	121 N·m (89 ft. lbs.)
Frame Nut	115 N·m (85 ft. lbs.)
Stabilizer Bar	
Clamp Bolt	54 N·m (40 ft. lbs.)
Link Upper Nut	37 N·m (27 ft. lbs.)
Link Lower Nut	68 N·m (50 ft. lbs.)
Track Bar	
Ball Stud Nut	95 N·m (70 ft. lbs.)
Axle Bracket Bolt	176 N·m (130 ft. lbs.)

SPECIAL TOOLS

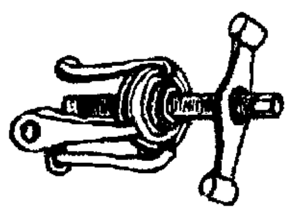
LINK/COIL SUSPENSION



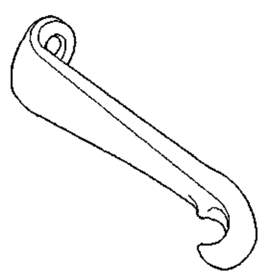
Puller C-3894–A



Remover, Wheel Stud C-4150A



Puller, Hub/Bearing C-844



Puller Leg C-844-1

AUTHENTIC RESTORATION PRODUCT

REAR SUSPENSION

INDEX

GENERAL INFORMATION

WEIGHT DISTRIBUTION

A vehicle should always be loaded so the vehicle weight center-line is located immediately forward of the rear axle. Correct vehicle loading provides proper front tire-to-road contact. This results in maximum vehicle handling stability and safety. Incorrect vehicle weight distribution can cause excessive tire tread wear, spring fatigue or failure, and erratic steering.

DESCRIPTION AND OPERATION

SUSPENSION COMPONENT

The rear suspension is comprised of:

- Drive Axle
- Leaf Springs
- Dual-Action Shock Absorbers
- Stabilizer Bar (optional)
- Jounce Bumpers

Leaf Springs: The rear suspension system uses a multi-leaf springs and a solid drive axle. The forward end of the springs are mounted to the body rail hangers through rubber bushings. The rearward end of the springs are attached to the body by the use of shackles. The spring and shackles use rubber bushings. The bushing help to isolate road noise. The shackles allow the springs to change their length as the vehicle moves over various road conditions.

Shock Absorbers: Ride control is accomplished through the use of dual-action shock absorbers. The shocks dampen the jounce and rebound as the vehicle travels over various road conditions. The top of the shock absorbers are bolted to the body crossmember. The bottom of the shocks are bolted to the axle bracket.

Stabilizer Bar: The stabilizer bar is used to minimize vehicle body roll. The spring steel bar helps to control the vehicle body in relationship to the suspension. The bar extends across the underside of the vehicle and is bolted to the axle. Links at the end of the bar are bolted to the frame.

Jounce Bumpers: The jounce bumpers are used to limit the spring and axle travel. They are bolted to the frame rail above the axle.

CAUTION: Suspension components with rubber/urethane bushings (except stabilizer bar) should be tightened with the vehicle at normal ride height. It is important to have the springs supporting the weight of the vehicle when the fasteners are torqued. If springs are not at their normal ride position, vehicle ride comfort could be affected and premature bushing wear may occur.

DIAGNOSIS AND TESTING

SPRING AND SHOCK DIAGNOSIS

A knocking or rattling noise from a shock absorber may be caused by movement between mounting bushings and metal brackets or attaching components. These noises can usually be stopped by tightening the attaching nuts. If the noise persists, inspect for damaged and worn bushings, and attaching components. Repair as necessary if any of these conditions exist.

A squeaking noise from the shock absorber may be caused by the hydraulic valving and may be intermittent. This condition is not repairable and the shock absorber must be replaced.

The shock absorbers are not refillable or adjustable. If a malfunction occurs, the shock absorber must be replaced. To test a shock absorber, hold it in an upright position and force the piston in and out of the cylinder four or five times. The action throughout each stroke should be smooth and even.

DIAGNOSIS AND TESTING (Continued)

The spring eye and shock absorber bushings do not require any type of lubrication. Do not attempt to stop spring bushing noise by lubricating them. Grease and mineral oil-base lubricants will deteriorate the bushing rubber.

If the vehicle is used for severe, off-road operation, the springs should be examined periodically. Check for broken and shifted leafs, loose and missing clips, and broken center bolts. Refer to Spring and Shock Absorber Diagnosis chart for additional information.

SPRING AND SHOCK ABSORBER DIAGNOSIS

CONDITION	POSSIBLE CAUSES	CORRECTION
SPRING SAGS	1. Broken leaf. 2. Spring fatigue.	1. Replace spring. 2. Replace spring.
SPRING NOISE	1. Loose spring clamp bolts. 2. Worn bushings. . Worn or missing spring tip inserts.	1. Tighten to specification. 2. Replace bushings. 3. Replace spring tip inserts.
SHOCK NOISE	1. Loose mounting fastener. 2. Worn bushings. 3. Leaking shock.	1. Tighten to specification. 2. Replace shock. 3. Replace shock.

REMOVAL AND INSTALLATION

SHOCK ABSORBER

REMOVAL

(1) Raise vehicle and support axle.

(2) Remove the bolt and flag nut from the frame crossmember bracket (Fig. 1).

(3) Remove the bolt and nut from the axle bracket.

(4) Remove the rear shock absorber from the vehicle.

INSTALLATION

(1) Position shock absorber in brackets.

(2) Install bolts through the brackets and shock. Install flag nut on top bolt and nut on lower bolt.

(3) Tighten upper and lower bolts to specifications

(4) Remove the support and lower vehicle.

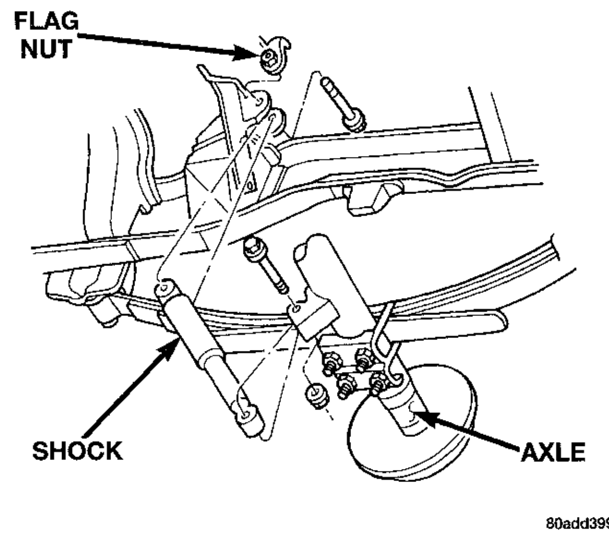


Fig. 1 Shock Absorber

STABILIZER BAR

REMOVAL

(1) Raise and support vehicle.

(2) Remove nuts from the links at the stabilizer bar and separate the links with Puller C-3894-A (Fig. 2).

(3) Remove stabilizer bar retainer nuts and retainers (Fig. 3).

(4) Remove stabilizer bar and replace worn, cracked or distorted bushings.

(5) Remove links upper mounting nuts and bolts and remove links.

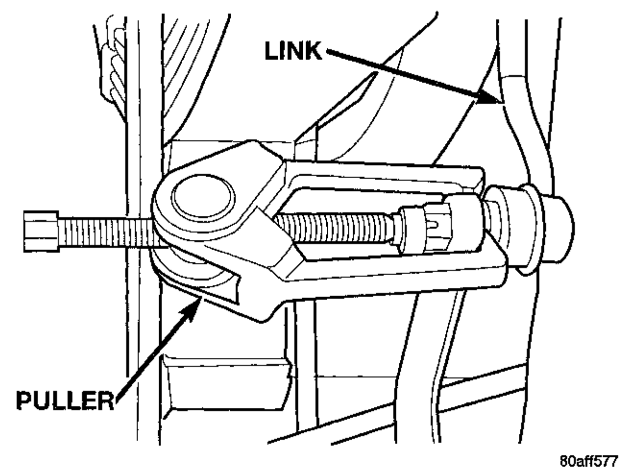


Fig. 2 Stabilizer Link

INSTALLATION

(1) Install link into frame brackets and install mounting nuts and bolts.

(2) Install the stabilizer bar and center it with equal spacing on both sides. Install stabilizer bar retainers and tighten nuts to 54 N·m (40 ft. lbs.).

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REMOVAL AND INSTALLATION (Continued)

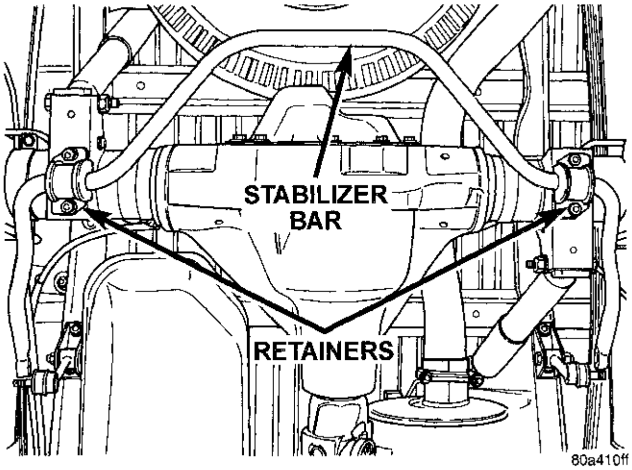


Fig. 3 Stabilizer Bar Mounting Bolts And Retainers

(3) Install stabilizer link ball studs into the bar and tighten nuts to 68 N·m (50 ft. lbs.).

(4) Remove support and lower vehicle.

(5) Tighten upper link mounting nuts to 68 N·m (50 ft. lbs.).

LEAF SPRING

REMOVAL

(1) Raise vehicle and support axle to remove all weight from springs.

(2) Remove the nuts and spring clamp bolts that attach the spring to the axle (Fig. 4) and (Fig. 5) and (Fig. 6).

(3) Remove the nuts and bolts from the spring front and rear shackle eyes. **Note: To remove front eye bolt on left side spring fuel tank must be removed, refer to Group 14 for fuel tank procedure.**

(4) Remove spring from vehicle.

(5) Remove shackle from spring.

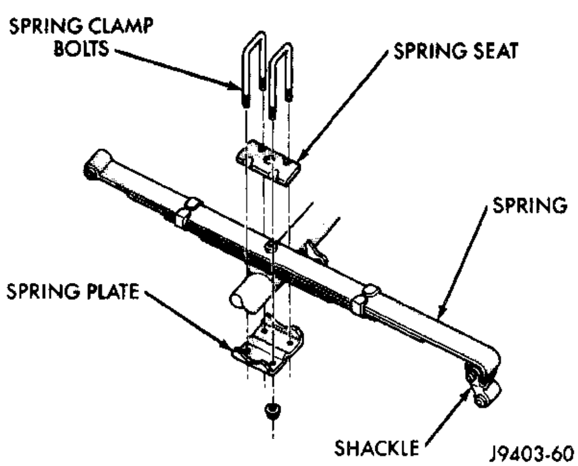


Fig. 4 Rear Spring—4X2

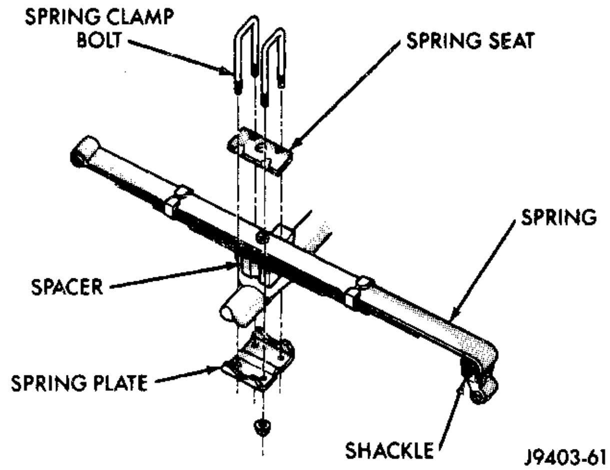


Fig. 5 Rear Spring—4X4

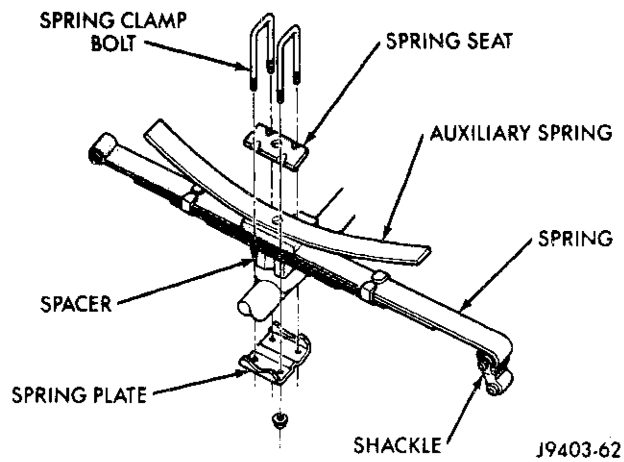


Fig. 6 Rear Spring—Cab-Chassis 11000 GVW

INSTALLATION

(1) Install shackle on rear spring eye and install bolt and nut.

(2) Position spring on axle shaft tube so spring center bolt is inserted into the locating hole in the axle tube spring pad or spacer.

(3) Align spring front eye with bolt hole in the front bracket. Install the eye pivot bolt and nut.

(4) Align shackle eye with bolt hole in rear bracket. Install bolt and nut.

(5) Tighten the spring front and rear eye pivot bolt snug do not torque.

(6) Install spring clamp bolts and the retaining nuts.

(7) Align the auxiliary spring with the primary spring if equipped. Tighten the nuts until they force the plate flush against the axle tube.

(8) Remove the supports and lower the vehicle so that the weight is being supported by the tires.

(9) Tighten the spring clamp retaining nuts to specifications

REMOVAL AND INSTALLATION (Continued)

(10) Tighten spring front and rear eye pivot bolt nuts and shackle eye to specifications.

DISASSEMBLY AND ASSEMBLY

SPRING EYE BUSHINGS

DISASSEMBLE

(1) Remove the spring from the vehicle.
(2) Position the spring eye in a press.
(3) Press the bushing out with an appropriate size driver.

ASSEMBLE

(1) Press new bushing into the spring eye with an appropriate size driver. The bushing should be centered in the spring eye.
(2) Install the spring on the vehicle.

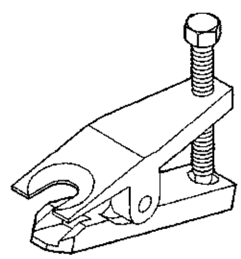
SPECIFICATIONS

TORQUE CHART

DESCRIPTION	TORQUE
Shock Absorber	
Lower Nut	136 N·m (100 ft. lbs.)
Upper Nut	136 N·m (100 ft. lbs.)
Spring Clamp Nuts	
6,010-10,500 GVW	149 N·m (110 ft. lbs.)
11,000 GVW Cab-Chassis	163 N·m (120 ft. lbs.)
Spring Front and Rear Eye and Shackle	
Bolt/Nut 6,010-7,500 GVW	149 N·m (110 ft. lbs.)
Bolt/Nut 8,800-11,000 GVW	163 N·m (120 ft. lbs.)
Stabilizer Bar	
Retainer Nuts	54 N·m (40 ft. lbs.)
Link Ball Stud Nut	68 N·m (50 ft. lbs.)
Link Upper Nut	68 N·m (50 ft. lbs.)
Frame Bracket Nuts	54 N·m (40 ft. lbs.)
Jounce Bumper	
Bolts	54 N·m (40 ft. lbs.)

SPECIAL TOOLS

REAR SUSPENSION



Remover MB-990635

Mopar AUTHENTIC RESTORATION PRODUCT

DIFFERENTIAL AND DRIVELINE

CONTENTS

PROPELLER SHAFTS

INDEX

GENERAL INFORMATION

PROPELLER SHAFTS

The function of a propeller shaft is to transmit power from one point to another in a smooth action. The shaft is designed to send torque through an angle from the transmission (transfer case on 4WD vehicles) to the axle.

The propeller shaft must operate through constantly changing relative angles between the transmission and axle. It must also be capable of changing length while transmitting torque. The axle rides suspended by springs in a floating motion. This means the propeller shaft must be able to change angles when going over various roads. This is accomplished through universal joints, which permit the propeller shaft to operate at different angles. The slip joints (or yokes) permit contraction or expansion.

Tubular propeller shafts are balanced by the manufacturer with weights spot welded to the tube.

Before undercoating a vehicle, the propeller shaft and the U-joints should be removed if possible. If removal is not possible, make sure that the propellor shaft and u-joints are fully covered. This will prevent the undercoating from causing an out of balance condition and vibration.

CAUTION: Use exact replacement parts for attaching the propeller shafts to ensure safe operation. The specified torque must always be applied when tightening the fasteners.

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GENERAL INFORMATION (Continued)

CENTER BEARING

The two–piece propeller shaft uses a center bearing to support the shafts. Two types of center bearings are used. Type 1 is used with the 9 1/4 axle. Type 2 is used with the Dana axles (Fig. 1). Both types are mounted in the same location.

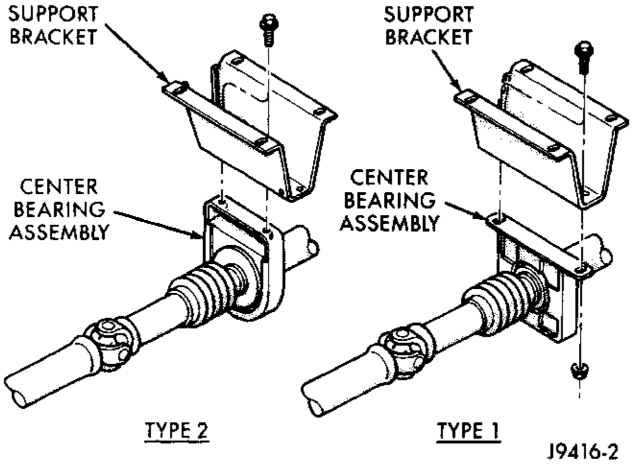

Fig. 1 Center Bearing

LUBRICATION

The factory installed universal joints are lubricated for the life of the vehicle. All universal joints should be inspected for leakage and damage each time the vehicle is serviced. If seal leakage or damage exists, the universal joint should be replaced. Refer to Group 0, Lubrication and Maintenance, for additional information.

PROPELLER SHAFT JOINT ANGLE

When two shafts come together at a common joint, the bend that is formed is called the operating angle. The larger the angle, the larger the amount of angular acceleration and deceleration of the joint. This speeding up and slowing down of the joint must be cancelled to produce a smooth power flow. This is done through the phasing of a propeller shaft and ensuring that the proper propeller shaft joint working angles are maintained.

A propeller shaft is properly phased when the yoke ends are in the same plane, or in line. A twisted shaft will make the yokes out of phase and cause a noticeable vibration.

When taking propeller shaft joint angle measurements, or checking the phasing, of two piece shafts, consider each shaft separately.

Ideally the driveline system should have;

- Angles that are equal or opposite within 1 degree of each other.
- Have a 3 degree maximum operating angle.
- Have at least a 1/2 degree continuous operating (propeller shaft) angle.

Engine speed (rpm) is the main factor in determining the maximum allowable operating angle. As a guide to the maximum normal operating angles refer to (Fig. 2).

PROPELLER SHAFT R.P.M.	MAX. NORMAL OPERATING ANGLES
5000	3°
4500	3°
4000	4°
3500	5°
3000	5°
2500	7°
2000	8°
1500	11°

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Fig. 2 Maximum Angles And Engine Speed

PRECAUTIONS

Use the exact replacement parts when installing the propeller shafts. The use of the correct replacement parts helps to ensure safe operation. All fasteners must be torqued to the specified values for safe operation.

Also make alignment reference marks (Fig. 3) on the propeller shaft yoke and axle, or transmission, yoke prior to servicing. This helps to eliminate possible vibration.

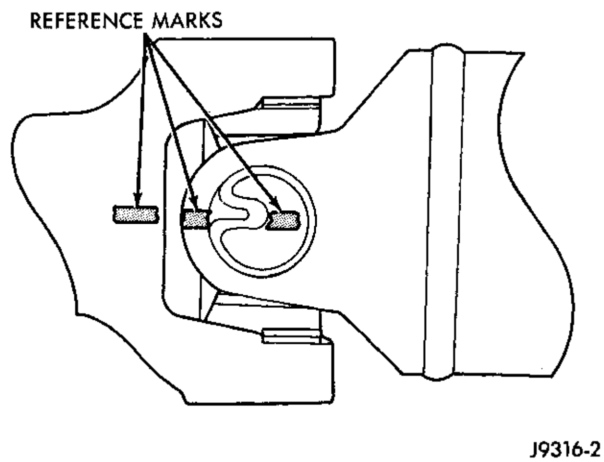

Fig. 3 Reference Marks on Yokes

CAUTION: Do not allow the propeller shaft to drop or hang from any propeller shaft joint during removal. Attach the propeller shaft to the vehicle underside with wire to prevent damage to the joints.

CAUTION: It is very important to protect the external machined surface of the slip yoke from damage during and after propeller shaft removal. If the yoke is damaged, the transmission extension seal may be damaged and therefore cause a leak.

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DIAGNOSIS AND TESTING

VIBRATION

Tires that are out-of-round, or wheels that are unbalanced, will cause a low frequency vibration. Refer to Group 22, Tires and Wheels, for additional information.

Brake drums that are unbalanced will cause a harsh, low frequency vibration. Refer to Group 5, Brakes, for additional information.

Driveline vibration can also result from loose or damaged engine mounts. Refer to Group 9, Engines, for additional information.

Propeller shaft vibration increases as the vehicle speed is increased. A vibration that occurs within a specific speed range is not usually caused by a propeller shaft being unbalanced. Defective universal joints, or an incorrect propeller shaft angle, are usually the cause of such a vibration.

UNBALANCE

NOTE: Removing and re-indexing the propeller shaft 180° relative to the yoke may eliminate some vibrations.

If propeller shaft is suspected of being unbalanced, it can be verified with the following procedure:

(1) Raise the vehicle.

(2) Clean all the foreign material from the propeller shaft and the universal joints.

(3) Inspect the propeller shaft for missing balance weights, broken welds, and bent areas. **If the propeller shaft is bent, it must be replaced.**

(4) Inspect the universal joints to ensure that they are not worn, are properly installed, and are correctly aligned with the shaft.

(5) Check the universal joint clamp screws torque.

(6) Remove the wheels and tires. Install the wheel lug nuts to retain the brake drums or rotors.

(7) Mark and number the shaft six inches from the yoke end at four positions 90° apart.

(8) Run and accelerate the vehicle until vibration occurs. Note the intensity and speed the vibration occurred. Stop the engine.

(9) Install a screw clamp at position 1 (Fig. 4).

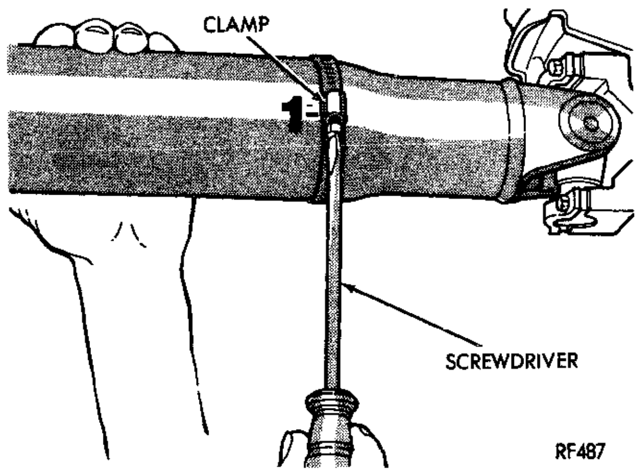

Fig. 4 Clamp Screw At Position 1

DRIVELINE VIBRATION

Drive Condition	Possible Cause	Correction
PROPELLER SHAFT	a. Undercoating or other foreign material on shaft.	a. Clean exterior of shaft and wash with solvent.
	b. Loose U-joint clamp screws.	b. Tighten screws properly.
	c. Loose or bent U-joint yoke or excessive runout.	c. Install replacement yoke.
	d. Incorrect drive line angularity.	d. Correct angularity
	e. Rear spring center bolt not in seat.	e. Loosen spring U-bolts and seat center bolts.
	f. Worn U-joint bearings.	f. Replace U-joint.
	g. Propeller shaft damaged (bent tube) or out of balance.	g. Install replacement propeller shaft.
	h. Broken rear spring.	h. Replace rear spring.
	i. Excessive runout or unbalanced condition.	i. Reindex propeller shaft 180°, test and correct as necessary.
	j. Excessive drive pinion gear shaft yoke runout.	j. Reindex propeller shaft 180° and evaluate.
UNIVERSAL JOINT NOISE	a. U-joint clamp screws loose.	a. Tighten screws with specified torque.
	b. Lack of lubrication.	b. Replace U-joint.

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DIAGNOSIS AND TESTING (Continued)

(10) Start the engine and re-check for vibration. If there is little or no change in vibration, move the clamp to one of the other three positions. Repeat the vibration test.

(11) If there is no difference in vibration at the other positions, the source of the vibration may not be propeller shaft.

(12) If the vibration decreased, install a second clamp (Fig. 5) and repeat the test.

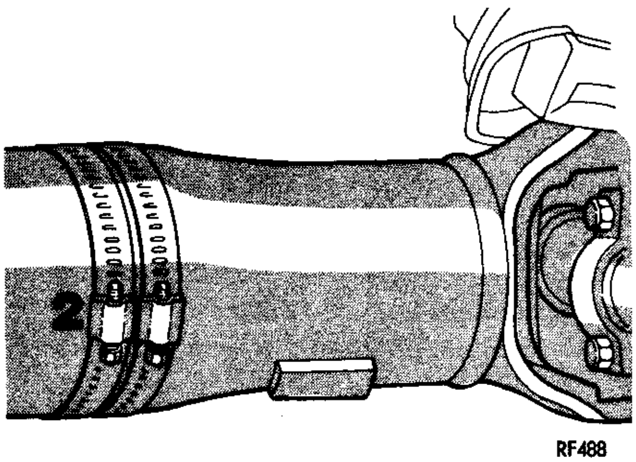

Fig. 5 Two Clamp Screws At The Same Position

(13) If the additional clamp causes an additional vibration, separate the clamps (1/4 inch above and below the mark). Repeat the vibration test (Fig. 6).

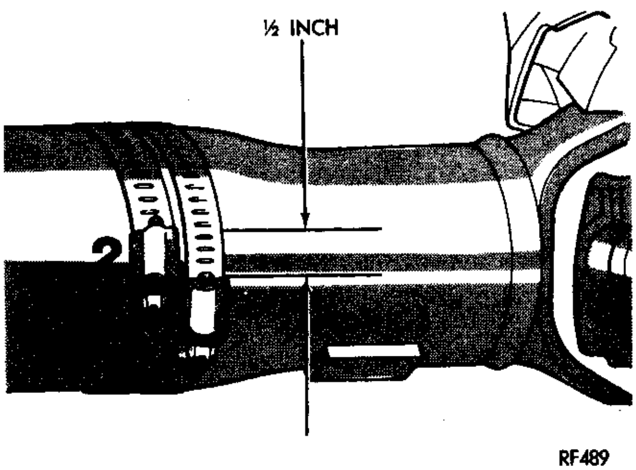

Fig. 6 Clamp Screws Separated

(14) Increase distance between the clamp screws and repeat the test until the amount of vibration is at the lowest level. Bend the slack end of the clamps so the screws will not loosen.

(15) If the vibration remains unacceptable, apply the same steps to the front end of the propeller shaft.

(16) Install the wheel and tires. Lower the vehicle.

RUNOUT

(1) Remove dirt, rust, paint, and undercoating from the propeller shaft surface where the dial indicator will contact the shaft.

(2) The dial indicator must be installed perpendicular to the shaft surface.

(3) Measure runout at the center and ends of the shaft sufficiently far away from weld areas to ensure that the effects of the weld process will not enter into the measurements.

(4) Refer to Runout Specifications chart.

(5) If the propeller shaft runout is out of specification, remove the propeller shaft, index the shaft 180°, and re-install the propeller shaft. Measure shaft runout again.

(6) If the propeller shaft runout is now within specifications, mark the shaft and yokes for proper orientation.

(7) If the propeller shaft runout is not within specifications, verify that the runout of the transmission/transfer case and axle are within specifications. Correct as necessary and re-measure propeller shaft runout.

(8) Replace the propeller shaft if the runout still exceeds the limits.

RUNOUT SPECIFICATIONS

Front of Shaft	0.020 in. (0.50 mm)
Center of Shaft	0.025 in. (0.63 mm)
Rear of Shaft	0.020 in. (0.50 mm)
NOTE: Measure front/rear runout approximately 3 inches (76 mm) from the weld seam at each end of the shaft tube for tube lengths over 30 inches. For tube lengths under 30 inches, the maximum allowed runout is 0.020 in. (0.50 mm) for the full length of the tube.	

SERVICE PROCEDURES

DRIVELINE ANGLE MEASUREMENT PREPARATION

Before measuring universal joint angles, the following must be done;

- Inflate all tires to correct pressure.
- Check the angles in the same loaded or unloaded condition as when the vibration occurred. Propeller shaft angles change according to the amount of load in the vehicle.
- Check the condition of all suspension components and verify all fasteners are torqued to specifications.
- Check the condition of the engine and transmission mounts and verify all fasteners are torqued to specifications.

SERVICE PROCEDURES (Continued)

PROPELLER SHAFT ANGLE MEASUREMENT

ONE-PIECE PROPELLER SHAFT

To accurately check driveline alignment, raise and support the vehicle at the axles as level as possible. Allow the wheels and propeller shaft to turn. Remove any external bearing snap rings (if equipped) from universal joint so that the inclinometer base sits flat.

(1) Rotate the shaft until transmission/transfer case output yoke bearing cap is facing downward.

Always make measurements from front to rear.

(2) Place Inclinometer on yoke bearing cap (A) parallel to the shaft (Fig. 7). Center bubble in sight glass and record measurement.

This measurement will give you the transmission or Output Yoke Angle (A).

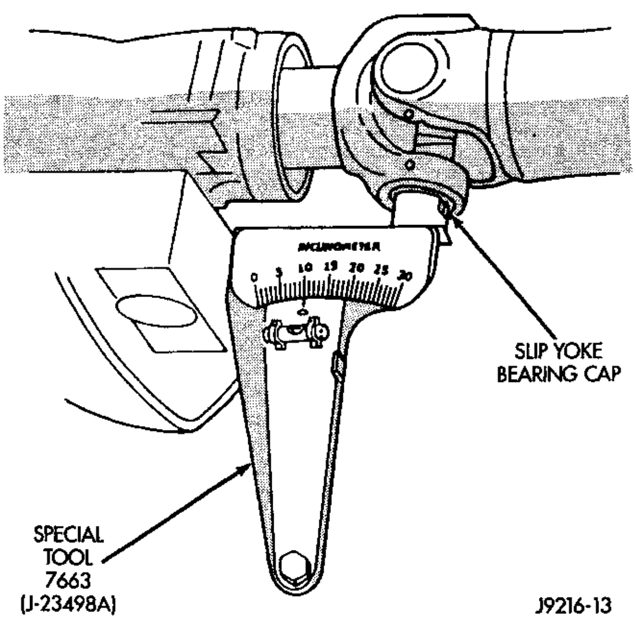

Fig. 7 Front (Output) Angle Measurement (A)

(3) Rotate propeller shaft 90 degrees and place Inclinometer on yoke bearing cap parallel to the shaft (Fig. 8). Center bubble in sight glass and record measurement. This measurement can also be taken at the rear end of the shaft.

This measurement will give you the propeller shaft angle (C).

(4) Subtract smaller figure from larger (C minus A) to obtain transmission output operating angle.

(5) Rotate propeller shaft 90 degrees and place Inclinometer on pinion yoke bearing cap parallel to the shaft (Fig. 9). Center bubble in sight glass and record measurement.

This measurement will give you the pinion shaft or input yoke angle (B).

(6) Subtract smaller figure from larger (C minus B) to obtain axle Input Operating Angle.

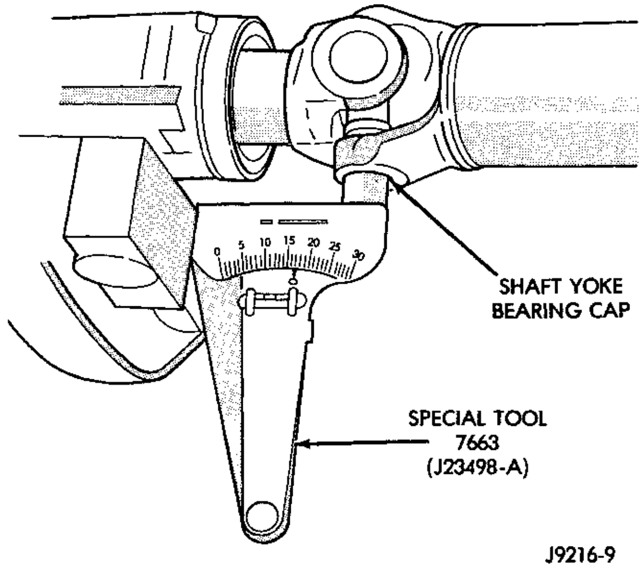

Fig. 8 Propeller Shaft Angle Measurement (C)

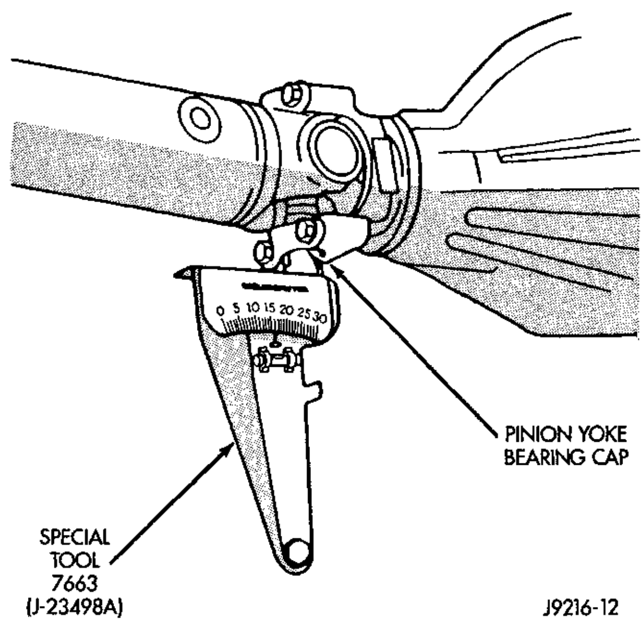

Fig. 9 Rear (Input) Angle Measurement (B)

Refer to rules given below and the example in for additional information.

- Good cancellation of U–joint operating angles (within 1°).
- Operating angles less than 3°.
- At least 1/2 of one degree continuous operating (propeller shaft) angle.

TWO-PIECE PROPELLER SHAFT

The procedure to measure the propeller shaft angles involved with a two-piece propeller shaft is the same as those for a one-piece propeller shaft. The following additional conditions also apply:

SERVICE PROCEDURES (Continued)

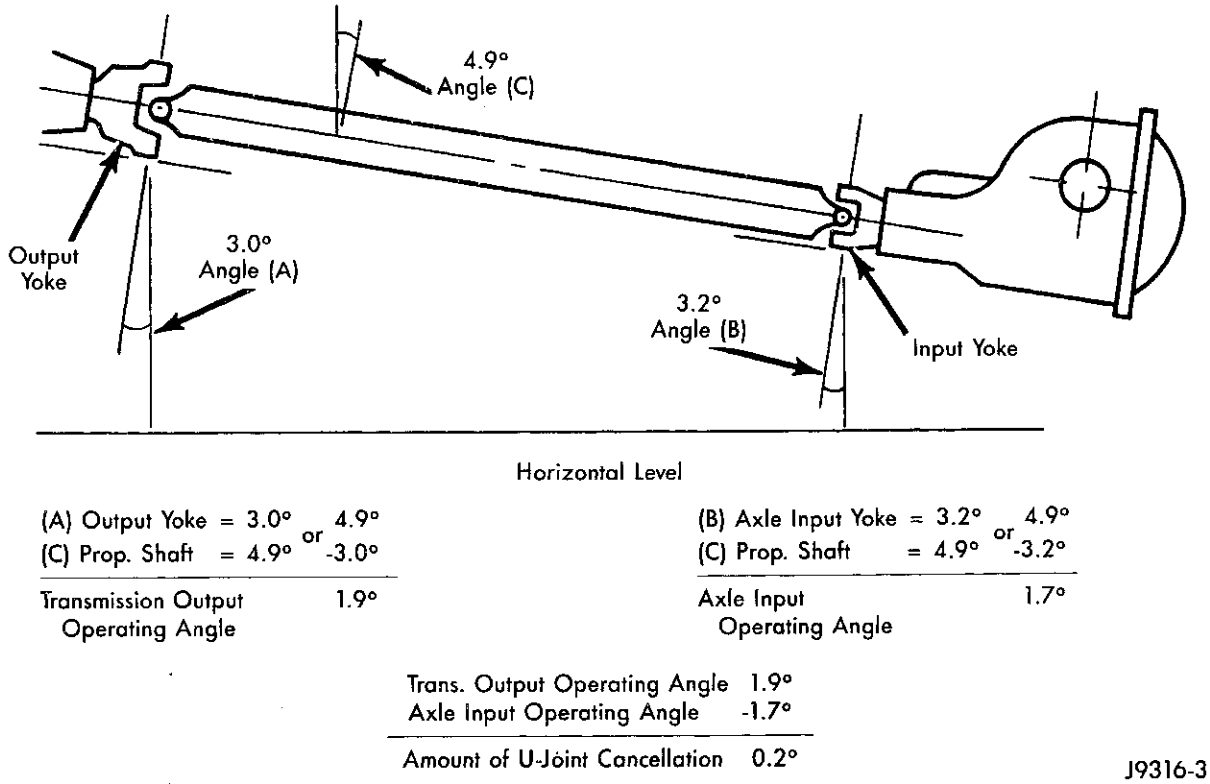

Fig. 10 Universal Joint Angle Example

- The front half-shaft must be parallel to the rear axle pinion gear shaft.
- The front and rear half-shafts must be offset by a minimum of 1/2 of a degree. From the transmission/transfer case output shaft and from each other.
- Excessive variation in measurement angles of A, B or C indicate propeller mis-alignment.
- Vertical alignment of a two-piece shaft at the yokes should be greater than one-half degree and as close to one degree as possible.

REMOVAL AND INSTALLATION

FRONT PROPELLER SHAFT

REMOVAL

(1) Shift the transmission and transfer case to their neutral positions. Raise and support vehicle. Remove skid plate, if equipped.

(2) Using a suitable marker, mark a line across the yoke at the transfer case, the link yoke, and pro-

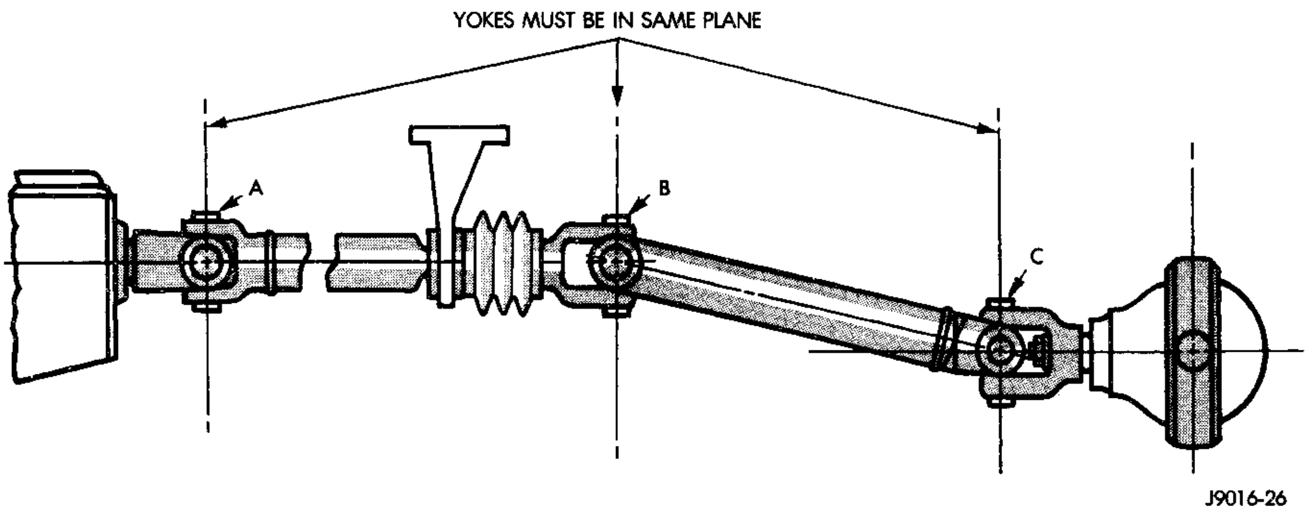

Fig. 11 Universal Joint Angle—Two-Piece Shaft

REMOVAL AND INSTALLATION (Continued)

peller shaft yoke at the rear of the front propeller shaft for installation reference.

(3) Mark a line across the propeller shaft yoke and the pinion shaft yoke for installation reference.

(4) Remove the universal joint strap bolts at the pinion shaft yoke (Fig. 12).

(5) Remove the bolts holding the propeller shaft to the transfer case yoke flange.

(6) Remove the propeller shaft.

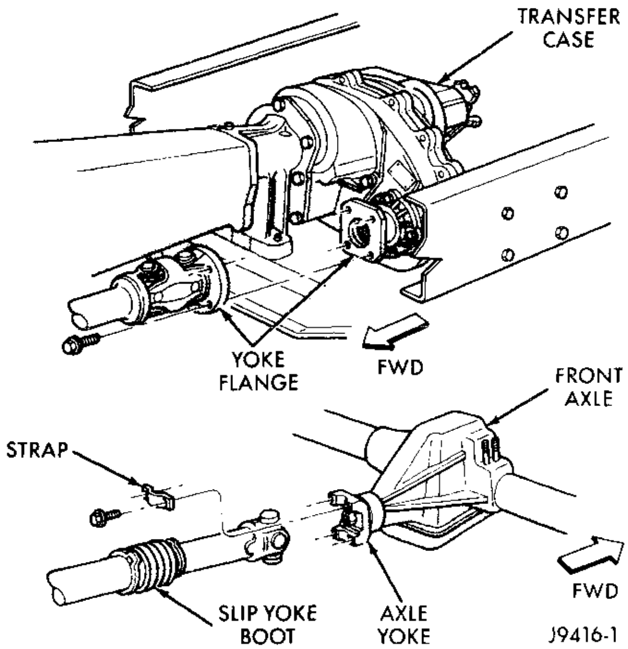

Fig. 12 Front Propeller Shaft

INSTALLATION

(1) Position front propeller shaft under vehicle with rear universal joint over the transfer case yoke flange.

(2) Place front universal joint into the axle pinion yoke.

(3) Align mark on the rear link yoke and universal joint to the mark on the transfer case yoke flange.

(4) Loosely install bolts to hold universal joint to transfer case yoke flange.

(5) Align mark on front universal joint to the mark on the axle pinion yoke.

(6) Install bolts to hold front universal joint to axle pinion yoke. Tighten bolts to 19 N·m (14 ft. lbs.).

(7) Tighten bolts to hold universal joint to transfer case yoke flange to 88 N·m (65 ft. lbs.).

(8) Install skid plate, if equipped.

(9) Lower vehicle and road test to verify repair.

REAR PROPELLER SHAFT

REMOVAL

(1) Raise and support vehicle on safety stands.

(2) Shift the transmission to the Neutral position.

(3) Using a suitable marker, mark a line across the axle pinion yoke and the propeller shaft yoke for installation reference.

(4) Using a suitable marker, mark the outline of the center bearing on the frame crossmember for installation reference, if equipped.

(5) Remove bolts that attach the center bearing to the support bracket (Fig. 13), if equipped.

(6) Remove the bolts holding the universal joint clamps to the pinion yoke.

(7) Slide the slip yoke off of the transmission, or transfer case, output shaft and remove the propeller shaft (Fig. 14).

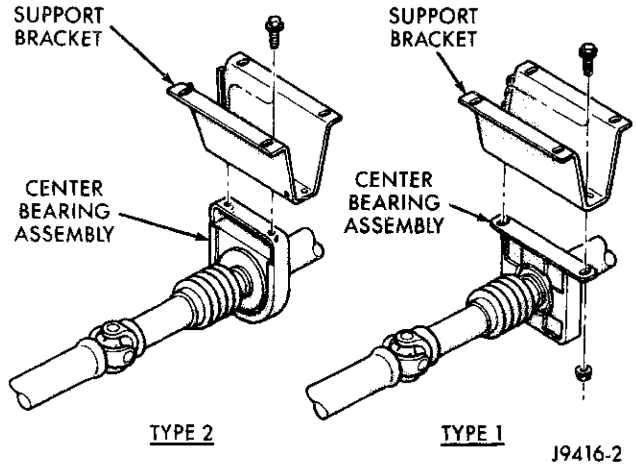

Fig. 13 Center Bearing

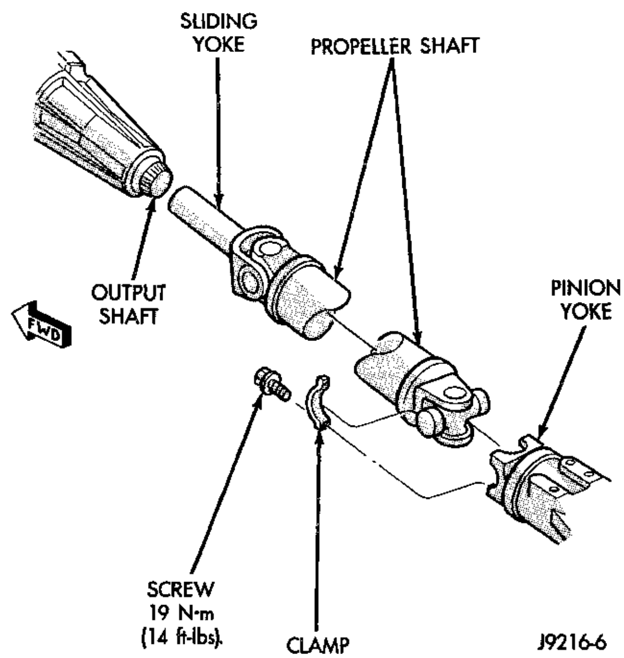

Fig. 14 Rear Propeller Shaft

REMOVAL AND INSTALLATION (Continued)

INSTALLATION

(1) Slide the slip yoke onto the transmission, or transfer case, output shaft.
(2) Align the installation reference marks made on the propeller shaft and pinion yoke.
(3) Align and install the center bearing to the support bracket, if necessary.
(4) Install the bolts and tighten to 68 N·m (50 ft. lbs.) torque.
(5) Position universal joint into pinion yoke.
(6) Tighten the universal joint strap bolts to:
- Dana Axle: 29 N·m (22 ft. lbs.) torque.
- 9 1/4 Axle: 19 N·m (14 ft. lbs.) torque.

(7) Lower the vehicle.

CENTER BEARING

Two types of center bearings are used. The two types are not interchangeable. Be sure to install the same type as the vehicle was built with.

REMOVAL

(1) Remove rear propeller shaft.
(2) Remove slip joint boot clamp and separate the two half-shafts.
(3) Use hammer and punch to tap slinger away from shaft to provide room for bearing splitter.
(4) Position Bearing Splitter Tool 1130 between slinger and shaft.

CAUTION: Do not damage shaft spline during removal of center bearing.

(5) Set shaft in press and press bearing off the shaft.

INSTALLATION

(1) Install new slinger on shaft and drive into position with appropriate installer tool.
(2) Install new center bearing on shaft with Bearing Installer Tool 6052. Drive on shaft with hammer until bearing is seated.
(3) Clean shaft splines and apply a coat of multi–purpose grease.
(4) Align master splines and slide front and rear half-shafts together. Reposition slip yoke boot and install new clamp.
(5) Install propeller shaft in vehicle.

DISASSEMBLY AND ASSEMBLY

SINGLE CARDAN UNIVERSAL JOINT

DISASSEMBLY

Individual components of cardan universal joints are not serviceable. If worn or leaking, they must be replaced as an assembly.
(1) Remove the propeller shaft.
(2) Using a soft drift, tap the outside of the bearing cap assembly to loosen snap ring.
(3) Remove snap rings from both sides of yoke (Fig. 15).

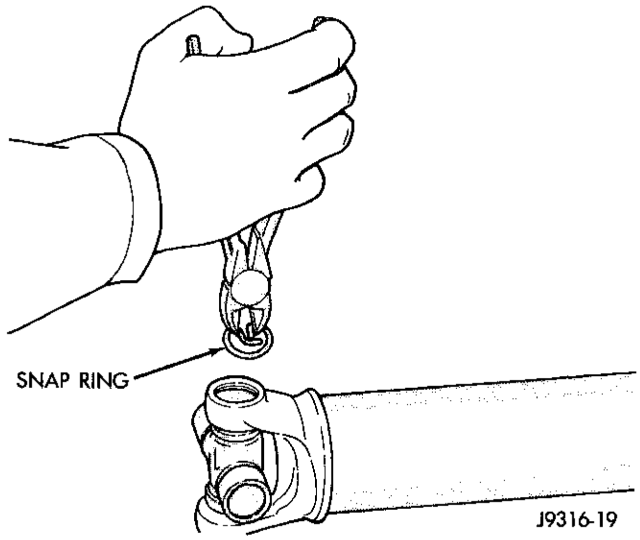

Fig. 15 Remove Snap Ring

(4) Set the yoke in an arbor press or vise with a socket whose inside diameter is large enough to receive the bearing cap positioned beneath the yoke.
(5) Position the yoke with the grease fitting, if equipped, pointing up.
(6) Place a socket with an outside diameter smaller than the upper bearing cap on the upper bearing cap and press the cap through the yoke to release the lower bearing cap (Fig. 16).

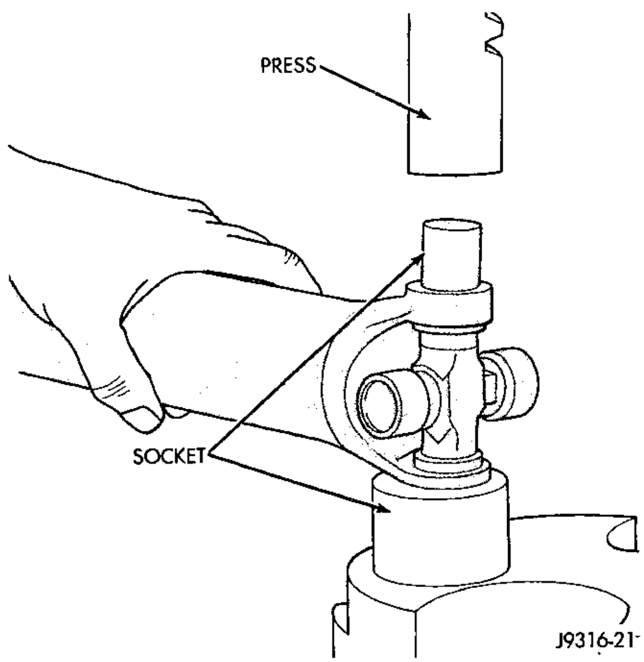

Fig. 16 Press Out Bearing

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DISASSEMBLY AND ASSEMBLY (Continued)

(7) If the bearing cap will not pull out of the yoke by hand after pressing, tap the yoke ear near the bearing cap to dislodge the cap.

(8) To remove the opposite bearing cap, turn the yoke over and straighten the cross in the open hole. Then, carefully press the end of the cross until the remaining bearing cap can be removed (Fig. 17).

CAUTION: If the cross or bearing cap are not straight during installation, the bearing cap will score the walls of the yoke bore and damage can occur.

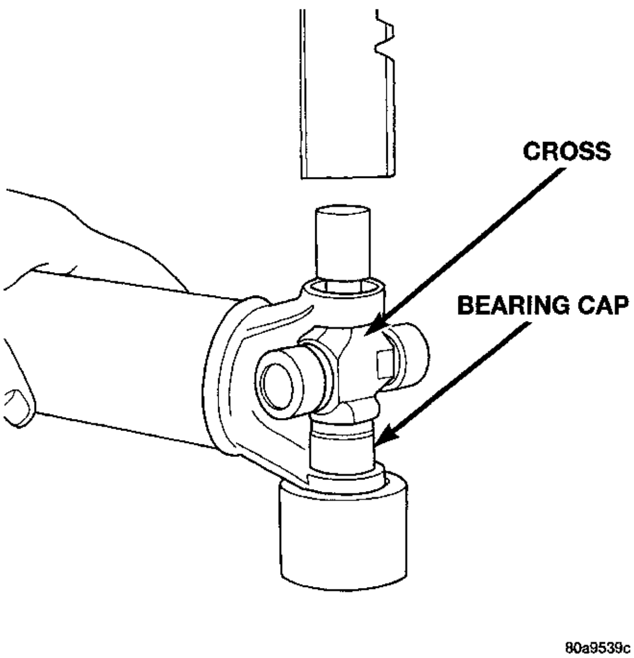

Fig. 17 Press Out Remaining Bearing

ASSEMBLY

(1) Apply extreme pressure (EP) N.L.G.I. Grade 1 or 2 grease to inside of yoke bores to aid in installation.

(2) Position the cross in the yoke with its lube fitting, if equipped, pointing up (Fig. 18).

(3) Place a bearing cap over the trunnion and align the cap with the yoke bore (Fig. 19). Keep the needle bearings upright in the bearing assembly. A needle bearing lying at the bottom of the cap will prevent proper assembly.

(4) Press the bearing cap into the yoke bore enough to install a snap ring.

(5) Install a snap ring.

(6) Repeat Step 3 and Step 4 to install the opposite bearing cap. If the joint is stiff or binding, strike the yoke with a soft hammer to seat the needle bearings.

(7) Add grease to lube fitting, if equipped.

(8) Install the propeller shaft.

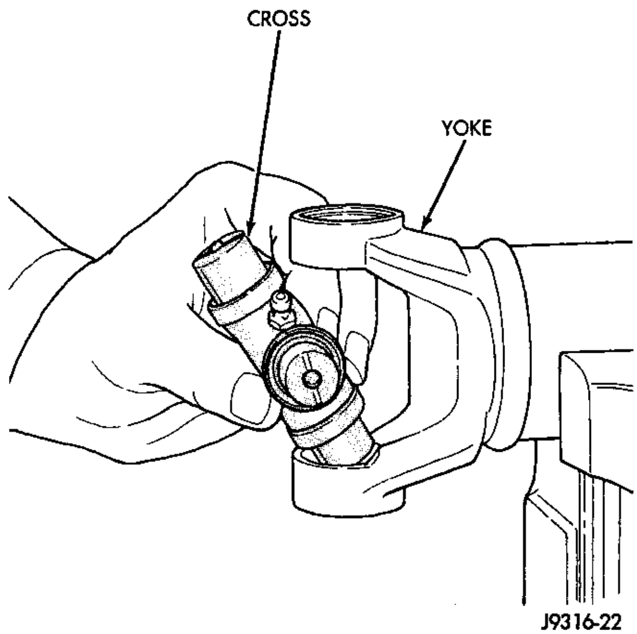

Fig. 18 Install Cross In Yoke

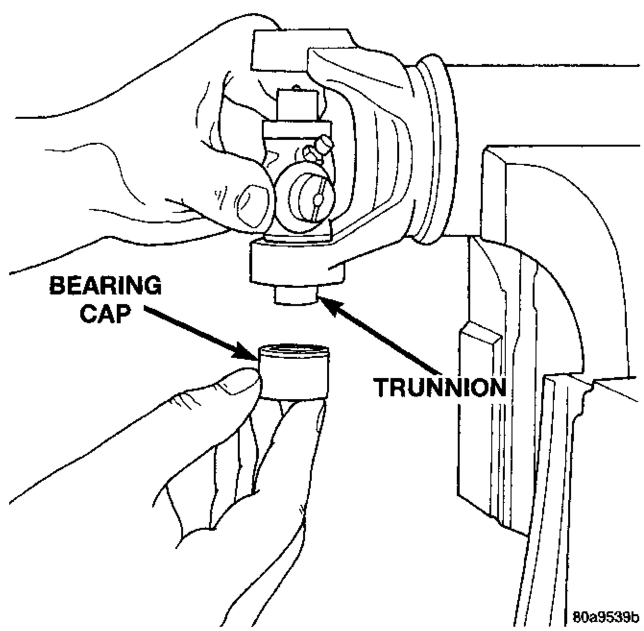

Fig. 19 Install Bearing On Trunnion

DOUBLE CARDAN JOINT

DISASSEMBLY

Individual components of cardan universal joints are not serviceable. If worn or leaking, they must be replaced as an assembly.

(1) Remove the propeller shaft.

(2) Using a soft drift, tap the outside of the bearing cap assembly to loosen snap ring.

DISASSEMBLY AND ASSEMBLY (Continued)

(3) Remove all the bearing cap snap rings (Fig. 20).

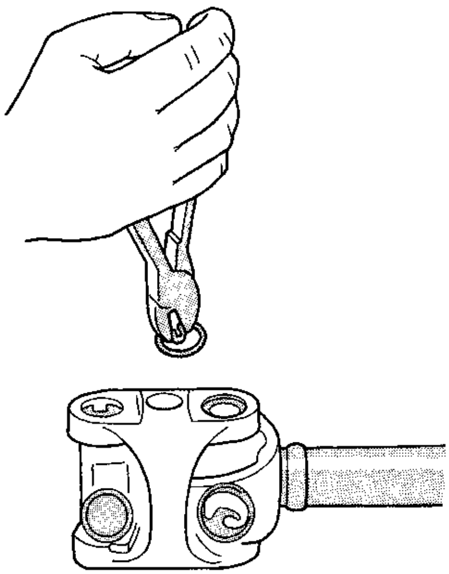
J9316-5

Fig. 20 Remove Snap Rings

(4) Set the joint in an arbor press or vise with a socket whose inside diameter is large enough to receive the bearing cap positioned beneath the link yoke.

(5) Place a socket with an outside diameter smaller than the upper bearing cap on the upper bearing cap and partially press one bearing cap from the outboard side of the link yoke enough to grasp the bearing cap with vise jaws (Fig. 21). Be sure to remove grease fittings that interfere with removal.

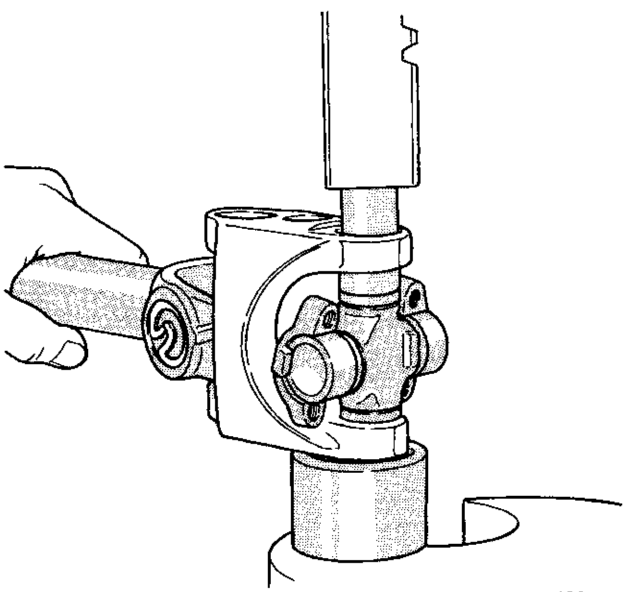
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Fig. 21 Press Out Bearing

(6) Grasp the protruding bearing by vise jaws. Tap the link yoke with a mallet and drift to dislodge the bearing cap from the yoke (Fig. 22).

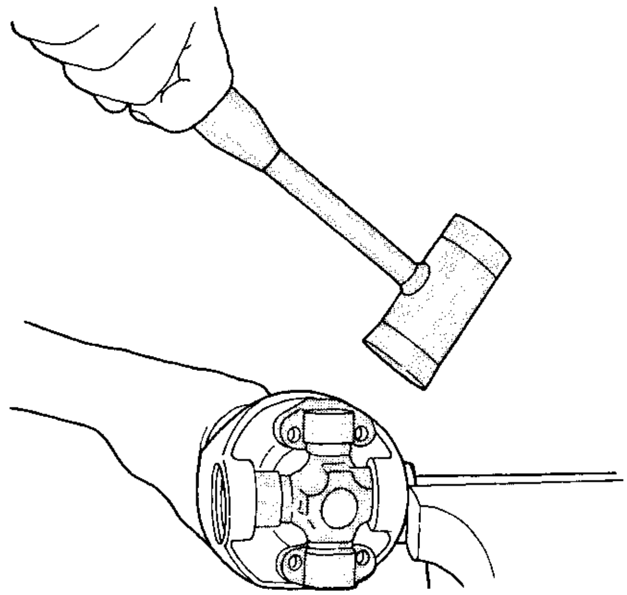
J9316-7

Fig. 22 Remove Bearing From Yoke

(7) Flip assembly and repeat Step 4, Step 5, and Step 6 to remove the opposite bearing cap. This will then allow removal of the cross centering kit assembly and spring (Fig. 23).

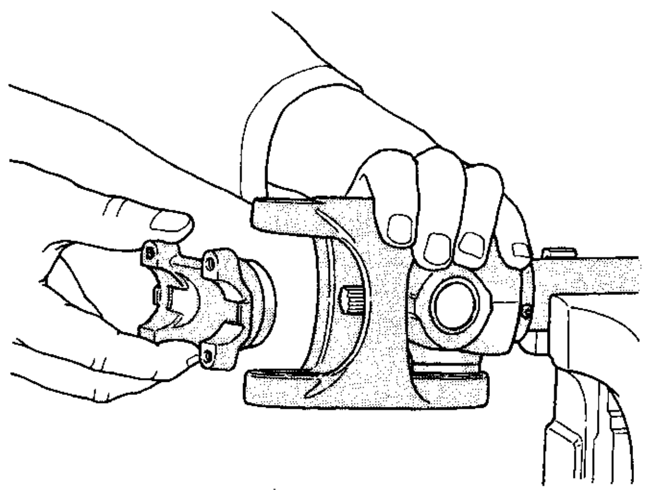
J9316-8

Fig. 23 Remove Centering Kit

(8) Press the remaining bearing caps out the other end of the link yoke as described above to complete the disassembly.

AUTHENTIC RESTORATION PRODUCT

DISASSEMBLY AND ASSEMBLY (Continued)

ASSEMBLY

During assembly, ensure that the alignment marks on the link yoke and propeller shaft yoke are aligned.

(1) Apply extreme pressure (EP) N.L.G.I. Grade 1 or 2 grease to inside of yoke bores to aid in installation.

(2) Fit a cross into the propeller shaft yoke (Fig. 24).

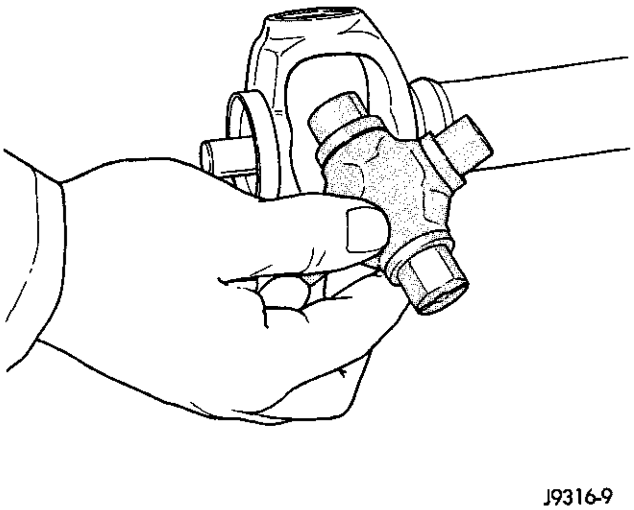

Fig. 24 Install Cross In Yoke

(3) Place a bearing cap over the trunnion and align the cap with the yoke bore (Fig. 25). Keep the needle bearings upright in the bearing assembly. A needle bearing lying at the bottom of the cap will prevent proper assembly.

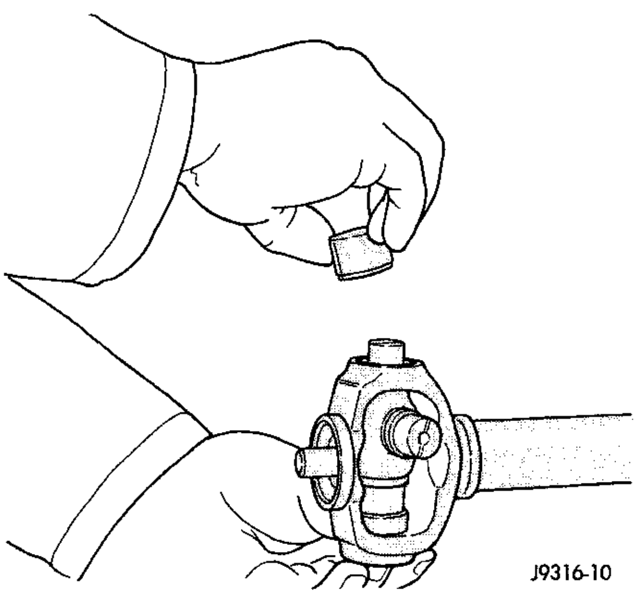

Fig. 25 Install Bearing Cap

(4) Press the bearing cap into the yoke bore enough to install a snap ring (Fig. 26).

(5) Install a snap ring.

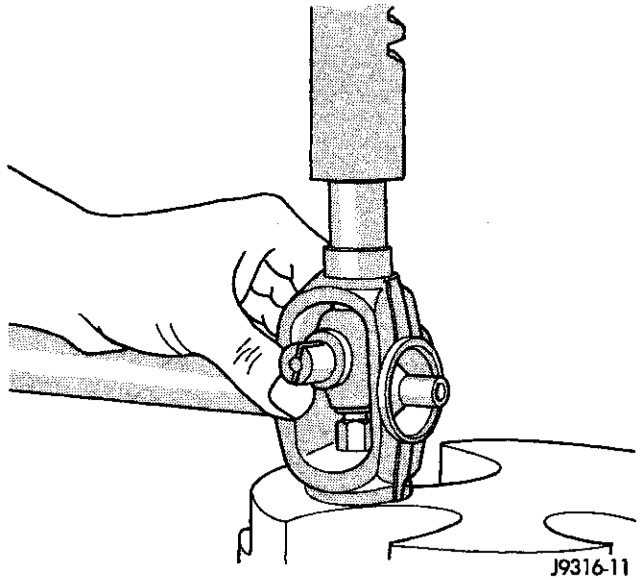

Fig. 26 Press In Bearing Cap

(6) Flip the propeller shaft yoke and install the bearing cap onto the opposite trunnion. Install a snap ring (Fig. 27).

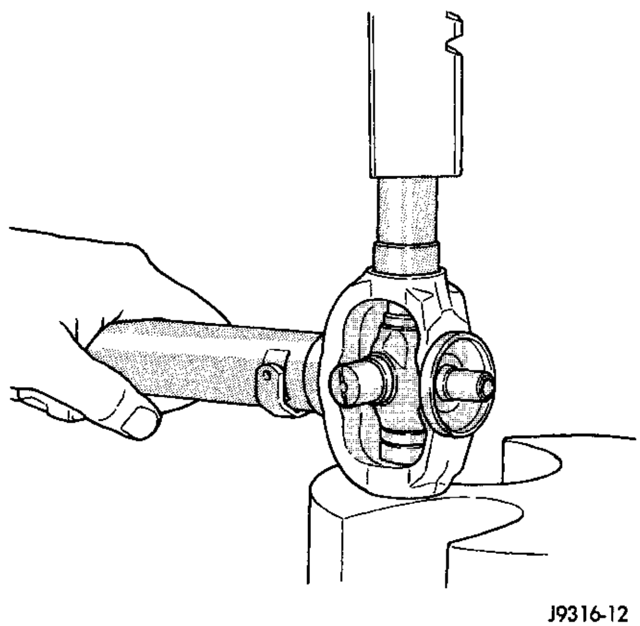

Fig. 27 Press In Bearing Cap

(7) Fit the link yoke on the remaining two trunnions and press both bearing caps into place (Fig. 28).

(8) Install snap rings.

AUTHENTIC RESTORATION PRODUCTS

DISASSEMBLY AND ASSEMBLY (Continued)

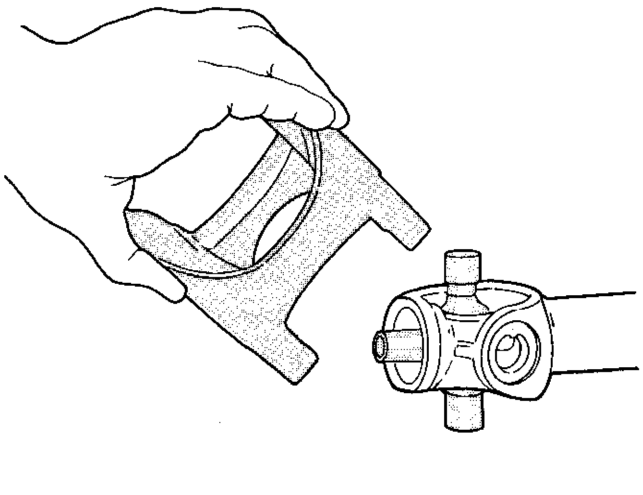

Fig. 28 Install Link Yoke

(9) Install the centering kit assembly inside the link yoke making sure the spring is properly positioned (Fig. 29).

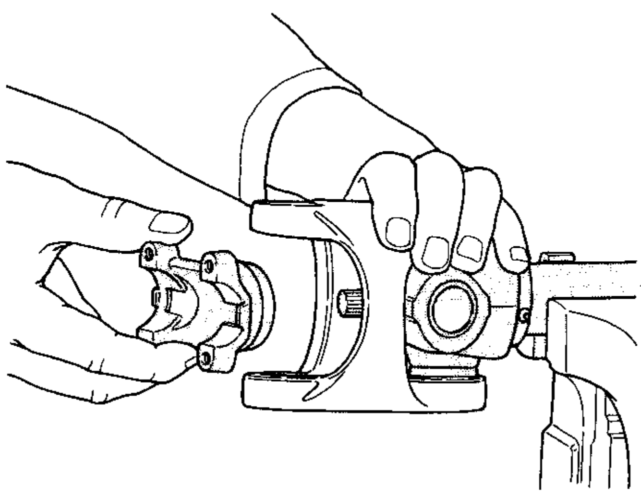

Fig. 29 Install Centering Kit

(10) Place two bearing caps on opposite trunnions of the remaining cross. Fit the open trunnions into the link yoke bores and the bearing caps into the centering kit (Fig. 30).

(11) Press the remaining two bearing caps into place and install snap rings (Fig. 31).

(12) Tap the snap rings to allow them to seat into the grooves (Fig. 32).

(13) Check for proper assembly. Flex the joint beyond center, it should snap over-center in both directions when correctly assembled (Fig. 33).

(14) Install the propeller shaft.

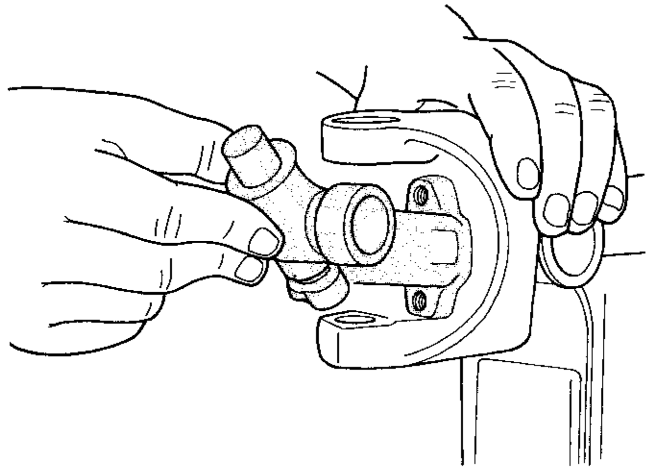

Fig. 30 Install Remaining Cross

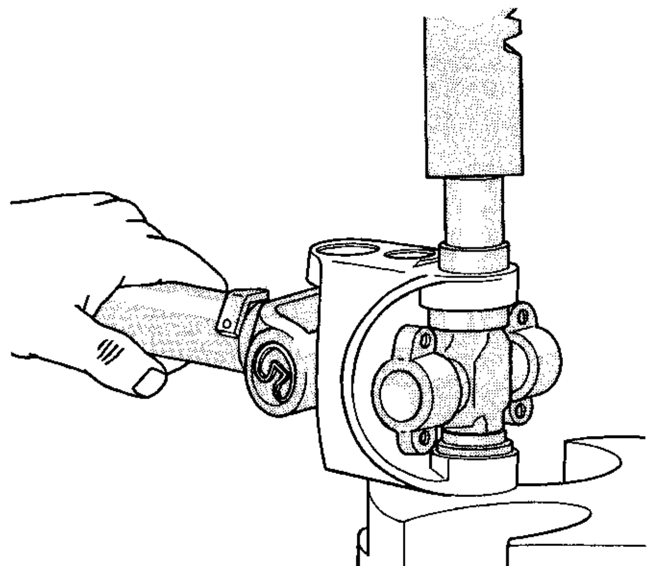

Fig. 31 Press In Bearing Cap

CLEANING AND INSPECTION

PROPELLER SHAFT

(1) Clean all universal joint bores with cleaning solvent and a wire brush.

(2) Inspect the yokes for distortion, cracks, and worn bearing cap bores.

ADJUSTMENTS

ADJUSTMENT AT AXLE WITH LEAF SPRINGS

Adjust the pinion shaft angle at the springs with tapered shims (Fig. 34). Install tapered shims between the springs and axle pad to correct the

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ADJUSTMENTS (Continued)

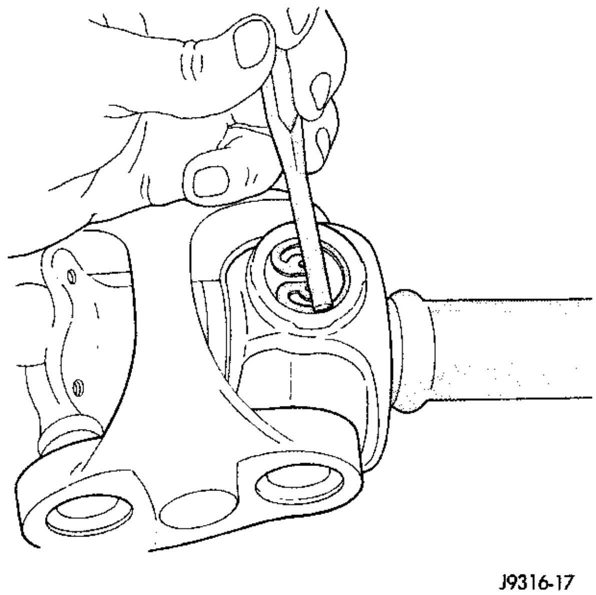


Fig. 32 Seat Snap Rings In Groove

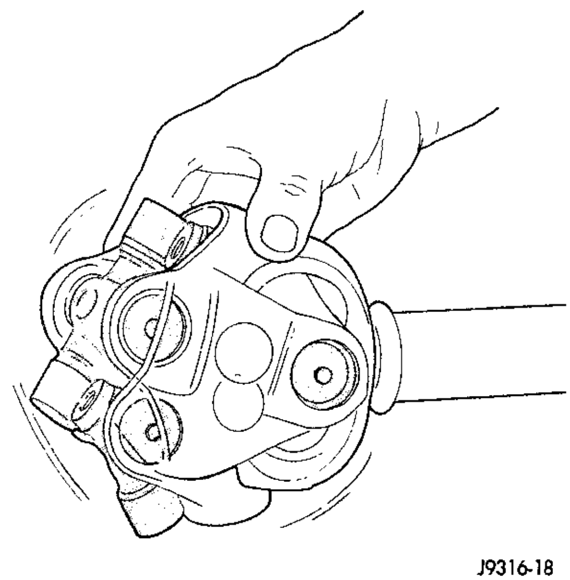


Fig. 33 Check Assembly

angle. Refer to Group 2, Suspension, for additional information.

CENTER BEARING ADJUSTMENT

Drive away shudder is a vibration that occurs at first acceleration from a stop. Shudder vibration usually peaks at the engines highest torque output. Shudder is a symptom associated with vehicles using a two-piece propeller shaft. To decrease shudder, lower the center bearing in 1/8 inch increments. Use shim stock or fabricated plates (Fig. 35). Plate stock must be used to maintain compression of the rubber

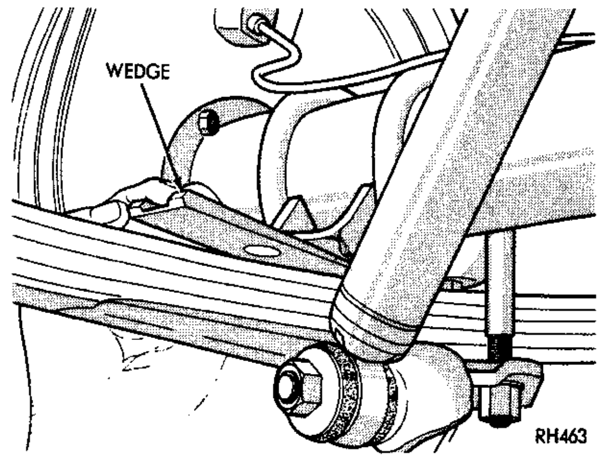


Fig. 34 Angle Adjustment at Leaf Springs

insulator around the bearing. Do not use washers. Replace the original bolts with the appropriate increased length bolts.

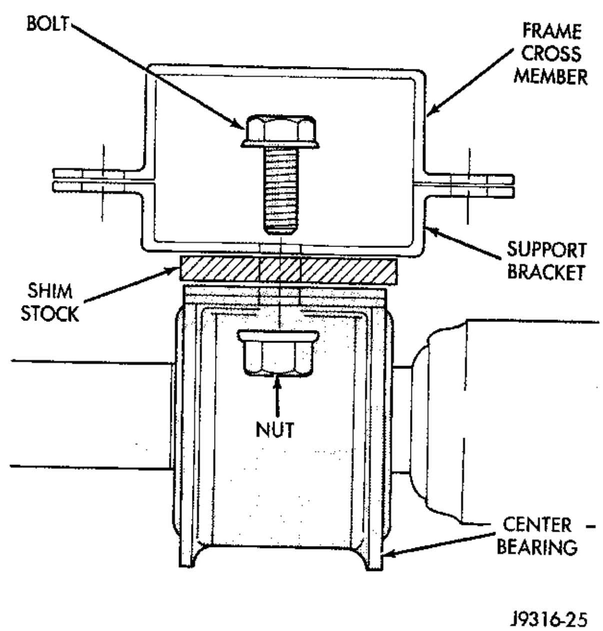


Fig. 35 Center Bearing Adjustment—Typical

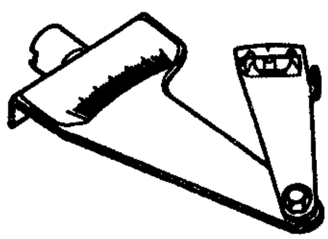
SPECIFICATIONS

TORQUE

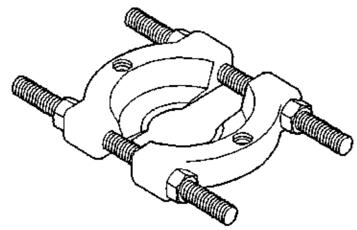
DESCRIPTION	TORQUE
FRONT SHAFT	
Bolts, flange yoke	88 N·m (65 ft. lbs.)
Bolts, axle yoke	19 N·m (14 ft. lbs.)
REAR SHAFT AXLE YOKE BOLTS	
9 1/4 Axle	19 N·m (14 ft. lbs.)
Dana Axle	30 N·m (22 ft. lbs.)
CENTER BEARING BRACKET	
Frame Bolts	68 N·m (50 ft. lbs.)
Bearing Bolts	68 N·m (50 ft. lbs.)

SPECIAL TOOLS

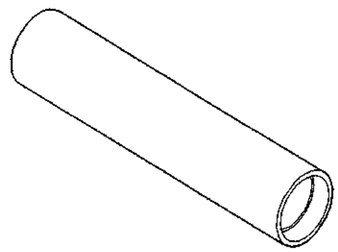
PROPELLER SHAFT



Inclinometer—7663



Bearing Splitter—1130



Installer, Bearing—6052

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216 AND 248 FBI AXLES

INDEX

GENERAL INFORMATION

216 AND 248 FBI AXLES

The housing for the 216 and 248 Front Beam-design Iron (FBI) axles consists of an iron center casting with tubes on each side. The tubes are pressed into and welded to the differential housing.

The integral type housing, hypoid gear design has the centerline of the pinion set below the centerline of the ring gear.

The axle has a vent used to relieve internal pressure caused by lubricant vaporization and internal expansion.

The axles are equipped with semi-floating axle shafts, meaning that loads are supported by the hub bearings. The axle shafts are retained by nuts at the hub bearings. The hub bearings are bolted to the steering knuckle at the outboard end of the axle tube yoke. The hub bearings are serviced as an assembly.

The axles are equipped with ABS brake sensors. The sensors are attached to the knuckle assemblies and the tone rings are pressed onto the axle shaft. **Use care when removing axle shafts as NOT to damage the tone wheel or the sensor.**

The stamped steel cover provides a means for inspection and servicing the differential.

The 216 and 248 FBI axles have the assembly part number and gear ratio listed on a tag. The tag is attached to the housing cover by one of the cover bolts. Build date identification codes are stamped on the cover side of a axle tube.

The differential case is a one-piece design. The differential pinion mate shaft is retained with a roll pin. Differential bearing preload and ring gear backlash is adjusted by the use of shims. The shims are located between the differential bearing cones and case. Pinion bearing preload is set and maintained by the use of a collapsible spacer.

AXLE IDENTIFICATION

The axle differential covers can be used for identification of the axle (Fig. 1) and (Fig. 2). A tag is also attached to the cover.

GENERAL INFORMATION (Continued)

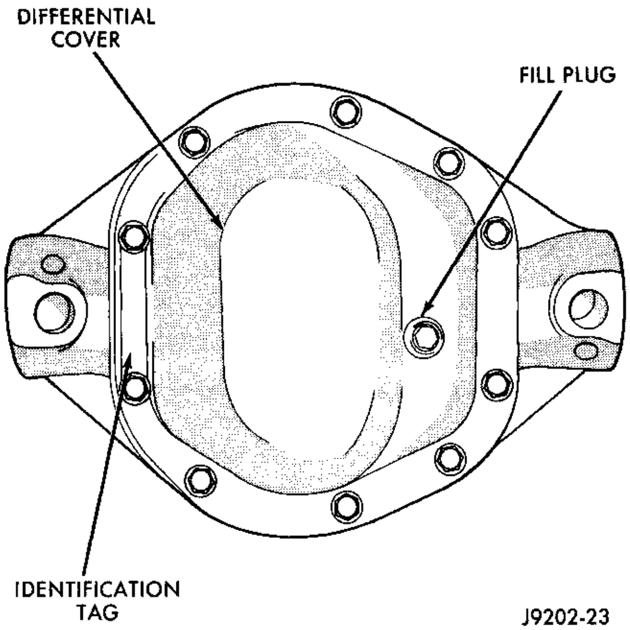

Fig. 1 216 FBI Differential Cover

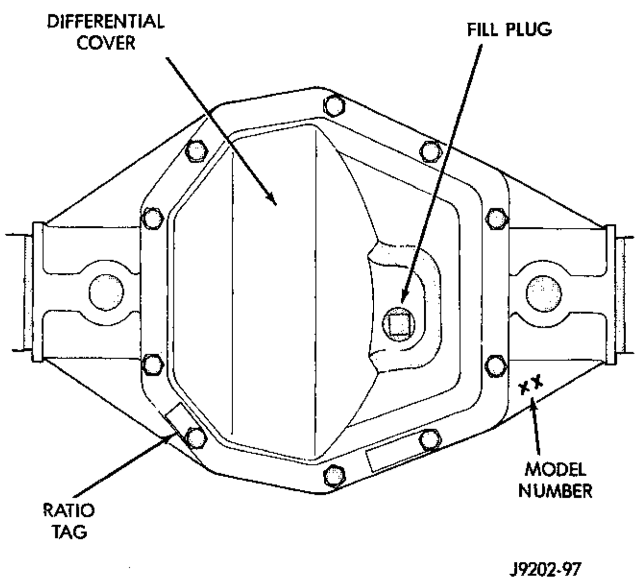

Fig. 2 248 FBI Differential Cover

LUBRICANT SPECIFICATIONS

A multi–purpose, hypoid gear lubricant which conforms to the following specifications should be used. Mopar® Hypoid Gear Lubricant conforms to all of these specifications.

- The lubricant should have MIL–L–2105C and API GL 5 quality specifications.
- Lubricant is a thermally stable SAE 80W–90 gear lubricant.

The 216 FBI axle lubricant capacity is 2.3 L (4.8 pts.). The 248 FBI axle lubricant capacity is 3.6 L (7.6 pts.).

CAUTION: If axle is submerged in water, lubricant must be replaced immediately to avoid possible premature axle failure.

STANDARD DIFFERENTIAL

The differential gear system divides the torque between the axle shafts. It allows the axle shafts to rotate at different speeds when turning corners.

Each differential side gear is splined to an axle shaft. The pinion gears are mounted on a pinion mate shaft and are free to rotate on the shaft. The pinion gear is fitted in a bore in the differential case and is positioned at a right angle to the axle shafts.

In operation, power flow occurs as follows:

- The pinion gear rotates the ring gear
- The ring gear (bolted to the differential case) rotates the case
- The differential pinion gears (mounted on the pinion mate shaft in the case) rotate the side gears
- The side gears (splined to the axle shafts) rotate the shafts

During straight-ahead driving, the differential pinion gears do not rotate on the pinion mate shaft. This occurs because input torque applied to the gears is divided and distributed equally between the two side gears. As a result, the pinion gears revolve with the pinion mate shaft but do not rotate around it (Fig. 3).

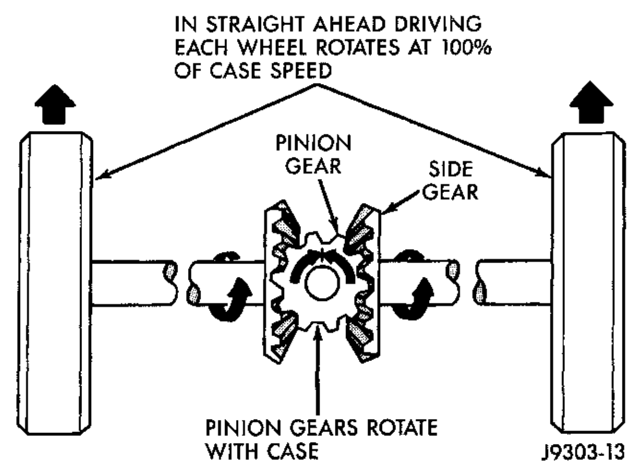

Fig. 3 Differential Operation—Straight Ahead Driving

When turning corners, the outside wheel must travel a greater distance than the inside wheel to complete a turn. The difference must be compensated for to prevent the tires from scuffing and skidding through turns. To accomplish this, the differential allows the axle shafts to turn at unequal speeds (Fig. 4). In this instance, the input torque applied to the pinion gears is not divided equally. The pinion gears now rotate around the pinion mate shaft in opposite directions. This allows the side gear and axle shaft

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GENERAL INFORMATION (Continued)

attached to the outside wheel to rotate at a faster speed.

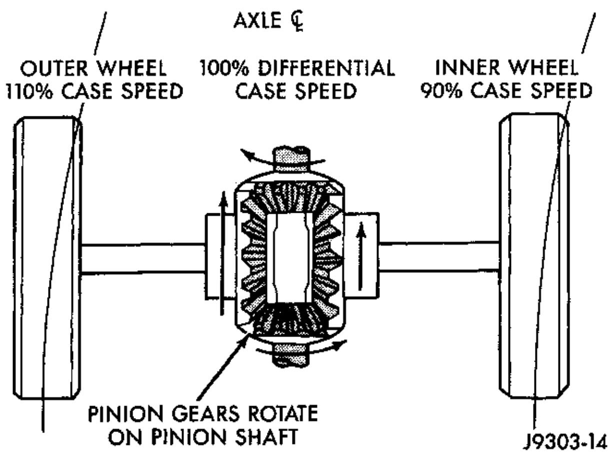

Fig. 4 Differential Operation—On Turns

DIAGNOSIS AND TESTING

GENERAL INFORMATION

Axle bearing problem conditions are usually caused by:
- Insufficient or incorrect lubricant.
- Foreign matter/water contamination.
- Incorrect bearing preload torque adjustment.
- Incorrect backlash.

Axle gear problem conditions are usually the result of:
- Insufficient lubrication.
- Incorrect or contaminated lubricant.
- Overloading (excessive engine torque) or exceeding vehicle weight capacity.
- Incorrect clearance or backlash adjustment.

Axle component breakage is most often the result of:
- Severe overloading.
- Insufficient lubricant.
- Incorrect lubricant.
- Improperly tightened components.

GEAR NOISE

Axle gear noise can be caused by insufficient lubricant, incorrect backlash, tooth contact, or worn/damaged gears.

Gear noise usually happens at a specific speed range. The range is 30 to 40 mph, or above 50 mph. The noise can also occur during a specific type of driving condition. These conditions are acceleration, deceleration, coast, or constant load.

When road testing, accelerate the vehicle to the speed range where the noise is the greatest. Shift out-of-gear and coast through the peak–noise range. If the noise stops or changes greatly:
- Check for insufficient lubricant.
- Incorrect ring gear backlash.
- Gear damage.

Differential side and pinion gears can be checked by turning the vehicle. They usually do not cause noise during straight–ahead driving when the gears are unloaded. The side gears are loaded during vehicle turns. A worn pinion gear mate shaft can also cause a snapping or a knocking noise.

BEARING NOISE

The axle shaft, differential and pinion gear bearings can all produce noise when worn or damaged. Bearing noise can be either a whining, or a growling sound.

Pinion gear bearings have a constant–pitch noise. This noise changes only with vehicle speed. Pinion bearing noise will be higher because it rotates at a faster rate. Drive the vehicle and load the differential. If bearing noise occurs, the rear pinion bearing is the source of the noise. If the bearing noise is heard during a coast, the front pinion bearing is the source.

Worn or damaged differential bearings usually produce a low pitch noise. Differential bearing noise is similar to pinion bearing noise. The pitch of differential bearing noise is also constant and varies only with vehicle speed.

Axle shaft bearings produce noise and vibration when worn or damaged. The noise generally changes when the bearings are loaded. Road test the vehicle. Turn the vehicle sharply to the left and to the right. This will load the bearings and change the noise level. Where axle bearing damage is slight, the noise is usually not noticeable at speeds above 30 mph.

LOW SPEED KNOCK

Low speed knock is generally caused by a worn U–joint or by worn side–gear thrust washers. A worn pinion gear shaft bore will also cause low speed knock.

VIBRATION

Vibration at the rear of the vehicle is usually caused by a:
- Damaged drive shaft.
- Missing drive shaft balance weight(s).
- Worn or out–of–balance wheels.
- Loose wheel lug nuts.
- Worn U–joint(s).
- Loose/broken springs.
- Damaged axle shaft bearing(s).
- Loose pinion gear nut.
- Excessive pinion yoke run out.
- Bent axle shaft(s).

Check for loose or damaged front–end components or engine/transmission mounts. These components

DIAGNOSIS AND TESTING (Continued)

can contribute to what appears to be a rear–end vibration. Do not overlook engine accessories, brackets and drive belts.

All driveline components should be examined before starting any repair.

Refer to Group 22, Wheels and Tires, for additional vibration information.

DRIVELINE SNAP

A snap or clunk noise when the vehicle is shifted into gear (or the clutch engaged), can be caused by:

- High engine idle speed
- Loose engine/transmission/transfer case mounts
- Worn U–joints
- Loose spring mounts
- Loose pinion gear nut and yoke
- Excessive ring gear backlash
- Excessive side gear/case clearance

The source of a snap or a clunk noise can be determined with the assistance of a helper. Raise the vehicle on a hoist with the wheels free to rotate. Instruct the helper to shift the transmission into gear. Listen for the noise, a mechanics stethoscope is helpful in isolating the source of a noise.

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DIAGNOSIS AND TESTING (Continued)

FRONT AXLES

DIAGNOSIS

CONDITION	POSSIBLE CAUSES	CORRECTION
WHEEL NOISE	1. Wheel loose. 2. Faulty, brinelled wheel bearing.	1. Tighten loose nuts. 2. Faulty or brinelled bearings must be replaced.
AXLE SHAFT NOISE	1. Misaligned axle shaft tube. 2. Bent or sprung axle shaft. 3. End play in drive pinion bearings. 4. Excessive gear backlash between ring gear and pinion gear. 5. Improper adjustment of drive pinion gear shaft bearings. 6. Loose drive pinion gearshaft yoke nut. 7. Improper wheel bearing adjustment. 8. Scuffed gear tooth contact surfaces.	1. Inspect axle shaft tube alignment. Correct as necessary. 2. Replace bent or sprung axle shaft. 3. Refer to Drive Pinion Bearing Pre-Load Adjustment. 4. Check adjustment of ring gear backlash and pinion gear. Correct as necessary. 5. Adjust drive pinion shaft bearings. 6. Tighten drive pinion gearshaft yoke nut with specified torque. 7. Readjust as necessary. 8. If necessary, replace scuffed gears.
AXLE SHAFT BROKE	1. Misaligned axle shaft tube. 2. Vehicle overloaded. 3. Erratic clutch operation. 4. Grabbing clutch.	1. Replace broken axle shaft after correcting axle shaft tube alignment. 2. Replace broken axle shaft. Avoid excessive weight on vehicle. 3. Replace broken axle shaft after inspecting for other possible causes. Avoid erratic use of clutch. 4. Replace broken axle shaft. Inspect clutch and make necessary repairs or adjustments.
DIFFERENTIAL CASE CRACKED	1. Improper adjustment of differential bearings. 2. Excessive ring gear backlash. 3. Vehicle overloaded. 4. Erratic clutch operation.	1. Replace cracked case; examine gears and bearings for possible damage. At reassembly, adjust differential bearings properly. 2. Replace cracked case; examine gears and bearings for possible damage. At reassembly, adjust ring gear backlash properly. 3. Replace cracked case; examine gears and bearings for possible damage. Avoid excessive weight on vehicle. 4. Replace cracked case. After inspecting for other possible causes, examine gears and bearings for possible damage. Avoid erratic use of clutch.
DIFFERENTIAL GEARS SCORED	1. Insufficient lubrication. 2. Improper grade of lubricant. 3. Excessive spinning of one wheel/tire.	1. Replace scored gears. Scoring marks on the drive face of gear teeth or in the bore are caused by instantaneous fusing of the mating surfaces. Scored gears should be replaced. Fill rear differential housing to required capacity with proper lubricant. Refer to Specifications. 2. Replace scored gears. Inspect all gears and bearings for possible damage. Clean and refill differential housing to required capacity with proper lubricant. 3. Replace scored gears. Inspect all gears, pinion bores and shaft for damage. Service as necessary.
LOSS OF LUBRICANT	1. Lubricant level too high.	1. Drain excess lubricant by removing fill plug and allow lubricant to level at lower edge of fill plug hole.

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DIAGNOSIS AND TESTING (Continued)

CONTINUED

CONDITION	POSSIBLE CAUSES	CORRECTION
LOSS OF LUBRICANT	2. Worn axle shaft seals. 3. Cracked differential housing. 4. Worn drive pinion gear shaft seal. 5. Scored and worn yoke. 6. Axle cover not properly sealed.	2. Replace worn seals. 3. Repair or replace housing as necessary. 4. Replace worn drive pinion gear shaft seal. 5. Replace worn or scored yoke and seal. 6. Remove cover and clean flange and reseal.
AXLE OVERHEATING	1. Lubricant level too low. 2. Incorrect grade of lubricant. 3. Bearings adjusted too tight. 4. Excessive gear wear. 5. Insufficient ring gear backlash.	1. Refill differential housing. 2. Drain, flush and refill with correct amount of the correct lubricant. 3. Readjust bearings. 4. Inspect gears for excessive wear or scoring. Replace as necessary. 5. Readjust ring gear backlash and inspect gears for possible scoring.
GEAR TEETH BROKE (RING GEAR AND PINION)	1. Overloading. 2. Erratic clutch operation. 3. Ice-spotted pavements. 4. Improper adjustments.	1. Replace gears. Examine other gears and bearings for possible damage. 2. Replace gears and examine the remaining parts for possible damage. Avoid erratic clutch operation. 3. Replace gears. Examine the remaining parts for possible damage. Replace parts as required. 4. Replace gears. Examine other parts for possible damage. Ensure ring gear backlash is correct.
AXLE NOISE	1. Insufficient lubricant. 2. Improper ring gear and drive pinion gear adjustment. 3. Unmatched ring gear and drive pinion gear. 4. Worn teeth on ring gear or drive pinion gear. 5. Loose drive pinion gear shaft bearings. 6. Loose differential bearings. 7. Misaligned or sprung ring gear. 8. Loose differential bearing cap bolts	1. Refill axle with correct amount of the proper lubricant. Also inspect for leaks and correct as necessary. 2. Check ring gear and pinion gear teeth contact pattern. 3. Remove unmatched ring gear and drive pinion gear. Replace with matched gear and drive pinion gear set. 4. Check teeth on ring gear and drive pinion gear for correct contact. If necessary, replace with new matched set. 5. Adjust drive pinion gearshaft bearing preload torque. 6. Adjust differential bearing preload torque. 7. Measure ring gear runout. 8. Tighten with specified torque

J9503-4

AUTHENTIC RESTORATION PRODUCT

DIAGNOSIS AND TESTING (Continued)

AXLE VACUUM SHIFT MOTOR DIAGNOSIS

VACUUM CONTROL SYSTEM

The disconnect axle control system consists of:

- Shift motor.
- Indicator switch.
- Vacuum switch.
- Vacuum harness (Fig. 5).

Refer to Group 21, Transmission and Transfer Case, for additional information.

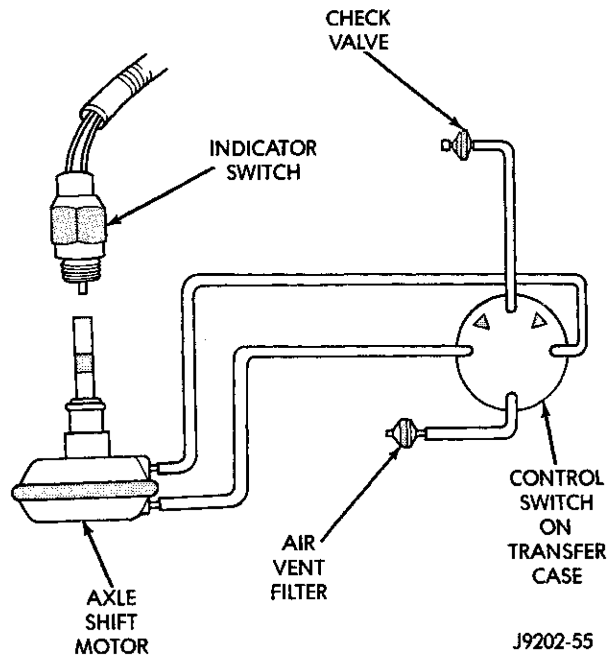

Fig. 5 Vacuum Control System

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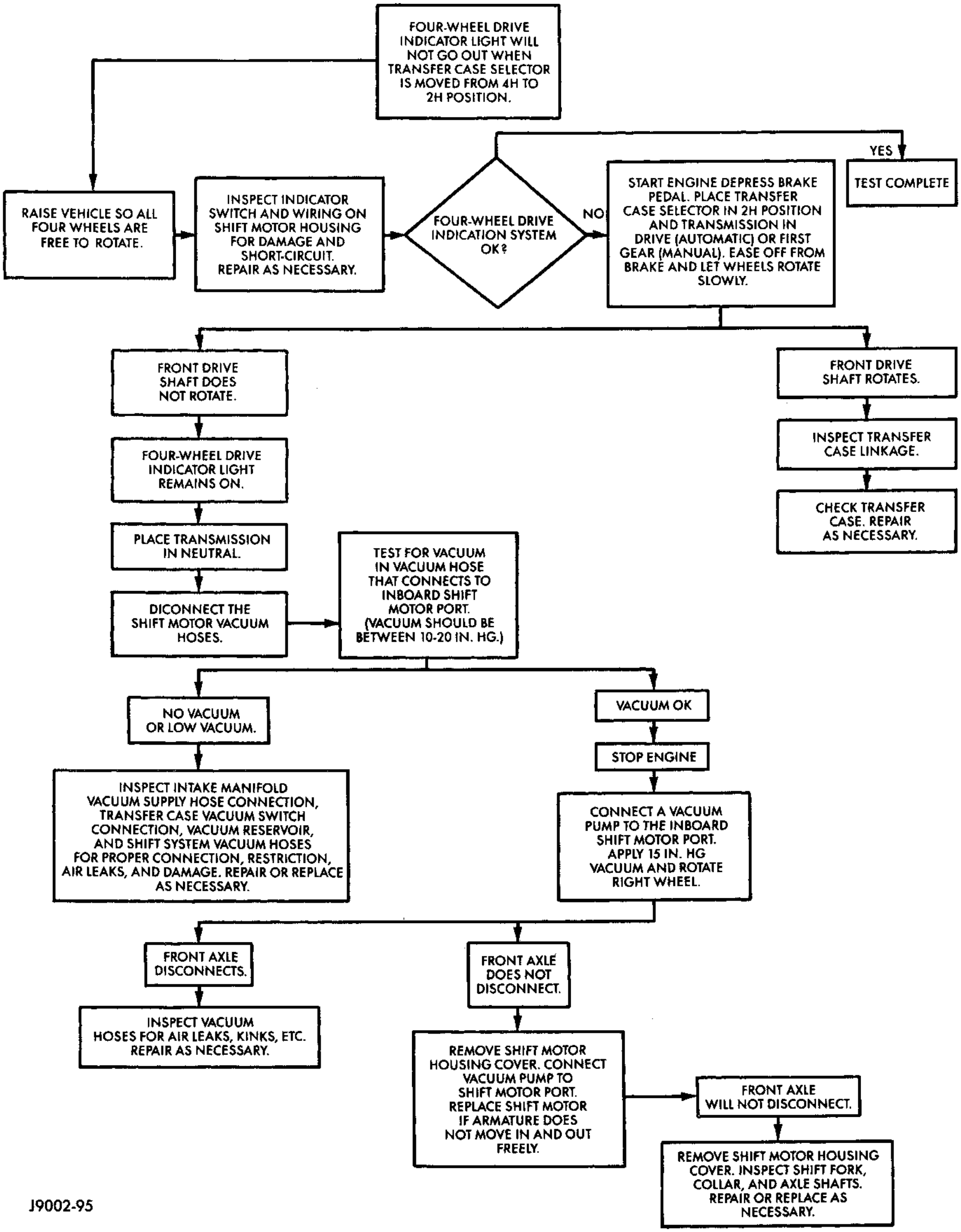
DIAGNOSIS AND TESTING (Continued)

AXLE VACUUM SHIFT MOTOR DIAGNOSIS
TWO-WHEEL DRIVE OPERATION DIAGNOSIS



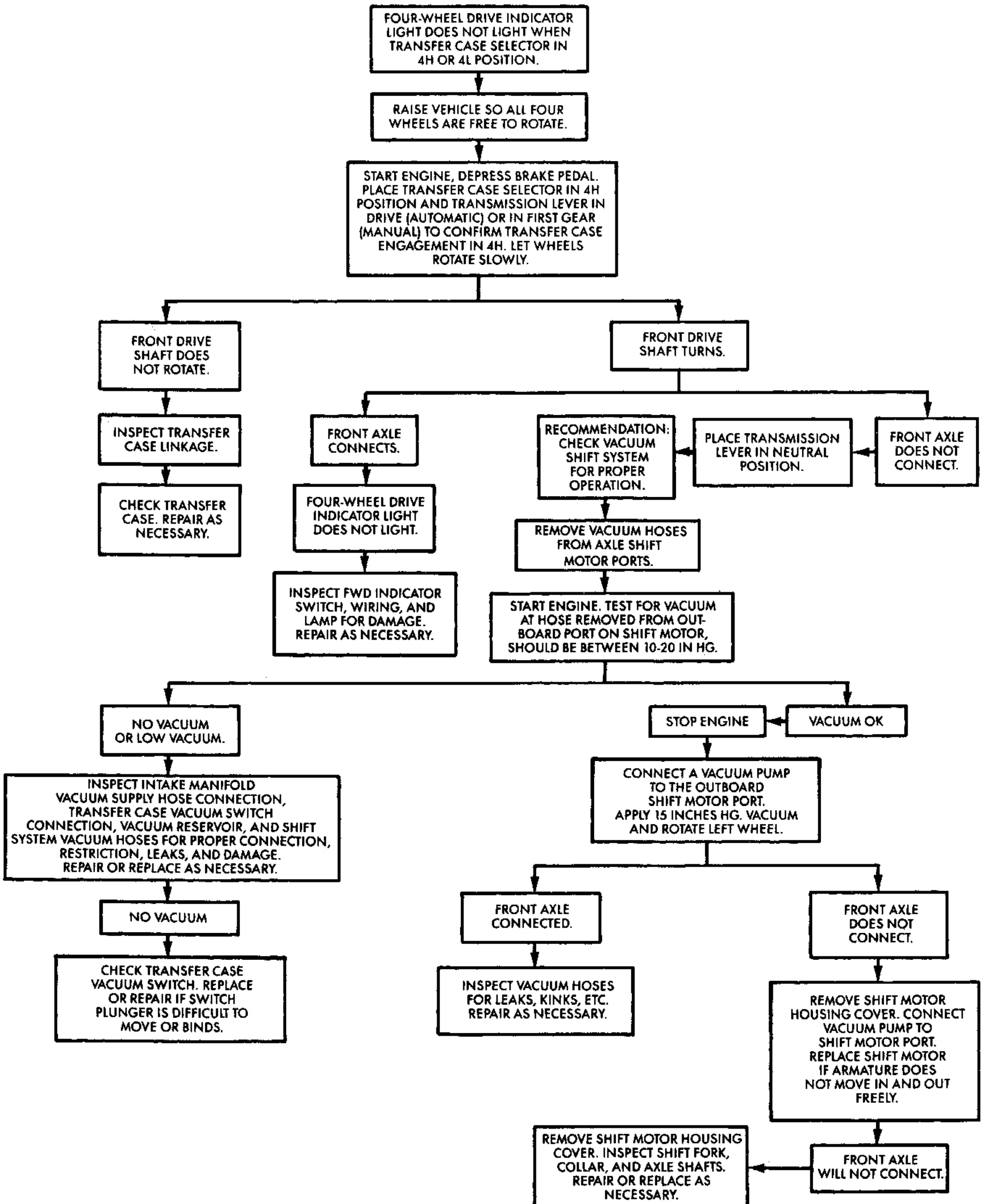
J9002-95

Mopar AUTHENTIC RESTORATION PRODUCT

DIAGNOSIS AND TESTING (Continued)

AXLE VACUUM SHIFT MOTOR DIAGNOSIS (CONT'D)

FOUR-WHEEL DRIVE OPERATION DIAGNOSIS



J9002-96

SERVICE PROCEDURES

LUBRICANT CHANGE

(1) Raise and support the vehicle.
(2) Remove the lubricant fill hole plug from the differential housing cover.
(3) Remove the differential housing cover and drain the lubricant from the housing.
(4) Clean the housing cavity with a flushing oil, light engine oil or lint free cloth. **Do not use water, steam, kerosene or gasoline for cleaning.**
(5) Remove the sealant from the housing and cover surfaces. Use solvent to clean the mating surfaces.
(6) Apply a bead of Mopar® Silicone Rubber Sealant, or equivalent, to the housing cover (Fig. 6).

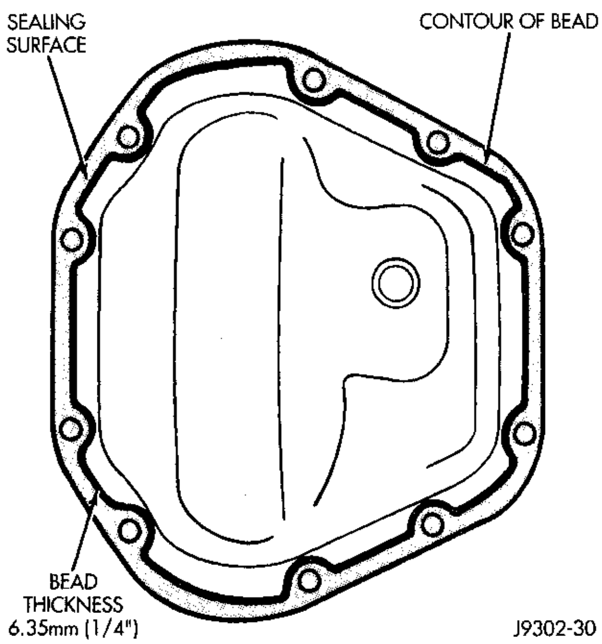


Fig. 6 Typical Housing Cover With Sealant

Install the housing cover within 5 minutes after applying the sealant.
(7) Install the cover and any identification tag. Tighten the cover bolts in a criss–cross pattern to 41 N·m (30 ft. lbs.) torque.
(8) Refill the differential with Mopar® Hypoid Gear Lubricant, or equivalent, to bottom of the fill plug hole. Refer to the Lubricant Specifications in this group for the quantity necessary.
(9) Install the fill hole plug and lower the vehicle.

REMOVAL AND INSTALLATION

AXLE ASSEMBLY

REMOVAL

(1) Raise and support the vehicle.
(2) Remove the wheels and tires.
(3) Remove the brake calipers and rotors. Refer to Group 5, Brakes, for proper procedures.
(4) Remove ABS wheel speed sensors, if equipped. Refer to Group 5, Brakes, for proper procedures.
(5) Disconnect the axle vent hose.
(6) Disconnect vacuum hose and electrical connector at disconnect housing.
(7) Remove the front propeller shaft.
(8) Disconnect the stabilizer bar links at the axle brackets.
(9) Disconnect the shock absorbers from axle brackets.
(10) Disconnect the track bar from the axle bracket.
(11) Disconnect the tie rod and drag link from the steering knuckles.
(12) Position the axle with a suitable lifting device under the axle assembly.
(13) Secure axle to lifting device.
(14) Mark suspension alignment cams for installation reference.
(15) Disconnect the upper and lower suspension arms from the axle bracket.
(16) Lower the axle. The coil springs will drop with the axle.
(17) Remove the coil springs from the axle bracket.

INSTALLATION

CAUTION: Suspension components with rubber bushings should be tightened with the weight of the vehicle on the suspension, at normal height. If springs are not at their normal ride position, vehicle ride comfort could be affected and premature bushing wear may occur. Rubber bushings must never be lubricated.

(1) Support the axle on a suitable lifting device.
(2) Secure axle to lifting device.
(3) Position the axle under the vehicle.
(4) Install the springs, retainer clip and bolts.
(5) Raise the axle and align it with the spring pads.
(6) Position the upper and lower suspension arms in the axle brackets. Install bolts, nuts and align the suspension alignment cams to the reference marks. Do not tighten at this time.
(7) Connect the track bar to the axle bracket and install the bolt. Do not tighten at this time.

AUTHENTIC RESTORATION PRODUCT

REMOVAL AND INSTALLATION (Continued)

(8) Install the shock absorber and tighten bolts to 121 N·m (89 ft. lbs.) torque.

(9) Install the stabilizer bar link to the axle bracket. Tighten the nut to 37 N·m (27 ft. lbs.) torque.

(10) Install the drag link and tie rod to the steering knuckles and tighten the nuts to 88 N·m (65 ft. lbs.) torque.

(11) Install the ABS wheel speed sensors, if equipped. Refer to group 5, Brakes, for proper procedures.

(12) Install the brake calipers and rotors. Refer to Group 5, Brakes, for proper procedures.

(13) Connect the vent hose to the tube fitting.

(14) Connect vacuum hose and electrical connector to disconnect housing.

(15) Install front propeller shaft.

(16) Check and add differential lubricant, if necessary. Refer to Lubricant Specifications in this section for lubricant requirements.

(17) Install the wheel and tire assemblies.

(18) Remove the supports and lower the vehicle.

(19) Tighten the upper suspension arm nuts at axle to 121 N·m (89 ft. lbs.) torque. Tighten the upper suspension arm nuts at frame to 84 N·m (62 ft. lbs.) torque.

(20) Tighten the lower suspension arm nuts at axle to 84 N·m (62 ft. lbs.) torque. Tighten the lower suspension arm nuts at frame to 119 N·m (88 ft. lbs.) torque.

(21) Tighten the track bar bolt at the axle bracket to 176 N·m (130 ft. lbs.) torque.

(22) Check the front wheel alignment.

PINION SHAFT SEAL—216 FBI AXLE

REMOVAL

(1) Raise and support the vehicle.

(2) Remove wheel and tire assemblies.

(3) Remove brake calipers and rotors

(4) Mark the propeller shaft and pinion yoke for installation reference.

(5) Remove the propeller shaft from the yoke.

(6) Rotate the pinion gear three or four times.

(7) Measure the amount of torque necessary to rotate the pinion gear with a (in. lbs.) dial-type torque wrench. Record the torque reading for installation reference.

(8) Remove the pinion yoke nut and washer. Use Remover C-452 and Wrench C-3281 to remove the pinion yoke (Fig. 7).

(9) Use suitable pry tool or slide hammer mounted screw to remove the pinion shaft seal.

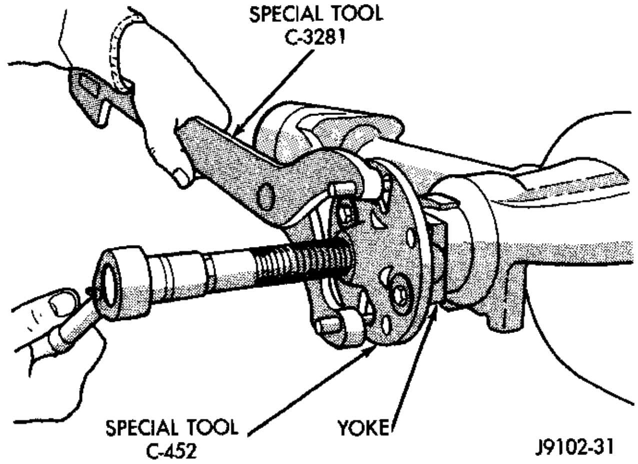


Fig. 7 Pinion Yoke Removal

INSTALLATION

(1) Apply a light coating of gear lubricant on the lip of pinion seal. Install seal with Installer C-3972-A and Handle C-4171 (Fig. 8).

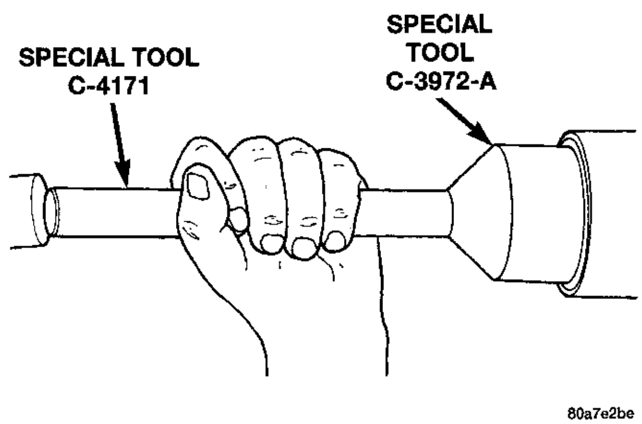


Fig. 8 Pinion Seal Installation

(2) Install yoke on the pinion gear with Installer W-162-D (Fig. 9).

CAUTION: Do not exceed the minimum tightening torque when installing the pinion yoke retaining nut. Damage to collapsible spacer or bearings may result.

(3) Install a new nut on the pinion gear. Tighten the nut only enough to remove the shaft end play.

(4) Rotate the pinion shaft using a (in. lbs.) torque wrench. Rotating torque should be equal to the reading recorded during removal, plus an additional 0.56 N·m (5 in. lbs.) (Fig. 10).

(5) If the rotating torque is to low, use Holder 6719 to hold the pinion yoke (Fig. 11), and tighten the pin-

REMOVAL AND INSTALLATION (Continued)

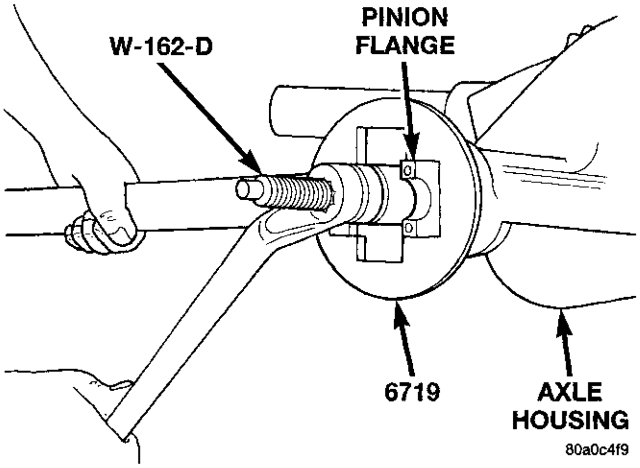


Fig. 9 Install Pinion Yoke

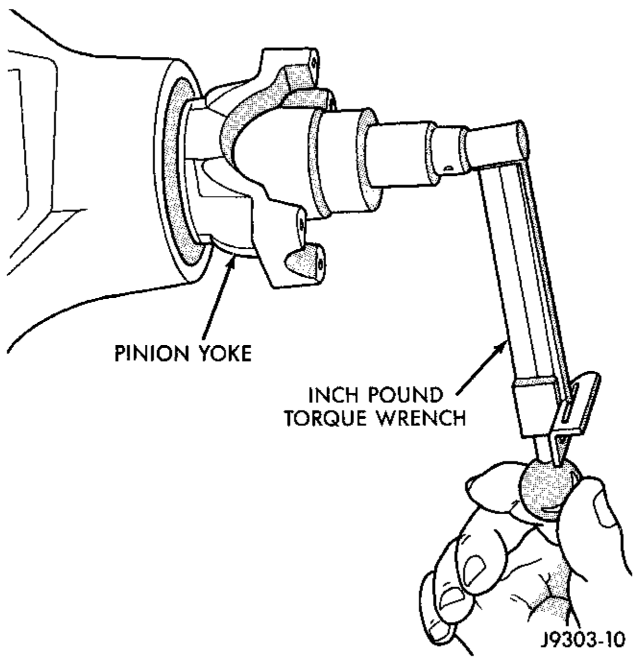


Fig. 10 Check Pinion Rotation Torque

ion shaft nut in 6.8 N·m (5 ft. lbs.) until proper rotating torque is achieved.

(6) Align the installation reference marks and attach the propeller shaft to the yoke.

(7) Check and add lubricant to axle, if necessary. Refer to Lubricant Specifications in this section for lubricant requirements.

(8) Install brake rotors and calipers.

(9) Install wheel and tire assemblies.

(10) Lower the vehicle.

PINION SHAFT SEAL—248 FBI AXLE

REMOVAL

(1) Raise and support the vehicle.

(2) Remove wheel and tire assemblies.

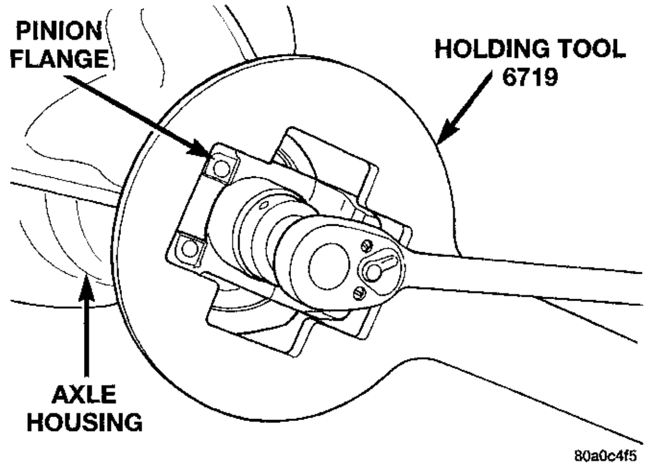


Fig. 11 Tightening Pinion Shaft Nut

(3) Remove brake calipers and rotors

(4) Mark the propeller shaft and pinion yoke for installation reference.

(5) Remove the propeller shaft from the yoke.

(6) Rotate the pinion gear three or four times.

(7) Measure the amount of torque necessary to rotate the pinion gear with a (in. lbs.) dial-type torque wrench. Record the torque reading for installation reference.

(8) Remove the pinion yoke nut and washer. Use Remover C-452 and Wrench C-3281 to remove the pinion yoke (Fig. 12).

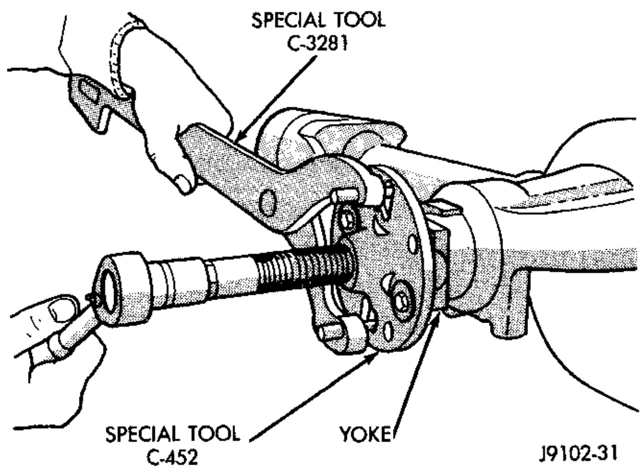


Fig. 12 Pinion Yoke Removal

(9) Use suitable pry tool or slide hammer mounted screw to remove the pinion shaft seal.

INSTALLATION

(1) Apply a light coating of gear lubricant on the lip of pinion seal. Install seal with Installer 8108 and Handle C-4171 (Fig. 13).

(2) Install yoke on the pinion gear with Installer C-3718 and Holder 6719 (Fig. 14).

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REMOVAL AND INSTALLATION (Continued)

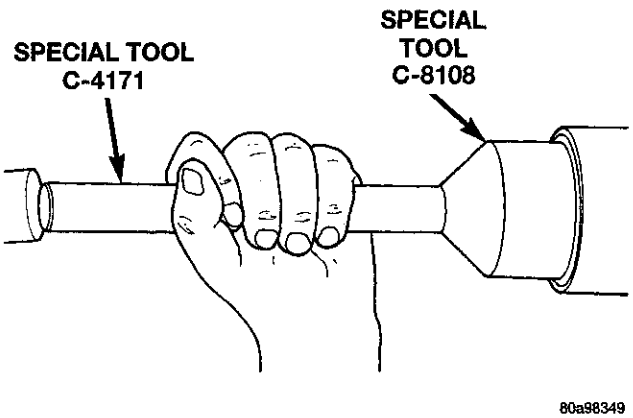

Fig. 13 Pinion Seal Installation

CAUTION: Do not exceed the minimum tightening torque when installing the pinion yoke retaining nut. Damage to collapsible spacer or bearings may result.

(3) Install a new nut on the pinion gear. Tighten the nut only enough to remove the shaft end play.

(4) Rotate the pinion shaft using a (in. lbs.) torque wrench. Rotating torque should be equal to the reading recorded during removal, plus an additional 0.56 N·m (5 in. lbs.) (Fig. 15).

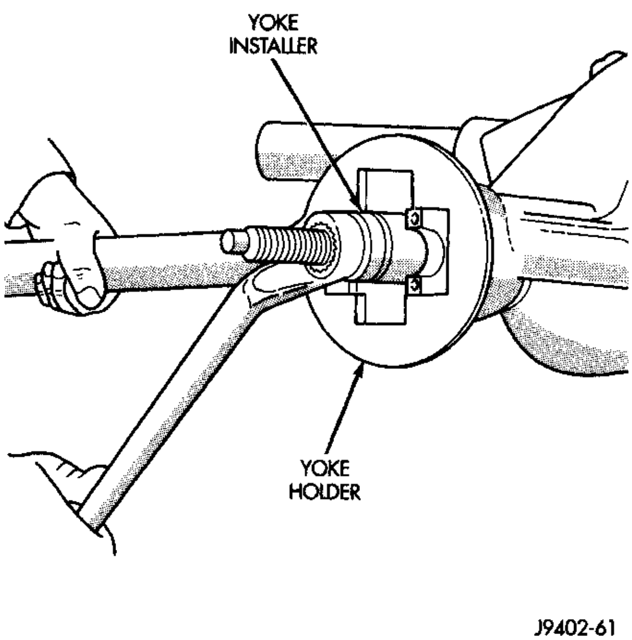

Fig. 14 Install Pinion Yoke

(5) If the rotating torque is to low, use Holder 6719 to hold the pinion yoke (Fig. 16), and tighten the pinion shaft nut in 6.8 N·m (5 ft. lbs.) until proper rotating torque is achieved.

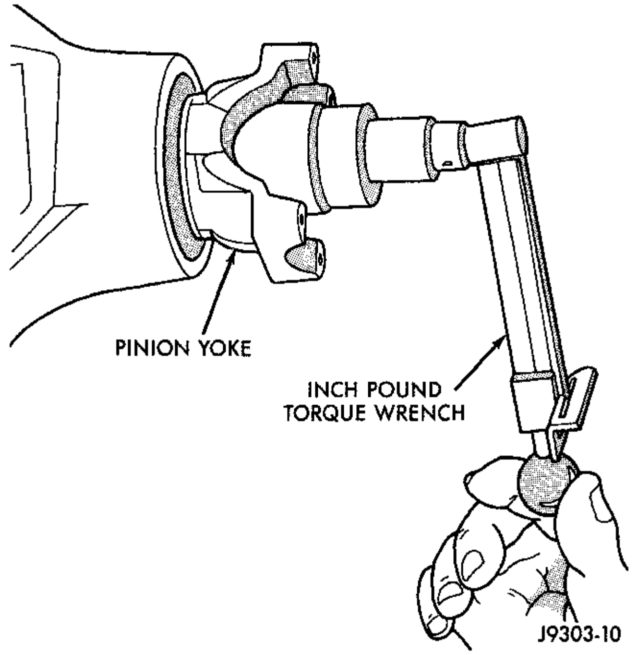

Fig. 15 Check Pinion Rotation Torque

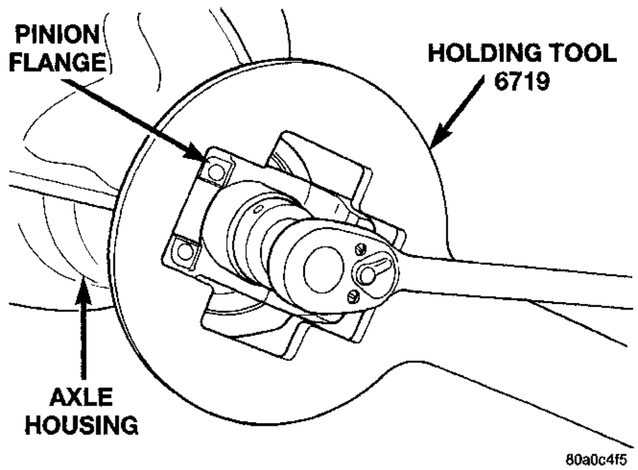

Fig. 16 Tightening Pinion Shaft Nut

(6) Align the installation reference marks and attach the propeller shaft to the yoke.

(7) Check and add lubricant to axle, if necessary. Refer to Lubricant Specifications in this section for lubricant requirements.

(8) Install brake rotors and calipers.

(9) Install wheel and tire assemblies.

(10) Lower the vehicle.

AXLE SHIFT MOTOR

REMOVAL

(1) Disconnect the vacuum and wiring connector from the shift housing.

(2) Remove indicator switch.

REMOVAL AND INSTALLATION (Continued)

(3) Remove the shift motor housing cover, gasket and shield from the housing (Fig. 17).

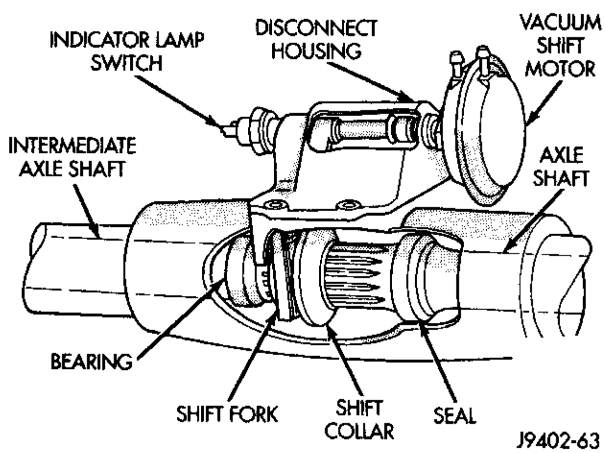

Fig. 17 Shift Motor Housing

INSTALLATION

(1) Install the shift motor housing gasket and cover. Ensure the shift fork is correctly guided into the shift collar groove.

(2) Install the shift motor housing shield and attaching bolts. Tighten the bolts to 11 N·m (96 in. lbs.) torque.

(3) Add 148 ml (5 ounces) of API grade GL 5 hypoid gear lubricant to the shift motor housing. Add lubricant through indicator switch mounting hole.

(4) Install indicator switch, electrical connector and vacuum harness.

HUB BEARING AND AXLE SHAFT

REMOVAL

(1) Raise and support the vehicle.

(2) Remove the wheel and tire assembly.

(3) Remove the brake caliper and rotor. Refer to Group 5, Brakes, for proper procedures.

(4) Remove ABS wheel speed sensor, if equipped. Refer to Group 5, Brakes, for proper procedures.

(5) Remove the cotter pin and axle hub nut.

(6) Remove the hub to knuckle bolts (Fig. 18). Remove the hub bearing from the steering knuckle and axle shaft.

(7) Remove the brake dust shield.

(8) Remove the axle shaft from the housing. Avoid damaging the axle shaft oil seal.

INSTALLATION

(1) Clean the axle shaft and apply a thin film of Mopar® Wheel Bearing Grease to the shaft splines, seal contact surface, hub bore.

(2) Install the axle shaft into the housing and differential side gears. Avoid damaging the axle shaft oil seals in the differential.

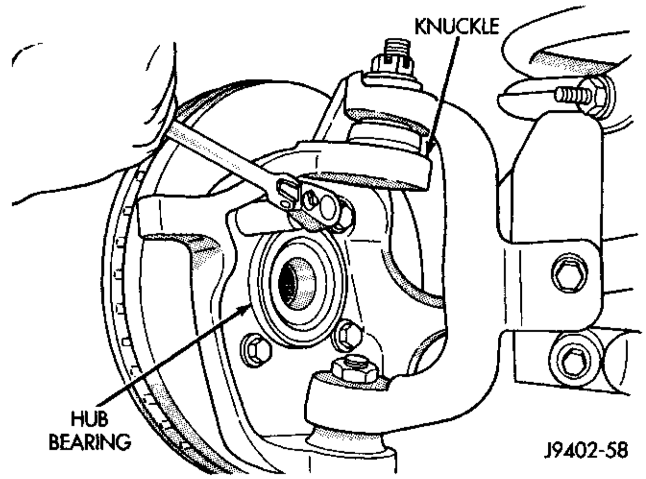

Fig. 18 Hub and Knuckle

(3) Install dust shield and hub bearing on knuckle, and axle shaft.

(4) Install the hub bearing to knuckle bolts and tighten to 170 N·m (125 ft. lbs.) torque.

(5) Install the axle washer and nut, tighten nut to 237 N·m (175 ft. lbs.) torque. Align nut to next cotter pin hole and install new cotter pin.

(6) Install ABS wheel speed sensor. Refer to Group 5, Brakes, for proper procedures.

(7) Install the brake rotor and caliper. Refer to Group 5, Brakes, for proper procedures.

(8) Install the wheel and tire assembly.

(9) Remove support and lower the vehicle.

AXLE SHAFT—CARDAN U-JOINT

Single cardan U–joint components are not serviceable. If defective, they must be replaced as a unit. If the bearings, seals, spider, or bearing caps are damaged or worn, replace the complete U–joint.

REMOVAL

CAUTION: Clamp only the narrow forged portion of the yoke in the vise. Also, to avoid distorting the yoke, do not over tighten the vise jaws.

(1) Remove axle shaft.

(2) Remove the bearing cap retaining snap rings (Fig. 19).

It can be helpful to saturate the bearing caps with penetrating oil prior to removal.

(3) Locate a socket where the inside diameter is larger in diameter than the bearing cap. Place the socket (receiver) against the yoke and around the perimeter of the bearing cap to be removed.

(4) Locate a socket where the outside diameter is smaller in diameter than the bearing cap. Place the socket (driver) against the opposite bearing cap.

REMOVAL AND INSTALLATION (Continued)

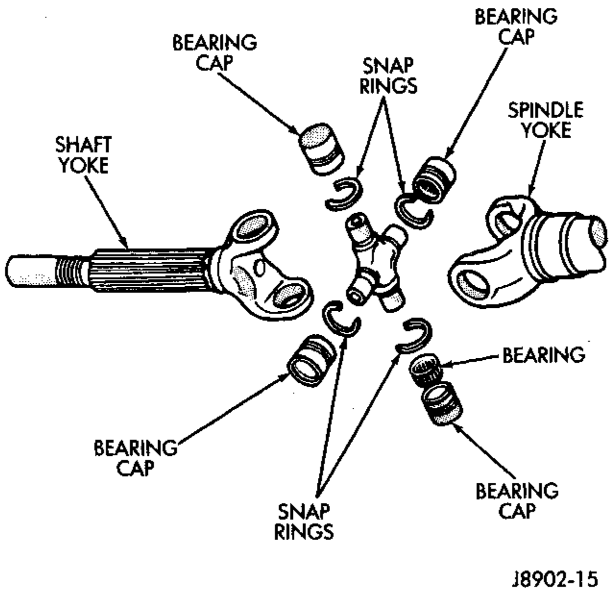

Fig. 19 Axle Shaft Outer U–Joint

(5) Position the yoke with the sockets in a vise (Fig. 20).

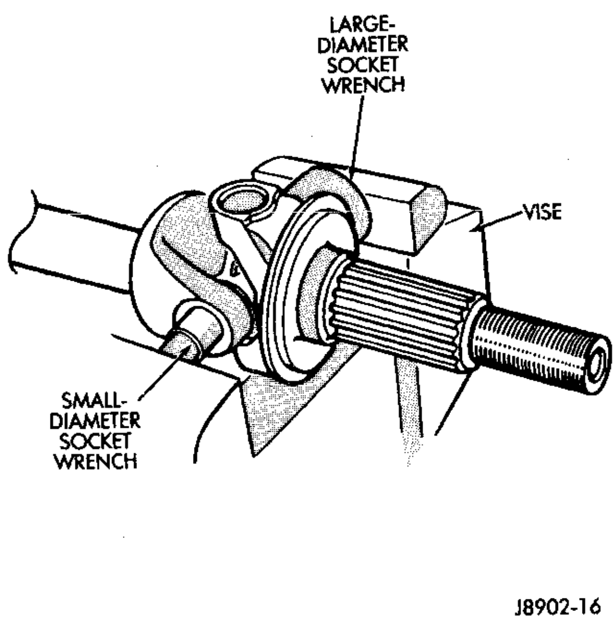

Fig. 20 Yoke Bearing Cap Removal

(6) Compress the vise jaws to force the bearing cap into the larger socket (receiver).

(7) Release the vise jaws. Remove the sockets and bearing cap that was partially forced out of the yoke.

(8) Repeat the above procedure for the remaining bearing cap.

(9) Remove the remaining bearing cap, bearings, seals and spider from the propeller shaft yoke.

INSTALLATION

(1) Pack the bearing caps 1/3 full of wheel bearing lubricant. Apply extreme pressure (EP), lithium–base lubricant to aid in installation.

(2) Position the spider in the yoke. Insert the seals and bearings. Tap the bearing caps into the yoke bores far enough to hold the spider in position.

(3) Place the socket (driver) against one bearing cap. Position the yoke with the socket wrench in a vise.

(4) Compress the vise to force the bearing caps into the yoke. Force the caps enough to install the retaining clips.

(5) Install the bearing cap retaining clips.

(6) Install axle shaft.

STEERING KNUCKLE—216 FBI AXLE

REMOVAL

(1) Remove hub bearing and axle shaft.

(2) Remove tie-rod or drag link end from the steering knuckle arm.

(3) Remove the ABS sensor wire and bracket from knuckle.

(4) Remove the cotter pin from the upper ball stud nut. Remove the upper and lower ball stud nuts.

(5) Strike the steering knuckle with a brass hammer to loosen. Remove knuckle from axle tube yokes.

INSTALLATION

(1) Position the steering knuckle on the ball studs.

(2) Install and tighten lower ball stud nut to 108 N·m (80 ft. lbs.) torque. Advance nut to next slot to line up hole and install new cotter pin.

(3) Install and tighten upper ball stud nut to 101 N·m (75 ft. lbs.) torque. Advance nut to next slot to line up hole and install new cotter pin.

(4) Install the hub bearing and axle shaft.

(5) Install tie-rod or drag link end onto the steering knuckle arm.

(6) Install the ABS sensor wire and bracket to the knuckle. Refer to Group 5, Brakes, for proper procedures.

STEERING KNUCKLE—248 FBI AXLE

REMOVAL

(1) Remove hub bearing and axle shaft.

(2) Remove tie-rod or drag link end from the steering knuckle arm.

(3) Remove the ABS sensor wire and bracket from knuckle. Refer to Group 5, Brakes, for proper procedures.

(4) Remove the cotter pin from the upper ball stud nut. Remove the upper and lower ball stud nuts.

(5) Strike the steering knuckle with a brass hammer to loosen.

(6) Remove knuckle from axle tube yokes.

REMOVAL AND INSTALLATION (Continued)

INSTALLATION

(1) Position the steering knuckle on the ball studs.

(2) Install and tighten lower ball stud nut to 47 N·m (35 ft. lbs.) torque. Do not install cotter pin at this time.

(3) Install and tighten upper ball stud nut to 94 N·m (70 ft. lbs.) torque. Advance nut to next slot to line up hole and install new cotter pin.

(4) Retorque lower ball stud nut to 190–217 N·m (140–160 ft. lbs.) torque. Advance nut to next slot to line up hole and install new cotter pin.

(5) Install the hub bearing and axle shaft.

(6) Install tie-rod or drag link end onto the steering knuckle arm.

(7) Install the ABS sensor wire and bracket to the knuckle. Refer to Group 5, Brakes, for proper procedure.

BALL STUDS—216 FBI AXLE

REMOVAL

(1) Position tools as shown to remove upper ball stud (Fig. 21).

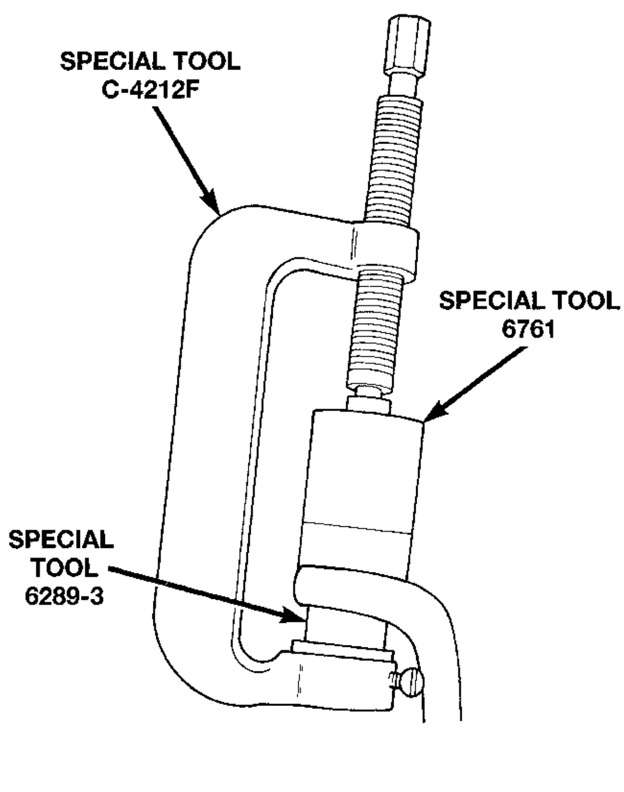

Fig. 21 Upper Ball Stud Remove

(2) Position tools as shown to remove lower ball stud (Fig. 22).

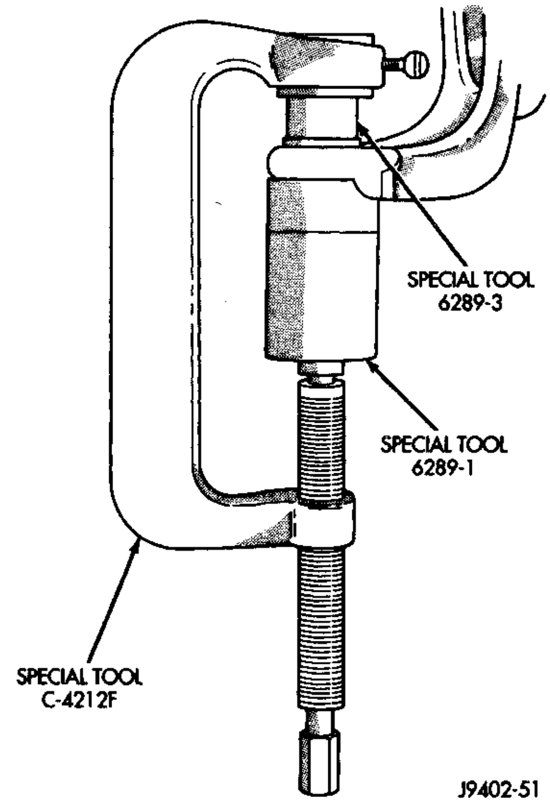

Fig. 22 Lower Ball Stud Remove

INSTALLATION

(1) Position tools as shown to install upper ball stud (Fig. 23).

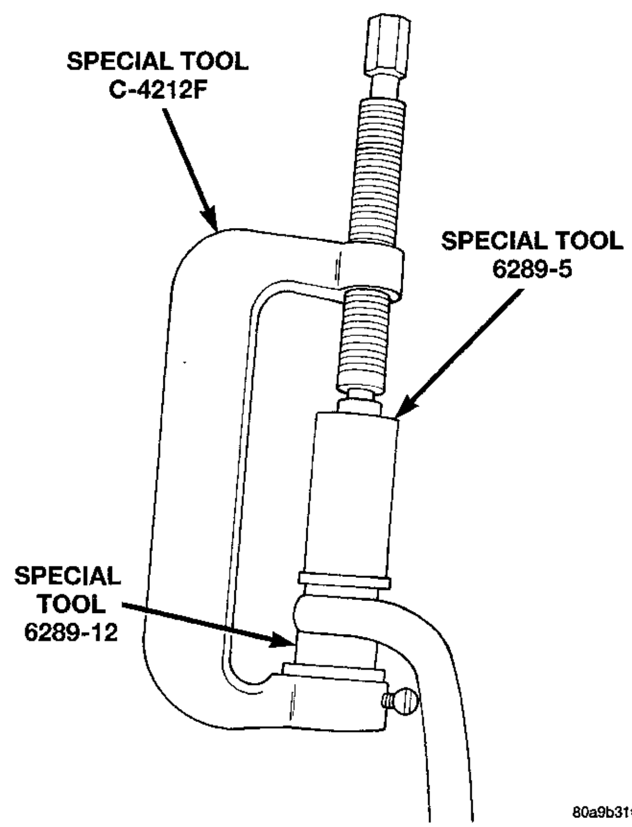

Fig. 23 Upper Ball Stud Install

AUTHENTIC RESTORATION PRODUCT

REMOVAL AND INSTALLATION (Continued)

(2) Position tools as shown to install upper ball stud (Fig. 24).

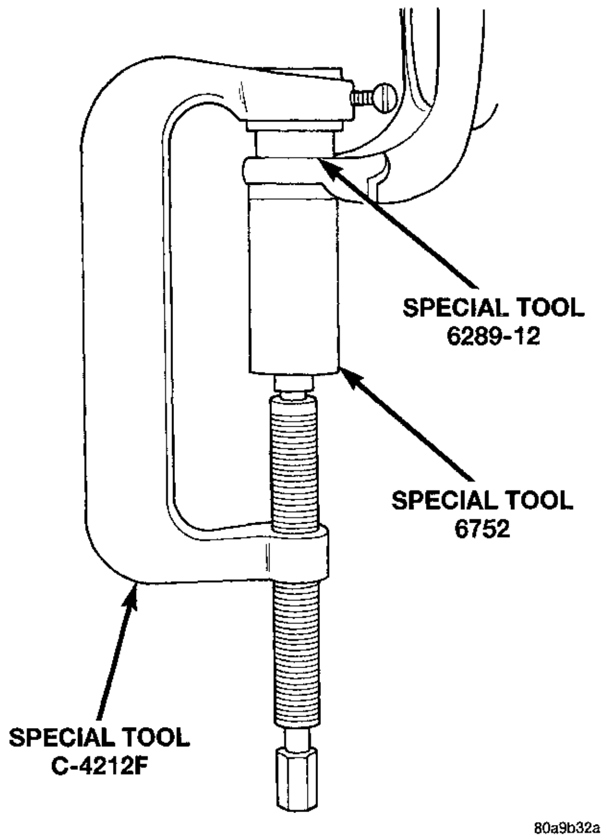

Fig. 24 Lower Ball Stud Install

BALL STUDS—248 FBI AXLE

REMOVAL

(1) Position tools as shown to remove upper ball stud (Fig. 25).

(2) Position tools as shown to remove lower ball stud (Fig. 26).

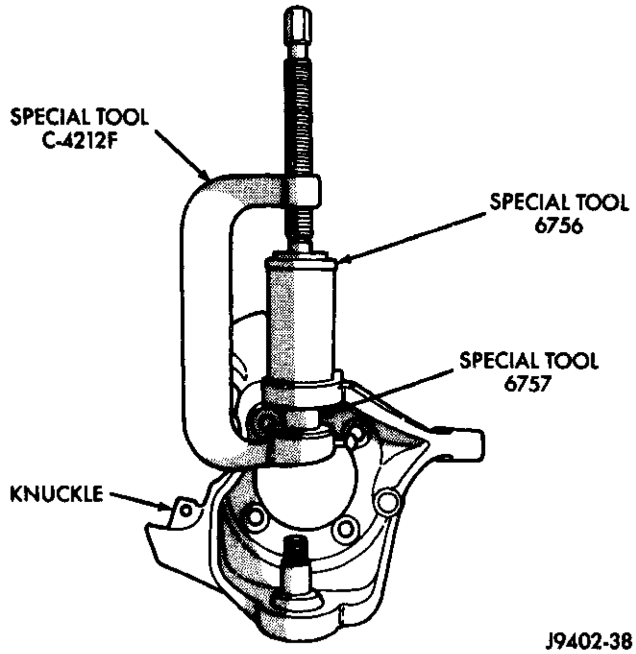

Fig. 25 Upper Ball Stud Remove

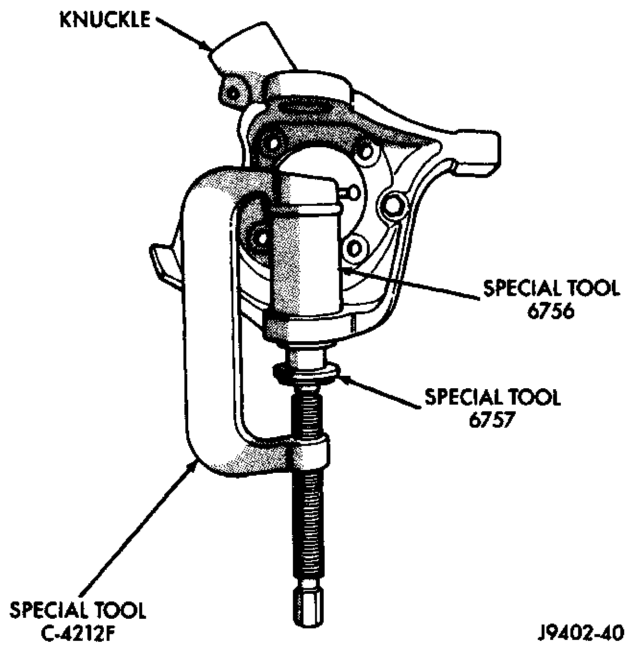

Fig. 26 Lower Ball Stud Remove

REMOVAL AND INSTALLATION (Continued)

INSTALLATION

(1) Position tools as shown to install upper ball stud (Fig. 27).

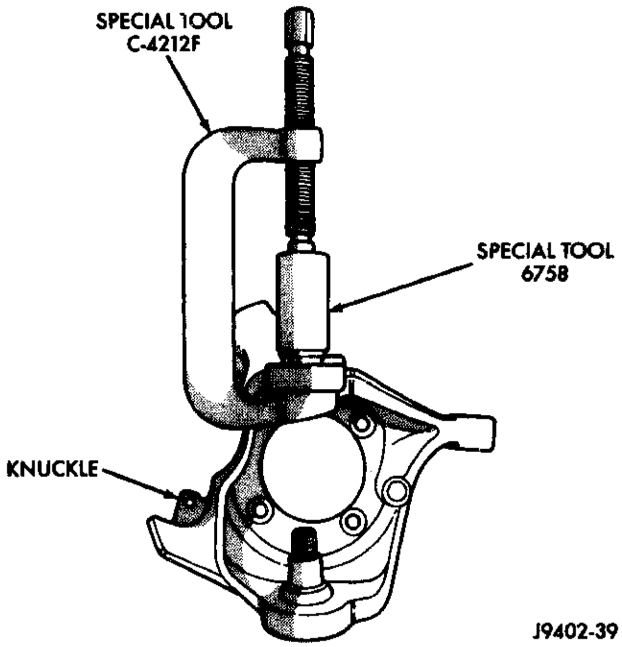

Fig. 27 Upper Ball Stud Install

(2) Position tools as shown to install lower ball stud (Fig. 28).

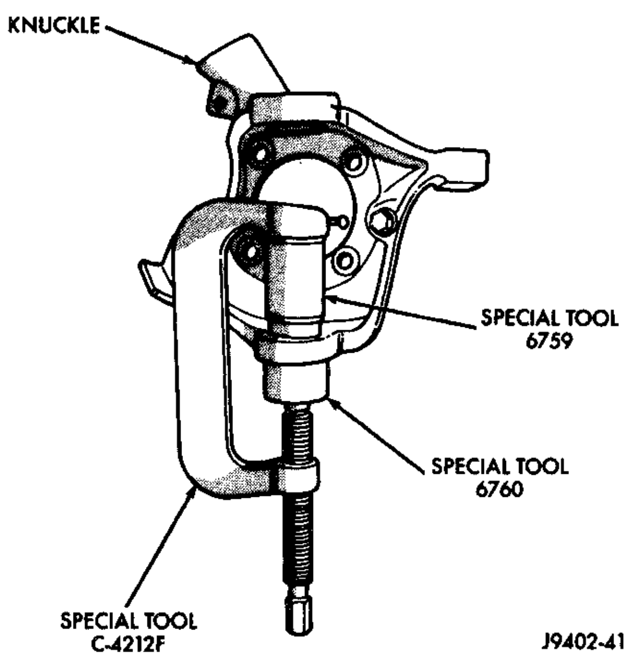

Fig. 28 Lower Ball Stud Install

DIFFERENTIAL

REMOVAL

(1) Remove axle shafts.

(2) Note the orientation of the installation reference letters stamped on the bearing caps and housing machined sealing surface (Fig. 29).

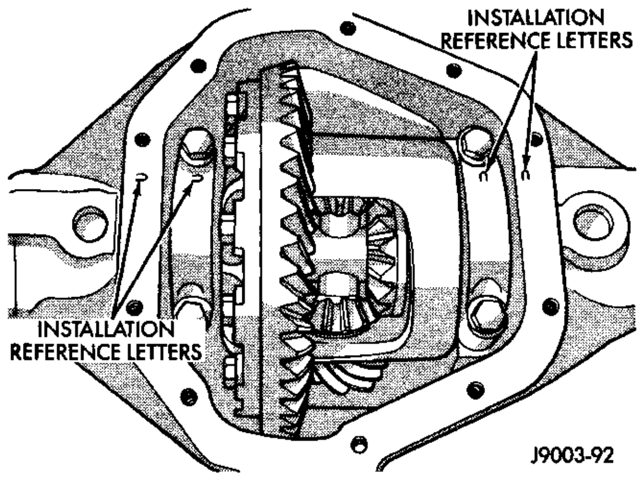

Fig. 29 Bearing Cap Identification

(3) Remove the differential bearing caps.

(4) Position Spreader W–129–B with the tool dowel pins seated in the locating holes (Fig. 30).

(5) Install the hold down clamps and tighten the tool turnbuckle finger–tight.

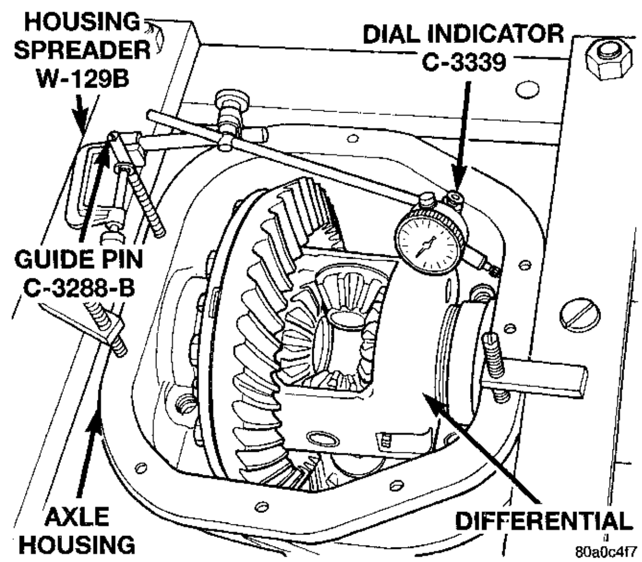

Fig. 30 Spread Differential Housing

(6) Install a Guide Pin C-3288-B at the left side of the differential housing. Attach dial indicator to housing pilot stud. Load the indicator plunger against the opposite side of the housing (Fig. 30) and zero the indicator.

(7) Spread the housing enough to remove the case from the housing. Measure the distance with the dial indicator (Fig. 30).

REMOVAL AND INSTALLATION (Continued)

CAUTION: Do not spread over 0.50 mm (0.020 in). If the housing is over-spread, it could be distorted or damaged.

(8) Remove the dial indicator.
(9) Pry the differential case loose from the housing. To prevent damage, pivot on housing with the end of the pry bar against spreader (Fig. 31).

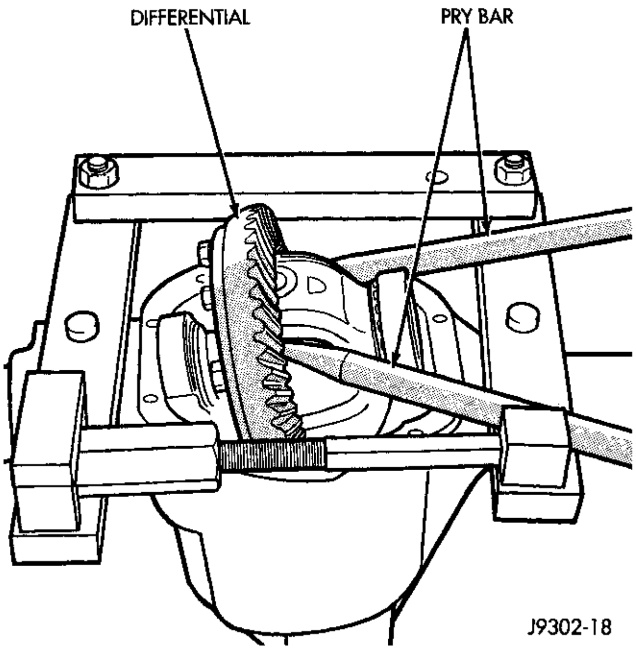

Fig. 31 Differential Removal

(10) Remove the case from housing. Mark or tag bearing cups to indicate which side they were removed from.

INSTALLATION

(1) Position Spreader W–129–B with the tool dowel pins seated in the locating holes (Fig. 30). Install the hold down clamps and tighten the tool turnbuckle finger–tight.
(2) Install a Guide Pin C-3288-B at the left side of the differential housing. Attach dial indicator to housing pilot stud. Load the indicator plunger against the opposite side of the housing (Fig. 30) and zero the indicator.
(3) Spread the housing enough to install the case in the housing. Measure the distance with the dial indicator (Fig. 30).

CAUTION: Do not spread over 0.50 mm (0.020 in). If the housing is over-spread, it could be distorted or damaged.

(4) Remove the dial indicator.
(5) Install differential in housing.
(6) Install case in the housing. Tap the differential case with a rawhide or rubber mallet to ensure the bearings are fully seated in the differential housing (Fig. 32).
(7) Remove the spreader.

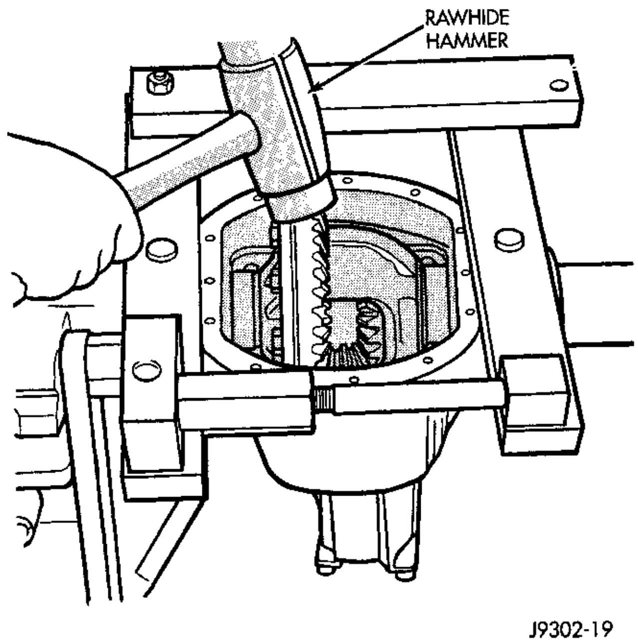

Fig. 32 Differential Installation

(8) Install the bearing caps at their original locations (Fig. 33). Tighten the bearing cap bolts to 109 N·m (80 ft. lbs.) torque.
(9) Install axle shafts.

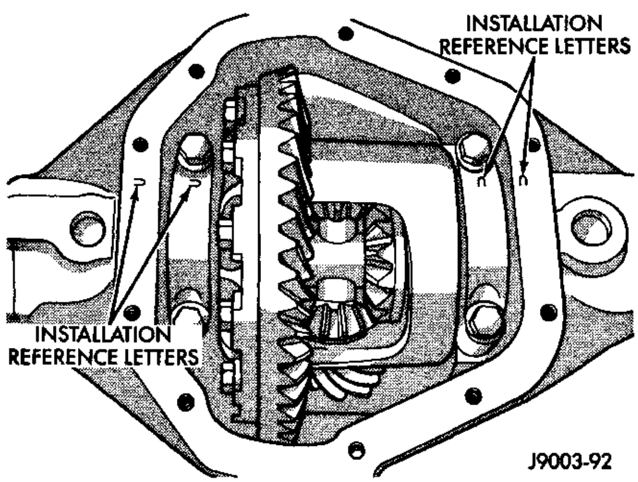

Fig. 33 Differential Bearing Cap Reference Letters

DIFFERENTIAL SIDE BEARINGS—216 FBI AXLE

REMOVAL

(1) Remove differential case from axle housing.

REMOVAL AND INSTALLATION (Continued)

(2) Remove the bearings from the differential case with Puller/Press C-293-PA, Adapters C-293-18, and Adapter C-293-3 (Fig. 34).

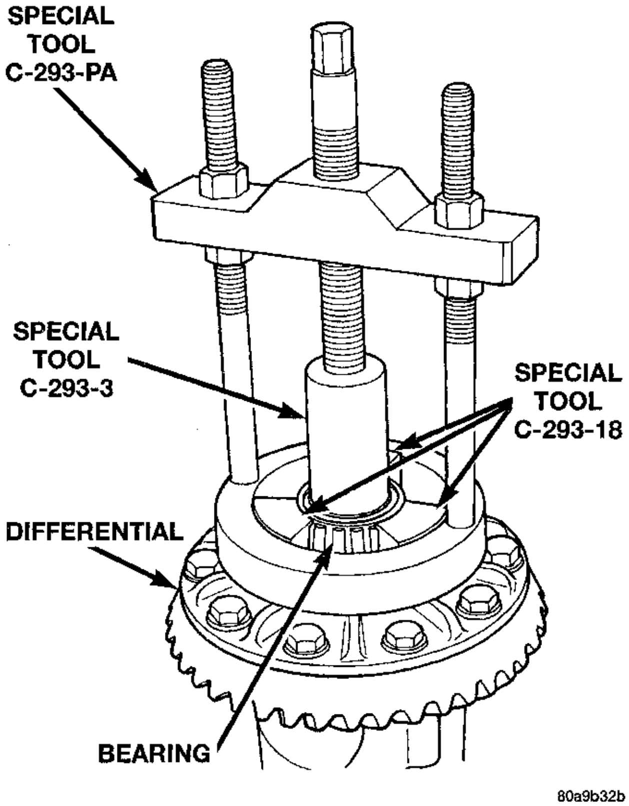

Fig. 34 Differential Bearing Removal

(3) Remove differential preload shims from differential case hubs. Tag the shims to identify which side of the differential they came from.

INSTALLATION

If ring and pinion gears have been replaced, verify differential side bearing preload and gear mesh backlash.

(1) Install differential preload shims on differential case hubs.

(2) Using tool D-156 with handle C-4171, install differential side bearings (Fig. 35).

(3) Install differential in axle housing.

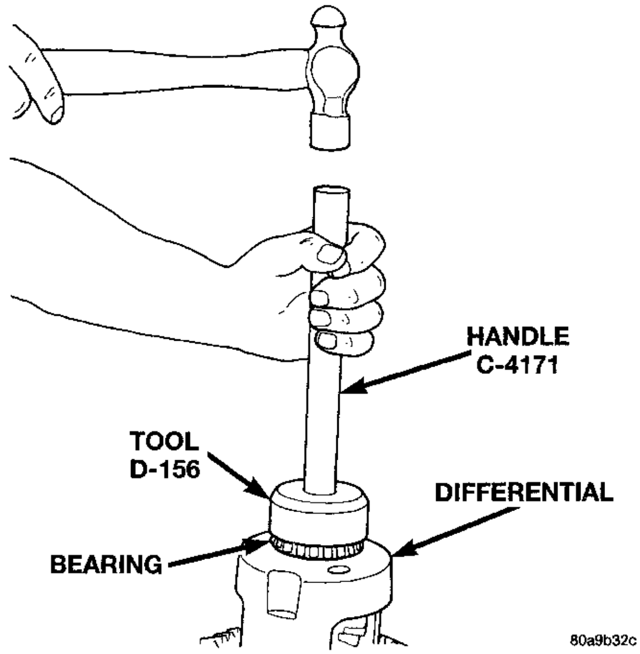

Fig. 35 Install Differential Side Bearings

DIFFERENTIAL SIDE BEARINGS—248 AXLES

REMOVAL

(1) Remove differential case from axle housing.

(2) Remove the bearings from the differential case with Puller/Press C-293-PA, Adapters C-293-62, and Step Plate C-4487-1 (Fig. 36).

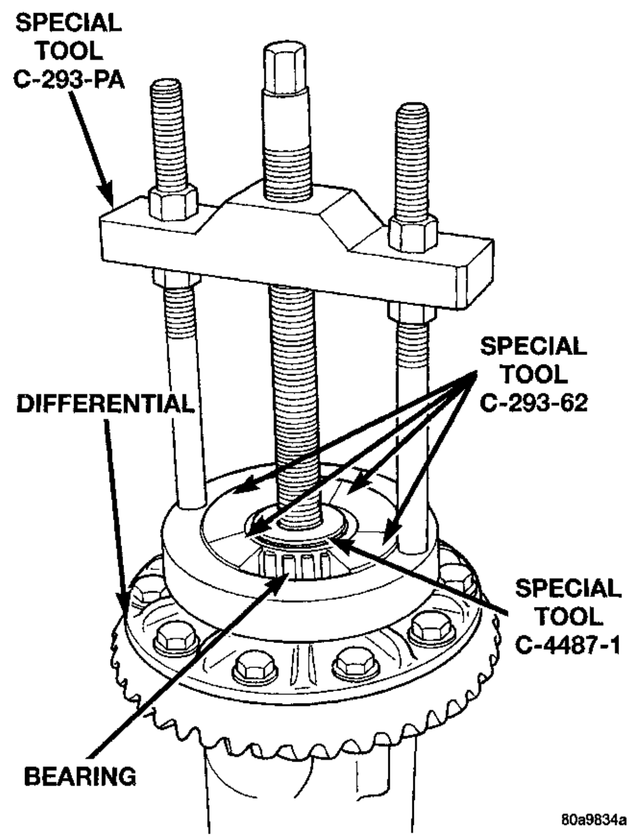

Fig. 36 Differential Bearing Removal

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REMOVAL AND INSTALLATION (Continued)

INSTALLATION

(1) Using tool C-4190 with handle C-4171, install differential side bearings (Fig. 37).

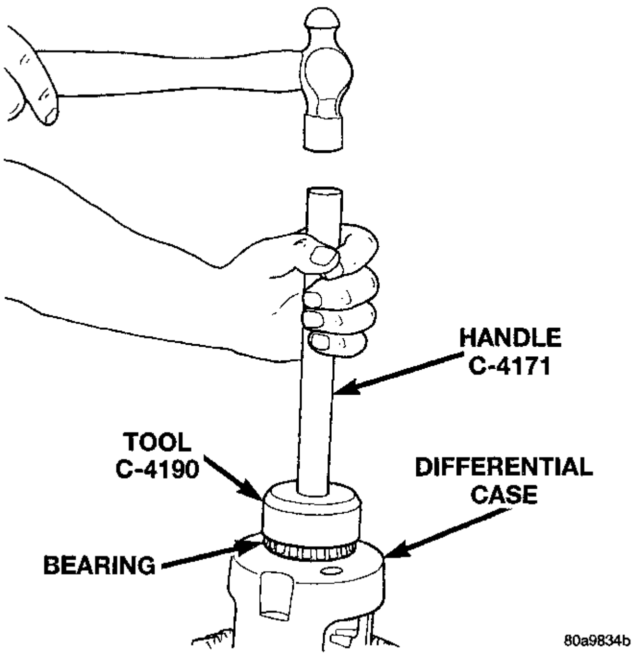

Fig. 37 Install Differential Side Bearings

(2) Install differential case in axle housing.

AXLE SHAFT OIL SEAL

REMOVAL

(1) Remove the axle shaft seal from the differential housing with a long drift or punch. **Be careful not to damage housing.**

(2) Clean the inside perimeter of the differential housing with fine crocus cloth.

INSTALLATION

(1) Apply a light film of oil to the inside lip of the new axle shaft seal.

(2) Install the inner axle seal (Fig. 38). It may be necessary to substitute Installer C-3716-A for Installer C-3972-A on 216 FBI axles.

INTERMEDIATE AXLE SHAFT

REMOVAL

(1) Remove the vacuum shift motor housing.

(2) Remove the outer axle shaft.

(3) Remove the inner axle shaft seal from the shift motor housing with a long drift or punch. Be careful not to damage housing.

(4) Remove intermediate axle shaft and shift collar.

(5) Remove the intermediate axle shaft bearing (Fig. 39).

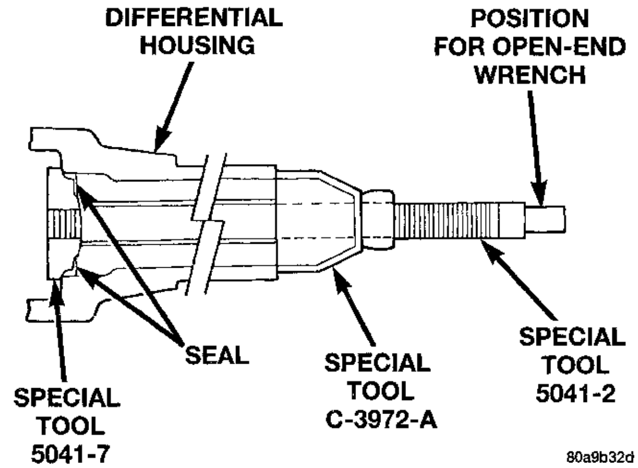

Fig. 38 Axle Seal Installation

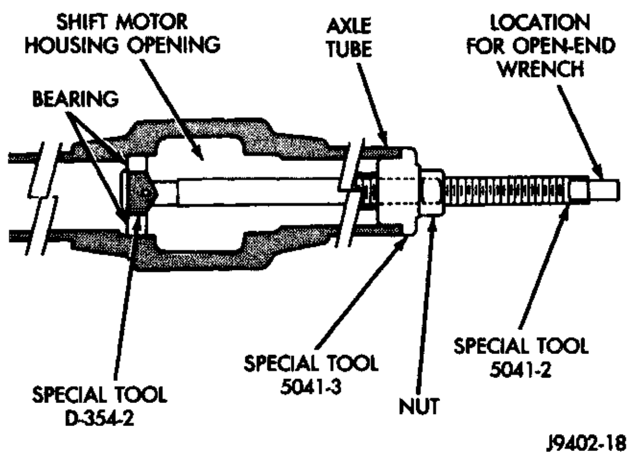

Fig. 39 Intermediate Shaft Bearing Removal

INSTALLATION

(1) Position the bearing on installation tool. Seat the bearing in the housing bore (Fig. 40).

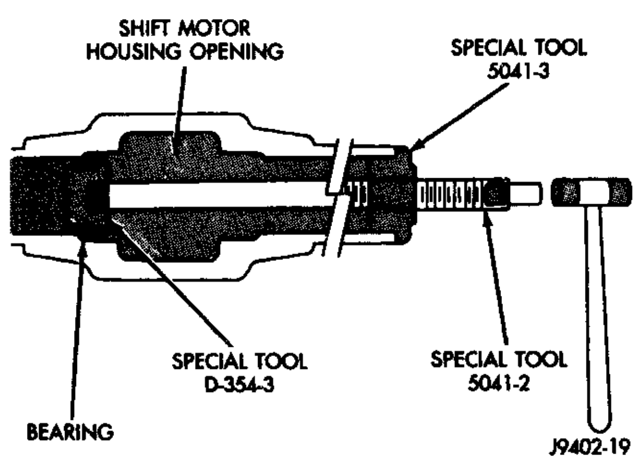

Fig. 40 Intermediate Shaft Bearing Installation

REMOVAL AND INSTALLATION (Continued)

(2) Clean the inside perimeter of the axle shaft tube with fine crocus cloth.

(3) Apply a light film of oil to the inside lip of the new axle shaft seal.

(4) Install the inner axle seal (Fig. 41) or (Fig. 42). **The inner axle seal position is different on a 216 FBI axle then a 248 FBI axle. Be sure to use the correct installer.**

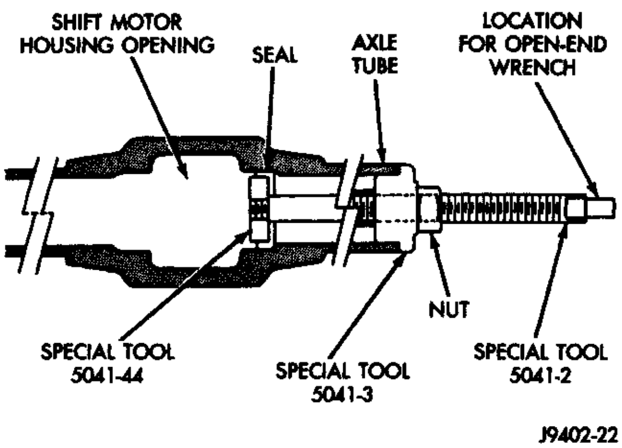

Fig. 41 Inner Axle Seal Installation—216 FBI Axle

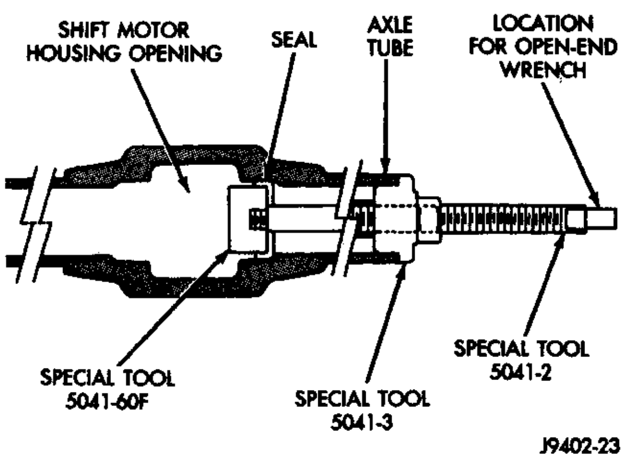

Fig. 42 Inner Axle Seal Installation—248 FBI Axle

(5) Install the shift collar in the axle housing.

(6) Lubricate the splined end of the intermediate axle shaft with multi-purpose lubricant.

(7) Insert the intermediate axle shaft into the differential side gear.

CAUTION: Apply all–purpose lubricant to the axle shaft splines to prevent damage to the seal during axle shaft installation.

(8) Insert the axle shaft into the tube. Engage the splined end of the shaft with the shift collar.

(9) Install the vacuum shift motor housing.

RING GEAR

The ring and pinion gears are service in a matched set. Do not replace the ring gear without replacing the pinion gear.

REMOVAL

(1) Remove differential from axle housing.

(2) Place differential case in a suitable vise with soft metal jaw protectors. (Fig. 43)

(3) Remove bolts holding ring gear to differential case.

(4) Using a soft hammer, drive ring gear from differential case (Fig. 43).

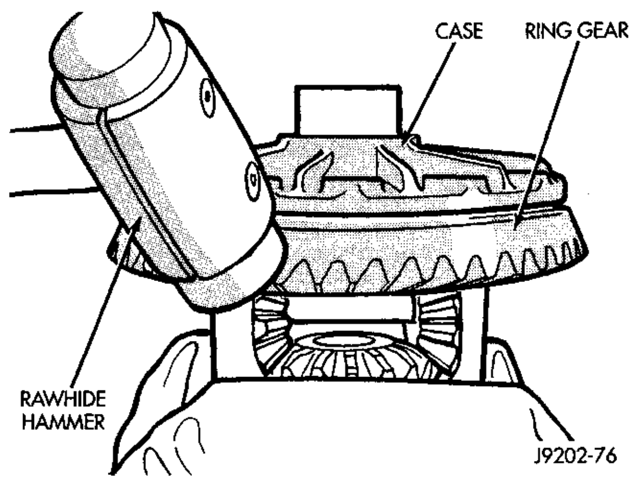

Fig. 43 Ring Gear Removal

INSTALLATION

CAUTION: Do not reuse the bolts that held the ring gear to the differential case. The bolts can fracture causing extensive damage.

(1) Invert the differential case and start two ring gear bolts. This will provide case-to-ring gear bolt hole alignment.

(2) Install new ring gear bolts and alternately tighten to 95–122 N·m (70–90 ft. lbs.) torque for 216 FBI axles and 163–190 N·m (120–140 ft. lbs.) for 248 FBI axles (Fig. 44).

(3) Install differential in axle housing and verify gear mesh and contact pattern.

PINION GEAR

NOTE: The ring and pinion gears are serviced in a matched set. Do not replace the pinion gear without replacing the ring gear.

REMOVAL

(1) Remove differential assembly from axle housing.

REMOVAL AND INSTALLATION (Continued)

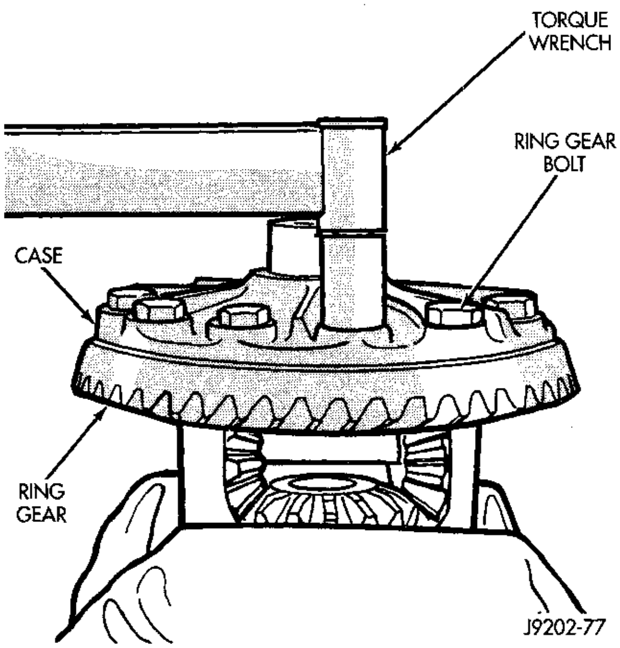

Fig. 44 Ring Gear Bolt Installation

(2) Mark the pinion yoke and propeller shaft for installation alignment.

(3) Disconnect propeller shaft from pinion yoke. Using suitable wire, tie propeller shaft to underbody.

(4) Using Yoke Holder 6719 to hold yoke, remove the pinion yoke nut and washer.

(5) Using Remover C–452 and Wrench C–3281, remove the pinion yoke from the pinion shaft (Fig. 45).

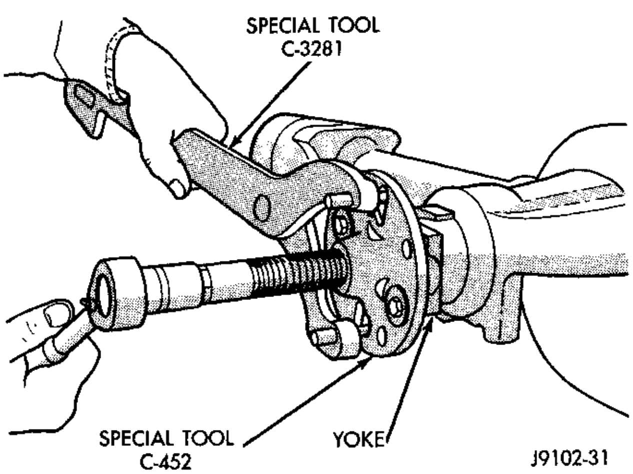

Fig. 45 Pinion Yoke Removal

(6) Remove the pinion gear from housing (Fig. 46). Catch the pinion with your hand to prevent it from falling and being damaged.

(7) Remove the pinion gear seal with a slide hammer or suitable pry bar.

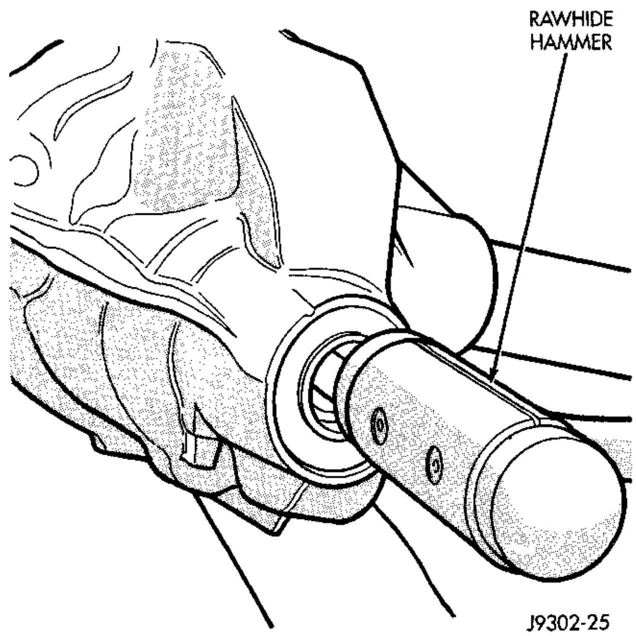

Fig. 46 Remove Pinion Gear

(8) Remove oil slinger, if equipped, and the front pinion bearing.

(9) Remove the front pinion bearing cup and seal with Remover D-147 for 216 FBI axles, or D-158 for 248 FBI axles, and Handle C–4171 (Fig. 47).

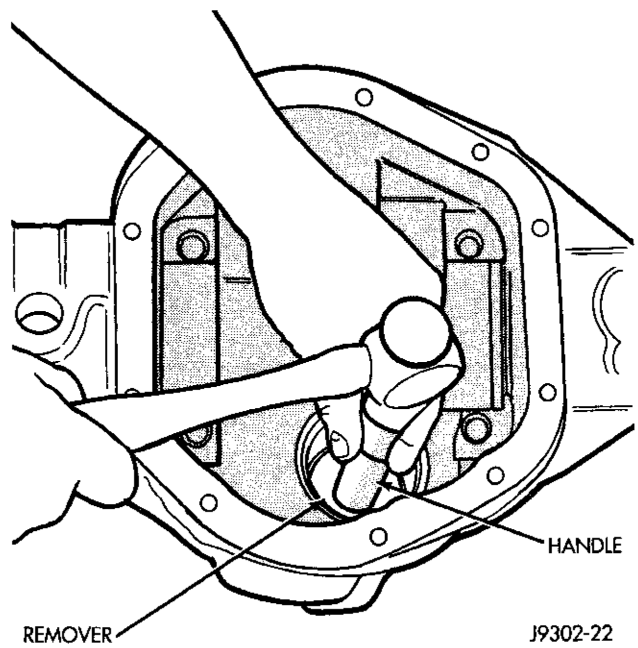

Fig. 47 Front Bearing Cup Removal

(10) Remove the rear bearing cup from housing (Fig. 48). Use Remover D-149 for 216 FBI axles, or D-162 for 248 FBI axles, and Handle C–4171.

(11) Remove the collapsible preload spacer (Fig. 49).

REMOVAL AND INSTALLATION (Continued)

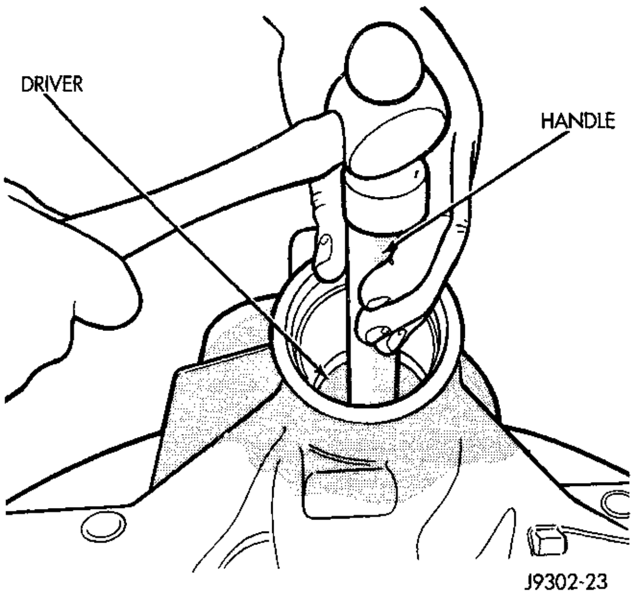

Fig. 48 Rear Bearing Cup Removal

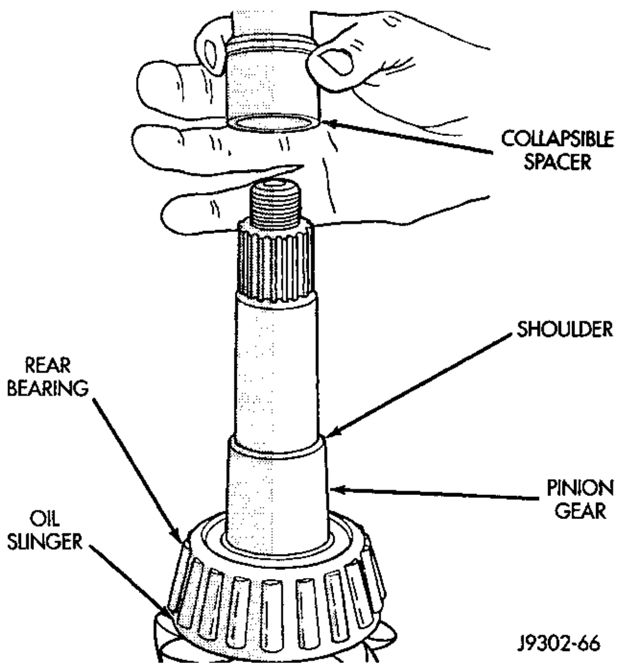

Fig. 49 Collapsible Spacer

(12) Remove the rear pinion bearing from the pinion with Puller/Press C-293-PA and Adapters C-293-40 for 216 FBI axles, or C-293-37 for 248 FBI axles (Fig. 50).

Place 4 adapter blocks so they do not damage the bearing cage.

(13) Remove the depth shims from the pinion gear shaft. Record the thickness of the depth shims.

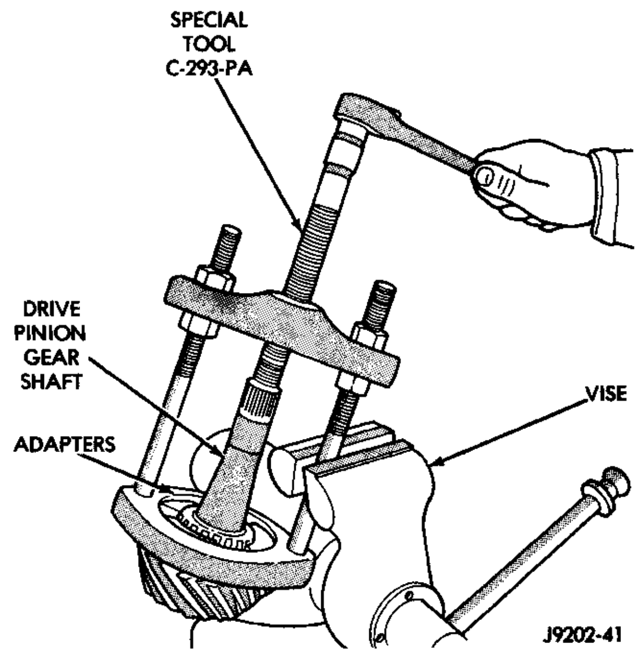

Fig. 50 Rear Bearing Removal

INSTALLATION

(1) Apply Mopar® Door Ease stick lubricant to outside surface of bearing cups.

(2) Install the pinion rear bearing cup with Installer D-146 for 216 FBI axles, or D-111 for 248 FBI axles, and Handle C-4171 (Fig. 51). Ensure cup is correctly seated.

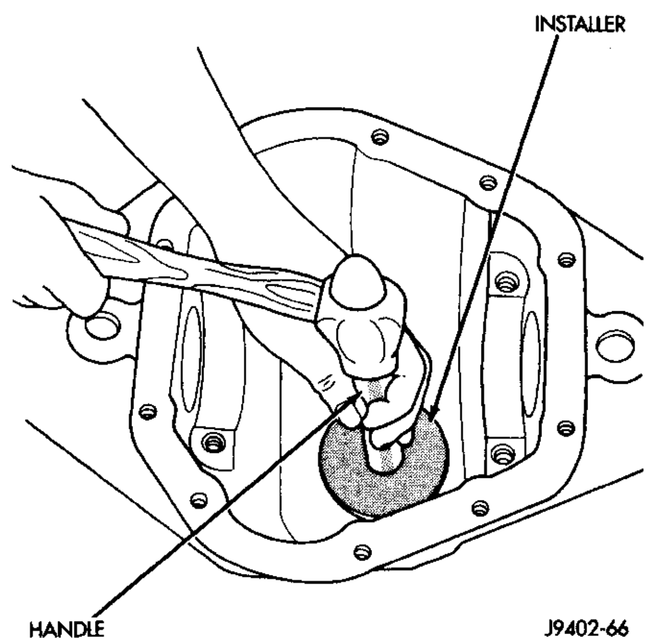

Fig. 51 Pinion Rear Bearing Cup Installation

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REMOVAL AND INSTALLATION (Continued)

(3) Install the pinion front bearing cup with Installer D-144 for 216 FBI axles, or D-146 for 248 FBI axles, and Handle C–4171 (Fig. 52).

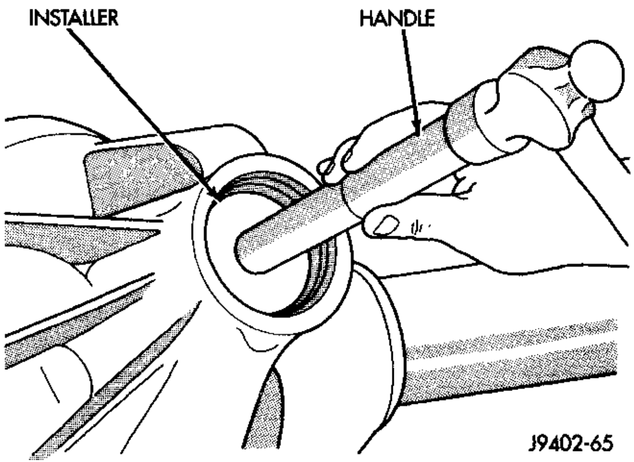

Fig. 52 Pinion Front Bearing Cup Installation

(4) Install pinion front bearing, oil slinger. Apply a light coating of gear lubricant on the lip of pinion seal.

(5) Install pinion seal with Installer C-3972-A for 216 FBI axles (Fig. 53), or 8108 for 248 FBI axles (Fig. 54), and Handle C-4171.

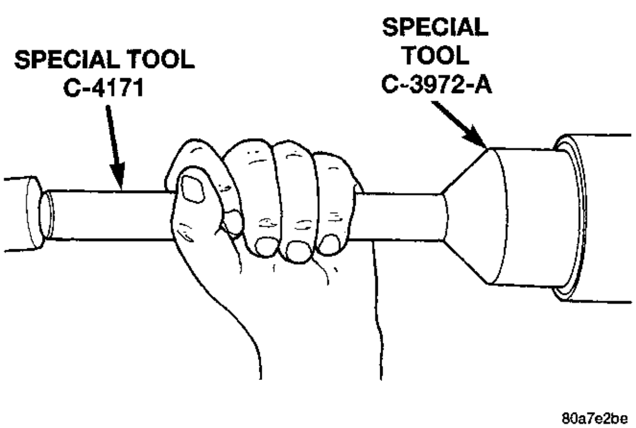

Fig. 53 Pinion Seal Installation—216 FBI Axle

NOTE: Pinion depth shims are placed between the rear pinion bearing cone and pinion gear to achieve proper ring and pinion gear mesh. If the factory installed ring and pinion gears are reused, the pinion depth shim should not require replacement. Refer to Pinion Gear Depth paragraph in this section to select the proper thickness shim before installing rear pinion bearing cone.

(6) Place the proper thickness depth shim on the pinion gear and install the rear bearing.

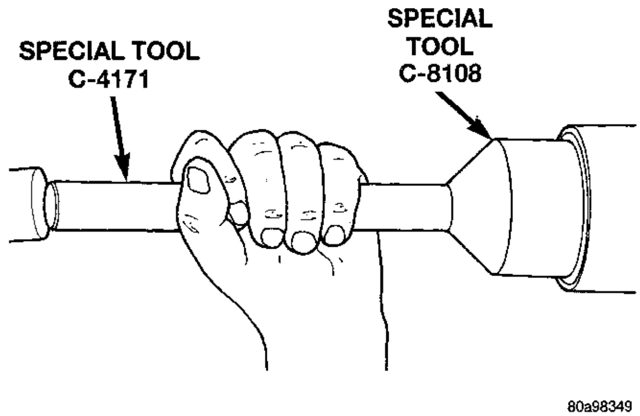

Fig. 54 Pinion Seal Installation—248 FBI Axle

(7) Install the rear bearing and oil slinger, if equipped, on the pinion gear with Installer W-262 for 216 FBI axles, or C-3095-A for 248 FBI axles, (Fig. 55).

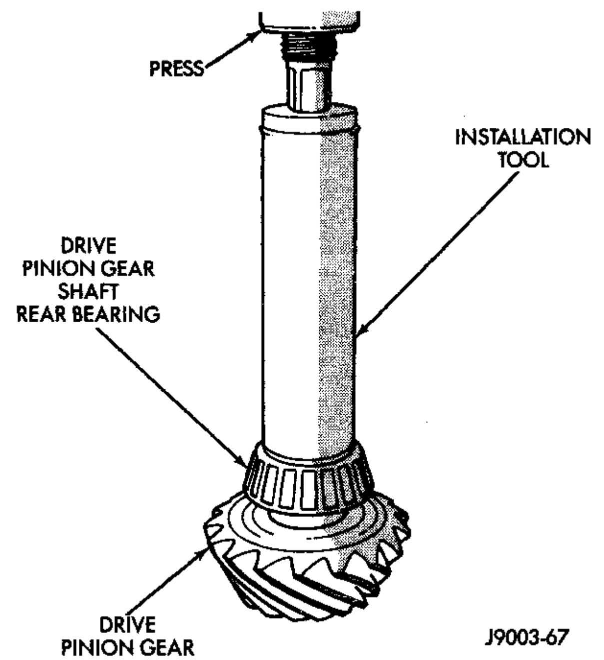

Fig. 55 Shaft Rear Bearing Installation

(8) Install a new collapsible preload spacer on pinion shaft (Fig. 56).

(9) Install pinion gear in housing.

(10) Install yoke with Installer W-162-D for 216 FBI axles, or C-3718 for 248 FBI axles, and Yoke Holder 6719 (Fig. 57).

(11) Install the yoke washer and a new nut on the pinion gear. Tighten the nut to 217 N·m (160 ft. lbs.) for 216 FBI axles, or 291 N·m (215 ft. lbs.) for 248 FBI axles, minimum. **Do not over–tighten.** Maxi-

REMOVAL AND INSTALLATION (Continued)

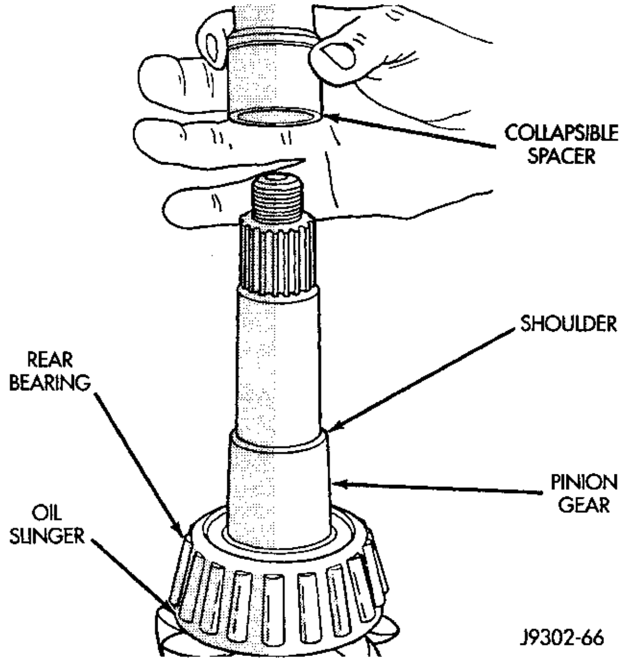

Fig. 56 Collapsible Preload Spacer

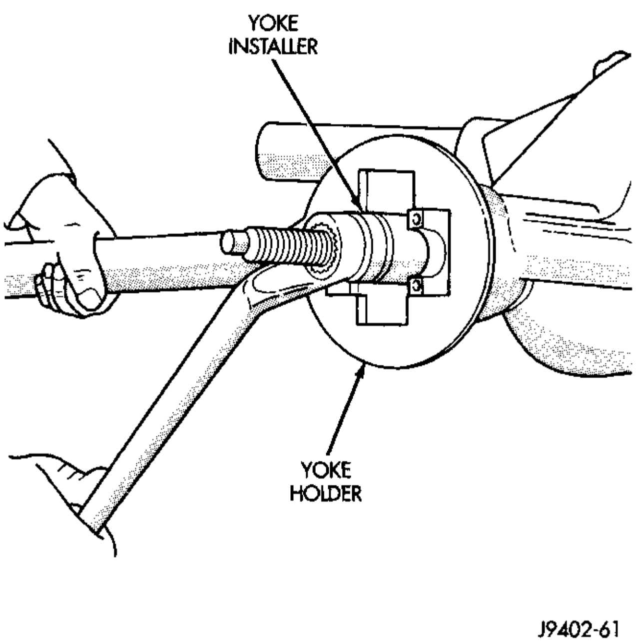

Fig. 57 Pinion Yoke Installation

mum torque is 271 N·m (200 ft. lbs.) for 216 FBI axles and 380 N·m (280 ft. lbs.) for 248 FBI axles.

CAUTION: Never loosen pinion gear nut to decrease pinion gear bearing preload torque and never exceed specified preload torque. If preload torque is exceeded a new collapsible spacer must be installed. The torque sequence will have to be repeated.

(12) Use Yoke Holder 6719 to retain the yoke (Fig. 58). Tighten the nut in 6.8 N·m (5 ft. lbs.) until the rotating torque is achieved. Measure the preload torque frequently to avoid over-tightening the nut.

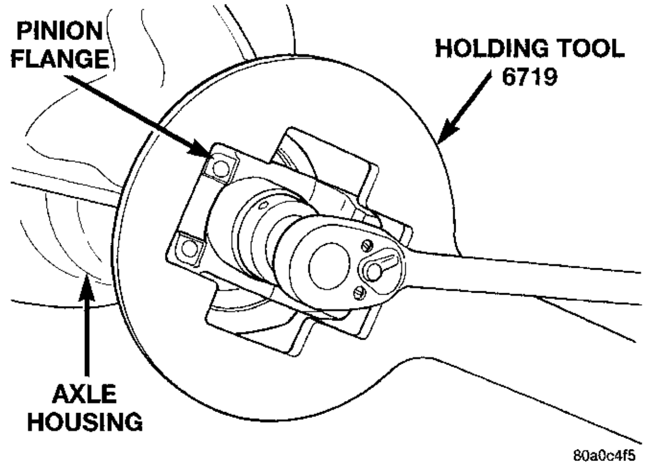

Fig. 58 Tightening Pinion Nut

(13) Check bearing preload torque with an inch pound torque wrench (Fig. 59). The torque necessary to rotate the pinion gear should be:

- Original Bearings — 1 to 3 N·m (10 to 20 in. lbs.).
- New Bearings — 2 to 5 N·m (15 to 35 in. lbs.).

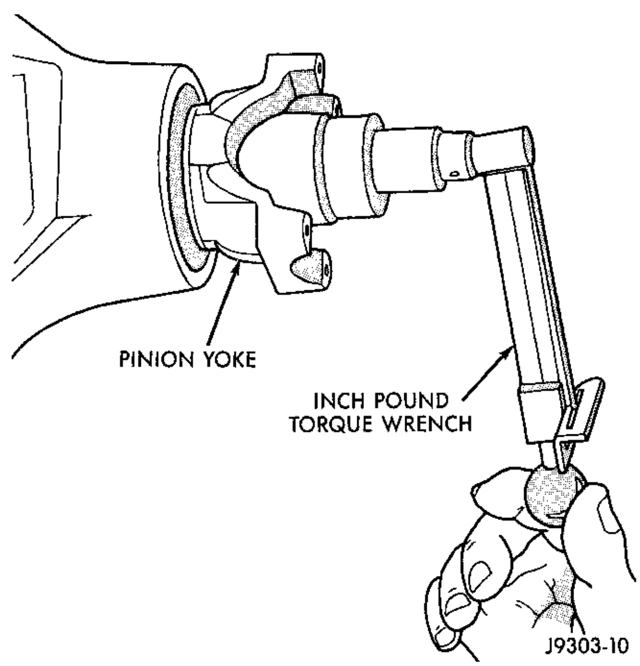

Fig. 59 Check Pinion Gear Rotation Torque

FINAL ASSEMBLY

After pinion gear depth, differential bearing preload, and gear lash has been determined, install the pinion gear and differential assembly and proceed with this procedure.

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REMOVAL AND INSTALLATION (Continued)

(1) Install the axle shafts. Refer to Axle Shaft Installation within this group.

(2) Scrape the residual sealant from the housing and cover mating surfaces. Clean the mating surfaces with mineral spirits. Apply a bead of Mopar Silicone Rubber Sealant on the housing cover (Fig. 60). Allow the sealant to cure for a few minutes.

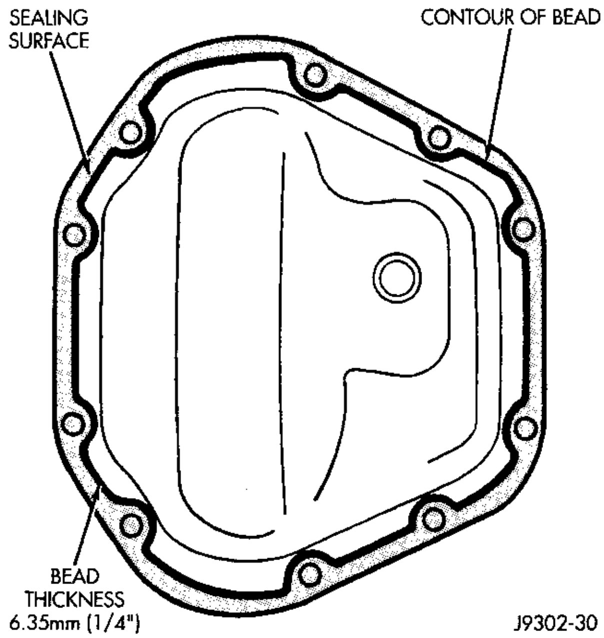

Fig. 60 Typical Housing Cover With Sealant

Install the housing cover within 5 minutes after applying the sealant.

(3) Install the cover on the differential with the attaching bolts. Install the identification tag. Tighten the cover bolts to 41 N·m (30 ft. lbs.) torque.

CAUTION: Overfilling the differential can result in lubricant foaming and overheating.

(4) Refill the differential housing with the specified quantity of Mopar Hypoid Gear Lubricant.

(5) Install the fill hole plug and tighten to 34 N·m (25 ft. lbs.) torque.

DISASSEMBLY AND ASSEMBLY

AXLE SHIFT MOTOR

DISASSEMBLY

(1) Remove the E-clips from the shift motor housing and shaft. Remove shift motor and shift fork from the housing (Fig. 61).

(2) Remove the O-ring seal from the shift motor shaft.

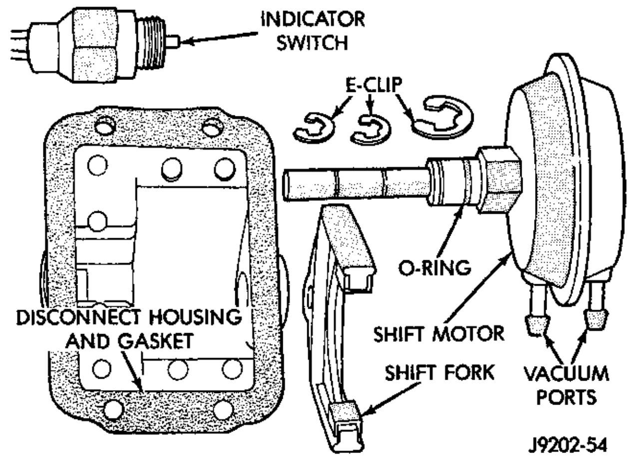

Fig. 61 Shift Motor Components

(3) Clean and inspect all components. If any component is excessively worn or damaged, it should be replaced.

ASSEMBLY

(1) Install a new O-ring seal on the shift motor shaft.

(2) Insert the shift motor shaft through the hole in the housing and shift fork. The shift fork offset should be toward the differential.

(3) Install the E-clips on the shift motor shaft and housing.

STANDARD DIFFERENTIAL

DISASSEMBLY

(1) Remove roll-pin holding mate shaft in housing.

(2) Remove pinion gear mate shaft (Fig. 62).

(3) Rotate the differential side gears and remove the pinion mate gears and thrust washers (Fig. 63).

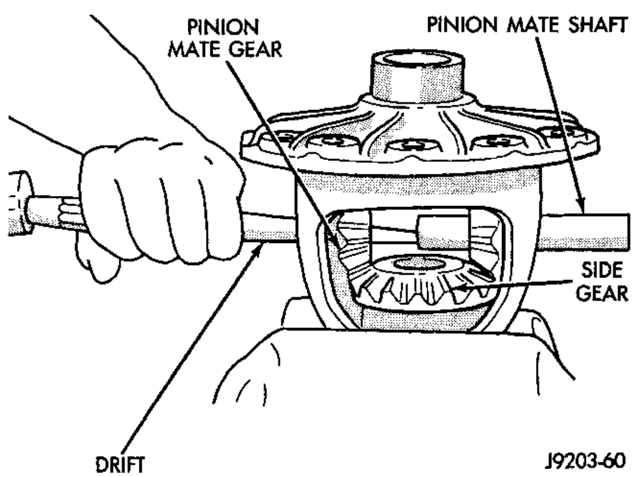

Fig. 62 Pinion Mate Shaft Removal

DISASSEMBLY AND ASSEMBLY (Continued)

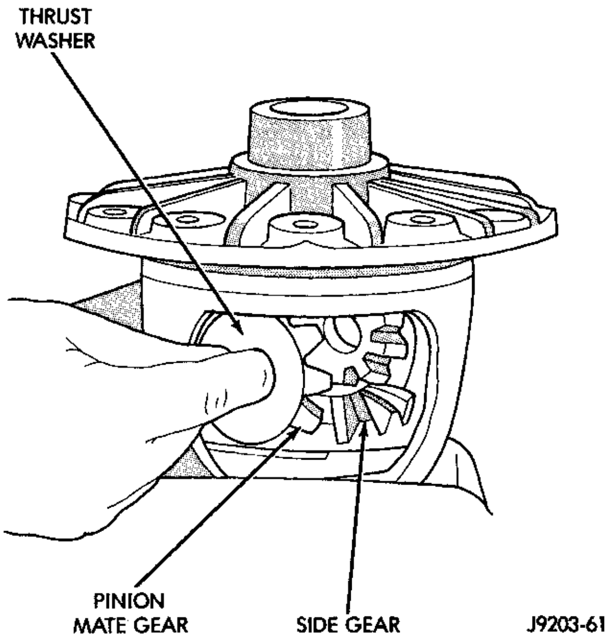

Fig. 63 Pinion Mate Gear Removal

(4) Remove the differential side gears and thrust washers.

ASSEMBLY

(1) Install the differential side gears and thrust washers.

(2) Install the pinion mate gears and thrust washers.

(3) Install the pinion gear mate shaft.

(4) Align the hole in the pinion gear mate shaft with the hole in the differential case.

(5) Install and seat the pinion mate shaft roll-pin in the differential case and mate shaft with a punch and hammer (Fig. 64). Peen the edge of the roll-pin hole in the differential case slightly in two places, 180° apart.

(6) Lubricate all differential components with hypoid gear lubricant.

CLEANING AND INSPECTION

CARDAN U-JOINT

Clean all the U–joint yoke bores with cleaning solvent and a wire brush. Ensure that all the rust and foreign matter are removed from the bores.

Inspect the yokes for distortion, cracks and worn bearing cap bores.

Replace the complete U–joint if any of the components are defective.

AXLE COMPONENTS

Wash differential components with cleaning solvent and dry with compressed air. **Do not steam clean the differential components.**

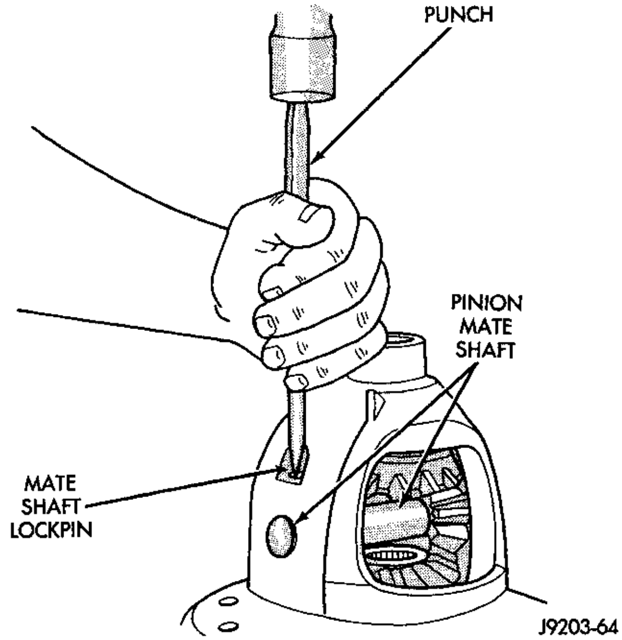

Fig. 64 Pinion Mate Shaft Roll-Pin Installation

Wash bearings with solvent and towel dry, or dry with compressed air. DO NOT spin bearings with compressed air. **Cup and bearing must be replaced as matched sets only.**

Clean axle shaft tubes and oil channels in housing.

Inspect for;

- Smooth appearance with no broken/dented surfaces on the bearing rollers or the roller contact surfaces.
- Bearing cups must not be distorted or cracked.
- Machined surfaces should be smooth and without any raised edges.
- Raised metal on shoulders of cup bores should be removed with a hand stone.
- Wear and damage to pinion gear mate shaft, pinion gears, side gears and thrust washers. Replace as a matched set only.
- Ring and pinion gear for worn and chipped teeth.
- Ring gear for damaged bolt threads. Replaced as a matched set only.
- Pinion yoke for cracks, worn splines, pitted areas, and a rough/corroded seal contact surface. Repair or replace as necessary.
- Preload shims for damage and distortion. Install new shims, if necessary.

ADJUSTMENTS

PINION GEAR DEPTH

GENERAL INFORMATION

Ring and pinion gears are supplied as matched sets only. The identifying numbers for the ring and

ADJUSTMENTS (Continued)

pinion gear are etched into the face of each gear (Fig. 65). A plus (+) number, minus (–) number or zero (0) is etched into the face of the pinion gear. This number is the amount (in thousandths of an inch) the depth varies from the standard depth setting of a pinion etched with a (0). The standard setting from the center line of the ring gear to the back face of the pinion is 109.5 mm (4.312 inches) for 216 FBI axles and 127 mm (5.00 in.) for 248 FBI axles. The standard depth provides the best teeth contact pattern. Refer to Backlash and Contact Pattern Analysis Paragraph in this section for additional information.

Compensation for pinion depth variance is achieved with select shims. The shims are placed under the inner pinion bearing cone (Fig. 66).

If a new gear set is being installed, note the depth variance etched into both the original and replacement pinion gear. Add or subtract the thickness of the original depth shims to compensate for the difference in the depth variances. Refer to the Depth Variance charts.

Note where Old and New Pinion Marking columns intersect. Intersecting figure represents plus or minus amount needed.

Note the etched number on the face of the drive pinion gear (–1, –2, 0, +1, +2, etc.). The numbers represent thousands of an inch deviation from the standard. If the number is negative, add that value to the required thickness of the depth shim(s). If the number is positive, subtract that value from the thickness of the depth shim(s). If the number is 0 no change is necessary. Refer to the Pinion Gear Depth Variance Chart.

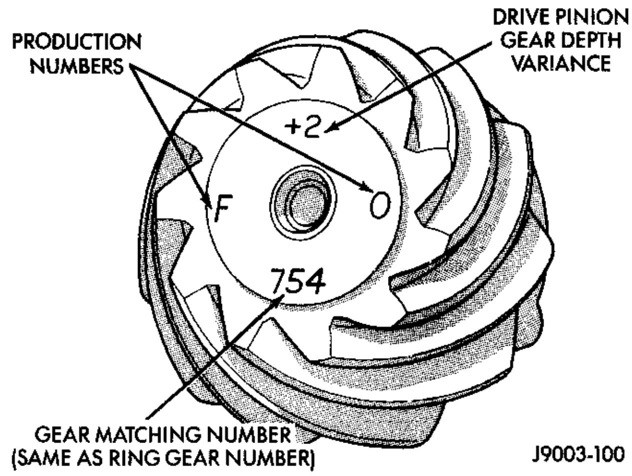

Fig. 65 Pinion Gear ID Numbers

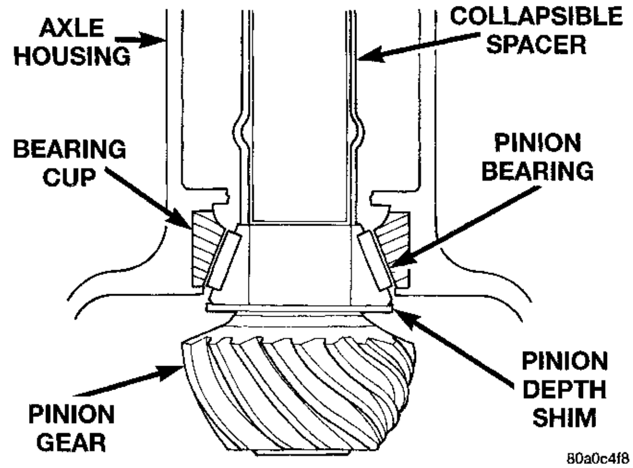

Fig. 66 Shim Locations

PINION GEAR DEPTH VARIANCE

Original Pinion Gear Depth Variance	Replacement Pinion Gear Depth Variance								
	−4	−3	−2	−1	0	+1	+2	+3	+4
+4	+0.008	+0.007	+0.006	+0.005	+0.004	+0.003	+0.002	+0.001	0
+3	+0.007	+0.006	+0.005	+0.004	+0.003	+0.002	+0.001	0	−0.001
+2	+0.006	+0.005	+0.004	+0.003	+0.002	+0.001	0	−0.001	−0.002
+1	+0.005	+0.004	+0.003	+0.002	+0.001	0	−0.001	−0.002	−0.003
0	+0.004	+0.003	+0.002	+0.001	0	−0.001	−0.002	−0.003	−0.004
−1	+0.003	+0.002	+0.001	0	−0.001	−0.002	−0.003	−0.004	−0.005
−2	+0.002	+0.001	0	−0.001	−0.002	−0.003	−0.004	−0.005	−0.006
−3	+0.001	0	−0.001	−0.002	−0.003	−0.004	−0.005	−0.006	−0.007
−4	0	−0.001	−0.002	−0.003	−0.004	−0.005	−0.006	−0.007	−0.008

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ADJUSTMENTS (Continued)

PINION DEPTH MEASUREMENT AND ADJUSTMENT

Measurements are taken with pinion cups and pinion bearings installed in housing. Take measurements with a Pinion Gauge Set 6730 and Dial Indicator C-3339 (Fig. 67).

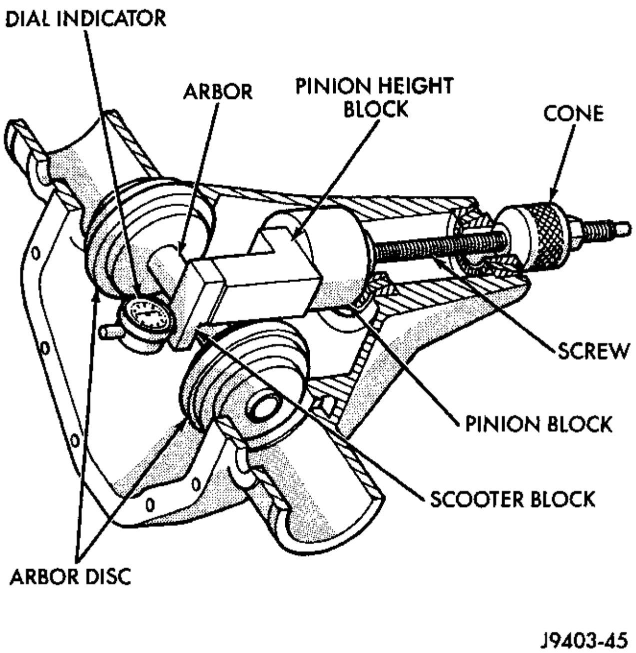

Fig. 67 Pinion Gear Depth Gauge Tools—Typical

(1) Assemble Pinion Height Block 6739, Pinion Block 6736, and rear pinion bearing onto Screw 6741 (Fig. 67) for the 248 FBI axle. For the 216 FBI axle, use Pinion Block 6734.

(2) Insert assembled height gauge components, rear bearing and screw into axle housing through pinion bearing cups (Fig. 68).

(3) Install front pinion bearing and Cone 6740 hand tight (Fig. 67).

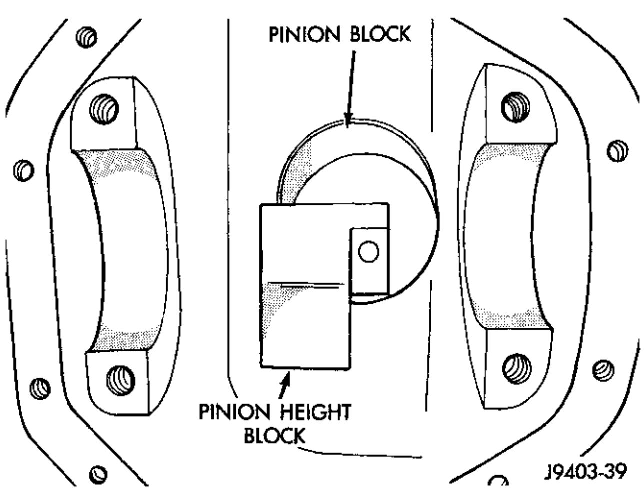

Fig. 68 Pinion Height Block—Typical

(4) Place Arbor Disc 6732 on Arbor D–115–3 and position in the bearing cradles (Fig. 69). Install differential bearing caps on Arbor Discs and tighten cap bolts. Refer to the Torque Specifications in this section.

NOTE: Arbor Discs 6732 have different step diameters to fit other axle sizes. Pick correct size step for axle being serviced.

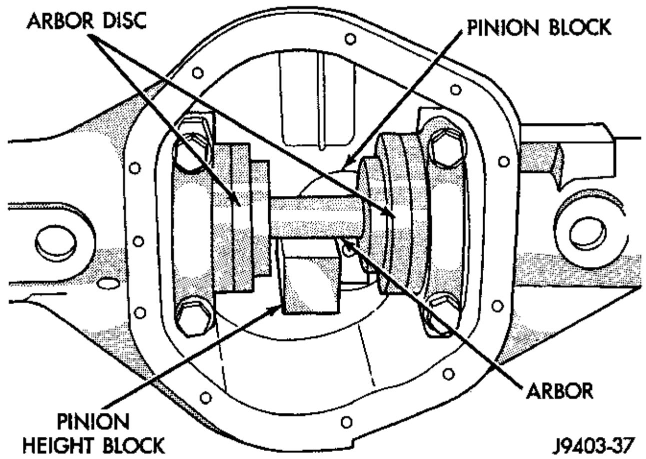

Fig. 69 Gauge Tools In Housing—Typical

(5) Assemble Dial Indicator C-3339 into Scooter Block D-115-2 and secure set screw.

(6) Place Scooter Block/Dial Indicator in position in axle housing so dial probe and scooter block are flush against the surface of the pinion height block. Hold scooter block in place and zero the dial indicator face to the pointer. Tighten dial indicator face lock screw.

(7) With scooter block still in position against the pinion height block, slowly slide the dial indicator probe over the edge of the pinion height block. Observe how many revolutions counterclockwise the dial pointer travels (approximately 0.125 in.) to the out-stop of the dial indicator.

(8) Slide the dial indicator probe across the gap between the pinion height block and the arbor bar with the scooter block against the pinion height block (Fig. 70). When the dial probe contacts the arbor bar, the dial pointer will turn clockwise. Bring dial pointer back to zero against the arbor bar, do not turn dial face. Continue moving the dial probe to the crest of the arbor bar and record the highest reading. If the dial indicator can not achieve the zero reading, the rear bearing cup or the pinion depth gauge set is not installed correctly.

(9) Select a shim equal to the dial indicator reading plus the drive pinion gear depth variance number etched in the face of the pinion gear (Fig. 65) using the opposite sign on the variance number. For exam-

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ADJUSTMENTS (Continued)

ple, if the depth variance is –2, add +0.002 in. to the dial indicator reading.

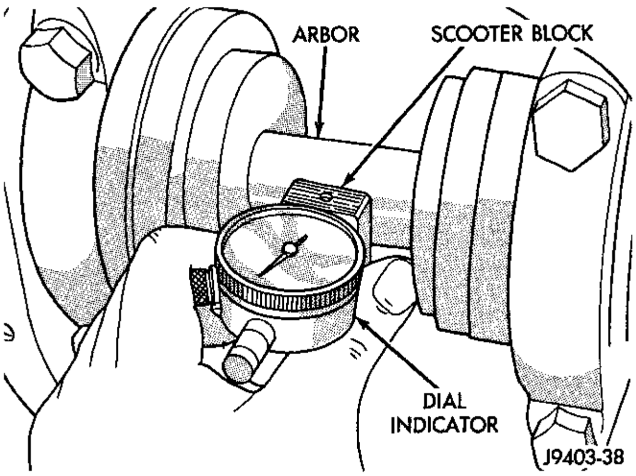

Fig. 70 Pinion Gear Depth Measurement—Typical

(10) Remove the measurement tools from the differential housing.

DIFFERENTIAL BEARING PRELOAD AND GEAR BACKLASH

INTRODUCTION

Differential side bearing preload and gear backlash is achieved by selective shims positioned behind the differential side bearing cones. The proper shim thickness can be determined using slip-fit dummy bearings D-345 for the 216 FBI axles, or D-343 for the 248 FBI axles, in place of the differential side bearings and a dial indicator C-3339. Before proceeding with the differential bearing preload and gear backlash measurements, measure the pinion gear depth and prepare the pinion gear for installation. Establishing proper pinion gear depth is essential to establishing gear backlash and tooth contact patterns. After the overall shim thickness to take up differential side play is measured, the pinion gear is installed, and the gear backlash shim thickness is measured. The overall shim thickness is the total of the dial indicator reading and the preload specification added together. The gear backlash measurement determines the thickness of the shim used on the ring gear side of the differential case. Subtract the gear backlash shim thickness from the total overall shim thickness and select that amount for the pinion gear side of the differential (Fig. 71). Differential shim measurements are performed with axle spreader W-129-B removed.

SHIM SELECTION

NOTE: It is difficult to salvage the differential side bearings during the removal procedure. Install replacement bearings if necessary.

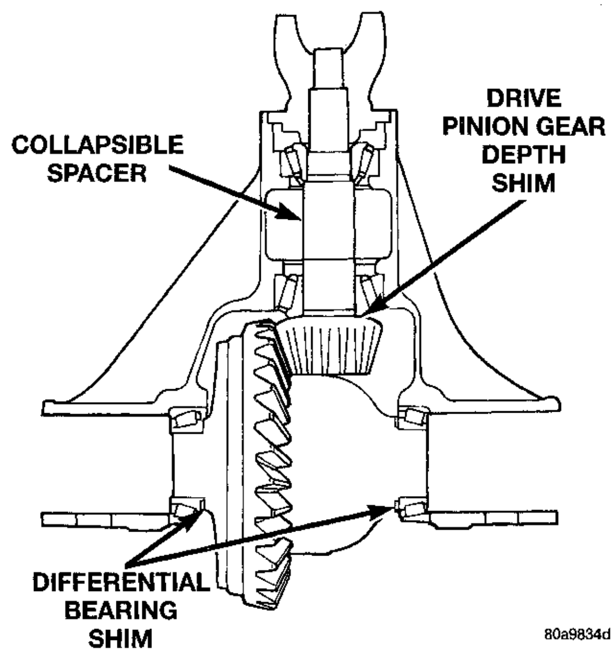

Fig. 71 Axle Adjustment Shim Locations

(1) Remove differential side bearings from differential case.

(2) Remove factory installed shims from differential case.

(3) Install ring gear on differential case and tighten bolts to specification, if necessary.

(4) Install dummy side bearings D-345 for 216 FBI axles, or D-343 for 248 FBI axles, on differential case.

(5) Install differential case in axle housing.

(6) Install the marked bearing caps in their correct positions. Install and snug the bolts (Fig. 72).

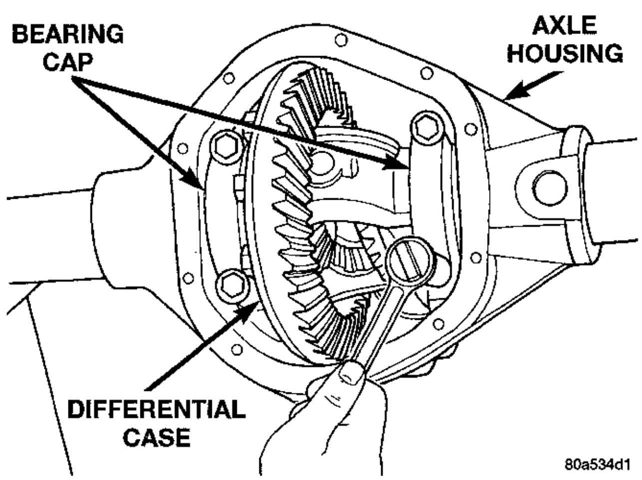

Fig. 72 Tighten Bolts Holding Bearing Caps

(7) Using a dead-blow type mallet, seat the differential dummy bearings to each side of the axle housing (Fig. 73) and (Fig. 74).

ADJUSTMENTS (Continued)

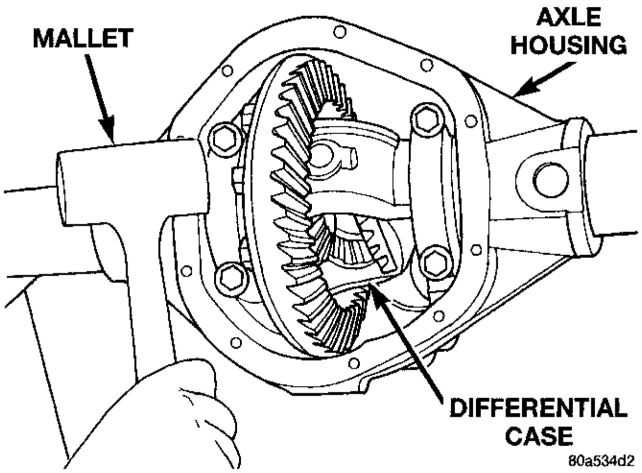

Fig. 73 Seat Pinion Gear Side Differential Dummy Side Bearing

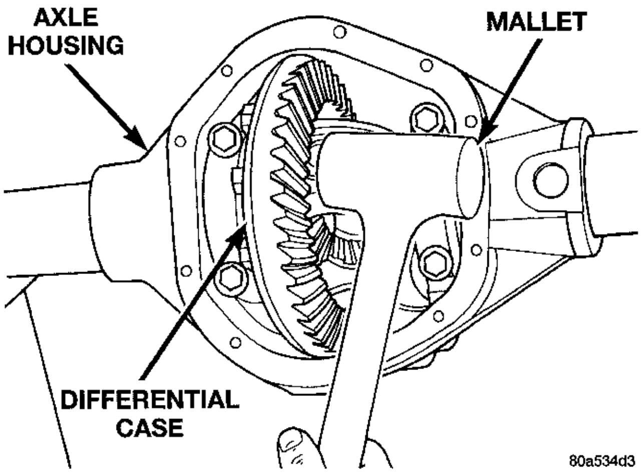

Fig. 74 Seat Ring Gear Side Differential Dummy Side Bearing

(8) Thread guide stud C-3288-B into rear cover bolt hole below ring gear (Fig. 75).

(9) Attach a dial indicator C-3339 to guide stud. Position the dial indicator plunger on a flat surface between the ring gear bolt heads (Fig. 75).

(10) Push and hold differential case to pinion gear side of axle housing (Fig. 76).

(11) Zero dial indicator face to pointer (Fig. 76).

(12) Push and hold differential case to ring gear side of the axle housing (Fig. 77).

(13) Record dial indicator reading (Fig. 77).

(14) Add 0.015 in. (0.38 mm) to the zero end play total. This new total represents the thickness of shims to compress, or preload the new bearings when the differential is installed.

(15) Rotate dial indicator out of the way on the guide stud.

(16) Remove differential case and dummy bearings from axle housing.

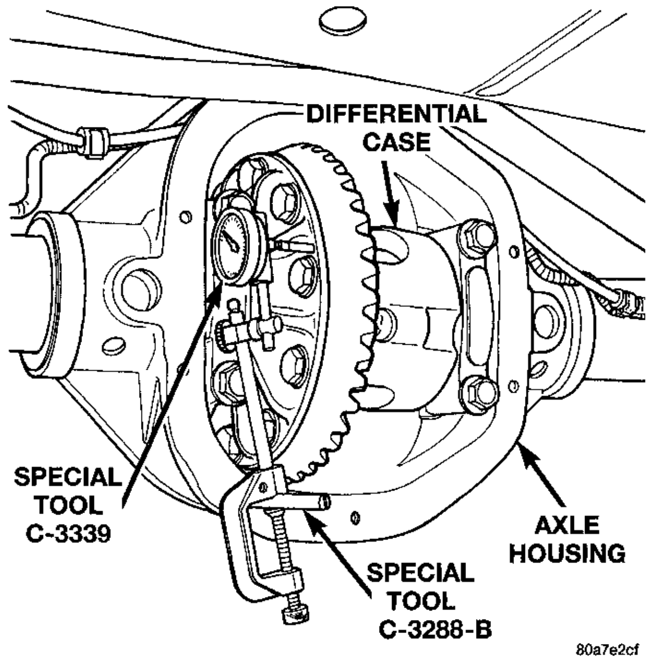

Fig. 75 Differential Side play Measurement

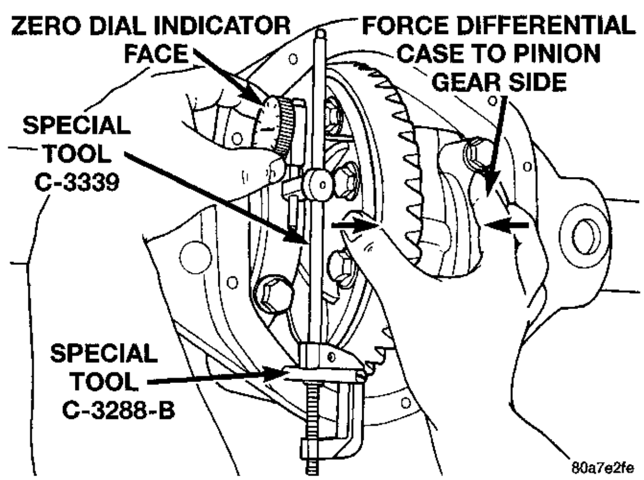

Fig. 76 Hold Differential Case and Zero Dial Indicator

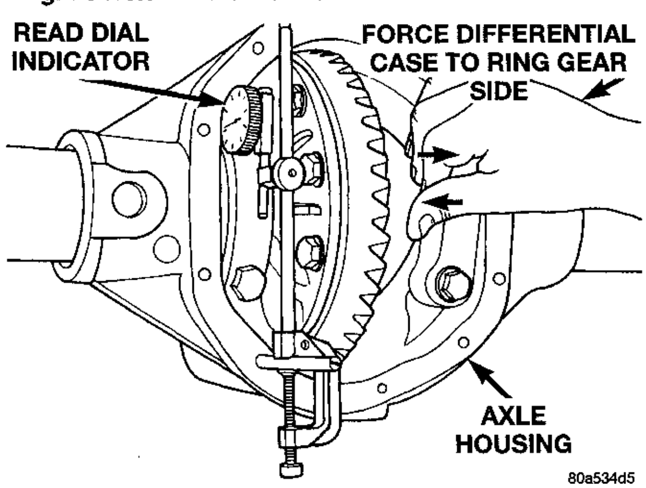

Fig. 77 Hold Differential Case and Read Dial Indicator

ADJUSTMENTS (Continued)

(17) Install the pinion gear in axle housing. Install the pinion yoke, or flange, and establish the correct pinion rotating torque.

(18) Install differential case and dummy bearings D-345 for 216 FBI axles, or D-343 for 248 FBI axles, in axle housing (without shims), install bearing caps and tighten bolts snug.

(19) Seat ring gear side dummy bearing (Fig. 74).

(20) Position the dial indicator plunger on a flat surface between the ring gear bolt heads. (Fig. 75).

(21) Push and hold differential case toward pinion gear (Fig. 78).

(22) Zero dial indicator face to pointer (Fig. 78).

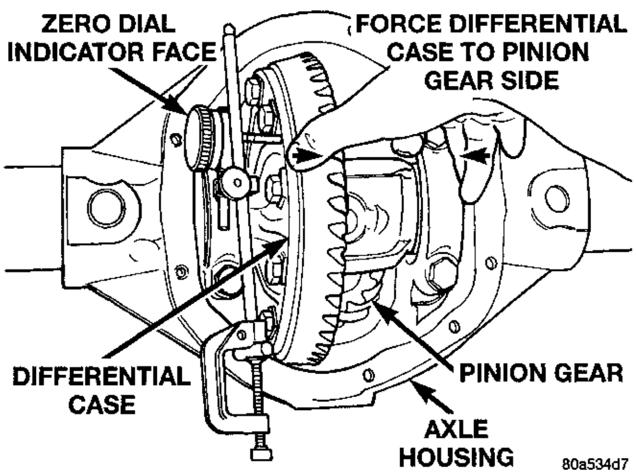

Fig. 78 Hold Differential Case and Zero Dial Indicator

(23) Push and hold differential case to ring gear side of the axle housing (Fig. 79).

(24) Record dial indicator reading (Fig. 79).

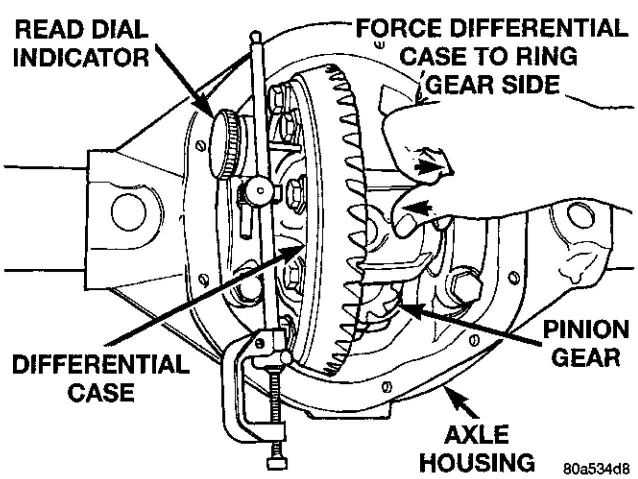

Fig. 79 Hold Differential Case and Read Dial Indicator

(25) This is the thickness shim required on the ring gear side of the differential case to achieve proper backlash.

(26) Subtract the backlash shim thickness from the total preload shim thickness. The remainder is the shim thickness required on the pinion side of the axle housing.

(27) Rotate dial indicator out of the way on guide stud.

(28) Remove differential case and dummy bearings from axle housing.

(29) Install side bearing shims on differential case hubs.

(30) Install side bearings and cups on differential case.

(31) Install spreader W-129-B on axle housing and spread axle opening enough to receive differential case.

(32) Install differential case in axle housing.

(33) Remove spreader from axle housing.

(34) Rotate the differential case several times to seat the side bearings.

(35) Position the indicator plunger against a ring gear tooth (Fig. 80).

(36) Push and hold ring gear upward while not allowing the pinion gear to rotate.

(37) Zero dial indicator face to pointer.

(38) Push and hold ring gear downward while not allowing the pinion gear to rotate. Dial indicator reading should be between 0.12 mm (0.005 in.) and 0.20 mm (0.008 in.). If backlash is not within specifications transfer the necessary amount of shim thickness from one side of the axle housing to the other (Fig. 80).

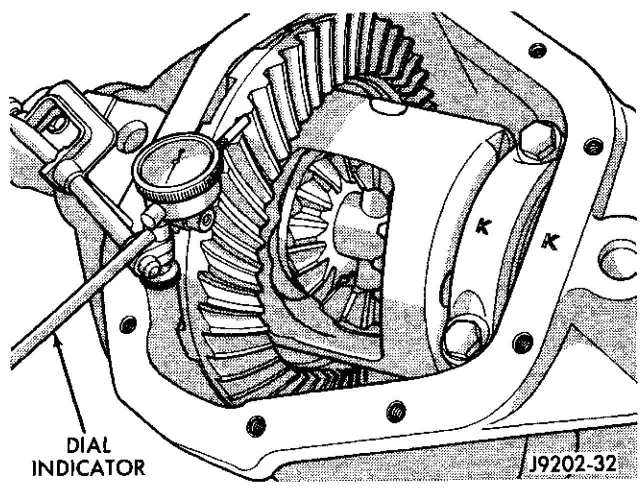

Fig. 80 Ring Gear Backlash Measurement

(39) Verify differential case and ring gear runout by measuring ring to pinion gear backlash at several locations around the ring gear. Readings should not vary more than 0.05 mm (0.002 in.). If readings vary more than specified, the ring gear or the differential case is defective.

ADJUSTMENTS (Continued)

After the proper backlash is achieved, perform Gear Contact Pattern Analysis procedure.

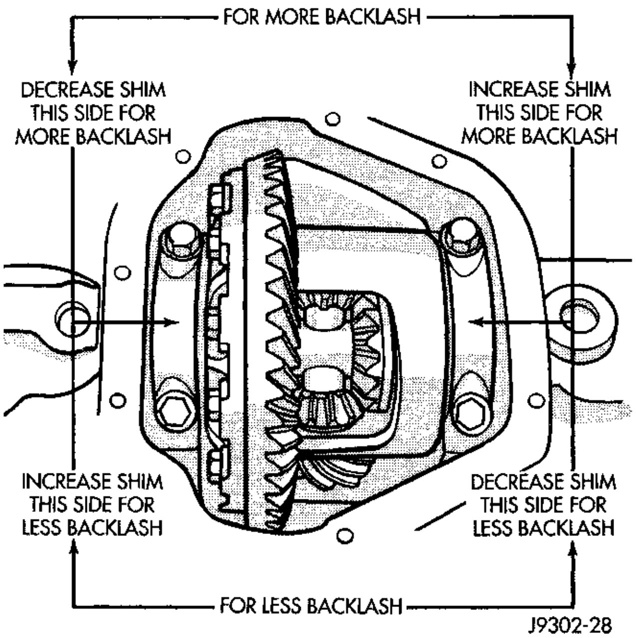

Fig. 81 Backlash Shim Adjustment

GEAR CONTACT PATTERN ANALYSIS

The ring and pinion gear teeth contact patterns will show if the pinion gear depth is correct in the axle housing. It will also show if the ring gear backlash has been adjusted correctly. The backlash can be adjusted within specifications to achieve desired tooth contact patterns.

(1) Apply a thin coat of hydrated ferric oxide, or equivalent, to the drive and coast side of the ring gear teeth.

(2) Wrap, twist, and hold a shop towel around the pinion yoke to increase the turning resistance of the pinion gear. This will provide a more distinct contact pattern.

(3) Using a boxed end wrench on a ring gear bolt, Rotate the differential case one complete revolution in both directions while a load is being applied from shop towel.

The areas on the ring gear teeth with the greatest degree of contact against the pinion gear teeth will squeegee the compound to the areas with the least amount of contact. Note and compare patterns on the ring gear teeth to Gear Tooth Contact Patterns chart (Fig. 82) and adjust pinion depth and gear backlash as necessary.

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ADJUSTMENTS (Continued)

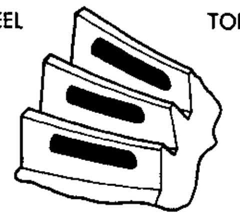
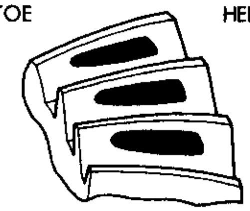
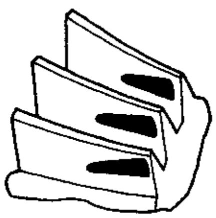
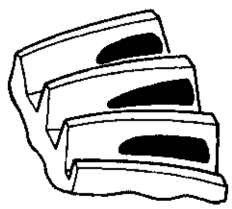
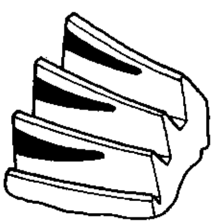
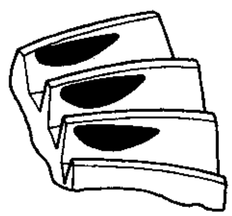
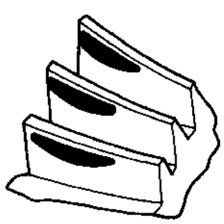
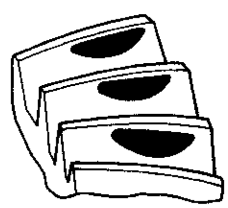
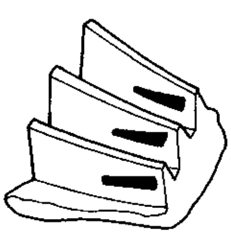
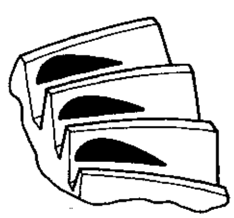
DRIVE SIDE OF RING GEAR TEETH	COAST SIDE OF RING GEAR TEETH	
HEEL TOE 	TOE HEEL 	DESIRABLE CONTACT PATTERN. PATTERN SHOULD BE CENTERED ON THE DRIVE SIDE OF TOOTH. PATTERN SHOULD BE CENTERED ON THE COAST SIDE OF TOOTH, BUT MAY BE SLIGHTLY TOWARD THE TOE. THERE SHOULD ALWAYS BE SOME CLEARANCE BETWEEN CONTACT PATTERN AND TOP OF THE TOOTH.
		RING GEAR BACKLASH CORRECT. **THINNER** PINION GEAR DEPTH SHIM REQUIRED.
		RING GEAR BACKLASH CORRECT. **THICKER** PINION GEAR DEPTH SHIM REQUIRED.
		PINION GEAR DEPTH SHIM CORRECT. **DECREASE** RING GEAR BACKLASH.
		PINION GEAR DEPTH SHIM CORRECT. **INCREASE** RING GEAR BACKLASH.

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Fig. 82 Gear Tooth Contact Patterns

SPECIFICATIONS

216 AND 248 FBI AXLES

216 FBI AXLE

DESCRIPTION	SPEC.
Axle Type	Hypoid
Lubricant	Thermal Stable SAE 80W–90
Lube Capacity	2.3 L (4.8 pts.)
Axle Ratio	3.54, 3.92, 4.09
Ring Gear Diameter	215.9 mm (8.50 in.)
Pinion Standard Setting	109.5 mm (4.312 in.)
Pinion Bearing Preload	
Original Bearing	1–2 N·m (10–20 in. lbs.)
New Bearing	2–5 N·m (15–35 in. lbs.)

248 FBI AXLE

DESCRIPTION	SPEC.
Axle Type	Hypoid
Lubricant	Thermal Stable SAE 80W–90
Lube Capacity	3.6 L (7.6 pts.)
Axle Ratio	3.54, 4.10
Ring Gear Diameter	247.6 mm (9.75 in.)
Pinion Standard Setting	127 mm (5.000 in.)
Pinion Bearing Preload	
Original Bearing	1–2 N·m (10–20 in. lbs.)
New Bearing	2–5 N·m (15–35 in. lbs.)

TORQUE

216 FBI AXLE

DESCRIPTION	TORQUE
Plug, Fill Hole	34 N·m (25 ft. lbs.)
Bolt, Diff. Cover	41 N·m (30 ft. lbs.)
Bolt, Bearing Cap	108 N·m (80 ft. lbs.)
Nut, Pinion	217–271 N·m (160–200 ft.lbs.)
Bolt, Ring Gear	95–122 N·m (70–90 ft. lbs.)
Bolt, Shift Motor	11 N·m (8 ft. lbs.)
Nut, Axle	237 N·m (175 ft. lbs.)
Bolt, Wheel Brg.	170 N·m (125 ft. lbs.)
Nut, Lower Ball Stud	108 N·m (80 ft. lbs.)
Nut, Upper Ball Stud	101 N·m (75 ft. lbs.)
Bolt, RWAL/ABS Sensor	11 N·m (96 in. lbs.)

248 FBI AXLE

DESCRIPTION	TORQUE
Plug, Fill Hole	34 N·m (25 ft. lbs.)
Bolt, Diff. Cover	41 N·m (30 ft. lbs.)
Bolt, Bearing Cap	108 N·m (80 ft. lbs.)
Nut, Pinion	291–380 N·m (215–280 ft.lbs.)
Bolt, Ring Gear	163–190 N·m (120–140 ft. lbs.)
Bolt, Shift Motor	11 N·m (8 ft. lbs.)
Nut, Axle	237 N·m (175 ft. lbs.)
Bolt, Wheel Brg.	170 N·m (125 ft. lbs.)
Nut, Lower Ball Stud	190–217 N·m (140–160 ft. lbs.)
Nut, Upper Ball Stud	94 N·m (70 ft. lbs.)
Bolt, RWAL/ABS Sensor	11 N·m (96 in. lbs.)

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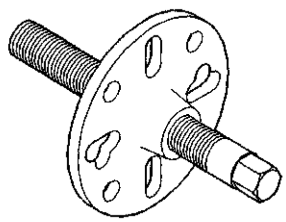
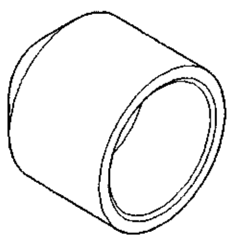
SPECIAL TOOLS

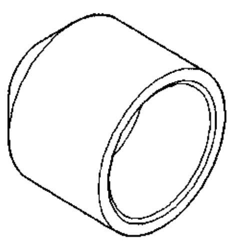
216 AND 248 FBI AXLES



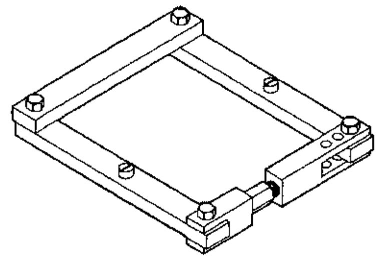
Remover—C-452



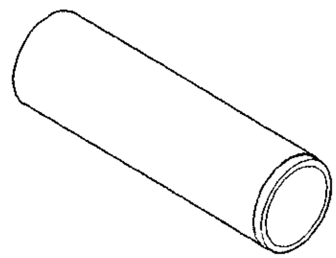
Installer, Seal—C-3972-A



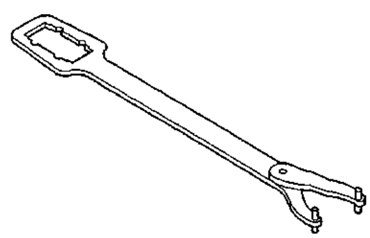
Installer, Seal—8108



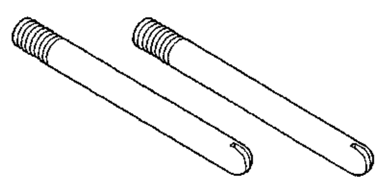
Spreader, Differential—W-129-B



Installer—C-3095-A



Holder—C-3281



Pilots—C-3288-B

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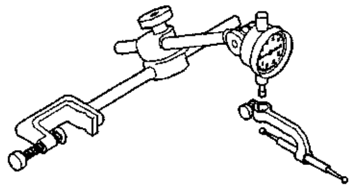
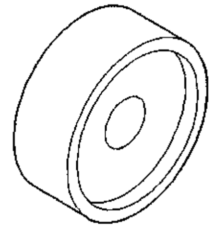
SPECIAL TOOLS (Continued)



Dial Indicator Set—C-3339



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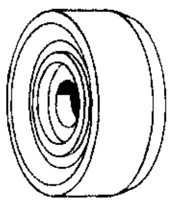
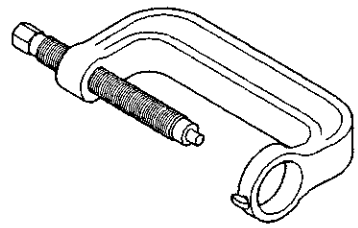
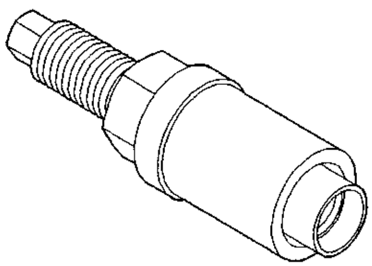


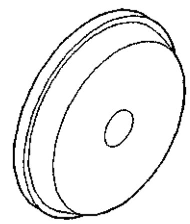
Driver—C-3716-A



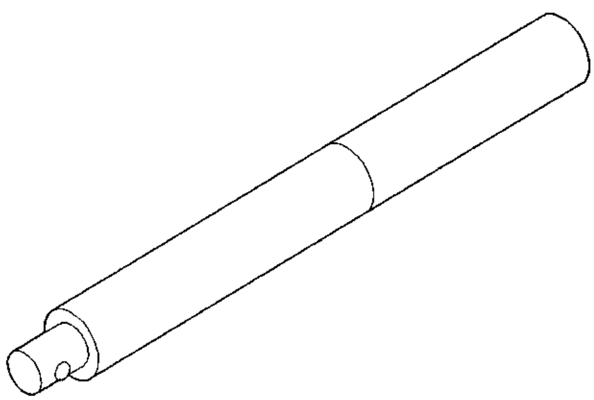
Press, Ball Joint Remover/Installer—C-4212-F



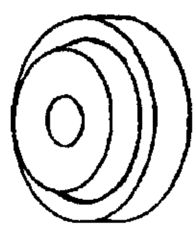
Installer—C-3718



Installer, Pinion Bearing Cup—D-111



Handle—C-4171



Installer, Pinion Bearing Cup—D-144

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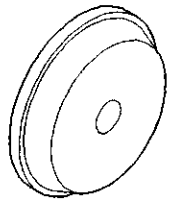
SPECIAL TOOLS (Continued)



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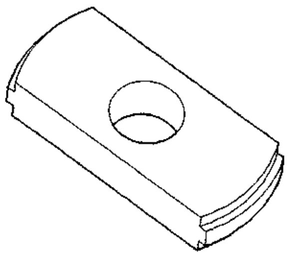

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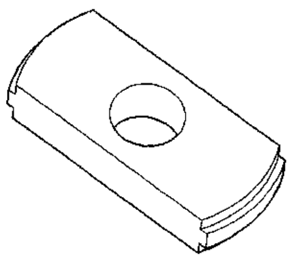

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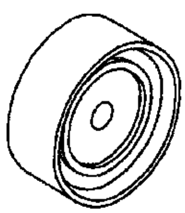

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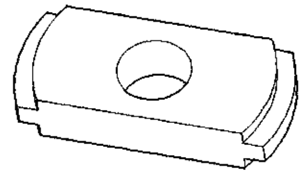

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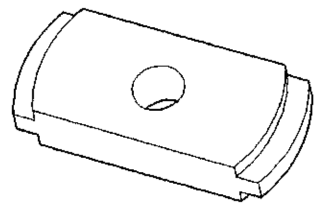

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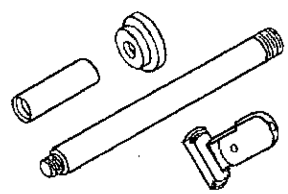
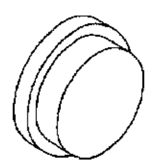
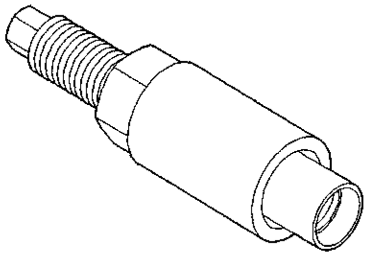


Remover/Installer Set—D-354

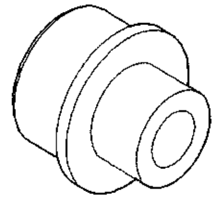


Button, Bearing Puller —DD-914-42

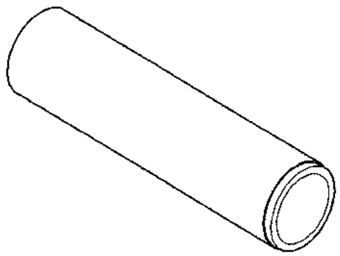
SPECIAL TOOLS (Continued)



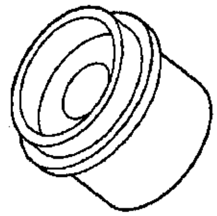
Installer—W-162-D



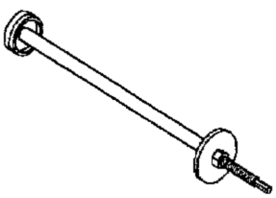
Remover, Ball Stud—6289-3



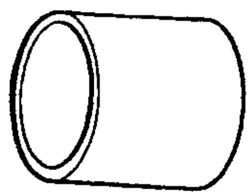
Installer, Pinion Bearing—W-262



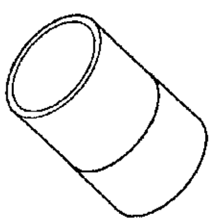
Adapter, Ball Stud Installer—6289-12



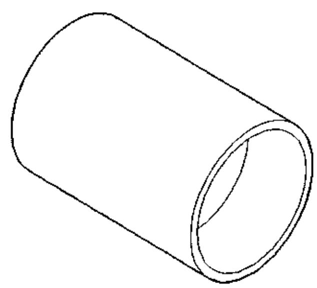
Installer Set—5041



Installer, Ball Stud—6289-5

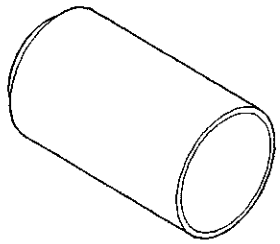


Receiver, Ball Stud—6289-1



Installer, Ball Stud—6752

SPECIAL TOOLS (Continued)



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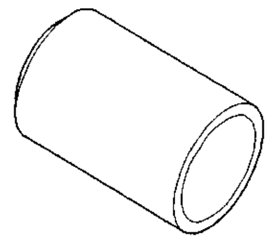
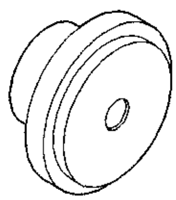
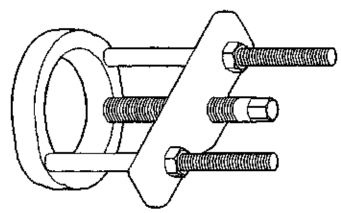


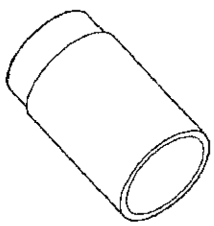
Installer, Ball Stud—6761



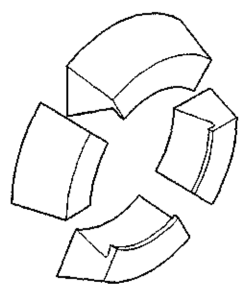
Remover, Ball Stud—6757



Puller/Press—C-293-PA



Receiver, Ball Stud—6759



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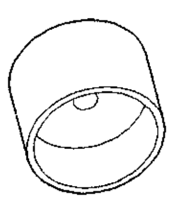
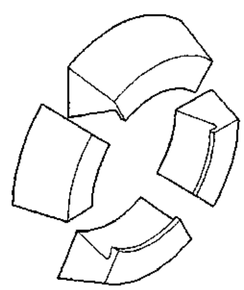


Installer, Ball Stud—6760



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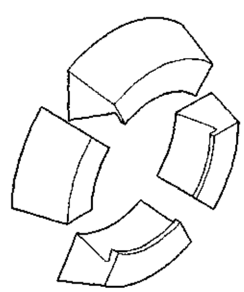

Adapter, Bearing Puller—C-293-40

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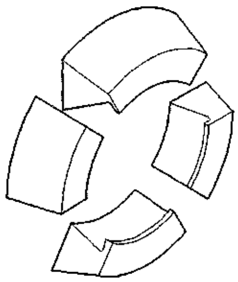
SPECIAL TOOLS (Continued)



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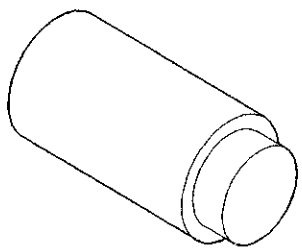
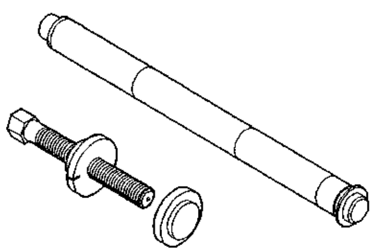
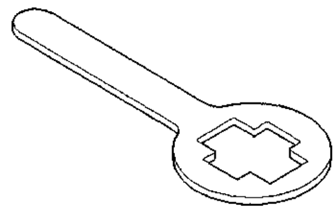


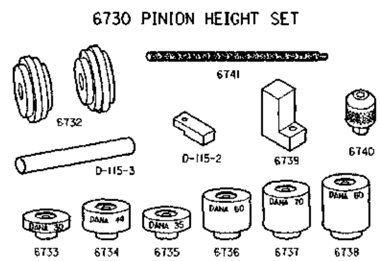
Adapter—C-293-3



Remover/Installer—C-4487



Holder—6719



Set, Pinion Depth Setting—6730

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9 1/4 REAR AXLE

INDEX

GENERAL INFORMATION

9 1/4 AXLES

The 9 1/4 Inch axle housings consist of a cast iron center section with axle shaft tubes extending from either side. The tubes are pressed into and welded to the differential housing to form a one-piece axle housing (Fig. 1).

The axles have a vent hose to relieve internal pressure caused by lubricant vaporization and internal expansion.

The axles are equipped with semi-floating axle shafts, meaning vehicle loads are supported by the axle shaft and bearings. The axle shafts are retained by C-clips in the differential side gears.

The removable, stamped steel cover provides a means for inspection and service without removing the complete axle from the vehicle.

Both axles have the assembly part number and gear ratio listed on tag. The tag is attached to the differential housing by a cover bolt.

The rear wheel anti-lock (RWAL) brake speed sensor is attached to the top, forward exterior of the differential housing. A seal is located between the sensor and the wire harness connector. The seal must be in place when the wire connector is connected to the sensor. The RWAL brake exciter ring is press-fitted onto the differential case against the ring gear flange.

The differential case is a one-piece design. The differential pinion mate shaft is retained with a threaded pin. Differential bearing preload and ring gear backlash are set and maintained by threaded adjusters at the outside of the differential housing. Pinion bearing preload is set and maintained by the use of a collapsible spacer.

Axles equipped with a Trac-Lok™ differential are optional. A Trac-Lok differential has a one-piece differential case, and the same internal components as a standard differential, plus two clutch disc packs.

GENERAL INFORMATION (Continued)

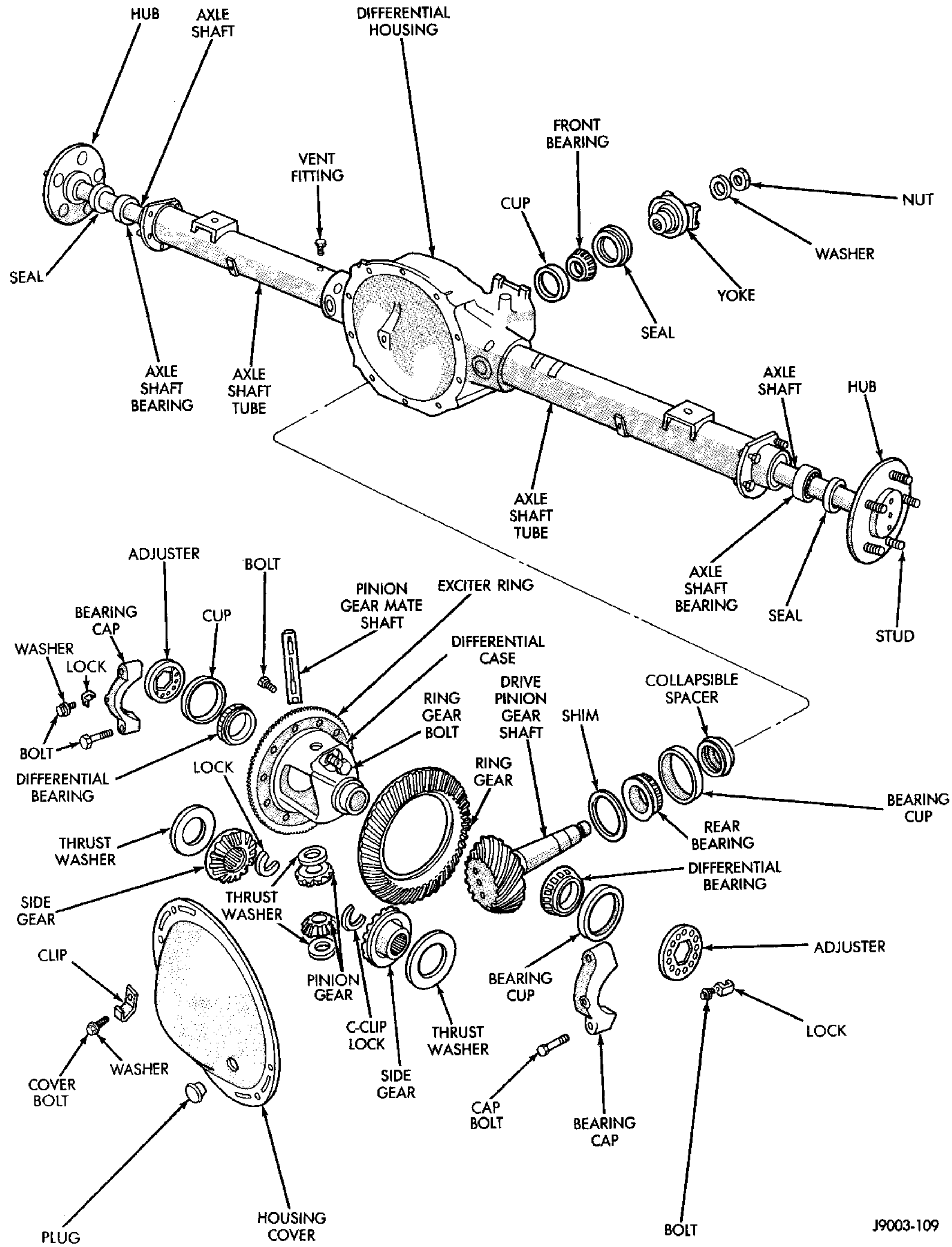

Fig. 1 9 1/4 Axle

AUTHENTIC RESTORATION PRODUCT

GENERAL INFORMATION (Continued)

AXLE IDENTIFICATION

The axle differential cover can be used for identification of the axle and (Fig. 2). An identification tag is attached to the differential cover.

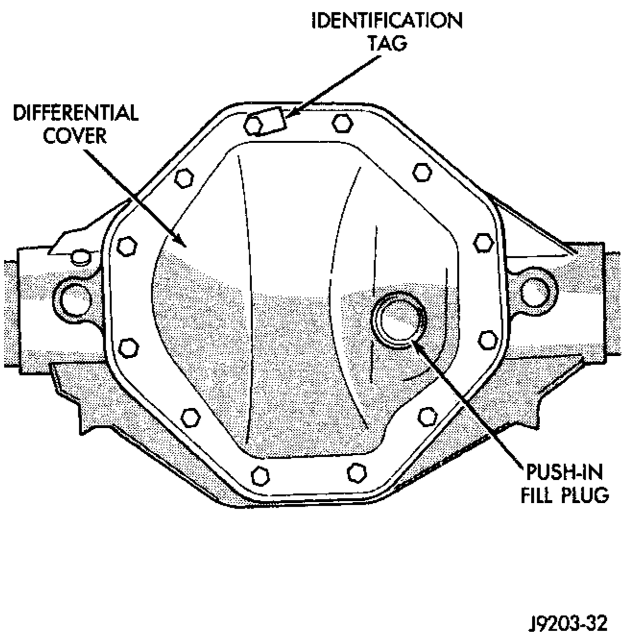

Fig. 2 Differential Cover 9 1/4 Inch Axle

LUBRICANTS

Multi-purpose, hypoid gear lubricant should be used for rear axles with a standard differential. The lubricant should have a MIL-L-2105C and API GL 5 quality specifications.

Trac-Lok differentials require the addition of 5 oz. of friction modifier to the axle lubricant after service. The 9 1/4 axle lubricant capacity is 2.32 L (4.9 pts.) total, including friction modifier, if necessary.

NOTE: If the rear axle is submerged in water, the lubricant must be replaced immediately. Avoid the possibility of premature axle failure resulting from water contan nation of the lubricant.

DESCRIPTION AND OPERATION

STANDARD DIFFERENTIAL

The differential gear system divides the torque between the axle shafts. It allows the axle shafts to rotate at different speeds when turning corners.

Each differential side gear is splined to an axle shaft. The pinion gears are mounted on a pinion mate shaft and are free to rotate on the shaft. The pinion gear is fitted in a bore in the differential case and is positioned at a right angle to the axle shafts.

In operation, power flow occurs as follows:

- The pinion gear rotates the ring gear
- The ring gear (bolted to the differential case) rotates the case
- The differential pinion gears (mounted on the pinion mate shaft in the case) rotate the side gears
- The side gears (splined to the axle shafts) rotate the shafts

During straight-ahead driving, the differential pinion gears do not rotate on the pinion mate shaft. This occurs because input torque applied to the gears is divided and distributed equally between the two side gears. As a result, the pinion gears revolve with the pinion mate shaft but do not rotate around it (Fig. 3).

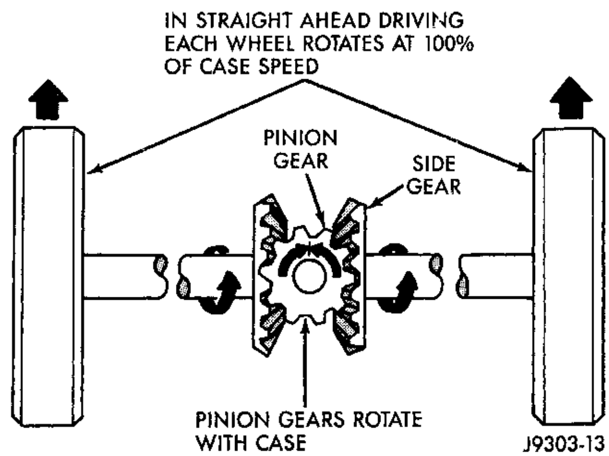

Fig. 3 Differential Operation—Straight Ahead Driving

When turning corners, the outside wheel must travel a greater distance than the inside wheel to complete a turn. The difference must be compensated for to prevent the tires from scuffing and skidding through turns. To accomplish this, the differential allows the axle shafts to turn at unequal speeds (Fig. 4). In this instance, the input torque applied to the pinion gears is not divided equally. The pinion gears now rotate around the pinion mate shaft in opposite directions. This allows the side gear and axle shaft attached to the outside wheel to rotate at a faster speed.

TRAC-LOK OPERATION

In a conventional differential, if one wheel spins, the opposite wheel will generate only as much torque as the spinning wheel.

In the Trac-lok differential, part of the ring gear torque is transmitted through clutch packs which contain multiple discs. The clutches will have radial grooves on the plates, and concentric grooves on the discs or bonded fiber material that is smooth in appearance.

In operation, the Trac-lok clutches are engaged by two concurrent forces. The first being the preload force exerted through Belleville spring washers

DESCRIPTION AND OPERATION (Continued)

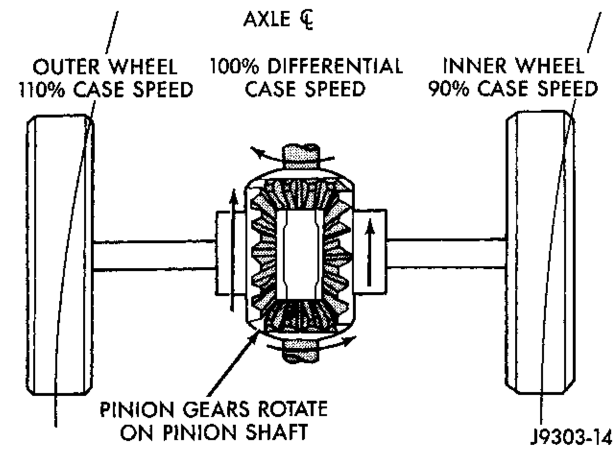

Fig. 4 Differential Operation—On Turns

within the clutch packs. The second is the separating forces generated by the side gears as torque is applied through the ring gear (Fig. 5).

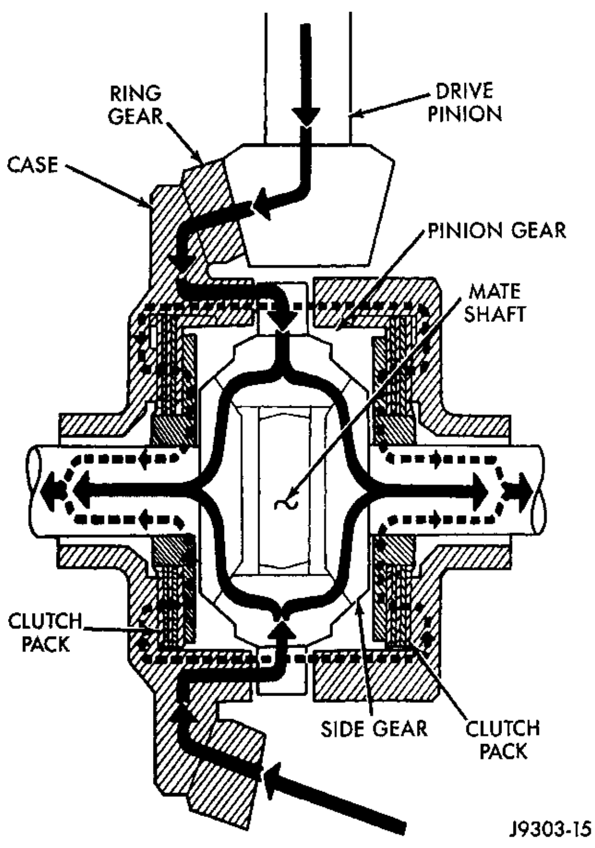

Fig. 5 Trac-lok Limited Slip Differential Operation

The Trac-lok design provides the differential action needed for turning corners and for driving straight ahead during periods of unequal traction. When one wheel looses traction, the clutch packs transfer additional torque to the wheel having the most traction. Trac-lok differentials resist wheel spin on bumpy roads and provide more pulling power when one wheel looses traction. Pulling power is provided continuously until both wheels loose traction. If both wheels slip due to unequal traction, Trac-lok operation is normal. In extreme cases of differences of traction, the wheel with the least traction may spin.

DIAGNOSIS AND TESTING

GENERAL INFORMATION

Axle bearing problem conditions are usually caused by:
- Insufficient or incorrect lubricant.
- Foreign matter/water contamination.
- Incorrect bearing preload torque adjustment.
- Incorrect backlash.

Axle gear problem conditions are usually the result of:
- Insufficient lubrication.
- Incorrect or contaminated lubricant.
- Overloading (excessive engine torque) or exceeding vehicle weight capacity.
- Incorrect clearance or backlash adjustment.

Axle component breakage is most often the result of:
- Severe overloading.
- Insufficient lubricant.
- Incorrect lubricant.
- Improperly tightened components.

GEAR NOISE

Axle gear noise can be caused by insufficient lubricant, incorrect backlash, tooth contact, or worn/damaged gears.

Gear noise usually happens at a specific speed range. The range is 30 to 40 mph, or above 50 mph. The noise can also occur during a specific type of driving condition. These conditions are acceleration, deceleration, coast, or constant load.

When road testing, accelerate the vehicle to the speed range where the noise is the greatest. Shift out-of-gear and coast through the peak–noise range. If the noise stops or changes greatly:
- Check for insufficient lubricant.
- Incorrect ring gear backlash.
- Gear damage.

Differential side and pinion gears can be checked by turning the vehicle. They usually do not cause noise during straight–ahead driving when the gears are unloaded. The side gears are loaded during vehicle turns. A worn pinion gear mate shaft can also cause a snapping or a knocking noise.

BEARING NOISE

The axle shaft, differential and pinion gear bearings can all produce noise when worn or damaged.

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DIAGNOSIS AND TESTING (Continued)

Bearing noise can be either a whining, or a growling sound.

Pinion gear bearings have a constant–pitch noise. This noise changes only with vehicle speed. Pinion bearing noise will be higher because it rotates at a faster rate. Drive the vehicle and load the differential. If bearing noise occurs, the rear pinion bearing is the source of the noise. If the bearing noise is heard during a coast, the front pinion bearing is the source.

Worn or damaged differential bearings usually produce a low pitch noise. Differential bearing noise is similar to pinion bearing noise. The pitch of differential bearing noise is also constant and varies only with vehicle speed.

Axle shaft bearings produce noise and vibration when worn or damaged. The noise generally changes when the bearings are loaded. Road test the vehicle. Turn the vehicle sharply to the left and to the right. This will load the bearings and change the noise level. Where axle bearing damage is slight, the noise is usually not noticeable at speeds above 30 mph.

LOW SPEED KNOCK

Low speed knock is generally caused by a worn U–joint or by worn side–gear thrust washers. A worn pinion gear shaft bore will also cause low speed knock.

VIBRATION

Vibration at the rear of the vehicle is usually caused by a:

- Damaged drive shaft.
- Missing drive shaft balance weight(s).
- Worn or out–of–balance wheels.
- Loose wheel lug nuts.
- Worn U–joint(s).
- Loose/broken springs.
- Damaged axle shaft bearing(s).
- Loose pinion gear nut.
- Excessive pinion yoke run out.
- Bent axle shaft(s).

Check for loose or damaged front–end components or engine/transmission mounts. These components can contribute to what appears to be a rear–end vibration. Do not overlook engine accessories, brackets and drive belts.

All driveline components should be examined before starting any repair.

Refer to Group 22, Wheels and Tires, for additional vibration information.

DRIVELINE SNAP

A snap or clunk noise when the vehicle is shifted into gear (or the clutch engaged), can be caused by:

- High engine idle speed
- Loose engine/transmission/transfer case mounts
- Worn U–joints
- Loose spring mounts
- Loose pinion gear nut and yoke
- Excessive ring gear backlash
- Excessive side gear/case clearance

The source of a snap or a clunk noise can be determined with the assistance of a helper. Raise the vehicle on a hoist with the wheels free to rotate. Instruct the helper to shift the transmission into gear. Listen for the noise, a mechanics stethoscope is helpful in isolating the source of a noise.

TRAC–LOK DIFFERENTIAL NOISE

The most common problem is a chatter noise when turning corners. Before removing a Trac-lok unit for repair, drain, flush and refill the axle with the specified lubricant. Refer to Lubricant change in this Group.

A container of Mopar® Trac-lok Lubricant (friction modifier) should be added after repair service or during a lubricant change.

After changing the lubricant, drive the vehicle and make 10 to 12 slow, figure-eight turns. This maneuver will pump lubricant through the clutches. This will correct the condition in most instances. If the chatter persists, clutch damage could have occurred.

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DIAGNOSIS AND TESTING (Continued)

DIAGNOSIS CHART

CONDITION	POSSIBLE CAUSES	CORRECTION
WHEEL NOISE	1. Wheel loose. 2. Faulty, brinelled wheel bearing.	1. Tighten loose nuts. 2. Faulty or brinelled bearings must be replaced.
AXLE SHAFT NOISE	1. Misaligned axle shaft tube. 2. Bent or sprung axle shaft. 3. End play in drive pinion bearings. 4. Excessive gear backlash between ring gear and pinion gear. 5. Improper adjustment of drive pinion gear shaft bearings. 6. Loose drive pinion gearshaft yoke nut. 7. Improper wheel bearing adjustment. 8. Scuffed gear tooth contact surfaces.	1. Inspect axle shaft tube alignment. Correct as necessary. 2. Replace bent or sprung axle shaft. 3. Refer to Drive Pinion Bearing Pre-Load Adjustment. 4. Check adjustment of ring gear backlash and pinion gear. Correct as necessary. 5. Adjust drive pinion shaft bearings. 6. Tighten drive pinion gearshaft yoke nut with specified torque. 7. Readjust as necessary. 8. If necessary, replace scuffed gears.
AXLE SHAFT BROKE	1. Misaligned axle shaft tube. 2. Vehicle overloaded. 3. Erratic clutch operation. 4. Grabbing clutch.	1. Replace broken axle shaft after correcting axle shaft tube alignment. 2. Replace broken axle shaft. Avoid excessive weight on vehicle. 3. Replace broken axle shaft after inspecting for other possible causes. Avoid erratic use of clutch. 4. Replace broken axle shaft. Inspect clutch and make necessary repairs or adjustments.
DIFFERENTIAL CASE CRACKED	1. Improper adjustment of differential bearings. 2. Excessive ring gear backlash. 3. Vehicle overloaded. 4. Erratic clutch operation.	1. Replace cracked case; examine gears and bearings for possible damage. At reassembly, adjust differential bearings properly. 2. Replace cracked case; examine gears and bearings for possible damage. At reassembly, adjust ring gear backlash properly. 3. Replace cracked case; examine gears and bearings for possible damage. Avoid excessive weight on vehicle. 4. Replace cracked case. After inspecting for other possible causes, examine gears and bearings for possible damage. Avoid erratic use of clutch.
DIFFERENTIAL GEARS SCORED	1. Insufficient lubrication. 2. Improper grade of lubricant. 3. Excessive spinning of one wheel/tire.	1. Replace scored gears. Scoring marks on the drive face of gear teeth or in the bore are caused by instantaneous fusing of the mating surfaces. Scored gears should be replaced. Fill rear differential housing to required capacity with proper lubricant. Refer to Specifications. 2. Replace scored gears. Inspect all gears and bearings for possible damage. Clean and refill differential housing to required capacity with proper lubricant. 3. Replace scored gears. Inspect all gears, pinion bores and shaft for damage. Service as necessary.
LOSS OF LUBRICANT	1. Lubricant level too high.	1. Drain excess lubricant by removing fill plug and allow lubricant to level at lower edge of fill plug hole.

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DIAGNOSIS AND TESTING (Continued)

CONT., DIAGNOSIS CHART

CONDITION	POSSIBLE CAUSES	CORRECTION
LOSS OF LUBRICANT	2. Worn axle shaft seals. 3. Cracked differential housing. 4. Worn drive pinion gear shaft seal. 5. Scored and worn yoke. 6. Axle cover not properly sealed.	2. Replace worn seals. 3. Repair or replace housing as necessary. 4. Replace worn drive pinion gear shaft seal. 5. Replace worn or scored yoke and seal. 6. Remove cover and clean flange and reseal.
AXLE OVERHEATING	1. Lubricant level too low. 2. Incorrect grade of lubricant. 3. Bearings adjusted too tight. 4. Excessive gear wear. 5. Insufficient ring gear backlash.	1. Refill differential housing. 2. Drain, flush and refill with correct amount of the correct lubricant. 3. Readjust bearings. 4. Inspect gears for excessive wear or scoring. Replace as necessary. 5. Readjust ring gear backlash and inspect gears for possible scoring.
GEAR TEETH BROKE (RING GEAR AND PINION)	1. Overloading. 2. Erratic clutch operation. 3. Ice-spotted pavements. 4. Improper adjustments.	1. Replace gears. Examine other gears and bearings for possible damage. 2. Replace gears and examine the remaining parts for possible damage. Avoid erratic clutch operation. 3. Replace gears. Examine the remaining parts for possible damage. Replace parts as required. 4. Replace gears. Examine other parts for possible damage. Ensure ring gear backlash is correct.
AXLE NOISE	1. Insufficient lubricant. 2. Improper ring gear and drive pinion gear adjustment. 3. Unmatched ring gear and drive pinion gear. 4. Worn teeth on ring gear or drive pinion gear. 5. Loose drive pinion gear shaft bearings. 6. Loose differential bearings. 7. Misaligned or sprung ring gear. 8. Loose differential bearing cap bolts	1. Refill axle with correct amount of the proper lubricant. Also inspect for leaks and correct as necessary. 2. Check ring gear and pinion gear teeth contact pattern. 3. Remove unmatched ring gear and drive pinion gear. Replace with matched gear and drive pinion gear set. 4. Check teeth on ring gear and drive pinion gear for correct contact. If necessary, replace with new matched set. 5. Adjust drive pinion gearshaft bearing preload torque. 6. Adjust differential bearing preload torque. 7. Measure ring gear runout. 8. Tighten with specified torque

J9503-4

DIAGNOSIS AND TESTING (Continued)

TRAC–LOK TEST

WARNING: WHEN SERVICING VEHICLES WITH A TRAC–LOK DIFFERENTIAL DO NOT USE THE ENGINE TO TURN THE AXLE AND WHEELS. BOTH REAR WHEELS MUST BE RAISED AND THE VEHICLE SUPPORTED. A TRAC–LOK AXLE CAN EXERT ENOUGH FORCE IF ONE WHEEL IS IN CONTACT WITH A SURFACE TO CAUSE THE VEHICLE TO MOVE.

The differential can be tested without removing the differential case by measuring rotating torque. Make sure brakes are not dragging during this measurement.

(1) Place blocks in front and rear of both front wheels.

(2) Raise one rear wheel until it is completely off the ground.

(3) Engine off, transmission in neutral, and parking brake off.

(4) Remove wheel and bolt Special Tool 6790 to studs.

(5) Use torque wrench on special tool to rotate wheel and read rotating torque (Fig. 6).

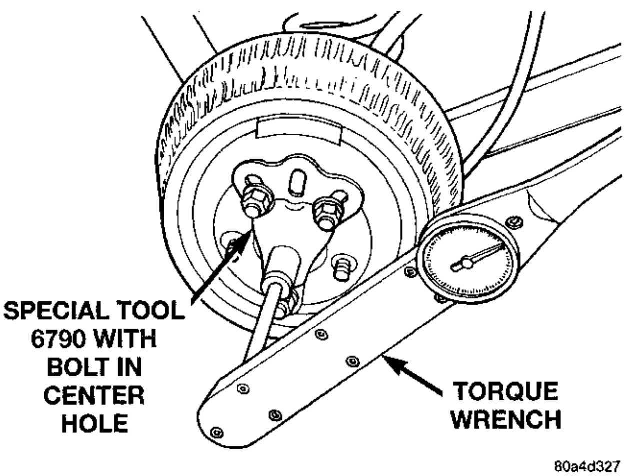

Fig. 6 Trac-lok Test —Typical

(6) If rotating torque is less than 22 N·m (30 ft. lbs.) or more than 271 N·m (200 ft. lbs.) on either wheel the unit should be serviced.

SERVICE PROCEDURES

LUBRICANT CHANGE

(1) Raise and support the vehicle.

(2) Remove the lubricant fill hole plug from the differential housing cover.

(3) Remove the differential housing cover and drain the lubricant from the housing.

(4) Clean the housing cavity with a flushing oil, light engine oil, or lint free cloth. **Do not use water, steam, kerosene, or gasoline for cleaning.**

(5) Remove the original sealant from the housing and cover surfaces.

(6) Apply a bead of Mopar® Silicone Rubber Sealant, or equivalent, to the housing cover (Fig. 7).

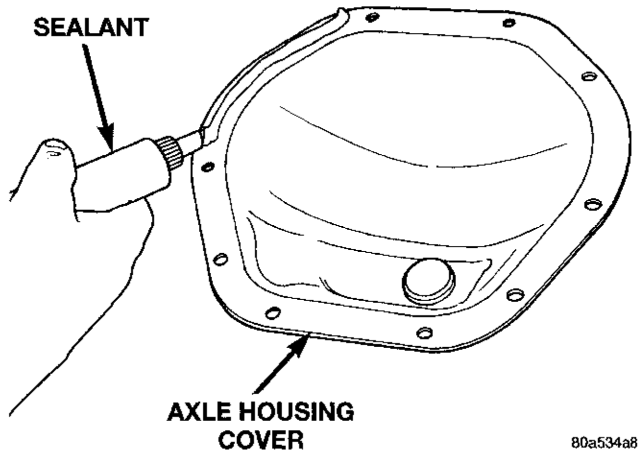

Fig. 7 Apply Sealant

Install the housing cover within 5 minutes after applying the sealant.

(7) Install the cover and any identification tag. Tighten the cover bolts to 41 N·m (30 ft. lbs.) torque.

(8) For Trac–lok differentials, a quantity of Mopar® Trac–lok lubricant (friction modifier), or equivalent, must be added after repair service or a lubricant change. Refer to the Lubricant Specifications section of this group for the quantity necessary.

(9) Fill differential with Mopar® Hypoid Gear Lubricant, or equivalent, to bottom of the fill plug hole. Refer to the Lubricant Specifications section of this group for the quantity necessary.

CAUTION: Overfilling the differential can result in lubricant foaming and overheating.

(10) Install the fill hole plug and lower the vehicle.

(11) Trac–lok differential equipped vehicles should be road tested by making 10 to 12 slow figure-eight turns. This maneuver will pump the lubricant through the clutch discs to eliminate a possible chatter noise complaint.

REMOVAL AND INSTALLATION

REAR AXLE

REMOVAL

(1) Raise and support the vehicle.

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REMOVAL AND INSTALLATION (Continued)

(2) Position a suitable lifting device under the axle.
(3) Secure axle to device.
(4) Remove the wheels and tires.
(5) Secure brake drums to the axle shaft.
(6) Remove the RWAL sensor from the differential housing, if necessary. Refer to Group 5, Brakes, for proper procedures.
(7) Disconnect the brake hose at the axle junction block. Do not disconnect the brake hydraulic lines at the wheel cylinders. Refer to Group 5, Brakes, for proper procedures.
(8) Disconnect the parking brake cables and cable brackets.
(9) Disconnect the vent hose from the axle shaft tube.
(10) Mark the propeller shaft and yoke for installation alignment reference.
(11) Remove propeller shaft.
(12) Disconnect shock absorbers from axle.
(13) Remove the spring clamps and spring brackets. Refer to Group 2, Suspension, for proper procedures.
(14) Separate the axle from the vehicle.

INSTALLATION

(1) Raise the axle with lifting device and align to the leaf spring centering bolts.
(2) Install the spring clamps and spring brackets. Refer to Group 2, Suspension, for proper procedures.
(3) Install shock absorbers and tighten nuts to 82 N·m (60 ft. lbs.) torque.
(4) Install the RWAL sensor to the differential housing, if necessary. Refer to Group 5, Brakes, for proper procedures.
(5) Connect the parking brake cables and cable brackets.
(6) Install the brake drums. Refer to Group 5, Brakes, for proper procedures.
(7) Connect the brake hose to the axle junction block. Refer to Group 5, Brakes, for proper procedures.
(8) Install axle vent hose.
(9) Align propeller shaft and pinion yoke reference marks. Install universal joint straps and bolts. Tighten to 19 N·m (14 ft. lbs.) torque.
(10) Install the wheels and tires.
(11) Add gear lubricant, if necessary. Refer to Lubricant Specifications in this section for lubricant requirements.
(12) Remove lifting device from axle and lower the vehicle.

AXLE SHAFT

REMOVAL

(1) Raise and support vehicle. Ensure that the transmission is in neutral.
(2) Remove wheel and tire assembly.
(3) Remove brake drum. Refer to Group 5, Brakes, for proper procedure.
(4) Clean all foreign material from housing cover area.
(5) Loosen housing cover bolts. Drain lubricant from the housing and axle shaft tubes. Remove housing cover.
(6) Rotate differential case so that pinion mate gear shaft lock screw is accessible. Remove lock screw and pinion mate gear shaft from differential case (Fig. 8).

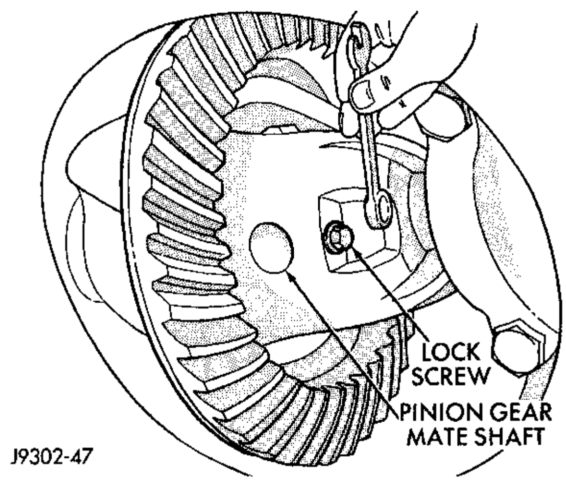

Fig. 8 Mate Shaft Lock Screw

(7) Push axle shaft inward and remove axle shaft C–clip lock from the axle shaft (Fig. 9).

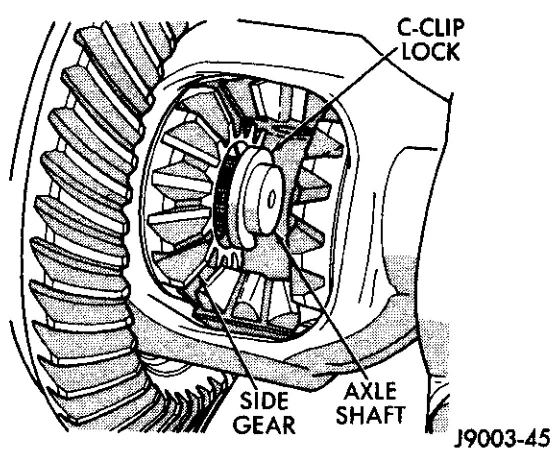

Fig. 9 Axle Shaft C–Clip Lock

REMOVAL AND INSTALLATION (Continued)

(8) Remove axle shaft. Use care to prevent damage to axle shaft bearing and seal, which will remain in axle shaft tube.
(9) Inspect axle shaft seal for leakage or damage.
(10) Inspect roller bearing contact surface on axle shaft for signs of brinelling, galling and pitting. If any of these conditions exist, the axle shaft and/or bearing and seal must be replaced.

INSTALLATION

(1) Lubricate bearing bore and seal lip with gear lubricant. Insert axle shaft through seal, bearing, and engage it into side gear splines.

NOTE: Use care to prevent shaft splines from damaging axle shaft seal lip.

(2) Insert C–clip lock in end of axle shaft. Push axle shaft outward to seat C–clip lock in side gear.
(3) Insert pinion mate shaft into differential case and through thrust washers and pinion gears.
(4) Align hole in shaft with hole in the differential case and install lock screw with Loctite® on the threads. Tighten lock screw to 11 N·m (8 ft. lbs.) torque.
(5) Install cover and add fluid. Refer to Lubricant Change procedure in this section for procedure and lubricant requirements.
(6) Install brake drum. Refer to Group 5, Brakes, for proper procedures.
(7) Install wheel and tire.
(8) Lower vehicle.

9 1/4 LD AXLE SEAL AND BEARING

REMOVAL

(1) Remove axle shaft.
(2) Remove axle shaft seal from the end of the axle tube with a small pry bar (Fig. 10).

NOTE: The seal and bearing can be removed at the same time with the bearing removal tool.

(3) Remove the axle shaft bearing from the axle tube with Bearing Removal Tool Set 6310, using Adapter Foot 6310-9 (Fig. 11).

INSTALLATION

NOTE: Do not install the original axle shaft seal. Always install a new seal.

(1) Wipe the axle tube bore clean. Remove any old sealer or burrs from the tube.
(2) Install the axle shaft bearing with Installer C-4198 and Handle C-4171 (Fig. 12). Ensure that the bearing part number is against the installer. Verify that the bearing in installed straight and the tool fully contacts the axle tube when seating the bearing.
(3) Install a new axle seal with Installer C-4076-B and Handle C-4735-1. When the tool contacts the axle tube, the seal is installed to the correct depth.
(4) Coat the lip of the seal with axle lubricant for protection prior to installing the axle shaft.
(5) Install the axle shaft.

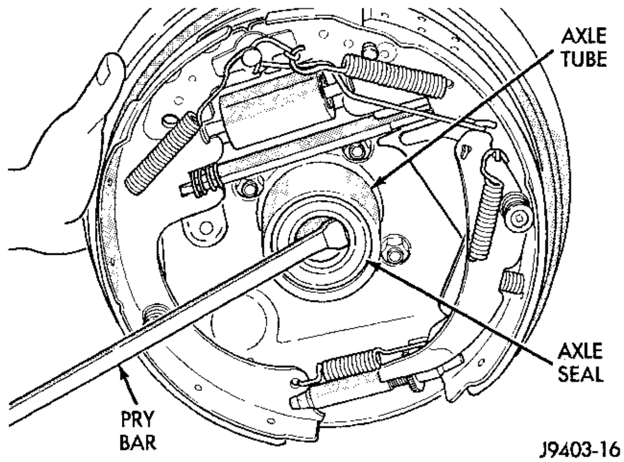

Fig. 10 Axle Seal Removal

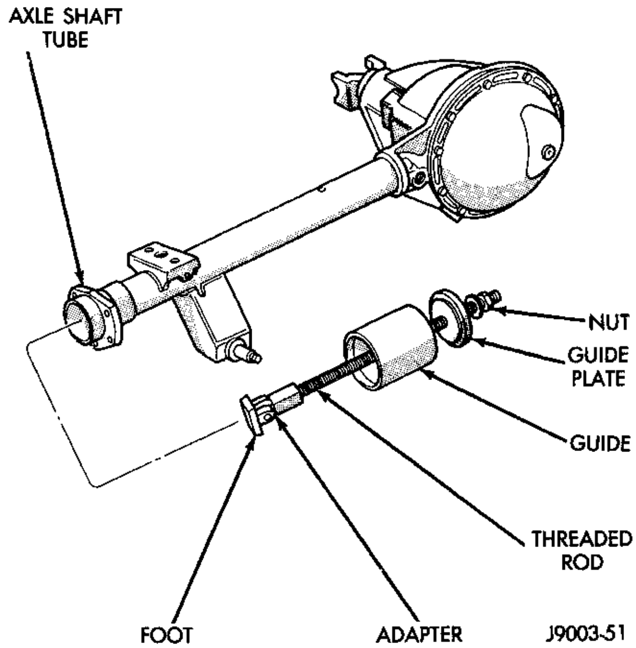

Fig. 11 Axle Shaft Bearing Removal Tool

9 1/4 HD AXLE SEAL AND BEARING

REMOVAL

(1) Remove axle shaft.
(2) Remove axle shaft seal from the end of the axle tube with a small pry bar (Fig. 13).

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REMOVAL AND INSTALLATION (Continued)

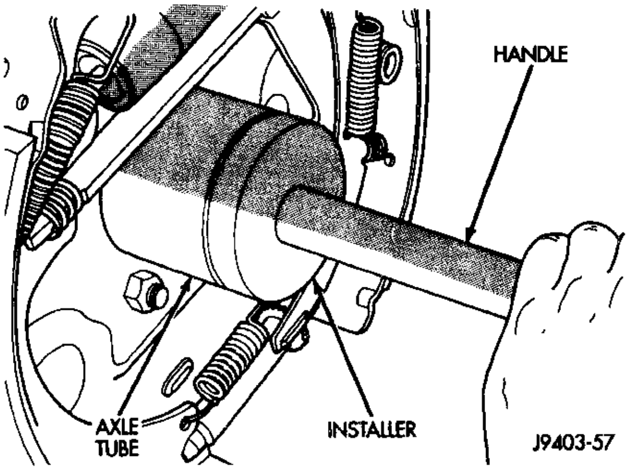

Fig. 12 Axle Shaft Seal and Bearing Installation

(3) Remove the axle shaft bearing from the axle tube with Bearing Removal Tool C-4828 (Fig. 14).

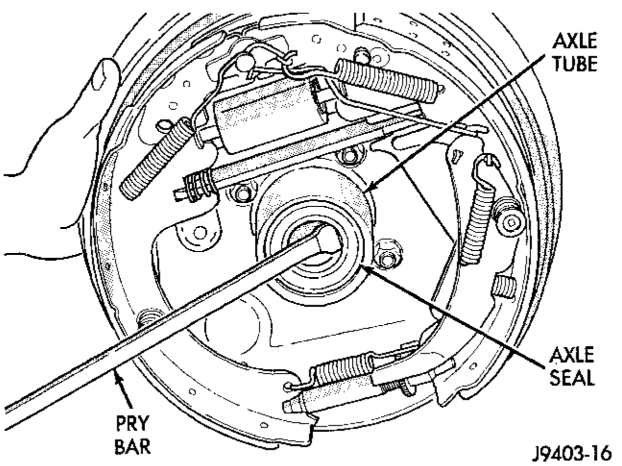

Fig. 13 Axle Seal Removal

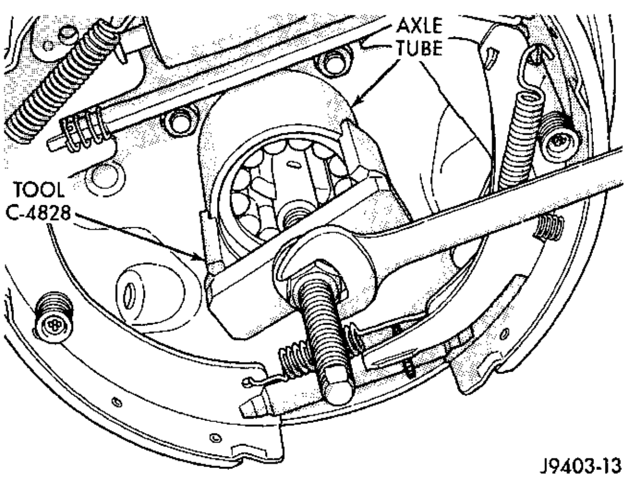

Fig. 14 Axle Shaft Bearing Removal Tool

INSTALLATION

NOTE: Do not install the original axle shaft seal. Always install a new seal.

(1) Wipe the axle tube bore clean. Remove any old sealer or burrs from the tube.

(2) Install the axle shaft bearing with Installer C-4826-1 and Handle C-4171 (Fig. 15). Ensure that the bearing part number is against the installer. Verify that the bearing in installed straight and the tool fully contacts the axle tube when seating the bearing.

(3) Install a new axle seal with Installer C-4826-1, Adapter C-4826-2, and Handle C-4171. When the tool contacts the axle tube, the seal is installed to the correct depth.

(4) Coat the lip of the seal with axle lubricant for protection prior to installing the axle shaft.

(5) Install the axle shaft.

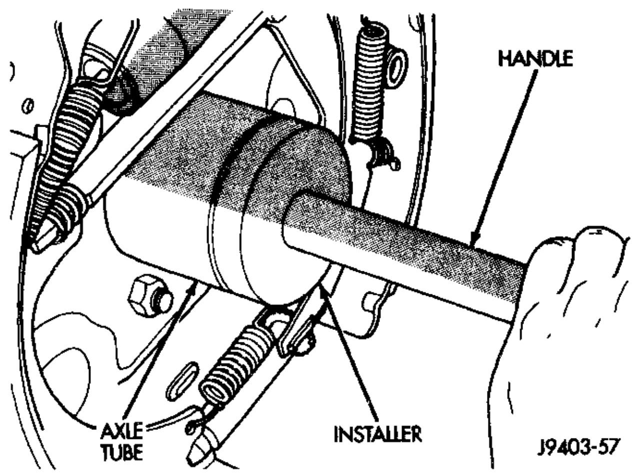

Fig. 15 Axle Shaft Seal and Bearing Installation

PINION SEAL

REMOVAL

(1) Raise and support the vehicle.

(2) Scribe a mark on the universal joint, pinion yoke, and pinion shaft for reference.

(3) Disconnect the propeller shaft from the pinion yoke. Secure the propeller shaft in an upright position to prevent damage to the rear universal joint.

(4) Remove the wheel and tire assemblies.

(5) Remove the brake drums to prevent any drag. The drag may cause a false bearing preload torque measurement.

(6) Rotate the pinion yoke three or four times.

(7) Measure the amount of torque necessary to rotate the pinion gear with a (in. lbs.) dial-type torque wrench. Record the torque reading for installation reference.

(8) Hold the yoke with Wrench 6719. Remove the pinion shaft nut and washer.

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REMOVAL AND INSTALLATION (Continued)

(9) Remove the yoke with Remover C-452 (Fig. 16).

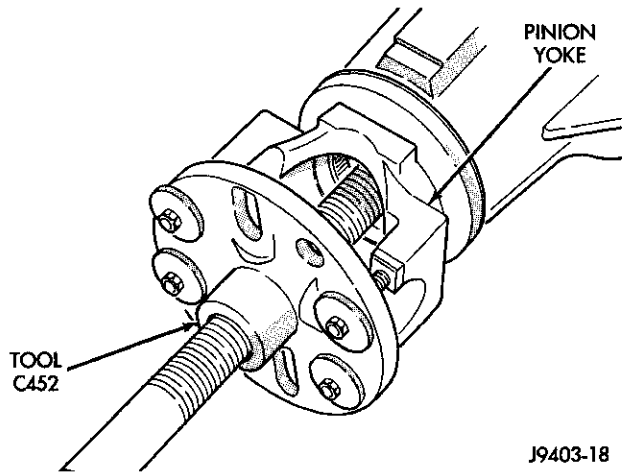

Fig. 16 Yoke Removal

(10) Remove the pinion shaft seal with suitable pry tool or slide-hammer mounted screw.

INSTALLATION

(1) Clean the seal contact surface in the housing bore.

(2) Examine the splines on the pinion shaft for burrs or wear. Remove any burrs and clean the shaft.

(3) Inspect pinion yoke for cracks, worn splines and worn seal contact surface. Replace yoke if necessary.

NOTE: The outer perimeter of the seal is pre-coated with a special sealant. An additional application of sealant is not required.

(4) Apply a light coating of gear lubricant on the lip of pinion seal.

(5) Install the new pinion shaft seal with Installer C-3860-A and Handle C-4171.

NOTE: The seal is correctly installed when the seal flange contacts the face of the differential housing flange.

(6) Position the pinion yoke on the end of the shaft with the reference marks aligned.

(7) Seat yoke on pinion shaft with Installer C-3718 and Wrench 6719.

(8) Remove the tools and install the pinion yoke washer. The convex side of the washer must face outward.

CAUTION: Do not exceed the minimum tightening torque when installing the pinion yoke retaining nut at this point. Damage to collapsible spacer or bearings may result.

(9) Hold pinion yoke with Yoke Holder 6719 and tighten shaft nut to 285 N·m (210 ft. lbs.) (Fig. 17). Rotate pinion shaft several revolutions to ensure the bearing rollers are seated.

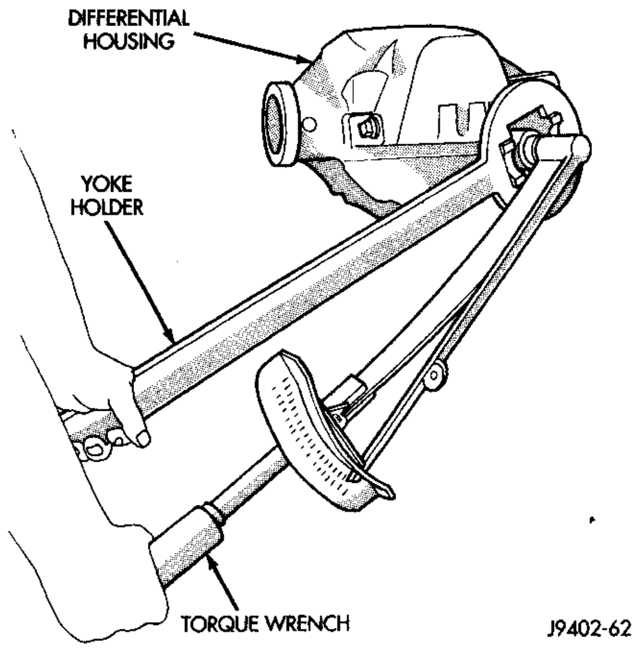

Fig. 17 Tightening Pinion Shaft Nut

(10) Rotate the pinion shaft using an (in. lbs.) torque wrench. Rotating torque should be equal to the reading recorded during removal, plus an additional 0.56 N·m (5 in. lbs.) (Fig. 18).

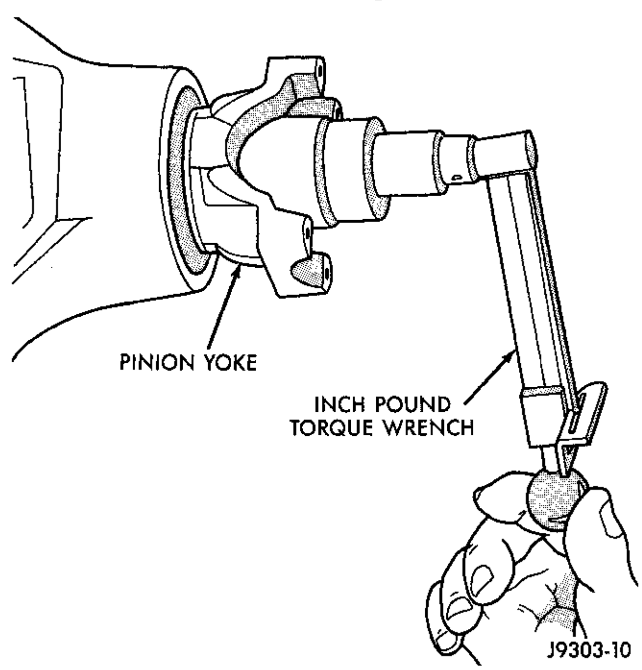

Fig. 18 Check Pinion Rotation Torque

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REMOVAL AND INSTALLATION (Continued)

CAUTION: Never loosen pinion gear nut to decrease pinion gear bearing rotating torque and never exceed specified preload torque. If rotating torque is exceeded a new collapsible spacer must be installed. The torque sequence will then have to be repeated.

(11) If the rotating torque is low, use Yoke Holder 6719 to hold the pinion yoke (Fig. 17) and tighten the pinion shaft nut in 6.8 N·m (5 ft. lbs.) increments until proper rotating torque is achieved.

NOTE: The bearing rotating torque should be constant during a complete revolution of the pinion. If the rotating torque varies, this indicates a binding condition.

(12) The seal replacement is unacceptable if the final pinion nut torque is less than 285 N·m (210 ft. lbs.).

(13) Install the propeller shaft with the installation reference marks aligned.

(14) Tighten the universal joint yoke clamp screws to 19 N·m (14 ft. lbs.).

(15) Install the brake drums.

(16) Install wheel and tire assemblies and lower the vehicle.

(17) Check the differential housing lubricant level.

DIFFERENTIAL

REMOVAL

(1) Remove the axle shafts.

(2) Remove RWAL/ABS sensor from housing.

NOTE: Side play resulting from bearing races being loose on case hubs requires replacement of the differential case.

(3) Mark the differential housing and the differential bearing caps for installation reference (Fig. 19).

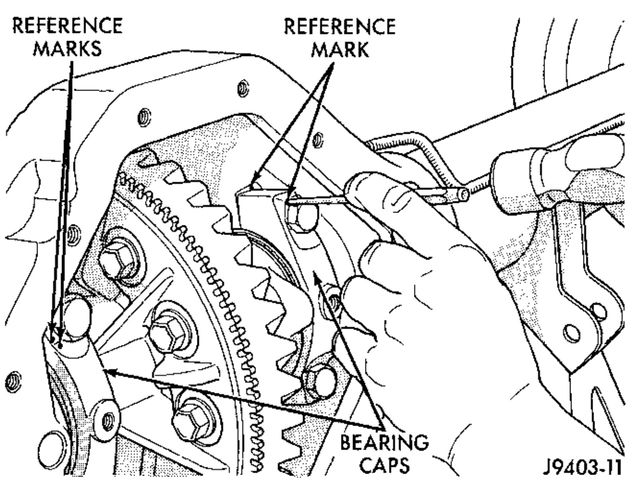

Fig. 19 Mark For Installation Reference

(4) Remove bearing threaded adjuster lock from each bearing cap. Loosen the bolts, but do not remove the bearing caps.

(5) Loosen the threaded adjusters with Wrench C-4164 (Fig. 20).

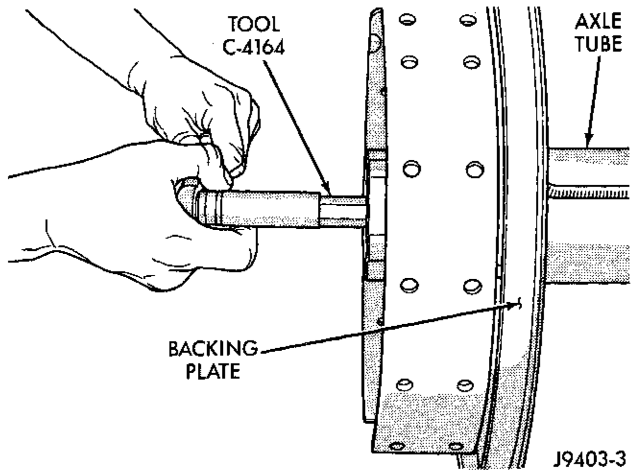

Fig. 20 Threaded Adjuster Tool

(6) Hold the differential case while removing bearing caps and adjusters.

(7) Remove the differential case.

NOTE: Each differential bearing cup and threaded adjuster must be kept with their respective bearing.

INSTALLATION

(1) Apply a coating of hypoid gear lubricant to the differential bearings, bearing cups, and threaded adjusters. A dab of grease can be used to keep the adjusters in position. Carefully position the assembled differential case in the housing.

(2) Observe the reference marks and install the differential bearing caps at their original locations (Fig. 21).

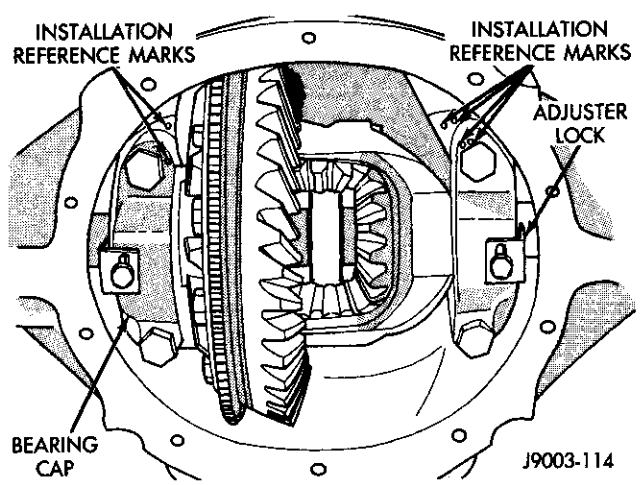

Fig. 21 Bearing Caps & Bolts

REMOVAL AND INSTALLATION (Continued)

(3) Install bearing cap bolts and tighten the upper bolts to 14 N·m (10 ft. lbs.). Tighten the lower bolts finger-tight until the bolt head is seated.

(4) Perform the differential bearing preload and adjustment procedure.

(5) Install axle shafts and differential housing cover.

DIFFERENTIAL SIDE BEARINGS

REMOVAL

(1) Remove differential case from axle housing.

(2) Remove the bearings from the differential case with Puller/Press C-293-PA and Adapters C-293-47 and Plug C-293-3 (Fig. 22).

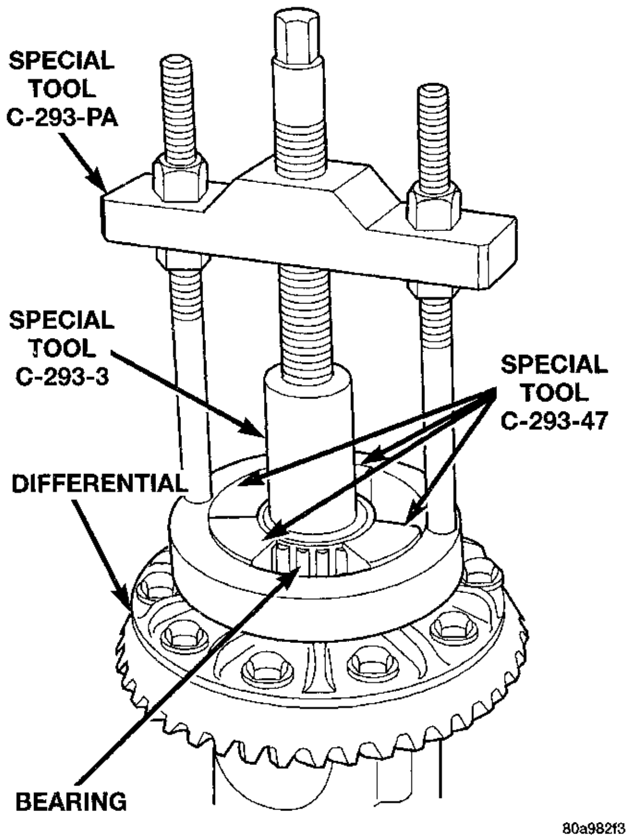

Fig. 22 Differential Bearing Removal

INSTALLATION

(1) Install differential side bearings. Use Installer C-4213 and Handle C-4171 (Fig. 23).

(2) Install differential case in axle housing.

RING GEAR AND EXCITER RING

NOTE: The ring and pinion gears are serviced in a matched set. Do not replace the ring gear without replacing the pinion gear.

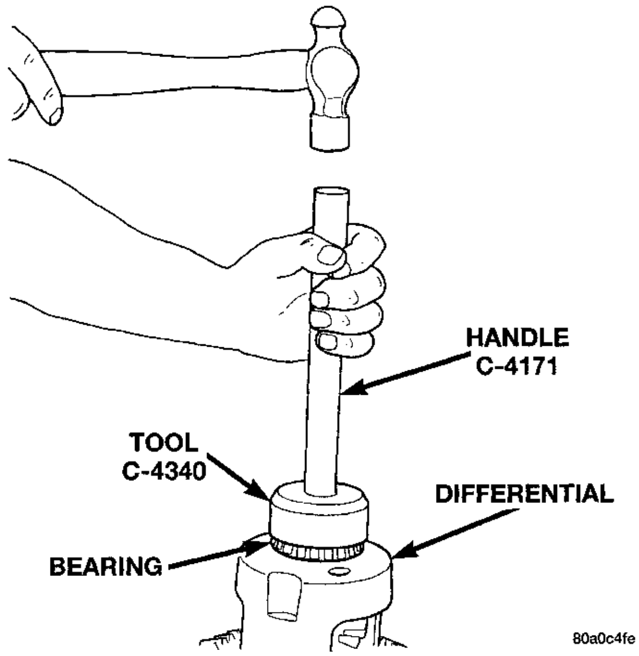

Fig. 23 Install Differential Side Bearings

REMOVAL

(1) Remove differential from axle housing.

(2) Place differential case in a suitable vise with soft metal jaw protectors. (Fig. 24).

(3) Remove bolts holding ring gear to differential case.

(4) Using a soft hammer, drive ring gear from differential case (Fig. 24).

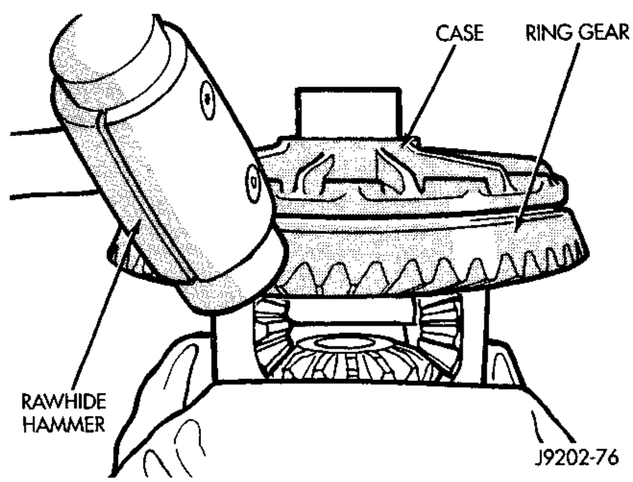

Fig. 24 Ring Gear Removal

(5) Use a brass drift and slowly tap the exciter ring from the differential case.

INSTALLATION

CAUTION: Do not reuse the bolts that held the ring gear to the differential case. The bolts can fracture causing extensive damage.

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REMOVAL AND INSTALLATION (Continued)

(1) Invert the differential case.
(2) Position exciter ring on differential case.
(3) Using a brass drift, slowly and evenly tap the exciter ring into position.
(4) Position ring gear on the differential case and start two ring gear bolts. This will provide case-to-ring gear bolt hole alignment.
(5) Invert the differential case in the vise.
(6) Install new ring gear bolts and alternately tighten to 157 N·m (115 ft. lbs.) torque (Fig. 25).
(7) Install differential in axle housing and verify gear mesh and contact pattern.

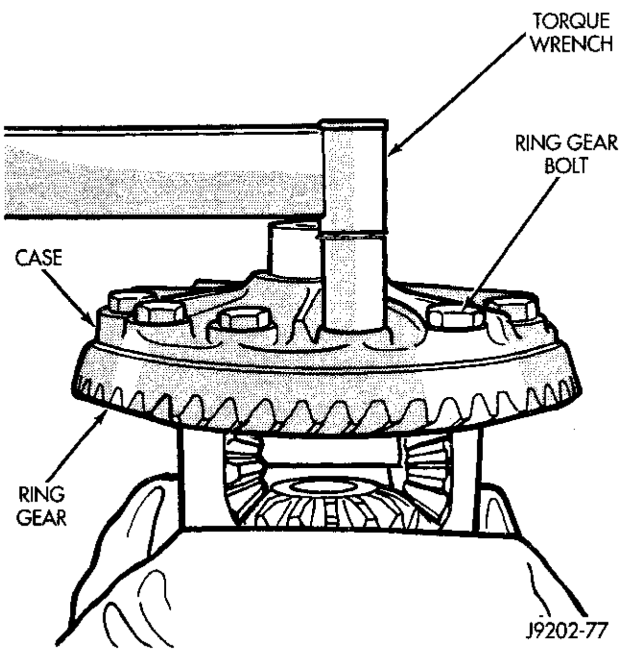

Fig. 25 Ring Gear Bolt Installation

PINION GEAR

NOTE: The ring and pinion gears are serviced in a matched set. Do not replace the pinion gear without replacing the ring gear.

REMOVAL

(1) Remove differential from the axle housing.
(2) Mark pinion yoke and propeller shaft for installation alignment.
(3) Disconnect propeller shaft from pinion yoke. Using suitable wire, tie propeller shaft to underbody.
(4) Using Yoke Holder 6719 to hold yoke and remove the pinion yoke nut and washer.
(5) Using Remover C–452, remove the pinion yoke from pinion shaft (Fig. 26).
(6) Partially install pinion nut onto pinion to protect the threads.

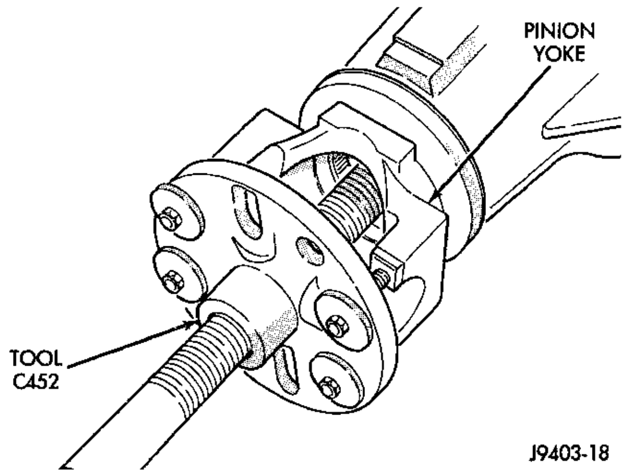

Fig. 26 Pinion Yoke Removal

(7) Remove the pinion gear from housing (Fig. 27). Catch the pinion with your hand to prevent it from falling and being damaged.

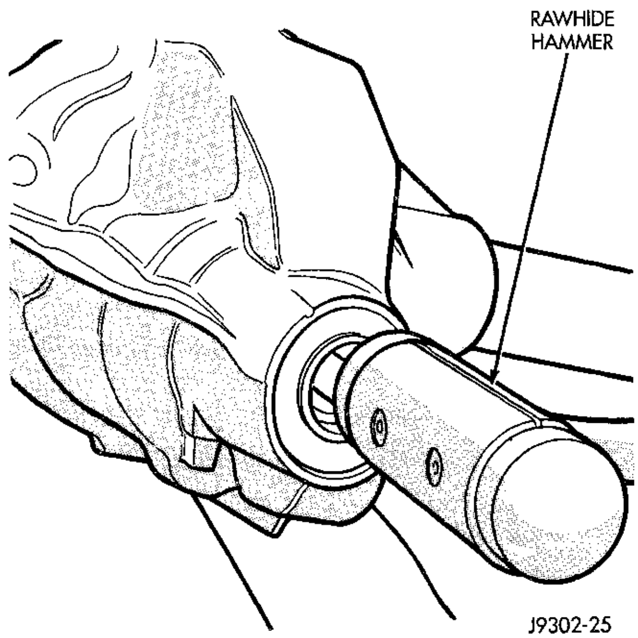

Fig. 27 Remove Pinion Gear

(8) Remove the pinion shaft seal with suitable pry tool or slide-hammer mounted screw.
(9) Remove oil slinger, if equipped, and front pinion bearing.
(10) Remove the front pinion bearing cup with Bearing Removal Tool Set 6310 and Adapter Foot 6310-9.
(11) Remove the rear bearing cup from housing (Fig. 28). Use Remover C-4309 and Handle C-4171 for the 9 1/4 axle.
(12) Remove the collapsible preload spacer (Fig. 29).

REMOVAL AND INSTALLATION (Continued)

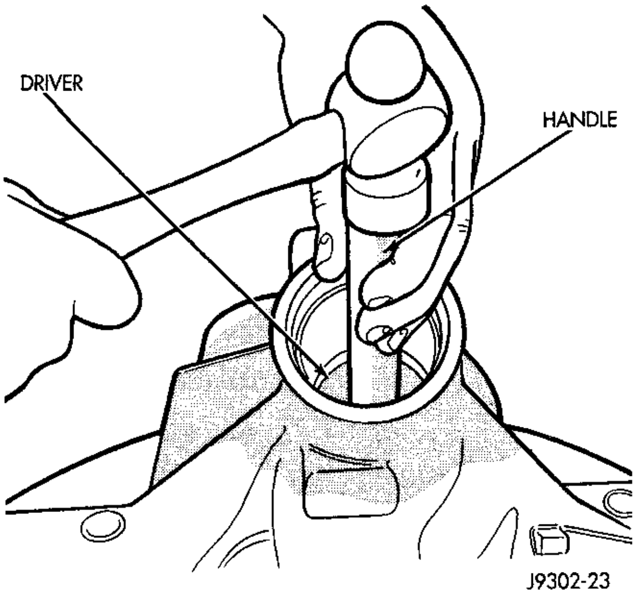

Fig. 28 Rear Bearing Cup Removal

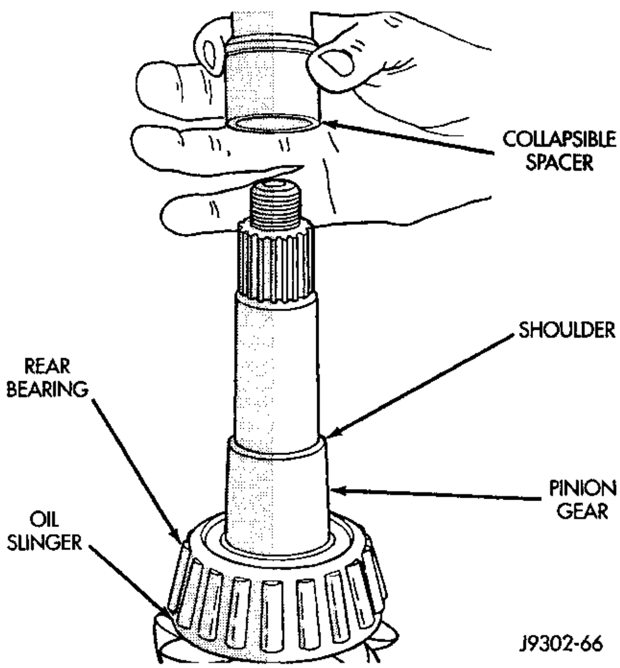

Fig. 29 Collapsible Spacer

(13) Remove the rear bearing from the pinion (Fig. 30) with Puller/Press C-293-PA and Adapters C-293-37.

Place 4 adapter blocks so they do not damage the bearing cage.

(14) Remove the depth shims from the pinion gear shaft. Record the thickness of the depth shims.

INSTALLATION

(1) Apply Mopar® Door Ease, or equivalent, stick lubricant to outside surface of bearing cup.

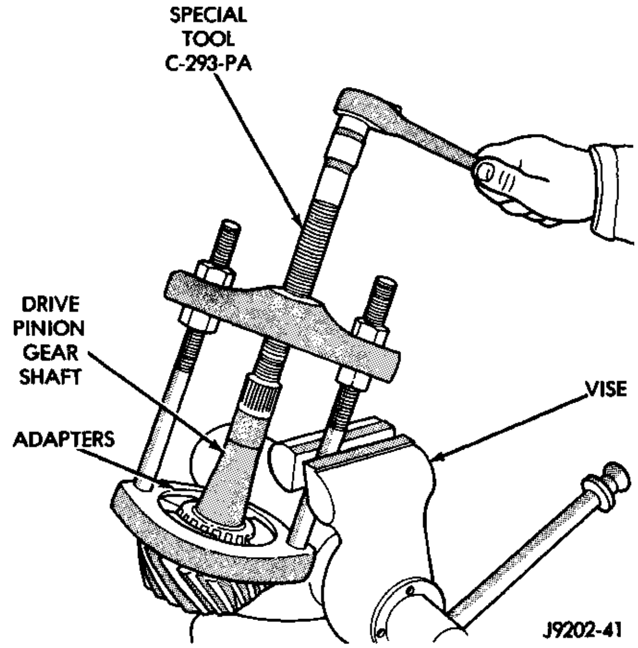

Fig. 30 Rear Bearing Removal

(2) Install the pinion rear bearing cup (Fig. 31) with Installer C-4310 and Driver Handle C–4171.

(3) Ensure cup is correctly seated.

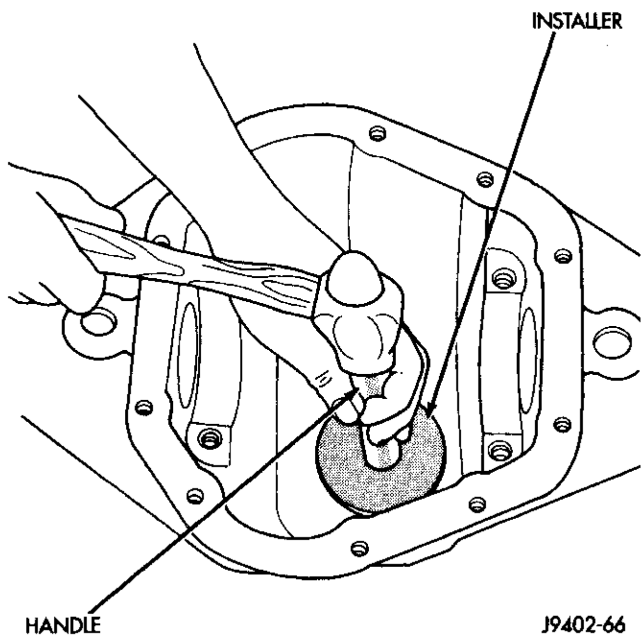

Fig. 31 Pinion Rear Bearing Cup Installation

(4) Apply Mopar® Door Ease, or equivalent, stick lubricant to outside surface of bearing cup.

(5) Install the pinion front bearing cup (Fig. 32) with Installer D–129 and Handle C–4171.

(6) Install pinion front bearing, and oil slinger, if equipped.

AUTHENTIC RESTORATION

REMOVAL AND INSTALLATION (Continued)

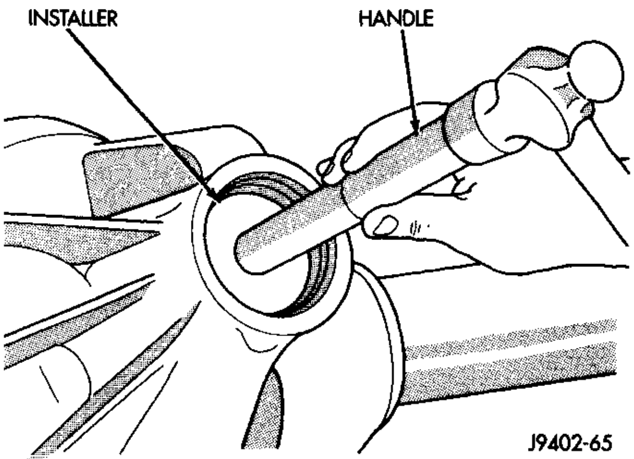

Fig. 32 Pinion Front Bearing Cup Installation

(7) Apply a light coating of gear lubricant on the lip of pinion seal.

(8) Install seal with Installer C-3860-A and Handle C-4171.

NOTE: Pinion depth shims are placed between the rear pinion bearing cone and pinion gear to achieve proper ring and pinion gear mesh. If the factory installed ring and pinion gears are reused, the pinion depth shim should not require replacement. If required, refer to Pinion Gear Depth to select the proper thickness shim before installing rear pinion bearing.

(9) Place the proper thickness depth shim on the pinion gear.

(10) Install the rear bearing and slinger, if equipped, on the pinion gear (Fig. 33) with Installer C-3095.

(11) Install a new collapsible preload spacer on pinion shaft and install pinion gear in housing (Fig. 34).

(12) Install pinion gear in housing.

(13) Install yoke with Installer C-3718 and Yoke Holder 6719.

(14) Install the yoke washer and a new nut on the pinion gear and tighten the pinion nut until there is zero bearing end-play. It will not be possible at this point to achieve zero bearing end-play if a new collapsible spacer was installed.

(15) Tighten the nut to 285 N·m (210 ft. lbs.).

CAUTION: Never loosen pinion gear nut to decrease pinion gear bearing rotating torque and never exceed specified preload torque. If preload torque or rotating torque is exceeded a new collapsible spacer must be installed. The torque sequence will then have to be repeated.

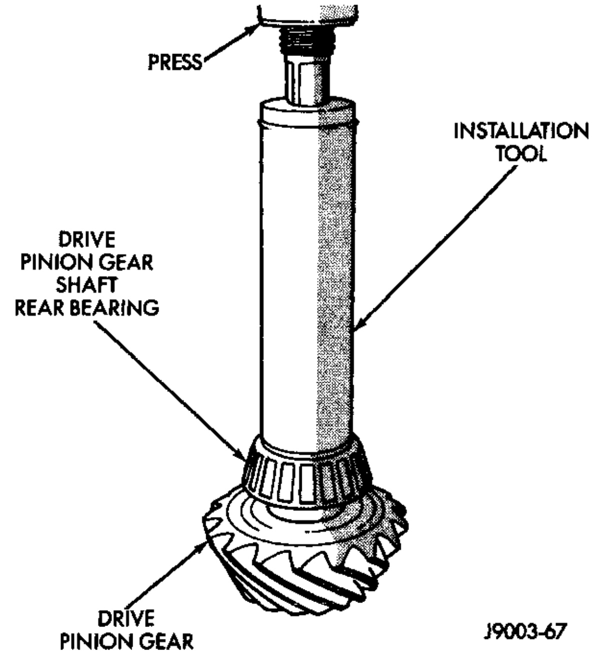

Fig. 33 Shaft Rear Bearing Installation

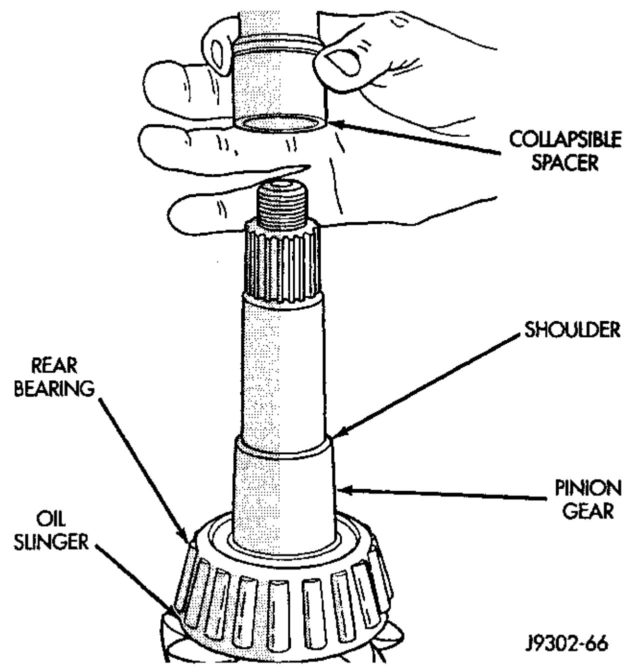

Fig. 34 Collapsible Preload Spacer

(16) Using Yoke Holder 6719, crush collapsible spacer until bearing end play is taken up.

(17) Slowly tighten the nut in 6.8 N·m (5 ft. lbs.) increments until the desired rotating torque is achieved. Measure the rotating torque frequently to avoid over crushing the collapsible spacer (Fig. 35).

(18) Check bearing rotating torque with an inch pound torque wrench (Fig. 35). The torque necessary to rotate the pinion gear should be:

REMOVAL AND INSTALLATION (Continued)

- Original Bearings — 1 to 3 N·m (10 to 20 in. lbs.).
- New Bearings — 2 to 5 N·m (15 to 35 in. lbs.).

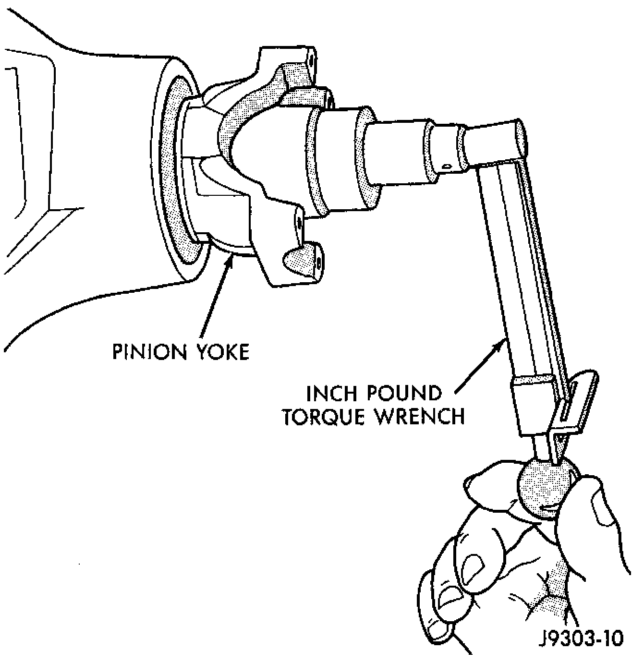

Fig. 35 Check Pinion Gear Rotating Torque

(19) Install propeller shaft.
(20) Install differential in housing.

FINAL ASSEMBLY

(1) Scrape the residual sealant from the housing and cover mating surfaces. Clean the mating surfaces with mineral spirits. Apply a bead of Mopar® Silicone Rubber Sealant, or equivalent, on the housing cover (Fig. 36).

Install the housing cover within 5 minutes after applying the sealant.

(2) Install the cover on the differential with the attaching bolts. Install the identification tag. Tighten the cover bolts to 41 N·m (30 ft. lbs.) torque.

CAUTION: Overfilling the differential can result in lubricant foaming and overheating.

(3) Refill the differential housing with gear lubricant. Refer to the Lubricant Specifications section of this group for the gear lubricant requirements.
(4) Install the fill hole plug.

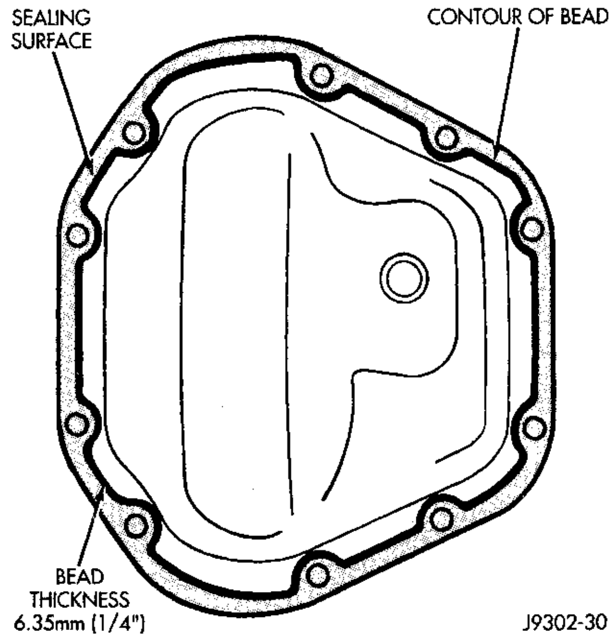

Fig. 36 Typical Housing Cover With Sealant

DISASSEMBLY AND ASSEMBLY

STANDARD DIFFERENTIAL

DISASSEMBLY

(1) Remove pinion gear mate shaft lock screw (Fig. 37).
(2) Remove pinion gear mate shaft.
(3) Rotate the differential side gears and remove the pinion mate gears and thrust washers (Fig. 38).

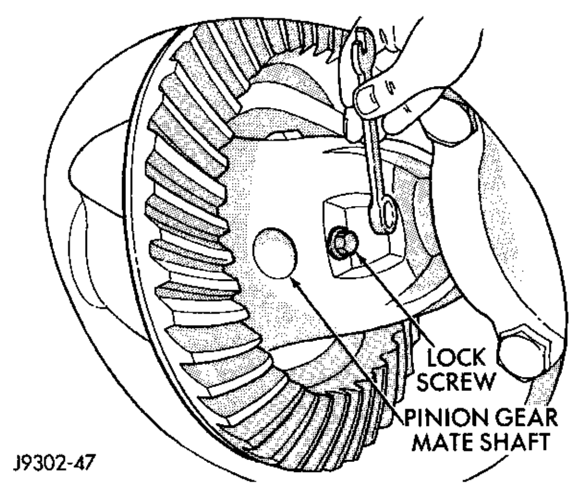

Fig. 37 Pinion Gear Mate Shaft Lock Screw

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DISASSEMBLY AND ASSEMBLY (Continued)

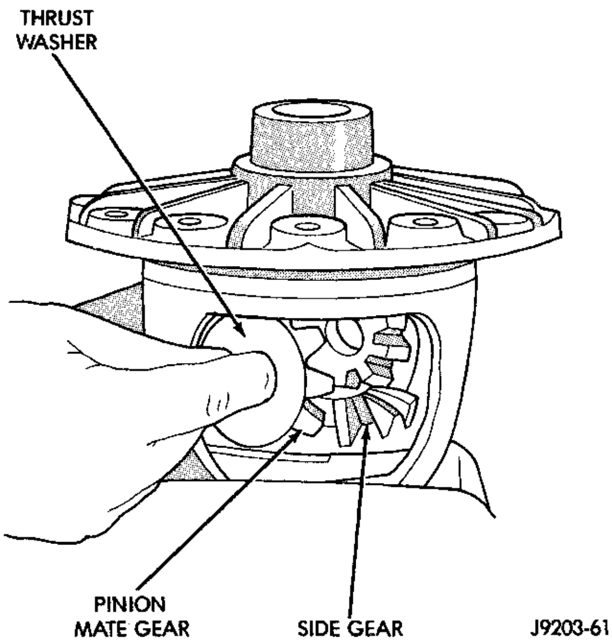

Fig. 38 Pinion Mate Gear Removal

(4) Remove the differential side gears and thrust washers.

ASSEMBLY

(1) Install the differential side gears and thrust washers.

(2) Install the pinion mate gears and thrust washers.

(3) Install the pinion gear mate shaft.

(4) Align the hole in the pinion gear mate shaft with the hole in the differential case and install the pinion gear mate shaft lock screw.

(5) Lubricate all differential components with hypoid gear lubricant.

9 1/4 TRAC-LOK DIFFERENTIAL

The Trac–lok differential components are illustrated in (Fig. 39). Refer to this illustration during repair service.

DISASSEMBLY

(1) Clamp Side Gear Holding Tool 8136 in a vise.

(2) Position the differential case on Side Gear Holding Tool 8136 (Fig. 40).

(3) Remove ring gear, if necessary. Ring gear removal is necessary only if the ring gear is to be replaced. The Trac-lok differential can be serviced with the ring gear installed.

(4) Remove the pinion gear mate shaft lock screw (Fig. 41).

(5) Remove the pinion gear mate shaft. If necessary, use a drift and hammer (Fig. 42).

(6) Install and lubricate Step Plate 8139-2 (Fig. 43).

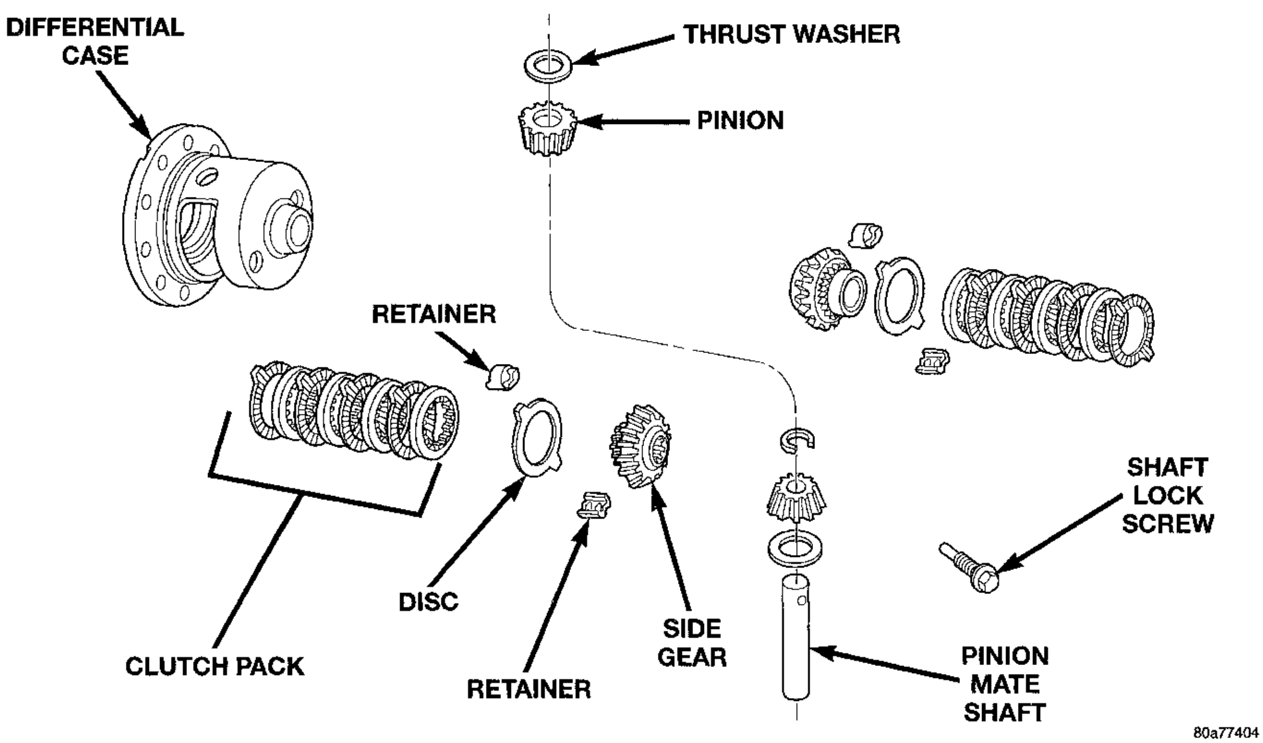

Fig. 39 Trac–lok Differential Components

DISASSEMBLY AND ASSEMBLY (Continued)

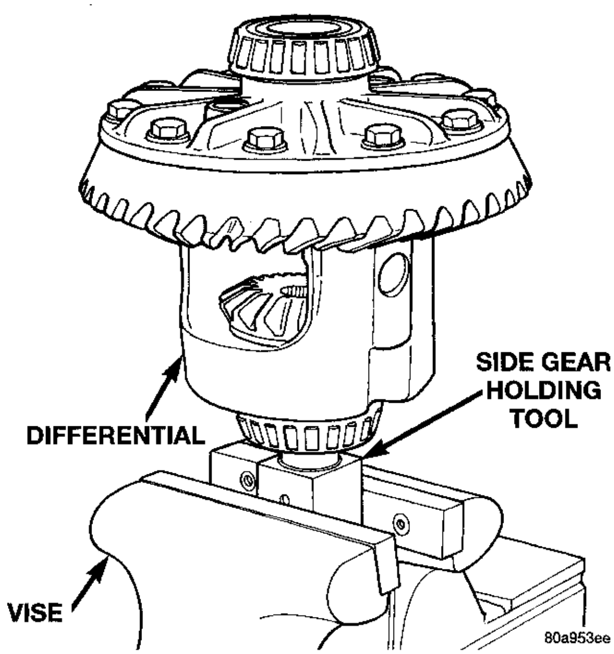

Fig. 40 Differential Case Holding Tool

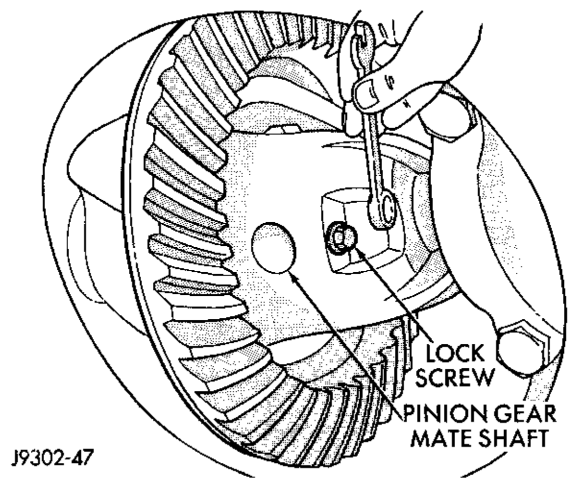

Fig. 41 Mate Shaft Lock Screw

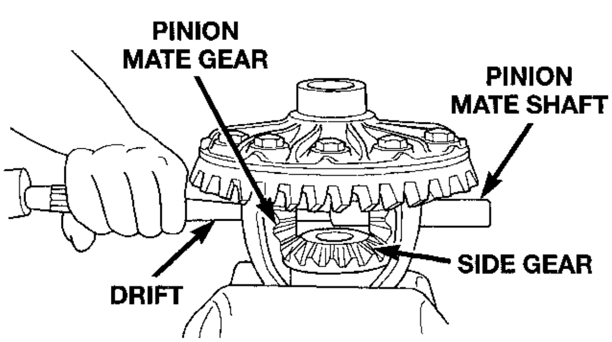

Fig. 42 Mate Shaft Removal

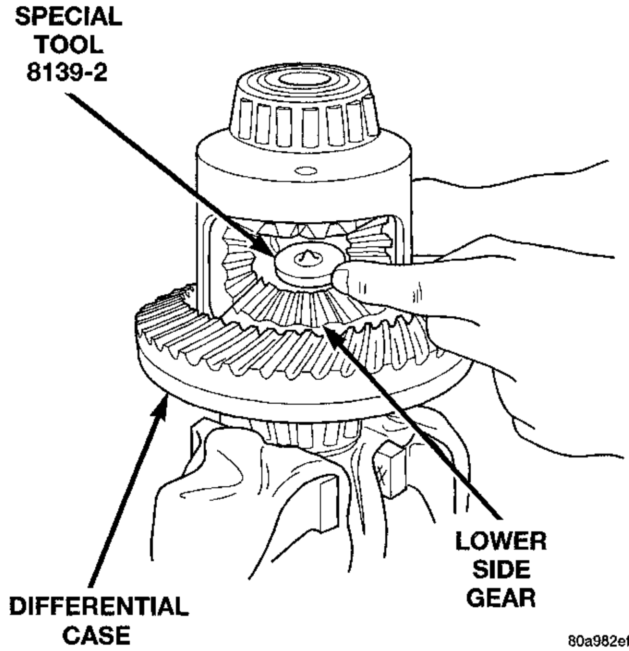

Fig. 43 Step Plate Tool Installation

(7) Assemble Threaded Adapter 8139-1 into top side gear. Thread Forcing Screw C-4487-2 into adapter until it becomes centered in adapter plate.

(8) Position a small screw driver in slot of Threaded Adapter 8139-1 (Fig. 44) to prevent adapter from turning.

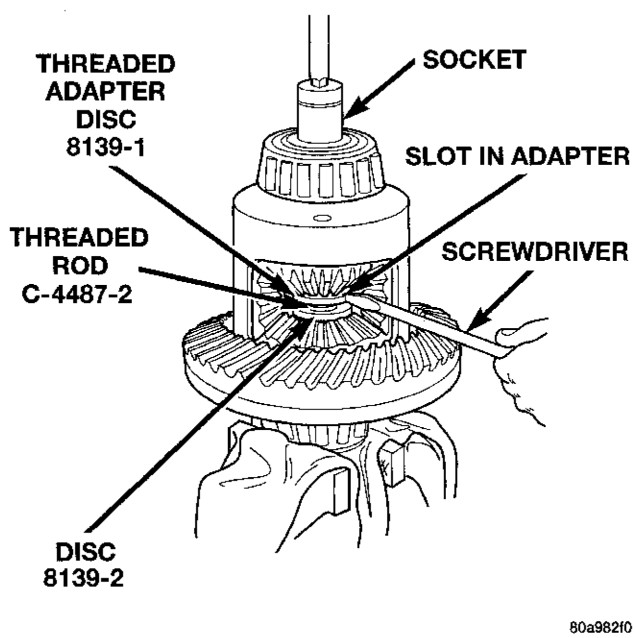

Fig. 44 Threaded Adapter Installation

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DISASSEMBLY AND ASSEMBLY (Continued)

(9) Tighten forcing screw tool 122 N·m (90 ft. lbs.) maximum to compress Belleville springs in clutch packs (Fig. 45).

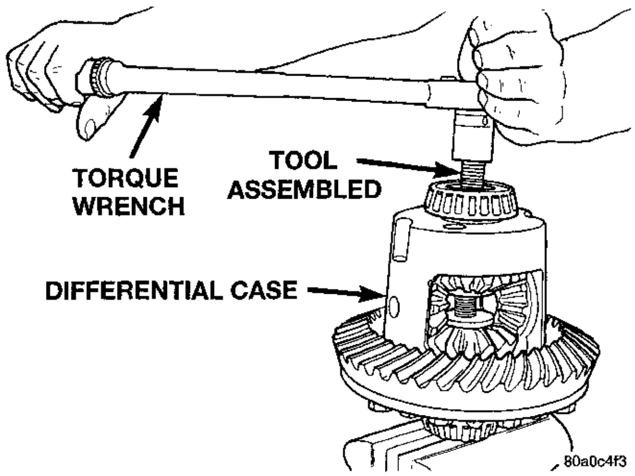

Fig. 45 Tighten Belleville Spring Compressor Tool

(10) Using an appropriate size feeler gauge, remove thrust washers from behind the pinion gears (Fig. 46).

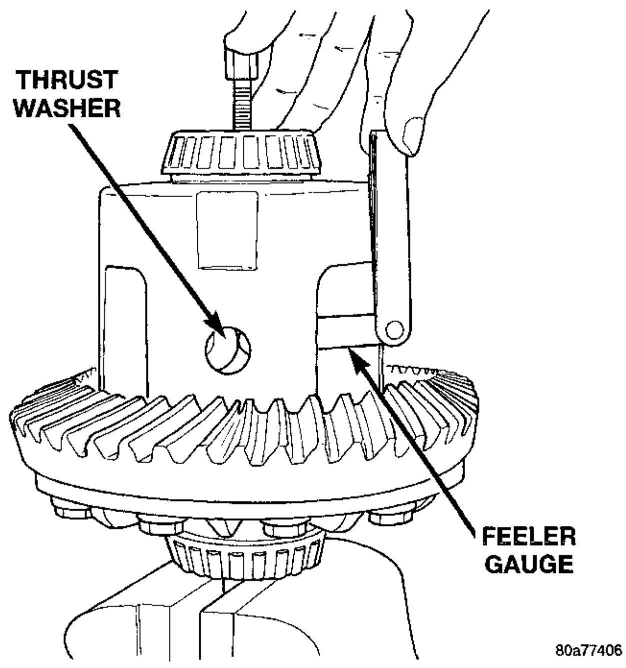

Fig. 46 Remove Pinion Gear Thrust Washer

(11) Insert Turning Bar C-4487-4 in case (Fig. 47).

(12) Loosen the Forcing Screw C-4487-2 in small increments until the clutch pack tension is relieved and the differential case can be turned using Turning Bar C-4487-4.

(13) Rotate differential case until the pinion gears can be removed.

(14) Remove pinion gears from differential case.

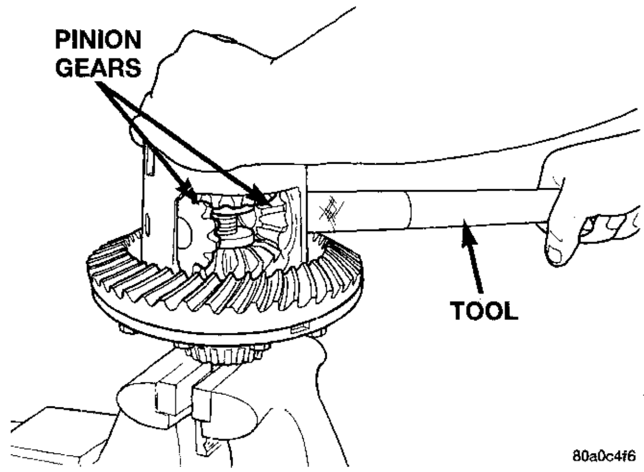

Fig. 47 Pinion Gear Removal

(15) Remove Forcing Screw C-4487-2, Step Plate 8139–2, and Threaded Adapter 8139-1.

(16) Remove top side gear, clutch pack retainer, and clutch pack. Keep plates in correct order during removal (Fig. 48).

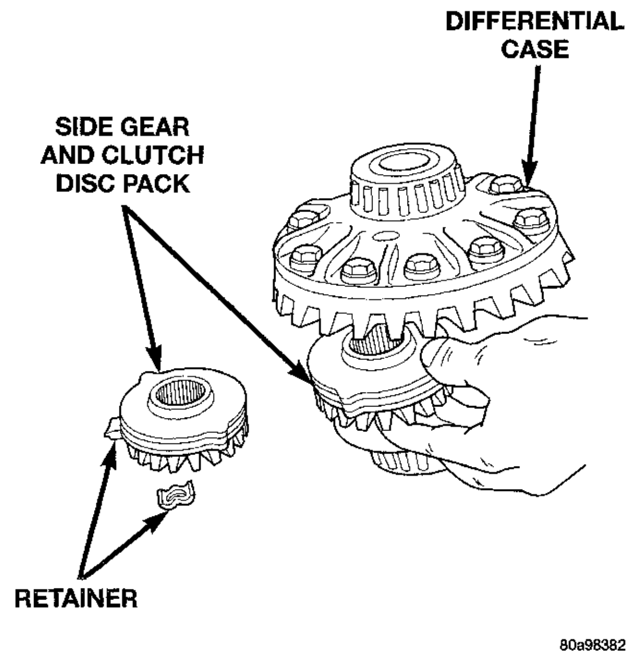

Fig. 48 Side Gear & Clutch Disc Removal

(17) Remove differential case from Side Gear Holding Tool 8136. Remove side gear, clutch pack retainer, and clutch pack. Keep plates in correct order during removal.

ASSEMBLY

NOTE: The clutch discs are replaceable as complete sets only. If one clutch disc pack is damaged, both packs must be replaced.

DISASSEMBLY AND ASSEMBLY (Continued)

Lubricate each component with gear lubricant before assembly.

(1) Assemble the clutch discs into packs and secure disc packs with retaining clips (Fig. 49).

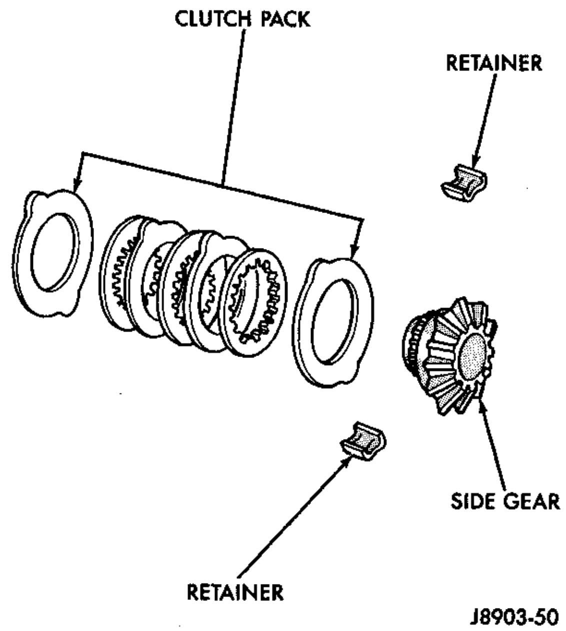

Fig. 49 Clutch Disc Pack

(2) Position assembled clutch disc packs on the side gear hubs.

(3) Install clutch pack and side gear in the ring gear side of the differential case (Fig. 50). **Be sure clutch pack retaining clips remain in position and are seated in the case pockets.**

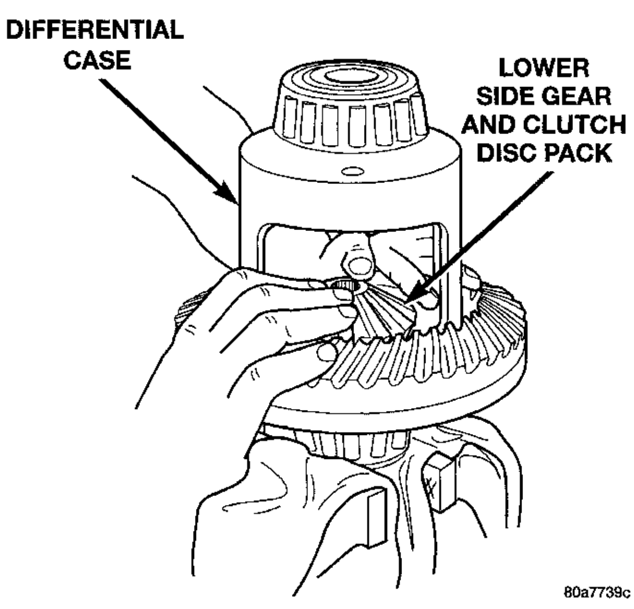

Fig. 50 Clutch Discs & Lower Side Gear Installation

(4) Position the differential case on Side Gear Holding Tool 8136.

(5) Install lubricated Step Plate 8139-2 in lower side gear (Fig. 51).

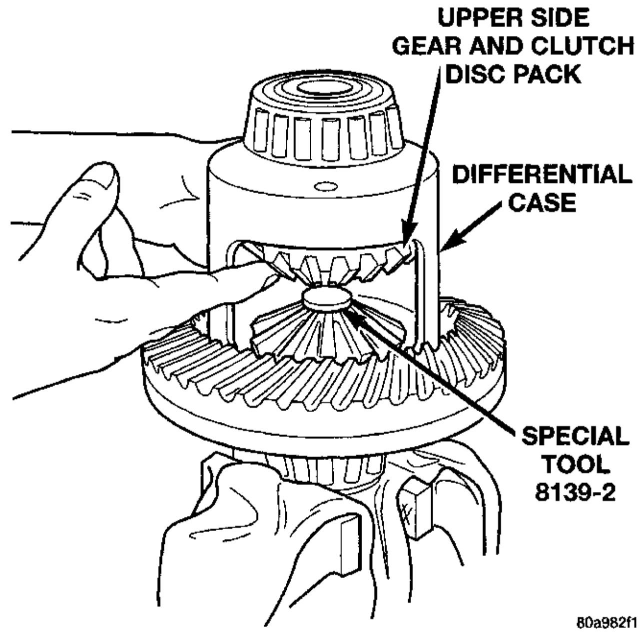

Fig. 51 Upper Side Gear & Clutch Disc Pack Installation

(6) Install the upper side gear and clutch disc pack (Fig. 51).

(7) Hold assembly in position. Insert Threaded Adapter 8139-1 into top side gear.

(8) Insert Forcing Screw C-4487-2.

(9) Tighten forcing screw tool to slightly compress clutch discs.

(10) Place pinion gears in position in side gears and verify that the pinion mate shaft holes are aligned.

(11) Rotate case with Turning Bar C-4487-4 until the pinion mate shaft holes in pinion gears align with holes in case. It may be necessary to slightly tighten the forcing screw in order to install the pinion gears.

(12) Tighten forcing screw to 122 N·m (90 ft. lbs.) maximum to compress the Belleville springs.

(13) Lubricate and install thrust washers behind pinion gears and align washers with a small screw driver. Insert mate shaft into each pinion gear to verify alignment.

(14) Remove Forcing Screw C-4487-2, Step Plate 8139-2, and Threaded Adapter 8139-1.

(15) Install pinion gear mate shaft and align holes in shaft and case.

(16) Install the pinion mate shaft lock screw finger tight to hold shaft during differential installation.

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DISASSEMBLY AND ASSEMBLY (Continued)

(17) Lubricate all differential components with hypoid gear lubricant.

CLEANING AND INSPECTION

9 1/4 AXLES

Wash differential components with cleaning solvent and dry with compressed air. **Do not steam clean the differential components.**

Wash bearings with solvent and towel dry, or dry with compressed air. DO NOT spin bearings with compressed air. **Cup and bearing must be replaced as matched sets only.**

Clean axle shaft tubes and oil channels in housing.

Inspect for:

- Smooth appearance with no broken/dented surfaces on the bearing rollers or the roller contact surfaces.
- Bearing cups must not be distorted or cracked.
- Machined surfaces should be smooth and without any raised edges.
- Raised metal on shoulders of cup bores should be removed with a hand stone.
- Wear and damage to pinion gear mate shaft, pinion gears, side gears and thrust washers. Replace as a matched set only.
- Ring and pinion gear for worn and chipped teeth.
- Ring gear for damaged bolt threads. Replaced as a matched set only.
- Pinion yoke for cracks, worn splines, pitted areas, and a rough/corroded seal contact surface. Repair or replace as necessary.
- Pinion depth shims for damage and distortion. Install new shims if necessary.
- The differential case. Replace the case if cracked or damaged.
- The axle shaft C-clip locks for cracks and excessive wear. Replace them if necessary.
- Each threaded adjuster to determine if it rotates freely. If an adjuster binds, repair the damaged threads or replace the adjuster.
- The RWAL exciter ring for damage and missing teeth. Verify that the ring is fully seated to the differential case flange.

Polish each axle shaft sealing surface with No. 600 crocus cloth. This can remove slight surface damage. Do not reduce the diameter of the axle shaft seal contact surface. When polishing, the crocus cloth should be moved around the circumference of the shaft (not in-line with the shaft).

TRAC-LOK

Clean all components in cleaning solvent. Dry components with compressed air. Inspect clutch pack plates for wear, scoring or damage. Replace both clutch packs if any one component in either pack is damaged. Inspect side and pinion gears. Replace any gear that is worn, cracked, chipped or damaged. Inspect differential case and pinion shaft. Replace if worn or damaged.

PRESOAK PLATES AND DISC

Plates and discs with fiber coating (no grooves or lines) must be presoaked in Friction Modifier before assembly. Soak plates and discs for a minimum of 20 minutes.

ADJUSTMENTS

9 1/4 AXLE PINION GEAR DEPTH

GENERAL INFORMATION

Ring and pinion gears are supplied as matched sets only. The identifying numbers for the ring and pinion gear are marked on the face of each gear (Fig. 52). A plus (+) number, minus (–) number or zero (0) is marked on the face of the pinion gear. This number is the amount (in thousandths of an inch) the depth varies from the standard depth setting of a pinion marked with a (0). The standard depth provides the best teeth contact pattern. Refer to Backlash and Contact Pattern Analysis Paragraph in this section for additional information.

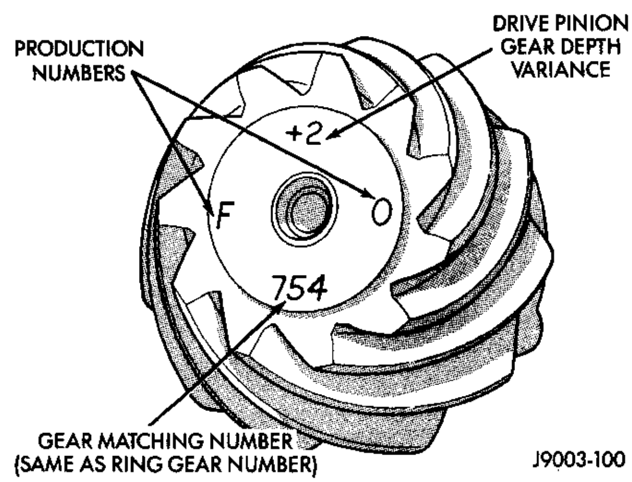

Fig. 52 Pinion Gear ID Numbers

Compensation for pinion depth variance is achieved with select shims. The shims are placed under the rear pinion bearing cone (Fig. 53).

If a new gear set is being installed, note the depth variance marked on both the original and replacement pinion gear. Add or subtract the thickness of the original depth shims to compensate for the difference in the depth variances. Refer to the Depth Variance charts.

ADJUSTMENTS (Continued)

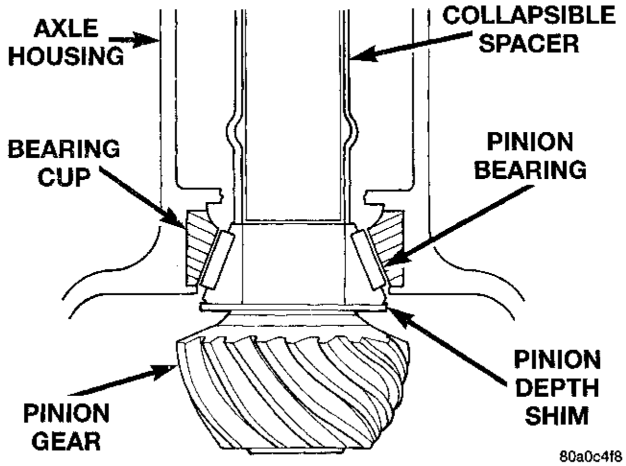

Fig. 53 Shim Locations

Note where Old and New Pinion Marking columns intersect. Intersecting figure represents plus or minus amount needed.

Note the marked number on the face of the drive pinion gear (–1, –2, 0, +1, +2, etc.). The numbers represent thousands of an inch deviation from the standard. If the number is negative, add that value to the required thickness of the depth shim(s). If the number is positive, subtract that value from the thickness of the depth shim(s). If the number is 0 no change is necessary. Refer to the Pinion Gear Depth Variance Chart.

PINION DEPTH MEASUREMENT AND ADJUSTMENT

(1) Install front bearing cup. Use Installer D-129 and Handle C-4171.

(2) Install rear bearing cup. Use Installer C-4310 and Handle C-4171.

(3) Use Pinion Gear Adjustment Gauge Set C-758-D6 (Fig. 54).

(4) Position Spacer SP-6017 over Shaft SP-526.

(5) Position pinion rear bearing on shaft.

(6) Position tools (with bearing) in the housing.

(7) Install Sleeve SP-1730.

(8) Install pinion front bearing.

(9) Install Spacer SP-6022.

(10) Install Sleeve SP-535A, Washer SP-534, and Nut SP-533.

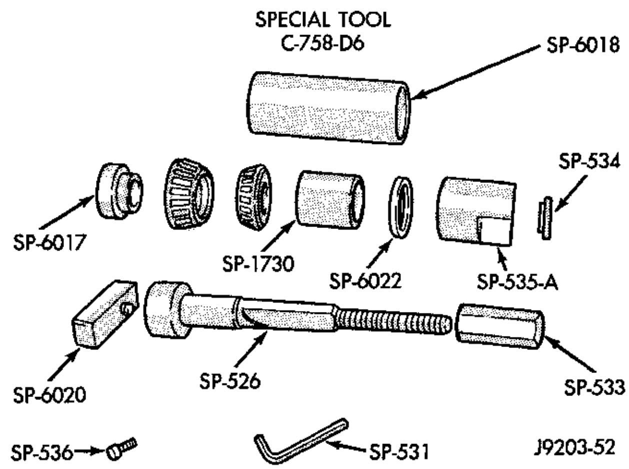

Fig. 54 9 1/4 Axle Pinion Adjustment Tools

(11) Tighten the nut to seat the pinion bearings in the housing. Allow the sleeve to turn several times during tightening to prevent brinelling bearing cups or bearings.

PINION GEAR DEPTH VARIANCE

Original Pinion Gear Depth Variance	Replacement Pinion Gear Depth Variance								
	−4	−3	−2	−1	0	+1	+2	+3	+4
+4	+0.008	+0.007	+0.006	+0.005	+0.004	+0.003	+0.002	+0.001	0
+3	+0.007	+0.006	+0.005	+0.004	+0.003	+0.002	+0.001	0	−0.001
+2	+0.006	+0.005	+0.004	+0.003	+0.002	+0.001	0	−0.001	−0.002
+1	+0.005	+0.004	+0.003	+0.002	+0.001	0	−0.001	−0.002	−0.003
0	+0.004	+0.003	+0.002	+0.001	0	−0.001	−0.002	−0.003	−0.004
−1	+0.003	+0.002	+0.001	0	−0.001	−0.002	−0.003	−0.004	−0.005
−2	+0.002	+0.001	0	−0.001	−0.002	−0.003	−0.004	−0.005	−0.006
−3	+0.001	0	−0.001	−0.002	−0.003	−0.004	−0.005	−0.006	−0.007
−4	0	−0.001	−0.002	−0.003	−0.004	−0.005	−0.006	−0.007	−0.008

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ADJUSTMENTS (Continued)

(12) Loosen the compression nut tool.

(13) Lubricate the pinion gear front and rear bearings with gear lubricant.

(14) Re-tighten the compression nut tool to 1-3 N·m (15-25 in. lbs.) torque.

(15) Rotate the pinion gear several complete revolutions to align the bearing rollers.

(16) Install Gauge Block (Fig. 55).

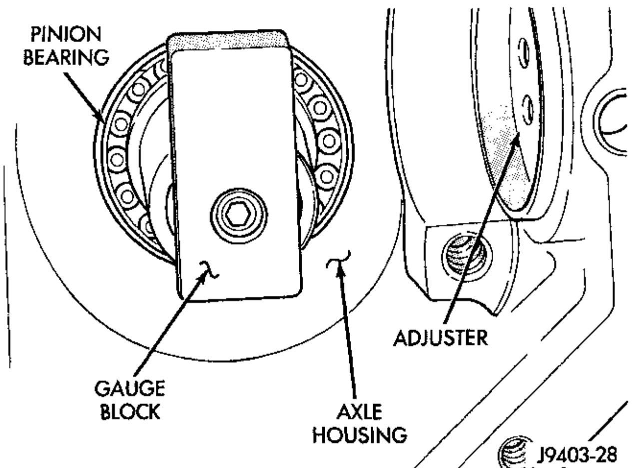


Fig. 55 Gauge Block

(17) Install Gauge Block SP-6020 at the end of SP-526.

(18) Install Cap Screw SP-536 and tighten with Wrench SP-531.

(19) Position Crossbore Arbor SP-6018 in the differential housing (Fig. 56).

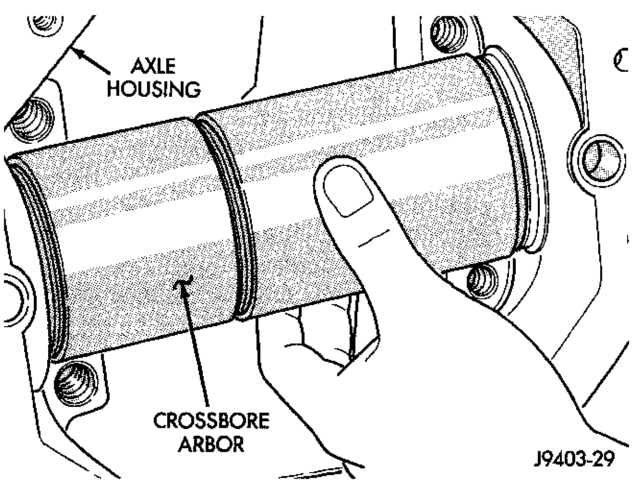


Fig. 56 Crossbore Arbor

(20) Center the tool.

(21) Position the bearing caps on the arbor tool.

(22) Install the attaching bolts.

(23) Tighten the cap bolts to 14 N·m (10 ft. lbs.).

(24) Trial fit depth shim(s) between the crossbore arbor and gauge block (Fig. 57). **The depth shim(s) fit must be snug but not tight (drag friction of a feeler gauge blade).**

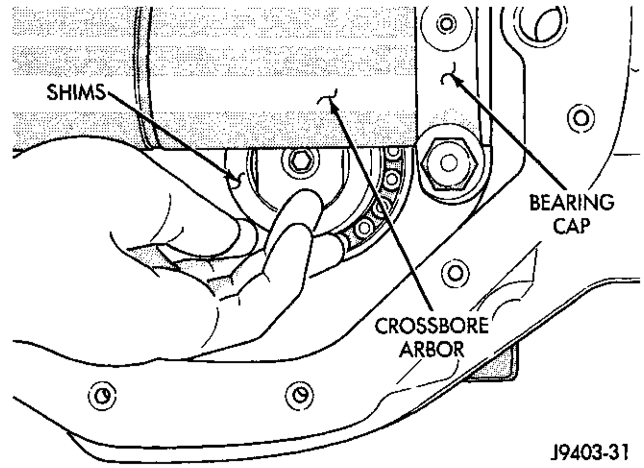


Fig. 57 Depth Shim(s) Selection

(25) Select a shim equal to the shim selected above plus the drive pinion gear depth variance number marked on the face of the pinion gear (Fig. 52) using the opposite sign on the variance number. For example, if the depth variance is –2, add +0.002 in. to the dial indicator reading.

NOTE: Depth shims are available in 0.001-inch increments from 0.020 inch to 0.038 inch.

(26) Remove the tools from the differential housing.

DIFFERENTIAL BEARING PRELOAD AND GEAR BACKLASH

The following must be considered when adjusting bearing preload and gear backlash:

- The maximum ring gear backlash variation is 0.003 inch (0.076 mm).
- Mark the gears so the same teeth are meshed during all backlash measurements.
- Maintain the torque while adjusting the bearing preload and ring gear backlash.
- Excessive adjuster torque will introduce a high bearing load and cause premature bearing failure. Insufficient adjuster torque can result in excessive differential case free-play and ring gear noise.
- Insufficient adjuster torque will not support the ring gear correctly and can cause excessive differential case free-play and ring gear noise.

NOTE: The differential bearing cups will not always immediately follow the threaded adjusters as they are moved during adjustment. To ensure accurate bearing cup responses to the adjustments:

- **Maintain the gear teeth engaged (meshed) as marked.**
- **The bearings must be seated by rapidly rotating the pinion gear a half turn back and forth.**
- **Do this five to ten times each time the threaded adjusters are adjusted.**

ADJUSTMENTS (Continued)

(1) Use Wrench C-4164 to adjust each threaded adjuster inward until the differential bearing free-play is eliminated (Fig. 58). Allow some ring gear backlash (approximately 0.01 inch/0.25 mm) between the ring and pinion gear. Seat the bearing cups with the procedure described above.

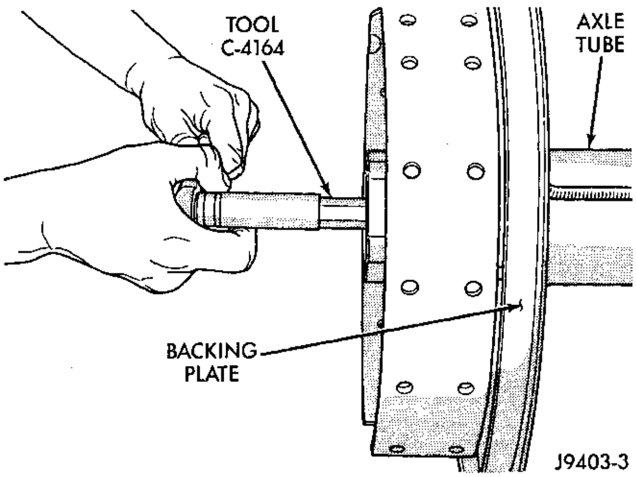


Fig. 58 Threaded Adjuster Tool

(2) Install dial indicator and position the plunger against the drive side of a ring gear tooth (Fig. 59). Measure the backlash at 4 positions (90 degrees apart) around the ring gear. Locate and mark the area of minimum backlash.

(3) Rotate the ring gear to the position of the least backlash. Mark the gear so that all future backlash measurements will be taken with the same gear teeth meshed.

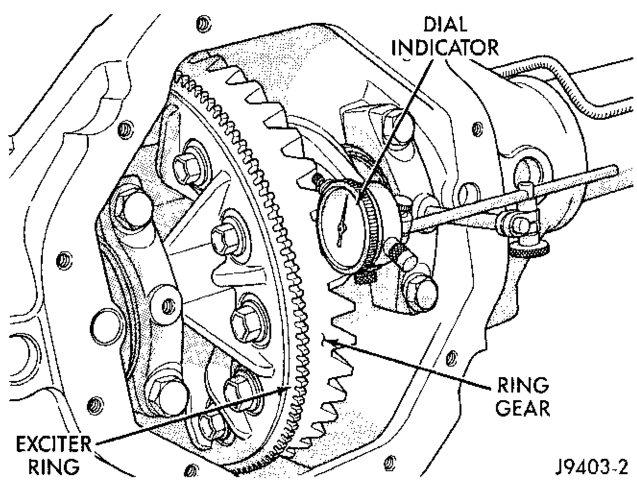


Fig. 59 Ring Gear Backlash Measurement

(4) Loosen the right-side, tighten the left-side threaded adjuster. Obtain backlash of 0.003 to 0.004 inch (0.076 to 0.102 mm) with each adjuster tightened to 14 N·m (10 ft. lbs.). Seat the bearing cups with the procedure described above.

(5) Tighten the differential bearing cap bolts to 136 N·m (100 ft. lbs.);

(6) Tighten the right-side threaded adjuster to 102 N·m (75 ft. lbs.). Seat the bearing cups with the procedure described above. Continue to tighten the right-side adjuster and seat bearing cups until the torque remains constant at 102 N·m (75 ft. lbs.)

(7) Measure the ring gear backlash. The range of backlash is 0.006 to 0.008 inch (0.15 to 0.203 mm).

(8) Continue increasing the torque at the right-side threaded adjuster until the specified backlash is obtained.

NOTE: The left-side threaded adjuster torque should have approximately 102 N·m (75 ft. lbs.). If the torque is considerably less, the complete adjustment procedure must be repeated.

(9) Tighten the left-side threaded adjuster until 102 N·m (75 ft. lbs.) torque is indicated. Seat the bearing rollers with the procedure described above. Do this until the torque remains constant.

(10) Install the threaded adjuster locks and tighten the lock screws to 10 N·m (90 in. lbs.).

After the proper backlash is achieved, perform the Gear Contact Analysis procedure.

GEAR CONTACT PATTERN ANALYSIS

The ring and pinion gear teeth contact patterns will show if the pinion gear depth is correct in the axle housing. It will also show if the ring gear backlash has been adjusted correctly. The backlash can be adjusted within specifications to achieve desired tooth contact patterns.

(1) Apply a thin coat of hydrated ferric oxide, or equivalent, to the drive and coast side of the ring gear teeth.

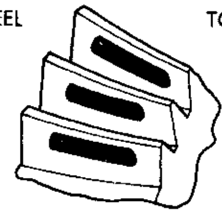
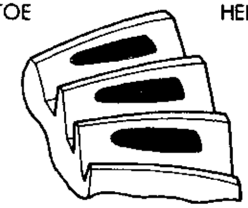
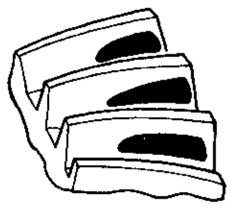
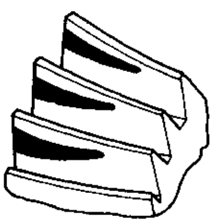
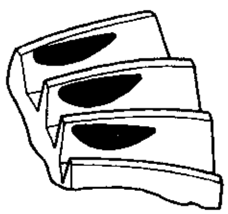
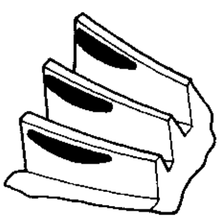
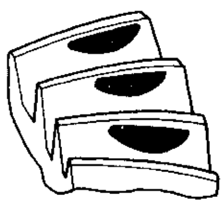
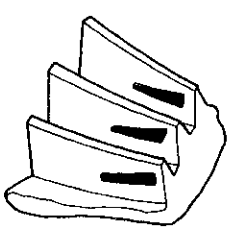
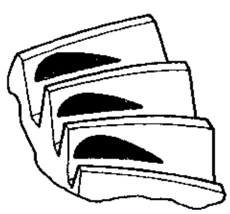
(2) Wrap, twist, and hold a shop towel around the pinion yoke to increase the turning resistance of the pinion gear. This will provide a more distinct contact pattern.

(3) Using a boxed end wrench on a ring gear bolt, Rotate the differential case one complete revolution in both directions while a load is being applied from shop towel.

The areas on the ring gear teeth with the greatest degree of contact against the pinion gear teeth will squeegee the compound to the areas with the least amount of contact. Note and compare patterns on the ring gear teeth to Gear Tooth Contact Patterns chart (Fig. 60) and adjust pinion depth and gear backlash as necessary.

AUTHENTIC RESTORATION PRODUCT

ADJUSTMENTS (Continued)

DRIVE SIDE OF RING GEAR TEETH	COAST SIDE OF RING GEAR TEETH	
HEEL  TOE	TOE  HEEL	DESIRABLE CONTACT PATTERN. PATTERN SHOULD BE CENTERED ON THE DRIVE SIDE OF TOOTH. PATTERN SHOULD BE CENTERED ON THE COAST SIDE OF TOOTH, BUT MAY BE SLIGHTLY TOWARD THE TOE. THERE SHOULD ALWAYS BE SOME CLEARANCE BETWEEN CONTACT PATTERN AND TOP OF THE TOOTH.
		RING GEAR BACKLASH CORRECT. **THINNER** PINION GEAR DEPTH SHIM REQUIRED.
		RING GEAR BACKLASH CORRECT. **THICKER** PINION GEAR DEPTH SHIM REQUIRED.
		PINION GEAR DEPTH SHIM CORRECT. **DECREASE** RING GEAR BACKLASH.
		PINION GEAR DEPTH SHIM CORRECT. **INCREASE** RING GEAR BACKLASH.

J9003-24

Fig. 60 Gear Tooth Contact Patterns

AUTHENTIC RESTORATION PRODUCT

ADJUSTMENTS (Continued)

SIDE GEAR CLEARANCE

When measuring side gear clearance, check each gear independently. If it necessary to replace a side gear, replace both gears as a matched set.

(1) Install the axle shafts and C-clip locks and pinion mate shaft.

(2) Measure each side gear clearance. Insert a matched pair of feeler gauge blades between the gear and differential housing on opposite sides of the hub (Fig. 61).

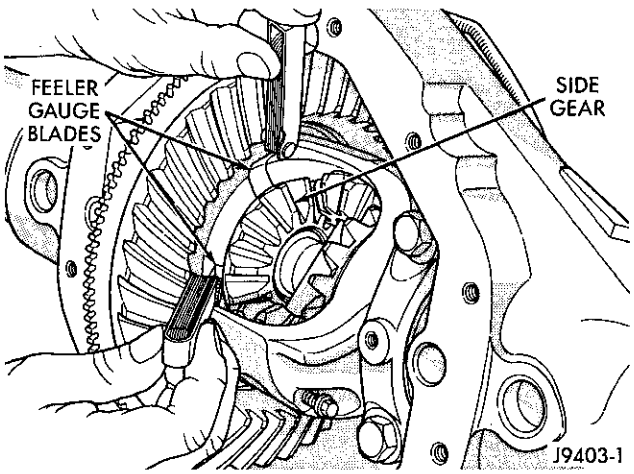


Fig. 61 Side Gear Clearance Measurement

(3) If side gear clearances is no more than 0.005 inch. Determine if the shaft is contacting the pinion gear mate shaft. **Do not remove the feeler gauges, inspect the axle shaft with the feeler gauge inserted behind the side gear.** If the end of the axle shaft is not contacting the pinion gear mate shaft, the side gear clearance is acceptable.

(4) If clearance is more than 0.005 inch (axle shaft not contacting mate shaft), record the side gear clearance. Remove the thrust washer and measure its thickness with a micrometer. Add the washer thickness to the recorded side gear clearance. The sum of gear clearance and washer thickness will determine required thickness of replacement thrust washer (Fig. 62).

SIDE GEAR CLEARANCE	0.007
THRUST WASHER THICKNESS	+ 0.033
TOTAL	0.040
	0.040
REPLACEMENT WASHER THICKNESS	– 0.037
NEW SIDE GEAR CLEARANCE	0.003

J9203-31

Fig. 62 Side Gear Calculations

In some cases, the end of the axle shaft will move and contact the mate shaft when the feeler gauge is inserted. The C-clip lock is preventing the side gear from sliding on the axle shaft.

(5) If there is no side gear clearance, remove the C-clip lock from the axle shaft. Use a micrometer to measure the thrust washer thickness. Record the thickness and re-install the thrust washer. Assemble the differential case without the C-clip lock installed and re-measure the side gear clearance.

(6) Compare both clearance measurements. If the difference is less than 0.012 inch (0.305 mm), add clearance recorded when the C-clip lock was installed to thrust washer thickness measured. The sum will determine the required thickness of the replacement thrust washer.

(7) If clearance is 0.012 inch (0.305 mm) or greater, both side gears must be replaced (matched set) and the clearance measurements repeated.

(8) If clearance (above) continues to be 0.012 inch (0.305 mm) or greater, the case must be replaced.

SPECIFICATIONS

9 1/4 INCH AXLE

Axle Type . . . . .Semi-floating, hypoid
Lubricant . . . . .SAE 80W-90
Lube Capacity . . . . .2.32 L (4.9 pts.)
Trac-lok Additive. . . . . .148 ml (5 oz.)
Axle Ratio. 3.21, 3.55, 3.92

Differential

Case Clearance . . . . .0.12 mm (0.005 in.)
Case Flange Runout. . . . . .0.076 mm (0.003 in.)

Ring gear

Diameter .23.50 cm (9.25 in.)
Backlash. . . . . .0.12-0.20 mm (0.005-0.008 in.)
Runout. .0.127 mm (0.005 in.)

Pinion Bearing Preload

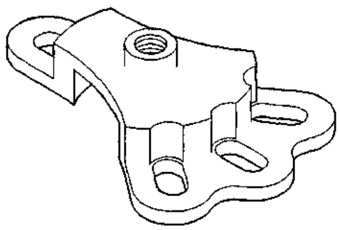
Original. . . . . .1-2 N·m (10-20 in.lbs.)
New . . . . .2–5 N·m (15–35 in. lbs.)

TORQUE

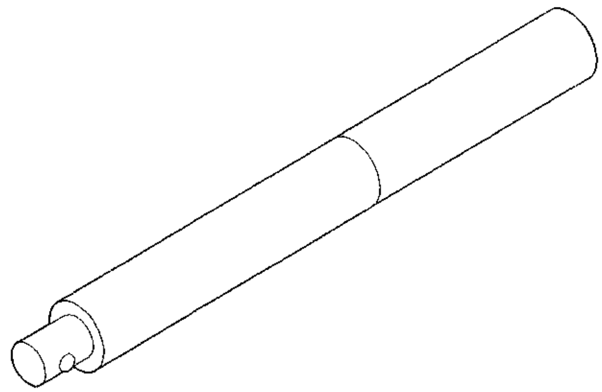
DESCRIPTION	TORQUE
Bolt, Diff. cover	41 N·m (30 ft. lbs.)
Bolt, Bearing cap	136 N·m (100 ft. lbs.)
Nut, Pinion–Minimum	285 N·m (210 ft. lbs.)
Bolt, Ring gear	157 N·m (115 ft. lbs.)
Bolt, Backing plate	64 N·m (48 ft. lbs.)
Bolt, RWAL/ABS sensor	24 N·m (18. ft. lbs.)
Screw, Pinion Mate Lock	11 N·m (8 ft. lbs.)

SPECIAL TOOLS

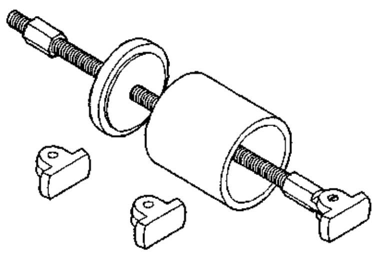
9 1/4 AXLES



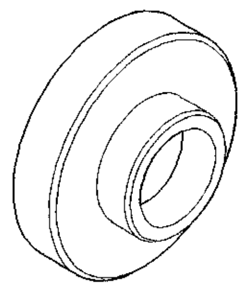
Puller, Hub—6790



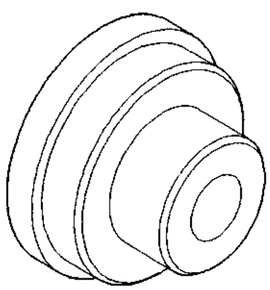
Handle—C-4171



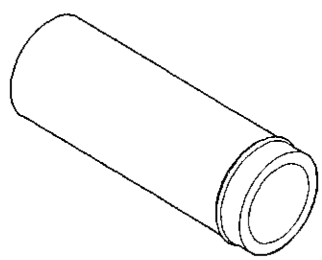
Remover, Bearing—6310



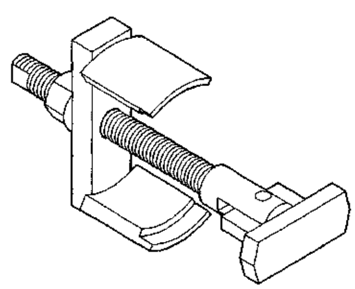
Installer—C-4076-B



Installer—C-4198

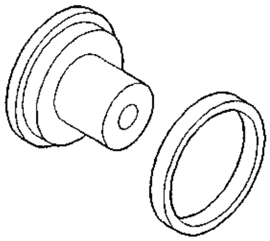


Handle—C-4735-1



Remover—C-4828

SPECIAL TOOLS (Continued)



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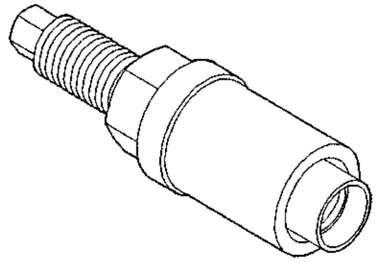
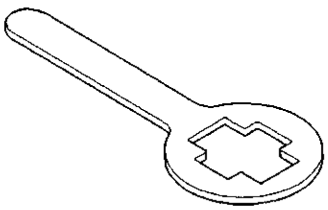
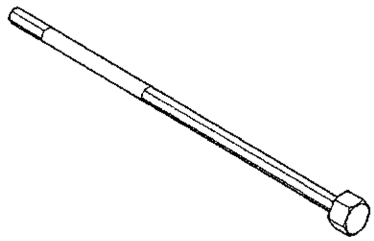


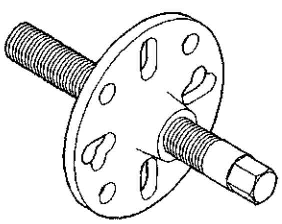
Installer—C-3718



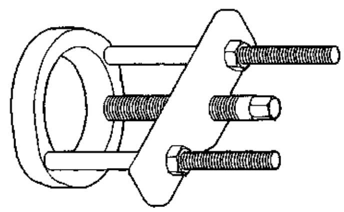
Holder—6719



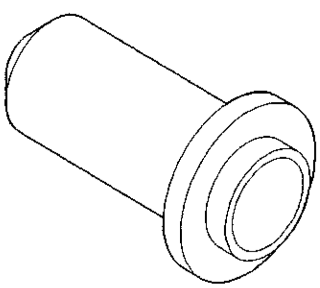
Adjustment Rod—C-4164



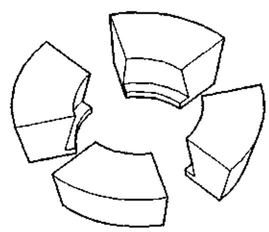
Puller—C-452



Puller/Press—C-293–PA



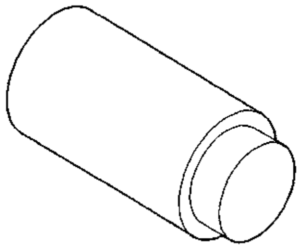
Installer—C-3860-A



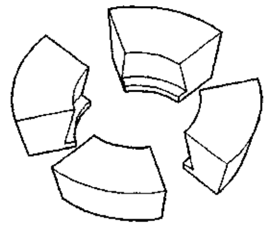
Adapters—C-293-47

AUTHENTIC RESTORATION PRODUCT

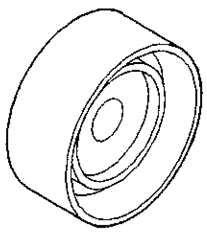
SPECIAL TOOLS (Continued)



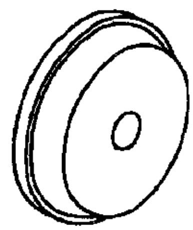
Plug—C-293-3



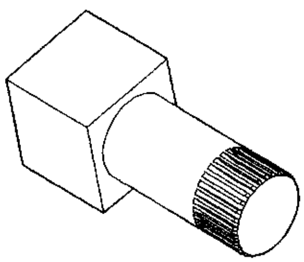
Adapters—C-293-37



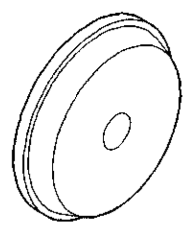
Installer—C-4213



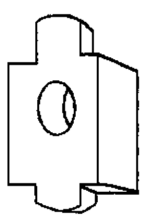
Installer—C-4310



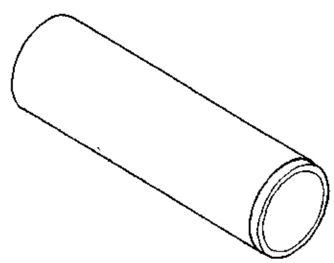
Holder—8136



Installer—D-129



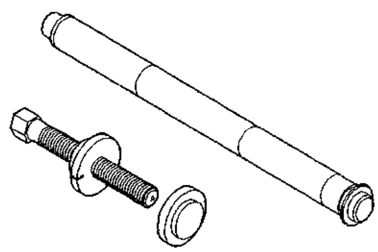
Remover—C-4309



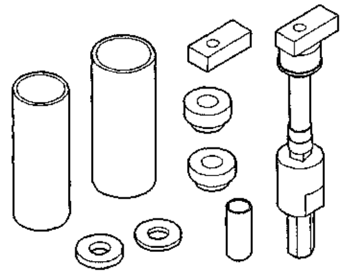
Installer—C-3095

AUTHENTIC RESTORATION PRODUCT Mopar

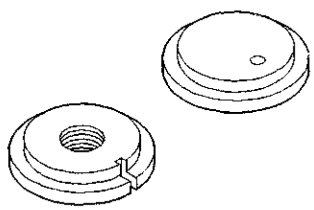
SPECIAL TOOLS (Continued)



Trac-lok Tools—C-4487



Gauge Set—C-758-D6



Trac-lok Tools—8139

AUTHENTIC RESTORATION PRODUCT

248 AND 267 RBI AXLES

INDEX

GENERAL INFORMATION

248 AND 267 RBI AXLE

The 248 and 267 Rear Beam-design Iron (RBI) axle housings consist of an iron center casting (differential housing) with axle shaft tubes extending from either side. The tubes are pressed in to form a one-piece axle housing.

The integral type housing, hypoid gear design has the centerline of the pinion set below the centerline of the ring gear.

The axles are equipped with full-floating axle shafts, meaning that loads are supported by the axle housing tubes. The full-float axle shafts are retained by bolts attached to the hub. The hub rides on two bearings at the outboard end of the axle tube. The axle shafts can be removed without disturbing or removing the wheel bearings. The wheel bearings are opposed tapered roller bearings and are contained in the hub assembly.

The removable, stamped steel cover provides a means for inspection and service without removing the complete axle from the vehicle. A small, stamped metal axle gear ratio identification tag is attached to the housing cover via one of the cover bolts. This tag also identifies the number of ring and pinion teeth.

The rear wheel anti-lock (RWAL) brake speed sensor is attached to the top, forward exterior of the differential housing. A seal is located between the sensor and the wire harness connector. The seal must be in place when the wire connector is connected to the sensor. The RWAL brake exciter ring is press-fitted onto the differential case against the ring gear flange.

The differential case for the standard differentials and the Trac-lok differential in the 248 RBI axle are a one-piece design. The differential pinion mate shaft is retained with a roll pin. Differential bearing preload and ring gear backlash are adjusted by the use of shims located between the differential bearing cones and case. Pinion bearing preload is set and maintained by the use of a collapsible spacer in the 248 RBI axle. The 267 RBI axle uses solid shims to maintain pinion bearing preload.

Axles equipped with a Trac-Lok™ differential are optional for the 248 RBI axle. A Trac-lok differential has a one-piece differential case and the same internal components as a standard differential plus two clutch disc packs.

GENERAL INFORMATION (Continued)

Axles equipped with a Power-Lok™ differential are optional for the 267 RBI axle. A Power-lok differential has a two-piece differential case. A Power-lok differential contains four pinion gears and a two-piece pinion mate cross shaft to provide increased torque to the non-slipping wheel through a ramping motion in addition to the standard Trac-lok components.

LUBRICANT SPECIFICATIONS

A multi–purpose, hypoid gear lubricant which conforms to the following specifications should be used. Mopar® Hypoid Gear Lubricant conforms to all of these specifications.

- The lubricant should have MIL–L–2105C and API GL 5 quality specifications.
- Lubricant is a thermally stable SAE 90W gear lubricant.

Trac-lok differentials require the addition of 0.18 L (6 oz.) of friction modifier to the axle lubricant. The 248 RBI axle lubricant capacity is 2.96 L (6.25 pts.) total, including the friction modifier if necessary.

Power-lok differentials require the addition of 0.24 L (8 oz.) of friction modifier to the axle lubricant. The 267 RBI axle lubricant capacity is 3.31 L (7.0 pts.) total, including the friction modifier.

CAUTION: If axle is submerged in water, lubricant must be replaced immediately to avoid possible premature axle failure.

DESCRIPTION AND OPERATION

STANDARD DIFFERENTIAL

The differential gear system divides the torque between the axle shafts. It allows the axle shafts to rotate at different speeds when turning corners.

Each differential side gear is splined to an axle shaft. The pinion gears are mounted on a pinion mate shaft and are free to rotate on the shaft. The pinion gear is fitted in a bore in the differential case and is positioned at a right angle to the axle shafts.

In operation, power flow occurs as follows:

- The pinion gear rotates the ring gear
- The ring gear (bolted to the differential case) rotates the case
- The differential pinion gears (mounted on the pinion mate shaft in the case) rotate the side gears
- The side gears (splined to the axle shafts) rotate the shafts

During straight-ahead driving, the differential pinion gears do not rotate on the pinion mate shaft. This occurs because input torque applied to the gears is divided and distributed equally between the two side gears. As a result, the pinion gears revolve with the pinion mate shaft but do not rotate around it (Fig. 1).

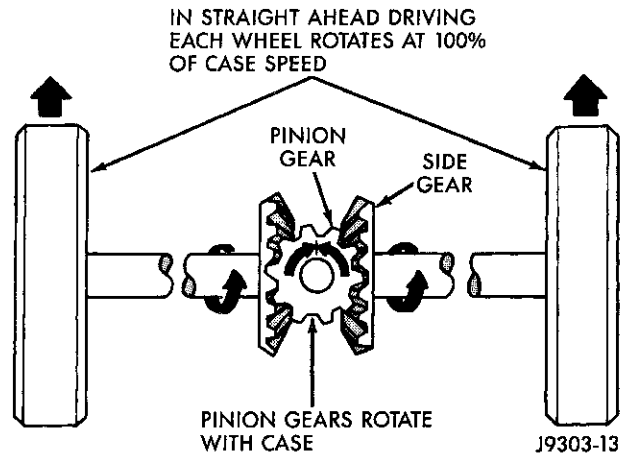


Fig. 1 Differential Operation—Straight Ahead Driving

When turning corners, the outside wheel must travel a greater distance than the inside wheel to complete a turn. The difference must be compensated for to prevent the tires from scuffing and skidding through turns. To accomplish this, the differential allows the axle shafts to turn at unequal speeds (Fig. 2). In this instance, the input torque applied to the pinion gears is not divided equally. The pinion gears now rotate around the pinion mate shaft in opposite directions. This allows the side gear and axle shaft attached to the outside wheel to rotate at a faster speed.

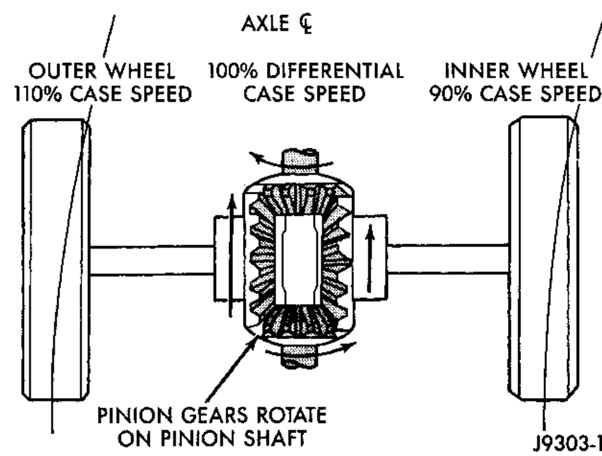


Fig. 2 Differential Operation—On Turns

TRAC-LOK/POWER-LOK OPERATION

In a conventional differential, if one wheel spins, the opposite wheel will generate only as much torque as the spinning wheel.

The 248 RBI axle is optionally equipped with a Trac-lok differential while the 267 RBI axle is optionally equipped with a Power-lok differential. Both differentials achieve the same results through slightly different means.

AUTHENTIC RESTORATION PRODUCT

DESCRIPTION AND OPERATION (Continued)

In the Trac-lok and Power-lok differentials, part of the ring gear torque is transmitted through clutch packs which contain multiple discs. The clutches will have radial grooves on the plates, and concentric grooves on the discs or bonded fiber material that is smooth in appearance.

In operation, the Trac-lok and Power-lok clutches are engaged by two concurrent forces. The first being the preload force exerted through Belleville spring washers within the clutch packs. The second is the separating forces generated by the side gears as torque is applied through the ring gear (Fig. 3).

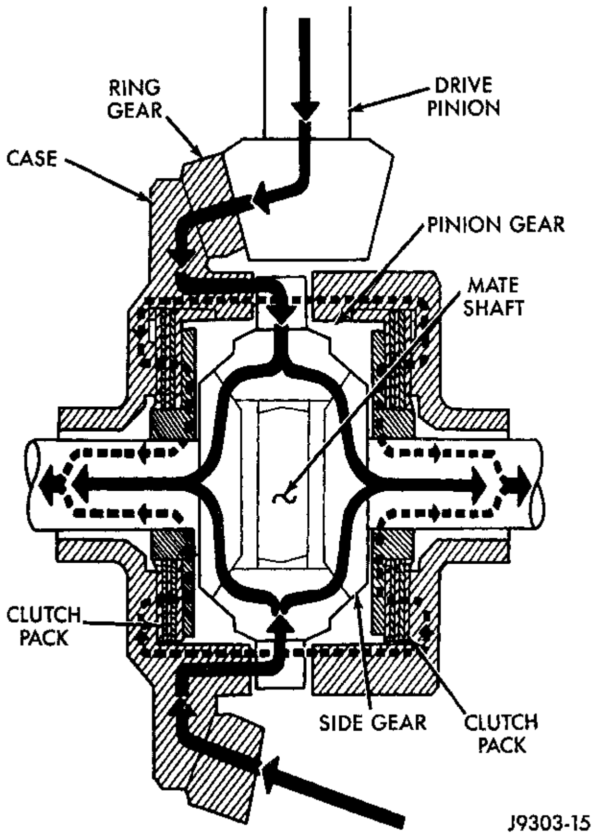


Fig. 3 Trac-lok/Power-lok Limited Slip Differential Operation

The Trac-lok and Power-lok designs provide the differential action needed for turning corners and for driving straight ahead during periods of unequal traction. When one wheel looses traction, the clutch packs transfer additional torque to the wheel having the most traction. The Power-lok differential additionally utilizes a ramping action supplied by the cross shafts to increase the force applied to the clutch packs to increase the torque supplied to the non-slipping wheel. Trac-lok and Power-lok differentials resist wheel spin on bumpy roads and provide more pulling power when one wheel looses traction. Pulling power is provided continuously until both wheels loose traction. If both wheels slip due to unequal traction, operation is normal. In extreme cases of differences of traction, the wheel with the least traction may spin.

DIAGNOSIS AND TESTING

GENERAL INFORMATION

Axle bearing problem conditions are usually caused by:

- Insufficient or incorrect lubricant.
- Foreign matter/water contamination.
- Incorrect bearing preload torque adjustment.
- Incorrect backlash.

Axle gear problem conditions are usually the result of:

- Insufficient lubrication.
- Incorrect or contaminated lubricant.
- Overloading (excessive engine torque) or exceeding vehicle weight capacity.
- Incorrect clearance or backlash adjustment.

Axle component breakage is most often the result of:

- Severe overloading.
- Insufficient lubricant.
- Incorrect lubricant.
- Improperly tightened components.

GEAR NOISE

Axle gear noise can be caused by insufficient lubricant, incorrect backlash, tooth contact, or worn/damaged gears.

Gear noise usually happens at a specific speed range. The range is 30 to 40 mph, or above 50 mph. The noise can also occur during a specific type of driving condition. These conditions are acceleration, deceleration, coast, or constant load.

When road testing, accelerate the vehicle to the speed range where the noise is the greatest. Shift out-of-gear and coast through the peak–noise range. If the noise stops or changes greatly:

- Check for insufficient lubricant.
- Incorrect ring gear backlash.
- Gear damage.

Differential side and pinion gears can be checked by turning the vehicle. They usually do not cause noise during straight–ahead driving when the gears are unloaded. The side gears are loaded during vehicle turns. A worn pinion gear mate shaft can also cause a snapping or a knocking noise.

BEARING NOISE

The axle shaft, differential and pinion gear bearings can all produce noise when worn or damaged. Bearing noise can be either a whining, or a growling sound.

DIAGNOSIS AND TESTING (Continued)

Pinion gear bearings have a constant–pitch noise. This noise changes only with vehicle speed. Pinion bearing noise will be higher because it rotates at a faster rate. Drive the vehicle and load the differential. If bearing noise occurs, the rear pinion bearing is the source of the noise. If the bearing noise is heard during a coast, the front pinion bearing is the source.

Worn or damaged differential bearings usually produce a low pitch noise. Differential bearing noise is similar to pinion bearing noise. The pitch of differential bearing noise is also constant and varies only with vehicle speed.

Axle shaft bearings produce noise and vibration when worn or damaged. The noise generally changes when the bearings are loaded. Road test the vehicle. Turn the vehicle sharply to the left and to the right. This will load the bearings and change the noise level. Where axle bearing damage is slight, the noise is usually not noticeable at speeds above 30 mph.

LOW SPEED KNOCK

Low speed knock is generally caused by a worn U–joint or by worn side–gear thrust washers. A worn pinion gear shaft bore will also cause low speed knock.

VIBRATION

Vibration at the rear of the vehicle is usually caused by a:

- Damaged drive shaft.
- Missing drive shaft balance weight(s).
- Worn or out–of–balance wheels.
- Loose wheel lug nuts.
- Worn U–joint(s).
- Loose/broken springs.
- Damaged axle shaft bearing(s).
- Loose pinion gear nut.
- Excessive pinion yoke run out.
- Bent axle shaft(s).

Check for loose or damaged front–end components or engine/transmission mounts. These components can contribute to what appears to be a rear–end vibration. Do not overlook engine accessories, brackets and drive belts.

All driveline components should be examined before starting any repair.

Refer to Group 22, Wheels and Tires, for additional vibration information.

DRIVELINE SNAP

A snap or clunk noise when the vehicle is shifted into gear (or the clutch engaged), can be caused by:

- High engine idle speed
- Loose engine/transmission/transfer case mounts
- Worn U–joints
- Loose spring mounts
- Loose pinion gear nut and yoke
- Excessive ring gear backlash
- Excessive side gear/case clearance

The source of a snap or a clunk noise can be determined with the assistance of a helper. Raise the vehicle on a hoist with the wheels free to rotate. Instruct the helper to shift the transmission into gear. Listen for the noise, a mechanics stethoscope is helpful in isolating the source of a noise.

TRAC–LOK/POWER–LOK DIFFERENTIAL NOISE

The most common problem is a chatter noise when turning corners. Before removing a Trac-lok/Power-lok unit for repair, drain, flush and refill the axle with the specified lubricant. Refer to Lubricant change in this Group.

A container of Mopar® Trac-lok Lubricant (friction modifier) should be added after repair service or during a lubricant change.

After changing the lubricant, drive the vehicle and make 10 to 12 slow, figure-eight turns. This maneuver will pump lubricant through the clutches. This will correct the condition in most instances. If the chatter persists, clutch damage could have occurred.

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DIAGNOSIS AND TESTING (Continued)

DIAGNOSIS CHART

CONDITION	POSSIBLE CAUSES	CORRECTION
WHEEL NOISE	1. Wheel loose. 2. Faulty, brinelled wheel bearing.	1. Tighten loose nuts. 2. Faulty or brinelled bearings must be replaced.
AXLE SHAFT NOISE	1. Misaligned axle shaft tube. 2. Bent or sprung axle shaft. 3. End play in drive pinion bearings. 4. Excessive gear backlash between ring gear and pinion gear. 5. Improper adjustment of drive pinion gear shaft bearings. 6. Loose drive pinion gearshaft yoke nut. 7. Improper wheel bearing adjustment. 8. Scuffed gear tooth contact surfaces.	1. Inspect axle shaft tube alignment. Correct as necessary. 2. Replace bent or sprung axle shaft. 3. Refer to Drive Pinion Bearing Pre-Load Adjustment. 4. Check adjustment of ring gear backlash and pinion gear. Correct as necessary. 5. Adjust drive pinion shaft bearings. 6. Tighten drive pinion gearshaft yoke nut with specified torque. 7. Readjust as necessary. 8. If necessary, replace scuffed gears.
AXLE SHAFT BROKE	1. Misaligned axle shaft tube. 2. Vehicle overloaded. 3. Erratic clutch operation. 4. Grabbing clutch.	1. Replace broken axle shaft after correcting axle shaft tube alignment. 2. Replace broken axle shaft. Avoid excessive weight on vehicle. 3. Replace broken axle shaft after inspecting for other possible causes. Avoid erratic use of clutch. 4. Replace broken axle shaft. Inspect clutch and make necessary repairs or adjustments.
DIFFERENTIAL CASE CRACKED	1. Improper adjustment of differential bearings. 2. Excessive ring gear backlash. 3. Vehicle overloaded. 4. Erratic clutch operation.	1. Replace cracked case; examine gears and bearings for possible damage. At reassembly, adjust differential bearings properly. 2. Replace cracked case; examine gears and bearings for possible damage. At reassembly, adjust ring gear backlash properly. 3. Replace cracked case; examine gears and bearings for possible damage. Avoid excessive weight on vehicle. 4. Replace cracked case. After inspecting for other possible causes, examine gears and bearings for possible damage. Avoid erratic use of clutch.
DIFFERENTIAL GEARS SCORED	1. Insufficient lubrication. 2. Improper grade of lubricant. 3. Excessive spinning of one wheel/tire.	1. Replace scored gears. Scoring marks on the drive face of gear teeth or in the bore are caused by instantaneous fusing of the mating surfaces. Scored gears should be replaced. Fill rear differential housing to required capacity with proper lubricant. Refer to Specifications. 2. Replace scored gears. Inspect all gears and bearings for possible damage. Clean and refill differential housing to required capacity with proper lubricant. 3. Replace scored gears. Inspect all gears, pinion bores and shaft for damage. Service as necessary.
LOSS OF LUBRICANT	1. Lubricant level too high.	1. Drain excess lubricant by removing fill plug and allow lubricant to level at lower edge of fill plug hole.

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AUTHENTIC RESTORATION PRODUCT

DIAGNOSIS AND TESTING (Continued)

CONT., DIAGNOSIS CHART

CONDITION	POSSIBLE CAUSES	CORRECTION
LOSS OF LUBRICANT	2. Worn axle shaft seals. 3. Cracked differential housing. 4. Worn drive pinion gear shaft seal. 5. Scored and worn yoke. 6. Axle cover not properly sealed.	2. Replace worn seals. 3. Repair or replace housing as necessary. 4. Replace worn drive pinion gear shaft seal. 5. Replace worn or scored yoke and seal. 6. Remove cover and clean flange and reseal.
AXLE OVERHEATING	1. Lubricant level too low. 2. Incorrect grade of lubricant. 3. Bearings adjusted too tight. 4. Excessive gear wear. 5. Insufficient ring gear backlash.	1. Refill differential housing. 2. Drain, flush and refill with correct amount of the correct lubricant. 3. Readjust bearings. 4. Inspect gears for excessive wear or scoring. Replace as necessary. 5. Readjust ring gear backlash and inspect gears for possible scoring.
GEAR TEETH BROKE (RING GEAR AND PINION)	1. Overloading. 2. Erratic clutch operation. 3. Ice-spotted pavements. 4. Improper adjustments.	1. Replace gears. Examine other gears and bearings for possible damage. 2. Replace gears and examine the remaining parts for possible damage. Avoid erratic clutch operation. 3. Replace gears. Examine the remaining parts for possible damage. Replace parts as required. 4. Replace gears. Examine other parts for possible damage. Ensure ring gear backlash is correct.
AXLE NOISE	1. Insufficient lubricant. 2. Improper ring gear and drive pinion gear adjustment. 3. Unmatched ring gear and drive pinion gear. 4. Worn teeth on ring gear or drive pinion gear. 5. Loose drive pinion gear shaft bearings. 6. Loose differential bearings. 7. Misaligned or sprung ring gear. 8. Loose differential bearing cap bolts	1. Refill axle with correct amount of the proper lubricant. Also inspect for leaks and correct as necessary. 2. Check ring gear and pinion gear teeth contact pattern. 3. Remove unmatched ring gear and drive pinion gear. Replace with matched gear and drive pinion gear set. 4. Check teeth on ring gear and drive pinion gear for correct contact. If necessary, replace with new matched set. 5. Adjust drive pinion gearshaft bearing preload torque. 6. Adjust differential bearing preload torque. 7. Measure ring gear runout. 8. Tighten with specified torque

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DIAGNOSIS AND TESTING (Continued)

TRAC–LOK/POWER–LOK TEST

WARNING: WHEN SERVICING VEHICLES WITH A TRAC–LOK/POWER–LOK DIFFERENTIAL DO NOT USE THE ENGINE TO TURN THE AXLE AND WHEELS. BOTH REAR WHEELS MUST BE RAISED AND THE VEHICLE SUPPORTED. A TRAC–LOK/POWER—LOK AXLE CAN EXERT ENOUGH FORCE IF ONE WHEEL IS IN CONTACT WITH A SURFACE TO CAUSE THE VEHICLE TO MOVE.

The differential can be tested without removing the differential case by measuring rotating torque. Make sure brakes are not dragging during this measurement.

(1) Place blocks in front and rear of both front wheels.

(2) Raise one rear wheel until it is completely off the ground.

(3) Engine off, transmission in neutral, and parking brake off.

(4) Remove wheel and bolt Special Tool 6790 to studs.

(5) Use torque wrench on special tool to rotate wheel and read rotating torque (Fig. 4).

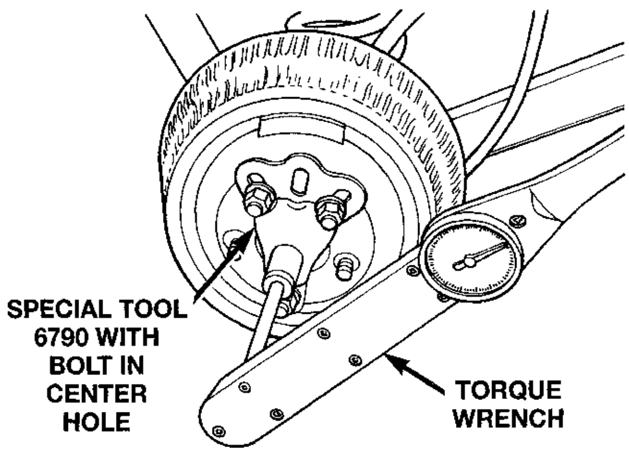

Fig. 4 Trac-lok\Power-lok Test —Typical

(6) If rotating torque is less than 22 N·m (30 ft. lbs.) or more than 271 N·m (200 ft. lbs.) on either wheel the unit should be serviced.

SERVICE PROCEDURES

LUBRICANT CHANGE

(1) Raise and support the vehicle.

(2) Remove the lubricant fill hole plug from the differential housing cover.

(3) Remove the differential housing cover and drain the lubricant from the housing.

(4) Clean the housing cavity with a flushing oil, light engine oil, or lint free cloth. **Do not use water, steam, kerosene, or gasoline for cleaning.**

(5) Remove the original sealant from the housing and cover surfaces.

(6) Apply a bead of Mopar® Silicone Rubber Sealant, or equivalent, to the housing cover (Fig. 5).

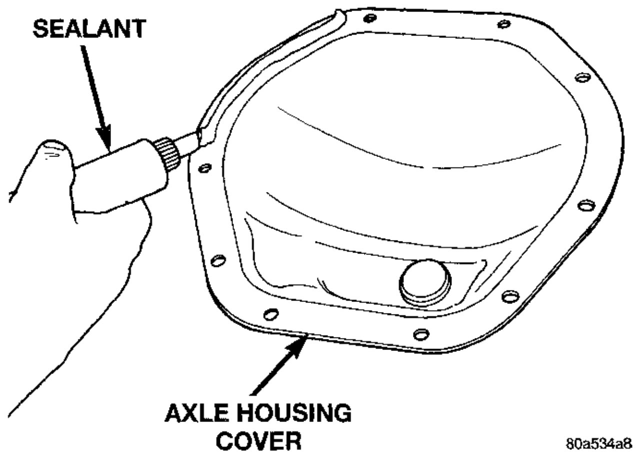

Fig. 5 Apply Sealant

Install the housing cover within 5 minutes after applying the sealant.

(7) Install the cover and any identification tag. Tighten the cover bolts to 41 N·m (30 ft. lbs.) torque.

(8) For Trac-lok/Power-lok differentials, a quantity of Mopar® Trac-lok lubricant (friction modifier), or equivalent, must be added after repair service or a lubricant change. Refer to the Lubricant Specifications section of this group for the quantity necessary.

(9) Fill differential with Mopar® Hypoid Gear Lubricant, or equivalent, to bottom of the fill plug hole. Refer to the Lubricant Specifications section of this group for the quantity necessary.

CAUTION: Overfilling the differential can result in lubricant foaming and overheating.

(10) Install the fill hole plug and lower the vehicle.

(11) Trac-lok/Power-lok differential equipped vehicles should be road tested by making 10 to 12 slow figure-eight turns. This maneuver will pump the lubricant through the clutch discs to eliminate a possible chatter noise complaint.

REMOVAL AND INSTALLATION

REAR AXLE

REMOVAL

(1) Raise and support the vehicle.

REMOVAL AND INSTALLATION (Continued)

(2) Position a suitable lifting device under the axle.
(3) Secure axle to device.
(4) Remove the wheels and tires.
(5) Secure brake drums to the axle shaft.
(6) Remove the RWAL sensor from the differential housing, if necessary. Refer to Group 5, Brakes, for proper procedures.
(7) Disconnect the brake hose at the axle junction block. Do not disconnect the brake hydraulic lines at the wheel cylinders. Refer to Group 5, Brakes, for proper procedures.
(8) Disconnect the parking brake cables and cable brackets.
(9) Disconnect the vent hose from the axle shaft tube.
(10) Mark the propeller shaft and yoke for installation alignment reference.
(11) Remove propeller shaft.
(12) Disconnect shock absorbers from axle.
(13) Remove the spring clamps and spring brackets. Refer to Group 2, Suspension, for proper procedures.
(14) Separate the axle from the vehicle.

INSTALLATION

(1) Raise the axle with lifting device and align to the leaf spring centering bolts.
(2) Install the spring clamps and spring brackets. Refer to Group 2, Suspension, for proper procedures.
(3) Install shock absorbers and tighten nuts to 82 N·m (60 ft. lbs.) torque.
(4) Install the RWAL sensor to the differential housing, if necessary. Refer to Group 5, Brakes, for proper procedures.
(5) Connect the parking brake cables and cable brackets.
(6) Install the brake drums. Refer to Group 5, Brakes, for proper procedures.
(7) Connect the brake hose to the axle junction block. Refer to Group 5, Brakes, for proper procedures.
(8) Install axle vent hose.
(9) Align propeller shaft and pinion yoke reference marks. Install universal joint straps and bolts. Tighten to 19 N·m (14 ft. lbs.) torque.
(10) Install the wheels and tires.
(11) Add gear lubricant, if necessary. Refer to Lubricant Specifications in this section for lubricant requirements.
(12) Remove lifting device from axle and lower the vehicle.

AXLE SHAFT

CAUTION: RAISE BOTH REAR WHEELS OFF THE SURFACE WHENEVER A REAR AXLE IS BEING SERVICED.

REMOVAL

(1) Remove the axle shaft flange bolts.
(2) Slide the axle shaft out from the axle tube.

INSTALLATION

(1) Clean the gasket contact surface area on the flange with an appropriate solvent. Install a new flange gasket and slide the axle shaft into the tube.
(2) Install the bolts and tighten to 122 N·m (90 ft. lbs.).

HUB AND AXLE BEARINGS

REMOVAL

(1) Remove wheel and tire assembly.
(2) Remove brake drum.
(3) Remove the axle shaft.
(4) Remove the lock wedge and adjustment nut. Use Socket DD-1241–JD to remove the adjustment nut.
(5) Remove the hub assembly. The outer axle bearing will slide out as the hub is being removed.
(6) Remove inner grease seal and discard. Use Installer 5064 and Handle C-4171 to drive grease seal and inner axle bearing from the hub.
(7) Remove the bearing cups from the hub bore. Use a brass drift, or an appropriate removal tool, to tap out the cups.

INSTALLATION

(1) Thoroughly clean both axle bearings and interior of the hub with an appropriate cleaning solvent.
(2) Install the bearing cups. Use Installer 8151 and Handle C-4171 to install the bearing cups.
(3) Apply lubricant to surface area of the bearing cup.
(4) Install the inner axle bearing in the hub.
(5) Install a new bearing grease seal. Use Installer 8149 and Handle C-4171 to install the grease seal.
(6) Inspect the bearing and seal contact surfaces on the axle tube spindle for burrs and/or roughness. Remove all the rough contact surfaces from the axle spindle. Apply a coating of multi-purpose NLGI, grade 2, EP-type lubricant to the axle.

CAUTION: Use care to prevent the bearing grease seal from contacting the axle tube spindle threads during installation. Otherwise, the seal could be damaged.

(7) Carefully slide the hub onto the axle.

REMOVAL AND INSTALLATION (Continued)

(8) Install the outer axle bearing.

(9) Install the hub bearing adjustment nut. Use Socket DD-1241–JD to install the adjustment nut.

(10) Tighten the adjustment nut to 163-190 N·m (120-140 ft. lbs.) while rotating the wheel.

(11) Loosen the adjustment nut 1/8 of-a-turn to provide 0.001-inch to 0.010-inch wheel bearing end play.

(12) Tap the locking wedge into the spindle keyway and adjustment nut. Try to ensure that the locking wedge is installed into a new position in the adjustment nut.

(13) Install the axle shaft.

(14) Install the brake drum.

(15) Install the wheel and tire assembly.

PINION SEAL

REMOVAL

(1) Raise and support the vehicle.

(2) Scribe a mark on the universal joint, pinion yoke, and pinion shaft for reference.

(3) Disconnect the propeller shaft from the pinion yoke. Secure the propeller shaft in an upright position to prevent damage to the rear universal joint.

(4) Remove the wheel and tire assemblies.

(5) Remove the brake drums to prevent any drag. The drag may cause a false bearing preload torque measurement.

(6) Rotate the pinion yoke three or four times.

(7) Measure the amount of torque necessary to rotate the pinion gear with a (in. lbs.) dial-type torque wrench. Record the torque reading for installation reference.

(8) Hold the yoke with Wrench 6719. Remove the pinion shaft nut and washer.

(9) Remove the yoke with Remover C-452 (Fig. 6).

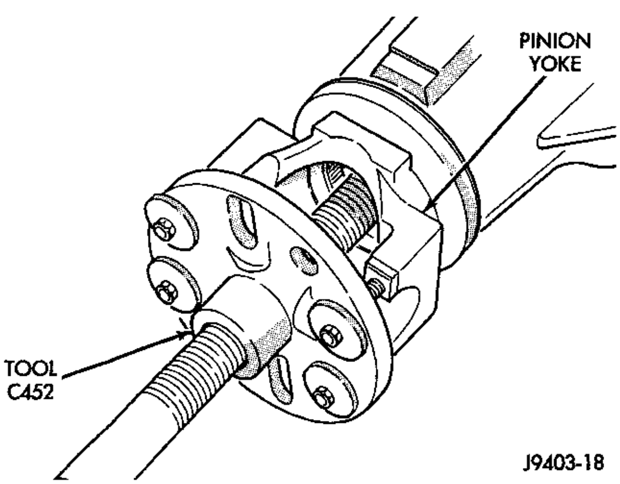

Fig. 6 Yoke Removal

(10) Remove the pinion shaft seal with suitable pry tool or slide-hammer mounted screw.

INSTALLATION

(1) Clean the seal contact surface in the housing bore.

(2) Examine the splines on the pinion shaft for burrs or wear. Remove any burrs and clean the shaft.

(3) Inspect pinion yoke for cracks, worn splines and worn seal contact surface. Replace yoke if necessary.

NOTE: The outer perimeter of the seal is pre-coated with a special sealant. An additional application of sealant is not required.

(4) Apply a light coating of gear lubricant on the lip of pinion seal.

(5) Install the new pinion shaft seal with Installer 8108 and Handle 4171 (Fig. 7).

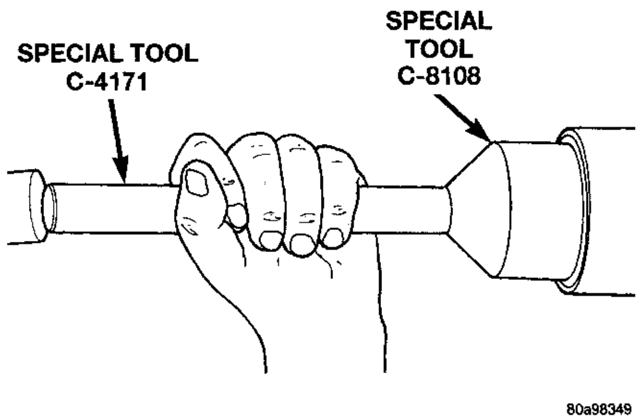

Fig. 7 Pinion Seal Installation

NOTE: The seal is correctly installed when the seal flange contacts the face of the differential housing flange.

(6) Position the pinion yoke on the end of the shaft with the reference marks aligned.

(7) Seat yoke on pinion shaft with Installer C-3718 and Wrench 6719.

(8) Remove the tools and install the pinion yoke washer and nut.

CAUTION: Do not exceed the minimum tightening torque when installing the pinion yoke retaining nut at this point. Damage to collapsible spacer, if equipped, or bearings may result.

(9) Hold pinion yoke with Yoke Holder 6719 and tighten shaft nut to 291.5 N·m (215 ft. lbs.) (Fig. 8). Rotate pinion shaft several revolutions to ensure the bearing rollers are seated.

(10) Rotate the pinion shaft using a (in. lbs.) torque wrench. Rotating resistance torque should be

REMOVAL AND INSTALLATION (Continued)

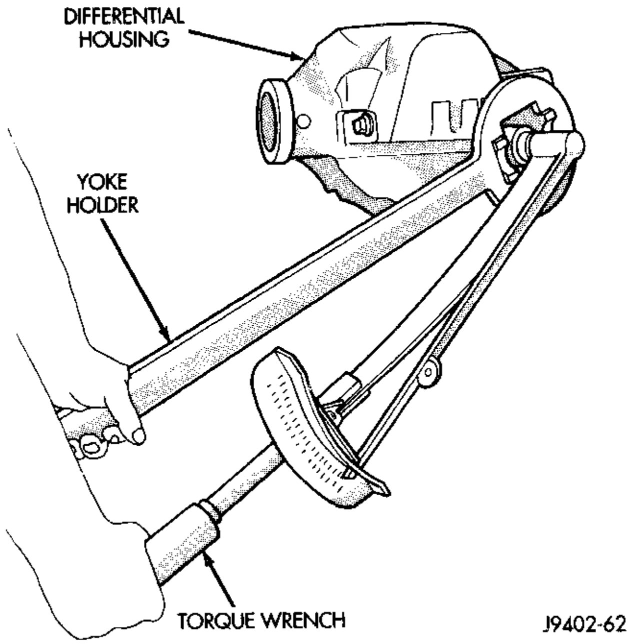

Fig. 8 Tightening Pinion Shaft Nut

equal to the reading recorded during removal, plus an additional 0.56 N·m (5 in. lbs.) (Fig. 9).

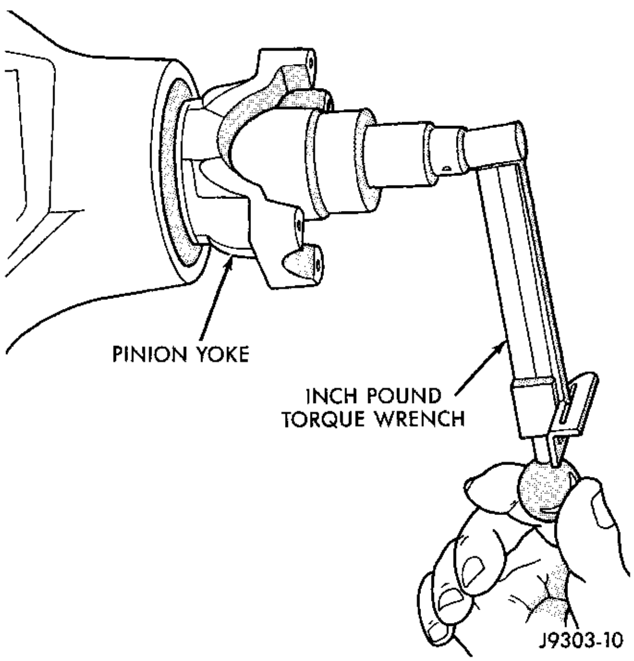

Fig. 9 Check Pinion Rotation Torque

CAUTION: Never loosen pinion gear nut to decrease pinion gear bearing rotating torque and never exceed specified preload torque. If preload torque is exceeded a new pinion nut and collapsible spacer, if equipped, must be installed. The torque sequence will then have to be repeated.

(11) If the rotating torque is low, use Yoke Holder 6719 to hold the pinion yoke (Fig. 8) and tighten the pinion shaft nut in 6.8 N·m (5 ft. lbs.) increments until proper rotating torque is achieved.

NOTE: The bearing rotating torque should be constant during a complete revolution of the pinion. If the rotating torque varies, this indicates a binding condition.

(12) Install the propeller shaft with the installation reference marks aligned.
(13) Tighten the universal joint yoke clamp screws to 19 N·m (14 ft. lbs.).
(14) Install the brake drums.
(15) Add gear lubricant to the differential housing, if necessary. Refer to the Lubricant Specifications for gear lubricant requirements.
(16) Install wheel and tire assemblies and lower the vehicle.

DIFFERENTIAL

REMOVAL

(1) Remove axle shafts.
(2) Note the orientation of the installation reference letters stamped on the bearing caps and housing machined sealing surface (Fig. 10).

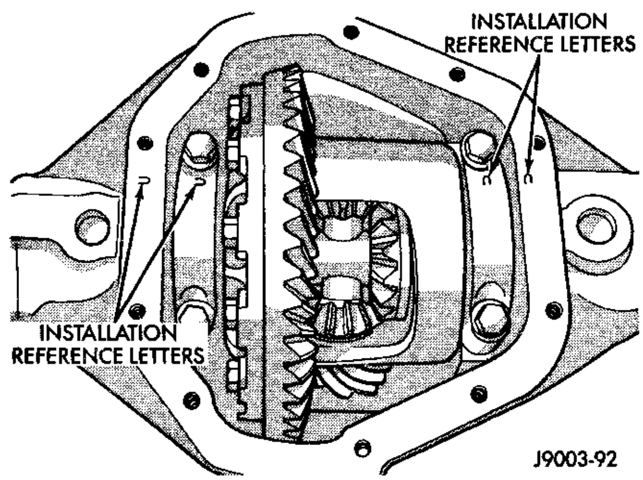

Fig. 10 Bearing Cap Identification

(3) Remove the differential bearing caps.
(4) Position Spreader W–129–B with the tool dowel pins seated in the locating holes (Fig. 11).
(5) Install the hold down clamps and tighten the tool turnbuckle finger–tight.
(6) Install a Guide Pin C-3288-B at the left side of the differential housing. Attach dial indicator to housing pilot stud. Load the indicator plunger against the opposite side of the housing (Fig. 11) and zero the indicator.

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REMOVAL AND INSTALLATION (Continued)

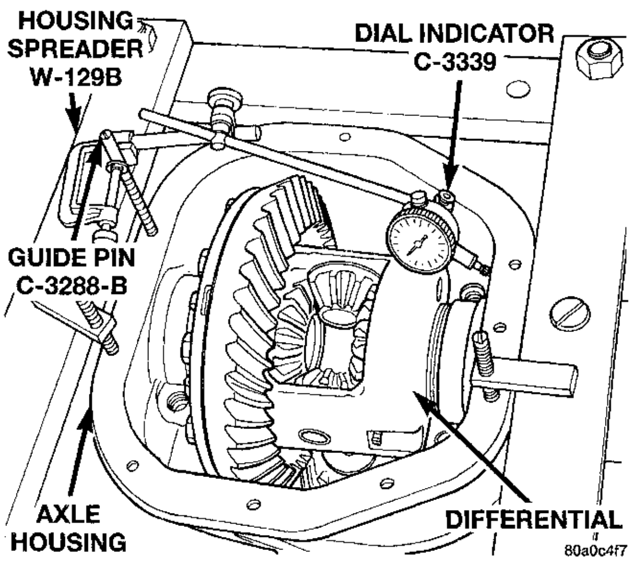

Fig. 11 Spread Differential Housing

(7) Spread the housing enough to remove the case from the housing. Measure the distance with the dial indicator (Fig. 11).

CAUTION: Do not spread over 0.50 mm (0.020 in). If the housing is over-spread, it could be distorted or damaged.

(8) Remove the dial indicator.

(9) Pry the differential case loose from the housing. To prevent damage, pivot on housing with the end of the pry bar against spreader (Fig. 12).

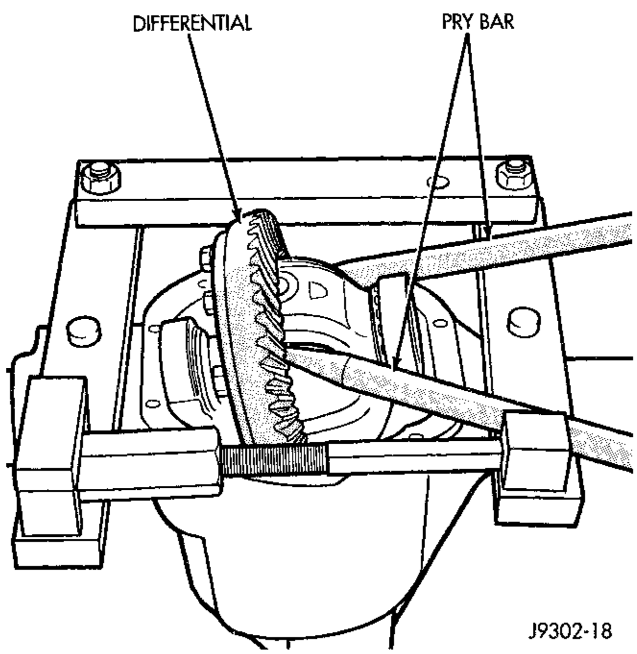

Fig. 12 Differential Removal

(10) Remove the case from housing. Mark or tag bearing cups to indicate which side they were removed from.

INSTALLATION

(1) Position Spreader W–129–B with the tool dowel pins seated in the locating holes (Fig. 11). Install the hold down clamps and tighten the tool turnbuckle finger–tight.

(2) Install a Guide Pin C-3288-B at the left side of the differential housing. Attach dial indicator to housing pilot stud. Load the indicator plunger against the opposite side of the housing (Fig. 11) and zero the indicator.

(3) Spread the housing enough to install the case in the housing. Measure the distance with the dial indicator (Fig. 11).

CAUTION: Do not spread over 0.50 mm (0.020 in). If the housing is over-spread, it could be distorted or damaged.

(4) Remove the dial indicator.

(5) Install differential in housing.

(6) Install case in the housing. Tap the differential case with a rawhide or rubber mallet to ensure the bearings are fully seated in the differential housing (Fig. 13).

(7) Remove the spreader.

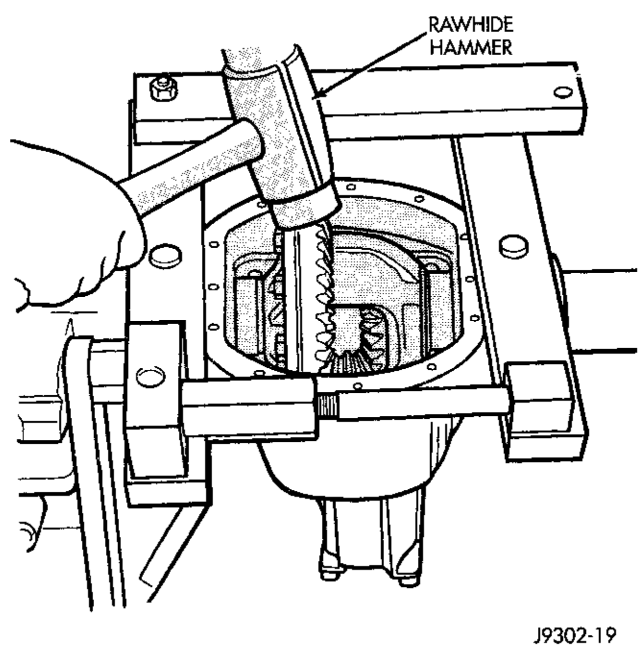

Fig. 13 Differential Installation

(8) Install the bearing caps at their original locations (Fig. 14). Tighten the bearing cap bolts to 109 N·m (80 ft. lbs.) torque.

(9) Install axle shafts.

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REMOVAL AND INSTALLATION (Continued)

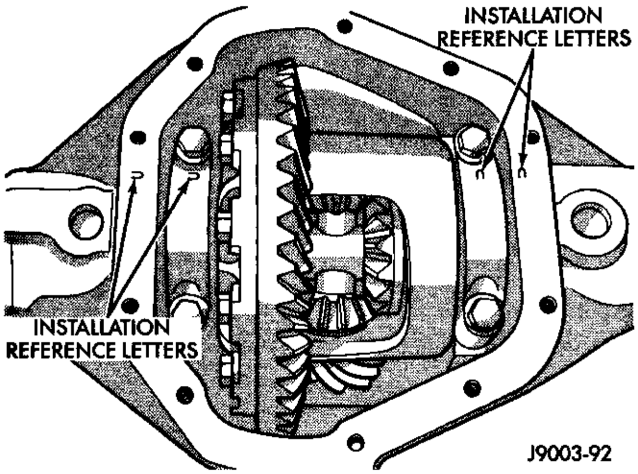

Fig. 14 Differential Bearing Cap Reference Letters

DIFFERENTIAL SIDE BEARINGS

REMOVAL

(1) Remove differential case from axle housing.

(2) Remove the bearings from the differential case with Puller/Press C-293-PA, Adapters C-293-62, and Step Plate C-4487-1 (Fig. 15).

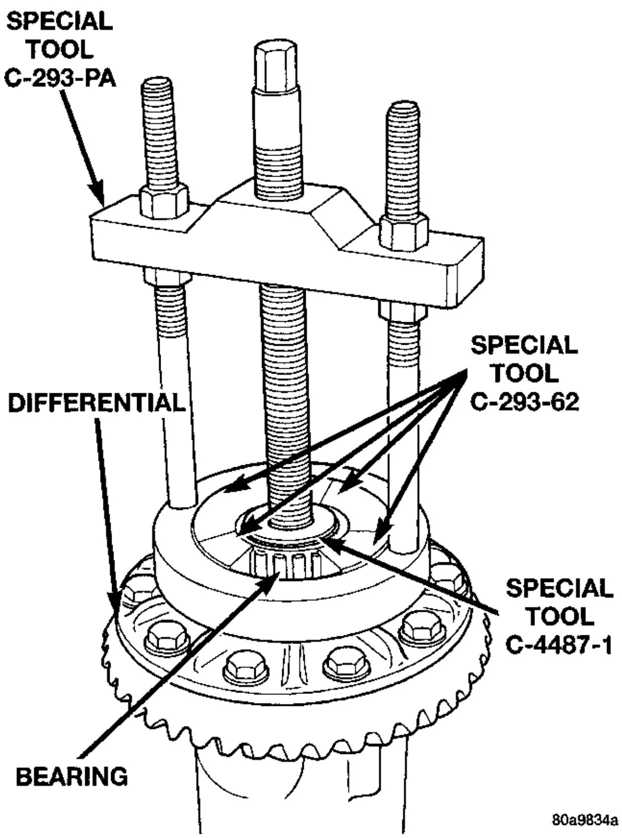

Fig. 15 Differential Bearing Removal

INSTALLATION

(1) Using tool C-4190 with handle C-4171, install differential side bearings (Fig. 16).

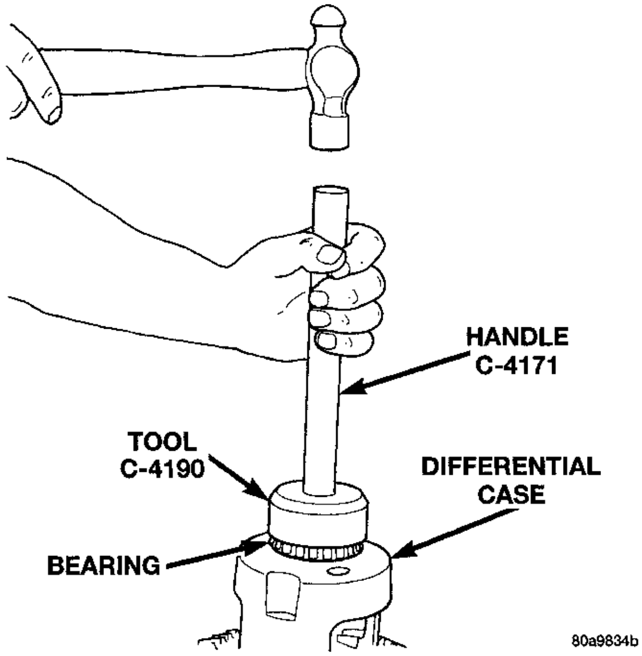

Fig. 16 Install Differential Side Bearings

(2) Install differential case in axle housing.

RING GEAR AND EXCITER RING

The ring and pinion gears are service in a matched set. Do not replace the ring gear without replacing the pinion gear.

REMOVAL

(1) Remove differential from axle housing.

(2) Place differential case in a suitable vise with soft metal jaw protectors. (Fig. 17)

(3) Remove bolts holding ring gear to differential case.

(4) Using a soft hammer, drive ring gear from differential case (Fig. 17).

(5) Use a brass drift and slowly tap the exciter ring from the differential case.

INSTALLATION

CAUTION: Do not reuse the bolts that held the ring gear to the differential case. The bolts can fracture causing extensive damage.

(1) Invert the differential case.

(2) Position exciter ring on differential case.

(3) Using a brass drift, slowly and evenly tap the exciter ring into position.

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REMOVAL AND INSTALLATION (Continued)

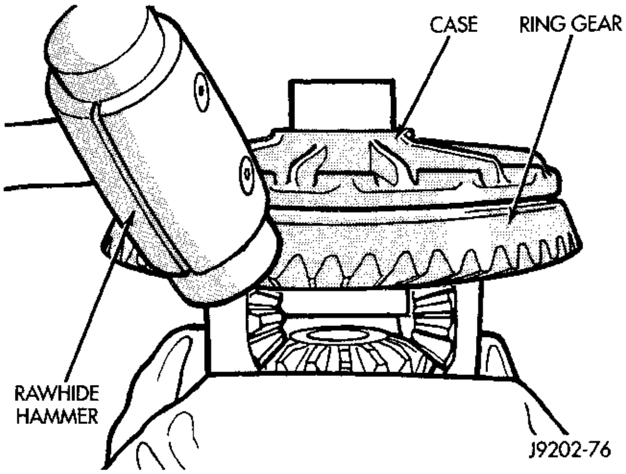

Fig. 17 Ring Gear Removal

(4) Invert the differential case and start two ring gear bolts. This will provide case-to-ring gear bolt hole alignment.

(5) Invert the differential case in the vise.

(6) Install new ring gear bolts and alternately tighten to 163–190 N·m (120–140 ft. lbs.) torque (Fig. 18).

(7) Install differential in axle housing and verify gear mesh and contact pattern.

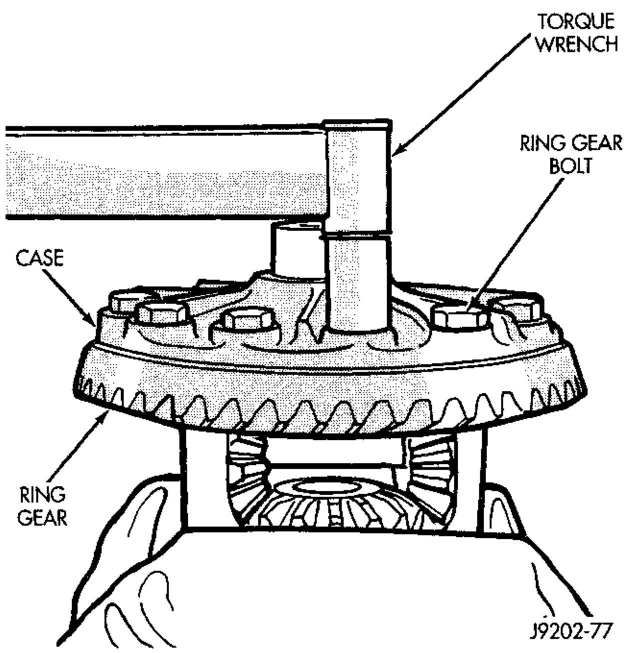

Fig. 18 Ring Gear Bolt Installation

PINION GEAR

NOTE: The ring and pinion gears are service in a matched set. Do not replace the pinion gear without replacing the ring gear.

REMOVAL

(1) Remove differential assembly from axle housing.

(2) Mark pinion yoke and propeller shaft for installation alignment.

(3) Disconnect propeller shaft from pinion yoke. Using suitable wire, tie propeller shaft to underbody.

(4) Using Yoke Holder 6719 to hold yoke, remove the pinion yoke nut and washer.

(5) Using Remover C–452 and Wrench C–3281, remove the pinion yoke from pinion shaft (Fig. 19).

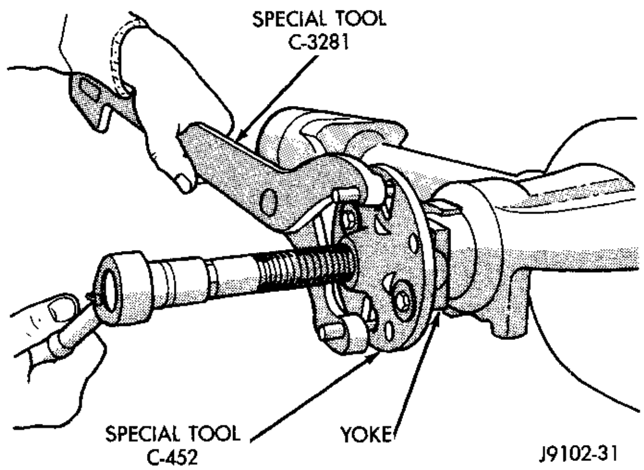

Fig. 19 Pinion Yoke Removal

(6) Remove the pinion gear from housing (Fig. 20). Catch the pinion with your hand to prevent it from falling and being damaged.

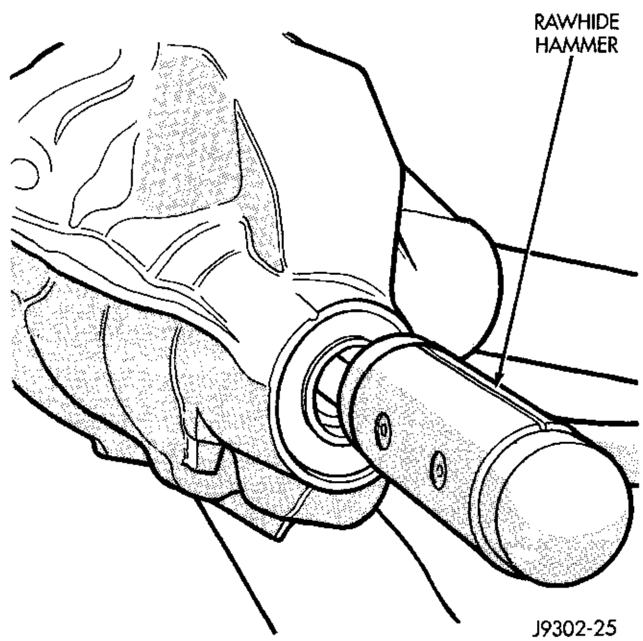

Fig. 20 Remove Pinion Gear

REMOVAL AND INSTALLATION (Continued)

(7) Remove the pinion seal with a slide hammer or suitable pry bar.

(8) Remove oil slinger, if equipped, and the front pinion bearing.

(9) Remove the front pinion bearing cup with Remover D-158 and Handle C–4171 (Fig. 21).

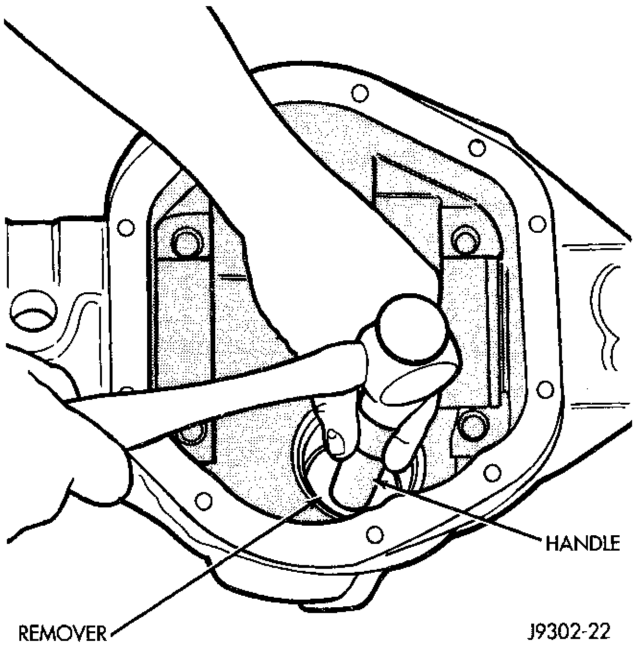

Fig. 21 Front Bearing Cup Removal

(10) Remove the rear bearing cup from housing (Fig. 22). Use Remover D-162 and Handle C–4171.

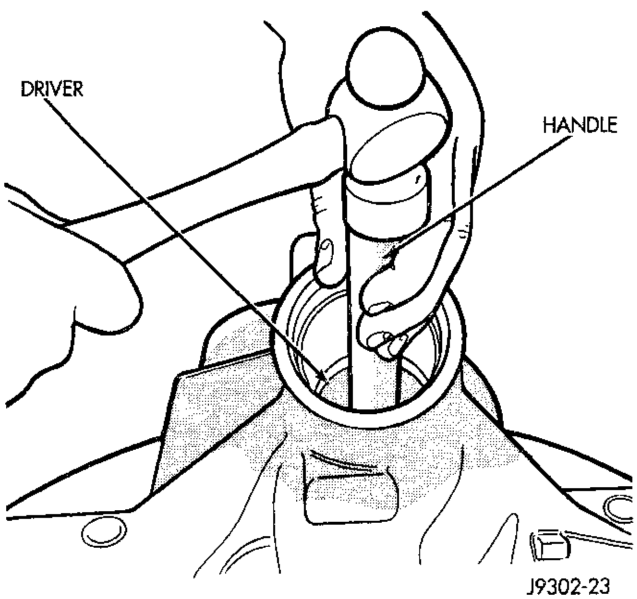

Fig. 22 Rear Bearing Cup Removal

(11) Remove the collapsible preload spacer (Fig. 23) from 248 RBI pinion gears.

(12) Remove the solid shims from 267 RBI pinion gears.

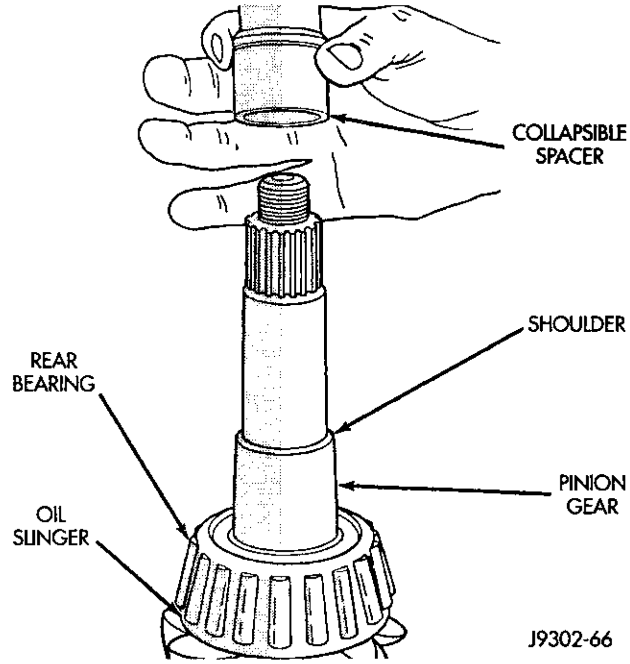

Fig. 23 Collapsible Spacer

(13) Remove the rear bearing from the pinion with Puller/Press C–293-PA and Adapters C–293–37 (Fig. 24). **Place 4 adapter blocks so they do not damage the bearing cage.**

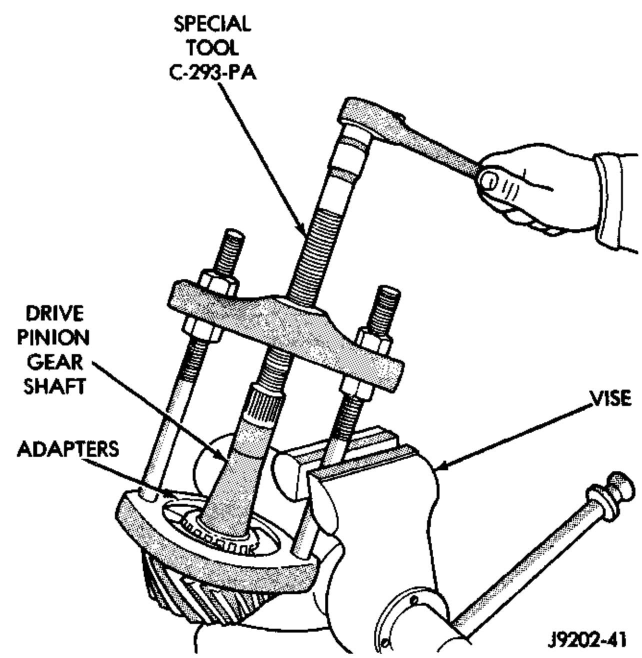

Fig. 24 Inner Bearing Removal

(14) Remove the pinion depth shims from the pinion gear shaft. Record the total thickness of the depth shims.

AUTHENTIC RESTORATION PRODUCT

REMOVAL AND INSTALLATION (Continued)

INSTALLATION

(1) Apply Mopar® Door Ease stick lubricant to outside surface of bearing cup. Install the pinion rear bearing cup with Installer D-111 and Handle C–4171 (Fig. 25). Ensure cup is correctly seated.

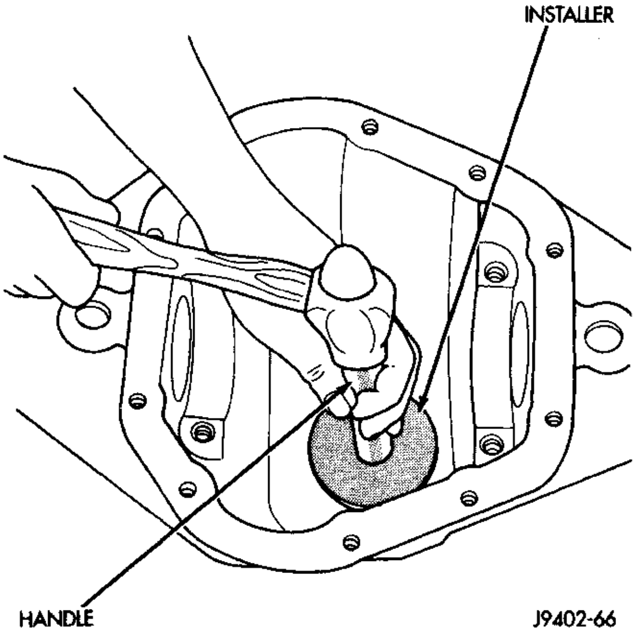

Fig. 25 Pinion Rear Bearing Cup Installation

(2) Apply Mopar® Door Ease stick lubricant to outside surface of bearing cup. Install the pinion front bearing cup with Installer D–146 and Handle C–4171 (Fig. 26).

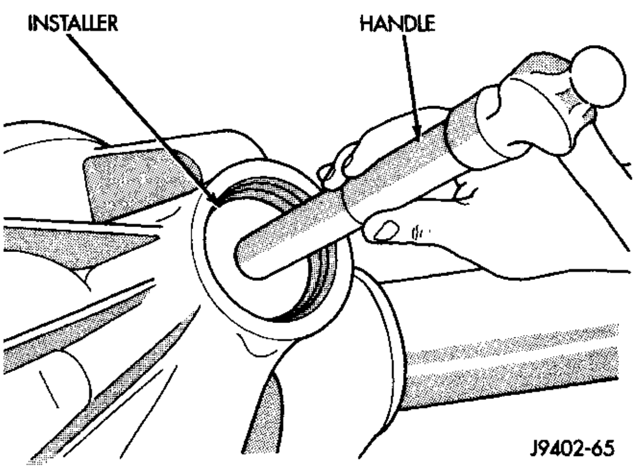

Fig. 26 Pinion Front Bearing Cup Installation

(3) Install pinion front bearing and oil slinger, if equipped. Apply a light coating of gear lubricant on the lip of pinion seal.

(4) Install seal with Installer 8108 and Handle C–4171 (Fig. 27).

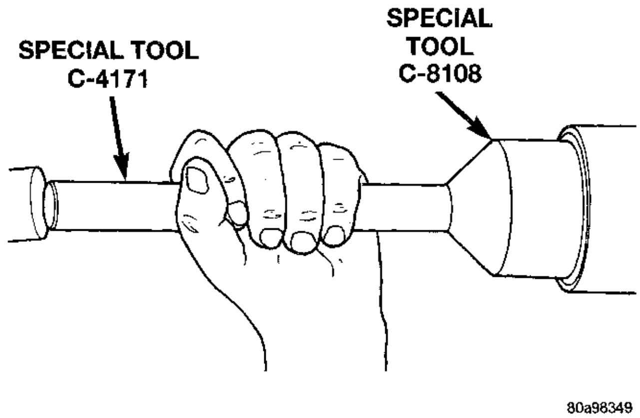

Fig. 27 Pinion Seal Installation

NOTE: Pinion depth shims are placed between the rear pinion bearing cone and pinion gear to achieve proper ring and pinion gear mesh. If the factory installed ring and pinion gears are reused, the pinion depth shim should not require replacement or adjustment. Refer to Pinion Gear Depth paragraph in this section to select the proper thickness shim before installing rear pinion bearing cone.

(5) Place the proper thickness pinion depth shim on the pinion gear.

(6) Install the rear bearing and oil slinger, if equipped, on the pinion gear with Installer C-3095-A (Fig. 28).

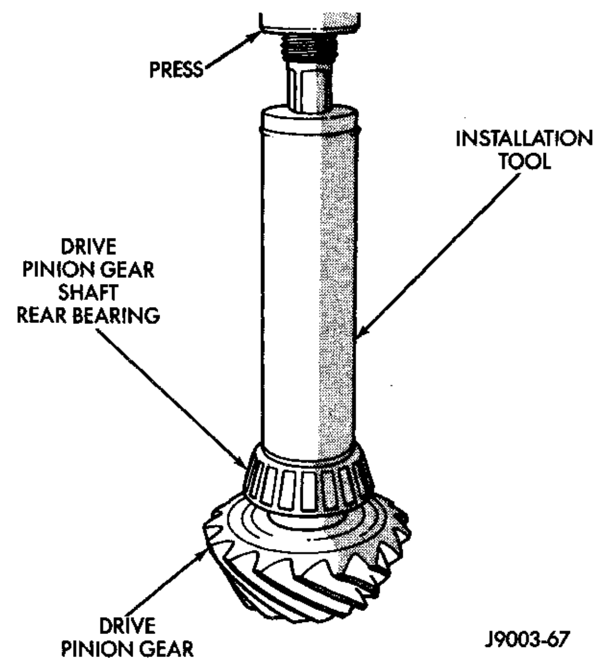

Fig. 28 Shaft Rear Bearing Installation

Mopar AUTHENTIC RESTORATION PRODUCT

REMOVAL AND INSTALLATION (Continued)

(7) Install a new collapsible preload spacer on pinion shaft (Fig. 29) on 248 RBI pinion gears.

(8) Install original solid shims on 267 RBI pinion gears.

(9) Install pinion gear in housing.

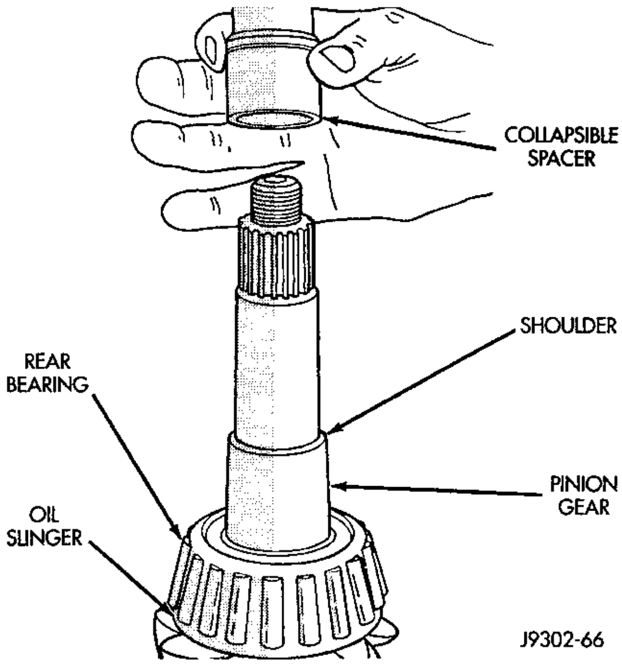

Fig. 29 Collapsible Preload Spacer

(10) Install yoke with Installer C–3718 and Yoke Holder 6719 (Fig. 30).

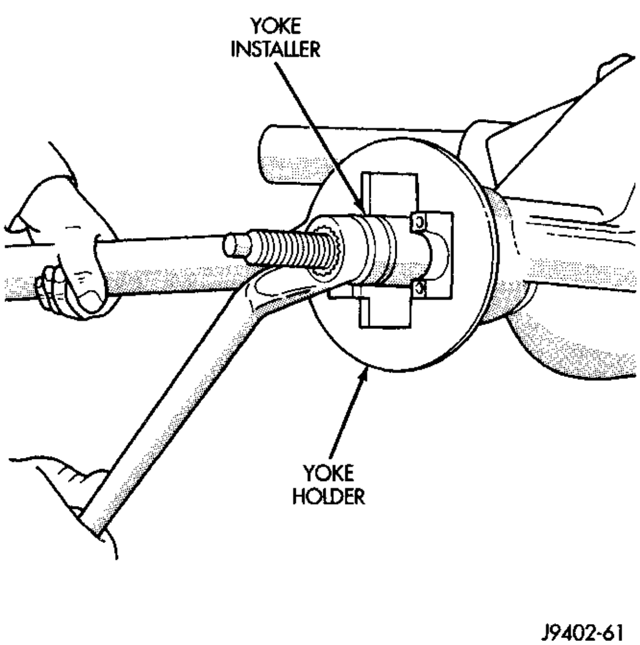

Fig. 30 Pinion Yoke Installation

(11) Install the yoke washer and a new nut on the pinion gear. Tighten the nut to 292 N·m (215 ft. lbs.) minimum. **Do not over-tighten.** Maximum torque is 447 N·m (330 ft. lbs.).

CAUTION: Never loosen pinion gear nut to decrease pinion gear bearing preload torque and never exceed specified preload torque. If preload torque is exceeded a new pinion nut and collapsible spacer, if equipped, must be installed. The torque sequence will have to be repeated.

(12) Tighten pinion nut as follows for 248 RBI axles:

(a) Using Yoke Holder 6719, and a torque wrench set at 447 N·m (330 ft. lbs.), crush collapsible spacer until bearing end play is taken up.

(b) Slowly tighten the nut in 6.8 N·m (5 ft. lbs.) increments until the rotating torque is achieved. Measure the rotating torque frequently to avoid over crushing the collapsible spacer (Fig. 31).

(13) Tighten pinion nut as follows for 267 RBI axles:

(a) If the rotating torque is greater than the desired rotating torque, remove the pinion yoke and decrease the thickness of the solid shim pack. Decreasing the shim pack thickness by 0.025 mm (0.001 in.) will increase the rotating torque approximately 0.9 N·m (8 in. lbs.).

(b) Slowly tighten the nut in 6.8 N·m (5 ft. lbs.) increments until the rotating torque or tightening torque of 447 N·m (330 ft. lbs.) is achieved. Measure the rotating torque frequently to avoid excessively preloading the pinion bearings (Fig. 31).

(c) If the maximum tightening torque is reached prior to achieving the desired rotating torque, remove the pinion yoke and increase the thickness of the solid shim pack. Increasing the shim pack thickness by 0.025 mm (0.001 in.) will decrease the rotating torque approximately 0.9 N·m (8 in. lbs.).

(14) Check bearing rotating torque with an inch pound torque wrench (Fig. 31). The torque necessary to rotate the pinion gear should be:

- Original Bearings — 1 to 3 N·m (10 to 20 in. lbs.).
- New Bearings — 2 to 5 N·m (15 to 35 in. lbs.).

(15) Align previously made marks on yoke and propeller shaft and install propeller shaft.

(16) Install differential housing into the axle housing.

FINAL ASSEMBLY

(1) Scrape the residual sealant from the housing and cover mating surfaces. Clean the mating surfaces with mineral spirits. Apply a bead of Mopar® Silicone Rubber Sealant, or equivalent, on the housing cover (Fig. 32).

AUTHENTIC RESTORATION

REMOVAL AND INSTALLATION (Continued)

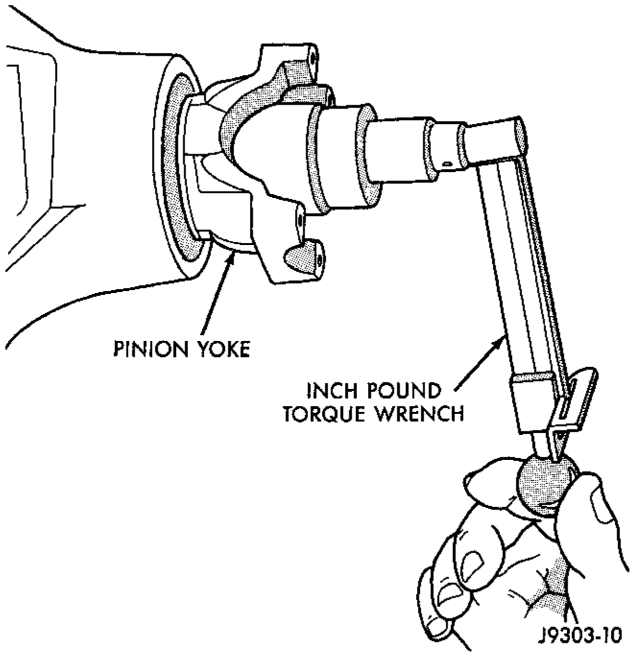

Fig. 31 Check Pinion Gear Rotation Torque

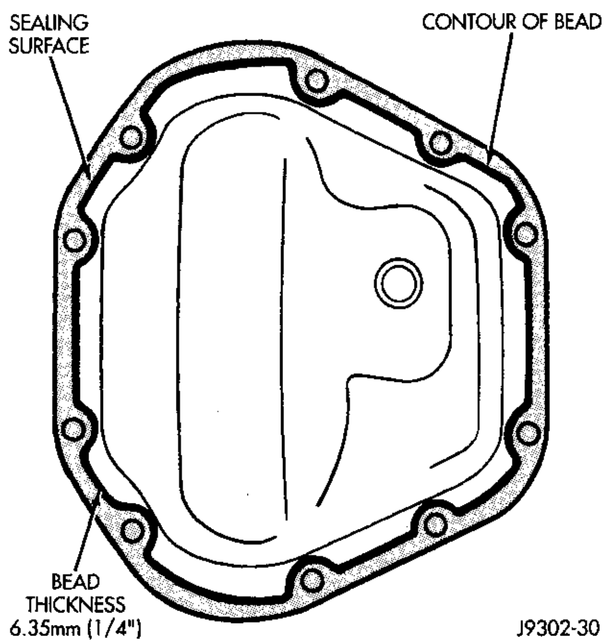

Fig. 32 Typical Housing Cover With Sealant

Install the housing cover within 5 minutes after applying the sealant.

(2) Install the cover on the differential with the attaching bolts. Install the identification tag. Tighten the cover bolts to 41 N·m (30 ft. lbs.) torque.

CAUTION: Overfilling the differential can result in lubricant foaming and overheating.

(3) Refill the differential housing with gear lubricant. Refer to the Lubricant Specifications section of this group for the gear lubricant requirements.

(4) Install the fill hole plug.

DISASSEMBLY AND ASSEMBLY

STANDARD DIFFERENTIAL

DISASSEMBLY

(1) Remove roll-pin holding mate shaft in housing.

(2) Remove pinion gear mate shaft (Fig. 33).

(3) Rotate the differential side gears and remove the pinion mate gears and thrust washers (Fig. 34).

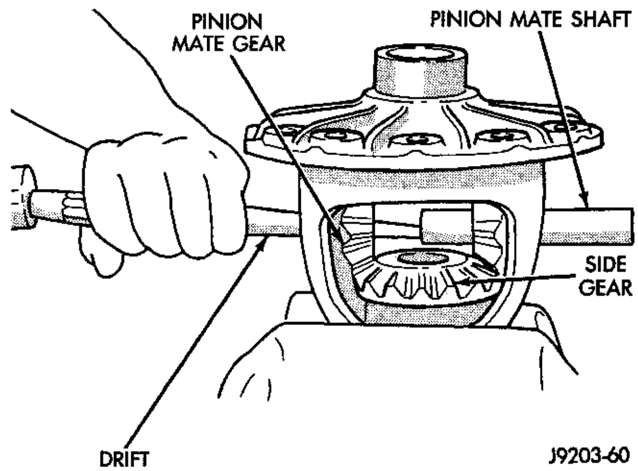

Fig. 33 Pinion Mate Shaft Removal

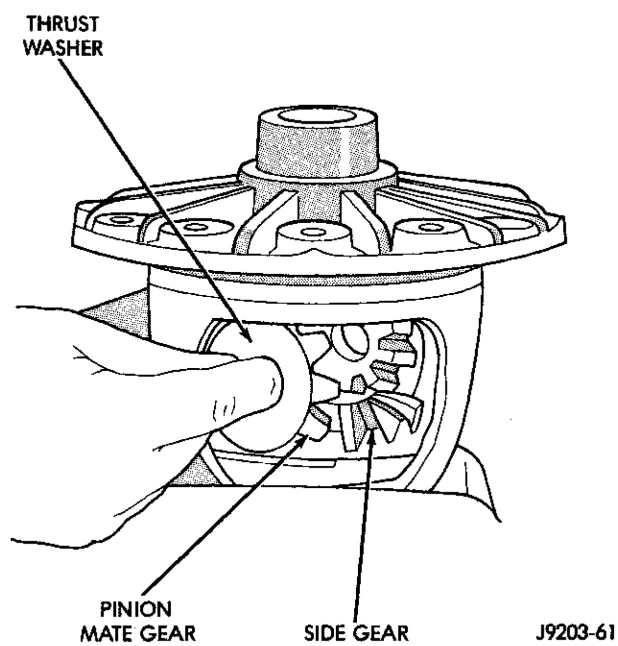

Fig. 34 Pinion Mate Gear Removal

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DISASSEMBLY AND ASSEMBLY (Continued)

(4) Remove the differential side gears and thrust washers.

ASSEMBLY

(1) Install the differential side gears and thrust washers.
(2) Install the pinion mate gears and thrust washers.
(3) Install the pinion gear mate shaft.
(4) Align the hole in the pinion gear mate shaft with the hole in the differential case.
(5) Install and seat the pinion mate shaft roll-pin in the differential case and mate shaft with a punch and hammer (Fig. 35). Peen the edge of the roll-pin hole in the differential case slightly in two places, 180° apart.
(6) Lubricate all differential components with hypoid gear lubricant.

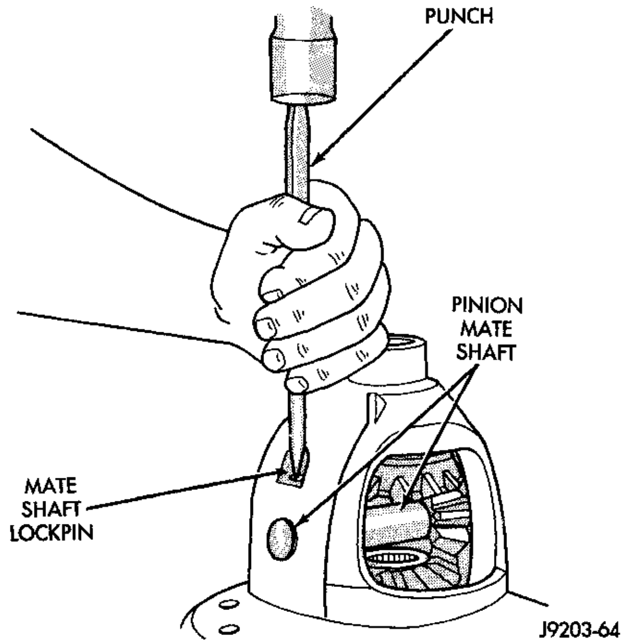

Fig. 35 Pinion Mate Shaft Roll-Pin Installation

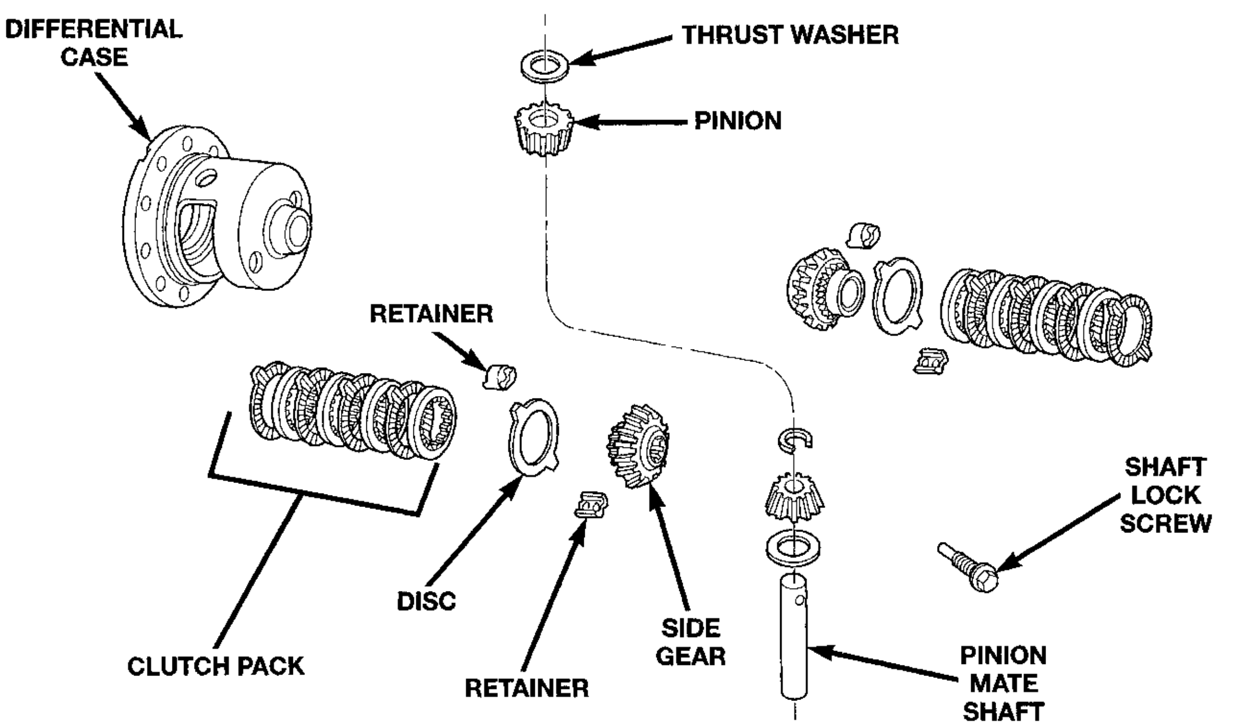

Fig. 36 Trac–Lok Differential Components—Typical

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DISASSEMBLY AND ASSEMBLY (Continued)

TRAC-LOK DIFFERENTIAL

The Trac–Lok differential components are illustrated in (Fig. 36). Refer to this illustration during repair service.

DISASSEMBLY

(1) Clamp Side Gear Holding Tool 6963-A in a vise.

(2) Position the differential case on Side Gear Holding Tool 6963-A (Fig. 37).

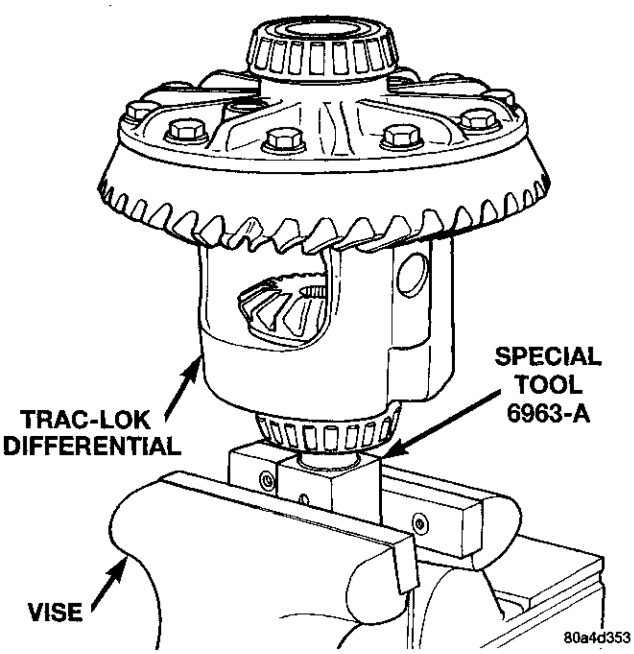

Fig. 37 Differential Case Holding Tool

(3) Remove ring gear, if necessary. Ring gear removal is necessary only if the ring gear is to be replaced. The Trac-Lok differential can be serviced with the ring gear installed.

(4) Remove the roll pin holding the pinion mate shaft into the housing.

(5) Remove the pinion gear mate shaft. If necessary, use a drift and hammer (Fig. 38).

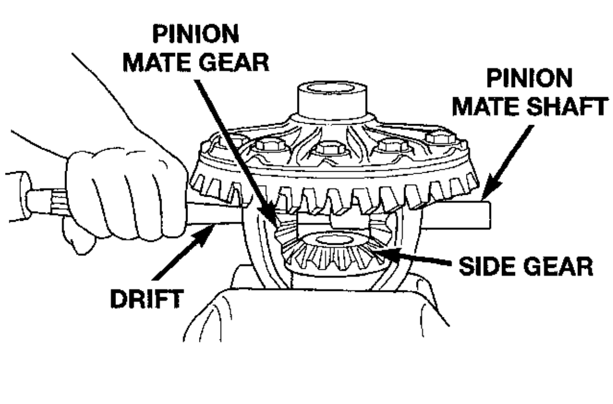

Fig. 38 Mate Shaft Removal

(6) Install and lubricate Step Plate C–4487–1 (Fig. 39).

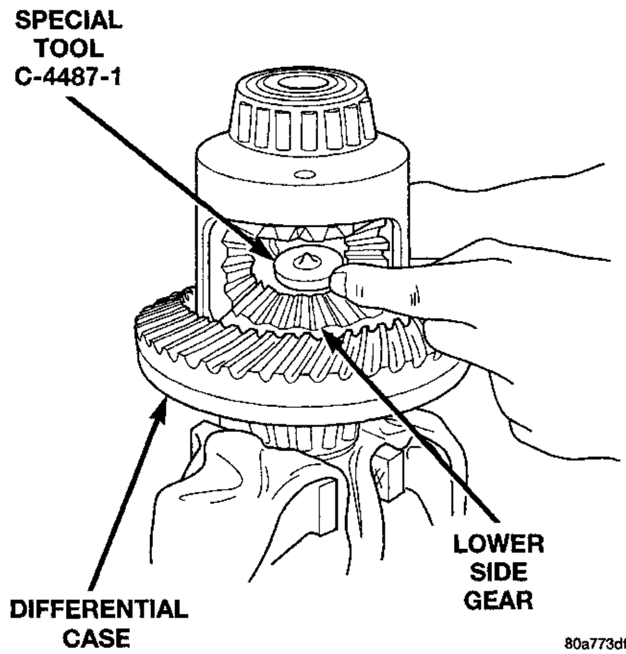

Fig. 39 Step Plate Tool Installation

(7) Assemble Threaded Adapter C–4487–3 into top side gear. Thread Forcing Screw C–4487–2 into adapter until it becomes centered in adapter plate.

(8) Position a small screw driver in slot of Threaded Adapter C–4487–3 (Fig. 40) to prevent adapter from turning.

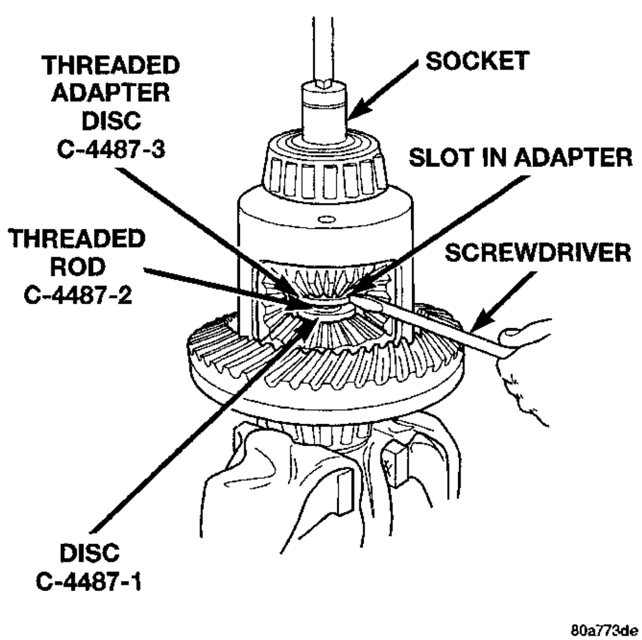

Fig. 40 Threaded Adapter Installation

DISASSEMBLY AND ASSEMBLY (Continued)

(9) Tighten forcing screw tool 122 N·m (90 ft. lbs.) (maximum) to compress Belleville springs in clutch packs (Fig. 41).

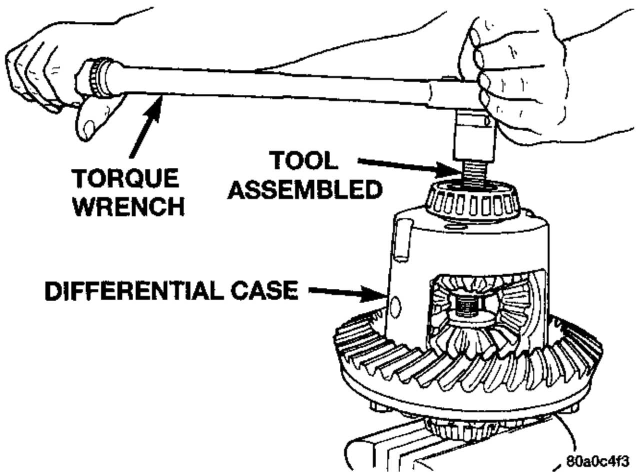

Fig. 41 Tighten Belleville Spring Compressor Tool

(10) Using an appropriate size feeler gauge, remove thrust washers from behind the pinion gears (Fig. 42).

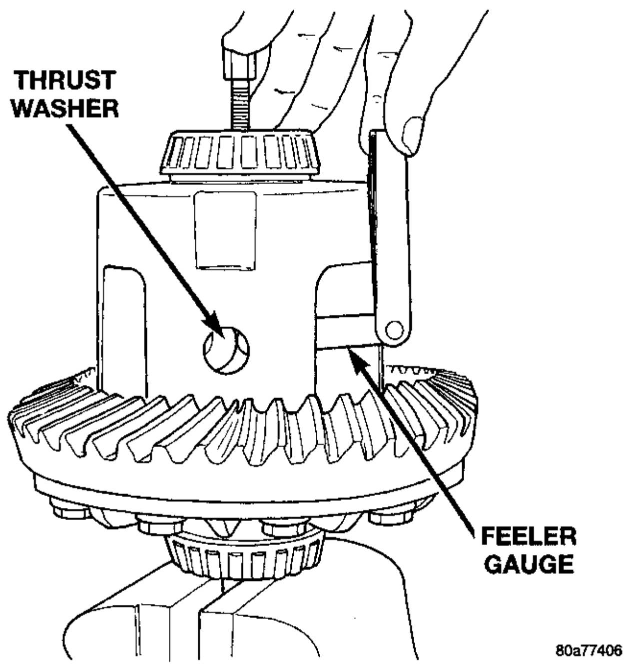

Fig. 42 Remove Pinion Gear Thrust Washer

(11) Insert Turning Bar C–4487–4 in case (Fig. 43).

(12) Loosen the Forcing Screw C-4487-2 in small increments until the clutch pack tension is relieved and the differential case can be turned using Turning Bar C-4487-4.

(13) Rotate differential case until the pinion gears can be removed.

(14) Remove pinion gears from differential case.

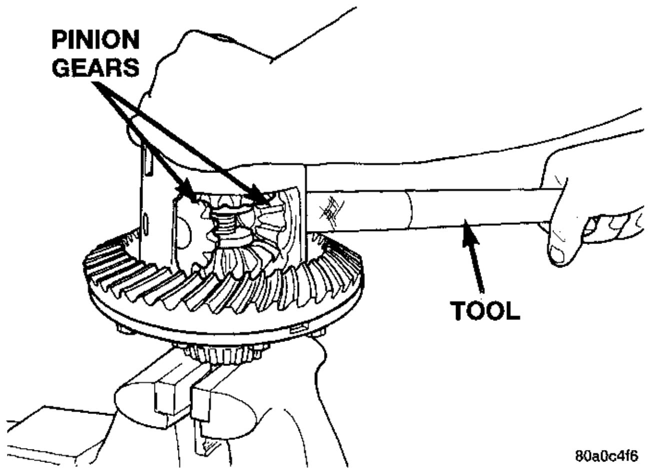

Fig. 43 Pinion Gear Removal

(15) Remove Forcing Screw C–4487-2, Step Plate C-4487-1, and Threaded Adapter C-4487-3.

(16) Remove top side gear, clutch pack retainer, and clutch pack. Keep plates in correct order during removal (Fig. 44).

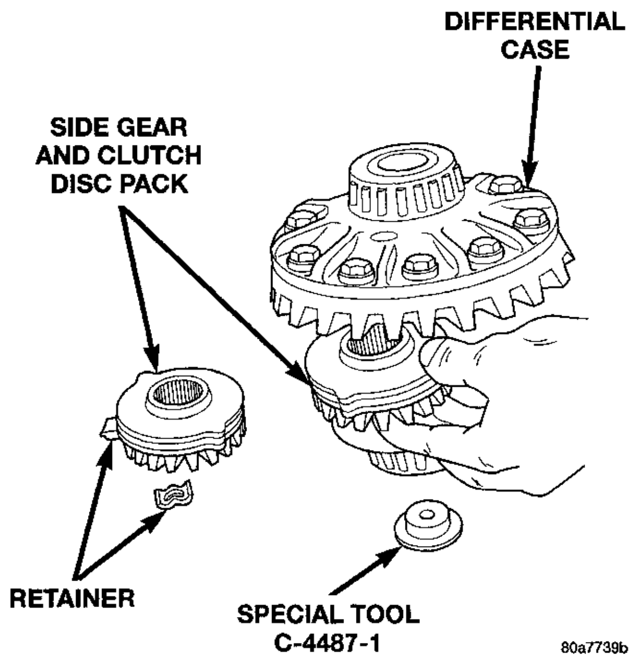

Fig. 44 Side Gear & Clutch Disc Removal

(17) Remove differential case from Side Gear Holding Tool 6963-A. Remove side gear, clutch pack retainer, and clutch pack. Keep plates in correct order during removal.

ASSEMBLY

NOTE: The clutch discs are replaceable as complete sets only. If one clutch disc pack is damaged, both packs must be replaced.

DISASSEMBLY AND ASSEMBLY (Continued)

Lubricate each component with gear lubricant before assembly.

(1) Assemble the clutch discs into packs and secure disc packs with retaining clips (Fig. 45).

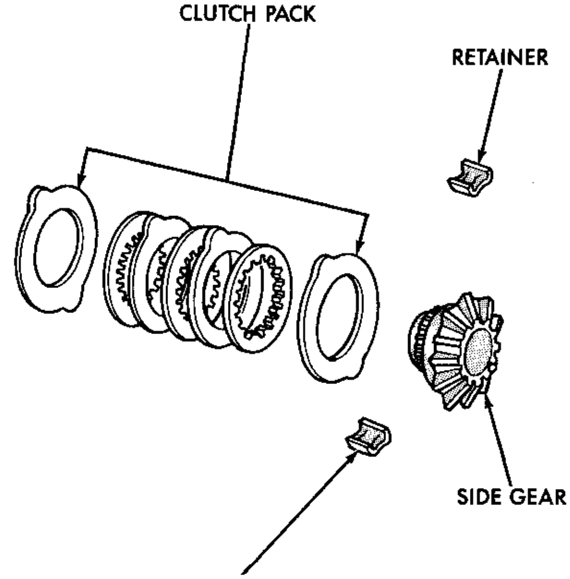

Fig. 45 Clutch Disc Pack

(2) Position assembled clutch disc packs on the side gear hubs.

(3) Install clutch pack and side gear in the ring gear side of the differential case (Fig. 46). **Be sure clutch pack retaining clips remain in position and are seated in the case pockets.**

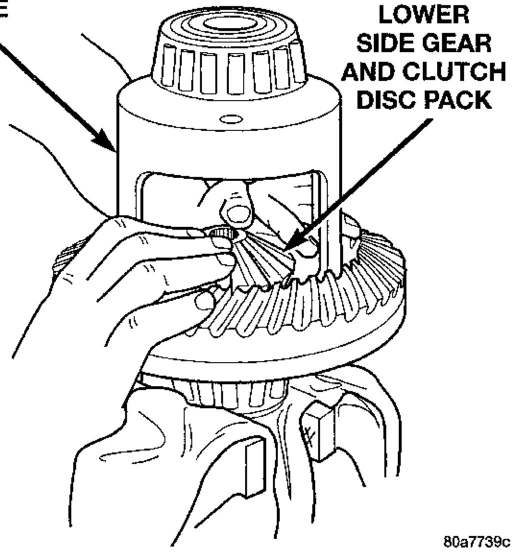

Fig. 46 Clutch Discs & Lower Side Gear Installation

(4) Position the differential case on Side Gear Holding Tool 6963-A.

(5) Install lubricated Step Plate C–4487–1 on side gear (Fig. 47).

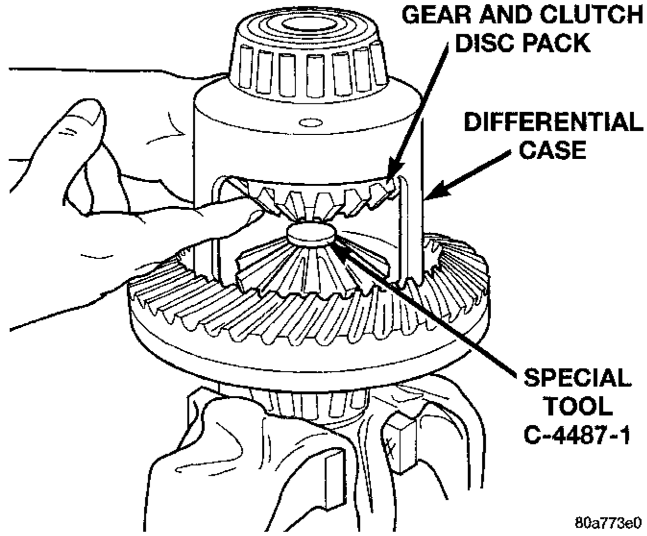

Fig. 47 Upper Side Gear & Clutch Disc Pack Installation

(6) Install the upper side gear and clutch disc pack (Fig. 47).

(7) Hold assembly in position. Insert Threaded Adapter C–4487–3 into top side gear.

(8) Insert Forcing Screw C–4487–2.

(9) Tighten forcing screw tool to slightly compress clutch discs.

(10) Place pinion gears in position in side gears and verify that the pinion mate shaft hole is aligned.

(11) Rotate case with Turning Bar C–4487–4 until the pinion mate shaft holes in pinion gears align with holes in case. It may be necessary to slightly tighten the forcing screw in order to install the pinion gears.

(12) Tighten forcing screw to 122 N·m (90 ft. lbs.) to compress the Belleville springs.

(13) Lubricate and install thrust washers behind pinion gears and align washers with a small screw driver. Insert mate shaft into each pinion gear to verify alignment.

(14) Remove forcing screw, threaded adapter, and step plate.

(15) Install pinion gear mate shaft and align holes in shaft and case.

(16) Install the pinion mate shaft roll pin. Peen the edge of roll pin hole in the differential case in two places, 180° apart.

If replacement side and/or pinion gears and thrust washers were installed, it is not necessary to measure the side gear backlash. Correct

DISASSEMBLY AND ASSEMBLY (Continued)

fit is due to close machining tolerances during manufacture.

(17) Lubricate all differential components with hypoid gear lubricant.

POWER-LOK—267 RBI

The 267 RBI Power-Lok differential has a two-piece cross shaft and uses 2 disc and 3 plates for each clutch pack. One plate and one disc in each clutch pack is dished.

DISASSEMBLY

Pay close attention to the clutch pack arrangement during this procedure. Note the direction of the concave and convex side of the plates and discs.

(1) Mark the ring gear half and cover half for installation reference (Fig. 48).

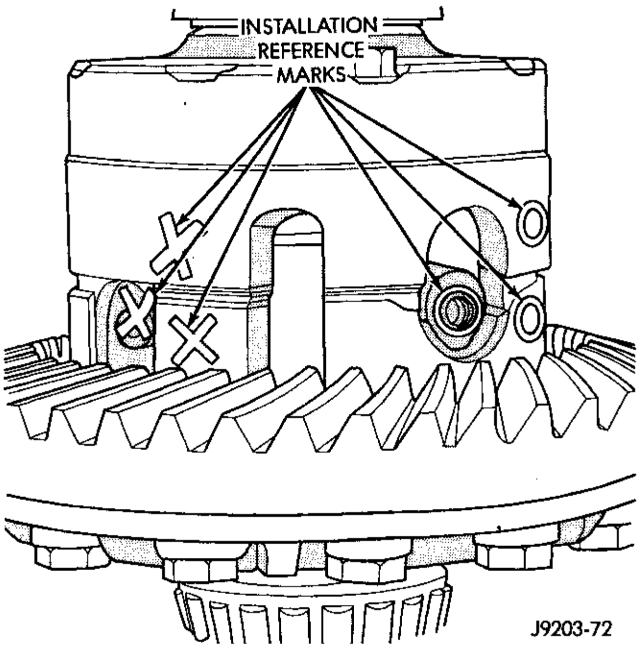

Fig. 48 Case Marked

(2) Remove the case attaching bolts and remove the button cover half (Fig. 49).

(3) Remove top clutch pack (Fig. 50).

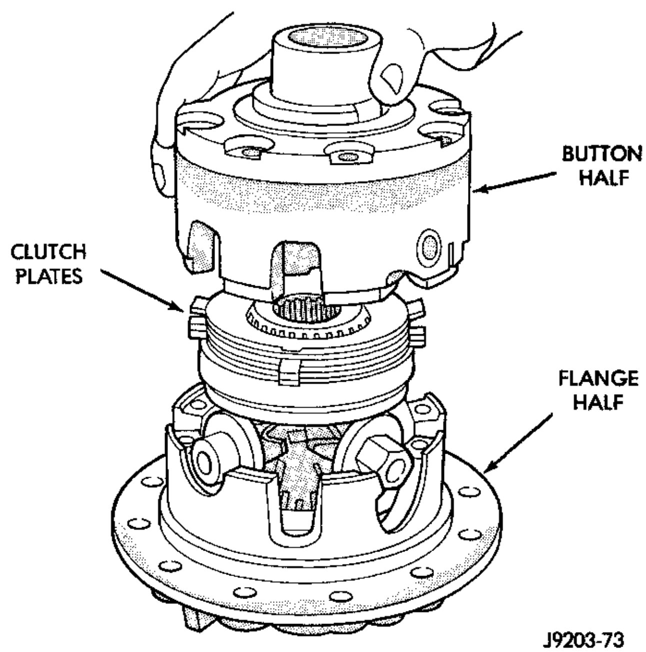

Fig. 49 Cover Half Removal

(4) Remove top side gear clutch ring.

(5) Remove top side gear.

(6) Remove pinion mate gears and cross shafts.

(7) Remove the same parts listed above from the ring gear flange half of the case. Keep these parts with the flange cover half for correct installation in their original positions.

ASSEMBLY

The clutch discs are replaceable as complete sets only. **If one clutch disc pack is damaged, both packs must be replaced.** Lubricate each component with gear lube before assembly and installation.

(1) Saturate the clutch plates with Mopar® Hypoid Gear Lubricant or Additive (Fig. 51). Assemble clutch packs into the side gear plate in exactly the same position as removed (Fig. 50).

(2) Line up the plate ears and install the assembled pack into the flange half (Fig. 52). Ensure that the clutch plate lugs enter the slots in the case. Also ensure that the clutch pack bottoms out on the case.

AUTHENTIC RESTORATION PRODUCT

DISASSEMBLY AND ASSEMBLY (Continued)

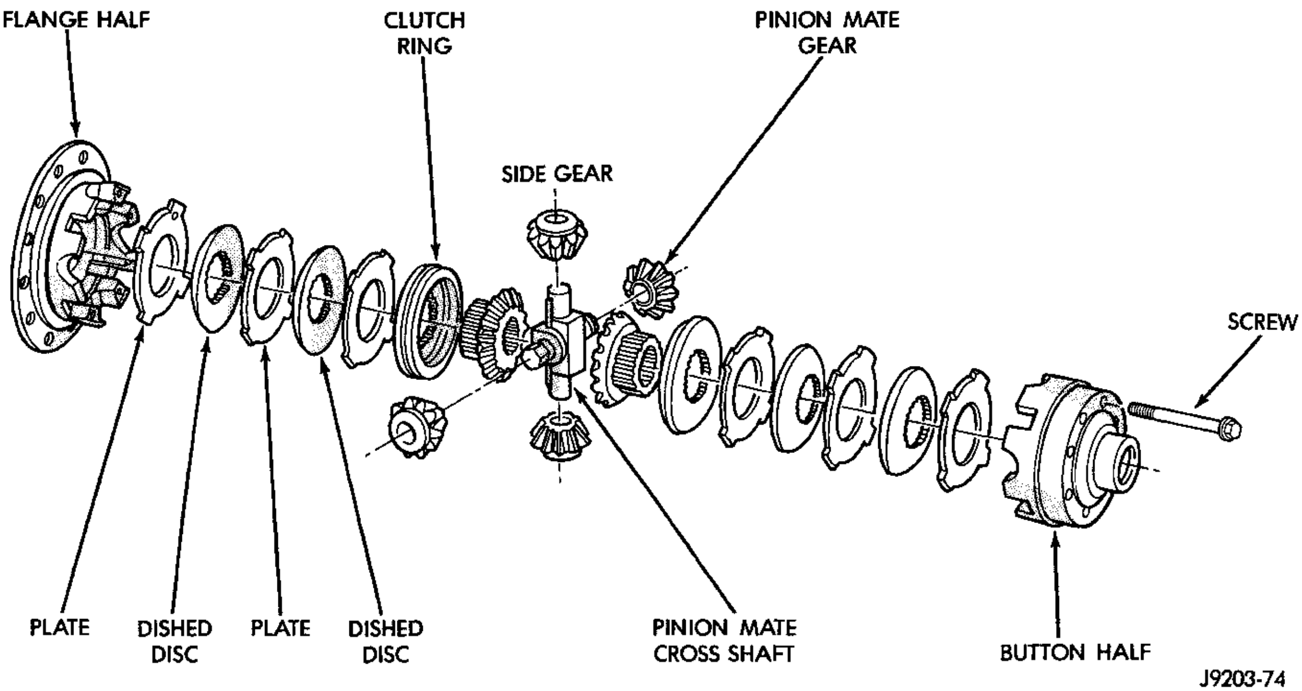

Fig. 50 Power–Lok Components

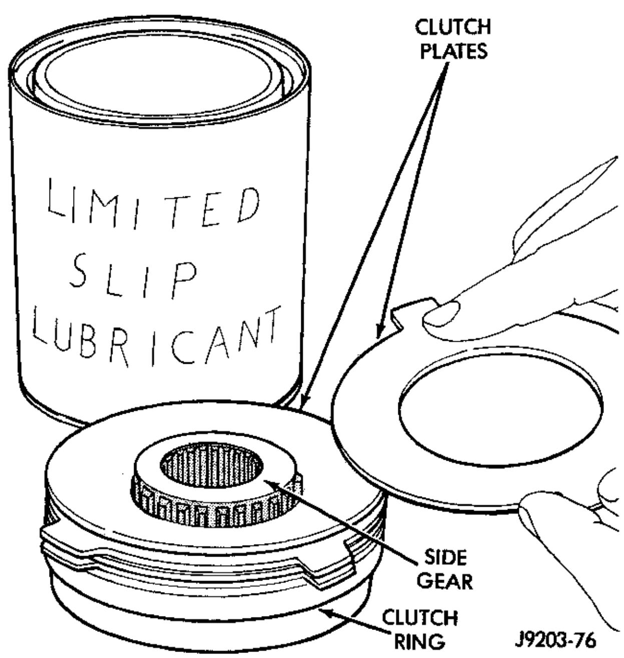

Fig. 51 Clutch Pack Power–Lok

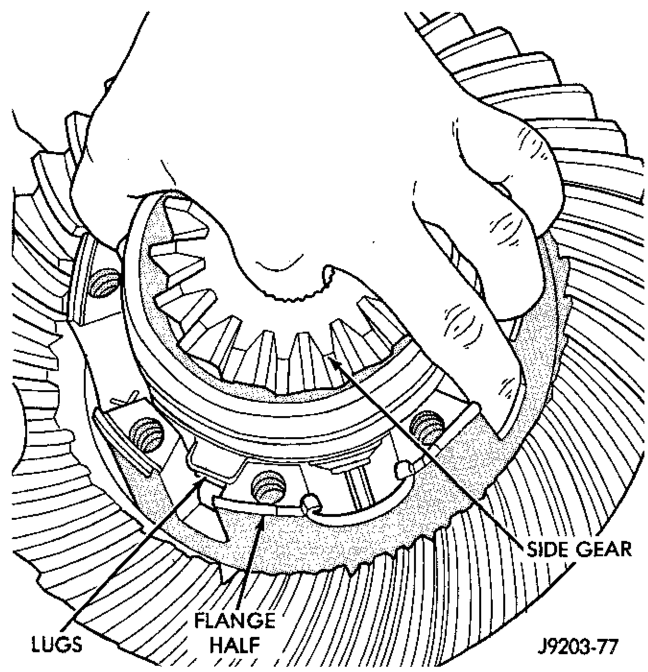

Fig. 52 Clutch Pack Installation

DISASSEMBLY AND ASSEMBLY (Continued)

(3) Install pinion mate shafts and pinion mate gears (Fig. 53). **Make sure shafts are correctly installed according to the alignment marks.**

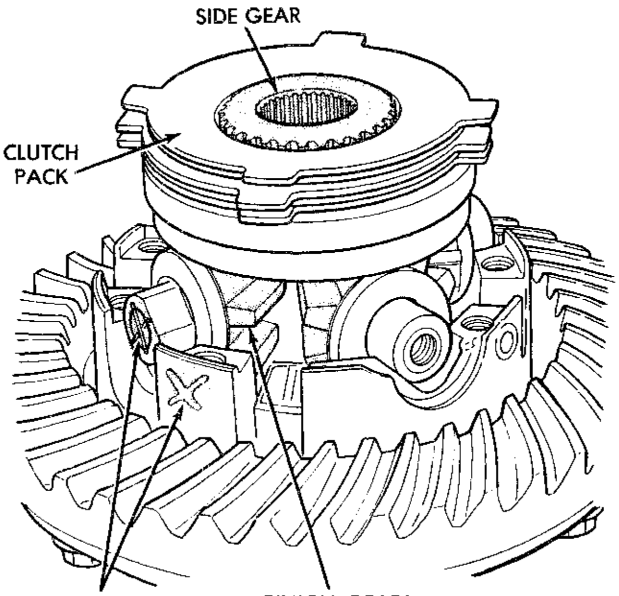

Fig. 53 Clutch Pack Installation

(4) Lubricate and install the other side gear and clutch pack (Fig. 52).

(5) Correctly align and assemble button half to flange half. Install case body screws finger tight.

(6) Tighten body screws alternately and evenly. Tighten screws to 89-94 N·m (65-70 ft. lbs.) torque (Fig. 54).

If bolt heads have 7 radial lines or the number 180 stamped on the head, tighten these bolts to 122-136 N·m (90-100 ft. lbs.) torque.

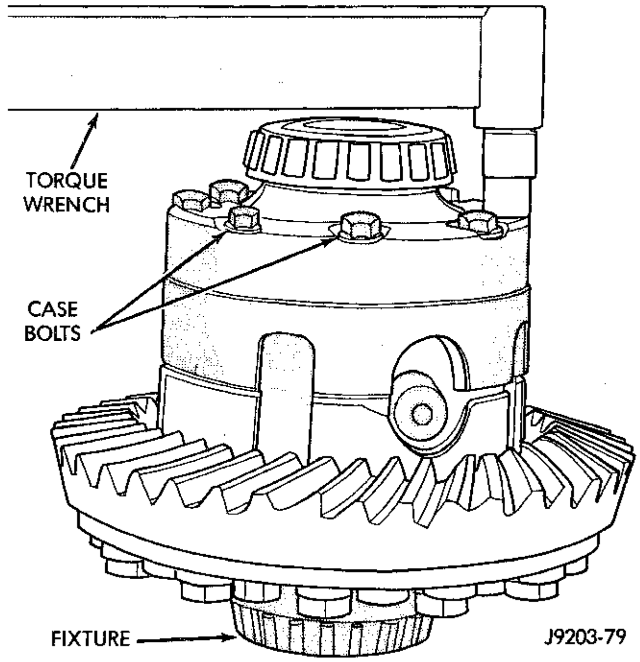

Fig. 54 Case Half Installation

CLEANING AND INSPECTION

AXLE COMPONENTS

Wash differential components with cleaning solvent and dry with compressed air. **Do not steam clean the differential components.**

Wash bearings with solvent and towel dry, or dry with compressed air. DO NOT spin bearings with compressed air. **Cup and bearing must be replaced as matched sets only.**

Clean axle shaft tubes and oil channels in housing. Inspect for;

- Smooth appearance with no broken/dented surfaces on the bearing rollers or the roller contact surfaces.
- Bearing cups must not be distorted or cracked.
- Machined surfaces should be smooth and without any raised edges.
- Raised metal on shoulders of cup bores should be removed with a hand stone.
- Wear and damage to pinion gear mate shaft, pinion gears, side gears and thrust washers. Replace as a matched set only.
- Ring and pinion gear for worn and chipped teeth.
- Ring gear for damaged bolt threads. Replaced as a matched set only.
- Pinion yoke for cracks, worn splines, pitted areas, and a rough/corroded seal contact surface. Repair or replace as necessary.
- Preload shims for damage and distortion. Install new shims, if necessary.

TRAC-LOK/POWER-LOK

Clean all components in cleaning solvent. Dry components with compressed air. Inspect clutch pack plates for wear, scoring or damage. Replace both clutch packs if any one component in either pack is damaged. Inspect side and pinion gears. Replace any gear that is worn, cracked, chipped or damaged. Inspect differential case and pinion shaft. Replace if worn or damaged.

PRESOAK PLATES AND DISC

Plates and discs with fiber coating (no grooves or lines) must be presoaked in Friction Modifier before assembly. Soak plates and discs for a minimum of 20 minutes.

ADJUSTMENTS

PINION GEAR DEPTH

GENERAL INFORMATION

Ring and pinion gears are supplied as matched sets only. The identifying numbers for the ring and pinion

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ADJUSTMENTS (Continued)

gear are etched into the face of each gear (Fig. 55). A plus (+) number, minus (–) number or zero (0) is etched into the face of the pinion gear. This number is the amount (in thousandths of an inch) the depth varies from the standard depth setting of a pinion etched with a (0). The standard setting from the center line of the ring gear to the back face of the pinion is 127.00 mm (5.000 in.) for the 248 RBI axle. The standard setting for the 267 RBI axle is 136.525 (5.375 in.). The standard depth provides the best teeth contact pattern. Refer to Backlash and Contact Pattern Analysis Paragraph in this section for additional information.

Compensation for pinion depth variance is achieved with select shims. The shims are placed under the inner pinion bearing cone (Fig. 56).

If a new gear set is being installed, note the depth variance etched into both the original and replacement pinion gear. Add or subtract the thickness of the original depth shims to compensate for the difference in the depth variances. Refer to the Depth Variance charts.

Note where Old and New Pinion Marking columns intersect. Intersecting figure represents plus or minus amount needed.

Note the etched number on the face of the drive pinion gear (–1, –2, 0, +1, +2, etc.). The numbers represent thousands of an inch deviation from the standard. If the number is negative, add that value to the required thickness of the depth shim(s). If the number is positive, subtract that value from the thickness of the depth shim(s). If the number is 0 no change is necessary. Refer to the Pinion Gear Depth Variance Chart.

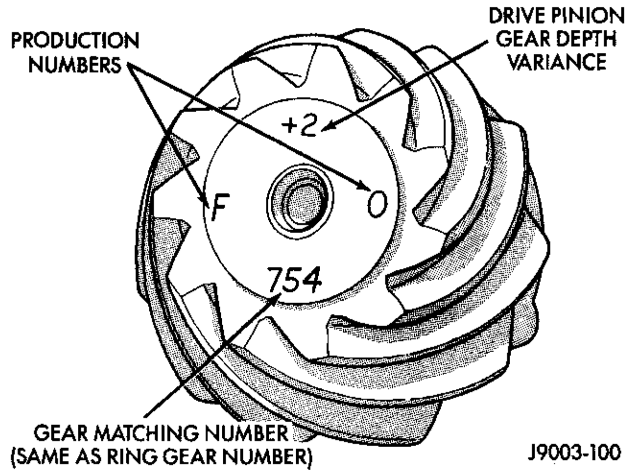

Fig. 55 Pinion Gear ID Numbers

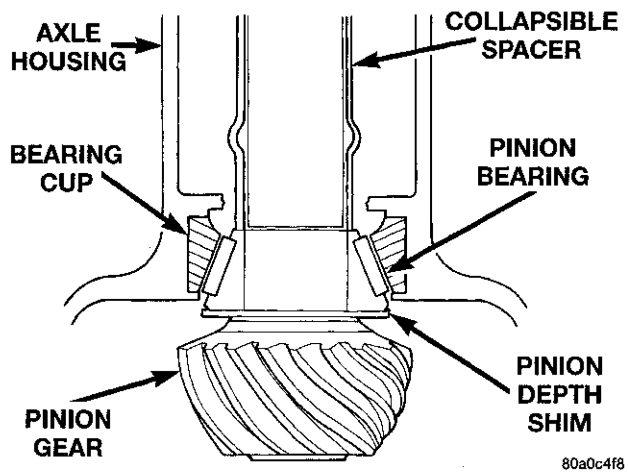

Fig. 56 Shim Locations—248 RBI Axle

PINION GEAR DEPTH VARIANCE

Original Pinion Gear Depth Variance	Replacement Pinion Gear Depth Variance								
	–4	–3	–2	–1	0	+1	+2	+3	+4
+4	+0.008	+0.007	+0.006	+0.005	+0.004	+0.003	+0.002	+0.001	0
+3	+0.007	+0.006	+0.005	+0.004	+0.003	+0.002	+0.001	0	–0.001
+2	+0.006	+0.005	+0.004	+0.003	+0.002	+0.001	0	–0.001	–0.002
+1	+0.005	+0.004	+0.003	+0.002	+0.001	0	–0.001	–0.002	–0.003
0	+0.004	+0.003	+0.002	+0.001	0	–0.001	–0.002	–0.003	–0.004
–1	+0.003	+0.002	+0.001	0	–0.001	–0.002	–0.003	–0.004	–0.005
–2	+0.002	+0.001	0	–0.001	–0.002	–0.003	–0.004	–0.005	–0.006
–3	+0.001	0	–0.001	–0.002	–0.003	–0.004	–0.005	–0.006	–0.007
–4	0	–0.001	–0.002	–0.003	–0.004	–0.005	–0.006	–0.007	–0.008

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ADJUSTMENTS (Continued)

PINION DEPTH MEASUREMENT AND ADJUSTMENT

Measurements are taken with pinion cups and pinion bearings installed in housing. Take measurements with a Pinion Gauge Set 6730 and Dial Indicator C-3339 (Fig. 57).

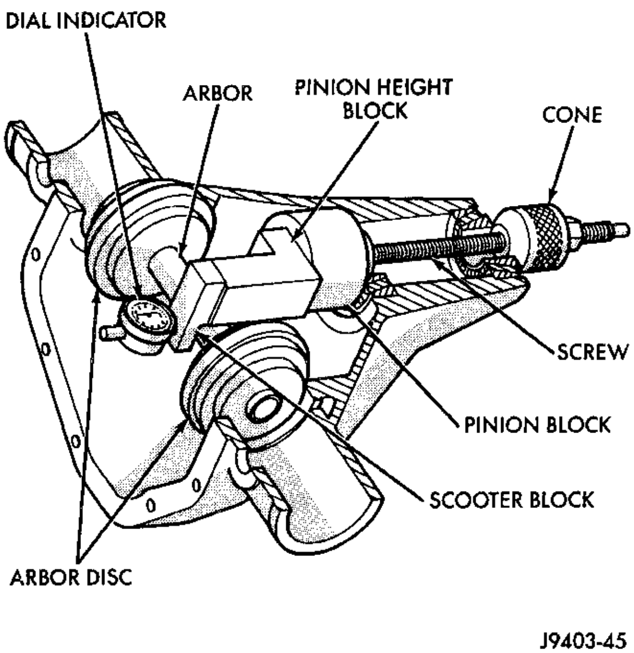

Fig. 57 Pinion Gear Depth Gauge Tools—Typical

(1) Assemble Pinion Height Block 6739, Pinion Block 6736, and rear pinion bearing onto Screw 6741 (Fig. 57) for the 248 RBI axle. For the 267 RBI axle, use Pinion Block 6737.

(2) Insert assembled height gauge components, rear bearing and screw into axle housing through pinion bearing cups (Fig. 58).

(3) Install front pinion bearing and Cone 6740 hand tight (Fig. 57).

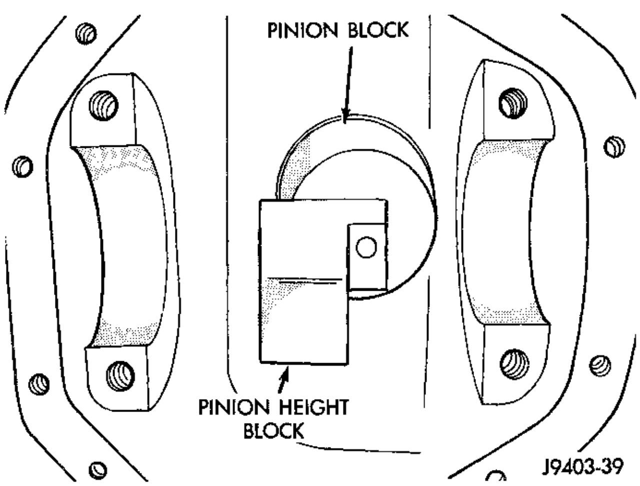

Fig. 58 Pinion Height Block—Typical

(4) Place Arbor Disc 6732 on Arbor D-115-3 in position in axle housing side bearing cradles (Fig. 59). Install differential bearing caps on Arbor Discs and tighten cap bolts. Refer to the Torque Specifications in this section.

NOTE: Arbor Discs 6732 have different step diameters to fit other axle sizes. Pick correct size step for axle being serviced.

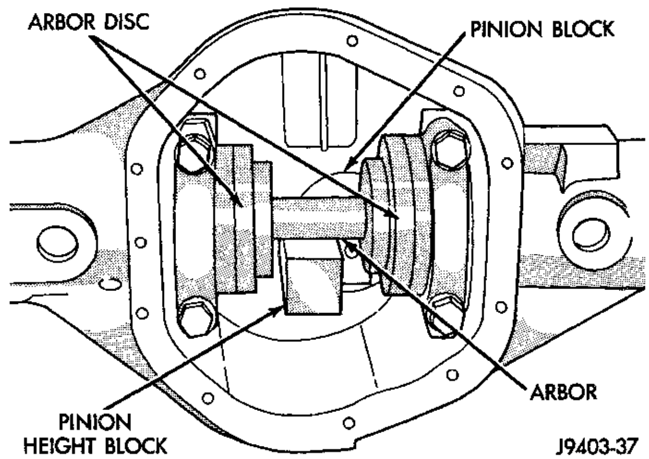

Fig. 59 Gauge Tools In Housing—Typical

(5) Assemble Dial Indicator C-3339 into Scooter Block D-115-2 and secure set screw.

(6) Place Scooter Block/Dial Indicator in position in axle housing so dial probe and scooter block are flush against the surface of the pinion height block. Hold scooter block in place and zero the dial indicator face to the pointer. Tighten dial indicator face lock screw.

(7) With scooter block still in position against the pinion height block, slowly slide the dial indicator probe over the edge of the pinion height block. Observe how many revolutions counterclockwise the dial pointer travels (approximately 0.125 in.) to the out-stop of the dial indicator.

(8) Slide the dial indicator probe across the gap between the pinion height block and the arbor bar with the scooter block against the pinion height block (Fig. 60). When the dial probe contacts the arbor bar, the dial pointer will turn clockwise. Bring dial pointer back to zero against the arbor bar, do not turn dial face. Continue moving the dial probe to the crest of the arbor bar and record the highest reading. If the dial indicator can not achieve the zero reading, the rear bearing cup or the pinion depth gauge set is not installed correctly.

(9) Select a shim equal to the dial indicator reading plus the drive pinion gear depth variance number etched in the face of the pinion gear (Fig. 55) using the opposite sign on the variance number. For

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ADJUSTMENTS (Continued)

example, if the depth variance is –2, add +0.002 in. to the dial indicator reading.

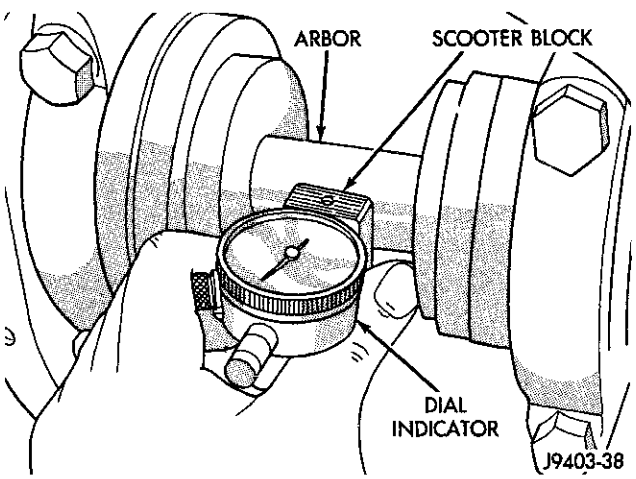

Fig. 60 Pinion Gear Depth Measurement—Typical

(10) Remove the pinion depth gauge components from the axle housing

DIFFERENTIAL BEARING PRELOAD AND GEAR BACKLASH

INTRODUCTION

Differential side bearing preload and gear backlash is achieved by selective shims positioned behind the differential side bearing cones. The proper shim thickness can be determined using slip-fit dummy bearings D-343 in place of the differential side bearings and a dial indicator C-3339. Before proceeding with the differential bearing preload and gear backlash measurements, measure the pinion gear depth and prepare the pinion gear for installation. Establishing proper pinion gear depth is essential to establishing gear backlash and tooth contact patterns. After the overall shim thickness to take up differential side play is measured, the pinion gear is installed, and the gear backlash shim thickness is measured. The overall shim thickness is the total of the dial indicator reading and the preload specification added together. The gear backlash measurement determines the thickness of the shim used on the ring gear side of the differential case. Subtract the gear backlash shim thickness from the total overall shim thickness and select that amount for the pinion gear side of the differential (Fig. 61). Differential shim measurements are performed with axle spreader W-129-B removed.

SHIM SELECTION

NOTE: It is difficult to salvage the differential side bearings during the removal procedure. Install replacement bearings if necessary.

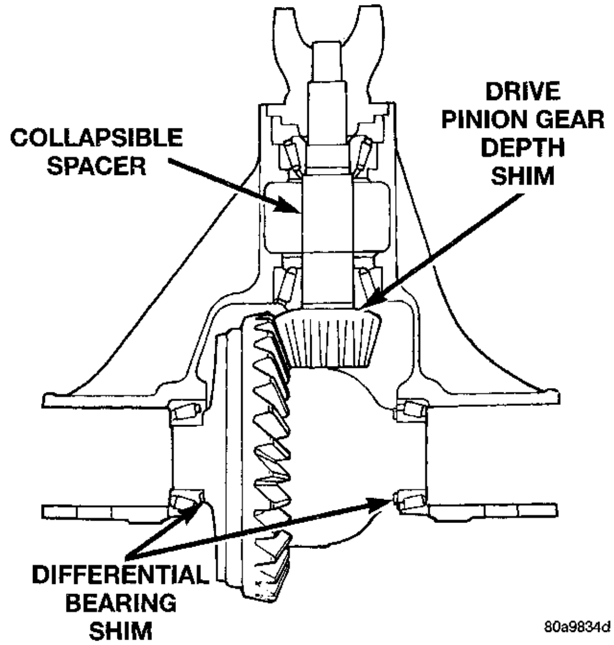

Fig. 61 Axle Adjustment Shim Locations—248 RBI

(1) Remove differential side bearings from differential case.

(2) Remove factory installed shims from differential case.

(3) Install ring gear on differential case and tighten bolts to specification, if necessary.

(4) Install dummy side bearings D-343 on differential case.

(5) Install differential case in axle housing.

(6) Install the marked bearing caps in their correct positions. Install and snug the bolts (Fig. 62).

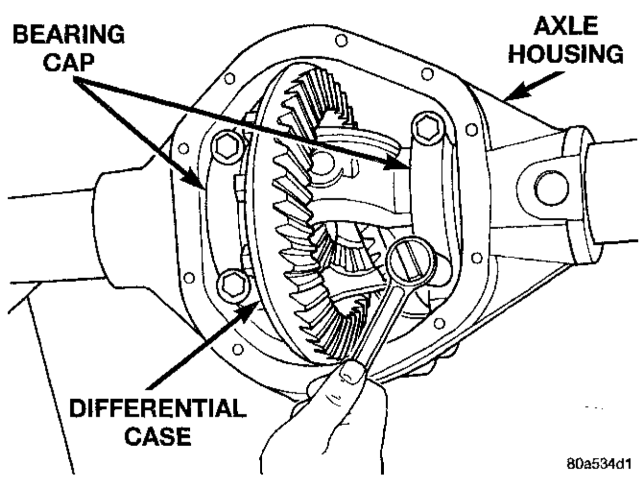

Fig. 62 Tighten Bolts Holding Bearing Caps

(7) Using a dead-blow type mallet, seat the differential dummy bearings to each side of the axle housing (Fig. 63) and (Fig. 64).

ADJUSTMENTS (Continued)

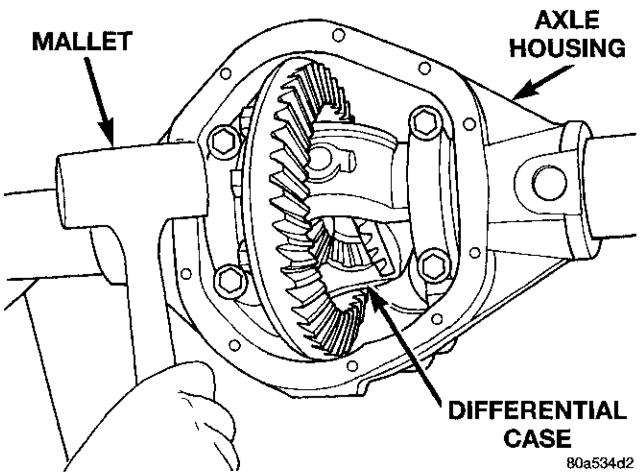

Fig. 63 Seat Pinion Gear Side Differential Dummy Side Bearing

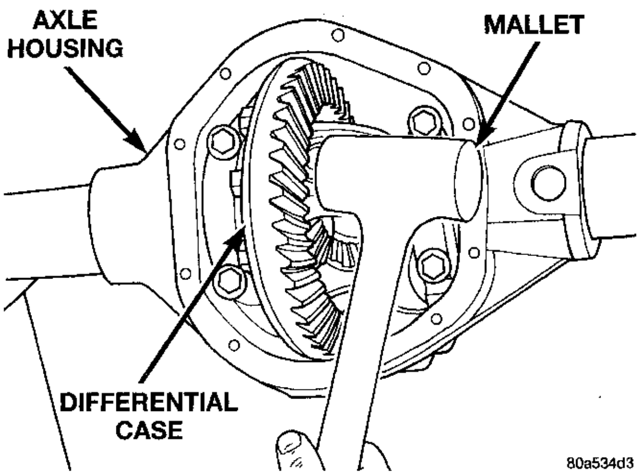

Fig. 64 Seat Ring Gear Side Differential Dummy Side Bearing

(8) Thread guide stud C-3288-B into rear cover bolt hole below ring gear (Fig. 65).

(9) Attach a dial indicator C-3339 to guide stud. Position the dial indicator plunger on a flat surface between the ring gear bolt heads (Fig. 65).

(10) Push and hold differential case to pinion gear side of axle housing (Fig. 66).

(11) Zero dial indicator face to pointer (Fig. 66).

(12) Push and hold differential case to ring gear side of the axle housing (Fig. 67).

(13) Record dial indicator reading (Fig. 67).

(14) Add 0.015 in. (0.38 mm) to the zero end play total. This new total represents the thickness of shims to compress, or preload the new bearings when the differential is installed.

(15) Rotate dial indicator out of the way on the guide stud.

(16) Remove differential case and dummy bearings from axle housing.

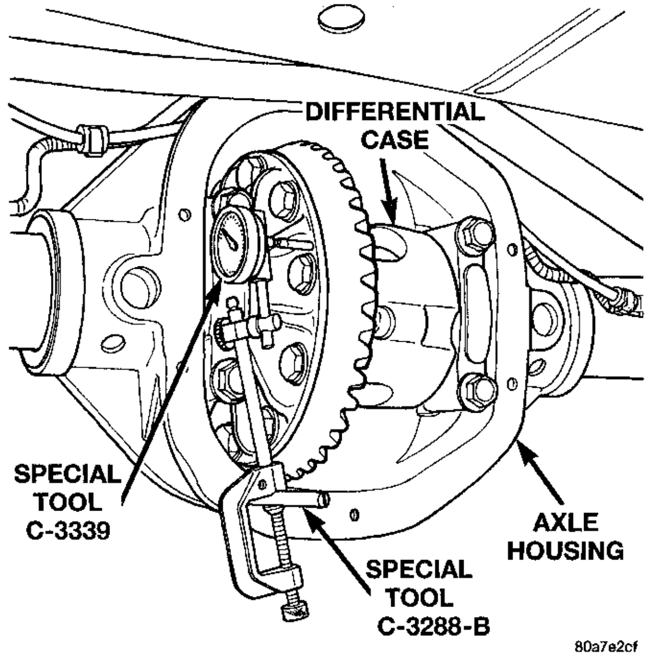

Fig. 65 Differential Side play Measurement

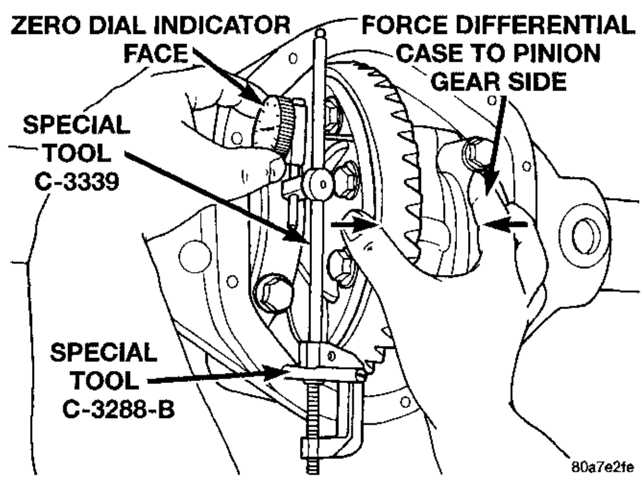

Fig. 66 Hold Differential Case and Zero Dial Indicator

(17) Install the pinion gear in axle housing. Install the pinion yoke, or flange, and establish the correct pinion rotating torque.

(18) Install differential case and dummy bearings D-343 in axle housing (without shims), install bearing caps and tighten bolts snug.

(19) Seat ring gear side dummy bearing (Fig. 64).

(20) Position the dial indicator plunger on a flat surface between the ring gear bolt heads.

(21) Push and hold differential case toward pinion gear (Fig. 66).

(22) Zero dial indicator face to pointer (Fig. 68).

(23) Push and hold differential case to ring gear side of the axle housing (Fig. 69).

(24) Record dial indicator reading (Fig. 69).

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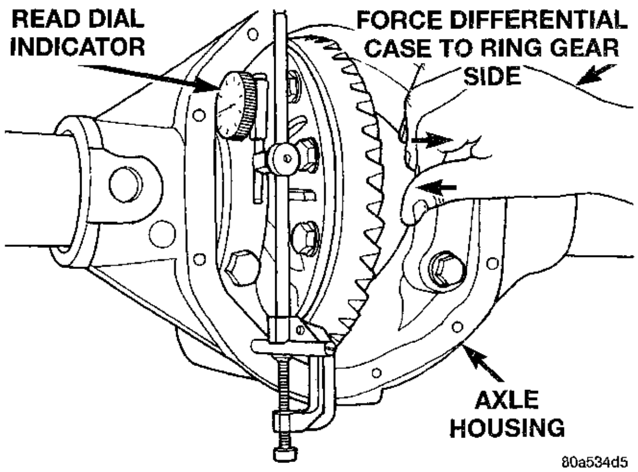

Fig. 67 Hold Differential Case and Read Dial Indicator

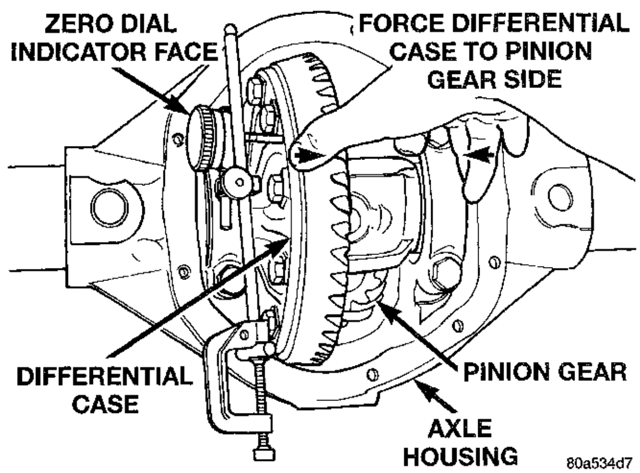

Fig. 68 Hold Differential Case and Zero Dial Indicator

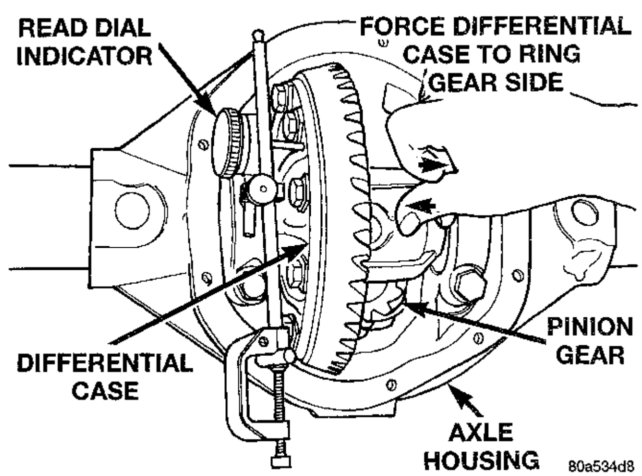

Fig. 69 Hold Differential Case and Read Dial Indicator

(25) This is the thickness shim required on the ring gear side of the differential case to achieve proper backlash.

(26) Subtract the backlash shim thickness from the total preload shim thickness. The remainder is the shim thickness required on the pinion side of the axle housing.

(27) Rotate dial indicator out of the way on guide stud.

(28) Remove differential case and dummy bearings from axle housing.

(29) Install side bearing shims on differential case hubs.

(30) Install side bearings and cups on differential case.

(31) Install spreader W-129-B on axle housing and spread axle opening enough to receive differential case.

(32) Install differential case in axle housing.

(33) Remove spreader from axle housing.

(34) Rotate the differential case several times to seat the side bearings.

(35) Position the indicator plunger against a ring gear tooth (Fig. 70).

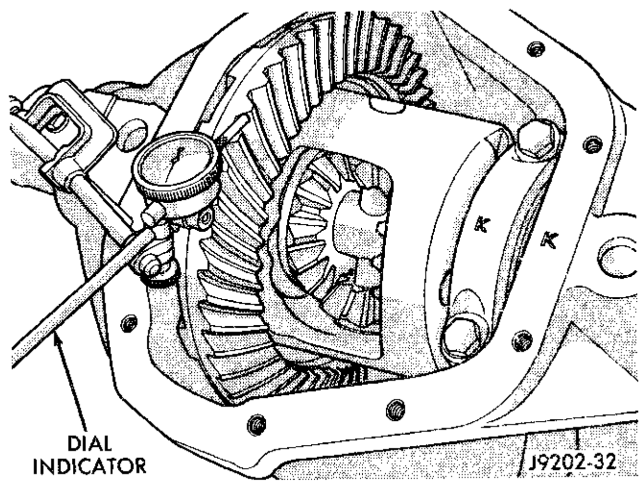

Fig. 70 Ring Gear Backlash Measurement

(36) Push and hold ring gear upward while not allowing the pinion gear to rotate.

(37) Zero dial indicator face to pointer.

(38) Push and hold ring gear downward while not allowing the pinion gear to rotate. Dial indicator reading should be between 0.12 mm (0.005 in.) and 0.20 mm (0.008 in.). If backlash is not within specifications transfer the necessary amount of shim thickness from one side of the axle housing to the other (Fig. 71).

(39) Verify differential case and ring gear runout by measuring ring to pinion gear backlash at several locations around the ring gear. Readings should not vary more than 0.05 mm (0.002 in.). If readings vary

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ADJUSTMENTS (Continued)

more than specified, the ring gear or the differential case is defective.

After the proper backlash is achieved, perform Gear Contact Pattern Analysis procedure.

GEAR CONTACT PATTERN ANALYSIS

The ring and pinion gear teeth contact patterns will show if the pinion gear depth is correct in the axle housing. It will also show if the ring gear backlash has been adjusted correctly. The backlash can be adjusted within specifications to achieve desired tooth contact patterns.

(1) Apply a thin coat of hydrated ferric oxide, or equivalent, to the drive and coast side of the ring gear teeth.

(2) Wrap, twist, and hold a shop towel around the pinion yoke to increase the turning resistance of the pinion gear. This will provide a more distinct contact pattern.

(3) Using a boxed end wrench on a ring gear bolt, Rotate the differential case one complete revolution in both directions while a load is being applied from shop towel.

The areas on the ring gear teeth with the greatest degree of contact against the pinion gear teeth will squeegee the compound to the areas with the least amount of contact. Note and compare patterns on the ring gear teeth to Gear Tooth Contact Patterns chart (Fig. 72) and adjust pinion depth and gear backlash as necessary.

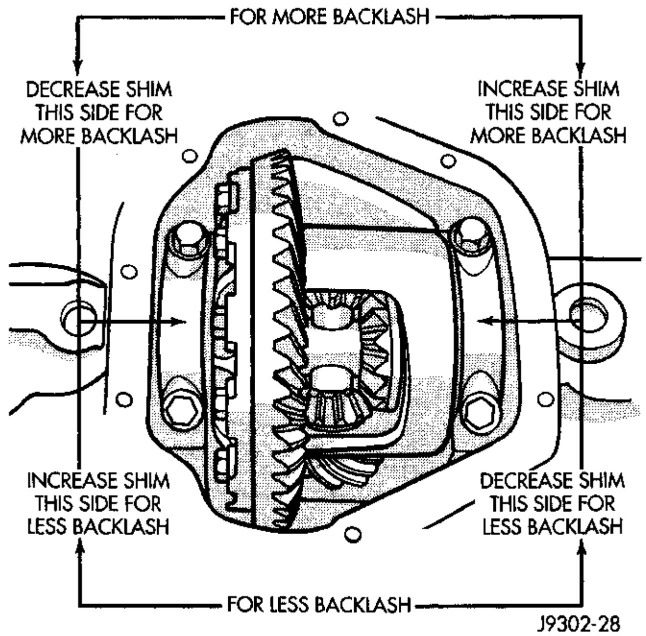

Fig. 71 Backlash Shim Adjustment

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ADJUSTMENTS (Continued)

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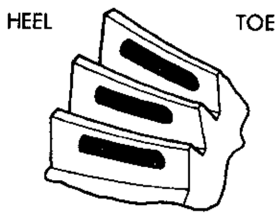
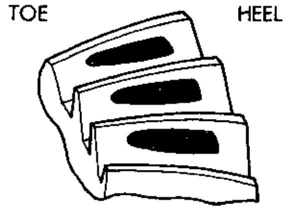
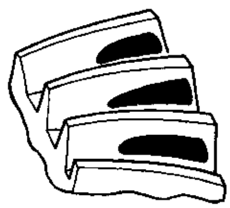
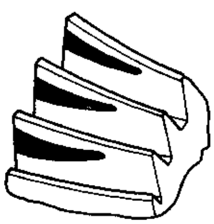
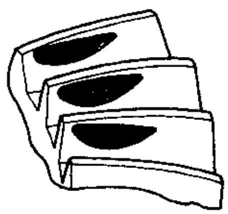
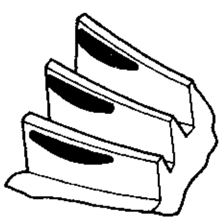
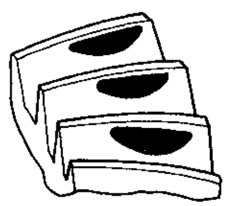
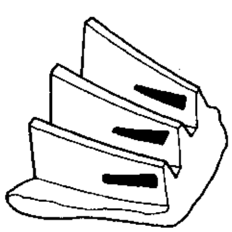
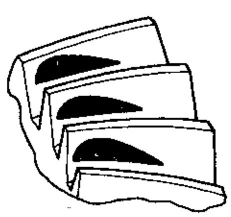
OF RING
GEAR TEETH

</td><td>COAST SIDE
OF RING
GEAR TEETH

</td><td>DESIRABLE CONTACT PATTERN. PATTERN SHOULD BE CENTERED ON THE DRIVE SIDE OF TOOTH. PATTERN SHOULD BE CENTERED ON THE COAST SIDE OF TOOTH, BUT MAY BE SLIGHTLY TOWARD THE TOE. THERE SHOULD ALWAYS BE SOME CLEARANCE BETWEEN CONTACT PATTERN AND TOP OF THE TOOTH.</td></tr>
<tr><td></td><td></td><td>RING GEAR BACKLASH CORRECT. THINNER PINION GEAR DEPTH SHIM REQUIRED.</td></tr>
<tr><td></td><td></td><td>RING GEAR BACKLASH CORRECT. THICKER PINION GEAR DEPTH SHIM REQUIRED.</td></tr>
<tr><td></td><td></td><td>PINION GEAR DEPTH SHIM CORRECT. DECREASE RING GEAR BACKLASH.</td></tr>
<tr><td></td><td></td><td>PINION GEAR DEPTH SHIM CORRECT. INCREASE RING GEAR BACKLASH.</td></tr>
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Fig. 72 Gear Tooth Contact Patterns

SPECIFICATIONS

248 AND 267 RBI AXLES

248 RBI AXLE

DESCRIPTION	SPEC.
Axle Type	Hypoid
Lubricant	SAE 90W
Lube Capacity	2.96 L (6.25 pts.)
Axle Ratio	3.55, 4.10
Ring Gear	
Diameter	247.7 mm (9.75 in.)
Backlash	0.10–0.23 mm (0.004–0.009 in.)
Pinion Std. Depth	127.0 mm (5.000 in.)
Pinion Bearing Preload	
Original Bearing	1–3 N·m (10–20 in. lbs.)
New Bearing	2–5 N·m (15–35 in. lbs.)

267 RBI AXLE

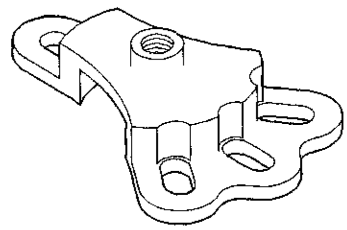
DESCRIPTION	SPEC.
Axle Type	Hypoid
Lubricant	SAE 90W
Lube Capacity	3.31 L (7.0 pts.)
Axle Ratio	3.54, 4.10
Ring Gear	
Diameter	266.7 mm (10.50 in.)
Backlash	0.10–0.23 mm (0.004–0.009 in.)
Pinion Std. Depth	136.525 mm (5.375 in.)
Pinion Bearing Preload	
Original Bearing	1–3 N·m (10–20 in. lbs.)
New Bearing	2–5 N·m (15–35 in. lbs.)

248 AND 267 RBI AXLE

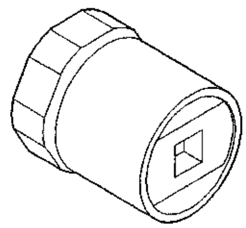
DESCRIPTION	TORQUE
Fill Hole Plug	34 N·m (25 ft. lbs.)
Diff. Cover Bolt	41 N·m (30 ft. lbs.)
Bearing Cap Bolt	108 N·m (80 ft. lbs.)
Pinion Nut	292-447 N·m (215–330 ft. lbs.)
Ring gear Bolt	163-190 N·m (120–140 ft. lbs.)
Axle to Hub Bolt	123 N·m (90 ft. lbs.)
Power-lok Body Screws	See Procedure
Hub Nut	163–190 N·m (120–140 ft. lbs.)

SPECIAL TOOLS

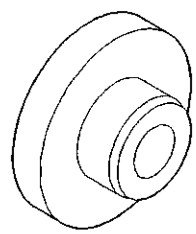
248 AND 267 RBI AXLES



Puller—6790



Wrench—DD-1241-JD



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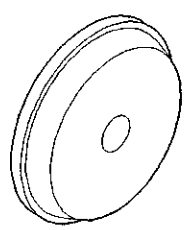

Installer—8151

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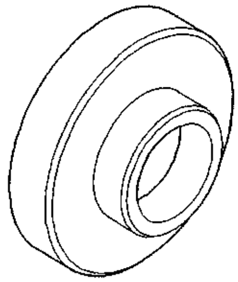
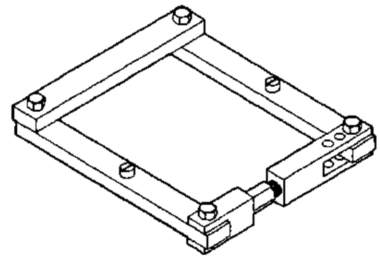
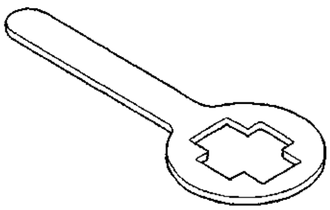
SPECIAL TOOLS (Continued)



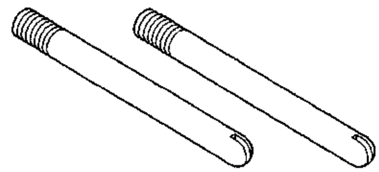
Installer—8149



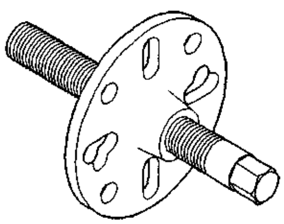
Spreader—W-129-B



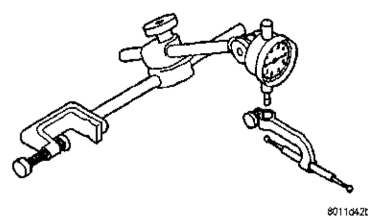
Holder—6719



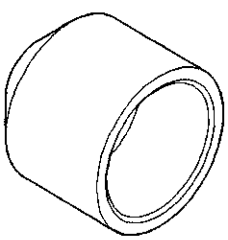
Guide Pin—C-3288-B



Puller—C-452



Dial Indicator—C-3339



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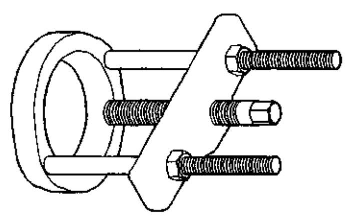

Puller/Press—C-293-PA

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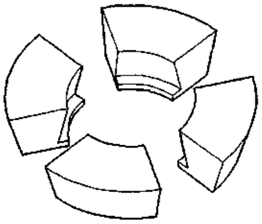
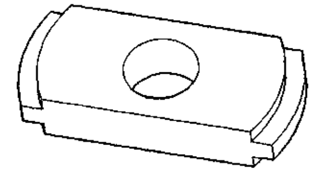
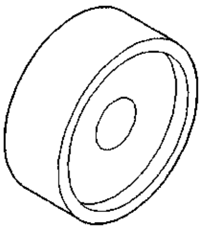
SPECIAL TOOLS (Continued)



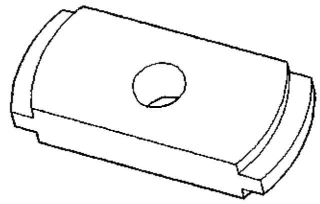
Adapters—C-293-62



Remover—D-158



Installer—C-4190



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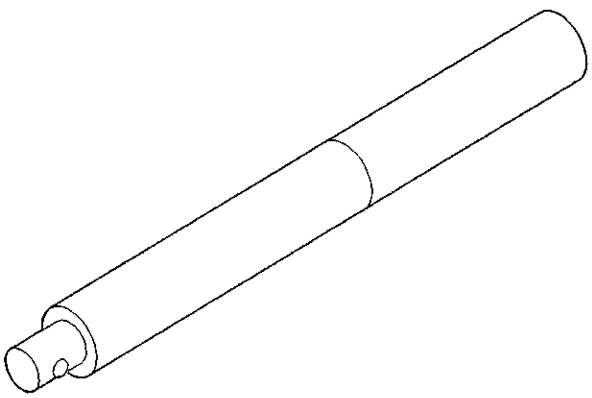
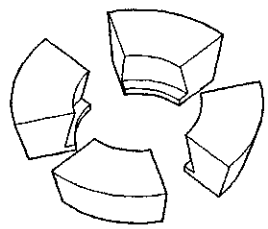


Handle—C-4171



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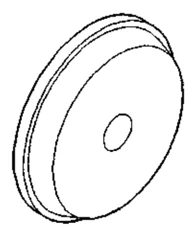

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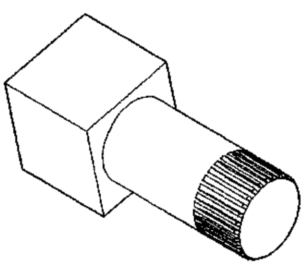
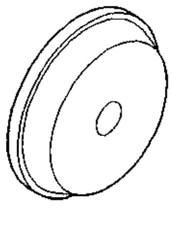


Holder—6963-A

AUTHENTIC RESTORATION PRODUCT

SPECIAL TOOLS (Continued)



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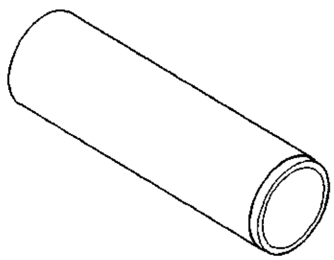

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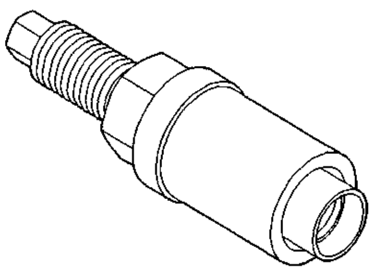
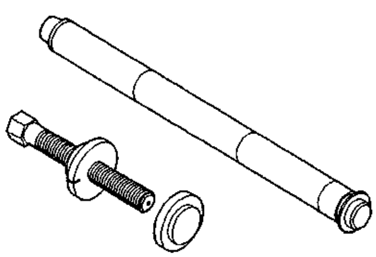
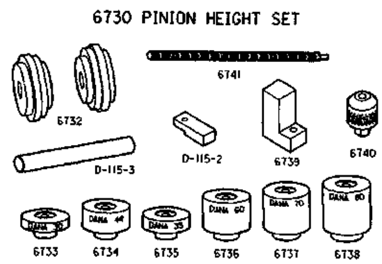


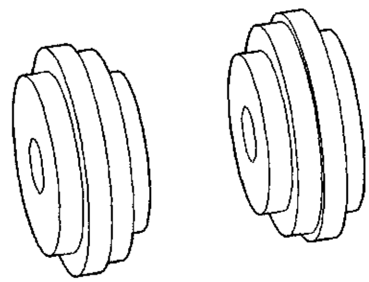
Installer—C-3718



Trac-lok Tools—C-4487



Gauge Set—6730



Arbor Discs—6732

286 RBI AXLE

INDEX

GENERAL INFORMATION

286 RBI AXLE

The 286 Rear Beam-design Iron (RBI) axle housings consist of an iron center casting (differential housing) with axle shaft tubes extending from either side. The tubes are pressed in to form a one-piece axle housing.

The integral type housing, hypoid gear design has the centerline of the pinion set below the centerline of the ring gear.

The axles are equipped with full-floating axle shafts, meaning that loads are supported by the axle housing tubes. The full-float axle shafts are retained by bolts attached to the hub. The hub rides on two bearings at the outboard end of the axle tube. The axle shafts can be removed without disturbing or removing the wheel bearings. The wheel bearings are opposed tapered roller bearings and are contained in the hub assembly.

The removable, stamped steel cover provides a means for inspection and service without removing the complete axle from the vehicle. A small, stamped metal axle gear ratio identification tag is attached to the housing cover via one of the cover bolts. This tag also identifies the number of ring and pinion teeth.

The rear wheel anti-lock (RWAL) brake speed sensor is attached to the top, forward exterior of the differential housing. A seal is located between the sensor and the wire harness connector. The seal must be in place when the wire connector is connected to the sensor. The RWAL brake exciter ring is press-fitted onto the differential case against the ring gear flange.

The differential case for the standard differential is a one-piece design. The differential pinion mate shaft is retained with a roll pin. Differential bearing preload and ring gear backlash are adjusted by the use of shims located between the differential bearing cones and case. Pinion bearing preload is set and maintained by the use of solid shims.

Axles equipped with a Trac-Lok™ differential are optional for the 286 RBI axle. A Trac-lok differential contains two clutch packs, four pinion gears, and a one-piece pinion mate cross shaft to provide increased torque to the non-slipping wheel in addition to the standard differential components. A Trac-lok differential for the 286 RBI axle has a two-piece differential case.

LUBRICANT SPECIFICATIONS

A multi-purpose, hypoid gear lubricant which conforms to the following specifications should be used.

AUTHENTIC RESTORATION PRODUCT

GENERAL INFORMATION (Continued)

Mopar® Hypoid Gear Lubricant conforms to all of these specifications.

• The lubricant should have MIL–L–2105C and API GL 5 quality specifications.

• Lubricant is a thermally stable SAE 80W-90 gear lubricant.

Trac-lok differential equipped 4X2 vehicles require the addition of 7 oz. of friction modifier to the axle lubricant. Trac-lok differential equipped 4X4 vehicles require the addition of 10 oz. of friction modifier to the axle lubricant. The 286 RBI axle lubricant capacity is 3.22 L (6.81 pts.) for 4X2 vehicles and 4.80 L (10.125 pts.) for 4X4 vehicles total, including the friction modifier if necessary.

CAUTION: If axle is submerged in water, lubricant must be replaced immediately to avoid possible premature axle failure.

DESCRIPTION AND OPERATION

STANDARD DIFFERENTIAL

The differential gear system divides the torque between the axle shafts. It allows the axle shafts to rotate at different speeds when turning corners.

Each differential side gear is splined to an axle shaft. The pinion gears are mounted on a pinion mate shaft and are free to rotate on the shaft. The pinion gear is fitted in a bore in the differential case and is positioned at a right angle to the axle shafts.

In operation, power flow occurs as follows:

• The pinion gear rotates the ring gear

• The ring gear (bolted to the differential case) rotates the case

• The differential pinion gears (mounted on the pinion mate shaft in the case) rotate the side gears

• The side gears (splined to the axle shafts) rotate the shafts

During straight-ahead driving, the differential pinion gears do not rotate on the pinion mate shaft. This occurs because input torque applied to the gears is divided and distributed equally between the two side gears. As a result, the pinion gears revolve with the pinion mate shaft but do not rotate around it (Fig. 1).

When turning corners, the outside wheel must travel a greater distance than the inside wheel to complete a turn. The difference must be compensated for to prevent the tires from scuffing and skidding through turns. To accomplish this, the differential allows the axle shafts to turn at unequal speeds (Fig. 2). In this instance, the input torque applied to the pinion gears is not divided equally. The pinion gears now rotate around the pinion mate shaft in opposite directions. This allows the side gear and axle shaft attached to the outside wheel to rotate at a faster speed.

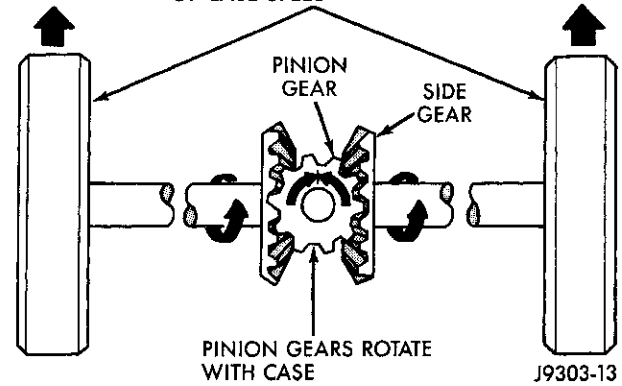


Fig. 1 Differential Operation—Straight Ahead Driving

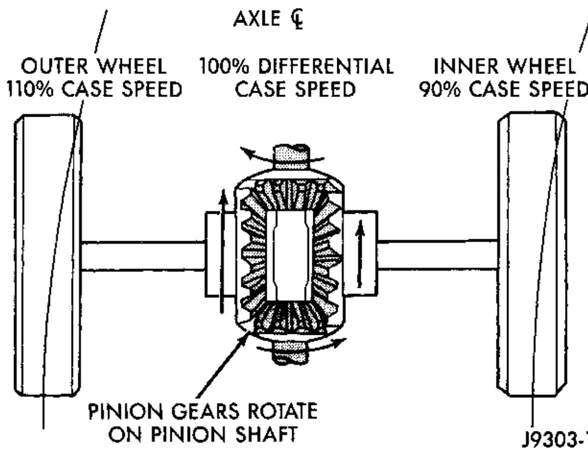


Fig. 2 Differential Operation—On Turns

TRAC-LOK OPERATION

In a conventional differential, if one wheel spins, the opposite wheel will generate only as much torque as the spinning wheel.

In the Trac-lok differential, part of the ring gear torque is transmitted through clutch packs which contain multiple discs. The clutches will have radial grooves on the plates, and concentric grooves on the discs or bonded fiber material that is smooth in appearance.

In operation, the Trac-lok clutches are engaged by two concurrent forces. The first being the preload force exerted through Belleville spring washers within the clutch packs. The second is the separating forces generated by the side gears as torque is applied through the ring gear (Fig. 3).

The Trac-lok design provides the differential action needed for turning corners and for driving straight ahead during periods of unequal traction. When one wheel looses traction, the clutch packs transfer addi-

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DESCRIPTION AND OPERATION (Continued)

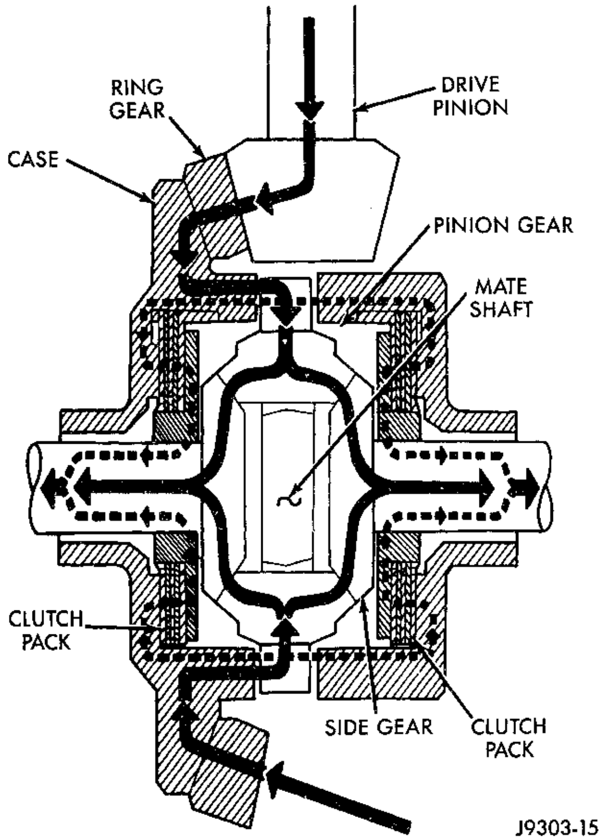

Fig. 3 Trac-lok Limited Slip Differential Operation

tional torque to the wheel having the most traction. Trac-lok differentials resist wheel spin on bumpy roads and provide more pulling power when one wheel looses traction. Pulling power is provided continuously until both wheels loose traction. If both wheels slip due to unequal traction, Trac-lok operation is normal. In extreme cases of differences of traction, the wheel with the least traction may spin.

DIAGNOSIS AND TESTING

GENERAL INFORMATION

Axle bearing problem conditions are usually caused by:

- Insufficient or incorrect lubricant.
- Foreign matter/water contamination.
- Incorrect bearing preload torque adjustment.
- Incorrect backlash.

Axle gear problem conditions are usually the result of:

- Insufficient lubrication.
- Incorrect or contaminated lubricant.
- Overloading (excessive engine torque) or exceeding vehicle weight capacity.
- Incorrect clearance or backlash adjustment.

Axle component breakage is most often the result of:

- Severe overloading.
- Insufficient lubricant.
- Incorrect lubricant.
- Improperly tightened components.

GEAR NOISE

Axle gear noise can be caused by insufficient lubricant, incorrect backlash, tooth contact, or worn/damaged gears.

Gear noise usually happens at a specific speed range. The range is 30 to 40 mph, or above 50 mph. The noise can also occur during a specific type of driving condition. These conditions are acceleration, deceleration, coast, or constant load.

When road testing, accelerate the vehicle to the speed range where the noise is the greatest. Shift out-of-gear and coast through the peak–noise range. If the noise stops or changes greatly:

- Check for insufficient lubricant.
- Incorrect ring gear backlash.
- Gear damage.

Differential side and pinion gears can be checked by turning the vehicle. They usually do not cause noise during straight–ahead driving when the gears are unloaded. The side gears are loaded during vehicle turns. A worn pinion gear mate shaft can also cause a snapping or a knocking noise.

BEARING NOISE

The axle shaft, differential and pinion gear bearings can all produce noise when worn or damaged. Bearing noise can be either a whining, or a growling sound.

Pinion gear bearings have a constant–pitch noise. This noise changes only with vehicle speed. Pinion bearing noise will be higher because it rotates at a faster rate. Drive the vehicle and load the differential. If bearing noise occurs, the rear pinion bearing is the source of the noise. If the bearing noise is heard during a coast, the front pinion bearing is the source.

Worn or damaged differential bearings usually produce a low pitch noise. Differential bearing noise is similar to pinion bearing noise. The pitch of differential bearing noise is also constant and varies only with vehicle speed.

Axle shaft bearings produce noise and vibration when worn or damaged. The noise generally changes when the bearings are loaded. Road test the vehicle. Turn the vehicle sharply to the left and to the right. This will load the bearings and change the noise level. Where axle bearing damage is slight, the noise is usually not noticeable at speeds above 30 mph.

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DIAGNOSIS AND TESTING (Continued)

LOW SPEED KNOCK

Low speed knock is generally caused by a worn U–joint or by worn side–gear thrust washers. A worn pinion gear shaft bore will also cause low speed knock.

VIBRATION

Vibration at the rear of the vehicle is usually caused by a:

- Damaged drive shaft.
- Missing drive shaft balance weight(s).
- Worn or out–of–balance wheels.
- Loose wheel lug nuts.
- Worn U–joint(s).
- Loose/broken springs.
- Damaged axle shaft bearing(s).
- Loose pinion gear nut.
- Excessive pinion yoke run out.
- Bent axle shaft(s).

Check for loose or damaged front–end components or engine/transmission mounts. These components can contribute to what appears to be a rear–end vibration. Do not overlook engine accessories, brackets and drive belts.

All driveline components should be examined before starting any repair.

Refer to Group 22, Wheels and Tires, for additional vibration information.

DRIVELINE SNAP

A snap or clunk noise when the vehicle is shifted into gear (or the clutch engaged), can be caused by:

- High engine idle speed
- Loose engine/transmission/transfer case mounts
- Worn U–joints
- Loose spring mounts
- Loose pinion gear nut and yoke
- Excessive ring gear backlash
- Excessive side gear/case clearance

The source of a snap or a clunk noise can be determined with the assistance of a helper. Raise the vehicle on a hoist with the wheels free to rotate. Instruct the helper to shift the transmission into gear. Listen for the noise, a mechanics stethoscope is helpful in isolating the source of a noise.

TRAC–LOK DIFFERENTIAL NOISE

The most common problem is a chatter noise when turning corners. Before removing a Trac-lok unit for repair, drain, flush and refill the axle with the specified lubricant. Refer to Lubricant change in this Group.

A container of Mopar® Trac-lok Lubricant (friction modifier) should be added after repair service or during a lubricant change.

After changing the lubricant, drive the vehicle and make 10 to 12 slow, figure-eight turns. This maneuver will pump lubricant through the clutches. This will correct the condition in most instances. If the chatter persists, clutch damage could have occurred.

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DIAGNOSIS AND TESTING (Continued)

DIAGNOSIS CHART

CONDITION	POSSIBLE CAUSES	CORRECTION
WHEEL NOISE	1. Wheel loose. 2. Faulty, brinelled wheel bearing.	1. Tighten loose nuts. 2. Faulty or brinelled bearings must be replaced.
AXLE SHAFT NOISE	1. Misaligned axle shaft tube. 2. Bent or sprung axle shaft. 3. End play in drive pinion bearings. 4. Excessive gear backlash between ring gear and pinion gear. 5. Improper adjustment of drive pinion gear shaft bearings. 6. Loose drive pinion gearshaft yoke nut. 7. Improper wheel bearing adjustment. 8. Scuffed gear tooth contact surfaces.	1. Inspect axle shaft tube alignment. Correct as necessary. 2. Replace bent or sprung axle shaft. 3. Refer to Drive Pinion Bearing Pre-Load Adjustment. 4. Check adjustment of ring gear backlash and pinion gear. Correct as necessary. 5. Adjust drive pinion shaft bearings. 6. Tighten drive pinion gearshaft yoke nut with specified torque. 7. Readjust as necessary. 8. If necessary, replace scuffed gears.
AXLE SHAFT BROKE	1. Misaligned axle shaft tube. 2. Vehicle overloaded. 3. Erratic clutch operation. 4. Grabbing clutch.	1. Replace broken axle shaft after correcting axle shaft tube alignment. 2. Replace broken axle shaft. Avoid excessive weight on vehicle. 3. Replace broken axle shaft after inspecting for other possible causes. Avoid erratic use of clutch. 4. Replace broken axle shaft. Inspect clutch and make necessary repairs or adjustments.
DIFFERENTIAL CASE CRACKED	1. Improper adjustment of differential bearings. 2. Excessive ring gear backlash. 3. Vehicle overloaded. 4. Erratic clutch operation.	1. Replace cracked case; examine gears and bearings for possible damage. At reassembly, adjust differential bearings properly. 2. Replace cracked case; examine gears and bearings for possible damage. At reassembly, adjust ring gear backlash properly. 3. Replace cracked case; examine gears and bearings for possible damage. Avoid excessive weight on vehicle. 4. Replace cracked case. After inspecting for other possible causes, examine gears and bearings for possible damage. Avoid erratic use of clutch.
DIFFERENTIAL GEARS SCORED	1. Insufficient lubrication. 2. Improper grade of lubricant. 3. Excessive spinning of one wheel/tire.	1. Replace scored gears. Scoring marks on the drive face of gear teeth or in the bore are caused by instantaneous fusing of the mating surfaces. Scored gears should be replaced. Fill rear differential housing to required capacity with proper lubricant. Refer to Specifications. 2. Replace scored gears. Inspect all gears and bearings for possible damage. Clean and refill differential housing to required capacity with proper lubricant. 3. Replace scored gears. Inspect all gears, pinion bores and shaft for damage. Service as necessary.
LOSS OF LUBRICANT	1. Lubricant level too high.	1. Drain excess lubricant by removing fill plug and allow lubricant to level at lower edge of fill plug hole.

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DIAGNOSIS AND TESTING (Continued)

CONT., DIAGNOSIS CHART

CONDITION	POSSIBLE CAUSES	CORRECTION
LOSS OF LUBRICANT	2. Worn axle shaft seals. 3. Cracked differential housing. 4. Worn drive pinion gear shaft seal. 5. Scored and worn yoke. 6. Axle cover not properly sealed.	2. Replace worn seals. 3. Repair or replace housing as necessary. 4. Replace worn drive pinion gear shaft seal. 5. Replace worn or scored yoke and seal. 6. Remove cover and clean flange and reseal.
AXLE OVERHEATING	1. Lubricant level too low. 2. Incorrect grade of lubricant. 3. Bearings adjusted too tight. 4. Excessive gear wear. 5. Insufficient ring gear backlash.	1. Refill differential housing. 2. Drain, flush and refill with correct amount of the correct lubricant. 3. Readjust bearings. 4. Inspect gears for excessive wear or scoring. Replace as necessary. 5. Readjust ring gear backlash and inspect gears for possible scoring.
GEAR TEETH BROKE (RING GEAR AND PINION)	1. Overloading. 2. Erratic clutch operation. 3. Ice-spotted pavements. 4. Improper adjustments.	1. Replace gears. Examine other gears and bearings for possible damage. 2. Replace gears and examine the remaining parts for possible damage. Avoid erratic clutch operation. 3. Replace gears. Examine the remaining parts for possible damage. Replace parts as required. 4. Replace gears. Examine other parts for possible damage. Ensure ring gear backlash is correct.
AXLE NOISE	1. Insufficient lubricant. 2. Improper ring gear and drive pinion gear adjustment. 3. Unmatched ring gear and drive pinion gear. 4. Worn teeth on ring gear or drive pinion gear. 5. Loose drive pinion gear shaft bearings. 6. Loose differential bearings. 7. Misaligned or sprung ring gear. 8. Loose differential bearing cap bolts	1. Refill axle with correct amount of the proper lubricant. Also inspect for leaks and correct as necessary. 2. Check ring gear and pinion gear teeth contact pattern. 3. Remove unmatched ring gear and drive pinion gear. Replace with matched gear and drive pinion gear set. 4. Check teeth on ring gear and drive pinion gear for correct contact. If necessary, replace with new matched set. 5. Adjust drive pinion gearshaft bearing preload torque. 6. Adjust differential bearing preload torque. 7. Measure ring gear runout. 8. Tighten with specified torque

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DIAGNOSIS AND TESTING (Continued)

TRAC–LOK TEST

WARNING: WHEN SERVICING VEHICLES WITH A TRAC–LOK DIFFERENTIAL DO NOT USE THE ENGINE TO TURN THE AXLE AND WHEELS. BOTH REAR WHEELS MUST BE RAISED AND THE VEHICLE SUPPORTED. A TRAC–LOK AXLE CAN EXERT ENOUGH FORCE IF ONE WHEEL IS IN CONTACT WITH A SURFACE TO CAUSE THE VEHICLE TO MOVE.

The differential can be tested without removing the differential case by measuring rotating torque. Make sure brakes are not dragging during this measurement.

(1) Place blocks in front and rear of both front wheels.

(2) Raise one rear wheel until it is completely off the ground.

(3) Engine off, transmission in neutral, and parking brake off.

(4) Remove wheel and bolt Special Tool 6790 to studs.

(5) Use torque wrench on special tool to rotate wheel and read rotating torque (Fig. 4).

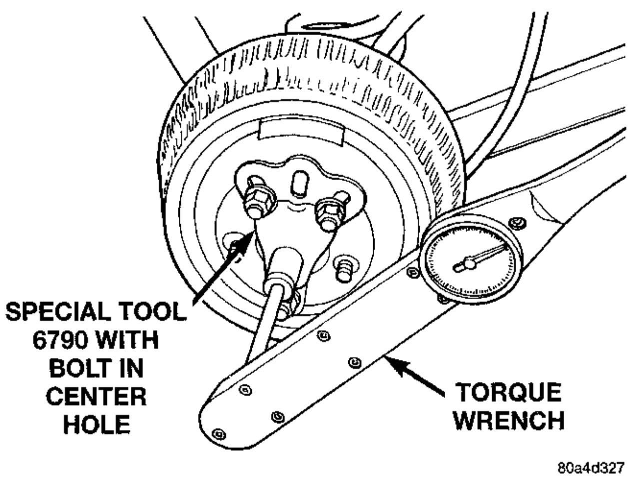

Fig. 4 Trac-lok Test —Typical

(6) If rotating torque is less than 22 N·m (30 ft. lbs.) or more than 271 N·m (200 ft. lbs.) on either wheel the unit should be serviced.

SERVICE PROCEDURES

LUBRICANT CHANGE

(1) Raise and support the vehicle.

(2) Remove the lubricant fill hole plug from the differential housing cover.

(3) Remove the differential housing cover and drain the lubricant from the housing.

(4) Clean the housing cavity with a flushing oil, light engine oil, or lint free cloth. **Do not use water, steam, kerosene, or gasoline for cleaning.**

(5) Remove the original sealant from the housing and cover surfaces.

(6) Apply a bead of Mopar® Silicone Rubber Sealant, or equivalent, to the housing cover (Fig. 5).

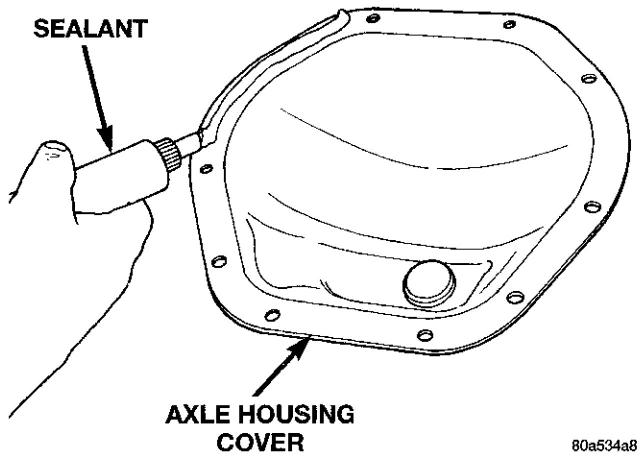

Fig. 5 Apply Sealant

Install the housing cover within 5 minutes after applying the sealant.

(7) Install the cover and any identification tag. Tighten the cover bolts to 41 N·m (30 ft. lbs.) torque.

(8) For Trac–lok differentials, a quantity of Mopar® Trac–lok lubricant (friction modifier), or equivalent, must be added after repair service or a lubricant change. Refer to the Lubricant Specifications section of this group for the quantity necessary.

(9) Fill differential with Mopar® Hypoid Gear Lubricant, or equivalent, to bottom of the fill plug hole. Refer to the Lubricant Specifications section of this group for the quantity necessary.

CAUTION: Overfilling the differential can result in lubricant foaming and overheating.

(10) Install the fill hole plug and lower the vehicle.

(11) Trac–lok differential equipped vehicles should be road tested by making 10 to 12 slow figure-eight turns. This maneuver will pump the lubricant through the clutch discs to eliminate a possible chatter noise complaint.

REMOVAL AND INSTALLATION

REAR AXLE

REMOVAL

(1) Raise and support the vehicle.

AUTHENTIC RESTORATION PRODUCTS

REMOVAL AND INSTALLATION (Continued)

(2) Position a suitable lifting device under the axle.
(3) Secure axle to device.
(4) Remove the wheels and tires.
(5) Secure brake drums to the axle shaft.
(6) Remove the RWAL sensor from the differential housing, if necessary. Refer to Group 5, Brakes, for proper procedures.
(7) Disconnect the brake hose at the axle junction block. Do not disconnect the brake hydraulic lines at the wheel cylinders. Refer to Group 5, Brakes, for proper procedures.
(8) Disconnect the parking brake cables and cable brackets.
(9) Disconnect the vent hose from the axle shaft tube.
(10) Mark the propeller shaft and yoke for installation alignment reference.
(11) Remove propeller shaft.
(12) Disconnect shock absorbers from axle.
(13) Remove the spring clamps and spring brackets. Refer to Group 2, Suspension, for proper procedures.
(14) Separate the axle from the vehicle.

INSTALLATION

(1) Raise the axle with lifting device and align to the leaf spring centering bolts.
(2) Install the spring clamps and spring brackets. Refer to Group 2, Suspension, for proper procedures.
(3) Install shock absorbers and tighten nuts to 82 N·m (60 ft. lbs.) torque.
(4) Install the RWAL sensor to the differential housing, if necessary. Refer to Group 5, Brakes, for proper procedures.
(5) Connect the parking brake cables and cable brackets.
(6) Install the brake drums. Refer to Group 5, Brakes, for proper procedures.
(7) Connect the brake hose to the axle junction block. Refer to Group 5, Brakes, for proper procedures.
(8) Install axle vent hose.
(9) Align propeller shaft and pinion yoke reference marks. Install universal joint straps and bolts. Tighten to 19 N·m (14 ft. lbs.) torque.
(10) Install the wheels and tires.
(11) Add gear lubricant, if necessary. Refer to Lubricant Specifications in this section for lubricant requirements.
(12) Remove lifting device from axle and lower the vehicle.

AXLE SHAFT

CAUTION: RAISE BOTH REAR WHEELS OFF THE SURFACE WHENEVER A REAR AXLE IS BEING SERVICED.

REMOVAL

(1) Remove the axle shaft flange bolts.
(2) Slide the axle shaft out from the axle tube.

INSTALLATION

(1) Clean the gasket contact surface area on the flange with an appropriate solvent. Install a new flange gasket and slide the axle shaft into the tube.
(2) Install the bolts and tighten to 122 N·m (90 ft. lbs.).

HUB AND AXLE BEARINGS

REMOVAL

(1) Remove wheel and tire assembly.
(2) Remove brake drum.
(3) Remove the axle shaft.
(4) Remove the lock wedge and adjustment nut. Use Socket DD-1241–JD to remove the adjustment nut.
(5) Remove the hub assembly. The outer axle bearing will slide out as the hub is being removed.
(6) Remove inner grease seal and discard. Use Installer 5064 and Handle C-4171 to drive grease seal and inner axle bearing from the hub.
(7) Remove the bearing cups from the hub bore. Use a brass drift, or an appropriate removal tool, to tap out the cups.

INSTALLATION

(1) Thoroughly clean both axle bearings and interior of the hub with an appropriate cleaning solvent.
(2) Install the bearing cups. Use Installer 8153 and Handle C-4171 to install the bearing cups.
(3) Apply lubricant to surface area of the bearing cup.
(4) Install the inner axle bearing in the hub.
(5) Install a new bearing grease seal. Use Installer 8152 and Handle C-4171 to install the grease seal.
(6) Inspect the bearing and seal contact surfaces on the axle tube spindle for burrs and/or roughness. Remove all the rough contact surfaces from the axle spindle. Apply a coating of multi-purpose NLGI, grade 2, EP-type lubricant to the axle.

CAUTION: Use care to prevent the bearing grease seal from contacting the axle tube spindle threads during installation. Otherwise, the seal could be damaged.

(7) Carefully slide the hub onto the axle.

REMOVAL AND INSTALLATION (Continued)

(8) Install the outer axle bearing.

(9) Install the hub bearing adjustment nut. Use Socket DD-1241–JD to install the adjustment nut.

(10) Tighten the adjustment nut to 163-190 N·m (120-140 ft. lbs.) while rotating the wheel.

(11) Loosen the adjustment nut 1/8 of-a-turn to provide 0.001-inch to 0.010-inch wheel bearing end play.

(12) Tap the locking wedge into the spindle keyway and adjustment nut. Try to ensure that the locking wedge is installed into a new position in the adjustment nut.

(13) Install the axle shaft.

(14) Install the brake drum.

(15) Install the wheel and tire assembly.

PINION SEAL

REMOVAL

(1) Raise and support the vehicle.

(2) Scribe a mark on the universal joint, pinion yoke, and pinion shaft for reference.

(3) Disconnect the propeller shaft from the pinion yoke. Secure the propeller shaft in an upright position to prevent damage to the rear universal joint.

(4) Remove the wheel and tire assemblies.

(5) Remove the brake drums to prevent any drag. The drag may cause a false bearing preload torque measurement.

(6) Rotate the pinion yoke three or four times.

(7) Measure the amount of torque necessary to rotate the pinion gear with a (in. lbs.) dial-type torque wrench. Record the torque reading for installation reference.

(8) Hold the yoke with Wrench 6719. Remove the pinion shaft nut and washer.

(9) Remove the yoke with Remover C-452 (Fig. 6).

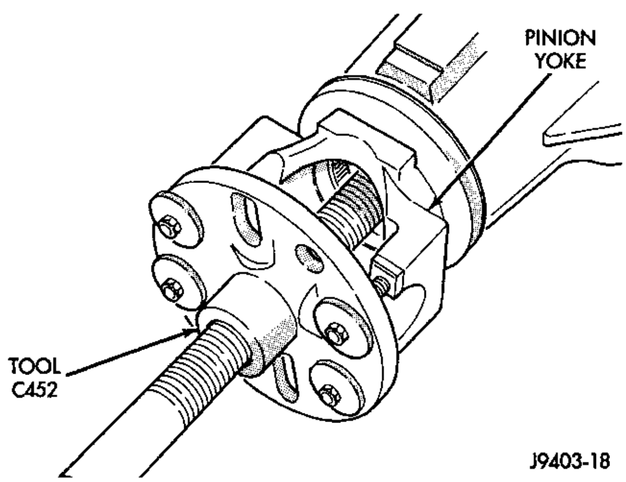

Fig. 6 Yoke Removal

(10) Remove the pinion shaft seal with suitable pry tool or slide-hammer mounted screw.

INSTALLATION

(1) Clean the seal contact surface in the housing bore.

(2) Examine the splines on the pinion shaft for burrs or wear. Remove any burrs and clean the shaft.

(3) Inspect pinion yoke for cracks, worn splines and worn seal contact surface. Replace yoke if necessary.

NOTE: The outer perimeter of the seal is pre-coated with a special sealant. An additional application of sealant is not required.

(4) Apply a light coating of gear lubricant on the lip of pinion seal.

(5) Install the new pinion shaft seal with Installer D-187-B and Handle C-4171.

NOTE: The seal is correctly installed when the seal flange contacts the face of the differential housing flange.

(6) Position the pinion yoke on the end of the shaft with the reference marks aligned.

(7) Seat yoke on pinion shaft with Installer D-191 and Wrench 6719 (Fig. 7).

(8) Remove the tools and install the pinion yoke washer and nut.

CAUTION: Do not exceed the minimum tightening torque when installing the pinion yoke retaining nut at this point. Damage to bearings may result.

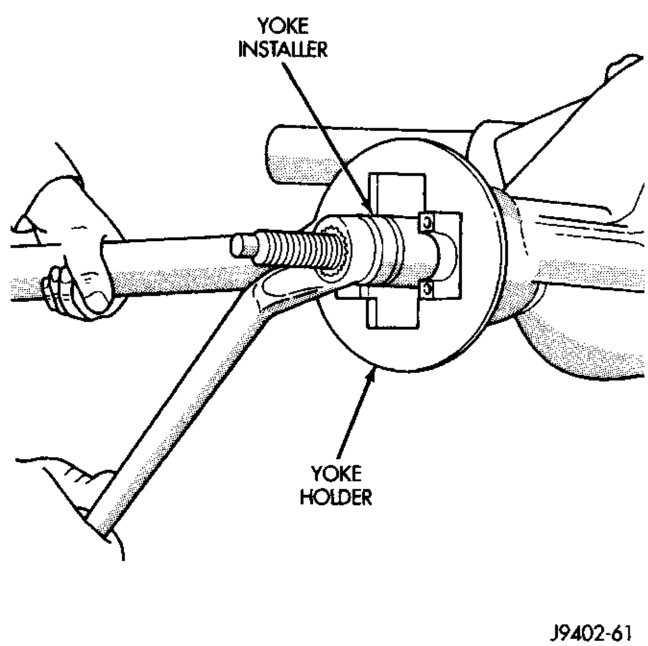

Fig. 7 Yoke Installation

(9) Hold pinion yoke with Yoke Holder 6719 and tighten shaft nut to 597 N·m (440 ft. lbs.) (Fig. 8).

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REMOVAL AND INSTALLATION (Continued)

Rotate pinion shaft several revolutions to ensure the bearing rollers are seated.

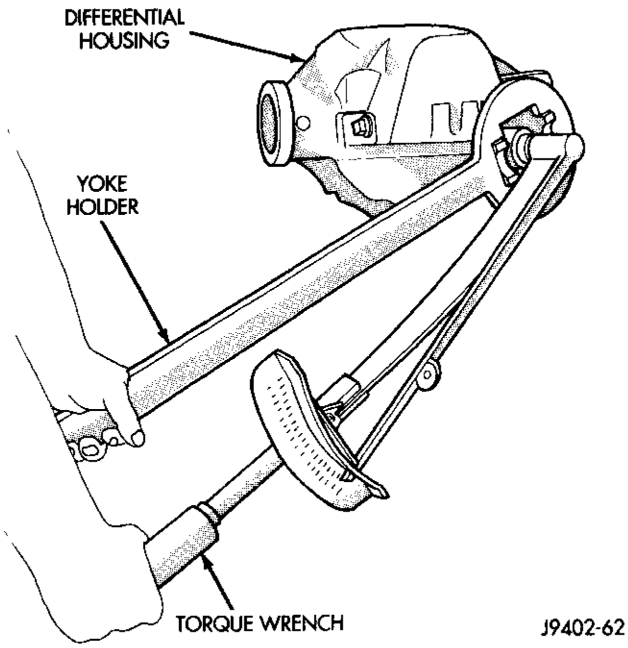

Fig. 8 Tightening Pinion Shaft Nut

(10) Rotate the pinion shaft using a (in. lbs.) torque wrench. Rotating resistance torque should be equal to the reading recorded during removal, plus an additional 0.56 N·m (5 in. lbs.) (Fig. 9).

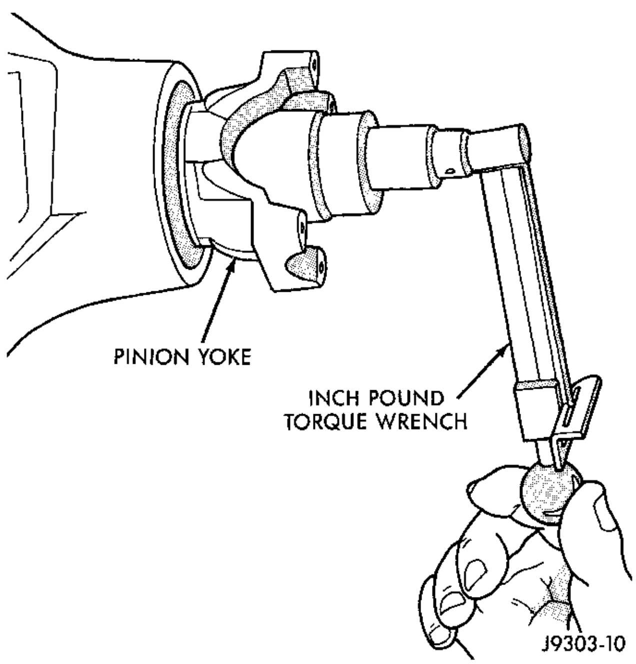

Fig. 9 Check Pinion Rotation Torque

(11) If the rotating torque is low, use Yoke Holder 6719 to hold the pinion yoke (Fig. 8) and tighten the pinion shaft nut in 6.8 N·m (5 ft. lbs.) increments until proper rotating torque is achieved.

NOTE: The bearing rotating torque should be constant during a complete revolution of the pinion. If the rotating torque varies, this indicates a binding condition.

(12) Install the propeller shaft with the installation reference marks aligned.

(13) Tighten the universal joint yoke clamp screws to 19 N·m (14 ft. lbs.).

(14) Install the brake drums.

(15) Add gear lubricant to the differential housing, if necessary. Refer to the Lubricant Specifications for gear lubricant requirements.

(16) Install wheel and tire assemblies and lower the vehicle.

DIFFERENTIAL

REMOVAL

(1) Remove axle shafts.

(2) Note the orientation of the installation reference letters stamped on the bearing caps and housing machined sealing surface (Fig. 10).

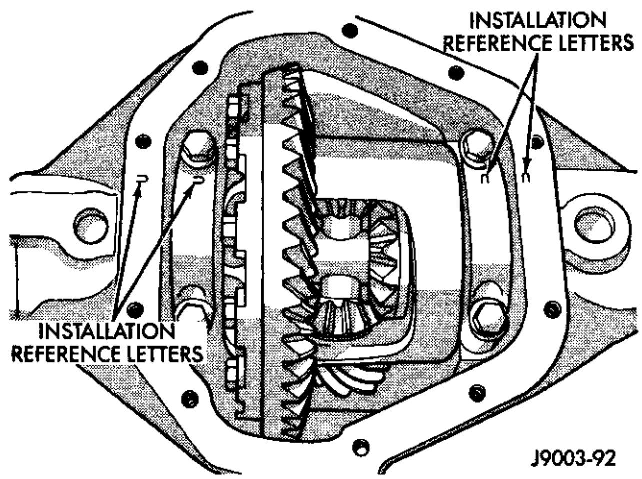

Fig. 10 Bearing Cap Identification

(3) Remove the differential bearing caps.

(4) Position Spreader W–129–B with the tool dowel pins seated in the locating holes (Fig. 11).

(5) Install the hold down clamps and tighten the tool turnbuckle finger–tight.

(6) Install a Guide Pin C-3288-B at the left side of the differential housing. Attach dial indicator to housing pilot stud. Load the indicator plunger against the opposite side of the housing (Fig. 11) and zero the indicator.

(7) Spread the housing enough to remove the case from the housing. Measure the distance with the dial indicator (Fig. 11).

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REMOVAL AND INSTALLATION (Continued)

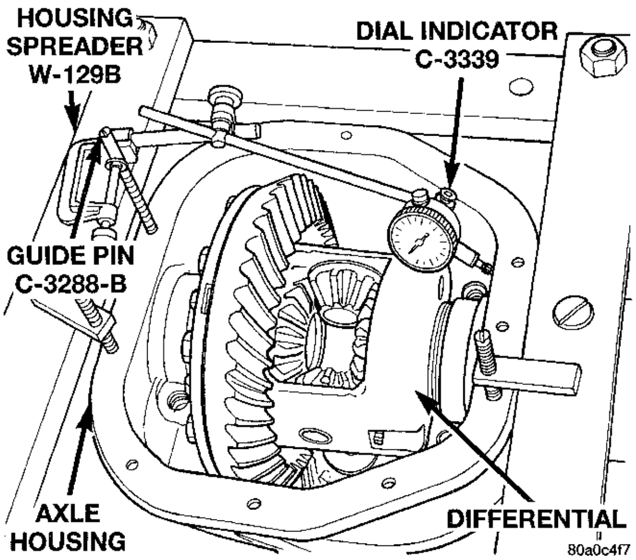

Fig. 11 Spread Differential Housing

CAUTION: Do not spread over 0.50 mm (0.020 in). If the housing is over-spread, it could be distorted or damaged.

(8) Remove the dial indicator.

(9) Pry the differential case loose from the housing. To prevent damage, pivot on housing with the end of the pry bar against spreader (Fig. 12).

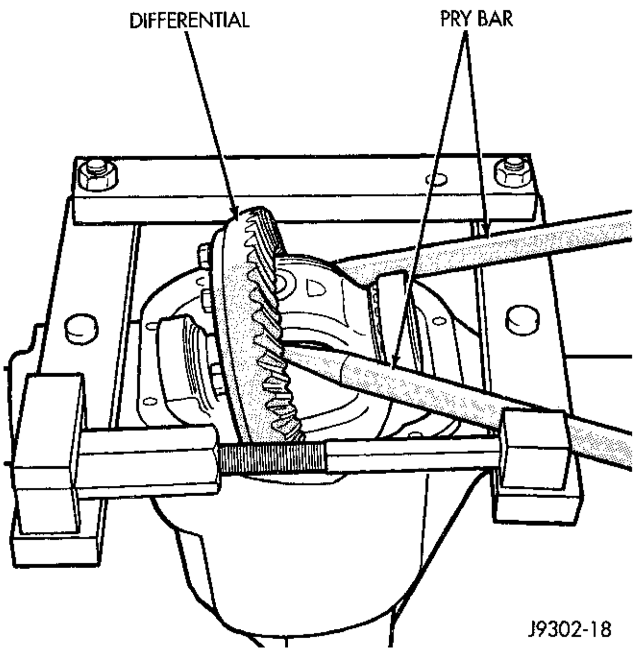

Fig. 12 Differential Removal

(10) Remove the case from housing. Mark or tag bearing cups to indicate which side they were removed from.

INSTALLATION

(1) Position Spreader W–129–B with the tool dowel pins seated in the locating holes (Fig. 11). Install the hold down clamps and tighten the tool turnbuckle finger–tight.

(2) Install a Guide Pin C-3288-B at the left side of the differential housing. Attach dial indicator to housing pilot stud. Load the indicator plunger against the opposite side of the housing (Fig. 11) and zero the indicator.

(3) Spread the housing enough to install the case in the housing. Measure the distance with the dial indicator (Fig. 11).

CAUTION: Do not spread over 0.50 mm (0.020 in). If the housing is over-spread, it could be distorted or damaged.

(4) Remove the dial indicator.

(5) Install differential in housing.

(6) Install case in the housing. Tap the differential case with a rawhide or rubber mallet to ensure the bearings are fully seated in the differential housing (Fig. 13).

(7) Remove the spreader.

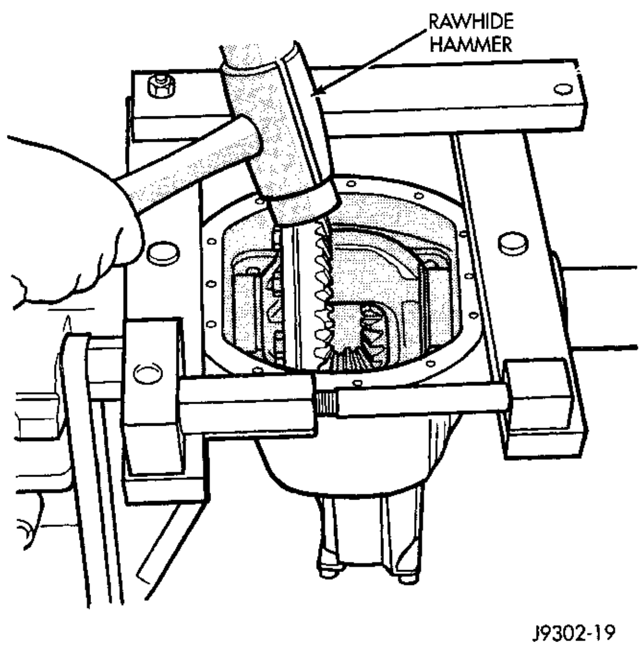

Fig. 13 Differential Installation

(8) Install the bearing caps at their original locations (Fig. 14). Tighten the bearing cap bolts to 109 N·m (80 ft. lbs.) torque.

(9) Install axle shafts.

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REMOVAL AND INSTALLATION (Continued)

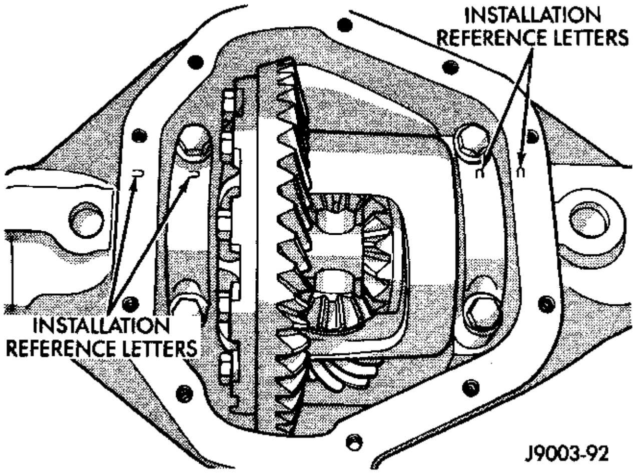

Fig. 14 Differential Bearing Cap Reference Letters

DIFFERENTIAL SIDE BEARINGS

REMOVAL

(1) Remove differential case from axle housing.

(2) Remove the bearings from the differential case with Press 938 and Bearing Splitter 1130 (Fig. 15).

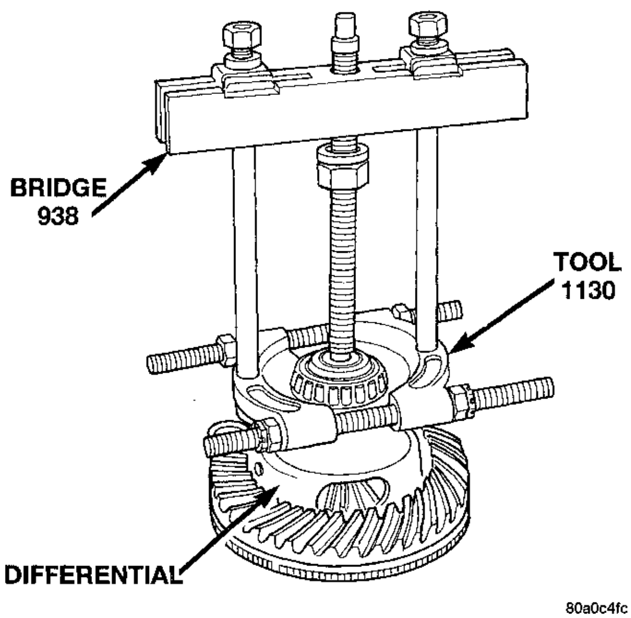

Fig. 15 Differential Bearing Removal

INSTALLATION

If ring and pinion gears have been replaced, verify differential side bearing preload and gear mesh backlash.

(1) Using tool C-4190 with handle C-4171, install differential side bearings (Fig. 16).

(2) Install differential in axle housing.

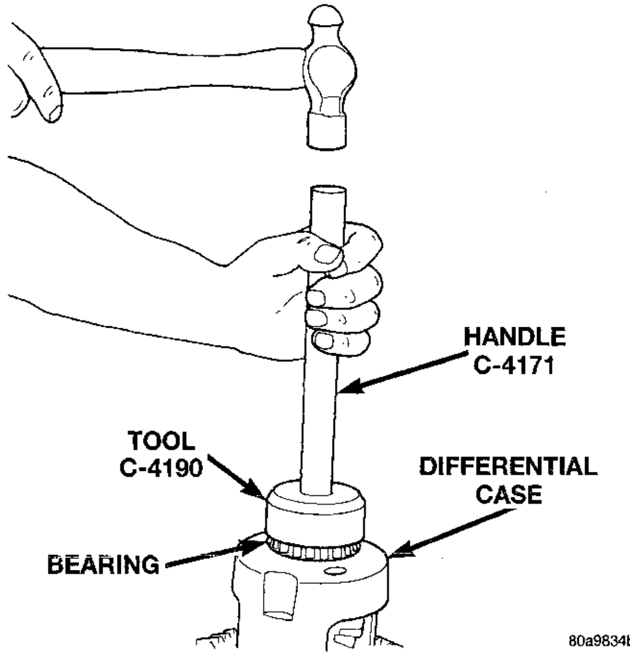

Fig. 16 Install Differential Side Bearings

RING GEAR AND EXCITER RING

REMOVAL

(1) Remove the differential case from axle housing.

(2) Clamp the differential case in a vise equipped with soft jaws.

(3) Remove and discard the ring gear bolts.

(4) Tap the ring gear off with a rawhide or plastic mallet (Fig. 17).

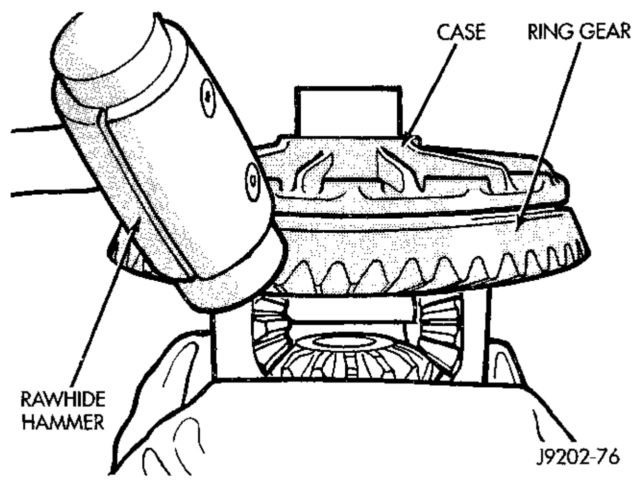

Fig. 17 Ring Gear Removal

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REMOVAL AND INSTALLATION (Continued)

(5) The exciter ring can be removed with a soft–faced hammer (Fig. 18). Discard exciter ring after removal.

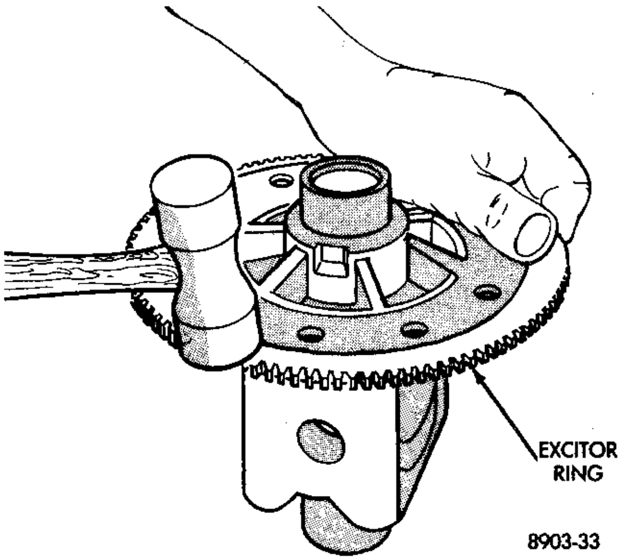

Fig. 18 Exciter Ring Removal

INSTALLATION

(1) If exciter ring was removed, align exciter ring tab with slot in differential case (Fig. 19).

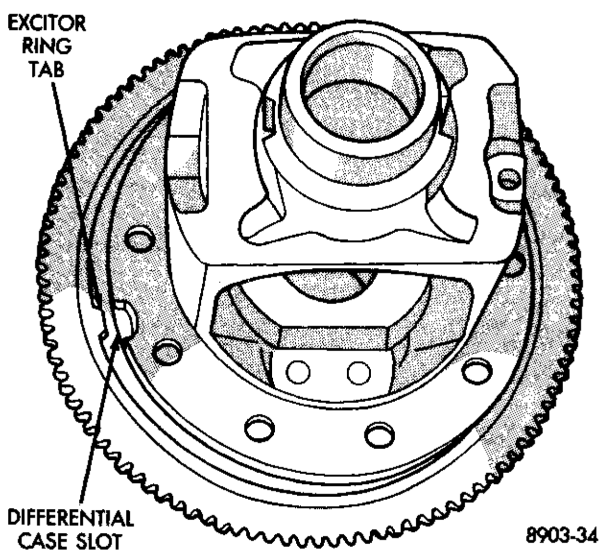

Fig. 19 Exciter Ring Alignment

(2) Invert the differential case and start two ring gear bolts. This will provide case to ring gear bolt hole alignment.

(3) Press the exciter ring onto the differential case using the ring gear as a pilot (Fig. 20).

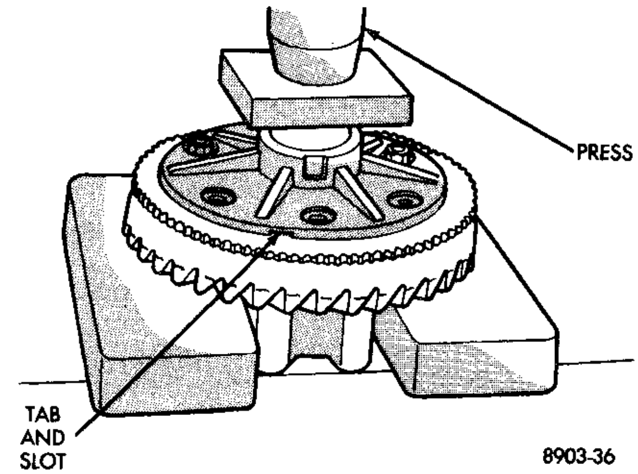

Fig. 20 Ring Gear Bolt Hole Alignment

(4) Install new ring gear bolts and alternately tighten to 272-325 N·m (200-240 ft. lbs.) torque.

PINION GEAR

REMOVAL

(1) Remove differential assembly from axle housing.

(2) Remove the pinion yoke nut and washer. Use Remover C-452 and Wrench C-3281 to remove the pinion yoke (Fig. 21).

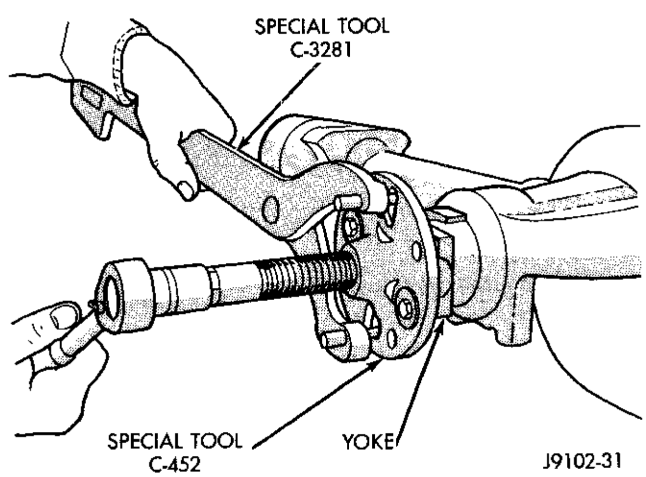

Fig. 21 Pinion Yoke Removal

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REMOVAL AND INSTALLATION (Continued)

(3) Remove the pinion gear from housing (Fig. 22). Catch the pinion with your hand to prevent it from falling and being damaged.

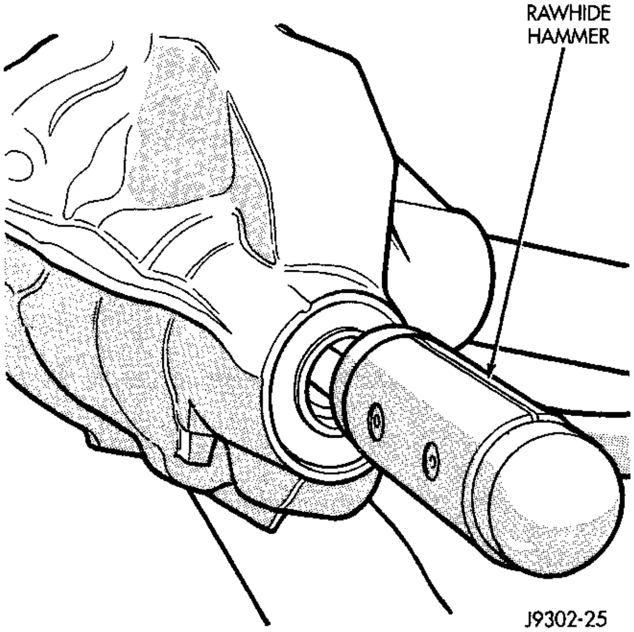

Fig. 22 Remove Pinion Gear

(4) Remove the pinion gear seal with a slide hammer or pry out with bar.

(5) Remove oil slinger, front bearing.

(6) Remove the front pinion bearing cup and seal with Remover C-4307 (Fig. 23).

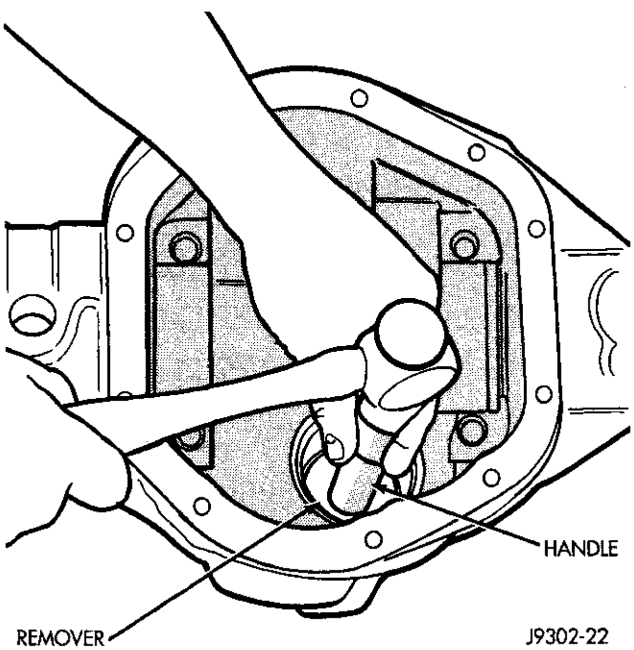

Fig. 23 Front Bearing Cup Removal

(7) Using Remover D-159, remove the rear bearing cup from housing (Fig. 24).

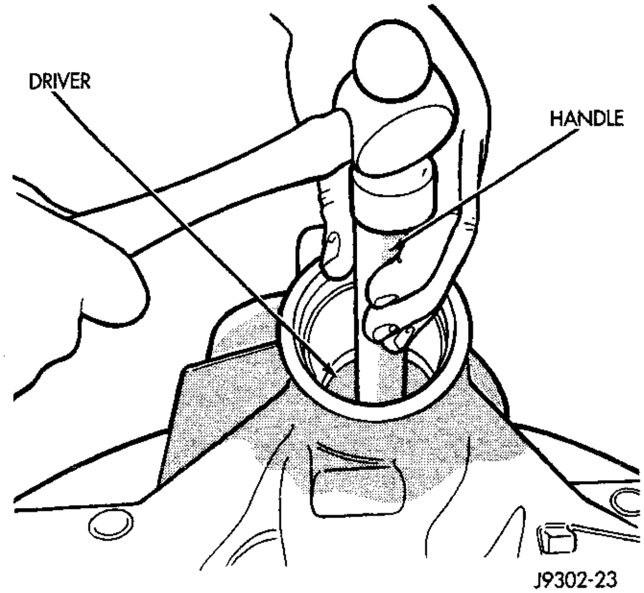

Fig. 24 Rear Bearing Cup Removal

(8) Remove the preload shims (Fig. 25).

(9) Remove the inner bearing from the pinion with Splitter 1130 and Bridge 938 (Fig. 26).

(10) Remove the depth shims from the pinion gear shaft. Record the thickness of the depth shims.

INSTALLATION

After selecting the proper pinion depth shim using the Pinion Depth Measurement paragraph in the Adjustment section of this Group, proceed with installation procedure.

(1) Place pinion depth shims in axle housing rear bearing bore.

(2) Install the pinion rear bearing cup with Installer C-4204 (Fig. 27). Ensure cup is correctly seated.

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REMOVAL AND INSTALLATION (Continued)

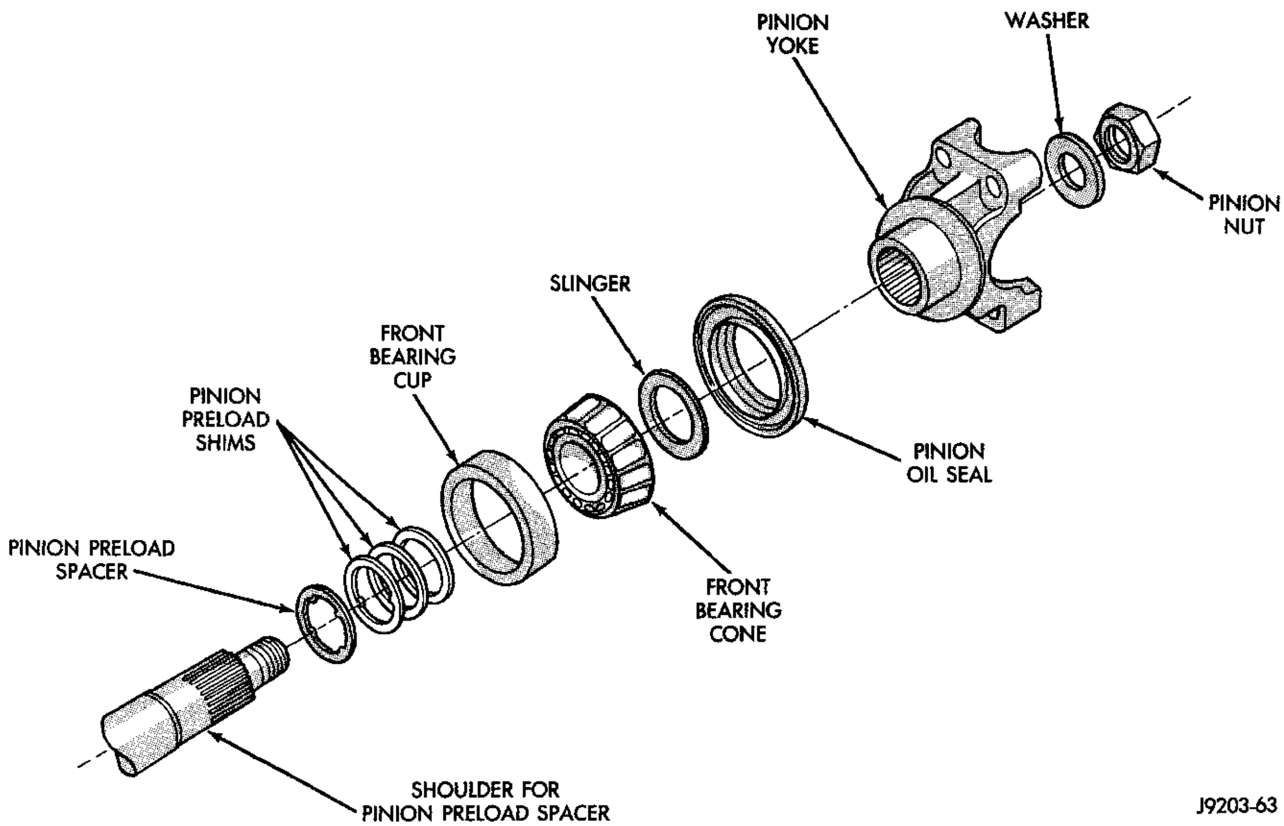

Fig. 25 Pinion Preload Shims

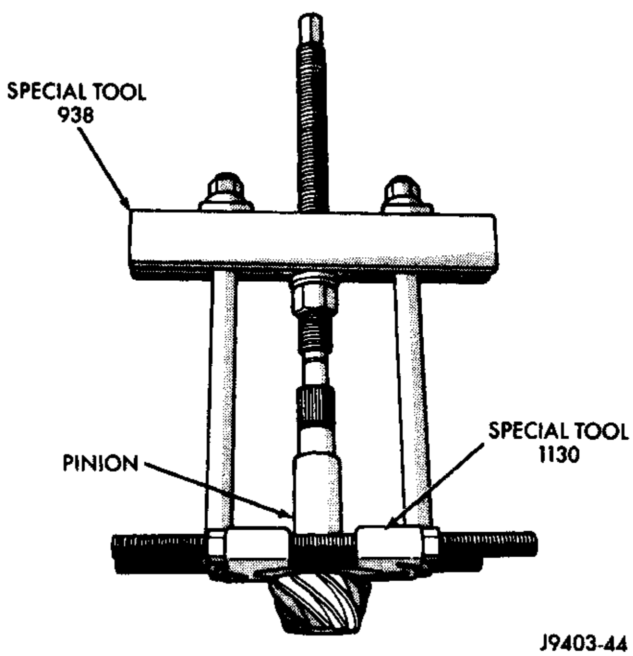

Fig. 26 Inner Bearing Removal

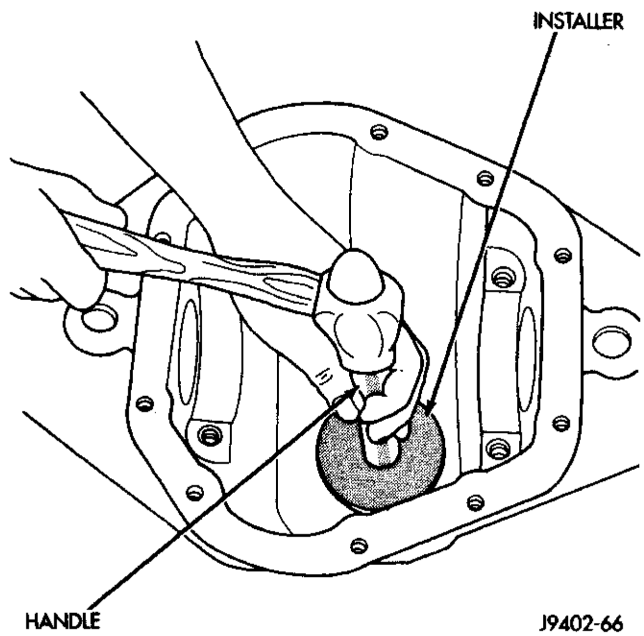

Fig. 27 Pinion Rear Bearing Cup Installation

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REMOVAL AND INSTALLATION (Continued)

(3) Install the pinion front bearing cup with Installer C-4308 (Fig. 28).

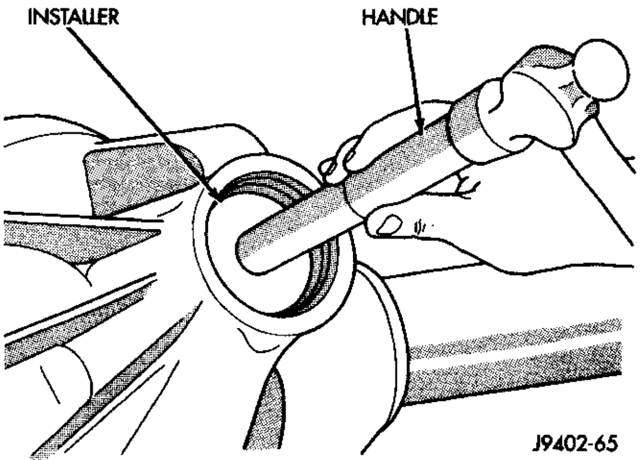

Fig. 28 Pinion Front Bearing Cup Installation

(4) Install pinion front bearing and oil slinger, if equipped.

(5) Apply a light coating of gear lubricant on the lip of pinion seal. Install seal with Installer D-187-B and Handle C-4171 (Fig. 29).

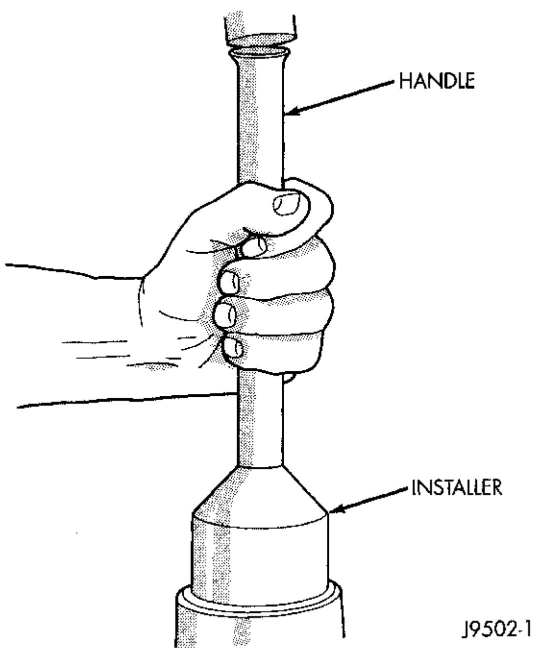

Fig. 29 Pinion Seal Installation

(6) Install the rear bearing and slinger, if equipped, on the pinion gear with Installer D-389 (Fig. 30).

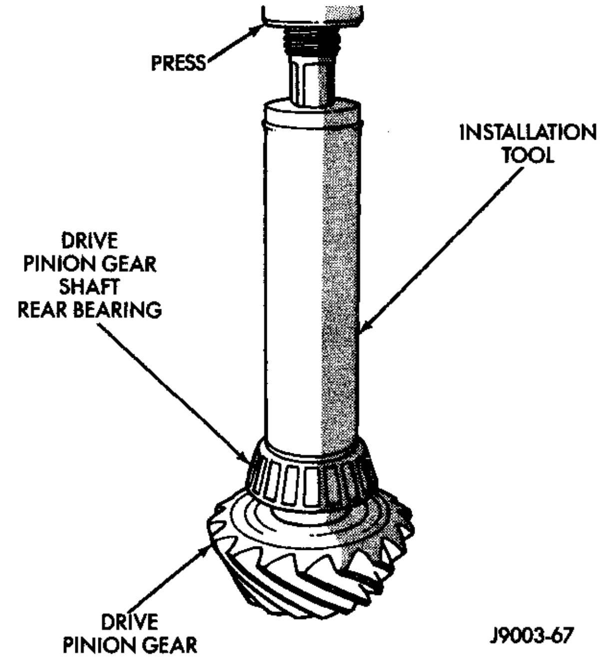

Fig. 30 Shaft Rear Bearing Installation

(7) Install pinion bearing preload shims (Fig. 31).

(8) Install yoke with Installer D-191 (Fig. 32).

(9) Install the yoke washer and a new nut on the pinion gear. Install yoke washer with concave surface against the yoke.

REMOVAL AND INSTALLATION (Continued)

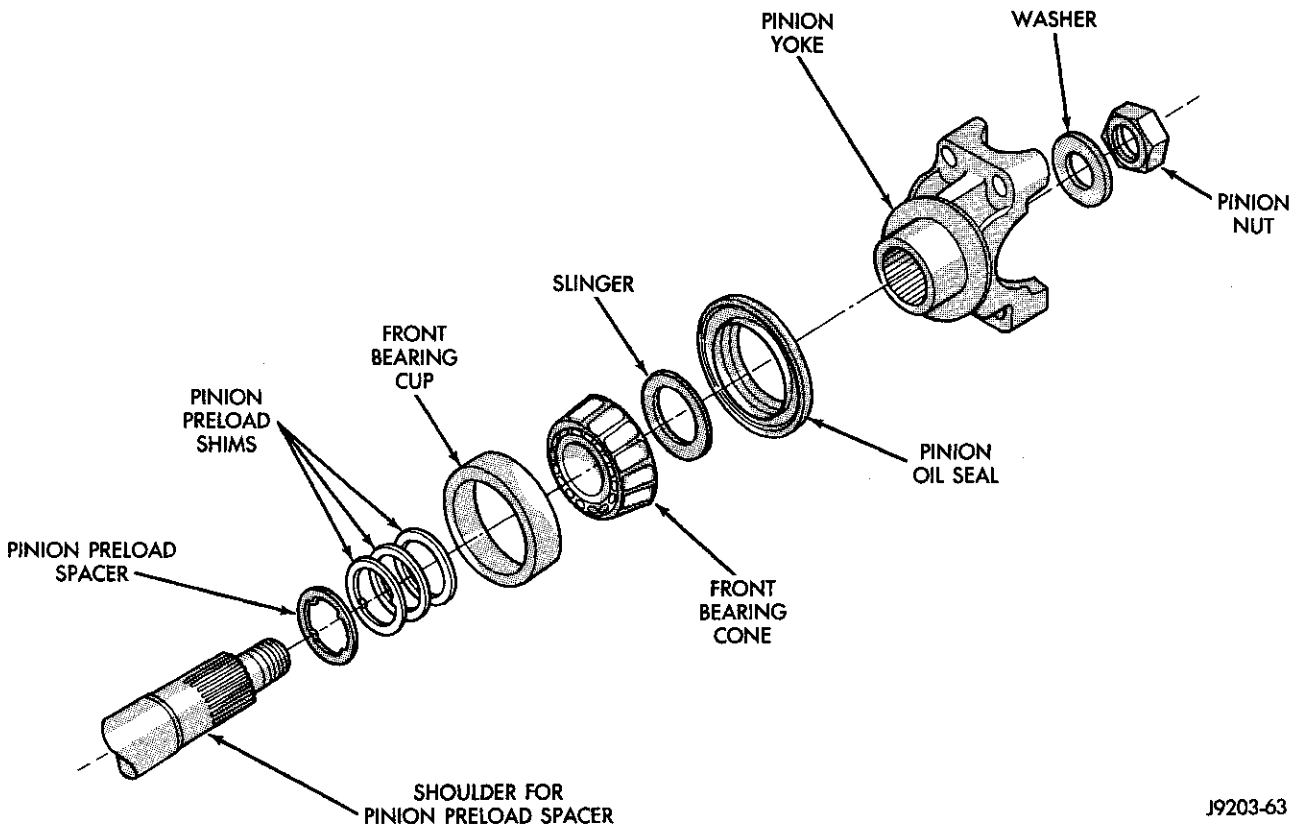

Fig. 31 Pinion Preload Shims

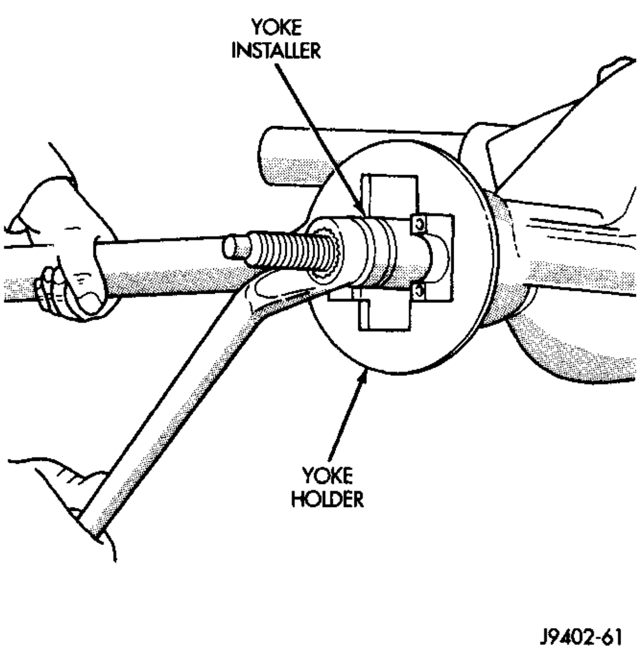

Fig. 32 Pinion Yoke Installation

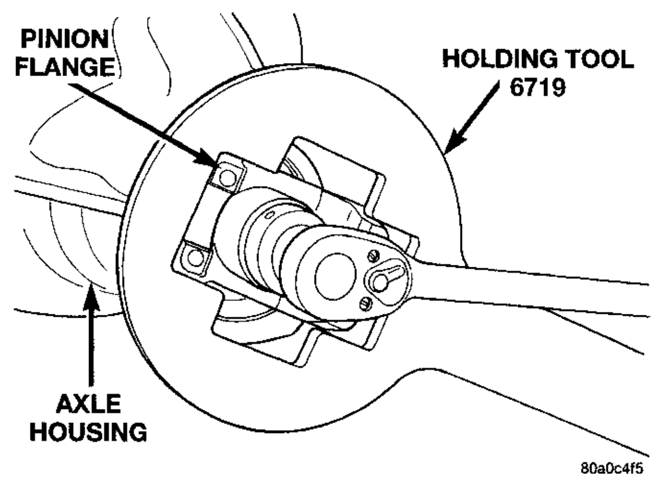

Fig. 33 Tightening Pinion Nut

REMOVAL AND INSTALLATION (Continued)

(10) Hold pinion yoke with Yoke Holder 6719 and tighten shaft nut to 597 N·m (440 ft. lbs.) (Fig. 34). Rotate pinion shaft several revolutions to ensure the bearing rollers are seated.

(11) Check bearing preload torque with an inch pound torque wrench (Fig. 35). The torque necessary to rotate the pinion gear should be:

- Original Bearings—1 to 3 N·m (10 to 20 in. lbs.).
- New Bearings—2 to 5 N·m (15 to 35 in. lbs.).

(12) If rotating torque is above the desired amount, remove the pinion yoke and increase the preload shim pack thickness. Increasing the shim pack thickness 0.025 mm (0.001 in.) will decrease the rotating torque approximately 0.9 N·m (8 in. lbs.).

(13) Tighten pinion shaft nut in 6.8 N·m (5 ft. lbs.) increments until the maximum tightening or desired rotating torque is reached.

(14) If the maximum tightening torque is reached prior to achieving the desired tightening torque, remove the pinion yoke and decrease the thickness of the preload shim pack. Decreasing the shim pack thickness 0.025 mm (0.001 in.) will increase the rotating torque approximately 0.9 N·m (8 in. lbs.).

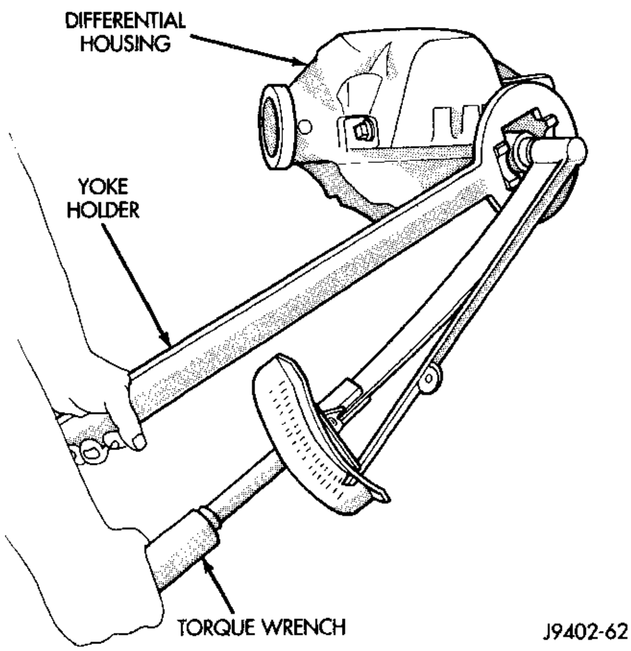

Fig. 34 Tighten Pinion Nut

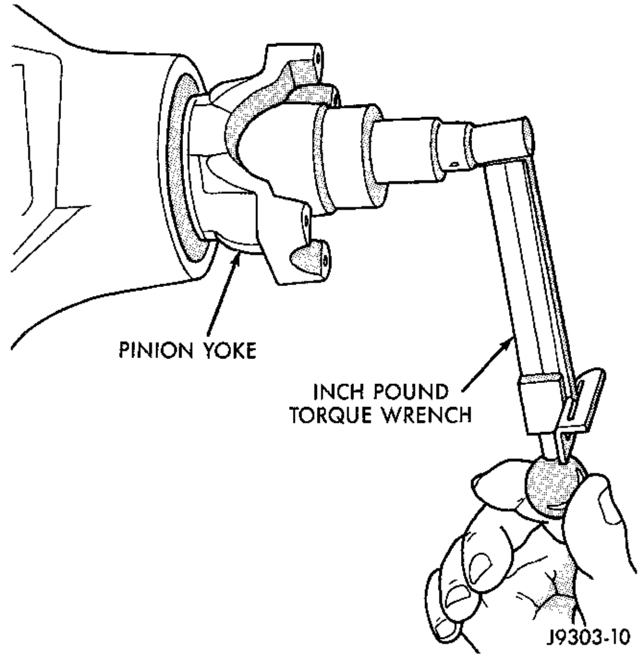

Fig. 35 Check Pinion Gear Rotation Torque

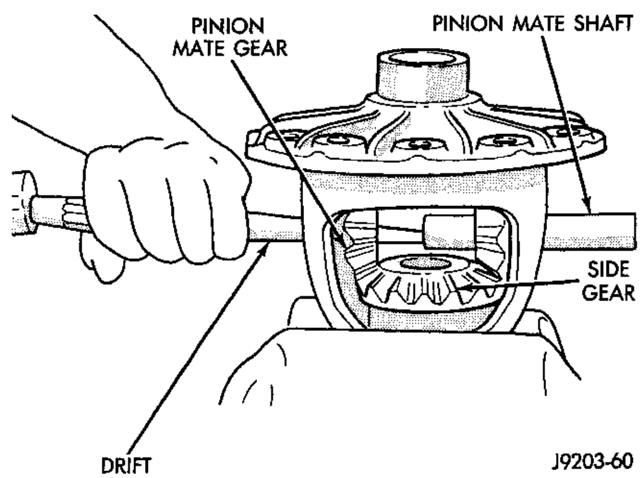

Fig. 36 Pinion Mate Shaft Removal

DISASSEMBLY AND ASSEMBLY

STANDARD DIFFERENTIAL

DISASSEMBLY

(1) Remove roll-pin holding mate shaft in housing.

(2) Remove pinion gear mate shaft (Fig. 36).

(3) Rotate the differential side gears and remove the pinion mate gears and thrust washers (Fig. 37).

(4) Remove the differential side gears and thrust washers.

ASSEMBLY

(1) Install the differential side gears and thrust washers.

(2) Install the pinion mate gears and thrust washers.

(3) Install the pinion gear mate shaft.

(4) Align the hole in the pinion gear mate shaft with the hole in the differential case.

(5) Install and seat the pinion mate shaft roll-pin in the differential case and mate shaft with a punch and hammer (Fig. 38). Peen the edge of the roll-pin hole in the differential case slightly in two places, 180° apart.

DISASSEMBLY AND ASSEMBLY (Continued)

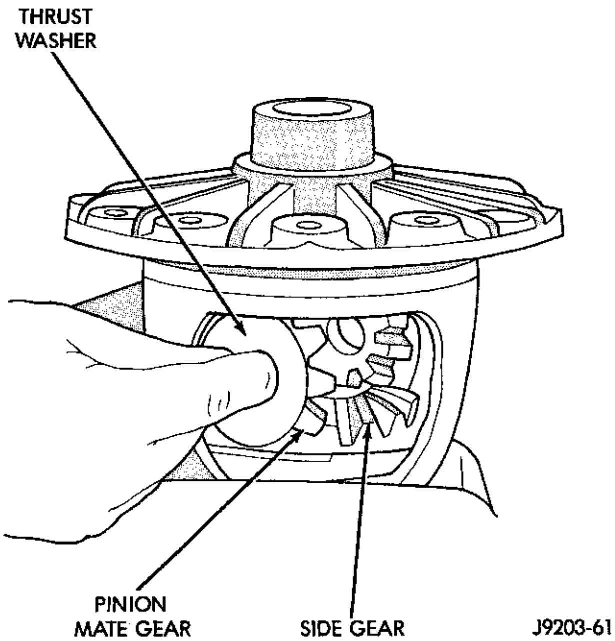

Fig. 37 Pinion Mate Gear Removal

(6) Lubricate all differential components with hypoid gear lubricant.

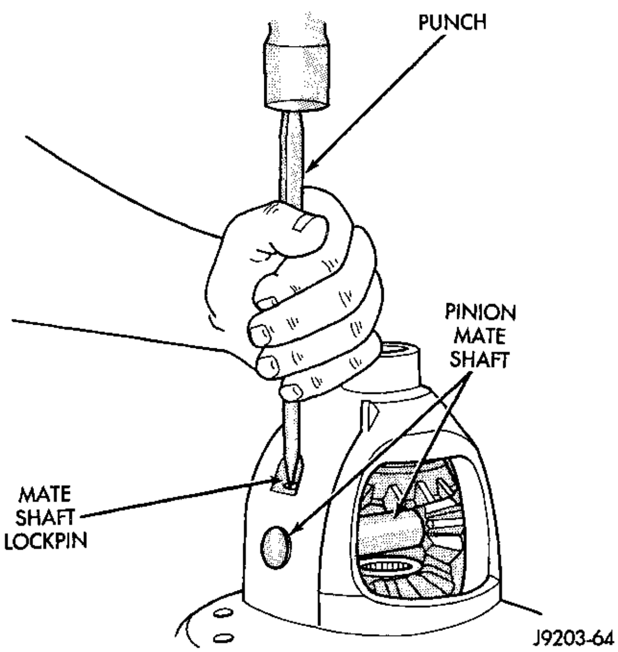

Fig. 38 Pinion Mate Shaft Roll-Pin Installation

TRAC-LOK DIFFERENTIAL

The 286 RBI Trac-Lok differential has a one-piece cross shaft and uses 6 disc and 5 plates for each clutch pack. Only one disc in each clutch pack is dished.

DISASSEMBLY

Pay close attention to the clutch pack arrangement during this procedure. Note the direction of the concave and convex side of the plates and discs.

(1) Mark the ring gear half and cover half for installation reference (Fig. 39).

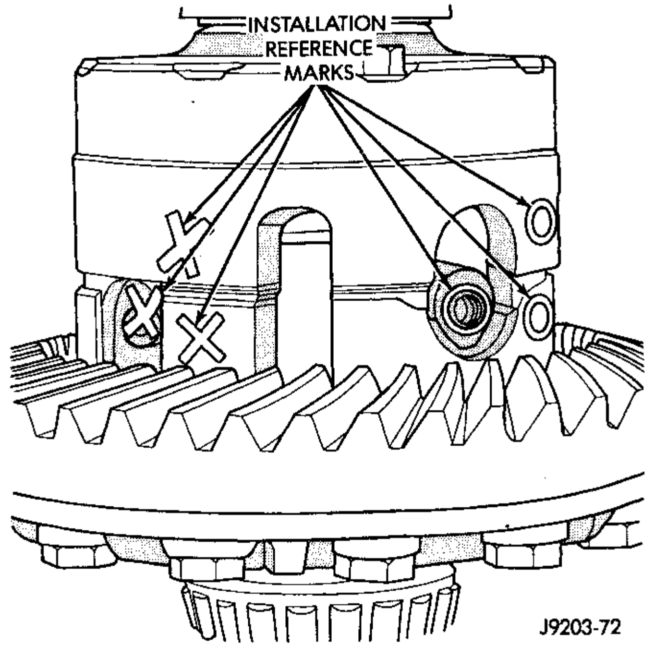

Fig. 39 Case Marked

(2) Remove the case attaching bolts and remove the button cover half (Fig. 40).

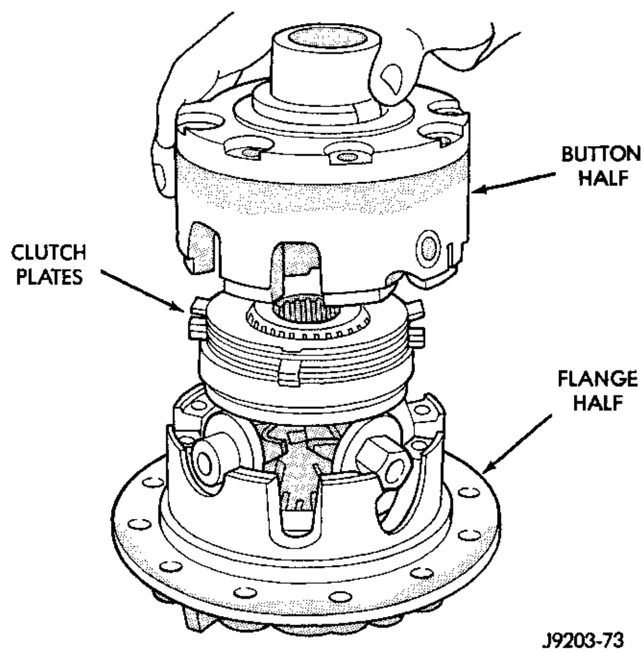

Fig. 40 Cover Half Removal

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DISASSEMBLY AND ASSEMBLY (Continued)

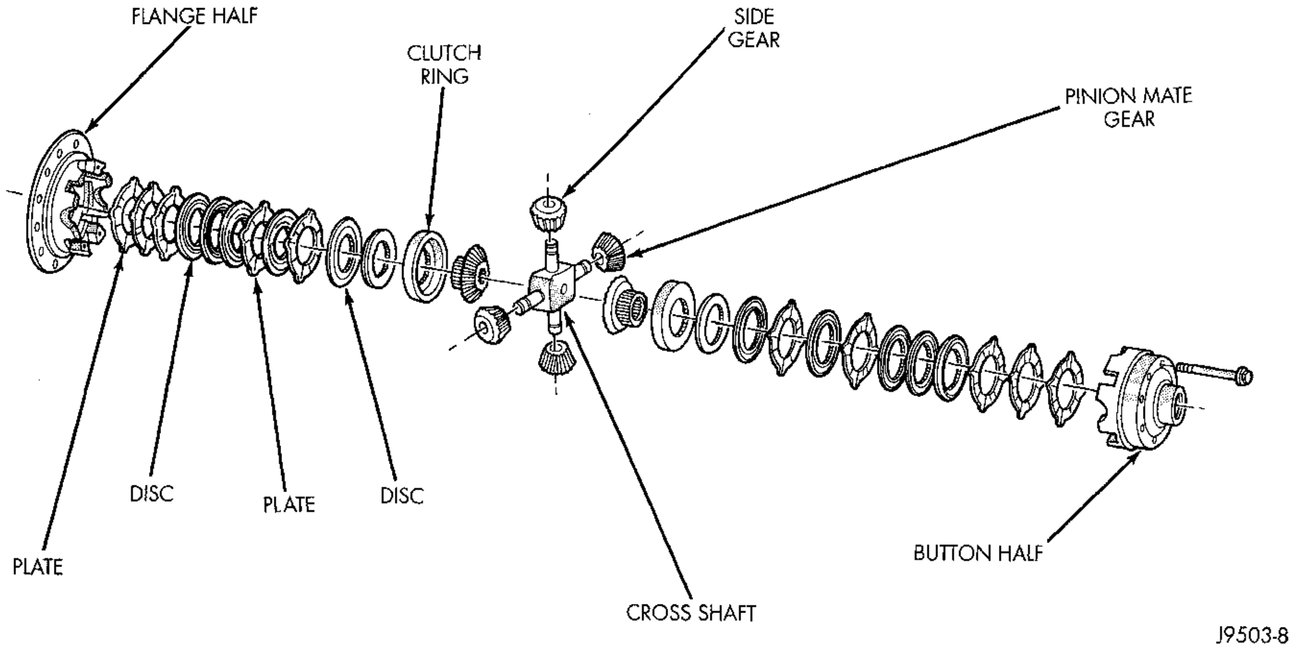

Fig. 41 Trac-Lok Components

(3) Remove top clutch pack (Fig. 41).
(4) Remove top side gear clutch ring.
(5) Remove top side gear.
(6) Remove pinion mate gears and cross shaft.
(7) Remove the same parts listed above from the ring gear flange half of the case. Keep these parts with the flange cover half for correct installation in their original positions.

ASSEMBLY

The clutch discs are replaceable as complete sets only. **If one clutch disc pack is damaged, both packs must be replaced.** Lubricate each component with gear lube before assembly and installation.

(1) Saturate the clutch plates with Mopar® Hypoid Gear Lubricant or Additive (Fig. 42). Assemble clutch packs into the side gear plate in exactly the same position as removed (Fig. 41).

(2) Line up the plate ears and install the assembled pack into the flange half (Fig. 43). Make sure the clutch plate lugs enter the slots in the case. Also make sure the clutch pack bottoms out on the case.

(3) Install pinion mate shafts and pinion mate gears (Fig. 44). **Make sure shafts are correctly installed according to the alignment marks.**

(4) Lubricate and install the other side gear and clutch pack (Fig. 43).

(5) Correctly align and assemble button half to flange half. Install case body screws finger tight.

(6) Tighten body screws alternately and evenly. Tighten screws to 89-94 N·m (65-70 ft. lbs.) torque (Fig. 45).

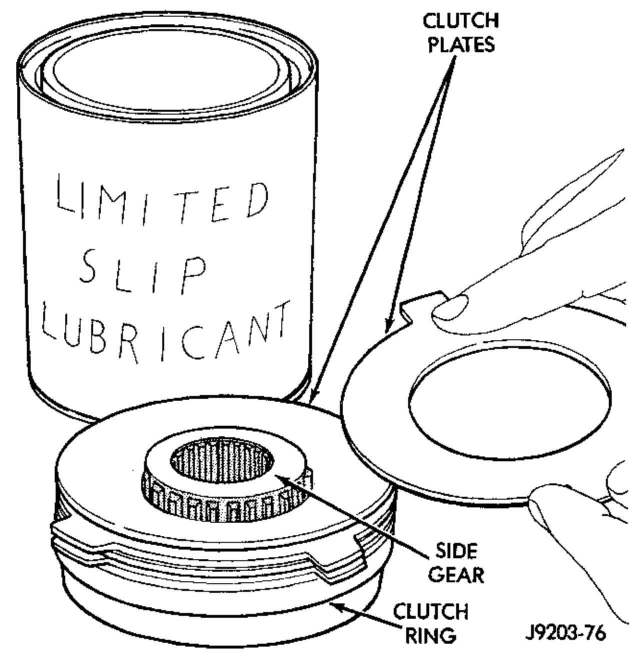

Fig. 42 Clutch Pack Assembly

If bolt heads have 7 radial lines or the number 180 stamped on the head, tighten these bolts to 122-136 N·m (90-100 ft. lbs.) torque.

DISASSEMBLY AND ASSEMBLY (Continued)

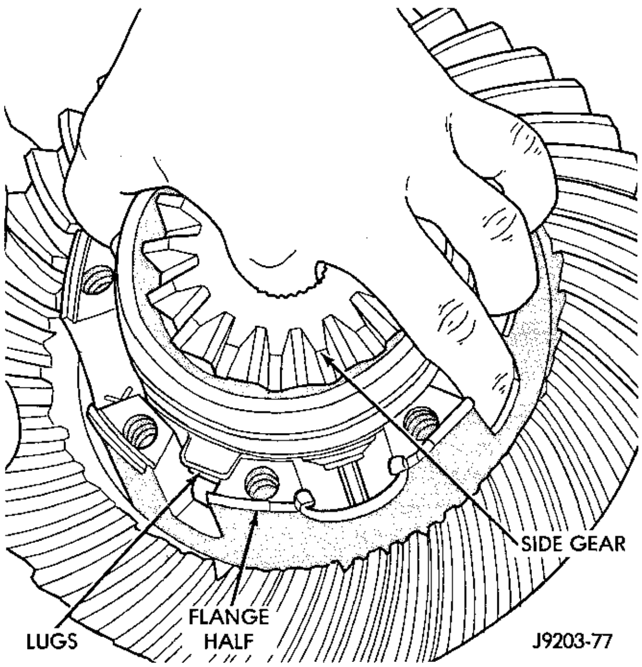

Fig. 43 Clutch Pack Installation

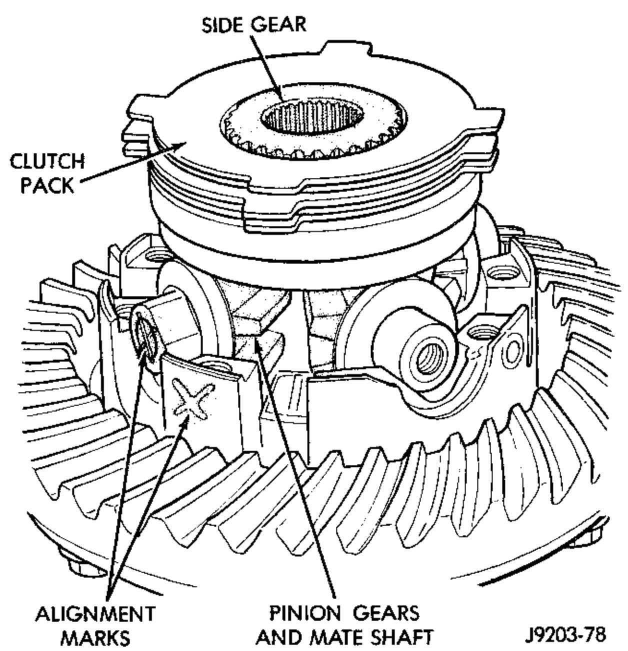

Fig. 44 Clutch Pack Installation

CLEANING AND INSPECTION

AXLE COMPONENTS

Wash differential components with cleaning solvent and dry with compressed air. **Do not steam clean the differential components.**

Wash bearings with solvent and towel dry, or dry with compressed air. DO NOT spin bearings with compressed air. **Cup and bearing must be replaced as matched sets only.**

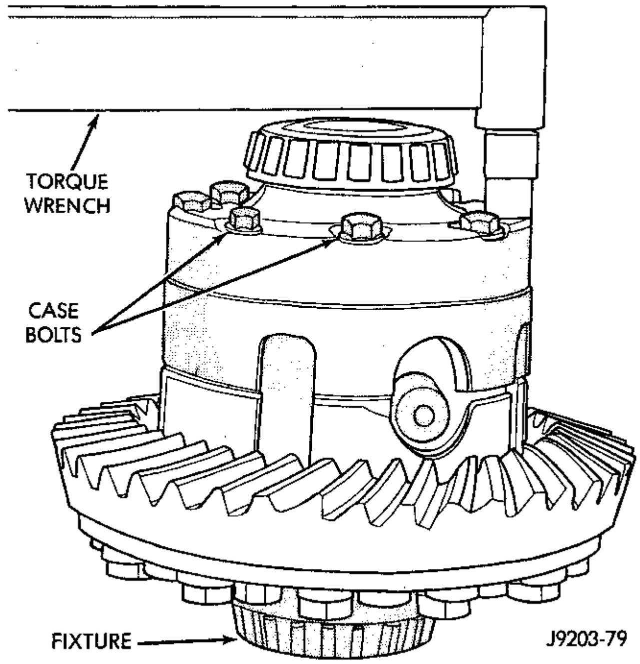

Fig. 45 Case Half Installation

Clean axle shaft tubes and oil channels in housing. Inspect for;

- Smooth appearance with no broken/dented surfaces on the bearing rollers or the roller contact surfaces.
- Bearing cups must not be distorted or cracked.
- Machined surfaces should be smooth and without any raised edges.
- Raised metal on shoulders of cup bores should be removed with a hand stone.
- Wear and damage to pinion gear mate shaft, pinion gears, side gears and thrust washers. Replace as a matched set only.
- Ring and pinion gear for worn and chipped teeth.
- Ring gear for damaged bolt threads. Replaced as a matched set only.
- Pinion yoke for cracks, worn splines, pitted areas, and a rough/corroded seal contact surface. Repair or replace as necessary.
- Preload shims for damage and distortion. Install new shims, if necessary.

TRAC-LOK

Clean all components in cleaning solvent. Dry components with compressed air. Inspect clutch pack plates for wear, scoring or damage. Replace both clutch packs if any one component in either pack is damaged. Inspect side and pinion gears. Replace any gear that is worn, cracked, chipped or damaged. Inspect differential case and pinion shaft. Replace if worn or damaged.

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CLEANING AND INSPECTION (Continued)

PRESOAK PLATES AND DISC

Plates and discs with fiber coating (no grooves or lines) must be presoaked in Friction Modifier before assembly. Soak plates and discs for a minimum of 20 minutes.

ADJUSTMENTS

PINION GEAR DEPTH

GENERAL INFORMATION

Ring and pinion gears are supplied as matched sets only. The identifying numbers for the ring and pinion gear are etched into the face of each gear (Fig. 46). A plus (+) number, minus (–) number or zero (0) is etched into the face of the pinion gear. This number is the amount (in thousandths of an inch) the depth varies from the standard depth setting of a pinion etched with a (0). The standard setting from the center line of the ring gear to the back face of the pinion is 147.625 mm (5.812 in.). The standard depth provides the best teeth contact pattern. Refer to Backlash and Contact Pattern Analysis Paragraph in this section for additional information.

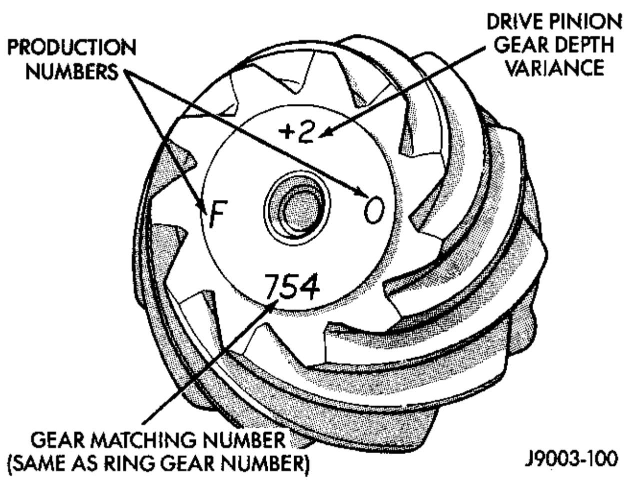

Fig. 46 Pinion Gear ID Numbers

Compensation for pinion depth variance is achieved with select shims. The shims are placed under the inner pinion bearing cone (Fig. 47).

If a new gear set is being installed, note the depth variance etched into both the original and replacement pinion gear. Add or subtract the thickness of the original depth shims to compensate for the difference in the depth variances. Refer to the Depth Variance charts.

Note where Old and New Pinion Marking columns intersect. Intersecting figure represents plus or minus amount needed.

Note the etched number on the face of the drive pinion gear (–1, –2, 0, +1, +2, etc.). The numbers represent thousands of an inch deviation from the standard. If the number is negative, add that value to the required thickness of the depth shim(s). If the number is positive, subtract that value from the thickness of the depth shim(s). If the number is 0 no change is necessary. Refer to the Pinion Gear Depth Variance Chart.

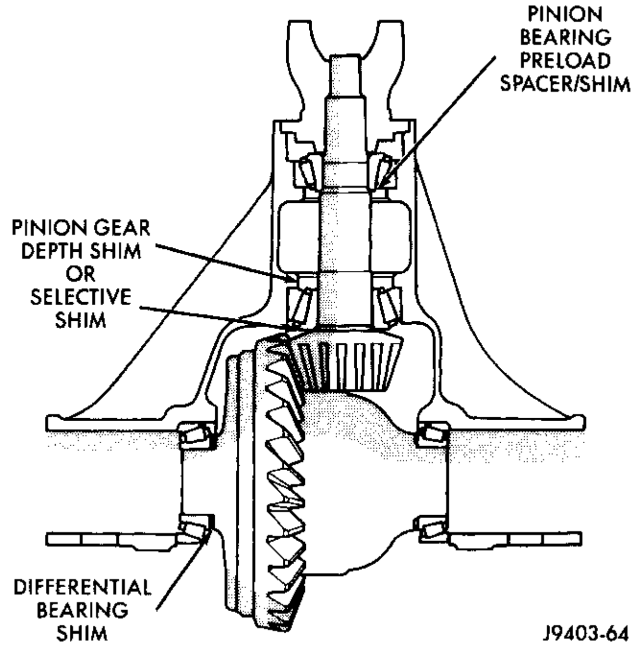

Fig. 47 Shim Locations

PINION DEPTH MEASUREMENT AND ADJUSTMENT

Measurements are taken with pinion cups and pinion bearings installed in housing. Take measurements with a Pinion Gauge Set 6730 and Dial Indicator C-3339 (Fig. 48).

(1) Assemble Pinion Height Block 6739, Pinion Block 6738, and rear pinion bearing onto Screw 6741 (Fig. 48).

(2) Insert assembled height gauge components, rear bearing and screw into axle housing through pinion bearing cups (Fig. 49).

(3) Install front pinion bearing and Cone 6740 hand tight (Fig. 48).

(4) Place Arbor Disc 6732 on Arbor D-115-3 in position in axle housing side bearing cradles (Fig. 50). Install differential bearing caps on Arbor Discs and tighten cap bolts. Refer to the Torque Specifications in this section.

NOTE: Arbor Discs 6732 have different step diameters to fit other axle sizes. Pick correct size step for axle being serviced.

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ADJUSTMENTS (Continued)

PINION GEAR DEPTH VARIANCE

Original Pinion Gear Depth Variance	Replacement Pinion Gear Depth Variance								
	−4	−3	−2	−1	0	+1	+2	+3	+4
+4	+0.008	+0.007	+0.006	+0.005	+0.004	+0.003	+0.002	+0.001	0
+3	+0.007	+0.006	+0.005	+0.004	+0.003	+0.002	+0.001	0	−0.001
+2	+0.006	+0.005	+0.004	+0.003	+0.002	+0.001	0	−0.001	−0.002
+1	+0.005	+0.004	+0.003	+0.002	+0.001	0	−0.001	−0.002	−0.003
0	+0.004	+0.003	+0.002	+0.001	0	−0.001	−0.002	−0.003	−0.004
−1	+0.003	+0.002	+0.001	0	−0.001	−0.002	−0.003	−0.004	−0.005
−2	+0.002	+0.001	0	−0.001	−0.002	−0.003	−0.004	−0.005	−0.006
−3	+0.001	0	−0.001	−0.002	−0.003	−0.004	−0.005	−0.006	−0.007
−4	0	−0.001	−0.002	−0.003	−0.004	−0.005	−0.006	−0.007	−0.008

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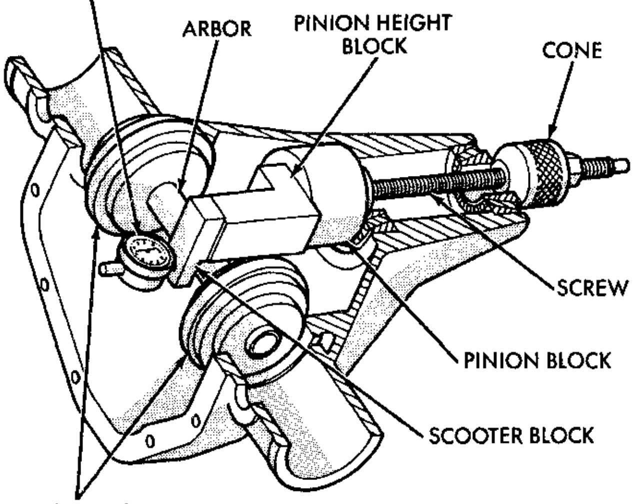

Fig. 48 Pinion Gear Depth Gauge Tools—Typical

(5) Assemble Dial Indicator C-3339 into Scooter Block D-115-2 and secure set screw.

(6) Place Scooter Block/Dial Indicator in position in axle housing so dial probe and scooter block are flush against the surface of the pinion height block. Hold scooter block in place and zero the dial indicator face to the pointer. Tighten dial indicator face lock screw.

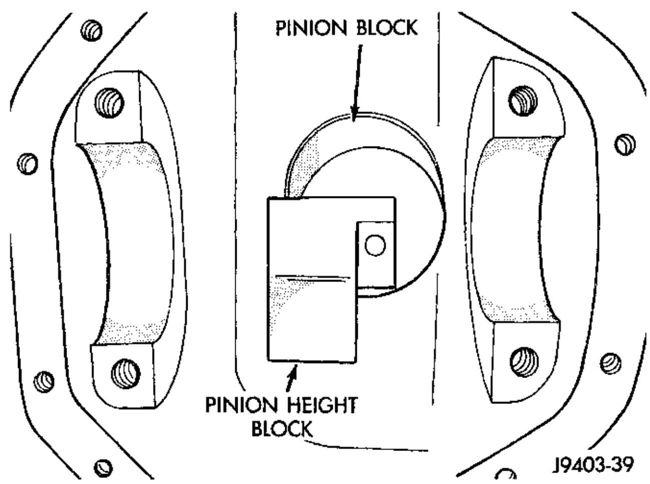

Fig. 49 Pinion Height Block—Typical

(7) With scooter block still in position against the pinion height block, slowly slide the dial indicator probe over the edge of the pinion height block. Observe how many revolutions counterclockwise the dial pointer travels (approximately 0.125 in.) to the out-stop of the dial indicator.

(8) Slide the dial indicator probe across the gap between the pinion height block and the arbor bar with the scooter block against the pinion height block (Fig. 51). When the dial probe contacts the arbor bar, the dial pointer will turn clockwise. Bring dial pointer back to zero against the arbor bar, do not turn dial face. Continue moving the dial probe to the crest of the arbor bar and record the highest reading. If the dial indicator can not achieve the zero reading,

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ADJUSTMENTS (Continued)

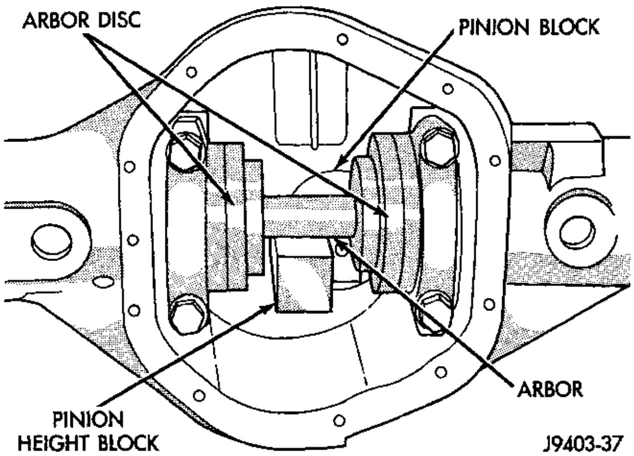

Fig. 50 Gauge Tools In Housing—Typical

the rear bearing cup or the pinion depth gauge set is not installed correctly.

(9) Select a shim equal to the dial indicator reading plus the drive pinion gear depth variance number etched in the face of the pinion gear (Fig. 46) using the opposite sign on the variance number. For example, if the depth variance is –2, add +0.002 in. to the dial indicator reading.

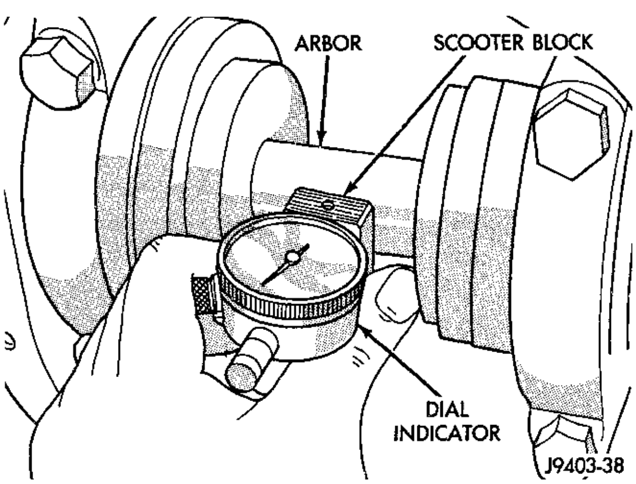

Fig. 51 Pinion Gear Depth Measurement—Typical

(10) Remove the pinion depth gauge components from the axle housing

DIFFERENTIAL BEARING PRELOAD AND GEAR BACKLASH

INTRODUCTION

Differential side bearing preload and gear backlash is achieved by selective shims positioned behind the differential side bearing cones. The proper shim thickness can be determined using slip-fit dummy bearings D-346 in place of the differential side bearings and a dial indicator C-3339. Before proceeding with the differential bearing preload and gear backlash measurements, measure the pinion gear depth and prepare the pinion gear for installation. Establishing proper pinion gear depth is essential to establishing gear backlash and tooth contact patterns. After the overall shim thickness to take up differential side play is measured, the pinion gear is installed, and the gear backlash shim thickness is measured. The overall shim thickness is the total of the dial indicator reading and the preload specification added together. The gear backlash measurement determines the thickness of the shim used on the ring gear side of the differential case. Subtract the gear backlash shim thickness from the total overall shim thickness and select that amount for the pinion gear side of the differential (Fig. 52). Differential shim measurements are performed with axle spreader W-129-B removed.

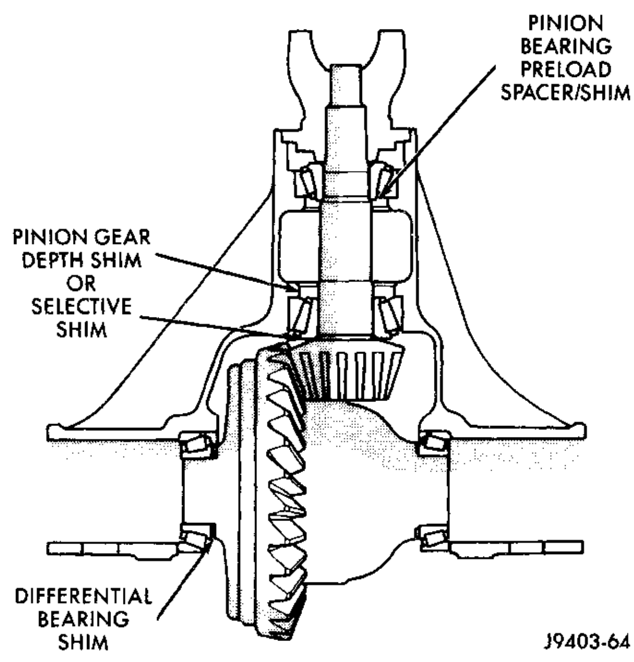

Fig. 52 Axle Adjustment Shim Locations

SHIM SELECTION

NOTE: It is difficult to salvage the differential side bearings during the removal procedure. Install replacement bearings if necessary.

(1) Remove differential side bearings from differential case.

(2) Remove factory installed shims from differential case.

(3) Install ring gear on differential case and tighten bolts to specification, if necessary.

(4) Install dummy side bearings D-346 on differential case.

(5) Install differential case in axle housing.

ADJUSTMENTS (Continued)

(6) Install the marked bearing caps in their correct positions. Install and snug the bolts (Fig. 53).

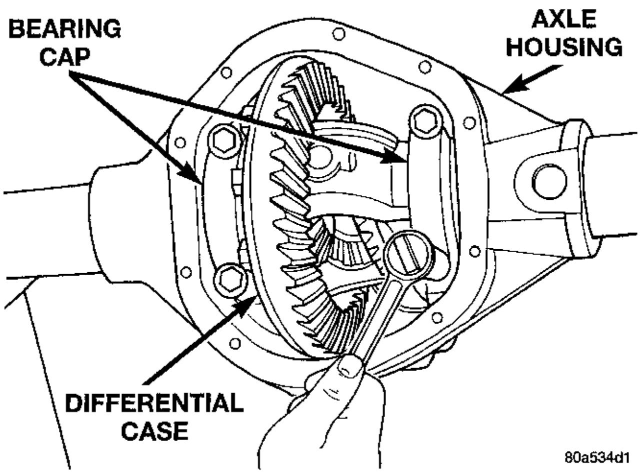

Fig. 53 Tighten Bolts Holding Bearing Caps

(7) Using a dead-blow type mallet, seat the differential dummy bearings to each side of the axle housing (Fig. 54) and (Fig. 55).

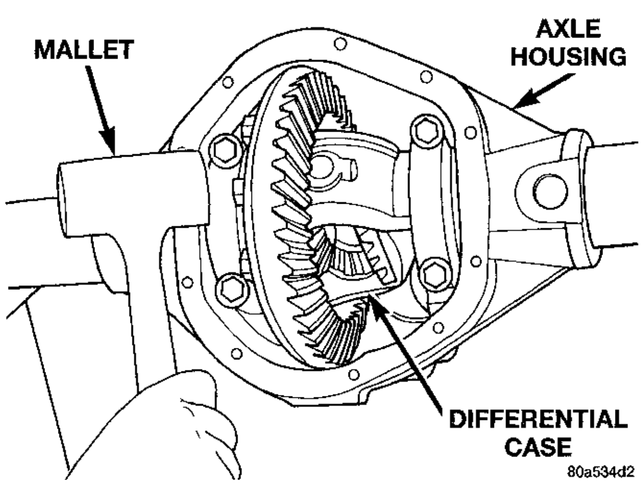

Fig. 54 Seat Pinion Gear Side Differential Dummy Side Bearing

(8) Thread guide stud C-3288-B into rear cover bolt hole below ring gear (Fig. 56).

(9) Attach a dial indicator C-3339 to guide stud. Position the dial indicator plunger on a flat surface between the ring gear bolt heads (Fig. 56).

(10) Push and hold differential case to pinion gear side of axle housing (Fig. 57).

(11) Zero dial indicator face to pointer (Fig. 57).

(12) Push and hold differential case to ring gear side of the axle housing (Fig. 58).

(13) Record dial indicator reading (Fig. 58).

(14) Add 0.010 in. (0..254 mm) to the zero end play total. This new total represents the thickness of shims to compress, or preload the new bearings when the differential is installed.

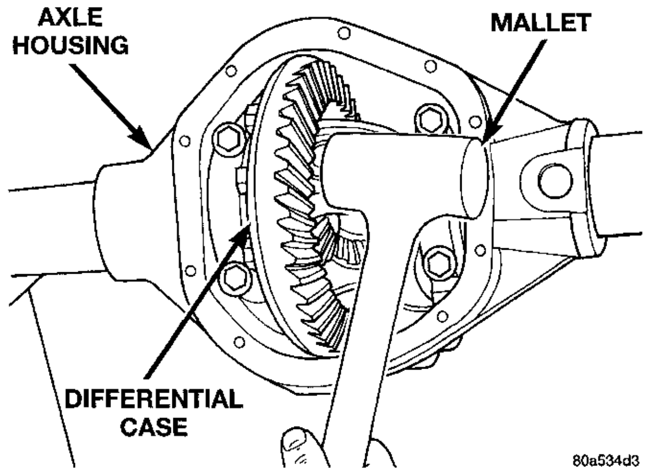

Fig. 55 Seat Ring Gear Side Differential Dummy Side Bearing

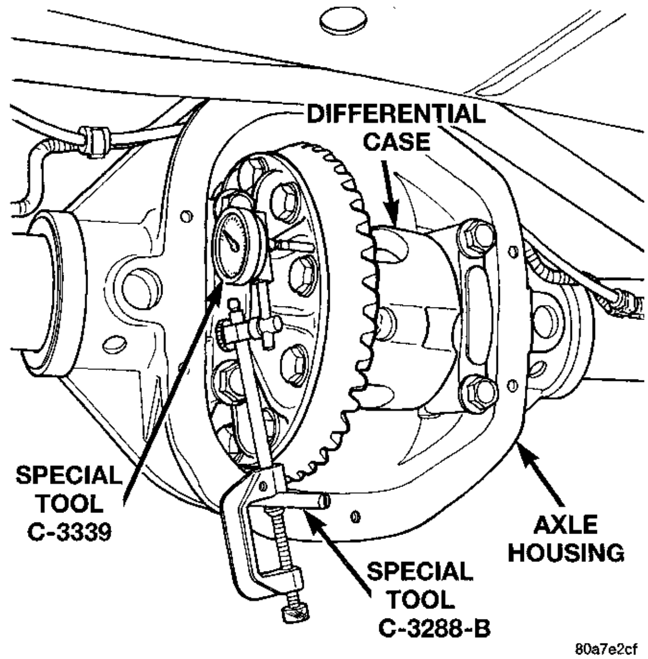

Fig. 56 Differential Side play Measurement

(15) Rotate dial indicator out of the way on the guide stud.

(16) Remove differential case and dummy bearings from axle housing.

(17) Install the pinion gear in axle housing. Install the pinion yoke, or flange, and establish the correct pinion rotating torque.

(18) Install differential case and dummy bearings D-346 in axle housing (without shims), install bearing caps and tighten bolts snug.

(19) Seat ring gear side dummy bearing (Fig. 54).

(20) Position the dial indicator plunger on a flat surface between the ring gear bolt heads. (Fig. 56).

(21) Push and hold differential case toward pinion gear (Fig. 59).

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ADJUSTMENTS (Continued)

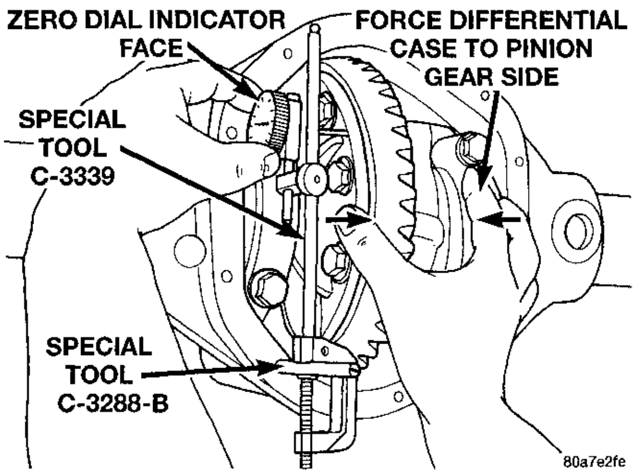

Fig. 57 Hold Differential Case and Zero Dial Indicator

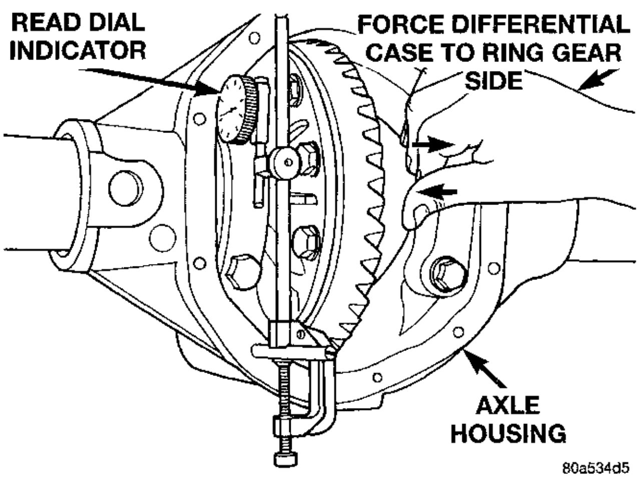

Fig. 58 Hold Differential Case and Read Dial Indicator

(22) Zero dial indicator face to pointer (Fig. 59).

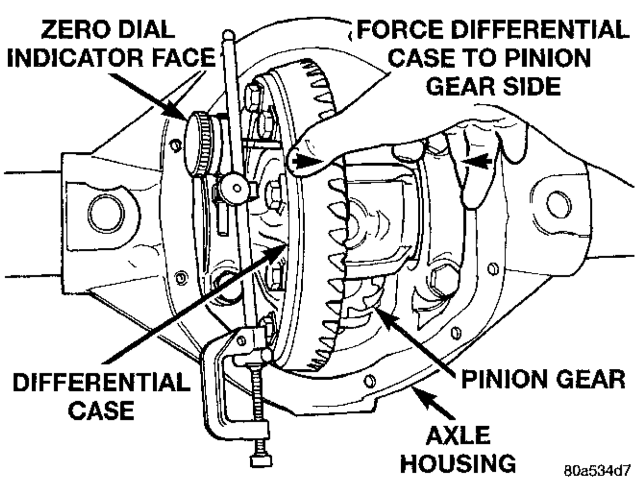

Fig. 59 Hold Differential Case and Zero Dial Indicator

(23) Push and hold differential case to ring gear side of the axle housing (Fig. 60).

(24) Record dial indicator reading (Fig. 60).

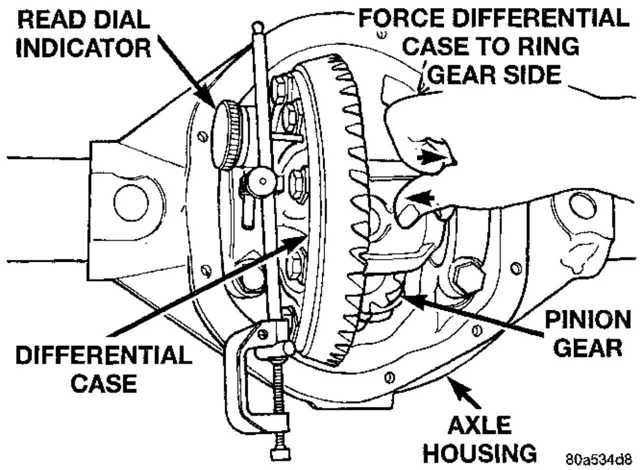

Fig. 60 Hold Differential Case and Read Dial Indicator

(25) This is the thickness shim required on the ring gear side of the differential case to achieve proper backlash.

(26) Subtract the backlash shim thickness from the total preload shim thickness. The remainder is the shim thickness required on the pinion side of the axle housing.

(27) Rotate dial indicator out of the way on guide stud.

(28) Remove differential case and dummy bearings from axle housing.

(29) Install side bearing shims on differential case hubs.

(30) Install side bearings and cups on differential case.

(31) Install spreader W-129-B on axle housing and spread axle opening enough to receive differential case.

(32) Install differential case in axle housing.

(33) Remove spreader from axle housing.

(34) Rotate the differential case several times to seat the side bearings.

(35) Position the indicator plunger against a ring gear tooth (Fig. 61).

(36) Push and hold ring gear upward while not allowing the pinion gear to rotate.

(37) Zero dial indicator face to pointer.

(38) Push and hold ring gear downward while not allowing the pinion gear to rotate. Dial indicator reading should be between 0.12 mm (0.005 in.) and 0.20 mm (0.008 in.). If backlash is not within specifications transfer the necessary amount of shim thickness from one side of the axle housing to the other (Fig. 62).

ADJUSTMENTS (Continued)

(39) Verify differential case and ring gear runout by measuring ring to pinion gear backlash at several locations around the ring gear. Readings should not vary more than 0.05 mm (0.002 in.). If readings vary more than specified, the ring gear or the differential case is defective.

After the proper backlash is achieved, perform Gear Contact Pattern Analysis procedure.

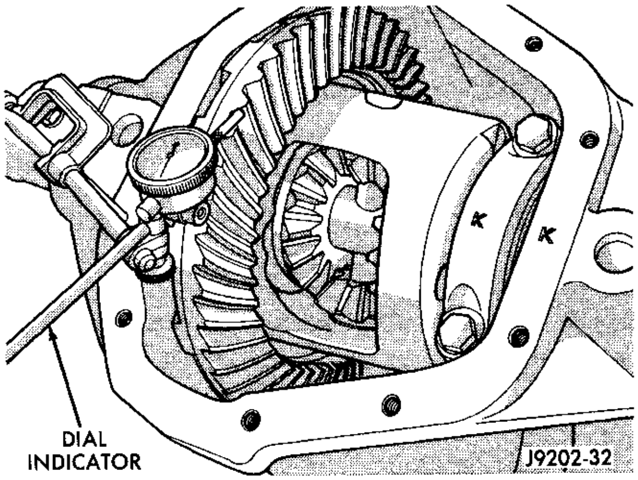

Fig. 61 Ring Gear Backlash Measurement

GEAR CONTACT PATTERN ANALYSIS

The ring and pinion gear teeth contact patterns will show if the pinion gear depth is correct in the axle housing. It will also show if the ring gear backlash has been adjusted correctly. The backlash can be adjusted within specifications to achieve desired tooth contact patterns.

(1) Apply a thin coat of hydrated ferric oxide, or equivalent, to the drive and coast side of the ring gear teeth.

(2) Wrap, twist, and hold a shop towel around the pinion yoke to increase the turning resistance of the pinion gear. This will provide a more distinct contact pattern.

(3) Using a boxed end wrench on a ring gear bolt, Rotate the differential case one complete revolution

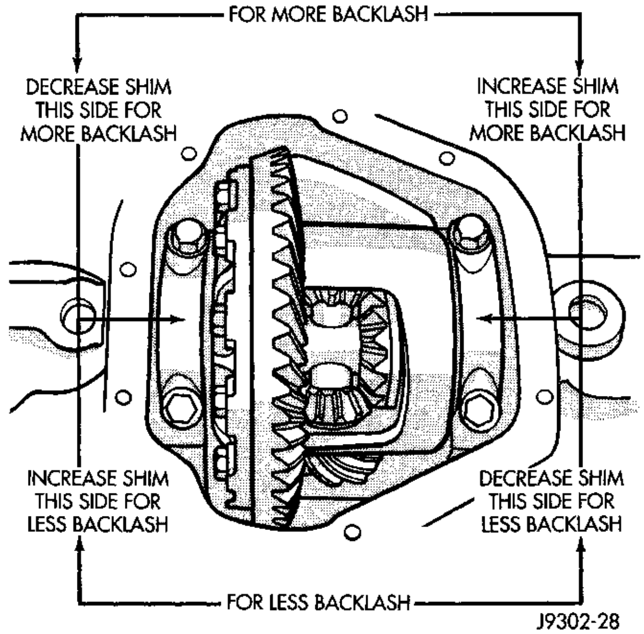

Fig. 62 Backlash Shim Adjustment

in both directions while a load is being applied from shop towel.

The areas on the ring gear teeth with the greatest degree of contact against the pinion gear teeth will squeegee the compound to the areas with the least amount of contact. Note and compare patterns on the ring gear teeth to Gear Tooth Contact Patterns chart (Fig. 63) and adjust pinion depth and gear backlash as necessary.

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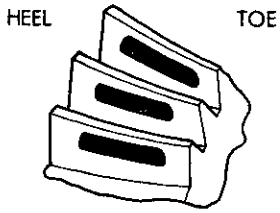
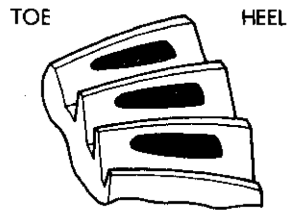
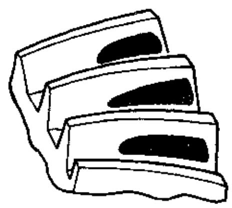
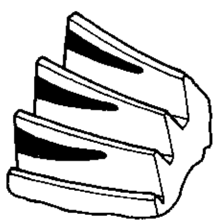
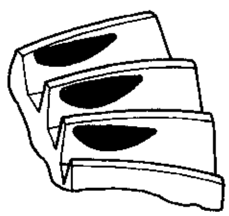
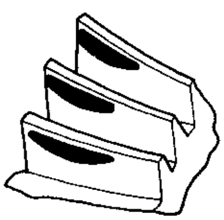
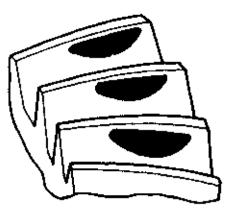
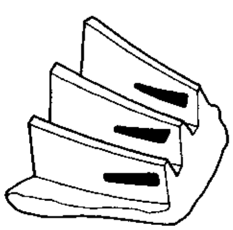
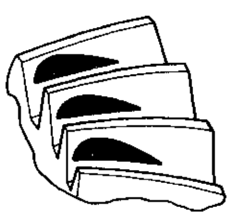
ADJUSTMENTS (Continued)

DRIVE SIDE OF RING GEAR TEETH	COAST SIDE OF RING GEAR TEETH	
		DESIRABLE CONTACT PATTERN. PATTERN SHOULD BE CENTERED ON THE DRIVE SIDE OF TOOTH. PATTERN SHOULD BE CENTERED ON THE COAST SIDE OF TOOTH, BUT MAY BE SLIGHTLY TOWARD THE TOE. THERE SHOULD ALWAYS BE SOME CLEARANCE BETWEEN CONTACT PATTERN AND TOP OF THE TOOTH.
		RING GEAR BACKLASH CORRECT. **THINNER** PINION GEAR DEPTH SHIM REQUIRED.
		RING GEAR BACKLASH CORRECT. **THICKER** PINION GEAR DEPTH SHIM REQUIRED.
		PINION GEAR DEPTH SHIM CORRECT. **DECREASE** RING GEAR BACKLASH.
		PINION GEAR DEPTH SHIM CORRECT. **INCREASE** RING GEAR BACKLASH.

J9003-24

Fig. 63 Gear Tooth Contact Patterns

SPECIFICATIONS

286 RBI AXLES

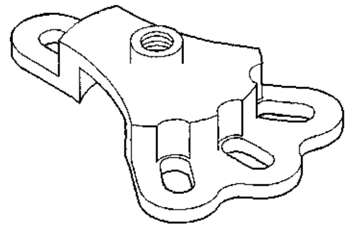
DESCRIPTION	SPEC.
Axle Type	Hypoid
Lubricant	Thermally Stable SAE 80W–90
Lube Capacity	
4x2	3.22 L (6.81 pts.)
4x4	4.80 L (10.125 pts.)
Axle Ratio	3.54, 4.10
Ring Gear	
Diameter	279.4 mm (11.00 in.)
Backlash	0.13–0.23 mm (0.005–0.009 in.)
Pinion Std. Depth	124.625 mm (5.812 in.)
Pinion Bearing Preload	
Original Bearing	1–3 N·m (10–20 in. lbs.)
New Bearing	2–5 N·m (15–35 in. lbs.)

TORQUE

DESCRIPTION	TORQUE
DIFFERENTIAL	
Plug, Fill Hole	34 N·m (25 ft. lbs.)
Bolts, Cover	41 N·m (30 ft. lbs.)
Bolts, Bearing Cap	108 N·m (80 ft. lbs.)
Nut, Pinion	597–678 N·m (440–500 ft. lbs.)
Bolt, Ring Gear	272–325 N·m (200–240 ft. lbs.)
Bolt, Axle to Hub	123 N·m (90 ft. lbs.)
RWAL/ABS Sensor Bolt	24 N·m (18 ft. lbs.)
TRAC-LOK CASE BOLT	
Standard	89–94 N·m (65–70 ft. lbs.)
Heavy Duty	122–136 N·m (90–100 ft. lbs.)
Nut, Hub	163–190 N·m (120–140 ft. lbs.)

SPECIAL TOOLS

286 RBI AXLES



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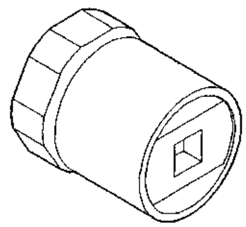

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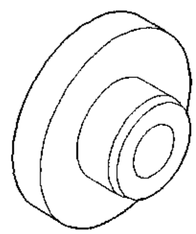

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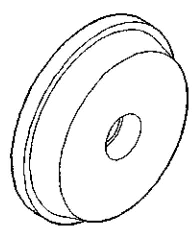

Installer, Bearing Cup—8153

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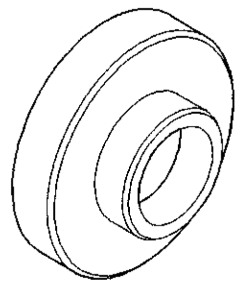
SPECIAL TOOLS (Continued)



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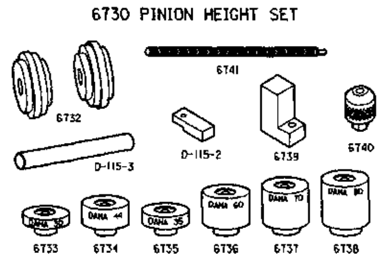

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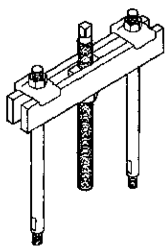

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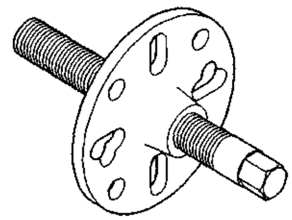

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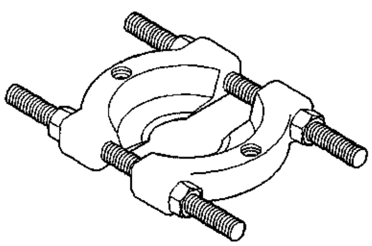

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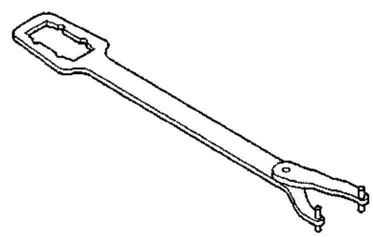

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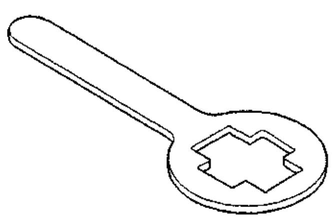

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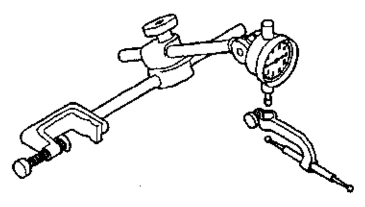

Dial Indicator Set—C-3339

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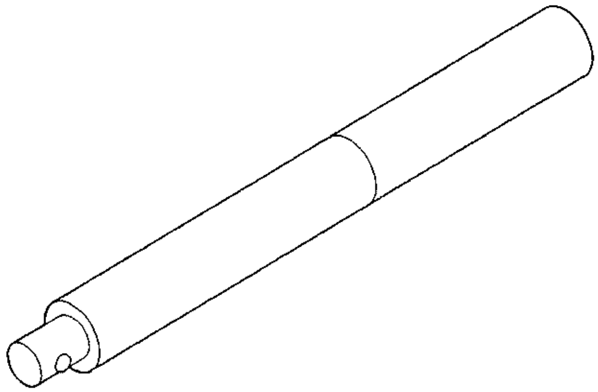

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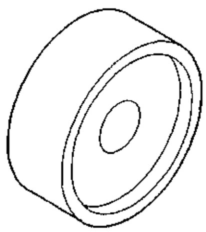

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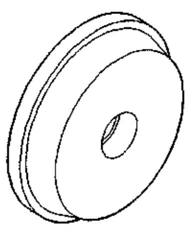

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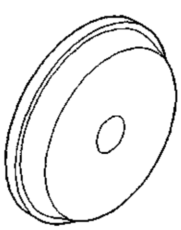

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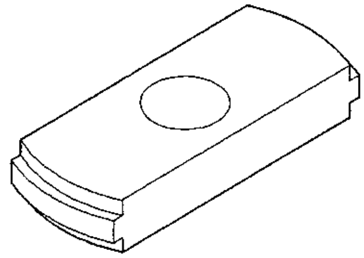

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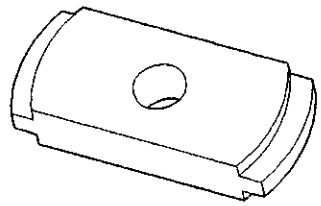
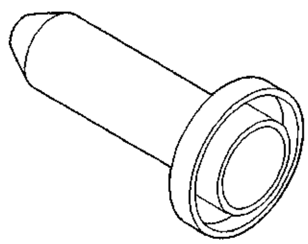


Remover, Pinion Bearing Cup—D-159



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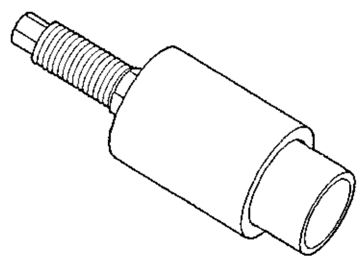

Installer, Pinion Yoke—D-191

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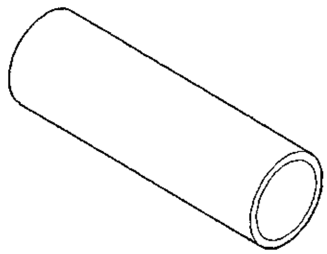

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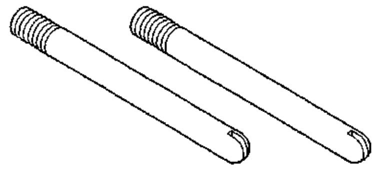

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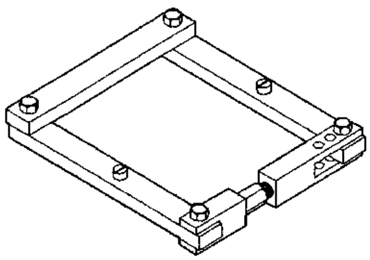

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BRAKES

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GENERAL INFORMATION

BRAKE SYSTEM

This vehicle is equipped with front disc brakes and rear drum brakes. The front disc brakes consist of single piston calipers and ventilated rotors. The rear brakes are dual brake shoe, internal expanding units with cast brake drums. The parking brake mechanism is cable operated and connected to the rear brake trailing shoes. Power brake assist is standard equipment. A vacuum operated power brake booster is used on gas engine vehicles. A hydraulic booster is used on diesel engine vehicles.

Two antilock brake systems are used on this vehicle. A rear wheel antilock (RWAL) brake system is standard. An all-wheel antilock brake system (ABS) is available as an option. The RWAL and ABS systems are designed to retard wheel lockup while braking. Retarding wheel lockup is accomplished by modulating fluid pressure to the wheel brake units. Both systems are monitored by a microprocessor which controls the operation of the systems.

SERVICE WARNINGS & CAUTIONS

WARNING: DUST AND DIRT ACCUMULATING ON BRAKE PARTS DURING NORMAL USE MAY CONTAIN ASBESTOS FIBERS FROM LININGS. BREATHING EXCESSIVE CONCENTRATIONS OF ASBESTOS FIBERS CAN CAUSE SERIOUS BODILY HARM. EXERCISE CARE WHEN SERVICING BRAKE PARTS. DO NOT CLEAN BRAKE PARTS WITH COMPRESSED AIR OR BY DRY BRUSHING. USE A VACUUM CLEANER SPECIFICALLY DESIGNED FOR THE REMOVAL OF ASBESTOS FIBERS FROM BRAKE COMPONENTS. IF A SUITABLE VACUUM CLEANER IS NOT AVAILABLE, CLEANING SHOULD BE DONE WITH A WATER DAMPENED CLOTH. DO NOT SAND, OR GRIND BRAKE LINING UNLESS EQUIPMENT USED IS DESIGNED TO CONTAIN THE DUST RESIDUE. DISPOSE OF ALL RESIDUE CONTAINING ASBESTOS FIBERS IN SEALED BAGS OR CONTAINERS TO MINIMIZE EXPOSURE TO YOURSELF AND OTHERS. FOLLOW PRACTICES PRESCRIBED BY THE OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION AND THE ENVIRONMENTAL PROTECTION AGENCY FOR THE HANDLING, PROCESSING, AND DISPOSITION OF DUST OR DEBRIS THAT MAY CONTAIN ASBESTOS FIBERS.

CAUTION: Never use gasoline, kerosene, alcohol, motor oil, transmission fluid, or any fluid containing mineral oil to clean the system components. These fluids damage rubber cups and seals. Use only fresh brake fluid or Mopar brake cleaner to clean or flush brake system components. These are the only cleaning materials recommended. If system contamination is suspected, check the fluid for dirt, discoloration, or separation into distinct layers. Also check the reservoir cap seal for distortion. Drain and flush the system with new brake fluid if contamination is suspected.

CAUTION: Use Mopar brake fluid, or an equivalent quality fluid meeting SAE/DOT standards J1703 and DOT 3. Brake fluid must be clean and free of contaminants. Use fresh fluid from sealed containers only to ensure proper antilock component operation.

CAUTION: Use Mopar multi-mileage or high temperature grease to lubricate caliper slide surfaces, drum brake pivot pins, and shoe contact points on the backing plates. Use multi-mileage grease or GE 661 or Dow 111 silicone grease on caliper bushings and slide pins to ensure proper operation.

DESCRIPTION AND OPERATION

BRAKE PEDAL

The brake booster is operated by a suspended type brake pedal. The pedal pivots on a shaft located in a mounting bracket attached to the dash panel. The pedal shaft is supported by bushings in the pedal and mounting bracket.

STOP LAMP SWITCH

The plunger type stop lamp switch is mounted on a bracket attached to the brake pedal support. The switch can be adjusted when necessary.

RED BRAKE WARNING LAMP

A red warning lamp is used for the service brake portion of the hydraulic system. The lamp is located in the instrument cluster. The red warning light alerts the driver if a pressure differential exists between the front and rear hydraulic systems or the parking brakes are applied.

The lamp is turned on momentarily when the ignition switch is turn to the on position. This is a self test to verify the lamp is operational.

POWER BRAKE BOOSTER

All gas engine vehicles are equipped with a tandem (dual) diaphragm power brake booster (Fig. 1). Two versions are used. A standard duty is used in all 1/2 ton models and a higher output version is used in 3/4 and 1 ton models. The standard and high output boosters are identified by code letters on the forward face of the booster (Fig. 1).

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DESCRIPTION AND OPERATION (Continued)

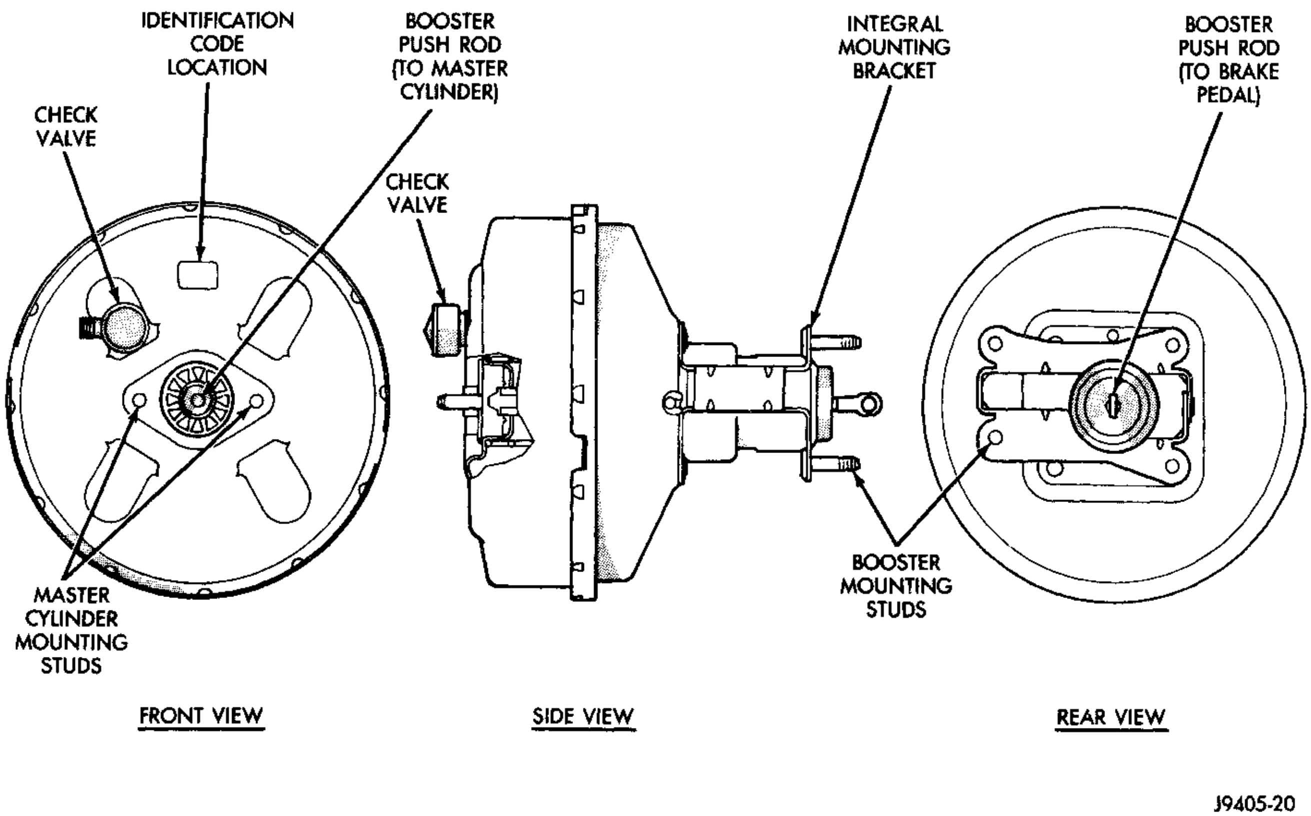

Fig. 1 Power Brake Booster

Booster I.D. code letters are as follows:

- 1/2 ton booster code: ZK
- 3/4 and 1 ton booster code: ZL

The only serviceable power brake booster components are the vacuum hose and check valve. The booster itself is not a repairable component. The booster must be replaced as an assembly whenever diagnosis indicates a fault has occurred.

VACUUM BRAKE BOOSTER OPERATION

The booster assembly consists of a housing divided into separate chambers by two internal diaphragms. The outer edge of each diaphragm is attached to the booster housing. The diaphragms are in turn, connected to the booster push rod.

Two push rods are used to operate the booster. One push rod connects the booster to the brake pedal. The second push rod (at the forward end of the housing), strokes the master cylinder pistons. The rear push rod is connected to the two diaphragms in the booster housing.

The atmospheric inlet valve is opened and closed by the push rod connected to the brake pedal. The booster vacuum supply is through a hose attached to a fitting on the intake manifold. The hose is connected to a vacuum check valve in the booster housing. The check valve is a one-way device that prevents vacuum leak back.

Power assist is generated by utilizing the pressure differential between normal atmospheric pressure and a vacuum. The vacuum needed for booster operation is taken directly from the engine intake manifold. The entry point for atmospheric pressure is through an inlet valve at the rear of the housing.

The forward portion of the booster housing (area in front of the two diaphragms), is exposed to manifold vacuum. The rear portion (area behind the diaphragms), is also under vacuum, but less vacuum then the forward portion.

Pressing the brake pedal causes the rear push rod to open the inlet valve. This exposes the area behind the diaphragms to atmospheric pressure. The resulting force applied to the diaphragms is what provides the extra boost in apply pressure for power assist. Pressure differential creates force imbalance and provides boost.

HYDRAULIC BRAKE BOOSTER

Vehicles equipped with a Hydraulic Booster (Fig. 2) use the booster to supply power assist to the brake system. The booster is mounted to the front cowl

AUTHENTIC RESTORATION PRODUCT

DESCRIPTION AND OPERATION (Continued)

panel on a bracket. The master cylinder is mounted to the front of the booster.

The hydraulic pressure is supplied to the booster from the power steering pump. The pressure line from the pump is connected to the booster. From the booster a second pressure line is connected to the steering gear. Return lines from the booster and steering gear are connected to the power steering pump reservoir.

A nitrogen charged pneumatic accumulator on the booster provides reserve power assist pressure. If power steering pump pressure is not available (broken belt/pump failure) the accumulator reserve pressure is used. This provides 2 or 3 stops at partial boost.

BRAKE PEDAL RELEASED

With the brake pedal released most of the hydraulic fluid is routed through the booster power section and to the steering gear. A portion of the fluid is diverted into the booster power section, then returns to the power steering pump reservoir.

BRAKE PEDAL DEPRESSED

With the brake pedal depressed, the input rod and piston move forward. This causes the lever assembly to move the sleeve forward to close off the holes leading to the open center of the spool valve. A small additional lever movement, moves the spool valve forward in the spool valve bore. The spool valve then diverts some hydraulic fluid into the cavity behind the booster piston building up hydraulic pressure. This hydraulic pressure moves the piston and output rod forward. The output rod moves the primary and secondary master cylinder pistons which applies hydraulic pressure to the brake system. When the brake pedal is released, the spool and sleeve assembly returns to it's normal position. Excess fluid behind the piston returns to the power steering pump reservoir through the return hose.

MANUAL BRAKE APPLICATION

The system is designed to permit manual brake application in the event hydraulic pressure is interrupted. A somewhat greater pedal effort is required to apply the brakes manually.

MASTER CYLINDER

A two-piece master cylinder is used on all models. The cylinder body containing the primary and secondary pistons is made of aluminum. The removable fluid reservoir is made of nylon reinforced with glass fiber. The reservoir is the only serviceable component.

The fluid compartments of the nylon reservoir are interconnected to permit fluid level equalization. However, the equalization feature does not affect circuit separation in the event of a front or rear brake malfunction. The reservoir compartments will retain enough fluid to operate the functioning hydraulic circuit.

Care must be exercised when removing/installing the master cylinder connecting lines. The threads in the cylinder fluid ports can be damaged if care is not exercised. Start all brake line fittings by hand to avoid cross threading.

The cylinder reservoir can be replaced when necessary. However, the aluminum body section of the master cylinder is not a repairable component.

NOTE: If diagnosis indicates that an internal malfunction has occurred, the aluminum body section must be replaced as an assembly.

COMBINATION VALVE

The combination valve contains a pressure differential valve and switch, metering valve and a rear brake proportioning valve on 1500 models. The combination valve/rear brake proportioning valve are not repairable and must be replaced as an assembly.

PRESSURE DIFFERENTIAL SWITCH

The pressure differential switch is connected to the brake warning lamp. The switch is triggered by movement of the switch valve. The purpose of the switch is to monitor fluid pressure in the separate front/rear brake hydraulic circuits.

A decrease or loss of fluid pressure in either hydraulic circuit will cause the switch valve to shuttle forward or rearward in response to the pressure differential. Movement of the switch valve will push the switch plunger upward. This closes the switch internal contacts completing the electrical circuit to the warning lamp. The switch valve may remain in an actuated position until repair restores system pressures to normal levels.

METERING VALVE

The metering valve is used to balance brake action between the front disc and rear drum brakes. The valve holds-off the intial pressure to the front disc brakes until the rear brake shoes retracting springs are overcome. The valve is designed to maintain front brake fluid pressure at 241-517 kPa (35-75 psi) until the hold-off limit of 310-689 kPa (100 psi) is reached. At this point, the metering valve opens completely permitting full fluid apply pressure to the front disc brakes. This reduces front brake lining wear during low deceleration stops.

PROPORTIONING VALVE (1500 Model)

The proportioning valve is used to balance front-rear brake action at high decelerations. The valve

DESCRIPTION AND OPERATION (Continued)

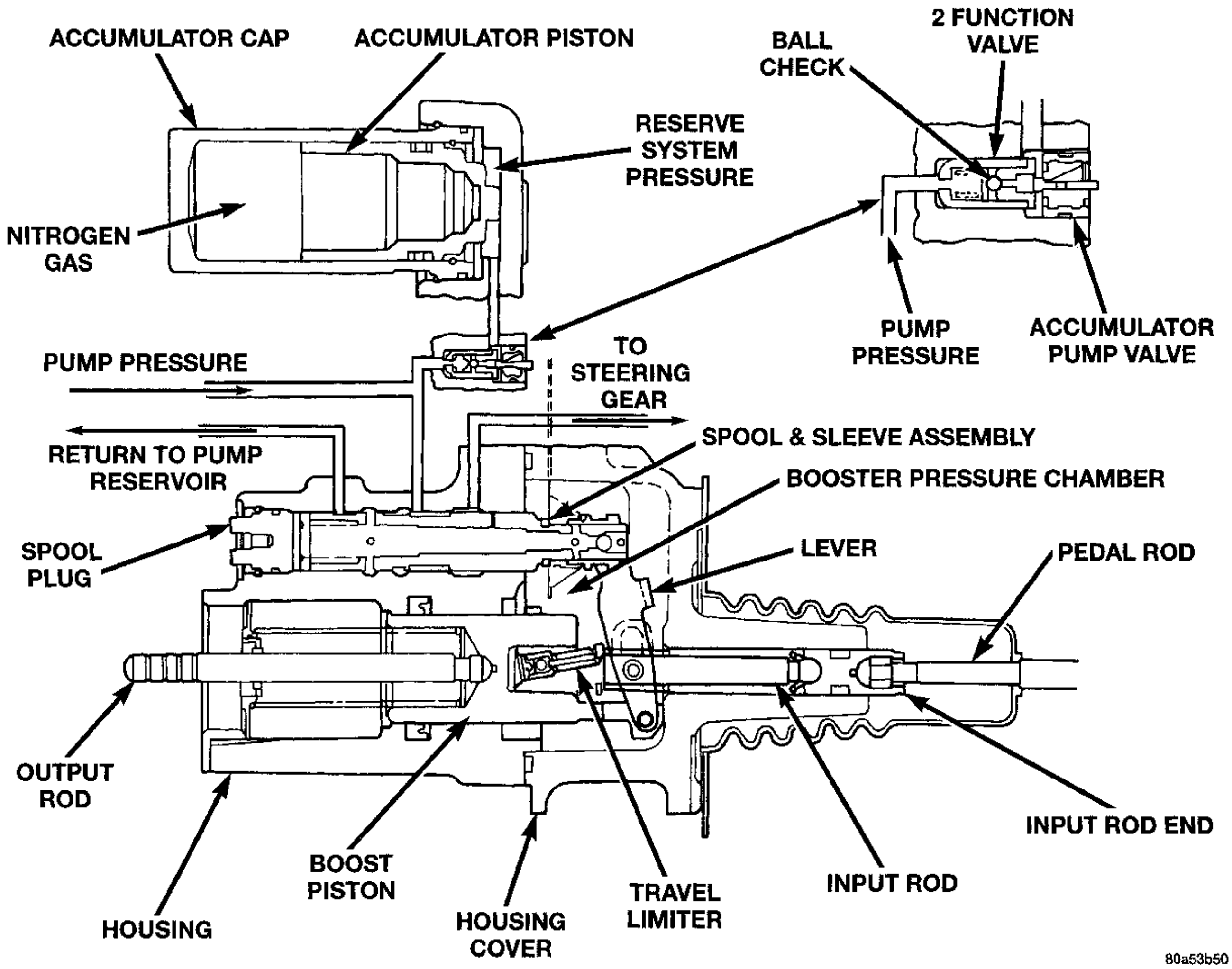

Fig. 2 Hydraulic Brake Booster

allows normal fluid flow during moderate braking. The valve only controls fluid flow during high decelerations brake stops, when a percentage of rear weight is transferred to the front wheels.

HEIGHT SENSING PROPORTIONING VALVE

The Height Sensing Proportioning Valve provides two different brake balance modes to the rear brake based on the vehicle load. This is accomplished by turning the valve on or off. When the vehicle is not loaded hydraulic pressure is reduced to the rear brakes after the split point. When the vehicle is carrying a full load the actuator lever moves up to change the valve setting. The valve now allows full hydraulic pressure to the rear brake. The valve contains a plunger, cam, torsional clutch spring and actuator shaft (Fig. 3). This valve is used on all 4WD 2500 vehicles with 8,800 GVW.

The valve is mounted to the left frame rail above the rear axle. The valve has an actuator lever connected by a link to the left lower shock bracket. The

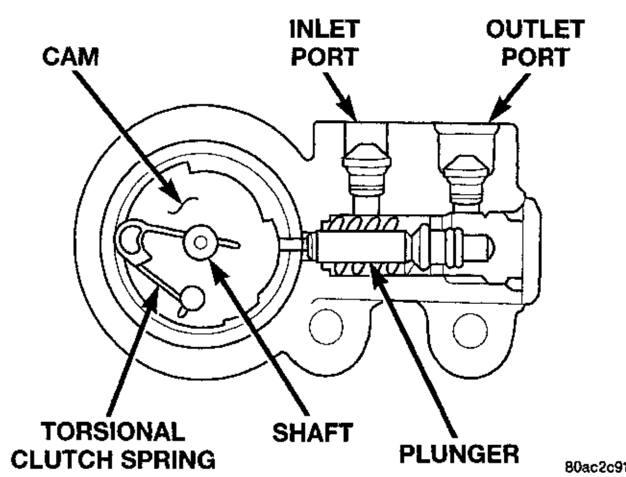

Fig. 3 Height Sensing Proportioning Valve

valve is turned on and off as the axle to frame height changes due to the load in the vehicle. A torsional clutch spring attached to the valve shaft and cam is used as an override feature. Once the valve is posi-

DESCRIPTION AND OPERATION (Continued)

tioned during brake application, the spring prevents the valve from changing position in the event of an abrupt suspension movement such as going over a bump. During this instance the cam is held in position while the shaft is allowed to rotate.

CAUTION: If the valve assembly is replaced for service, the lever must not be adjusted, it is preset at the factory. The Height Sensing Proportioning Valve is service as an assembly only.

FRONT DISC BRAKES

The calipers are a single piston type. The calipers are free to slide laterally, this allows continuous compensation for lining wear.

When the brakes are applied fluid pressure is exerted against the caliper piston. The fluid pressure is exerted equally and in all directions. This means pressure exerted against the caliper piston and within the caliper bore will be equal (Fig. 4).

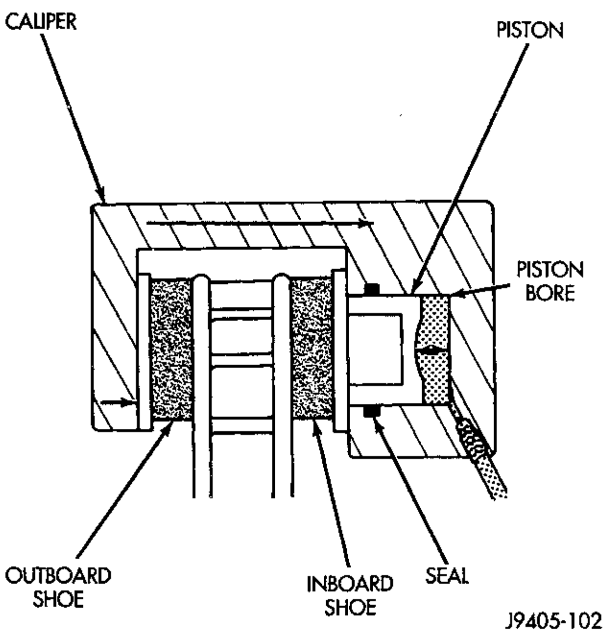

Fig. 4 Brake Caliper Operation

Fluid pressure applied to the piston is transmitted directly to the inboard brake shoe. This forces the shoe lining against the inner surface of the disc brake rotor. At the same time, fluid pressure within the piston bore forces the caliper to slide inward on the mounting bolts. This action brings the outboard brake shoe lining into contact with the outer surface of the disc brake rotor.

In summary, fluid pressure acting simultaneously on both piston and caliper, produces a strong clamping action. When sufficient force is applied, friction will stop the rotors from turning and bring the vehicle to a stop.

Application and release of the brake pedal generates only a very slight movement of the caliper and piston. Upon release of the pedal, the caliper and piston return to a rest position. The brake shoes do not retract an appreciable distance from the rotor. In fact, clearance is usually at, or close to zero. The reasons for this are to keep road debris from getting between the rotor and lining and in wiping the rotor surface clear each revolution.

The caliper piston seal controls the amount of piston extension needed to compensate for normal lining wear.

During brake application, the seal is deflected outward by fluid pressure and piston movement (Fig. 5). When the brakes (and fluid pressure) are released, the seal relaxes and retracts the piston.

The amount of piston retraction is determined by brake lining wear. Generally the amount is just enough to maintain contact between the piston and inboard brake shoe.

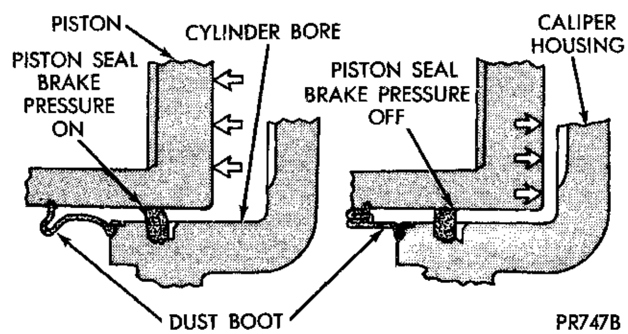

Fig. 5 Lining Wear Compensation By Piston Seal

DRUM BRAKES

All models are equipped with rear drum brake assemblies. They are two-shoe, duo-servo units with an automatic adjuster mechanism.

Three different size drum brake assemblies are used:

- 1/2 ton (1500) models: 11 x 2 in.
- 3/4 ton (2500) models: 13 x 2.5 in.
- 1 ton (3500) models: 13 x 3.5 in.

Two different wheel cylinders are used. The difference being cylinder bore size. The cylinders used on 1/2 and 3/4 ton models have a bore diameter of 23.8 mm (0.937 or 15/16 in.). The cylinders used on 1 ton models have a bore diameter of 27 mm (1.06 or 1-1/16 in.).

The drum brakes are a semi-floating, self-energizing, servo action design. The brake shoes are not fixed on the support plate. This type of brake allows the shoes to pivot and move vertically to a certain extent.

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DESCRIPTION AND OPERATION (Continued)

In operation, fluid apply pressure causes the wheel cylinder pistons to move outward. This movement is transferred directly to the brake shoes by the cylinder connecting links. The resulting brake shoe expansion brings the lining material into contact with the rotating brake drum.

Two forces affect the brake shoes once they contact the drum. The first force being hydraulic pressure exerted through the wheel cylinder pistons. And the second force is the friction generated turning torque of the rotating drum.

The drum forces both brake shoes to move in the same direction of rotation. Servo action begins with the primary brake shoe which begins to wedge (or wrap) itself against the rotating drum surface. This force is transmitted equally to the secondary brake shoe through the adjuster screw and anchor pin. The net result is that each shoe helps the other exert extra force against the drum. It is servo action that creates the wedging (or wrap) effect which produces increased force on the drum braking surface.

All drum brake assemblies are equipped with a self adjusting mechanism. The components forming the mechanism consist of the: adjuster screw, adjuster lever, actuating lever (11 inch brake), lever return spring and the adjuster lever spring. The adjuster lever on the 13 inch brake, is also equipped with a lever and tension spring.

The adjuster mechanism performs two important functions. First, is in maintaining proper brake shoe operating clearance. And second, is to maintain brake pedal height. The mechanism does so, by adjusting the shoes in small increments to compensate for lining wear. The adjustment process is continuous throughout the useful life of the brake lining.

The adjuster components are all connected to the secondary brake shoes. Actual adjustment only occurs during reverse brake stops. Secondary brake shoe movement (during reverse stops), is what activates the adjuster components.

In operation, secondary shoe movement causes the adjuster lever spring to exert pull on the lever. This pivots the lever away from the adjuster screw teeth. When the stop is completed and the brakes released, the adjuster lever pivots back to a normal position. It is during this return movement of the lever when adjustment occurs. At this point, the lever comes back into contact with the adjuster screw teeth as it moves upward. The lever will then rotate the adjuster screw one or two teeth as needed for adjustment.

NOTE: The adjustment process requires a complete stop to actually occur. Rolling stops will NOT activate the adjuster components. In addition, the adjuster screws are left and right hand parts and must NOT be interchanged.

PARKING BRAKES

The parking brakes are operated by a system of cables and levers attached to the rear brake secondary shoes.

The rear drum brake shoes serve as the parking brakes. The shoes make contact with the brake drum surface by a cable and lever mechanism attached to the secondary brake shoe.

The front parking brake cable is connected to the parking brake pedal and to an intermediate cable. The intermediate cable connects the front cable to the rear cables.

The parking brake pedal assembly is mounted on the driver side cowl panel. The front cable is directly attached to the assembly. The pedal assembly contains a spring loaded, ratchet-type mechanism that will hold the cable in the applied position and allow the pedal to return. A rod used to release the ratchet mechanism and return the pedal to normal position.

BRAKE HOSES AND LINES

Flexible rubber hose is used at both front brakes and at the rear axle junction block. Double walled steel tubing is used to connect the master cylinder to the major hydraulic braking components and then to the flexible rubber hoses.

DIAGNOSIS AND TESTING

BASE BRAKE SYSTEM

Base brake components consist of the brake shoes, calipers, wheel cylinders, brake drums, rotors, brake lines, master cylinder, booster, and parking brake components.

Brake diagnosis involves determining if the problem is related to a mechanical, hydraulic, or vacuum operated component.

The first diagnosis step is the preliminary check.

PRELIMINARY BRAKE CHECK

(1) Check condition of tires and wheels. Damaged wheels and worn, damaged, or underinflated tires can cause pull, shudder, vibration, and a condition similar to grab.

(2) If complaint was based on noise when braking, check suspension components. Jounce front and rear of vehicle and listen for noise that might be caused by loose, worn or damaged suspension or steering components.

(3) Inspect brake fluid level and condition. Note that the brake reservoir fluid level will decrease in proportion to normal lining wear. **Also note that brake fluid tends to darken over time. This is normal and should not be mistaken for contamination.**

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DIAGNOSIS AND TESTING (Continued)

(a) If fluid level is abnormally low, look for evidence of leaks at calipers, wheel cylinders, brake lines, and master cylinder.

(b) If fluid appears contaminated, drain out a sample to examine. System will have to be flushed if fluid is separated into layers, or contains a substance other than brake fluid. The system seals and cups will also have to be replaced after flushing. Use clean brake fluid to flush the system.

(4) Check parking brake operation. Verify free movement and full release of cables and pedal. Also note if vehicle was being operated with parking brake partially applied.

(5) Check brake pedal operation. Verify that pedal does not bind and has adequate free play. If pedal lacks free play, check pedal and power booster for being loose or for bind condition. Do not road test until condition is corrected.

(6) Check booster vacuum check valve and hose.

(7) If components checked appear OK, road test the vehicle.

ROAD TESTING

(1) If complaint involved low brake pedal, pump pedal and note if it comes back up to normal height.

(2) Check brake pedal response with transmission in Neutral and engine running. Pedal should remain firm under constant foot pressure.

(3) During road test, make normal and firm brake stops in 25-40 mph range. Note faulty brake operation such as low pedal, hard pedal, fade, pedal pulsation, pull, grab, drag, noise, etc.

(4) Attempt to stop the vehicle with the parking brake only and note grab, drag, noise, etc.

PEDAL FALLS AWAY

A brake pedal that falls away under steady foot pressure is generally the result of a system leak. The leak point could be at a brake line, fitting, hose, or caliper/wheel cylinder. If leakage is severe, fluid will be evident at or around the leaking component.

Internal leakage (seal by-pass) in the master cylinder caused by worn or damaged piston cups, may also be the problem cause. However, internal leakage in the master cylinder, ABS or RWAL system may not be physically evident.

An internal leak in the ABS or RWAL system may also be the problem with no physically evident.

LOW PEDAL

If a low pedal is experienced, pump the pedal several times. If the pedal comes back up worn linings, rotors, drums, or rear brakes out of adjustment are the most likely causes. The proper course of action is to inspect and replace all worn component and make the proper adjustments.

SPONGY PEDAL

A spongy pedal is most often caused by air in the system. However, thin brake drums or substandard brake lines and hoses can also cause a spongy pedal. The proper course of action is to bleed the system, and replace thin drums and substandard quality brake hoses if suspected.

HARD PEDAL OR HIGH PEDAL EFFORT

A hard pedal or high pedal effort may be due to lining that is water soaked, contaminated, glazed, or badly worn. The power booster or check valve could also be faulty.

PEDAL PULSATION

Pedal pulsation is caused by components that are loose, or beyond tolerance limits.

The primary cause of pulsation are disc brake rotors with excessive lateral runout or thickness variation, or out of round brake drums. Other causes are loose wheel bearings or calipers and worn, damaged tires.

NOTE: Some pedal pulsation may be felt during ABS activation.

BRAKE DRAG

Brake drag occurs when the lining is in constant contact with the rotor or drum. Drag can occur at one wheel, all wheels, fronts only, or rears only.

Drag is a product of incomplete brake shoe release. Drag can be minor or severe enough to overheat the linings, rotors and drums.

Minor drag will usually cause slight surface charring of the lining. It can also generate hard spots in rotors and drums from the overheat-cool down process. In most cases, the rotors, drums, wheels and tires are quite warm to the touch after the vehicle is stopped.

Severe drag can char the brake lining all the way through. It can also distort and score rotors and drums to the point of replacement. The wheels, tires and brake components will be extremely hot. In severe cases, the lining may generate smoke as it chars from overheating.

Common causes of brake drag are:

- Seized or improperly adjusted parking brake cables.
- Loose/worn wheel bearing.
- Seized caliper or wheel cylinder piston.
- Caliper binding on corroded bushings or rusted slide surfaces.
- Loose caliper mounting.
- Drum brake shoes binding on worn/damaged support plates.
- Mis-assembled components.

DIAGNOSIS AND TESTING (Continued)

If brake drag occurs at all wheels, the problem may be related to a blocked master cylinder return port, or faulty power booster (binds-does not release).

BRAKE FADE

Brake fade is usually a product of overheating caused by brake drag. However, brake overheating and resulting fade can also be caused by riding the brake pedal, making repeated high deceleration stops in a short time span, or constant braking on steep mountain roads. Refer to the Brake Drag information in this section for causes.

BRAKE PULL

Front brake pull condition could result from:

- Contaminated lining in one caliper
- Seized caliper piston
- Binding caliper
- Loose caliper
- Rusty caliper slide surfaces
- Improper brake shoes
- Damaged rotor

A worn, damaged wheel bearing or suspension component are further causes of pull. A damaged front tire (bruised, ply separation) can also cause pull.

A common and frequently misdiagnosed pull condition is where direction of pull changes after a few stops. The cause is a combination of brake drag followed by fade at one of the brake units.

As the dragging brake overheats, efficiency is so reduced that fade occurs. Since the opposite brake unit is still functioning normally, its braking effect is magnified. This causes pull to switch direction in favor of the normally functioning brake unit.

An additional point when diagnosing a change in pull condition concerns brake cool down. Remember that pull will return to the original direction, if the dragging brake unit is allowed to cool down (and is not seriously damaged).

REAR BRAKE GRAB OR PULL

Rear grab or pull is usually caused by improperly adjusted or seized parking brake cables, contaminated lining, bent or binding shoes and support plates, or improperly assembled components. This is particularly true when only one rear wheel is involved. However, when both rear wheels are affected, the master cylinder or proportioning valve could be at fault.

BRAKES DO NOT HOLD AFTER DRIVING THROUGH DEEP WATER PUDDLES

This condition is generally caused by water soaked lining. If the lining is only wet, it can be dried by driving with the brakes very lightly applied for a mile or two. However, if the lining is both soaked and dirt contaminated, cleaning and/or replacement will be necessary.

BRAKE LINING CONTAMINATION

Brake lining contamination is mostly a product of leaking calipers or wheel cylinders, worn seals, driving through deep water puddles, or lining that has become covered with grease and grit during repair. Contaminated lining should be replaced to avoid further brake problems.

WHEEL AND TIRE PROBLEMS

Some conditions attributed to brake components may actually be caused by a wheel or tire problem.

A damaged wheel can cause shudder, vibration and pull. A worn or damaged tire can also cause pull.

Severely worn tires with very little tread left can produce a grab-like condition as the tire loses and recovers traction. Flat-spotted tires can cause vibration and generate shudder during brake operation. A tire with internal damage such as a severe bruise, cut, or ply separation can cause pull and vibration.

BRAKE NOISES

Some brake noise is common with rear drum brakes and on some disc brakes during the first few stops after a vehicle has been parked overnight or stored. This is primarily due to the formation of trace corrosion (light rust) on metal surfaces. This light corrosion is typically cleared from the metal surfaces after a few brake applications causing the noise to subside.

BRAKE SQUEAK/SQUEAL

Brake squeak or squeal may be due to linings that are wet or contaminated with brake fluid, grease, or oil. Glazed linings and rotors with hard spots can also contribute to squeak. Dirt and foreign material embedded in the brake lining will also cause squeak/squeal.

A very loud squeak or squeal is frequently a sign of severely worn brake lining. If the lining has worn through to the brake shoes in spots, metal-to-metal contact occurs. If the condition is allowed to continue, rotors and drums can become so scored that replacement is necessary.

BRAKE CHATTER

Brake chatter is usually caused by loose or worn components, or glazed/burnt lining. Rotors with hard spots can also contribute to chatter. Additional causes of chatter are out-of-tolerance rotors, brake lining not securely attached to the shoes, loose wheel bearings and contaminated brake lining.

DIAGNOSIS AND TESTING (Continued)

THUMP/CLUNK NOISE

Thumping or clunk noises during braking are frequently **not** caused by brake components. In many cases, such noises are caused by loose or damaged steering, suspension, or engine components. However, calipers that bind on the slide surfaces can generate a thump or clunk noise. In addition, worn out, improperly adjusted, or improperly assembled rear brake shoes can also produce a thump noise.

STOP LAMP SWITCH

Stop lamp switch operation can be tested with an ohmmeter. The ohmmeter is used to check continuity between the pin terminals at different plunger positions (Fig. 6).

NOTE: The switch wire harness must be disconnected before testing switch continuity.

SWITCH CIRCUIT IDENTIFICATION

- Terminals 1 and 2 are for the RWAL/ABS module and Powertrain Control Module (PCM) circuit
- Terminals 5 and 6 are for the stop lamp circuit
- Terminals 3 and 4 are for the speed control circuit

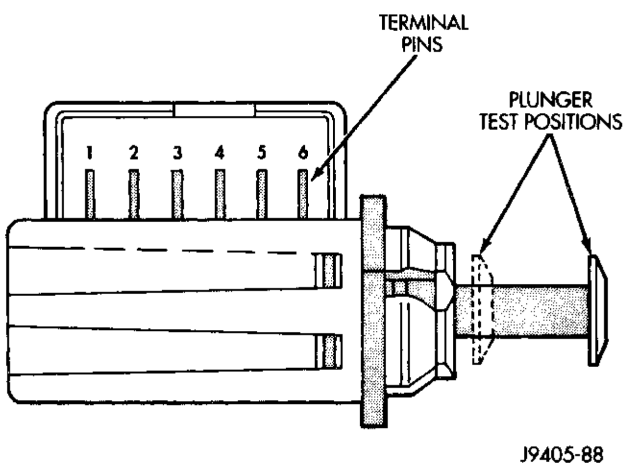

Fig. 6 Stop Lamp Switch Terminal Identification

SWITCH CONTINUITY TEST

(1) Check continuity between terminal pins 5 and 6 as follows:

(a) Pull plunger all the way out to fully extended position.

(b) Attach test leads to pins 5 and 6 and note ohmmeter reading.

(c) If continuity exists, proceed to next test. Replace switch if meter indicates lack of continuity (shorted or open).

(2) Check continuity between terminal pins 1 and 2 and pins 3 and 4 as follows:

(a) Push switch plunger inward to fully retracted position.

(b) Attach test leads to pins 1 and 2 and note ohmmeter reading.

(c) If continuity exists, switch is OK. Replace switch if meter indicates lack of continuity (switch is open).

RED BRAKE WARNING LAMP

The red warning lamp is in circuit with the parking brake switch and pressure differential switch in the combination valve.

The red lamp illuminates when the parking brakes are applied, or when a pressure drop occurs in the front or rear brake hydraulic circuit.

The lamp illuminates for approximately 2-4 seconds at every engine start up. This is a self test feature designed to check bulb and circuit operation.

A pressure drop in the front or rear brake hydraulic circuit activates the pressure differential valve inside the combination valve. A pressure decrease moves the valve toward the low pressure side. As the valve moves, it pushes the pressure differential switch contact plunger upward. This closes the switch internal contacts and completes the circuit to the red warning lamp. The lamp will remain on until repairs are made and normal fluid pressure restored.

MASTER CYLINDER/POWER BOOSTER

(1) Start engine and check booster vacuum hose connections. A hissing noise indicates vacuum leak. Correct any vacuum leak before proceeding.

(2) Stop engine and shift transmission into Neutral.

(3) Pump brake pedal until all vacuum reserve in booster is depleted.

(4) Press and hold brake pedal under light foot pressure. The pedal should hold firm, if the pedal falls away master cylinder is faulty (internal leakage).

(5) Start engine and note pedal action it should fall away slightly under light foot pressure then hold firm. If no pedal action is discernible, power booster, vacuum supply, or vacuum check valve is faulty. Proceed to the POWER BOOSTER VACUUM TEST.

(6) If the POWER BOOSTER VACUUM TEST passes, rebuild booster vacuum reserve as follows: Release brake pedal. Increase engine speed to 1500 rpm, close the throttle and immediately stop turn off ignition to stop engine.

(7) Wait a minimum of 90 seconds and try brake action again. Booster should provide two or more vacuum assisted pedal applications. If vacuum assist is not provided, booster is faulty.

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DIAGNOSIS AND TESTING (Continued)

POWER BOOSTER VACUUM TEST

(1) Connect vacuum gauge to booster check valve with short length of hose and T-fitting (Fig. 7).

(2) Start and run engine at curb idle speed for one minute.

(3) Observe the vacuum supply. If vacuum supply is not adequate, repair vacuum supply.

(4) Clamp hose shut between vacuum source and check valve.

(5) Stop engine and observe vacuum gauge.

(6) If vacuum drops more than one inch HG (33 millibars) within 15 seconds, booster diaphragm or check valve is faulty.

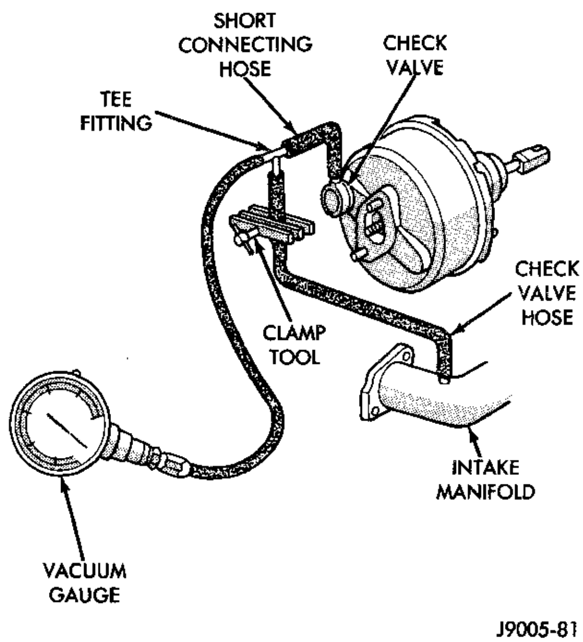

Fig. 7 Typical Booster Vacuum Test Connections

POWER BOOSTER CHECK VALVE TEST

(1) Disconnect vacuum hose from check valve.

(2) Remove check valve and valve seal from booster.

(3) Use a hand operated vacuum pump for test.

(4) Apply 15-20 inches vacuum at large end of check valve (Fig. 8).

(5) Vacuum should hold steady. If gauge on pump indicates vacuum loss, check valve is faulty and should be replaced.

HYDRAULIC BOOSTER

The hydraulic booster uses hydraulic pressure from the power steering pump. Before diagnosing a booster problem, first verify the power steering pump is operating properly. Perform the following checks.

- Check the power steering fluid level.
- Check the brake fluid level.
- Check all power steering hoses and lines for leaks and restrictions.

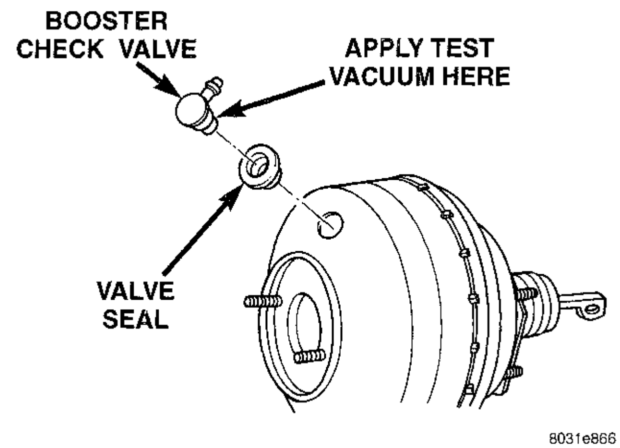

Fig. 8 Vacuum Check Valve And Seal

- Check power steering pump pressure.

NOISES

The hydraulic booster unit will produce certain characteristic booster noises. The noises may occur when the brake pedal is used in a manner not associated with normal braking or driving habits.

HISSING

A hissing noise may be noticed when above normal brake pedal pressure is applied, 40 lbs. or above. The noise will be more noticeable if the vehicle is not moving. The noise will increase with the brake pedal pressure and an increase of system operating temperature.

CLUNK-CHATTER-CLICKING

A clunk-chatter-clicking may be noticed when the brake pedal is released quickly, after above normal brake pedal pressure is applied 50-100 lbs..

BOOSTER FUNCTION TEST

With the engine off depress the brake pedal several times to discharge the accumulator. Then depress the brake pedal using 40 lbs. of force and start the engine. The brake pedal should fall and then push back against your foot. This indicates the booster is operating properly.

ACCUMULATOR LEAKDOWN

(1) Start the engine, apply the brakes and turn the steering wheel from lock to lock. This will ensure the accumulator is charged. Turn off the engine and let the vehicle sit for one hour. After one hour there should be at least two power assisted brake application with the engine off. If the system does not retain a charge the booster must be replaced.

(2) With the engine off depress the brake pedal several times to discharge the accumulator. Grasp the accumulator and see if it wobbles or turns. If it

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DIAGNOSIS AND TESTING (Continued)

does the accumulator has lost a gas charge and the booster must be replaced.

SEAL LEAKAGE

If the booster leaks from any of the seals the booster assembly must be replaced (Fig. 9).

- **INPUT ROD SEAL:** Fluid leakage from rear end of the booster.
- **PISTON SEAL:** Fluid leakage from vent at front of booster.
- **HOUSING SEAL:** Fluid leakage between housing and housing cover.
- **SPOOL VALVE SEAL:** Fluid leakage near spool plug.
- **RETURN PORT FITTING SEAL:** Fluid leakage from port fitting.

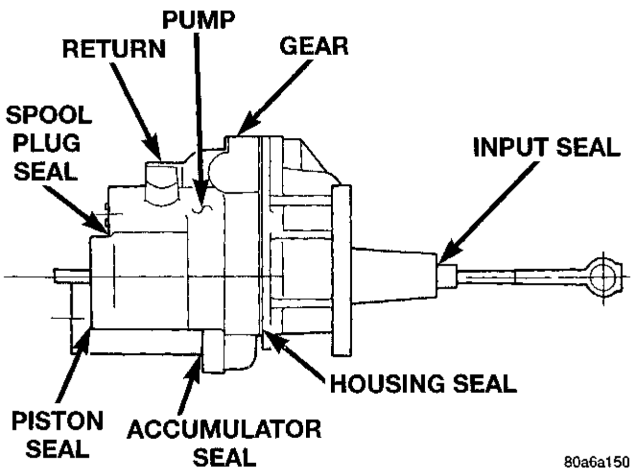

Fig. 9 Hydraulic Booster Seals

HEIGHT SENSING PROPORTIONING VALVE

The valve has a fixed split point when the vehicle is unloaded. The pressure is equal into and out of the valve up to the 150 psi. split point. After that the output pressure deceases on a .43 slope (Fig. 10). When the vehicle is loaded the actuator lever is moved upward, allowing full hydraulic pressure to the rear brakes. Hydraulic pressure into the valve is equal to the pressure coming out of the valve at all times.

COMBINATION VALVE

Pressure Differential Switch

(1) Have helper sit in drivers seat to apply brake pedal and observe red brake warning light.

(2) Raise vehicle on hoist.

(3) Connect bleed hose to a rear wheel cylinder and immerse hose end in container partially filled with brake fluid.

(4) Have helper press and hold brake pedal to floor and observe warning light.

HYDRAULIC BOOSTER DIAGNOSIS CHART

CONDITION	POSSIBLE CAUSES	CORRECTION
Slow Brake Pedal Return	1. Excessive seal friction in booster. 2. Faulty spool valve action. 3. Restriction in booster return hose. 4. Damaged input rod.	1. Replace booster. 2. Replace booster. 3. Replace hose. 4. Replace booster.
Excessive Brake Pedal Effort.	1. Internal or external seal leakage. 2. Faulty steering pump.	1. Replace booster. 2. Replace pump.
Brakes Self Apply	1. Dump valve faulty. 2. Contamination in hydraulic system. 3. Restriction in booster return hose.	1. Replace booster. 2. Flush hydraulic system and replace booster. 3. Replace hose.
Booster Chatter, Pedal Vibration	1. Slipping pump belt. 2. Low pump fluid level.	1. Replace power steering belt. 2. Fill pump and check for leaks.
Grabbing Brakes	1. Low pump flow. 2. Faulty spool valve action.	1. Test and repair/replace pump. 2. Replace booster.

(a) If warning light illuminates, switch is operating correctly.

(b) If light fails to illuminate, check circuit fuse, bulb, and wiring. The parking brake switch can be used to aid in identifying whether or not the brake light bulb and fuse is functional. Repair or replace parts as necessary and test differential pressure switch operation again.

(5) If warning light still does not illuminate, switch is faulty. Replace combination valve assembly, bleed brake system and verify proper switch and valve operation.

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DIAGNOSIS AND TESTING (Continued)

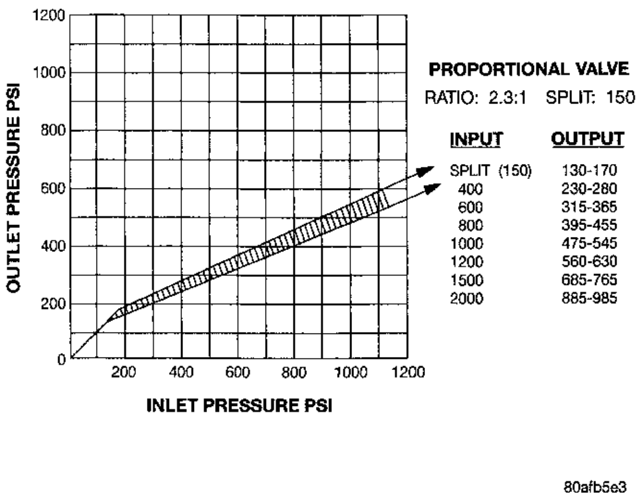

Fig. 10 Pressure Chart

DISC BRAKE ROTOR

The rotor braking surfaces should not be refinished unless necessary.

Light surface rust and scale can be removed with a lathe equipped with dual sanding discs. The rotor surfaces can be restored by machining in a disc brake lathe if surface scoring and wear are light.

Replace the rotor under the following conditions:

- severely scored
- tapered
- hard spots
- cracked
- below minimum thickness

ROTOR MINIMUM THICKNESS

Measure rotor thickness at the center of the brake shoe contact surface. Replace the rotor if worn below minimum thickness, or if machining would reduce thickness below the allowable minimum.

Rotor minimum thickness is usually specified on the rotor hub. The specification is either stamped or cast into the hub surface.

ROTOR RUNOUT

Check rotor lateral runout with dial indicator C-3339 (Fig. 11). Excessive lateral runout will cause brake pedal pulsation and rapid, uneven wear of the brake shoes. Position the dial indicator plunger approximately 25.4 mm (1 in.) inward from the rotor edge.

NOTE: Be sure wheel bearing has zero end play before checking rotor runout.

Maximum allowable rotor runout is 0.127 mm (0.005 in.).

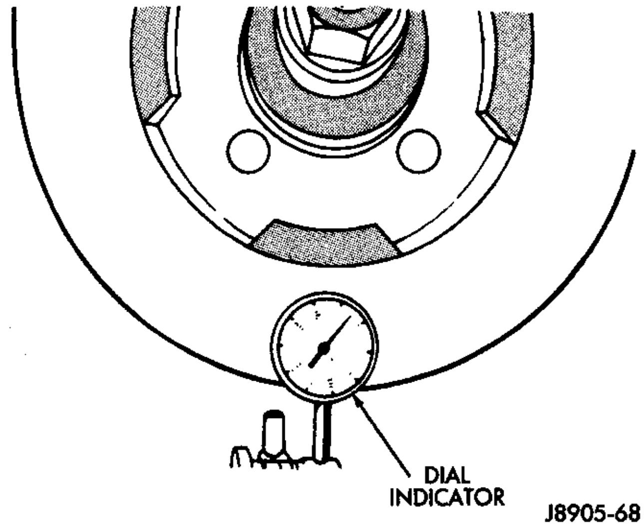

Fig. 11 Checking Rotor Runout And Thickness Variation

ROTOR THICKNESS VARIATION

Variations in rotor thickness will cause pedal pulsation, noise and shudder.

Measure rotor thickness at 6 to 12 points around the rotor face (Fig. 12).

Position the micrometer approximately 25.4 mm (1 in.) from the rotor outer circumference for each measurement.

Thickness should not **vary** by more than 0.025 mm (0.001 in.) from point-to-point on the rotor. Machine or replace the rotor if necessary.

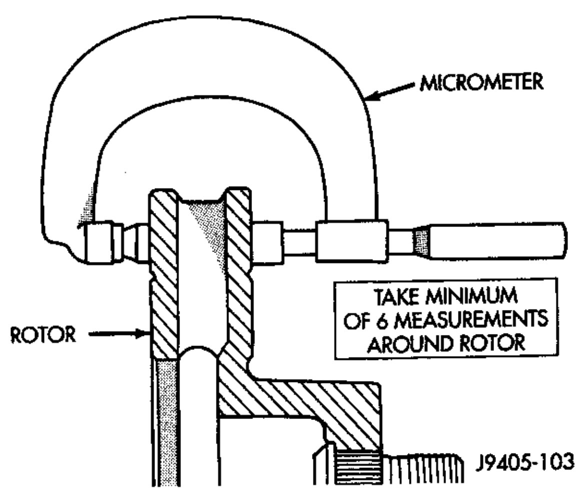

Fig. 12 Measuring Rotor Thickness

BRAKE DRUM

The maximum allowable diameter of the drum braking surface is stamped or cast into the drum outer edge. Generally, a drum can be machined to a maximum of 1.52 mm (0.060 in.) oversize. Always

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DIAGNOSIS AND TESTING (Continued)

replace the drum if machining would cause drum diameter to exceed the size limit indicated on the drum.

BRAKE DRUM RUNOUT

Measure drum diameter and runout with an accurate gauge. The most accurate method of measurement involves mounting the drum in a brake lathe and checking variation and runout with a dial indicator.

Variations in drum diameter should not exceed 0.076 mm (0.003 in.). Drum runout should not exceed 0.20 mm (0.008 in.) out of round. Machine the drum if runout or variation exceed these values. Replace the drum if machining causes the drum to exceed the maximum allowable diameter.

BRAKE LINE AND HOSES

Flexible rubber hose is used at both front brakes and at the rear axle junction block. Inspect the hoses whenever the brake system is serviced, at every engine oil change, or whenever the vehicle is in for service.

Inspect the hoses for surface cracking, scuffing, or worn spots. Replace any brake hose immediately if the fabric casing of the hose is exposed due to cracks or abrasions.

Also check brake hose installation. Faulty installation can result in kinked, twisted hoses, or contact with the wheels and tires or other chassis components. All of these conditions can lead to scuffing, cracking and eventual failure.

The steel brake lines should be inspected periodically for evidence of corrosion, twists, kinks, leaks, or other damage. Heavily corroded lines will eventually rust through causing leaks. In any case, corroded or damaged brake lines should be replaced.

Factory replacement brake lines and hoses are recommended to ensure quality, correct length and superior fatigue life. Care should be taken to make sure that brake line and hose mating surfaces are clean and free from nicks and burrs. Also remember that right and left brake hoses are not interchangeable.

Use new copper seal washers at all caliper connections. Be sure brake line connections are properly made (not cross threaded) and tightened to recommended torque.

BRAKE FLUID CONTAMINATION

Indications of fluid contamination are swollen or deteriorated rubber parts.

Swollen rubber parts indicate the presence of petroleum in the brake fluid.

To test for contamination, put a small amount of drained brake fluid in clear glass jar. If fluid separates into layers, there is mineral oil or other fluid contamination of the brake fluid.

If brake fluid is contaminated, drain and thoroughly flush system. Replace master cylinder, proportioning valve, caliper seals, wheel cylinder seals, Antilock Brakes hydraulic unit and all hydraulic fluid hoses.

SERVICE PROCEDURES

BRAKE FLUID LEVEL

Always clean the master cylinder reservoir and caps before checking fluid level. If not cleaned, dirt could enter the fluid.

The fluid fill level is indicated on the side of the master cylinder reservoir (Fig. 13).

The correct fluid level is to the FULL indicator on the side of the reservoir. If necessary, add fluid to the proper level.

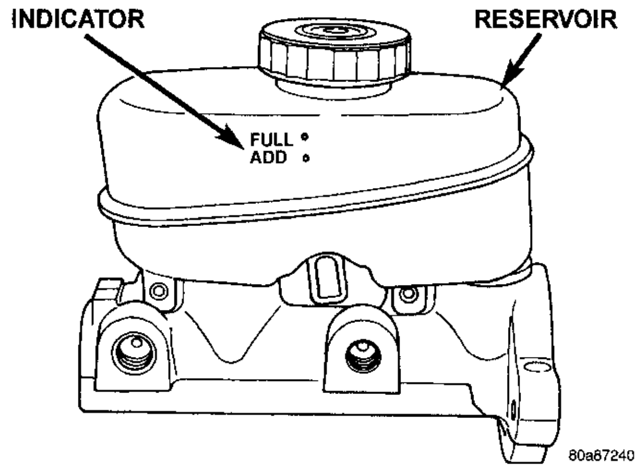

Fig. 13 Master Cylinder Fluid Level - Typical

FLUSHING HYDRAULIC BOOSTER

Flushing is required when the power steering/hydraulic booster system has become contaminated. Contaminated fluid in the booster system can cause seal deterioration and affect booster spool valve operation. Refer to Group 19 for flushing service procedure.

MASTER CYLINDER BLEEDING

A new master cylinder should be bled before installation on the vehicle. Required bleeding tools include bleed tubes and a wood dowel to stroke the pistons. Bleed tubes can be fabricated from brake line.

BLEEDING PROCEDURE

(1) Mount master cylinder in vise.

(2) Attach bleed tubes to cylinder outlet ports. Then position each tube end into reservoir (Fig. 14).

(3) Fill reservoir with fresh brake fluid.

(4) Press cylinder pistons inward with wood dowel. Then release pistons and allow them to return under

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SERVICE PROCEDURES (Continued)

spring pressure. Continue bleeding operations until air bubbles are no longer visible in fluid.

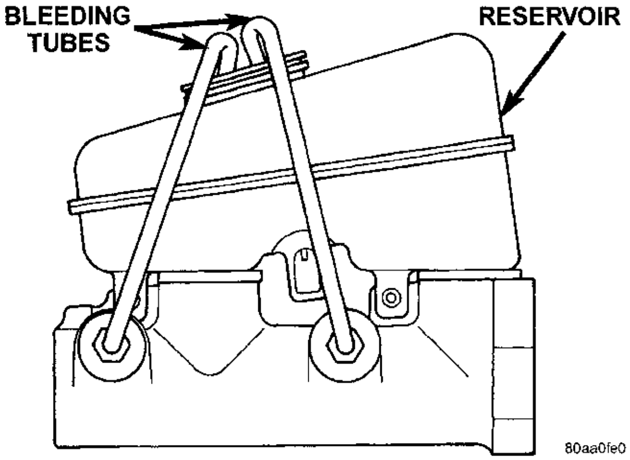

Fig. 14 Master Cylinder Bleeding–Typical

HYDRAULIC BOOSTER BLEEDING

The hydraulic booster is generally self-bleeding, this procedure will normally bleed the air from the booster. Normal driving and operation of the unit will remove any remaining trapped air.

BLEEDING

(1) Fill power steering pump reservoir.

(2) Disconnect fuel shutdown relay and crank the engine for several seconds. Refer to Group 14 Fuel System for relay location and WARNING.

(3) Check fluid level and add if necessary.

(4) Connect fuel shutdown relay and start the engine.

(5) Turn the steering wheel slowly from lock to lock twice.

(6) Stop the engine and discharge the accumulator by depressing the brake pedal 5 times.

(7) Start the engine and turn the steering wheel slowly from lock to lock twice.

(8) Turn off the engine and check fluid level and add if necessary.

NOTE: If fluid foaming occurs, wait for foam to dissipate and repeat steps 7 and 8.

BRAKE BLEEDING

Use Mopar brake fluid, or an equivalent quality fluid meeting SAE J1703-F and DOT 3 standards only. Use fresh, clean fluid from a sealed container at all times.

Do not pump the brake pedal at any time while bleeding. Air in the system will be compressed into small bubbles that are distributed throughout the hydraulic system. This will make additional bleeding operations necessary.

Do not allow the master cylinder to run out of fluid during bleed operations. An empty cylinder will allow additional air to be drawn into the system. Check the cylinder fluid level frequently and add fluid as needed.

Bleed only one brake component at a time in the following sequence:

- master cylinder
- combination valve
- right rear wheel
- left rear wheel
- right front wheel
- left front wheel

MANUAL BLEEDING

(1) Remove reservoir filler caps and fill reservoir with Mopar, or equivalent quality DOT 3 brake fluid.

(2) If calipers, or wheel cylinders were overhauled, open all caliper and wheel cylinder bleed screws. Then close each bleed screw as fluid starts to drip from it. Top off master cylinder reservoir once more before proceeding.

(3) Attach one end of bleed hose to bleed screw and insert opposite end in glass container partially filled with brake fluid (Fig. 15). Be sure end of bleed hose is immersed in fluid.

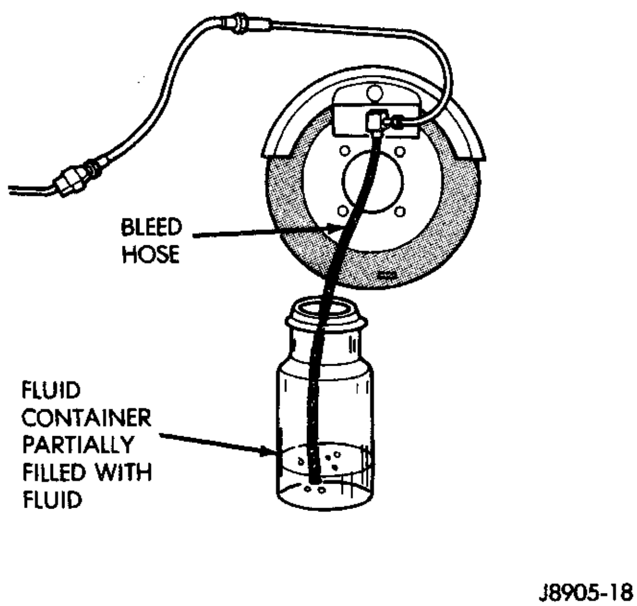

Fig. 15 Bleed Hose Setup

(4) Open up bleeder, then have a helper press down the brake pedal. Once the pedal is down close the bleeder. Repeat bleeding until fluid stream is clear and free of bubbles. Then move to the next wheel.

SERVICE PROCEDURES (Continued)

PRESSURE BLEEDING

Follow the manufacturers instructions carefully when using pressure equipment. Do not exceed the tank manufacturers pressure recommendations. Generally, a tank pressure of 15-20 psi is sufficient for bleeding.

Fill the bleeder tank with recommended fluid and purge air from the tank lines before bleeding.

Do not pressure bleed without a proper master cylinder adapter. The wrong adapter can lead to leakage, or drawing air back into the system. Use adapter provided with the equipment or Adapter 6921.

DISC ROTOR MACHINING

Rotor braking surfaces can be sanded or machined in a disc brake lathe.

The lathe must machine both sides of the rotor simultaneously with dual (two) cutter heads (Fig. 16). Equipment capable of machining only one side at a time will produce a tapered rotor.

The lathe should also be equipped with a grinder attachment or dual sanding discs for final cleanup or light refinishing (Fig. 17).

If the rotor surfaces only need minor cleanup of rust, scale, or minor scoring, use abrasive discs to clean up the rotor surfaces. However, when a rotor is scored or worn, machining with cutting tools will be required.

CAUTION: Do not machine the rotor if it will cause the rotor to fall below minimum allowable thickness.

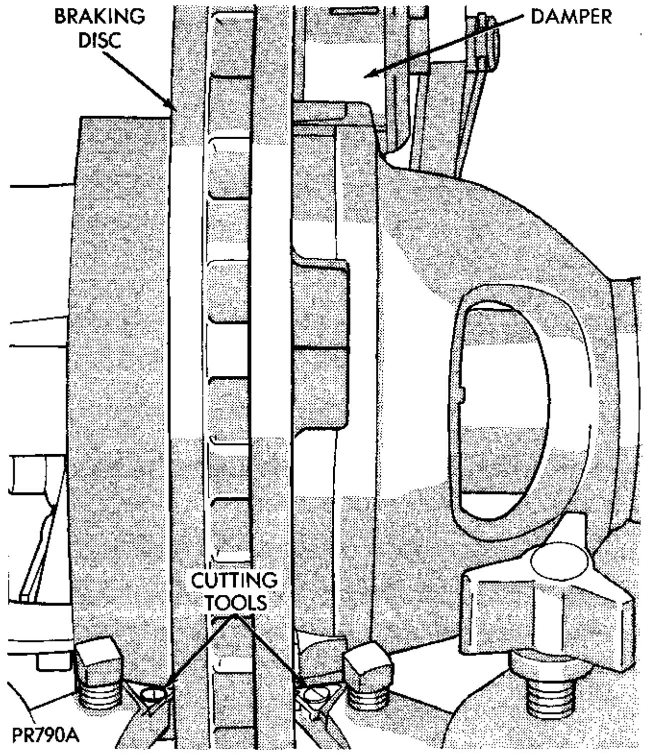

Fig. 16 Rotor Refinishing

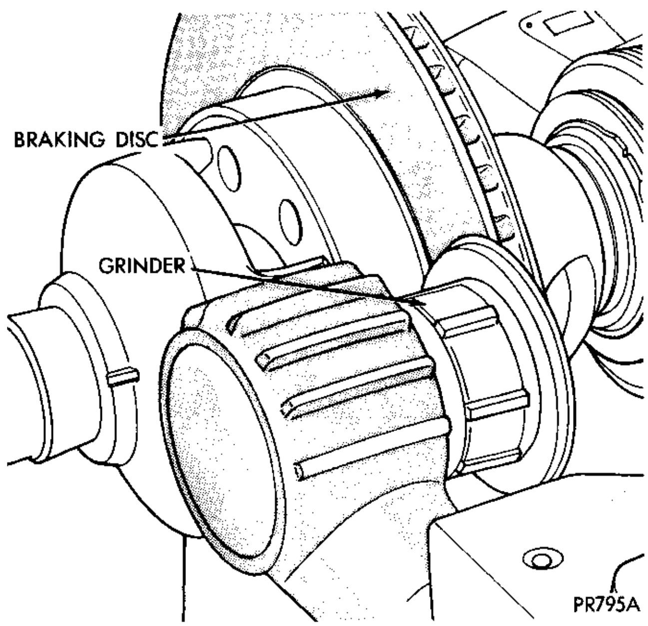

Fig. 17 Rotor Grinder

BRAKE DRUM MACHINING

The brake drums can be machined on a drum lathe when necessary. Initial machining cuts should be limited to 0.12 - 0.20 mm (0.005 - 0.008 in.) at a time as heavier feed rates can produce taper and surface variation. Final finish cuts of 0.025 to 0.038 mm (0.001 to 0.0015 in.) are recommended and will generally provide the best surface finish.

Be sure the drum is securely mounted in the lathe before machining operations. A damper strap should always be used around the drum to reduce vibration and avoid chatter marks.

The maximum allowable diameter of the drum braking surface is stamped or cast into the drum outer edge. Always replace the drum if machining would cause drum diameter to exceed the size limit indicated on the drum.

BRAKE LINE

Mopar preformed metal brake line is recommended and preferred for all repairs. However, double-wall steel line can be used for emergency repair when factory replacement parts are not readily available.

Special, heavy duty tube bending and flaring equipment is required to prepare double wall brake line. Special bending tools are needed to avoid kinking or twisting metal brake line. In addition, special flaring tools are needed to provide the inverted-type, double flare required on metal brake lines.

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SERVICE PROCEDURES (Continued)

FLARING PROCEDURE

(1) Cut off damaged tube with Tubing Cutter.

(2) Ream cut edges of tubing to ensure proper flare.

(3) Install replacement tube nut on section of tube to be repaired.

(4) Insert tube in flaring tool. Center tube in area between vertical posts.

(5) Place gauge form over the end of the tube.

(6) Push tubing through flaring tool jaws until tube contacts recessed notch in gauge that matches tube diameter.

(7) Squeeze flaring tool jaws to lock tubing in place.

(8) Insert plug on gauge in the tube. Then swing compression disc over gauge and center tapered flaring screw in recess of compression disc (Fig. 18).

(9) Tighten tool handle until plug gauge is seated on jaws of flaring tool. This will start the inverted flare.

(10) Remove the plug gauge and complete the inverted flare.

(11) Remove the flaring tools and verify that the inverted flare is correct.

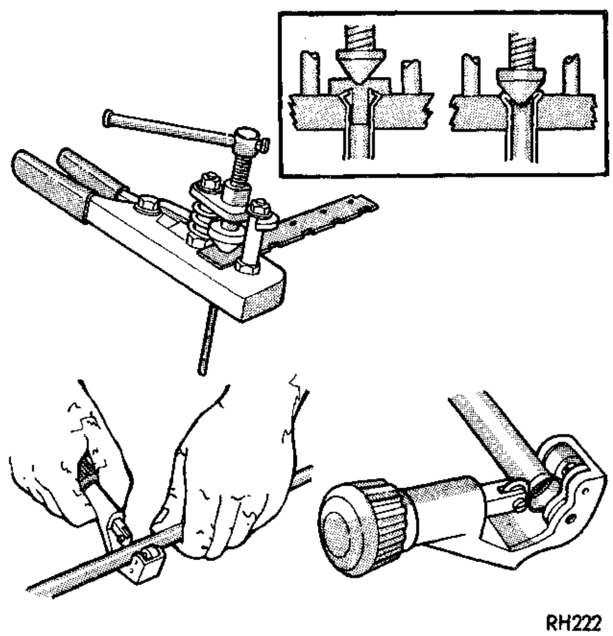

Fig. 18 Inverted Flare Tools

REMOVAL AND INSTALLATION

STOP LAMP SWITCH

REMOVAL

(1) Remove knee bolster for access to stop lamp switch and pedal.

(2) Disconnect switch harness (Fig. 19).

(3) Press and hold brake pedal in applied position.

(4) Rotate switch counterclockwise about 30° to align switch lock tab with notch in bracket.

(5) Pull switch rearward out of mounting bracket and release brake pedal.

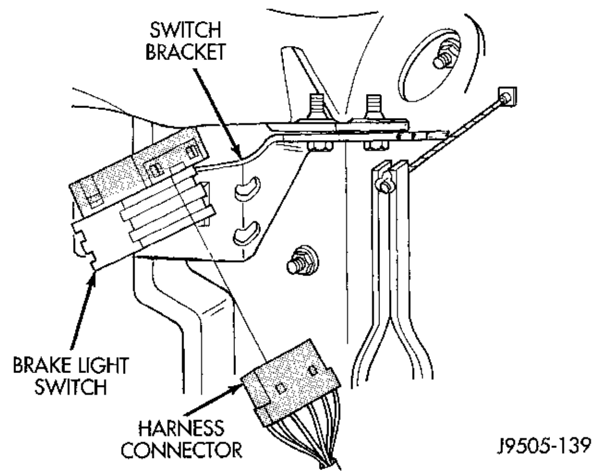

Fig. 19 Stop Lamp Switch & Harness Connector

INSTALLATION

(1) Pull switch plunger all the way out to fully extended position.

(2) Push switch plunger inward 4 detent positions (or clicks). This is required preset position for switch installation. Plunger will extend approximately 14 mm (0.55 in.) out of housing at this setting.

(3) Connect harness wires to switch.

(4) Press and hold brake pedal down.

(5) Install switch. Align tab on switch with notch in switch bracket (Fig. 20). Then insert switch in bracket and turn it clockwise about 30° to lock it in place.

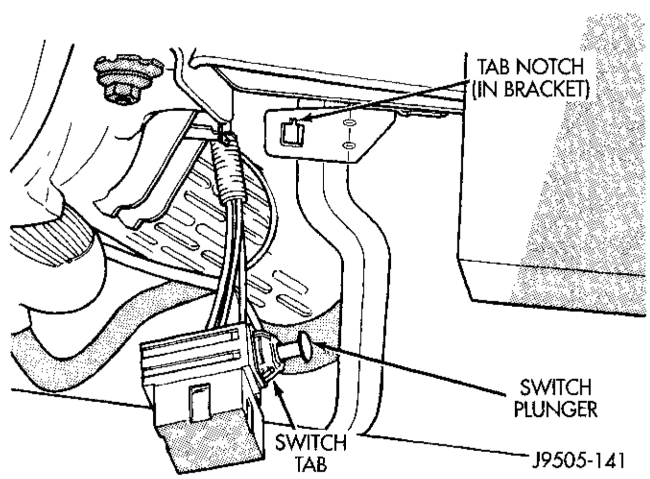

Fig. 20 Stop Lamp Switch

(6) Release brake pedal. Then lightly pull pedal fully rearward. Pedal will adjust switch plunger to correct position as pedal is moved to rear.

REMOVAL AND INSTALLATION (Continued)

CAUTION: Do not use excessive force to move the pedal rearward for switch adjustment. Excessive force will damage the switch.

BRAKE PEDAL

REMOVAL

(1) Remove knee bolster.
(2) Remove stop lamp switch.
(3) Remove switches from tabs on stop lamp switch bracket.
(4) Remove stop lamp switch bracket bolts and remove bracket (Fig. 21).

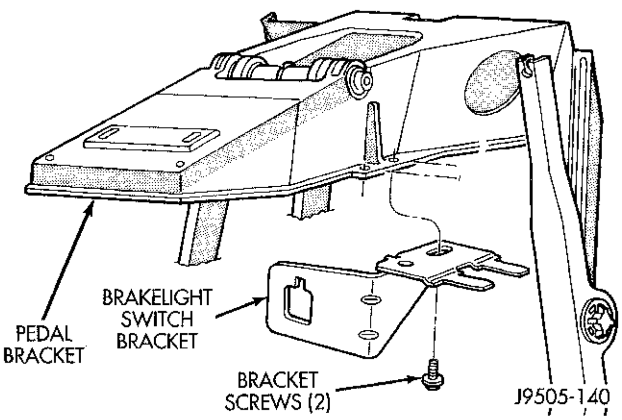

Fig. 21 Brake Lamp Switch Bracket

(5) Remove clip and washer attaching booster push rod and slide push rod off pedal.
(6) Remove E-clip from passenger side of pedal shaft (Fig. 22). Use flat blade screwdriver to pry clip out of shaft groove.
(7) Push shaft toward driver side of bracket just enough to expose opposite E-clip. Then remove E-clip with flat blade screwdriver.
(8) Push pedal shaft back and out of passenger side of bracket (Fig. 22).
(9) Remove pedal shaft, brake pedal, wave washer and bushings from vehicle.

INSTALLATION

(1) Replace bracket and pedal bushings if necessary. Lubricate shaft bores in bracket and pedal before installing bushings with Mopar Multi-mileage silicone grease.
(2) Apply liberal quantity of Mopar multi-mileage grease to pedal shaft and to pedal and bracket bushings.
(3) Position brake pedal in mounting bracket.
(4) Slide pedal shaft into bracket and through pedal from passenger side.

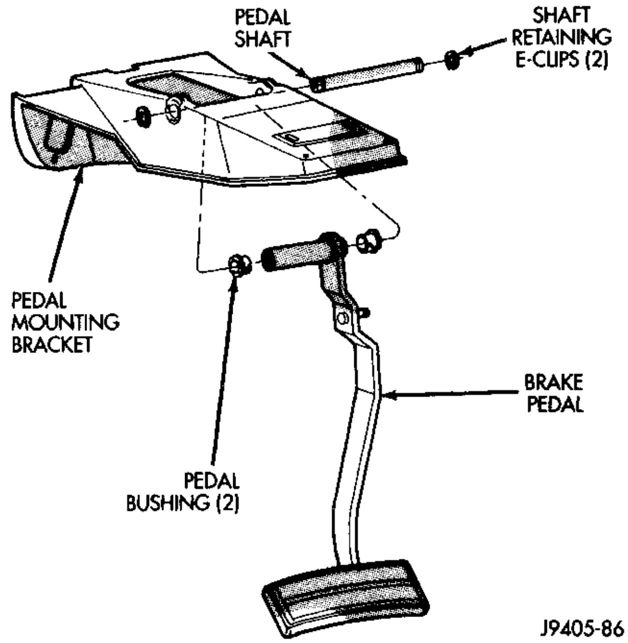

Fig. 22 Brake Pedal Mounting (With Automatic Transmission)

(5) Push pedal shaft out driver side of mounting bracket just enough to allow installation of retaining E-clip.
(6) Install the wave washer between the bracket and the pedal bushing on the passenger side.
(7) Push pedal shaft back toward passenger side of bracket and install remaining E-clip on pedal shaft.
(8) Install booster push rod on brake pedal. Secure push rod to pedal with washer and retaining clip.
(9) Install stop lamp switch bracket and switch.
(10) Install knee bolster.

COMBINATION VALVE

REMOVAL

(1) Remove pressure differential switch wire connector (Fig. 23) from the valve.
(2) Remove the brake lines from the valve.
(3) Remove the valve mounting bolt and remove the valve from the bracket.

INSTALLATION

(1) Position the valve on the bracket and install the mounting bolt. Tighten the mounting bolt to 23 N·m (210 in. lbs.).
(2) Install the brake lines into the valve and tighten to19-23 N·m (170-200 in. lbs.).
(3) Connect the pressure differential switch wire connector.
(4) Bleed the brake system.

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REMOVAL AND INSTALLATION (Continued)

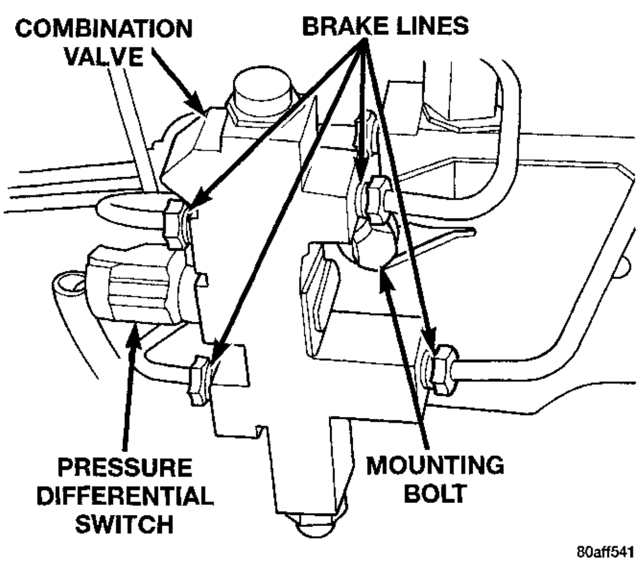

Fig. 23 Pressure Differential Switch

HEIGHT SENSING PROPORTIONING VALVE

REMOVAL

(1) Raise and support vehicle.
(2) Remove the link from the bracket (Fig. 24).
(3) Remove the link from the actuator lever (Fig. 25).
(4) Remove brake line and hose from the valve.
(5) Remove the two nuts from the frame mounting bracket and remove the valve assembly.

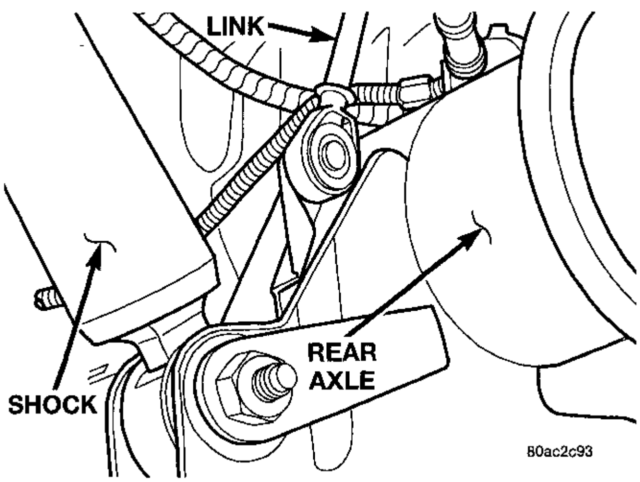

Fig. 24 Valve Link

INSTALLATION

(1) Install the valve assembly on the frame rail and tighten the mounting nut to 34 N·m (25 ft. lbs.).
(2) Install the brake line to the valve and tighten to 19 N·m (170 in. lbs.).
(3) Install the brake hose to the valve and tighten the bolt to 31 N·m (276 in. lbs.)

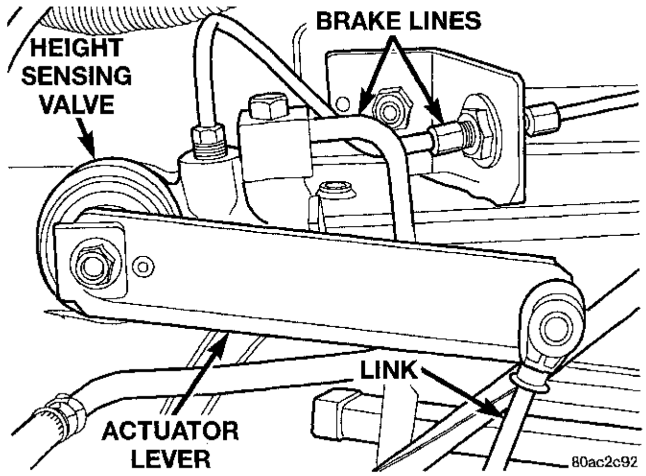

Fig. 25 Height Sensing Proportioning Valve

(4) Install the link to the actuator lever and bracket.
(5) Bleed rear brakes.
(6) Remove support and lower the vehicle.

MASTER CYLINDER

REMOVAL

(1) Remove brake lines from the master cylinder (Fig. 26).
(2) Remove mounting nut from the master cylinder (Fig. 26).
(3) Remove master cylinder.

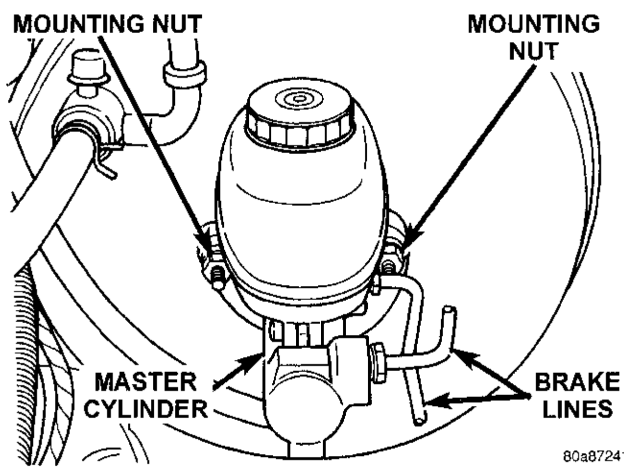

Fig. 26 Master Cylinder

INSTALLATION

NOTE: If master cylinder is replaced, bleed the cylinder before installation.

(1) Install master cylinder on booster mounting studs.
(2) Install mounting nuts and tighten to 28 N·m (21 ft. lbs.).

REMOVAL AND INSTALLATION (Continued)

(3) Install brake lines and tighten to 19-23 N·m (170-200 in. lbs.).

(4) Fill and bleed brake system.

VACUUM BRAKE BOOSTER

REMOVAL

(1) Remove the brake lines from the master cylinder.

(2) Remove nuts attaching the master cylinder to the booster studs. Then remove master cylinder.

(3) Disconnect vacuum hose at booster check valve.

(4) Remove knee bolster for access to brake pedal.

(5) Remove clip and washer securing booster push rod to brake pedal and slid rod off pedal (Fig. 27).

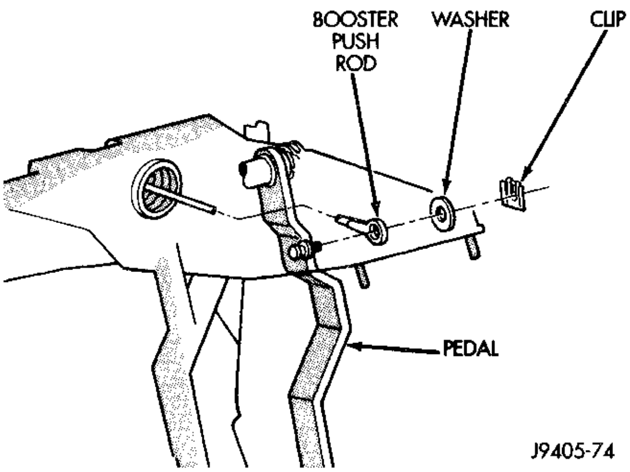

Fig. 27 Booster Push Rod

(6) Remove nuts attaching booster mounting studs to dash panel and pedal mounting bracket and remove booster (Fig. 28).

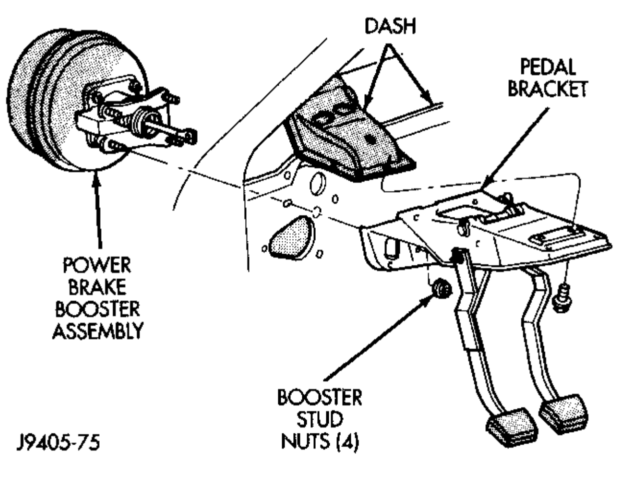

Fig. 28 Booster Mounting

INSTALLATION

(1) Position booster on engine compartment dash panel.

(2) Install and tighten booster mounting stud nuts to 28 N·m (21 ft. lbs.).

(3) Connect booster push rod to brake pedal.

(4) Install knee bolster.

(5) Connect vacuum hose to booster check valve.

(6) Install master cylinder on the booster and tighten mounting nuts to 28 N·m (21 ft. lbs.).

(7) Install the brake lines to master cylinder. Tighten brake line to 19-200 N·m (170-200 in. lbs.).

(8) Fill and bleed the brake system.

HYDRAULIC BOOSTER

WARNING: THE ACCUMULATOR CONTAINS HIGH PRESSURE GAS. DO NOT CARRY THE BOOSTER BY THE ACCUMULATOR OR DROP THE UNIT ON THE ACCUMULATOR.

REMOVAL

NOTE: If the booster is being replaced because the power steering fluid is contaminated, flush the power steering system before replacing the booster.

(1) With engine off depress the brake pedal several times to discharge the accumulator.

(2) Remove the brake lines from the master cylinder.

(3) Remove master cylinder mounting nuts.

(4) Remove the bracket from the hydraulic booster lines and master cylinder mounting studs.

(5) Remove the master cylinder.

(6) Remove the return hose and the two pressure lines from the hydraulic booster (Fig. 29).

(7) Remove the booster push rod clip, washer and rod remove from the brake pedal. (Fig. 30).

(8) Remove the mounting nuts from the hydraulic booster and remove the booster (Fig. 31).

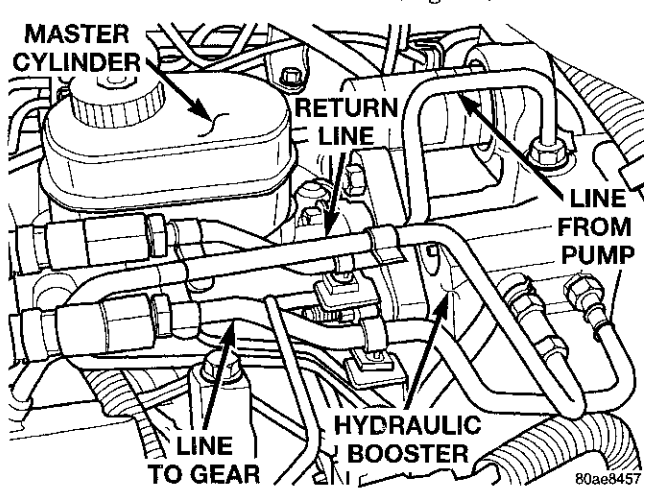

Fig. 29 Master Cylinder And Booster

REMOVAL AND INSTALLATION (Continued)

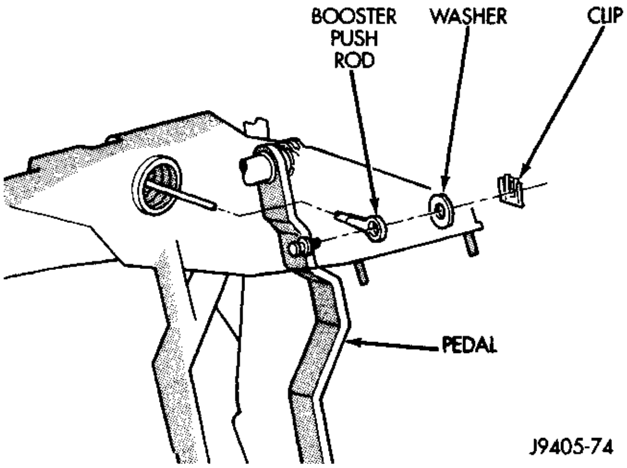

Fig. 30 Booster Push Rod

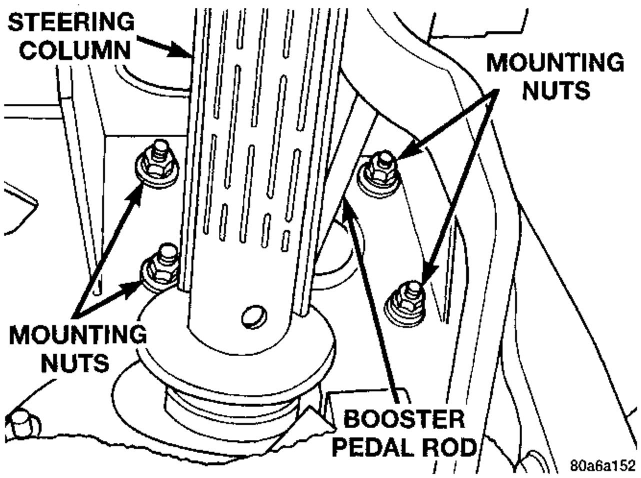

Fig. 31 Booster Mounting

INSTALLATION

(1) Install the hydraulic booster and tighten the mounting nuts to 28 N·m (21 ft. lbs.).

(2) Install the booster push rod, washer and clip onto the brake pedal.

(3) Install the master cylinder on the mounting studs. and tighten the mounting nuts to 28 N·m (21 ft. lbs.).

(4) Install the brake lines to the master cyclinder and tighten to 19-200 N·m (170-200 in. lbs.).

(5) Install the hydraulic booster line bracket onto the master cylinder mounting studs.

(6) Install the master cylinder mounting nuts and tighten to 28 N·m (21 ft. lbs.).

(7) Install the hydraulic booster pressure lines to the bracket and booster.

(8) Tighten the pressure lines to 28 N·m (21 ft. lbs.).

NOTE: Inspect o-rings on the pressure line fittings to insure they are in good condition before installation. Replace o-rings if necessary.

(9) Install the return hose to the booster.

(10) Fill and bleed the brake system.

(11) Fill the power steering pump with fluid.

CAUTION: Use only MOPAR power steering fluid or equivalent. Do not use automatic transmission fluid and do not overfill.

(12) Bleed the hydraulic booster.

DISC BRAKE CALIPER

REMOVAL

(1) Raise vehicle.

(2) Remove wheel and tire assemblies.

(3) Press caliper piston back into bore with large flat blade screwdriver (Fig. 32). Use large C-clamp to bottom piston in bore if additional force is required.

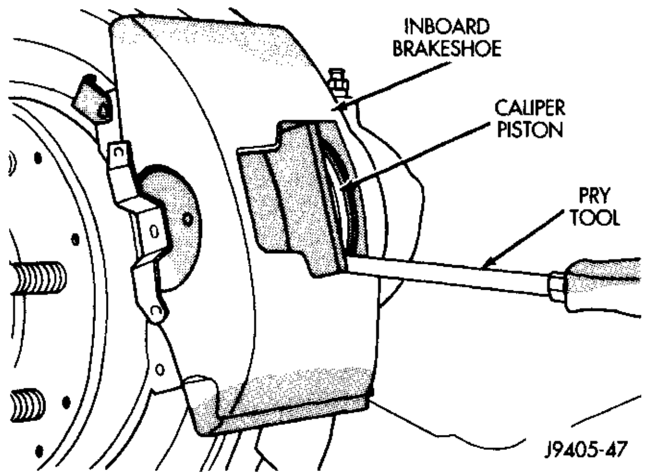

Fig. 32 Pressing Caliper Piston Into Bore

(4) Remove caliper mounting bolts with 3/8 hex wrench or socket (Fig. 33) and (Fig. 34).

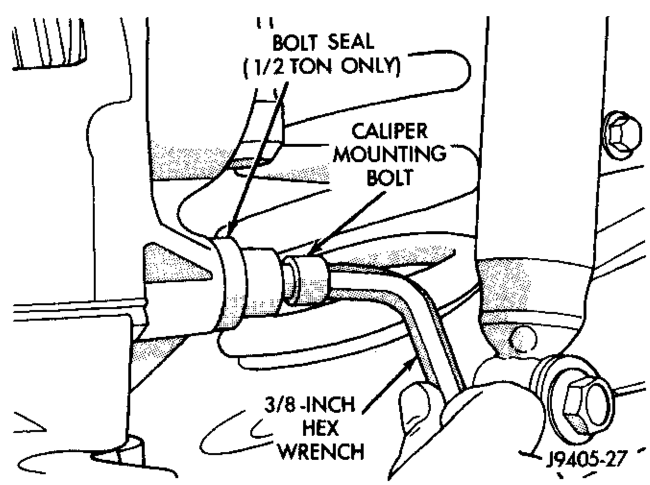

Fig. 33 Caliper Mounting Bolt (1/2 Ton)

REMOVAL AND INSTALLATION (Continued)

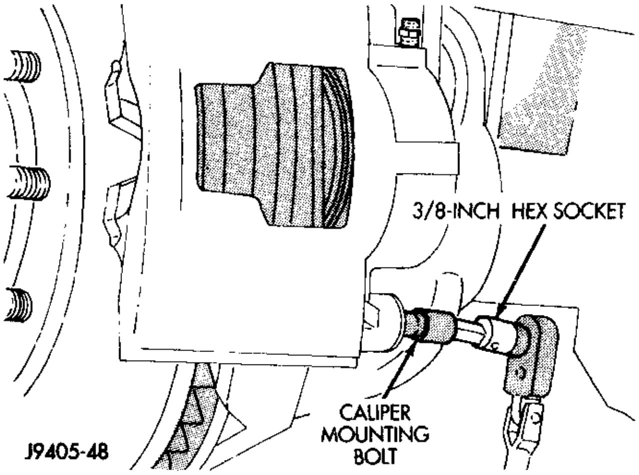

Fig. 34 Caliper Mounting Bolt (3/4 and 1 Ton)

(5) Rotate caliper rearward off rotor and out of steering knuckle support ledges (Fig. 35).

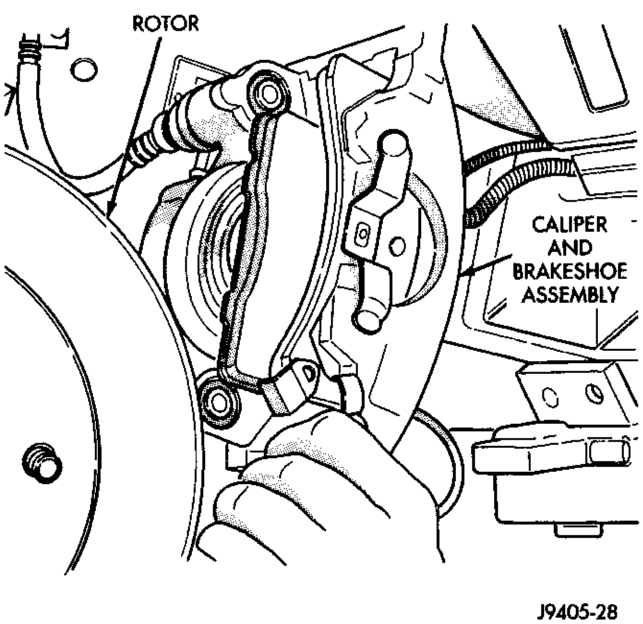

Fig. 35 Caliper Removal/Installation

(6) Remove front brake hose fitting bolt completely and remove caliper and brake shoes as assembly.

(7) Cover open end of front brake hose fitting to prevent dirt entry.

INSTALLATION

(1) Clean caliper and steering knuckle slide surfaces with wire brush. Then apply coat of silicone grease to slide surfaces.

(2) Install caliper over rotor and seat it on steering knuckle mounting arms.

(3) Start caliper mounting bolts by hand to avoid cross threading. Then tighten mounting bolts to 51 N·m (38 ft. lbs.).

(4) Connect brake hose to caliper (Fig. 36) and (Fig. 37). **Inure brake hose fitting is correctly seated against locating shoulder on caliper and hose is not twisted, or kinked before tightening fitting bolt.**

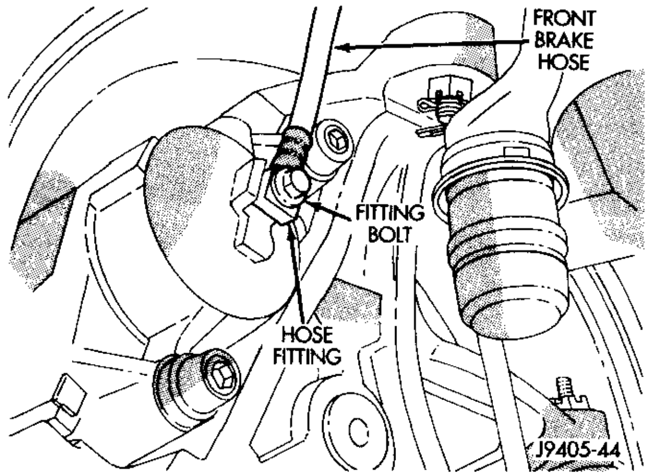

Fig. 36 Front Brake Hose Attachment

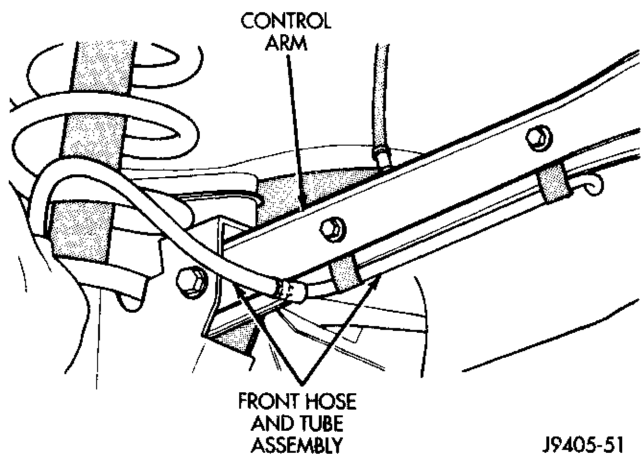

Fig. 37 Front Brake Hose Routing (4WD)

(5) Fill and bleed brake system. Refer to procedure in appropriate antilock brake section.

(6) Install wheel and tire assemblies and lower vehicle.

DISC BRAKE SHOES

REMOVAL

(1) Raise and support vehicle.

(2) Remove wheel and tire assemblies.

(3) Press caliper piston back into bore with large flat blade screwdriver. Use large C-clamp if more force is required to bottom piston in bore.

(4) Loosen bolt that secures front brake hose fitting bolt in caliper.

REMOVAL AND INSTALLATION (Continued)

(5) Remove caliper mounting bolts with 3/8 hex wrench or socket.

(6) Rotate caliper rearward off rotor and out of steering knuckle support ledges.

(7) Remove inboard and outboard brake shoes (Fig. 38) and (Fig. 39). Inboard shoe has spring clip that holds it in caliper piston. Tilt this shoe out at top to unseat clip. Outboard shoe has retaining spring that secures it in caliper. Unseat one spring end and rotate shoe out of caliper.

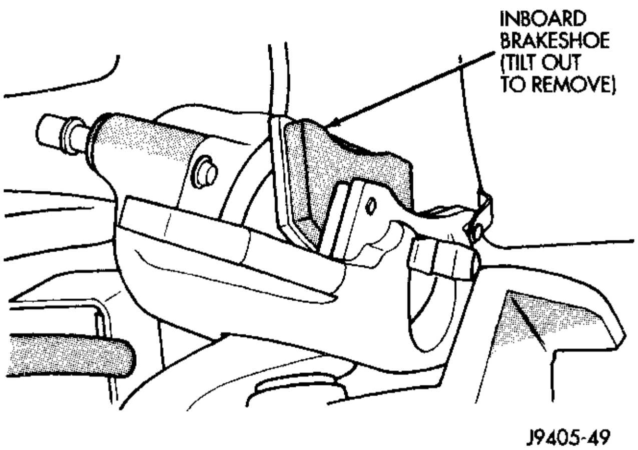

Fig. 38 Inboard Brake Shoe Removal

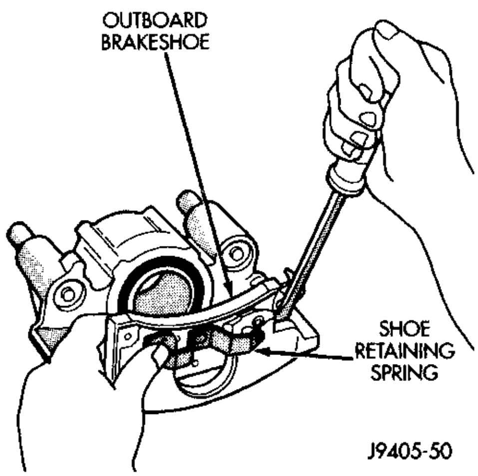

Fig. 39 Outboard Brake Shoe Removal

(8) Secure caliper to convenient chassis or suspension component with wire.

CAUTION: Do not allow the brake hose to support the caliper. Suspending the caliper by the brake hose can damage the hose and fitting joints. Use wire to support and secure the caliper to a chassis or suspension component.

If the brake shoes will be reused, do not intermix them. Keep the brake shoes with the caliper they were removed from.

INSTALLATION

NOTE: Replace riveted lining if worn to within 1.5 mm (1/16 in.) of rivet heads. Replace bonded lining if thickness is 3 mm (3/16 in.) or less.

(1) Clean caliper and steering knuckle slide surfaces with wire brush (Fig. 40). Then apply coat of Mopar multi-mileage grease to slide surfaces.

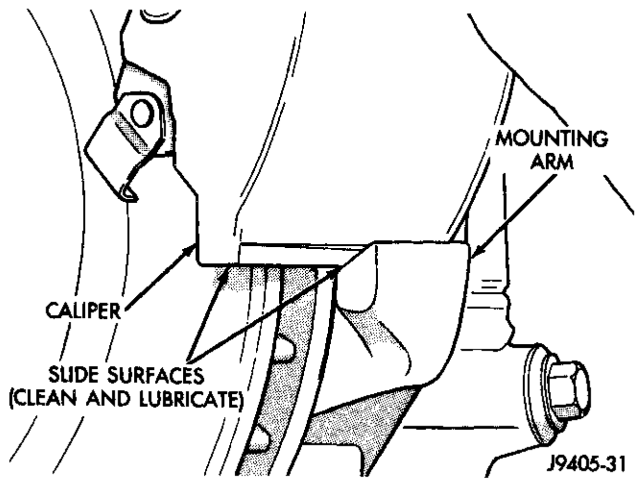

Fig. 40 Caliper And Steering Knuckle Slide Surfaces

(2) Lubricate caliper mounting bolts, collars, bushings and bores with silicone grease as follows:

- 1/2 ton models with 75 mm caliper, apply silicone grease to mounting pins and collars. Then fill space between bushings in caliper (Fig. 41).

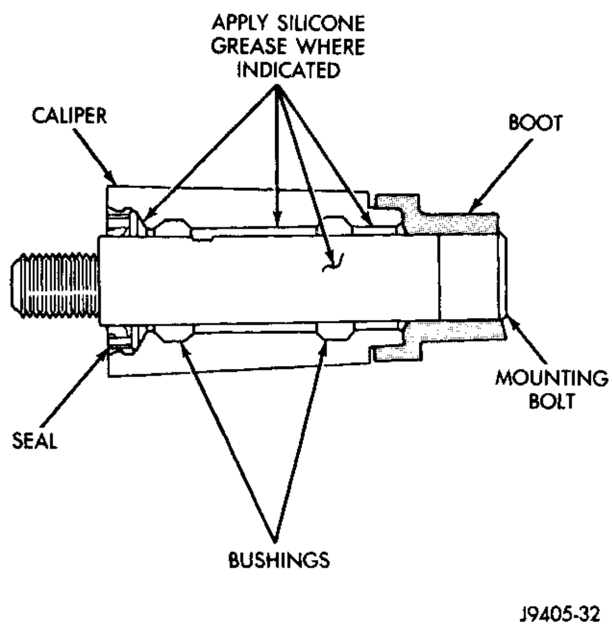

Fig. 41 Mounting Bolt Lubrication (75mm Caliper)

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REMOVAL AND INSTALLATION (Continued)

• 3/4 and 1 ton models with 80 or 86 mm calipers, coat mounting pin and interior of bushing with silicone grease (Fig. 42).

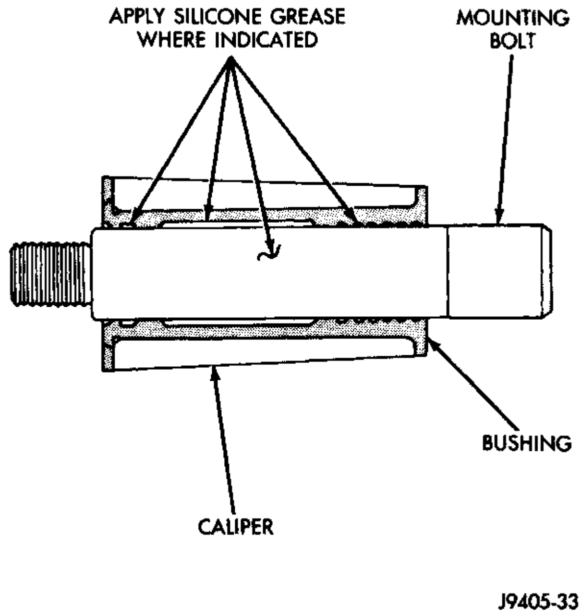

Fig. 42 Mounting Bolt Lubrication (80 or 86mm Caliper)

(3) Install inboard brake shoe in caliper. Be sure spring clip on shoe is properly aligned and seated in caliper piston (Fig. 43).

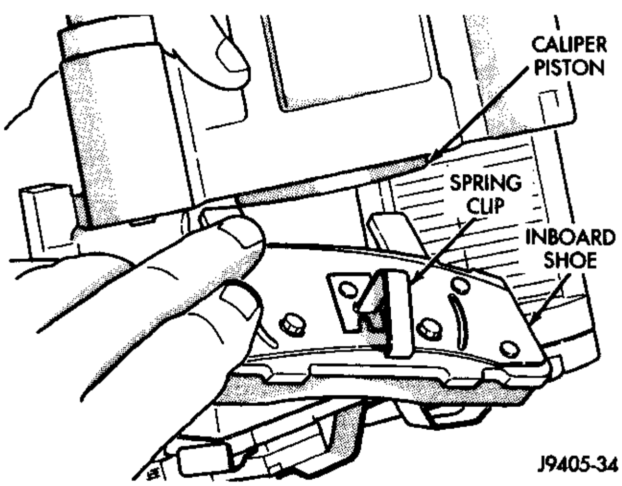

Fig. 43 Inboard Brake Shoe Installation

(4) Install outboard brake shoe in caliper. Be sure spring ends are seated in dimples in caliper (Fig. 44).

(5) Install caliper over rotor and into steering knuckle mounting arms (Fig. 45). **Be sure caliper is seated flush on mounting arm surfaces as shown.**

(6) Start caliper mounting bolts by hand to avoid cross threading. Then tighten mounting bolts to 51 N·m (38 ft.lbs.) torque.

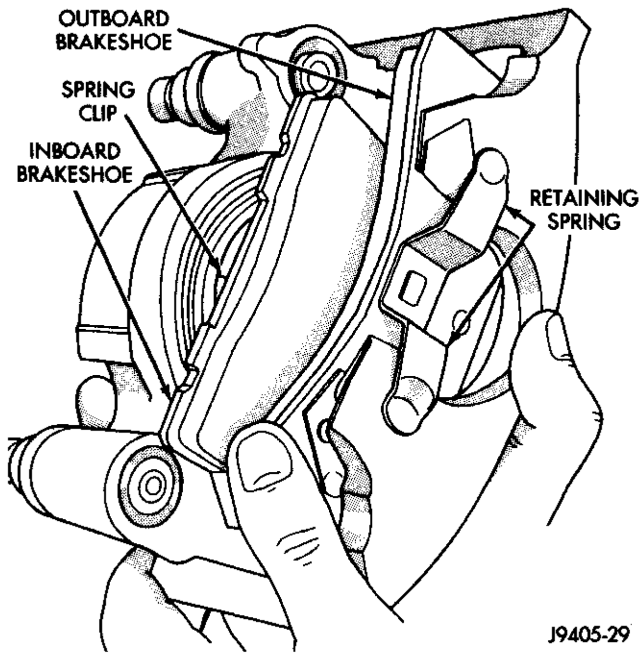

Fig. 44 Brake Shoe Position In Caliper

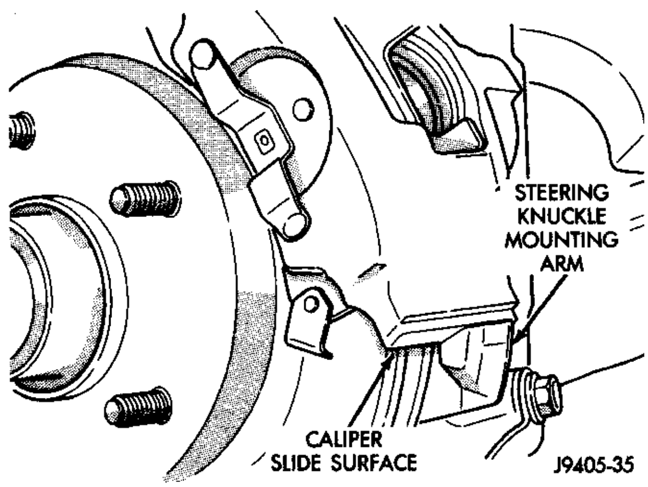

Fig. 45 Caliper Installation

(7) Install wheel and tire assemblies.

(8) Pump brake pedal to reseat caliper pistons and brake shoes. **Do not move vehicle until shoes have been properly seated.**

(9) Check brake fluid level and add fluid if necessary.

DISC BRAKE ROTOR – WITH TAPERED BEARINGS

REMOVAL

(1) Raise vehicle.
(2) Remove wheel and tire assembly.
(3) Remove caliper from rotor.
(4) Remove hub extension if equipped.

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REMOVAL AND INSTALLATION (Continued)

(5) Remove grease cap that covers cotter pin and hub nut.

(6) Remove cotter pin from spindle and wheel bearing adjusting nut (Fig. 46).

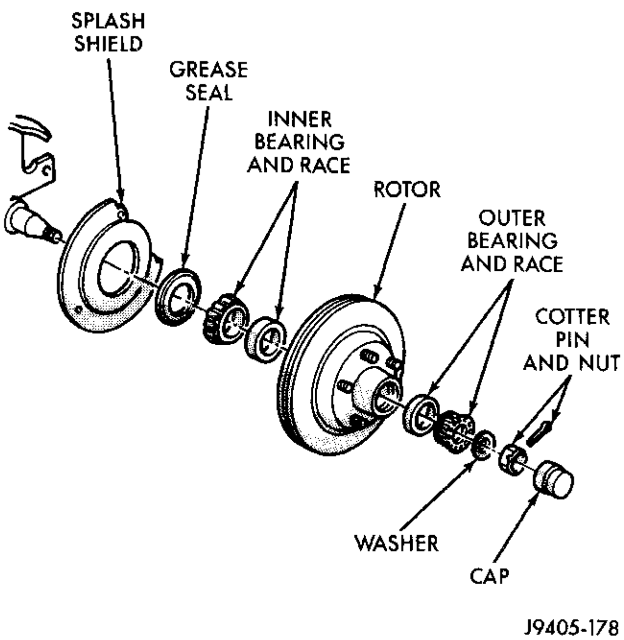

Fig. 46 Rotor And Hub Assembly (With Tapered Bearings)

(7) Remove locknut from wheel bearing adjusting nut. Then remove thrust washer and outer wheel bearing.

(8) Remove rotor and hub assembly from spindle.

(9) Inspect wheel bearings and interior of hub. If bearings need repacking, remove grease seal and inner wheel bearing from rotor hub.

INSTALLATION

(1) Repack wheel bearings with Mopar high temperature bearing grease. Apply grease to bearing races as well. Then install inner bearing in hub and install new grease seal.

(2) Apply liberal coat of bearing grease to spindle, interior of rotor hub, grease seal lip and seal surface of spindle.

(3) Install rotor and hub assembly on spindle.

(4) Install outer wheel bearing thrust washer and bearing adjusting nut. Tighten nut only enough to remove end play at this time.

(5) Install disc brake caliper. **Do not seat caliper pistons at this time. Pistons must not be seated until after wheel bearing adjustment has been completed.**

(6) Install wheel and tire assembly. Tighten wheel nuts snug but not to final torque at this time.

(7) Adjust wheel bearings by rotate wheel and fully tighten bearing adjusting nut to seat bearings. Loosen and tighten bearing adjusting nut once again while rotating wheel.

(8) Continue rotating wheel and back off adjusting nut until wheel end play is no more than 0.025 to 0.051 mm (0.001 to 0.002 in.).

(9) Install nut lock on adjusting nut and install new cotter pin. Adjusting nut can be tightened slightly to align cotter pin holes if necessary. Verify that wheel bearing adjustment is still OK.

(10) Install grease cap and wheel cover/hub cap.

(11) Install hub extension if equipped.

(12) Tighten lug nuts to proper torque.

DISC BRAKE ROTOR WITH 5 STUDS AND HUB BEARINGS

REMOVAL

(1) Raise and support vehicle.

(2) Remove wheel and tire assembly.

(3) Remove brake caliper.

(4) Remove rotor from hub bearing.

INSTALLATION

(1) Install rotor on hub bearing.

(2) Install brake caliper

(3) Install wheel and tire assemblies.

(4) Remove support and lower vehicle.

(5) Apply brakes several times to seat brake shoes and caliper piston. Do not move vehicle until firm brake pedal is obtained.

DISC BRAKE ROTOR WITH 8 STUDS AND HUB/BEARING

REMOVAL

(1) Raise and support vehicle.

(2) Remove wheel and tire assembly.

(3) Remove hub extension mounting nuts and remove the extension from the rotor if equipped (Fig. 47).

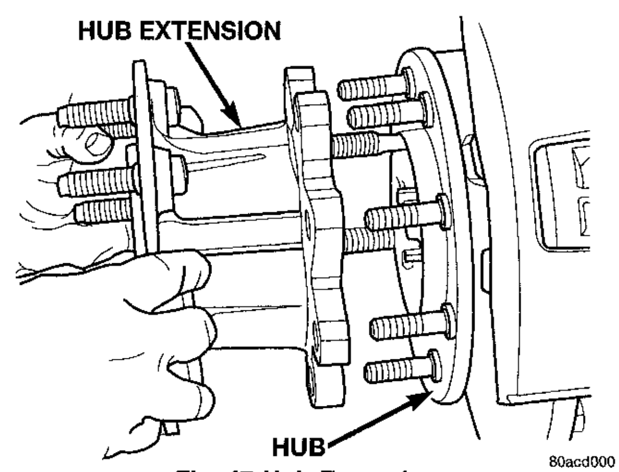

Fig. 47 Hub Extension

(4) Remove brake caliper.

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REMOVAL AND INSTALLATION (Continued)

(5) Remove the cotter pin and hub nut from the axle shaft (Fig. 48).

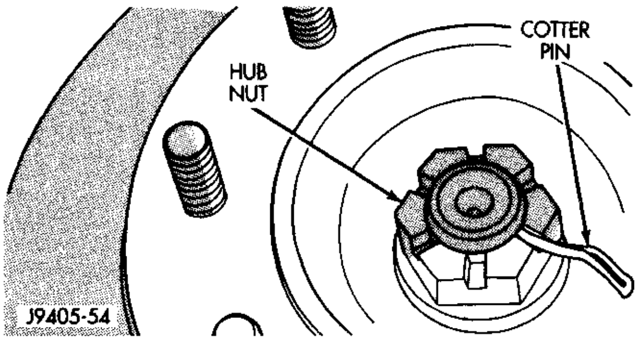

Fig. 48 Hub Nut Cotter Pin

(6) Disconnect the ABS wheel speed sensor wire from under the hood. Remove sensor wire from the frame and steering knuckle.

(7) Remove hub/bearing mounting bolts from inboard side of steering knuckle (Fig. 49).

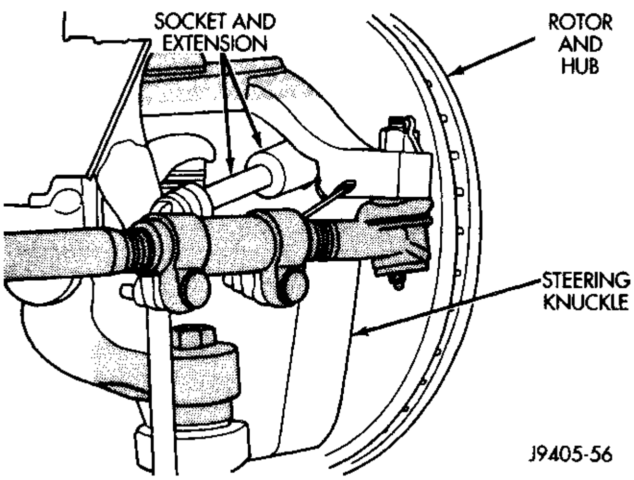

Fig. 49 Hub/Bearing Mounting Bolts

(8) Remove rotor hub/bearing assembly (Fig. 50), brake shield and spacer from the steering knuckle.

NOTE: If rotor hub assembly will not come out of the knuckle, use Puller C-844 with extra Puller Leg C-884-1 (Fig. 51) to remove the remove the assembly.

(9) Press out the wheel studs/hub extension studs and separate the rotor from the hub (Fig. 52).

INSTALLATION

(1) Position rotor on the hub/bearing.

(2) Press wheel studs/hub extension studs through the back side of the rotor and through the hub/bearing flange (Fig. 53).

(3) Apply liberal quantity of anti-seize compound to splines of front drive shaft.

(4) Insert two rearmost, top and bottom rotor hub bolts in steering knuckle. Insert bolts through back

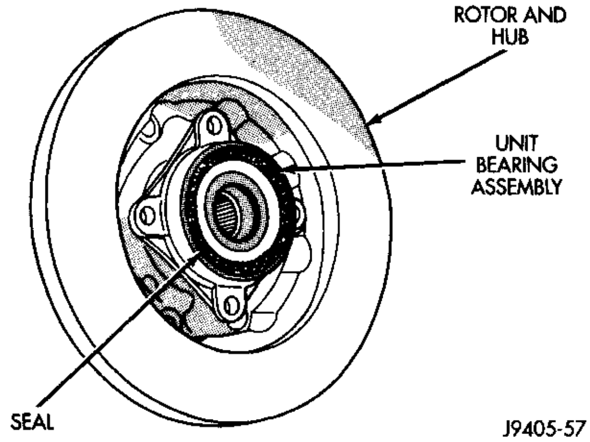

Fig. 50 Rotor Hub/Bearing Assembly

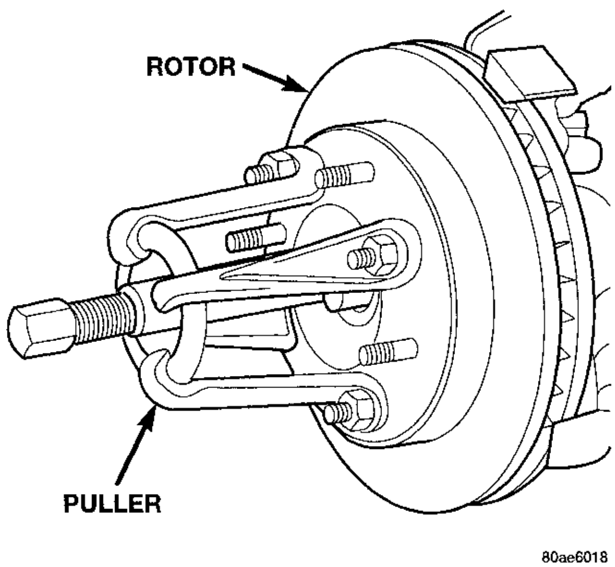

Fig. 51 Rotor Hub/Bearing Removal

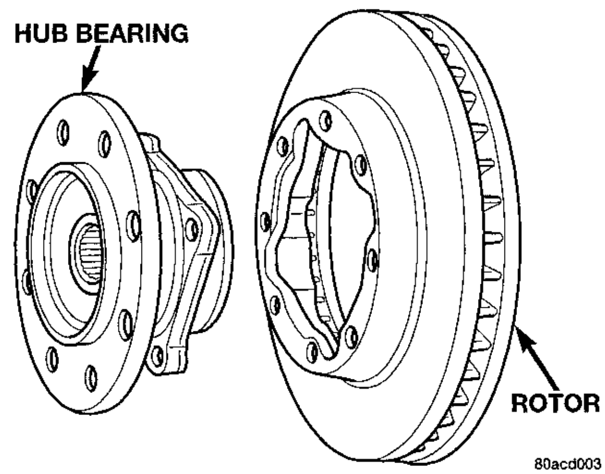

Fig. 52 Rotor And Hub/Bearing

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REMOVAL AND INSTALLATION (Continued)

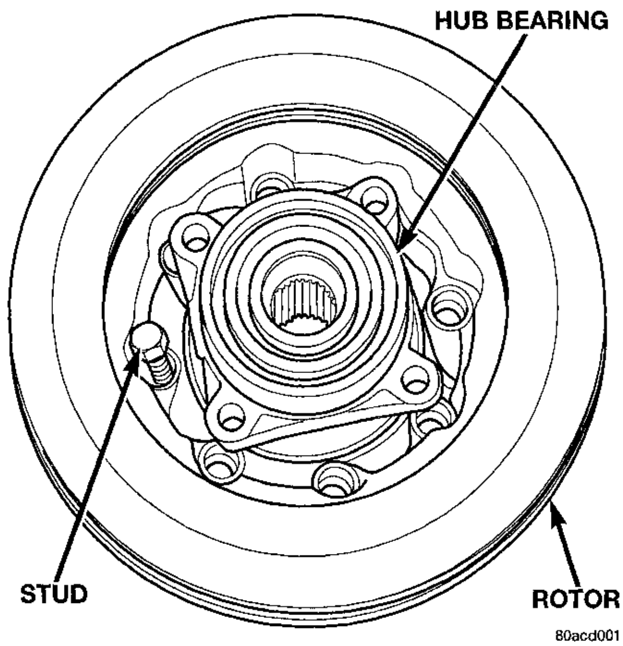

Fig. 53 Rotor, Hub/Bearing And Stud

side of knuckle so they extend out front face as shown.

(5) Position hub spacer (Fig. 54) and brake shield (Fig. 55) on bolts just installed in knuckle.

NOTE: If the vehicle is equipped with a wheel speed sensor the brake shield must be positioned on the hub bearing (Fig. 56).

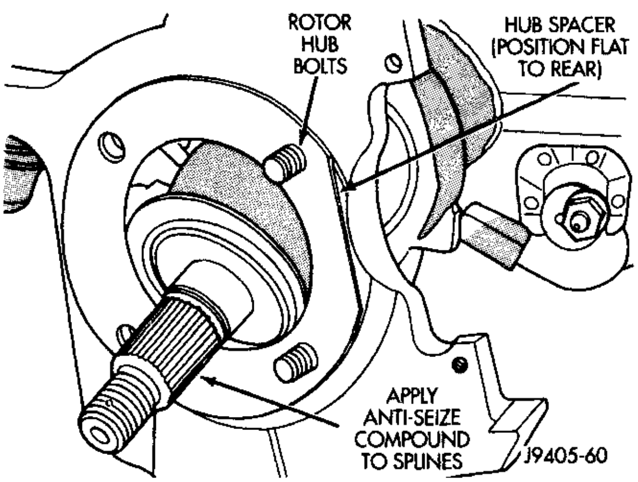

Fig. 54 Hub Spacer

(6) Align rotor hub with drive shaft and start shaft into rotor hub splines.

NOTE: Position wheel speed sensor wire at the top of the knuckle if equipped.

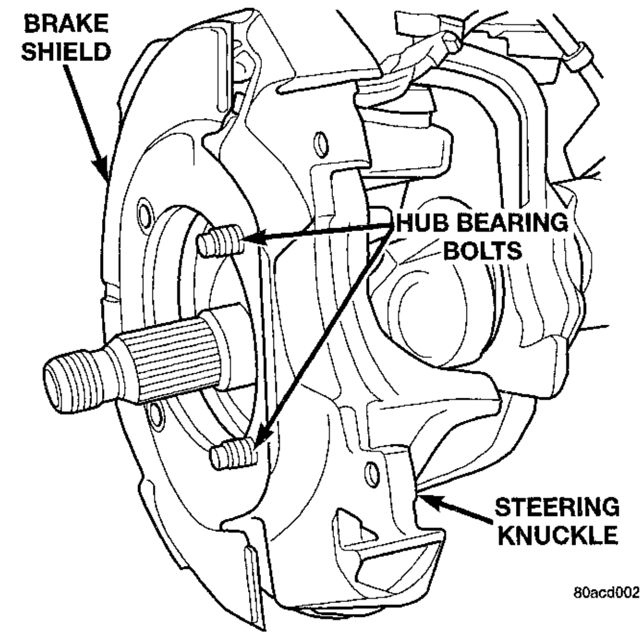

Fig. 55 Brake Shield

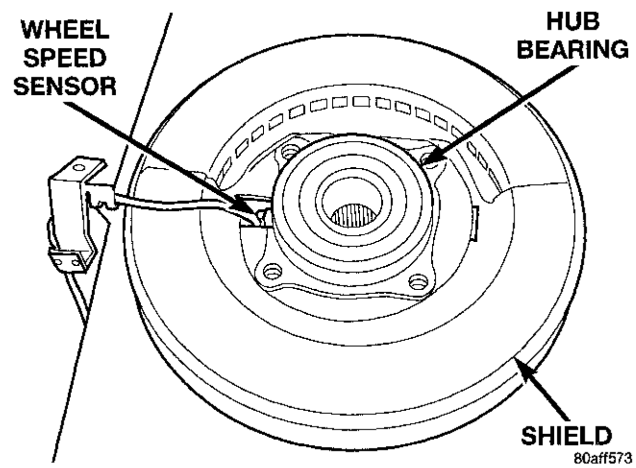

Fig. 56 Brake Shield With Wheel Speed Sensor

(7) Align bolt holes in hub/bearing flange with bolts installed in knuckle. Then thread bolts into bearing flange far enough to hold assembly in place.

(8) Install remaining bolts. Tighten hub/bearing bolts to 170 N·m (125 ft. lbs.).

(9) Install washer and hub nut and tighten to 237 N·m (175 ft. lbs.).

(10) Install new cotter pin in hub nut. Tighten nut as needed to align cotter pin hole in shaft with opening in nut.

(11) Install brake caliper.

(12) Install sensor wire to the steering knuckle and frame if equipped. Connect the wheel speed sensor wire under the hood.

(13) Install wheel and tire assemblies.

(14) Remove support and lower the vehicle.

REMOVAL AND INSTALLATION (Continued)

(15) Apply brakes several times to seat brake shoes and caliper piston. Do not move vehicle until firm brake pedal is obtained.

FRONT WHEEL BEARING

On models with tapered roller front wheel bearings, the bearings and races can be serviced when necessary. The bearing races do not require special tools for removal. The race can be removed with a long tapered brass drift. Race installation is performed with a bearing race driver set.

On vehicles with unit style hub bearings the unit is a bolted to the knuckle. 2500 and 3500 model vehicles with unit style hub bearing have the disc brake rotor pressed onto the unit with the wheel studs. The wheel studs must be pressed or driven out in order to separate the rotor from the hub bearing for replacement.

BRAKE SHOES - 11 INCH BRAKE

REMOVAL

(1) Raise vehicle.
(2) Remove rear wheels.
(3) Remove brake drums.

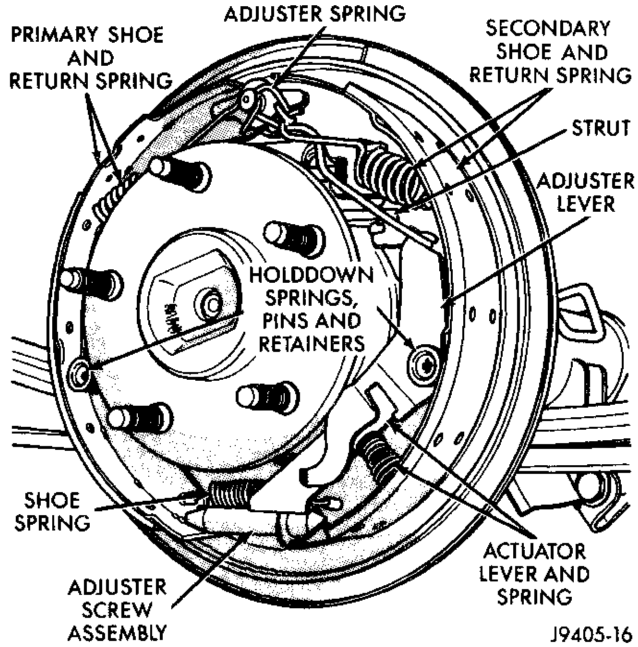

Fig. 57 Brake Shoe Mounting

(4) Remove primary (front) brake shoe return spring (Fig. 57) and (Fig. 58). Use brake spring pliers to unseat and remove spring from anchor pin.

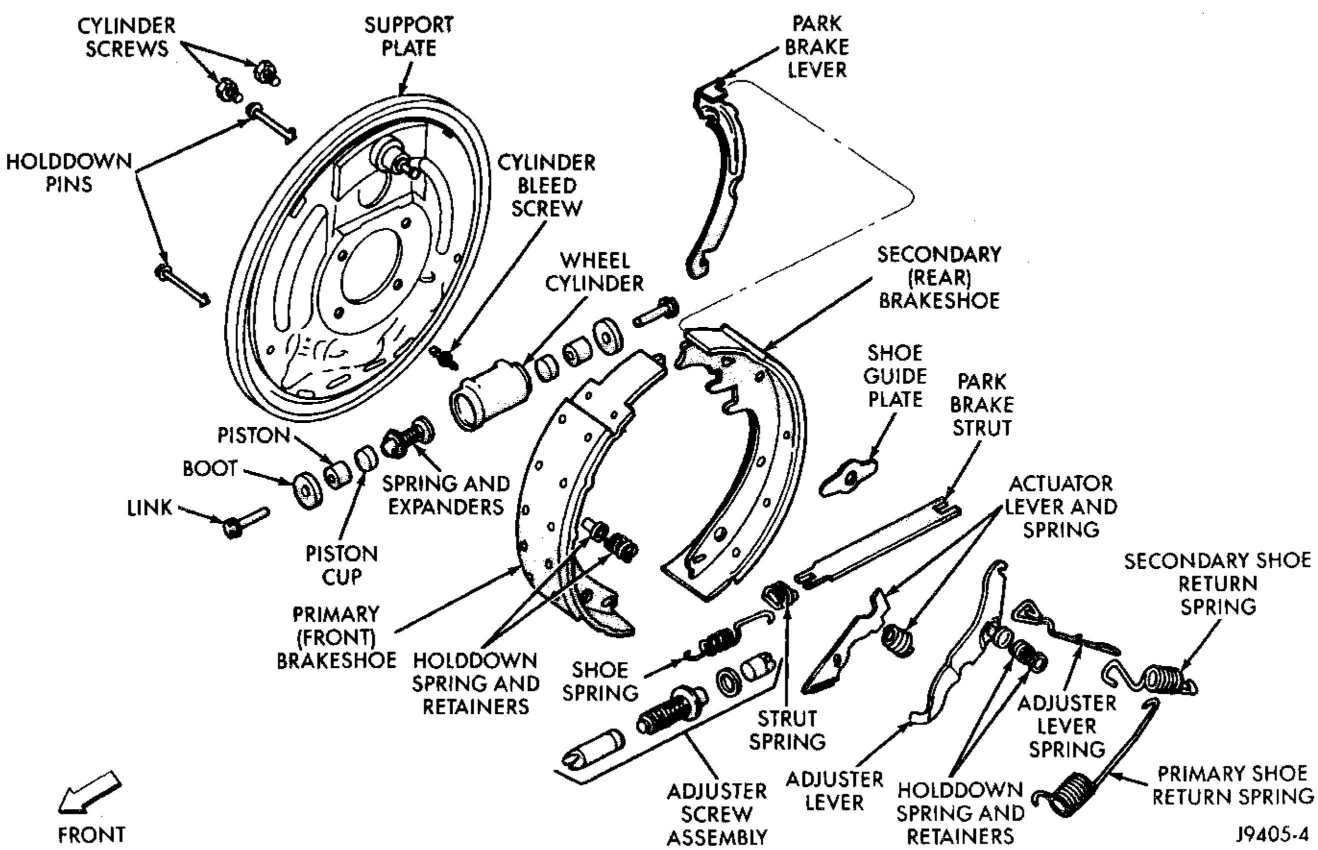

Fig. 58 Brake Shoes and Hardware

REMOVAL AND INSTALLATION (Continued)

(5) Remove primary shoe hold-down spring, pin and retainers. Use brake spring tool to rotate retainers and disengage pins.

(6) Tilt primary brake shoe outward. Then disengage shoe spring and remove primary brake shoe.

(7) Remove adjuster screw, shoe spring and park brake strut and spring.

CAUTION: The driver side adjuster screw has a right hand thread. The passenger side adjuster screw has a left hand thread. Do not interchange them as the brake shoes will not adjust properly.

(8) Remove secondary brake shoe hold-down spring, pin and retainers.

(9) Pull adjuster lever and retainer out of secondary brake shoe. Then rotate brake shoe out and up and remove adjuster spring and secondary shoe return spring.

(10) Disconnect park brake cable from lever on secondary brake shoe. Then remove brake shoe.

(11) If brake shoes are to be replaced, remove E-clip (or U-clip) that attaches park brake lever to secondary brake shoe and remove lever.

INSTALLATION

(1) Clean support plate with brake cleaner. Then smooth shoe contact pads with wire brush or emery cloth.

(2) Apply coat of high temperature bearing grease to each shoe contact pad on support plate (Fig. 59).

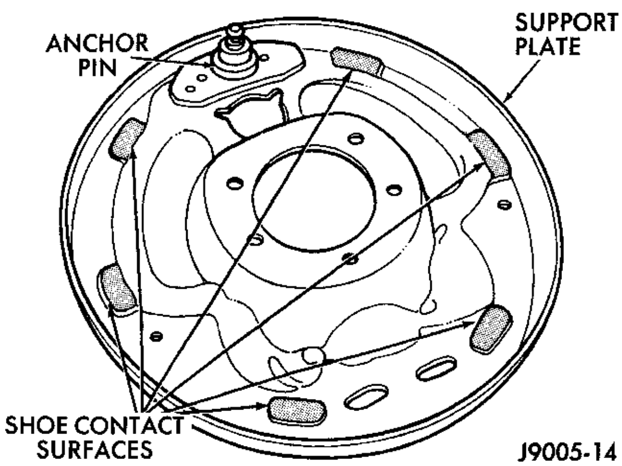

Fig. 59 Typical Brake Shoe Contact Pad Locations

(3) Lubricate adjuster levers and anchor pin and shoe contact surfaces on support plate with high temperature bearing grease.

(4) Clean and check operation of adjuster screw assemblies. Make sure each screw assembly rotates freely. Lubricate screw threads with spray lube. Replace either assembly if threads are heavily rusted, corroded, or damaged.

(5) Attach park brake lever to secondary brake shoe. use new U-clip to secure lever to shoe. If U-clip is used to secure shoe, pinch clip together with channel lock pliers to secure it. If E-clip is used, be sure clip is fully seated in notch.

(6) Attach park brake cable to lever.

(7) Position adjuster lever on secondary brake shoe. Then install spring retainer with shoulder on in lever and into shoe.

(8) Position secondary brake shoe on support plate. Use new hold-down spring, pin and retainer to secure shoe and adjuster lever.

(9) Attach shoe spring to secondary brake shoe. Connect long end of spring in secondary shoe.

(10) Engage parking brake strut in secondary brake shoe and install oval shaped spring on opposite end of strut (spring end of strut goes in primary shoe).

(11) Install primary brake shoe on support plate. Use new hold-down spring, pin and retainers to secure shoe. Be sure parking brake strut is seated in both brake shoes.

(12) Install actuator lever and spring. Hook actuator lever under adjuster lever as shown. Large diameter end of spring goes on shoe and small end on lever.

(13) Install adjuster screw assembly. Be sure star wheel is positioned adjacent to adjuster lever and that notches in buttons are properly seated on brake shoes.

CAUTION: Be sure the adjuster screws are installed on the correct side. The driver side adjuster screw has right hand threads and the passenger side has left hand threads. Also be sure the short end of the screw is toward the secondary brake shoe.

(14) Attach shoe spring to primary brake shoe.

(15) Install guide plate on anchor pin.

(16) Attach adjuster spring to adjuster lever.

(17) Install secondary brake shoe return spring in shoe.

(18) Attach secondary shoe return spring to adjuster spring. Then install adjuster spring on anchor pin.

(19) Install primary brake shoe return spring.

(20) Verify that adjuster and return springs are properly installed.

(21) Adjust brake shoes to drum with brake gauge.

(22) Install brake drum and wheel and tire assemblies.

(23) Lower vehicle.

REMOVAL AND INSTALLATION (Continued)

BRAKE SHOES – 13 INCH BRAKE

REMOVAL

(1) Raise vehicle.

(2) Remove rear wheel and tire assemblies.

(3) Remove brake drums.

(4) Remove primary (front) brake shoe return spring from anchor pin with brake spring pliers (Fig. 60).

(5) Remove primary brake shoe hold-down spring, pin and retainers with hold-down spring tool.

(6) Disconnect shoe spring and remove primary brake shoe and parking brake lever strut.

(7) Remove adjuster screw assembly.

(8) Remove secondary brake shoe hold-down spring, pin and retainers. Then remove adjuster lever, spring and spring retainer assembly. It is not necessary to disassemble adjuster lever components unless they are worn, or damaged.

(9) Disconnect parking brake cable from lever attached to secondary brake shoe. Then remove brake shoe.

(10) If brake shoes are to be replaced, remove E-clip attaching parking brake lever to secondary brake shoe and remove lever.

(11) Inspect wheel cylinder. If leakage is evident, remove and overhaul cylinder. Refer to overhaul procedure in this section.

INSTALLATION

(1) Clean support plate with brake cleaner. Then smooth shoe contact pads with wire brush or emery cloth.

(2) Lubricate adjuster levers and anchor pin and shoe contact surfaces on support plate with high temperature bearing grease.

(3) Clean and check operation of both adjuster screw assemblies. Replace either assembly if threads are heavily rusted, corroded, or damaged. Make sure each screw assembly rotates freely. Then lubricate adjuster screw threads with spray lube.

(4) Attach parking brake lever to secondary brake shoe. Use new E-clip to secure lever to shoe. If lever is secured with U-clip, pinch new clip together with channel lock pliers to secure it.

(5) Attach parking brake cable to parking brake lever.

(6) If adjuster lever was disassembled, reassemble it as follows:

(a) Clamp adjuster lever in vise (Fig. 61). **Clamp center portion of lever in vise only. Do not clamp bottom end of lever in vise. Lever**

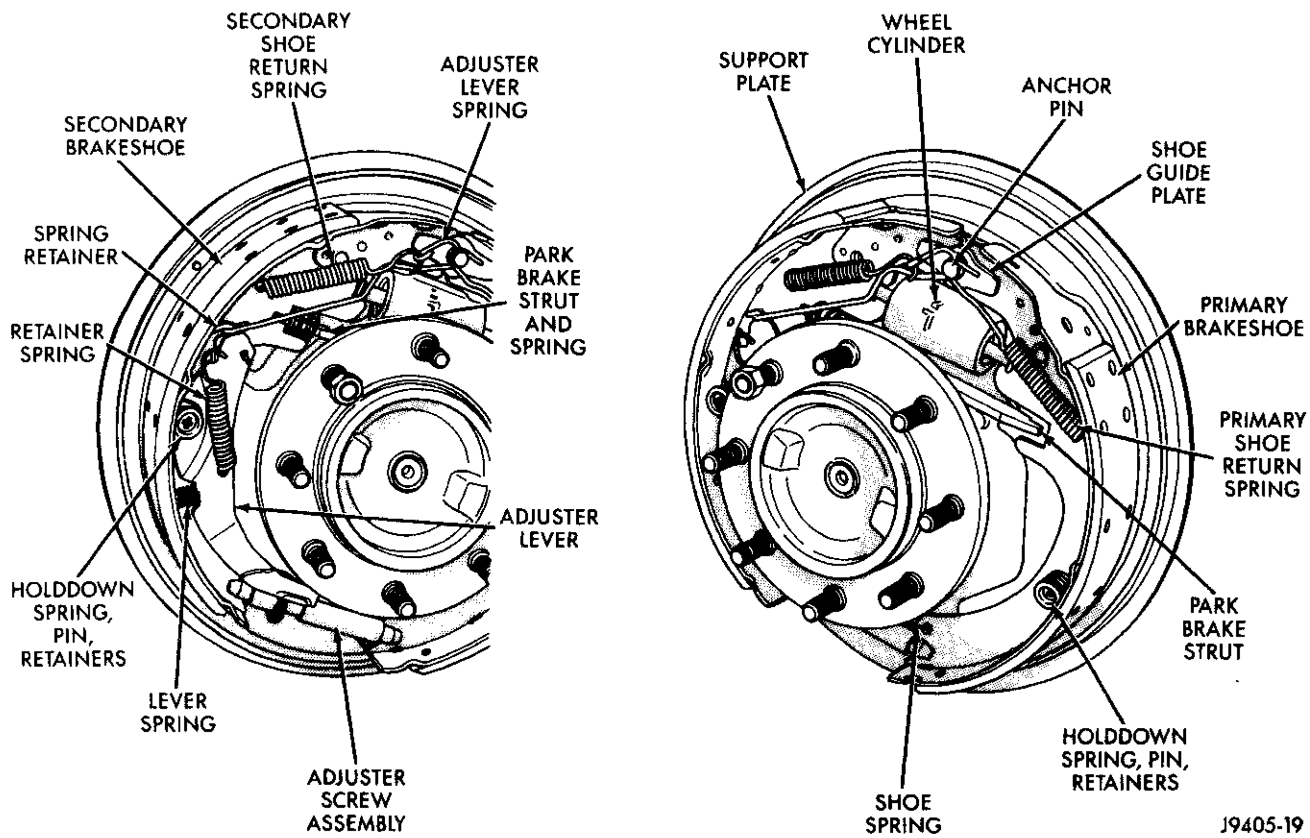

Fig. 60 Brake Shoes and Hardware (13 Inch Brake)

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REMOVAL AND INSTALLATION (Continued)

flange that rotates adjuster screw star wheel teeth is at bottom of lever and will be damaged.

(b) Position small, hooked spring retainer in upper end of lever (Fig. 61). Be sure tang on retainer is securely engaged in hole in lever. Locking pliers can be used to hold retainer in place after positioning.

(c) Secure retainer in lever with retainer spring. Hook spring over end of retainer as shown (Fig. 62). Needlenose pliers and number 2 Phillips screwdriver can be used to attach spring to lever and retainer.

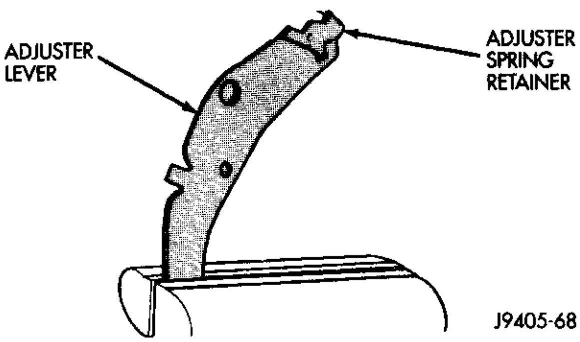

Fig. 61 Positioning Retainer On Adjuster Lever

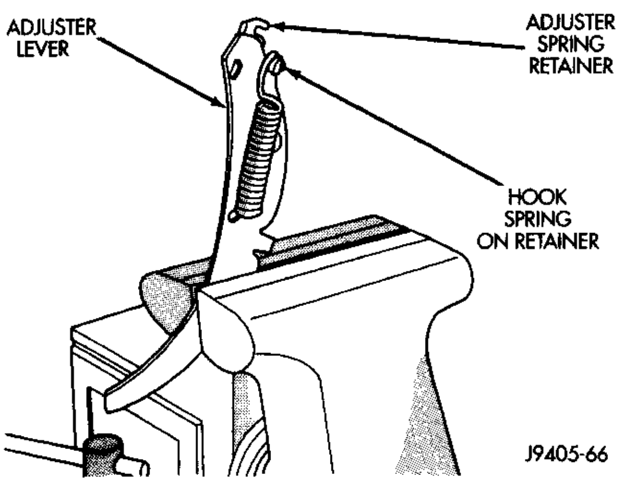

Fig. 62 Assembling Adjuster Lever, Spring And Retainer

(7) Install secondary brake shoe and adjuster lever as follows:

(a) Insert secondary shoe hold-down pin through support plate.

(b) Position secondary brake shoe on support plate and insert pin through shoe.

(c) Position adjuster lever on brake shoe and insert hold-down spring inner retainer into lever and shoe. Inner retainer has shoulder on it which seats in lever and shoe.

(d) Install hold-down spring over pin and seat it in inner retainer. Then install and seat hold-down spring outer retainer on pin with hold-down spring tool.

(8) Install adjuster lever spring between brake shoe and lever. Be sure spring is seated on lever tang.

(9) Attach shoe spring to secondary brake shoe. Long end of spring goes in secondary shoe.

(10) Install oval shaped spring on park brake strut and engage spring end of strut in secondary brake shoe.

(11) Install primary brake shoe on support plate. Use new hold-down spring, pin and retainers to secure shoe. Be sure parking brake strut is seated in both brake shoes.

(12) Install adjuster screw assembly. Be sure star wheel is positioned adjacent to adjuster lever and that notches in adjuster screw are properly seated on brake shoes.

CAUTION: Be sure the adjuster screws were not intermixed and are installed on the correct side. The driver side adjuster screw has right hand threads and the passenger side has left hand threads. Also be sure the short end of the screw is toward the secondary brake shoe.

(13) Attach shoe spring to primary brake shoe. Use brake spring pliers and long screwdriver to seat spring in shoe.

(14) Install shoe guide plate on anchor pin.

(15) Attach adjuster spring to spring retainer at top of adjuster lever. Then seat spring on anchor pin with brake spring pliers.

(16) Install secondary brake shoe return spring. Attach short end of spring to brake shoe. Then hook opposite end on adjuster spring. Use brake spring pliers, or a long shank screwdriver to engage return spring in adjuster spring.

(17) Install primary brake shoe return spring.

(18) Check component installation. Be sure adjuster screw, wheel cylinder links and park brake strut are all seated in brake shoes.

(19) Adjust brake shoes to drum with brake gauge.

(20) Install brake drums.

(21) Install wheel and tire assemblies and lower vehicle.

(22) Install wheel cover or hub cap.

WHEEL CYLINDER

REMOVAL

(1) Raise vehicle and remove tire and wheel assembly.

(2) Remove brake drum.

(3) Lift adjuster lever away from adjuster screw. Then turn screw star wheel until screw is fully retracted.

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REMOVAL AND INSTALLATION (Continued)

(4) Remove brake shoe return springs, adjuster spring and adjuster screw. Move upper ends of brake shoes apart to provide removal clearance for wheel cylinder links.

(5) Disconnect brake line from wheel cylinder.

(6) Remove wheel cylinder attaching screws and remove cylinder from support plate

INSTALLATION

(1) Apply thin coat of silicone sealer to wheel cylinder mounting surface of support plate (Fig. 63). Sealer prevents road splash from entering brake drum past cylinder.

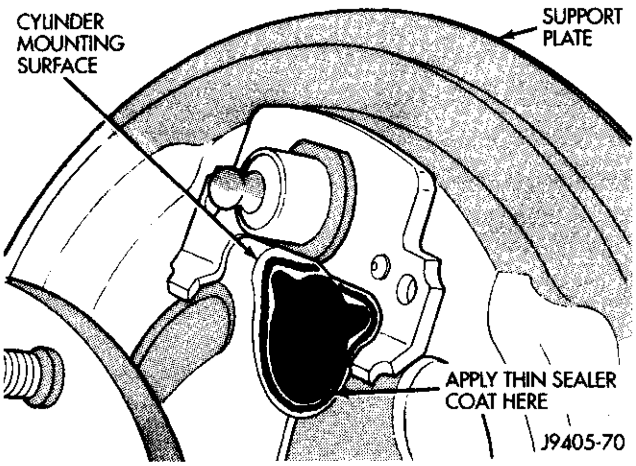

Fig. 63 Wheel Cylinder Mounting Surface

(2) Start brake line in cylinder inlet by hand. Do not tighten fitting at this time.

(3) Mount wheel cylinder on support plate and install cylinder attaching screws. Tighten screws to 20 N·m (15 ft. lbs.).

(4) Tighten brake line fitting to 13 N·m (115 in. lbs.).

(5) Install brake shoe components.

(6) Adjust brake shoes to drum using brake gauge.

(7) Install brake drum.

(8) Fill and bleed brake system.

(9) Install wheel and tire assemblies and lower vehicle.

BRAKE SUPPORT PLATE

REMOVAL

(1) Remove wheel and tire assemblies.

(2) Remove brake drums

(3) Remove axle shaft, refer to Group 3 for procedures.

(4) Remove brake shoes and hardware for access to parking brake cable.

(5) Remove parking brake cable from support plate.

(6) Disconnect brake line at wheel cylinder and remove cylinder.

(7) Remove bolts attaching support plate to axle and remove support plate.

INSTALLATION

(1) Apply thin bead of silicone sealer around axle mounting surface of support plate.

(2) Install support plate on axle flange. Tighten attaching bolts to 47-68 N·m (35-50 ft. lbs.).

(3) Apply thin bead of silicone sealer around wheel cylinder mounting surface. Install wheel cylinder on new support plate.

(4) Install parking brake cable in support plate.

(5) Install brake shoes and hardware.

(6) Install axle shaft, refer to Group 3 for procedure.

(7) Adjust brake shoes to drum with brake gauge.

(8) Install brake drums.

(9) Fill and bleed brake system.

(10) Install wheel and tire assemblies and lower vehicle.

FRONT PARKING BRAKE CABLE

REMOVAL

(1) Remove knee bolster.

(2) Release parking brake pedal completely.

(3) Raise vehicle.

(4) Loosen tensioner nut to create slack in front cable and extension cable (Fig. 64).

(5) Disengage front cable from extension cable connector. Extension cable also be removed at this time if necessary.

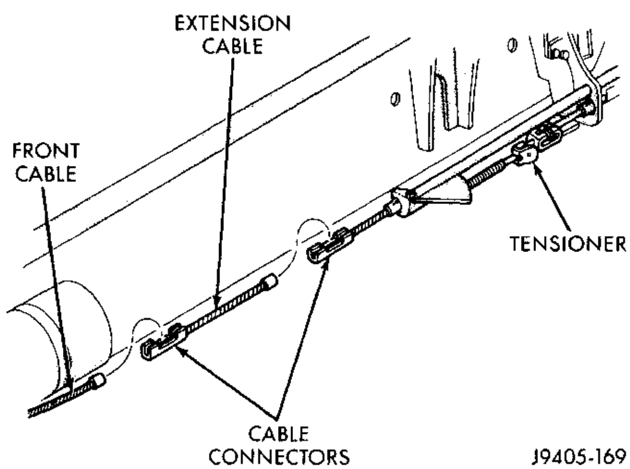

Fig. 64 Extension-To-Front Cable Attachment

(6) Lower vehicle.

(7) Roll back carpet and loosen cable grommet and cable retainer (Fig. 65). Then pull cable through floorpan grommet and remove cable.

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REMOVAL AND INSTALLATION (Continued)

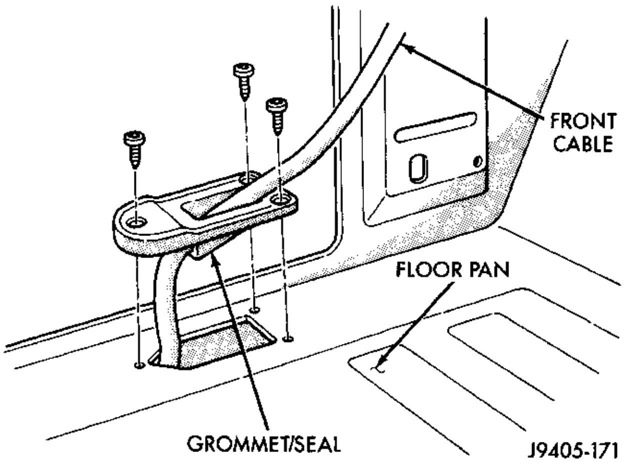

Fig. 65 Cable Grommet In Floorpan

(8) Disengage front cable from arm on foot pedal assembly (Fig. 66).

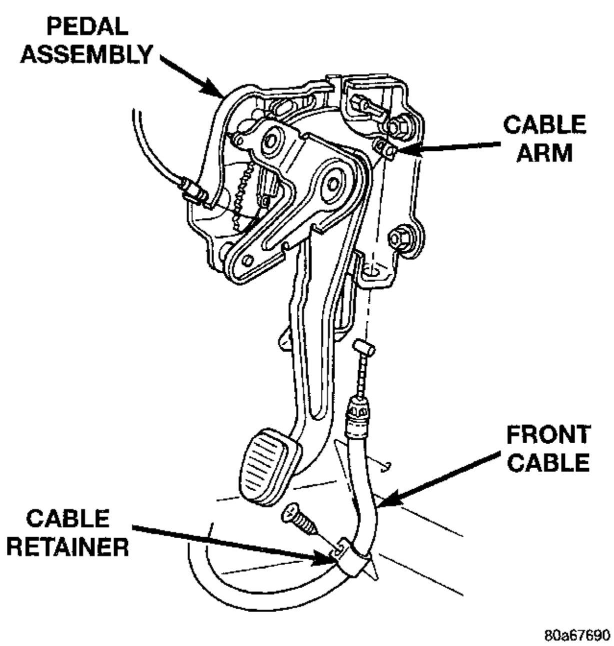

Fig. 66 Cable Attachment At Foot Pedal

INSTALLATION

(1) Insert new cable through floorpan grommet and up to arm on pedal assembly.

(2) Hook cable T-connector in arm on pedal assembly.

(3) Secure floorpan grommet/seal and cable retainer.

(4) Realign floor carpet.

(5) Install knee bolster.

(6) Engage front cable and extension cable in cable connectors. Make sure right rear cable is secured in tensioner connector.

(7) Adjust cable tensioner. Refer to procedure in this section.

REAR PARK BRAKE CABLE

REMOVAL

(1) Raise vehicle and remove necessary wheel and brake drum.

(2) Remove secondary brake shoe and disconnect cable from parking lever attached to secondary shoe.

(3) Compress rear cable retainer with hose clamp or pliers and pull cable out of support plate.

(4) Remove one (or both) cables reaction bracket on left rear fame rail.

(5) Disengage rear cable from tensioner (Fig. 67).

(6) Compress cable retainer with hose clamp or pliers and slide cable out of bracket.

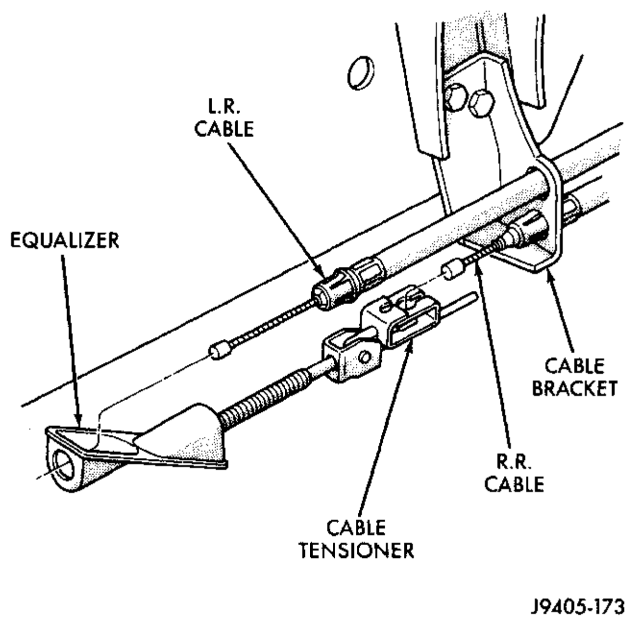

Fig. 67 Cable And Tensioner Attachment

INSTALLATION

(1) Route new cable to rear brake support plate.

(2) Insert cable through support plate, seat cable retainers and attach cable to parking brake lever on secondary brake shoe.

(3) Install brake shoes.

(4) Seat cable in body clips, reaction bracket, and frame bracket.

(5) Connect cable to tensioner.

(6) Adjust cable tensioner, Refer to procedure in this section.

(7) Install wheel and tire assemblies.

(8) Lower vehicle.

(9) Verify parking brake operation.

REMOVAL AND INSTALLATION (Continued)

PARKING BRAKE PEDAL

REMOVAL

(1) Release parking brakes.
(2) Raise vehicle.
(3) Loosen cable tensioner nut at equalizer to create slack in front cable.
(4) Lower vehicle.
(5) Remove knee bolster.
(6) Disconnect brakelamp wire from switch on pedal assembly.
(7) Roll carpet back, loosen front cable grommet from floorpan and cable retainer.
(8) Disengage cable end connector from arm on pedal assembly.
(9) Remove bolts/nuts from pedal assembly and remove assembly (Fig. 68).

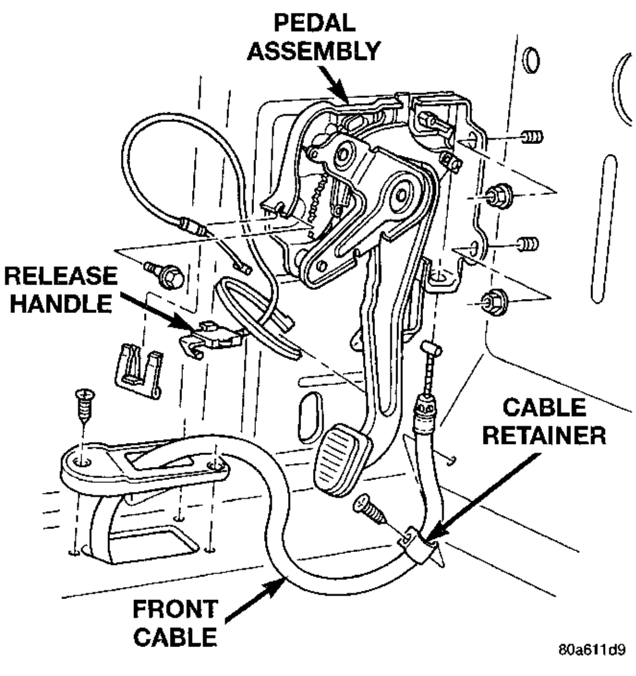

Fig. 68 Parking Brake Pedal Assembly

INSTALLATION

(1) Position replacement pedal assembly on dash and cowl.
(2) Install bolts/nuts and tighten to 28 N·m (21 ft. lbs.).
(3) Connect front cable to arm on pedal assembly.
(4) Tighten front cable grommet to floorpan and cable retainer, roll carpet back.
(5) Connect wires to brakelamp switch.
(6) Install knee bolster.
(7) Raise vehicle.
(8) Adjust parking brake cable tensioner.

DISASSEMBLY AND ASSEMBLY

MASTER CYLINDER RESERVOIR

REMOVAL

(1) Remove reservoir cap and empty fluid into drain container.
(2) Clamp cylinder body in vise with brass protective jaws.
(3) Remove pins that retain reservoir to master cylinder. Use hammer and pin punch to remove pins (Fig. 69).

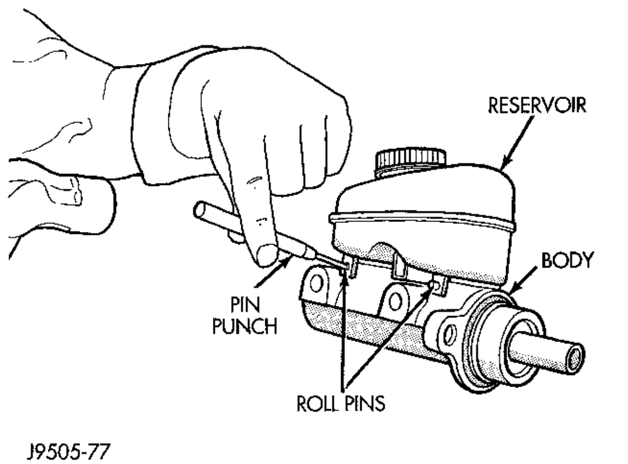

Fig. 69 Reservoir Retaining Pins

(4) Loosen reservoir from grommets with pry tool (Fig. 70).

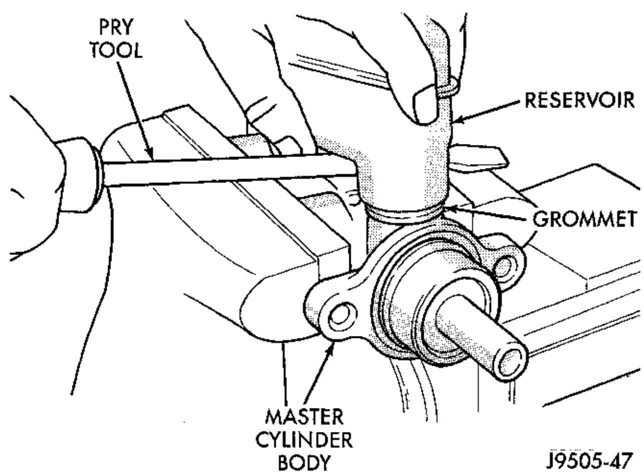

Fig. 70 Loosening Reservoir

(5) Remove reservoir by rocking it to one side and pulling free of grommets (Fig. 71).
(6) Remove old grommets from cylinder body (Fig. 72).

DISASSEMBLY AND ASSEMBLY (Continued)

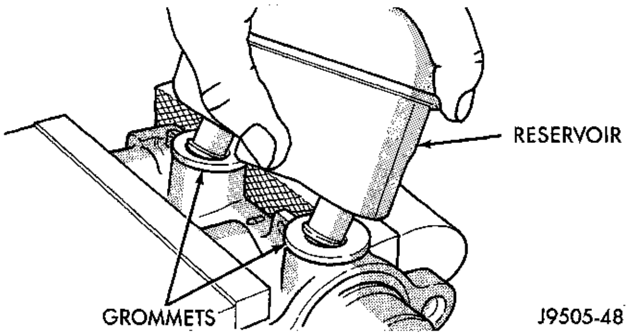

Fig. 71 Reservoir Removal

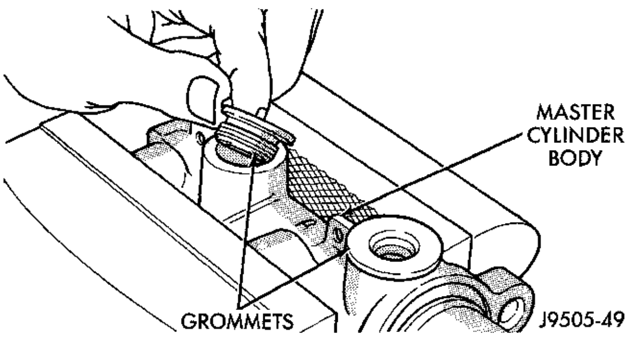

Fig. 72 Grommet Removal

INSTALLATION

CAUTION: Do not use any type of tool to install the grommets. Tools may cut, or tear the grommets creating a leak problem after installation. Install the grommets using finger pressure only.

(1) Lubricate new grommets with clean brake fluid and Install new grommets in cylinder body (Fig. 73). Use finger pressure to install and seat grommets.

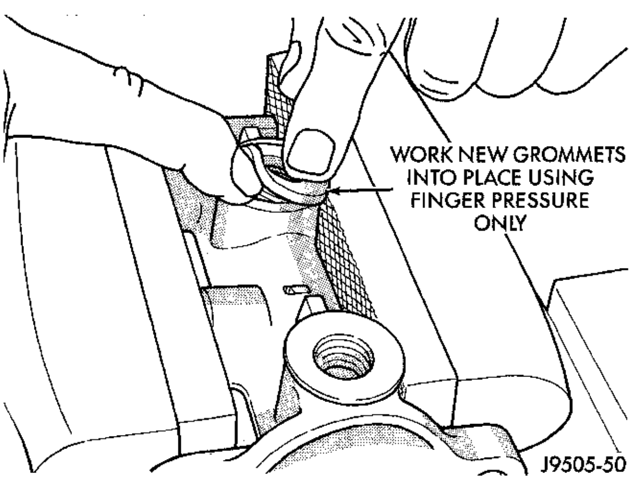

Fig. 73 Grommet Installation

(2) Start reservoir in grommets. Then rock reservoir back and forth while pressing downward to seat it in grommets.

(3) Install pins that retain reservoir to cylinder body.

(4) Fill and bleed master cylinder on bench before installation in vehicle.

DISC BRAKE CALIPER

DISASSEMBLY

(1) Drain brake fluid from caliper.

(2) Remove brake shoes from caliper.

(3) Pad interior of caliper with one-inch thickness of shop towels to cushion and protect caliper piston during removal (Fig. 74).

(4) Remove caliper piston with several **short bursts** of low pressure compressed air. Direct air through fluid inlet port to ease piston out of bore (Fig. 74).

CAUTION: Do not blow the piston out of the bore with sustained air pressure. This could result in a cracked piston. Use only enough air pressure to ease the piston out.

WARNING: NEVER ATTEMPT TO CATCH THE PISTON AS IT LEAVES THE BORE. THIS WILL RESULT IN PERSONAL INJURY.

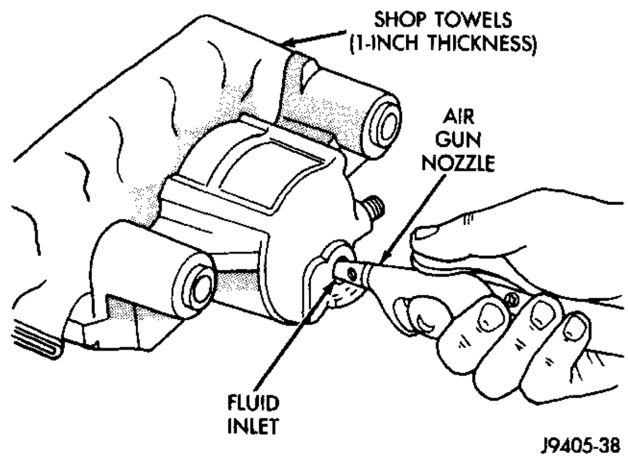

Fig. 74 Caliper Piston Removal

(5) Remove piston dust boot with a suitable pry tool (Fig. 75). **Do not scratch piston bore while removing boot.** Discard dust boot as it is not reusable.

(6) Remove piston seal from caliper and discard seal it is not reusable (Fig. 76) and (Fig. 77).

(7) Remove mounting bolts from calipers and inspect seals, boots, and bushings (Fig. 76) and (Fig. 77). Remove these components only if cut, worn, or damaged.

(8) Remove caliper bleed screw.

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DISASSEMBLY AND ASSEMBLY (Continued)

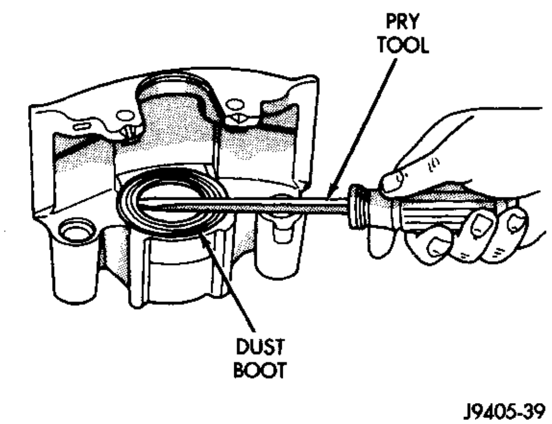

Fig. 75 Dust Boot Removal

ASSEMBLY

NOTE: Be sure caliper assembly area of workbench is clean and dry. This is important as dust, dirt, foreign material, oil, or solvents can damage seals, harm piston surfaces and contaminate fluid.

(1) Clean the caliper and piston with brake cleaner, clean brake fluid, or denatured alcohol. Do not use any other cleaning agents.

(2) Inspect condition of the caliper piston bore. The piston must be free of corrosion, rust, pitting, or scoring. replace the piston if it exhibits any of these conditions.

(3) A fiber brush can be used to clean the bore if necessary. The bore should be free of corrosion, pitting, or scoring. Discoloration of the bore is a normal condition and not cause for replacement. The bore can be lightly polished by hand but only with crocus cloth.

CAUTION: Never hone the caliper piston bore, or use any kind of abrasive material on the piston surface. Honing will result in an oversize bore and abrasives will damage the piston coating. Either of these practices will result in piston bind and eventual seizure.

(4) Inspect condition of the threads in the inlet and bleed screw ports. Replace the caliper if thread damage is evident. Do not attempt to salvage the threads.

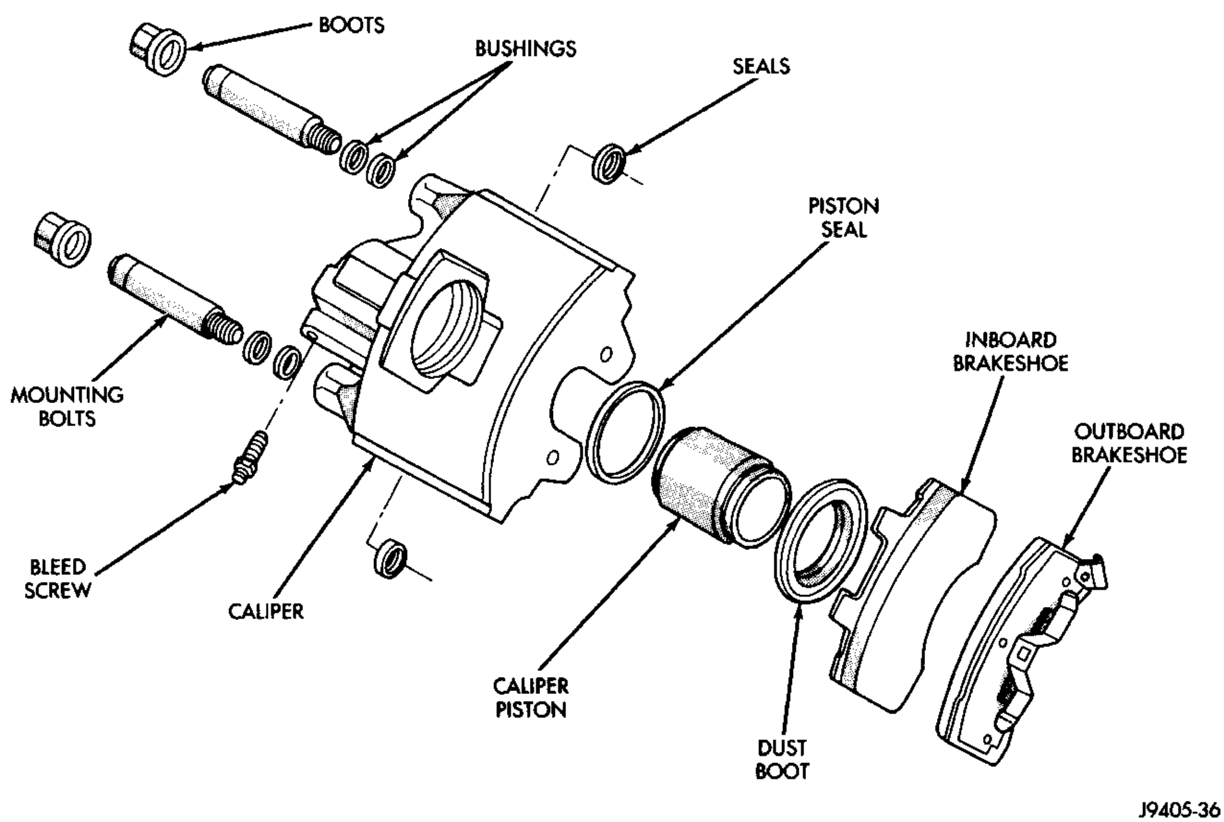

Fig. 76 Caliper Components (75/80 mm Caliper)

DISASSEMBLY AND ASSEMBLY (Continued)

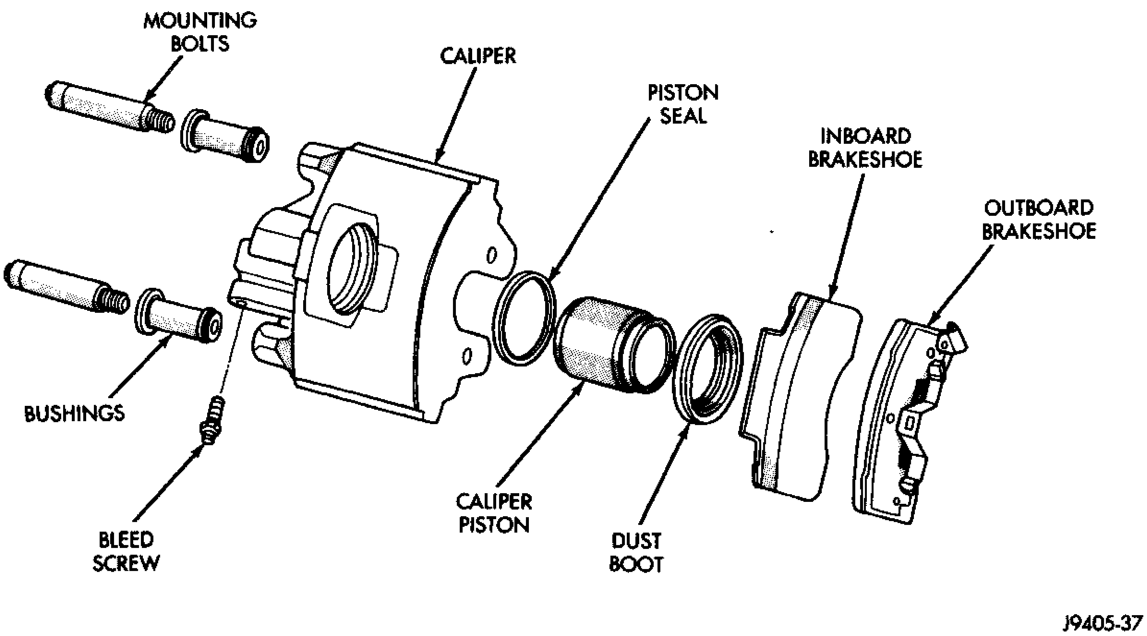

Fig. 77 Caliper Components (86 mm Caliper)

(5) Check the bushings in the caliper mounting bolt bores. Replace the bushings if worn, cut, or torn.

(6) Lubricate caliper piston, piston seal and piston bore with liberal quantity of clean, fresh brake fluid.

(7) Lightly lubricate lip of new boot with silicone grease. Install boot on piston and work boot lip into the groove at the top of piston (Fig. 78).

(8) Stretch boot rearward to straighten boot folds, then move boot forward until folds snap into place (Fig. 78).

(9) Install new piston seal into caliper bore. **Be sure square cut seal is fully seated and is not twisted.**

(10) Install piston down into the caliper bore by hand or with hammer handle. Push the piston down to the bottom of the caliper bore.

(11) Seat dust boot in caliper with installer (Fig. 79):

- 1/2 ton 75 mm caliper: Installer 6753
- 3/4 ton 80 mm caliper: Installer 6754
- 1 ton 86 mm caliper: Installer 6755

(12) Lubricate caliper mounting bolts, collars, bushings and bores with silicone grease.

(13) Install bushings, seals, boots and mounting bolts in caliper.

(14) Install caliper bleed screw.

WHEEL CYLINDER

DISASSEMBLY

(1) Remove push rods and boots (Fig. 80).

(2) Press pistons, cups and spring and expander out of cylinder bore.

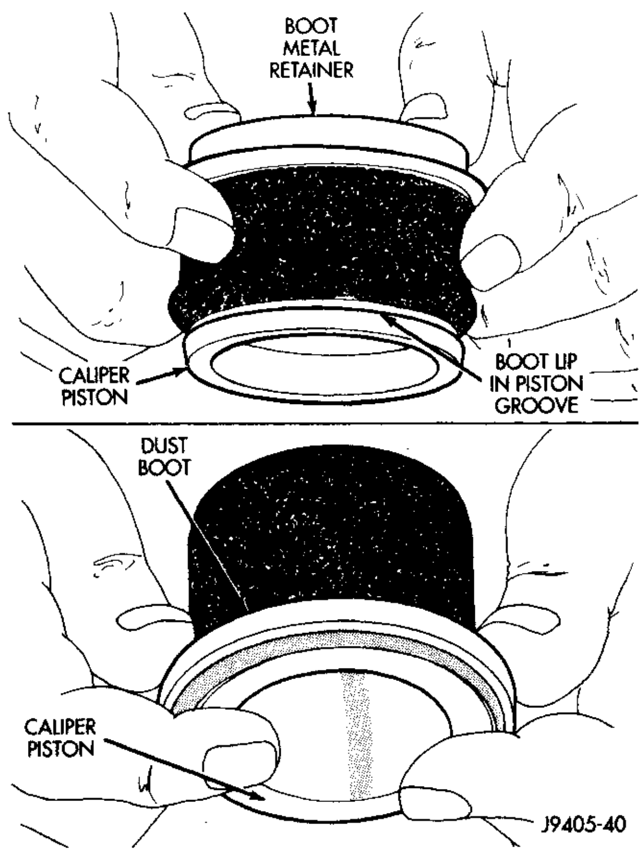

Fig. 78 Installing Dust Boot

(3) Remove bleed screw.

DISASSEMBLY AND ASSEMBLY (Continued)

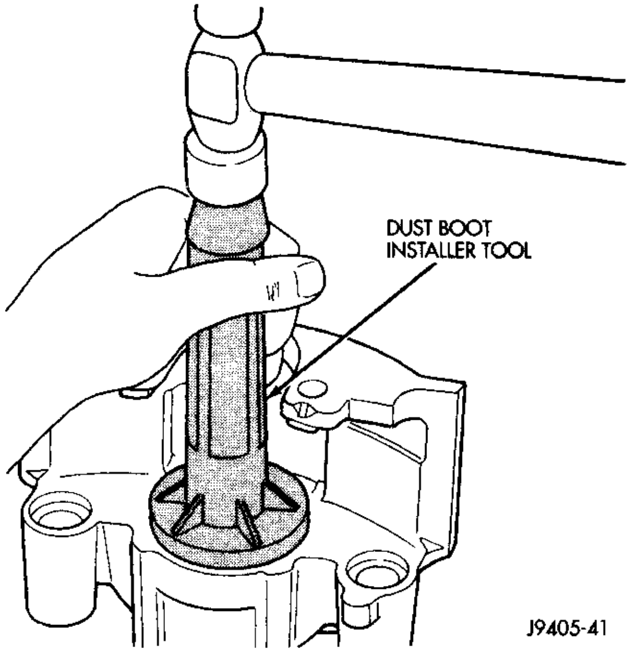

Fig. 79 Seating Dust Boot

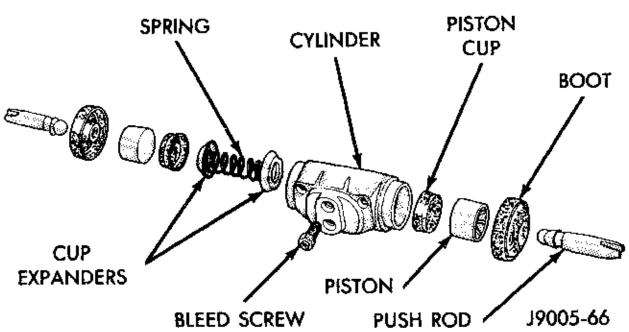

Fig. 80 Wheel Cylinder Components–Typical

ASSEMBLY

(1) Lubricate wheel cylinder bore, pistons, piston cups and spring and expander with clean brake fluid.

(2) Install first piston in cylinder bore. Then install first cup in bore and against piston. **Be sure lip of piston cup is facing inward (toward spring and expander) and flat side is against piston.**

(3) Install spring and expander followed by remaining piston cup and piston.

(4) Install boots on each end of cylinder and insert push rods in boots.

(5) Install cylinder bleed screw.

CLEANING AND INSPECTION

REAR DRUM BRAKE

CLEANING

Clean the individual brake components, including the support plate and wheel cylinder exterior, with a water dampened cloth or with brake cleaner. Do not use any other cleaning agents. Remove light rust and scale from the brake shoe contact pads on the support plate with fine sandpaper.

INSPECTION

As a general rule, riveted brake shoes should be replaced when worn to within 0.78 mm (1/32 in.) of the rivet heads. Bonded lining should be replaced when worn to a thickness of 1.6 mm (1/16 in.).

Examine the lining contact pattern to determine if the shoes are bent or the drum is tapered. The lining should exhibit contact across its entire width. Shoes exhibiting contact only on one side should be replaced and the drum checked for runout or taper.

Inspect the adjuster screw assembly. Replace the assembly if the star wheel or threads are damaged, or the components are severely rusted or corroded.

Discard the brake springs and retainer components if worn, distorted or collapsed. Also replace the springs if a brake drag condition had occurred. Overheating will distort and weaken the springs.

Inspect the brake shoe contact pads on the support plate, replace the support plate if any of the pads are worn or rusted through. Also replace the plate if it is bent or distorted (Fig. 81).

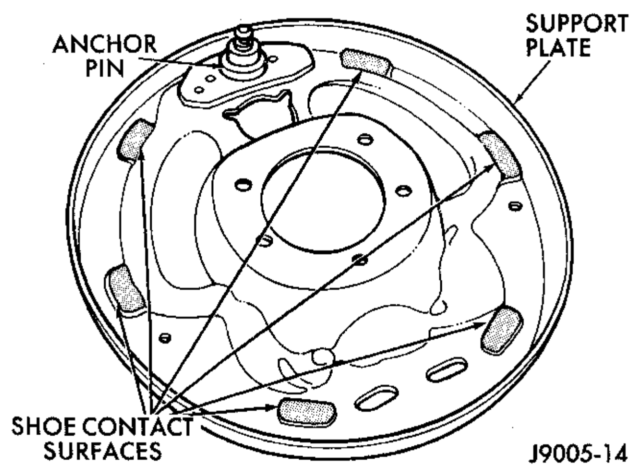

Fig. 81 Shoe Contact Surfaces

CALIPER

CLEANING

Clean the caliper components with clean brake fluid or brake clean only. Wipe the caliper and piston

AUTHENTIC RESTORATION PRODUCT

CLEANING AND INSPECTION (Continued)

dry with lint free towels or use low pressure compressed air.

CAUTION: Do not use gasoline, kerosene, thinner, or similar solvents. These products may leave a residue that could damage the piston and seal.

INSPECTION

The piston is made from a phenolic resin (plastic material) and should be smooth and clean.

The piston must be replaced if cracked or scored. Do not attempt to restore a scored piston surface by sanding or polishing.

CAUTION: If the caliper piston is replaced, install the same type of piston in the caliper. Never interchange phenolic resin and steel caliper pistons. The pistons, seals, seal grooves, caliper bore and piston tolerances are different.

The bore can be **lightly** polished with a brake hone to remove very minor surface imperfections (Fig. 82). The caliper should be replaced if the bore is severely corroded, rusted, scored, or if polishing would increase bore diameter more than 0.025 mm (0.001 inch).

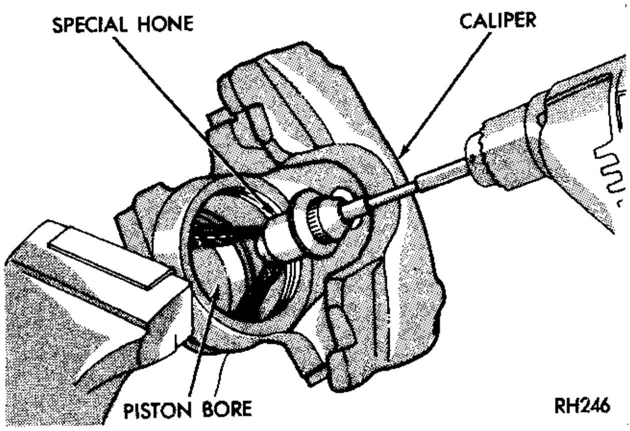

Fig. 82 Polishing Piston Bore

WHEEL CYLINDER

CLEANING

Clean the cylinder and pistons with clean brake fluid or brake cleaner only. Do not use any other cleaning agents.

Dry the cylinder and pistons with compressed air. Do not use rags or shop towels to dry the cylinder components. Lint from cloth material will adhere to the cylinder bores and pistons.

INSPECTION

Inspect the cylinder bore. Light discoloration and dark stains in the bore are normal and will not impair cylinder operation.

The cylinder bore can be lightly polished but only with crocus cloth. Replace the cylinder if the bore is scored, pitted or heavily corroded. Honing the bore to restore the surface is not recommended.

Inspect the cylinder pistons. The piston surfaces should be smooth and free of scratches, scoring and corrosion. Replace the pistons if worn, scored, or corroded. Do attempt to restore the surface by sanding or polishing.

Discard the old piston cups and the spring and expander. These parts are not reusable. The original dust boots may be reused but only if they are in good condition.

ADJUSTMENTS

STOP LAMP SWITCH

(1) Push and hold brake pedal down

(2) Pull switch plunger all the way out to fully extended position.

(3) Push switch plunger inward 4 detent positions (or clicks). This is required preset position. Plunger will extend approximately 14 mm (0.55 in.) out of housing at this setting.

(4) Release brake pedal. Then lightly pull pedal fully rearward. Pedal will adjust switch plunger to correct position as pedal is moved to rear.

CAUTION: Do not use excessive force to move the pedal rearward for switch adjustment. Excessive force will damage the switch.

REAR DRUM BRAKE

The rear drum brakes are equipped with a self-adjusting mechanism. Under normal circumstances, the only time adjustment is required is when the shoes are replaced, removed for access to other parts, or when one or both drums are replaced.

Adjustment can be made with a standard brake gauge or with adjusting tool. Adjustment is performed with the complete brake assembly installed on the backing plate.

ADJUSTMENT WITH BRAKE GAUGE

(1) Be sure parking brakes are fully released.

(2) Raise rear of vehicle and remove wheels and brake drums.

(3) Verify that left and right automatic adjuster levers and cables are properly connected.

(4) Insert brake gauge in drum. Expand gauge until gauge inner legs contact drum braking surface. Then lock gauge in position (Fig. 83).

(5) Reverse gauge and install it on brake shoes. Position gauge legs at shoe centers as shown (Fig. 84). If gauge does not fit (too loose/too tight), adjust shoes.

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ADJUSTMENTS (Continued)

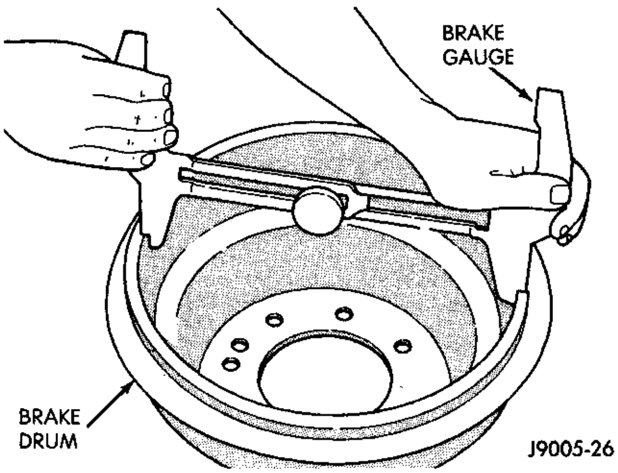

Fig. 83 Adjusting Gauge On Drum

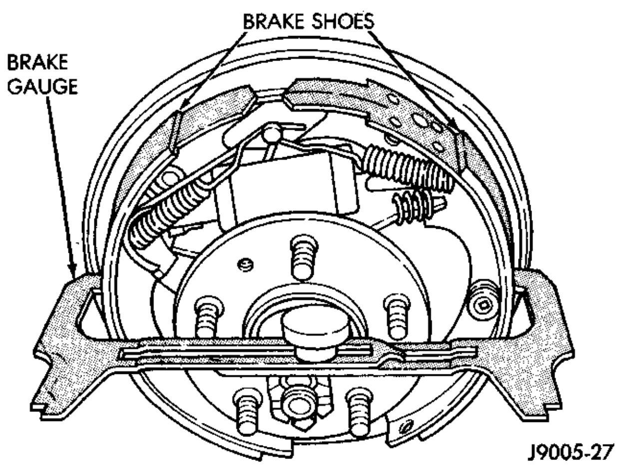

Fig. 84 Adjusting Gauge On Brake Shoes

(6) Pull shoe adjuster lever away from adjuster screw star wheel.

(7) Turn adjuster screw star wheel (by hand) to expand or retract brake shoes. Continue adjustment until gauge outside legs are light drag-fit on shoes.

(8) Install brake drums and wheels and lower vehicle.

(9) Drive vehicle and make one forward stop followed by one reverse stop. Repeat procedure 8-10 times to operate automatic adjusters and equalize adjustment.

NOTE: Bring vehicle to complete standstill at each stop. Incomplete, rolling stops will not activate automatic adjusters.

ADJUSTMENT WITH ADJUSTING TOOL

(1) Be sure parking brake lever is fully released.

(2) Raise vehicle so rear wheels can be rotated freely.

(3) Remove plug from each access hole in brake support plates.

(4) Loosen parking brake cable adjustment nut until there is slack in front cable.

(5) Insert adjusting tool through support plate access hole and engage tool in teeth of adjusting screw star wheel (Fig. 85).

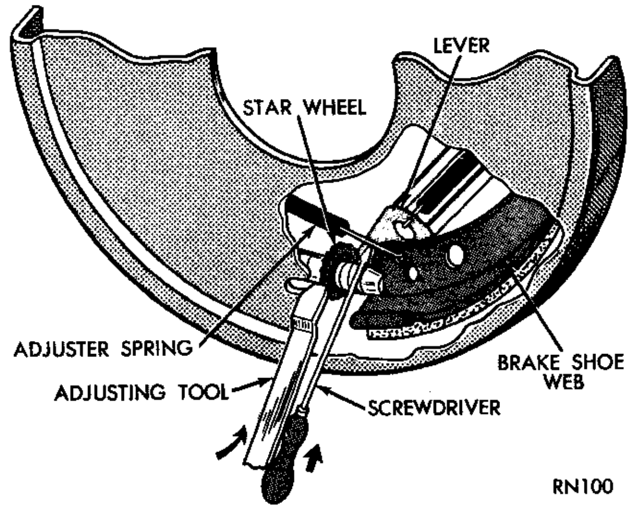

Fig. 85 Brake Adjustment

(6) Rotate adjuster screw star wheel (move tool handle upward) until slight drag can be felt when wheel is rotated.

(7) Push and hold adjuster lever away from star wheel with thin screwdriver.

(8) Back off adjuster screw star wheel until brake drag is eliminated.

(9) Repeat adjustment at opposite wheel. Be sure adjustment is equal at both wheels.

(10) Install support plate access hole plugs.

(11) Adjust parking brake cable and lower vehicle.

(12) Install brake drums and wheels and lower vehicle.

(13) Drive vehicle and make one forward stop followed by one reverse stop. Repeat procedure 8-10 times to operate automatic adjusters and equalize adjustment.

NOTE: Bring vehicle to complete standstill at each stop. Incomplete, rolling stops will not activate automatic adjusters.

PARKING BRAKE CABLE TENSIONER

NOTE: Tensioner adjustment is only necessary when the tensioner, or a cable has been replaced or disconnected for service. When adjustment is necessary, perform adjustment only as described in the following procedure. This is necessary to avoid faulty parking brake operation.

(1) Raise vehicle.

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ADJUSTMENTS (Continued)

(2) Back off cable tensioner adjusting nut to create slack in cables.

(3) Remove rear wheel and tire assemblies. Then remove brake drums.

(4) Check rear brake shoe adjustment with standard brake gauge.

(5) Replace worn brake shoes if necessary.

(6) Verify parking brake cables operate freely. Replace faulty cables if necessary.

(7) Install drums and verify that drums rotate freely without drag.

(8) Install wheel/tire assemblies.

(9) Lower vehicle enough for access to parking brake foot pedal.

(10) Fully apply parking brakes and leave brakes applied until adjustment is complete.

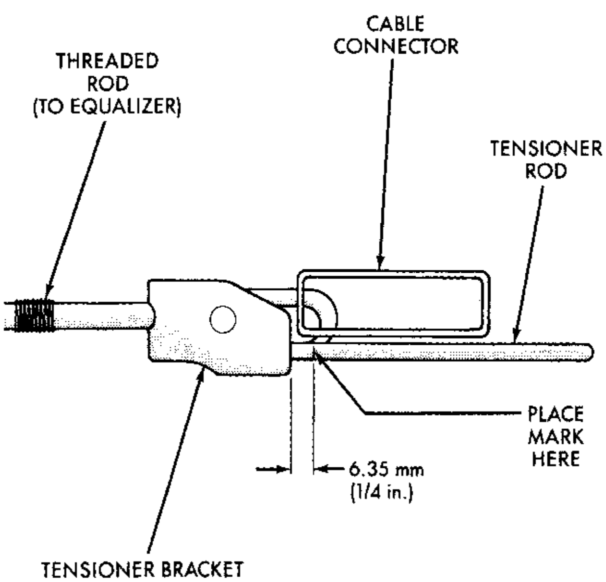
(11) Raise vehicle again.

(12) Mark tensioner rod 6.5 mm (1/4 in.) from edge of tensioner bracket (Fig. 86).

(13) Tighten adjusting nut at equalizer until mark on tensioner rod moves into alignment with tensioner bracket (Fig. 86).

CAUTION: Do not loosen, or tighten the tensioner adjusting nut for any reason after completing adjustment.

(14) Release parking brake and verify rear wheels rotate freely without drag. Then lower vehicle.



J9405-176

Fig. 86 Adjustment Mark On Cable Tensioner Rod

SPECIFICATIONS

BRAKE FLUID

The brake fluid used in this vehicle must conform to DOT 3 specifications and SAE J1703 standards. No other type of brake fluid is recommended or approved for usage in the vehicle brake system. Use only Mopar brake fluid or an equivalent from a tightly sealed container.

CAUTION: Never use reclaimed brake fluid or fluid from an container which has been left open. An open container will absorb moisture from the air and contaminate the fluid.

CAUTION: Never use any type of a petroleum-based fluid in the brake hydraulic system. Use of such type fluids will result in seal damage of the vehicle brake hydraulic system causing a failure of the vehicle brake system. Petroleum based fluids would be items such as engine oil, transmission fluid, power steering fluid ect.

BASE BRAKE

Disc Brake Caliper
Type . . . . Sliding

Caliper Piston Diameter
1500 . . . . 75 mm (2.95 in.)
2500 . . . . 80 mm (3.14 in.)
3500 . . . . 86 mm (3.38 in.)

Disc Brake Rotor
1500. . . . . 294×32 mm (11.57×1.26 in.)
2500 . . . . 317.5×38 mm (12.5×1.5 in.)
3500 . . . . 317.5×38 mm (12.5×1.5 in.)
Max. Runout. . . . . 0.127 mm (0.005 in.)
Max. Thickness Variation . . . . 0.025 mm (0.001 in.)

Minimum Rotor Thickness
1500 4X2. . . . . 30.86 mm (1.215 in.)
1500 4X4. . . . . 32.23 mm (1.2689 in.)
2500 4X2. . . . . 32.24 mm (1.2693 in.)
2500 4X4 LD. . . . . 32.24 mm (1.2693 in.)
2500 4X4 HD . . . . 38.64 mm (1.5213 in.)
3500 4X2. . . . . 38.56 mm (1.5182 in.)
2500 4X4. . . . . 38.64 mm (1.5213 in.)

Drum Brake
1500 . . . . 279×51 mm (11×2 in.)
2500 . . . . 330×63.5 mm (13×2.5 in.)
3500. . . . . 330×89 mm (13×3.5 in.)
Max. Runout. . . . . 0.20 mm (0.008 in.)
Max. Thickness Variation . . . . 0.076 mm (0.003 in.)

Wheel Cylinder Bore Size
1500 . . . . 23.8 mm (0.937 in.)
2500 4x2 . . . . 24 mm (0.944 in.)

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SPECIFICATIONS (Continued)

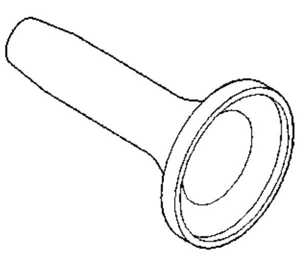
2500 4x4 .27 mm (1.06 in.)
3500/2500 .27 mm (1.06 in.)
Master Cylinder Bore
Size .31.8 mm (1.25 in.)
Brake Boosters
Type .Vacuum Dual Diaphragm
Type .Hydraulic

TORQUE CHART

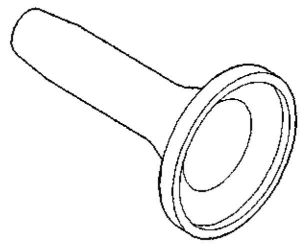
DESCRIPTION	TORQUE
Booster	
Mounting Nuts	28 N·m (21 ft. lbs.)
Diesel Hydraulic Booster	
Mounting Bolts	28 N·m (21 ft. lbs.)
Booster Lines	28 N·m (21 ft. lbs.)
Booster Hoses	31 N·m (23 ft. lbs.)
Master Cylinder	
Mounting Nuts	28 N·m (21 ft. lbs.)
Brake Lines	19-23 N·m (170-200 in. lbs.)
Combination Valve	
Mounting Bolt	23 N·m (210 in. lbs.)
Brake Lines	19-200 N·m (170-200 in. lbs.)
Proportioning Valve	
Mounting Nuts	34 N·m (25 dt. lbs.)
Brake Hose	31 N·m (276 in. lbs.)
Brake Lines	19-200 N·m (170-200 in. lbs.)
Caliper	
Mounting Bolts	51 N·m (38 ft. lbs.)
Wheel Cylinder	
Mounting Bolts	20 N·m (15 ft. lbs.)
Brake Line	13 N·m (115 in. lbs.)
Support Plate	
Mounting Bolts	47-68 N·m (35-50 ft. lbs.)
Park Brake Pedal Assembly	
Mounting Bolts/Nuts	28 N·m (21 ft. lbs.)

SPECIAL TOOLS

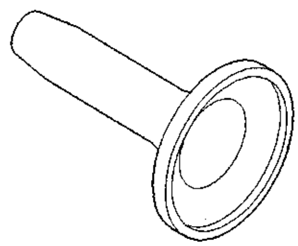
BASE BRAKES



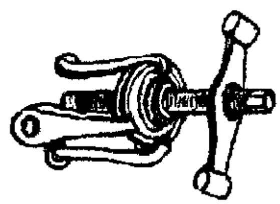
Installer, Brake Caliper Dust Boot 6753



Installer, Brake Caliper Dust Boot 6754



Installer, Brake Caliper Dust Boot 6755



Puller, Hub/Bearing C-844

Puller Leg C-844-1

AUTHENTIC RESTORATION PRODUCT

REAR WHEEL ANTILOCK BRAKES

INDEX

DESCRIPTION AND OPERATION

REAR WHEEL ANTILOCK

Rear Wheel Antilock (RWAL) brake system is standard equipment on all Dodge trucks and full size vans. The RWAL brake system is designed to prevent rear wheel lock-up under heavy braking conditions on virtually all types of road surfaces. Antilock braking is desirable because a vehicle which is stopped without locking the wheels will retain directional stability and some steering capability. This allows the driver to retain greater control of the vehicle during braking.

When the brakes are applied, hydraulic fluid is routed from the master cylinder's secondary circuit, through the combination valve, to the RWAL valve Hydraulic Control Unit (HCU). From there hydraulic fluid is routed to the rear brake wheel cylinders. The Controller Antilock Brake (CAB) monitors rear wheel speed through the rear wheel speed sensor (WSS). If a wheel is about to lock-up, the CAB signals the RWAL valve (HCU). The HCU modulates the hydraulic brake pressure to the rear wheels to prevent wheel lock-up.

NORMAL BRAKING

During light brake application, rear wheel deceleration is not sufficient to activate the antilock system components. During a normal stop hydraulic brake fluid flows unrestricted to the rear wheel cylinders to stop the vehicle. The antilock solenoid valves are inactive. The isolation valve is open and the dump valve is closed allowing normal fluid flow to the rear wheel cylinders.

ANTILOCK BRAKING

If the CAB senses that rear wheel speed deceleration is excessive, it will energize the isolation solenoid. This prevents a further increase of driver induced brake pressure to the rear wheels. If this initial action is not enough to prevent rear wheel lock-up, the CAB will momentarily energize a dump solenoid. This opens the dump valve to vent a small amount of isolated rear brake pressure to an accumulator. The action of fluid moving to the accumulator reduces the isolated brake pressure at the wheel cylinders. The dump (pressure venting) cycle is limited to very short time periods (milliseconds). The CAB will pulse the dump valve until rear wheel deceleration matches the vehicle's deceleration rate or the desired slip rate programmed into the CAB. The system will switch to normal braking once wheel locking tendencies are no longer present.

RWAL PERFORMANCE CHARACTERISTICS

WHEEL/TIRE SIZE AND INPUT SIGNALS

The antilock system depends on accurate signals from the rear wheel speed sensor, to achieve maximum antilock performance. Vehicle's wheels and tires should all be the same size and type to ensure an accurate signal. Tires other than those specified by the manufacturer may result in unsatisfactory antilock performance.

LOW VEHICLE SPEED

The RWAL braking system will revert to normal braking and automatically turn off if the vehicle is moving less than a few mph. The lower limit at which RWAL is cancelled may be different depending on tire and wheel diameters.

AUTHENTIC RESTORATION PRODUCT

DESCRIPTION AND OPERATION (Continued)

HYDRAULIC PRESSURE

The RWAL system controls hydraulic pressure to both rear wheels simultaneously, not each one independently. If one rear wheel starts to decelerate too rapidly, the RWAL system affects the hydraulic pressure to both rear brakes (Fig. 1).

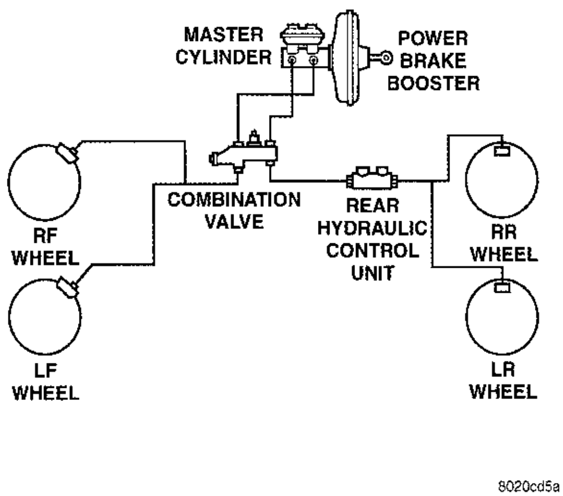


Fig. 1 RWAL Hydraulic Circuit

DIRECTIONAL STABILITY

The RWAL system operates on the rear wheels only, it is possible to lock the front wheels of the vehicle during a high deceleration stop. In this event, the vehicle will be stable, but the driver will be unable to alter the direction of the vehicle with the steering wheel (Fig. 2).

STOPPING DISTANCE

The RWAL brake system limits wheel slip to approximately 20%. This provides for maximum brake effectiveness. Wheel slip means how well the tires grip the road surface. With light or no braking there is no wheel slip. With the wheels locked (not rotating) during a panic stop, there is 100% wheel slip. To obtain the shortest stopping distance and the greatest control over the vehicle during heavy braking, approximately 20% wheel slip is most efficient, under most conditions.

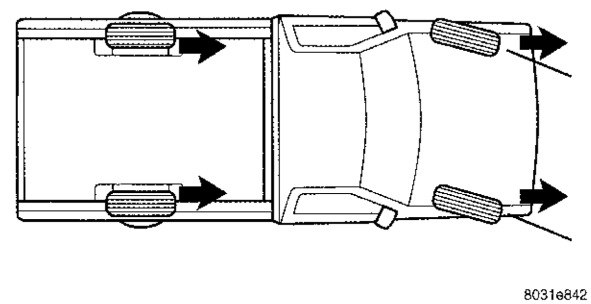


Fig. 2 Directional Stability

PEDAL FEEL

The brake pedal feel is similar to that of a conventional brake system. Under certain conditions the pedal may drop slightly when there is a need for pressure increase during a long antilock stop. The sequence of antilock events is to isolate, decrease, and then increase pressure to maintain brake effectiveness. When the system is in the increase mode is when the pedal will drop slightly.

TIRE NOISE

The RWAL system prevents complete rear wheel lock-up, but some wheel slip is desired to obtain optimum braking performance. During brake pressure modulation brake pressure is increased and wheel slip controlled by the CAB is allowed to reach up to approximately 20%. This means that the wheel rolling speed is approximately 20% less than that of a free rolling wheel at any given vehicle speed. The wheel slip may result in some tire "chirping", depending upon the road surface. This sound should not be interpreted as a total wheel lock-up and can be considered normal under most conditions.

BRAKE PEDAL

During antilock braking, the RWAL valve cycles rapidly in response to CAB inputs. The driver may experience a pulsing sensation in the brake pedal and vehicle as the valves modulate brake fluid pressure as needed. Brake pedal and vehicle pulsations during an antilock stop should be considered as normal.

AUTHENTIC RESTORATION PRODUCT

DESCRIPTION AND OPERATION (Continued)

RWAL COMPONENT LOCATION

COMPONENT	LOCATION	FUNCTION
CONTROLLER ANTILOCK BRAKE	Driver side inner fender on a bracket.	Tests, monitors and controls the rear brake system.
HYDRAULIC CONTROL UNIT/ RWAL VALVE	Driver side inner fender on a bracket.	Modulates hydraulic pressure to rear brakes during an ABS stop.
REAR WHEEL SPEED SENSOR	Top of the rear axle housing.	Sends an AC voltage sinewave to the CAB whose frequency is proportional to vehicle speed.
EXCITER RING	Ring gear inside the differential housing.	Used to pull the magnetic field across the wheel speed sensor's windings.
RED BRAKE WARNING LAMP	Instrument cluster.	Indicator for park brake engagement, hydraulic brake malfunction, or ABS malfunction.
AMBER ABS WARNING LAMP	Instrument cluster.	Indicator of an ABS malfunction.
BRAKE WARNING LAMP DIODE	Instrument panel harness near the parking brake switch.	Isolates the park brake switch circuit from the CAB for proper red brake warning lamp operation.
ISOLATION AND DUMP VALVE FUSE	Inside the CAB.	Fail-safe device for unwanted control of the isolation and dump solenoid/valves
ISOLATION AND DUMP SOLENOID/VALVES	Inside the HCU/RWAL valve.	Used to modulation hydraulic pressure to the rear brakes during an ABS stop.

CONTROLLER ANTILOCK BRAKES

The Controller Antilock Brakes (CAB) is a microprocessor which handles testing, monitoring and controlling the ABS brake system operation (Fig. 3). The CAB functions are:

- Perform self-test diagnostics.
- Monitors the RWAL brake system for proper operation.
- Controls the RWAL valve solenoids.

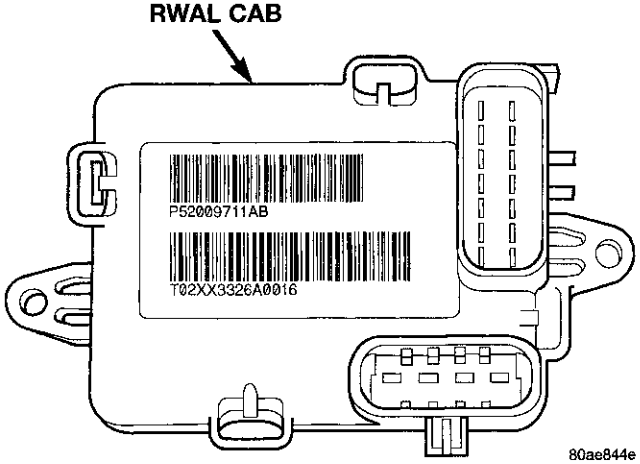


Fig. 3 RWAL CAB

NOTE: If the CAB needs to be replaced, the rear axle type and tire revolutions per mile must be programed into the new CAB. For axle type refer to Group 3 Differential and Driveline. For tire revolutions per mile refer to Group 22 Tire and Wheels. To program the CAB refer to the Chassis Diagnostic Manual.

SYSTEM SELF-TEST

When the ignition switch is turned-on the microprocessor RAM and ROM are tested. If an error occurs during the test a DTC will be set into the RAM memory. However it is possible the DTC will not be stored in memory if the error has occurred in the RAM module were the DTC's are stored. Also it is possible a DTC may not be stored if the error has occurred in the ROM which signals the RAM to store the DTC.

CAB INPUTS

The CAB continuously monitors the speed of the differential ring gear by monitoring signals generated by the rear wheel speed sensor. The CAB determines a wheel locking tendency when it recognizes the ring gear decelerating too rapidly. The CAB monitors the

DESCRIPTION AND OPERATION (Continued)

following inputs to determine when a wheel locking tendency may exists:

- Rear Wheel Speed Sensor
- Brake Lamp Switch
- Brake Warning Lamp Switch
- Reset Switch
- 4WD Switch (If equipped)

CAB OUTPUTS

The CAB controls the following outputs for antilock braking and brake warning information:

- RWAL Valve
- ABS Warning Lamp
- Brake Warning Lamp

RWAL VALVE

If the CAB senses that rear wheel speed deceleration is excessive, it will energize a isolation solenoid by providing battery voltage to the solenoid. This prevents a further increase of driver induced brake pressure to the rear wheels. If this initial action is not enough to prevent rear wheel lock-up, the CAB will momentarily energize a dump solenoid (the CAB energizes the dump solenoid by providing battery voltage to the solenoid). This opens the dump valve to vent a small amount of isolated rear brake pressure to an accumulator. The action of fluid moving to the accumulator reduces the isolated brake pressure at the wheel cylinders. The dump (pressure venting) cycle is limited to very short time periods (milliseconds). The CAB will pulse the dump valve until rear wheel deceleration matches the vehicle deceleration rate or the desired slip rate programmed into the CAB. The system will switch to normal braking once wheel locking tendencies are no longer present.

A predetermined maximum number of consecutive dump cycles can be performed during any one antilock stop. If excessive dump cycles occur, a DTC will be set and stored in the CAB memory. If during an antilock stop, the driver releases the brake pedal, the reset switch contacts will open. This signal to the CAB is an indication that pressure has equalized across the RWAL valve. The CAB will then reset the dump cycle counter in anticipation of the next antilock stop. Additionally, any fluid stored in the accumulator will force its way past the dump valve, back into the hydraulic circuit and return to the master cylinder.

A fuse internal to the CAB, provides a fail-safe device which prevents unwanted control over the isolation and dump solenoids. The fuse is in series with the isolation and dump solenoids output circuits. If the internal fuse is open, the CAB cannot provide voltage to energize either solenoid and antilock stops are prevented. If the fuse is open, the braking system will operate normally but without antilock control over rear brake pressure.

REAR WHEEL SPEED SENSOR AND EXCITER RING

The rear Wheel Speed Sensor (WSS) is mounted in the rear differential housing (Fig. 4). The WSS consists of a magnet surrounded by windings from a single strand of wire. The sensor sends a small AC signal to the CAB. This signal is generated by magnetic induction. The magnetic induction is created when a toothed sensor ring (exciter ring or tone wheel) passes the stationary magnetic WSS.

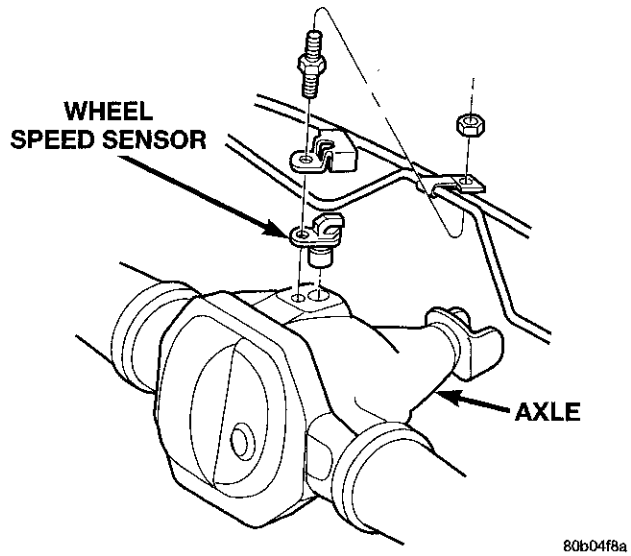


Fig. 4 Rear Wheel Speed Sensor Location

The exciter ring is press fitted onto the differential carrier next to the final drive ring gear (Fig. 5). For replacement procedure of the exciter ring, refer to Group 3 Differential and Driveline.

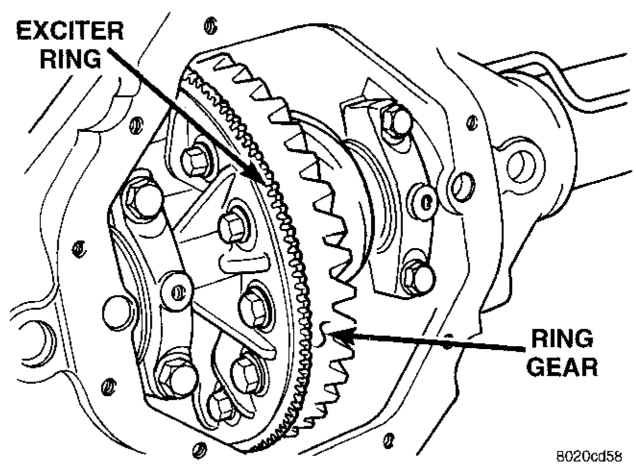


Fig. 5 Exciter Ring Location

When the ring gear is rotated, the exciter ring passes the tip of the WSS. As the exciter ring passes the tip of the WSS, the magnetic lines of force of the sensor are cut, causing the magnetic field to be moved across the sensor's windings. This, in turn

DESCRIPTION AND OPERATION (Continued)

causes current to flow through the WSS circuit (Fig. 6). Every time a tooth of the exciter ring passes the tip of the WSS, an AC signal is generated. Each AC signal (positive to negative signal or sinewave) is interpreted by the CAB. It then compares the frequency of the sinewave to a time value to calculate vehicle speed. The CAB continues to monitor the frequency to determine a deceleration rate that would indicate a possible wheel-locking tendency.

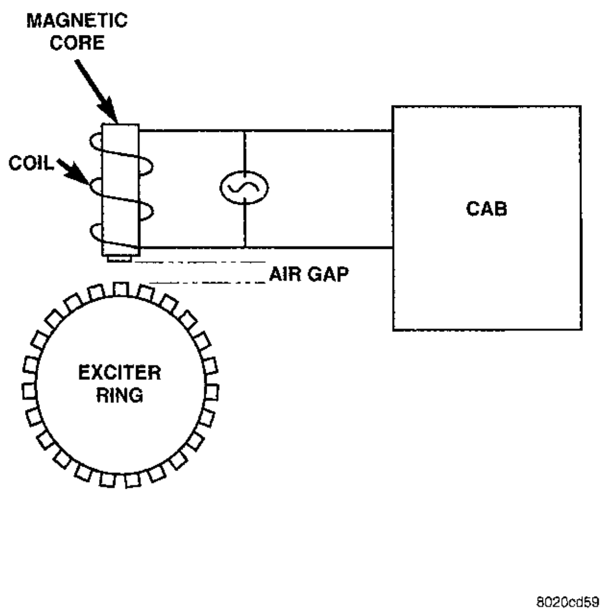


Fig. 6 Operation of the Wheel Speed Sensor

The signal strength of any magnetic induction sensor is directly affected by:

- Magnetic field strength; the stronger the magnetic field, the stronger the signal
- Number of windings in the sensor; more windings provide a stronger signal
- Exciter ring speed; the faster the exciter ring rotates, the stronger the signal will be
- Distance between the exciter ring teeth and WSS; the closer the WSS is to the exciter ring, the stronger the signal will be

The rear WSS is not adjustable. A clearance specification has been established for manufacturing tolerances. If the clearance is not within these specifications, then either the WSS or other components may be damaged. The clearance between the WSS and the exciter ring is 0.005 – 0.050 in.

The assembly plant performs a "Rolls Test" on every vehicle that leaves the assembly plant. One of the test performed is a test of the WSS. To properly test the sensor, the assembly plant connects test equipment to the Data Link Connector (DLC). This connector is located to the right of the steering column and attached to the lower portion of the instrument panel (Fig. 7). The rolls test terminal is spliced to the WSS circuit. The vehicle is then driven on a set of rollers and the WSS output is monitored for proper operation.

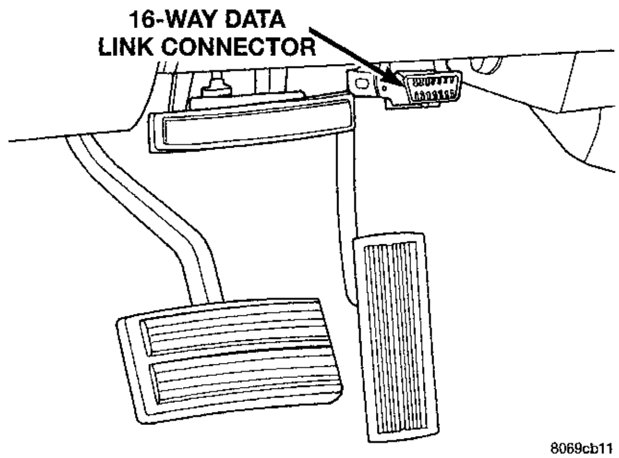


Fig. 7 Data Link Connector - Typical

BRAKE WARNING LAMPS

RED WARNING LAMP

The red brake warning lamp is used to alert the driver of a hydraulic fault or that the parking brake is applied. For the RWAL system, the red brake warning lamp also is used to alerts the driver of a problem with the RWAL system.

The brake warning lamp illuminates when ignition voltage is supplied to the bulb and a ground is provided for the bulb. The bulb has ignition voltage supplied to it any time the ignition switch is in the RUN or START positions. A ground for the bulb is provided when:

- The ignition switch is turned to the START position.
- The parking brakes are applied and the park brake switch is actuated.
- A hydraulic fault has occurred and the pressure differential switch is actuated.
- A RWAL fault has occurred.

ABS WARNING LAMP

The amber ABS warning lamp is used to alerts the driver of RWAL problem and identify DTCs stored in the CABs memory.

The ABS warning lamp illuminates when ignition voltage is supplied to the bulb and a ground is provided for the bulb. The bulb has ignition voltage supplied to it anytime the ignition switch is in the RUN or START positions. A ground for the bulb is provided by the CAB only. A circuit in the CAB monitors the brake warning lamp switch and the ignition switch bulb check circuit (grounds the brake warning lamp bulb during the START position). When the CAB

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DESCRIPTION AND OPERATION (Continued)

identifies a ground on this circuit, the CAB illuminates the ABS warning lamp.

STOP LAMP SWITCH

The primary function of the switch is to turn on the stop lamps during braking. The switch is also used to send signals to components that must know when the brakes are applied, such as the Powertrain Control Module (PCM), which uses the signal to cancel speed control. The CAB uses the brake switch signal to monitor brake pedal application. When the switch contacts open (brakes applied), the CAB receives the brake applied signal. The CAB then monitors the ABS system to anticipate the need for an ABS stop.

DIAGNOSIS AND TESTING

REAR WHEEL ANTILOCK

Diagnosis of base brake conditions which are mechanical in nature should be performed first. This includes brake noise, lack of power assist, parking brake, or vehicle vibration during normal braking.

The RWAL brake system performs several self-tests every time the ignition switch is turned on and the vehicle is driven. The CAB monitors the system inputs and outputs circuits to verify the system is operating properly. If the CAB senses a malfunction in the system it will set a DTC into memory and trigger the warning lamp.

NOTE: The MDS or DRB III scan tool is used to diagnose the RWAL system. For test procedures refer to the Chassis Diagnostic Manual. For additional information refer to the Antilock brake section in Group 8W.

SERVICE PROCEDURES

ABS SERVICE PRECAUTIONS

The ABS uses an electronic control module, the CAB. This module is designed to withstand normal current draws associated with vehicle operation. Care must be taken to avoid overloading the CAB circuits. **In testing for open or short circuits, do not ground or apply voltage to any of the circuits unless instructed to do so for a diagnostic procedure.** These circuits should only be tested using a high impedance multi-meter or the DRB tester as described in this section. Power should never be removed or applied to any control module with the ignition in the ON position. Before removing or connecting battery cables, fuses, or connectors, always turn the ignition to the OFF position.

CAUTION: Use only factory wiring harnesses. Do not cut or splice wiring to the brake circuits. The addition of after-market electrical equipment (car phone, radar detector, citizen band radio, trailer lighting, trailer brakes, ect.) on a vehicle equipped with antilock brakes may affect the function of the antilock brake system.

RWAL BRAKE BLEEDING

RWAL brake bleeding can be performed manually, or with pressure bleeding equipment.

Use Mopar DOT 3 brake fluid, or an equivalent meeting SAE J1703-F and DOT 3 standards, to fill and bleed the brake system.

Bleed only one brake component at a time. Recommended bleed sequence is:
- master cylinder
- combination valve
- rear antilock valve
- left rear wheel
- right rear wheel
- right front wheel
- left front wheel

MANUAL BLEEDING

Use a bleed hose at each caliper/cylinder bleed screw. Attach one end of the hose to the bleed screw and insert the opposite end in glass container partially filled with brake fluid. A glass container makes it easier to see air bubbles as they exit the bleed hose. Be sure the end of the bleed hose remains immersed in fluid. This prevents air from being drawn back into the system.

Do not allow the master cylinder to run out of fluid when bleeding the brakes. An empty cylinder will allow air to be drawn back into the system. Check fluid level frequently during bleeding operations.

Be sure to tighten each brake line fitting, or bleed screw once bleeding is completed. Loose fittings and bleed screws allows air to enter the system.

PRESSURE BLEEDING

If pressure bleeding equipment will be used, the front brake metering valve will have to be held open to bleed the front brakes. The valve stem is located in the forward end or top of the combination valve. The stem must either be pressed inward, or held outward slightly. a spring clip tool or helper is needed to hold the valve stem in position.

Follow the manufacturers instructions carefully when using pressure equipment. Do not exceed the tank manufacturers pressure recommendations. Generally, a tank pressure of 15-20 psi is sufficient for bleeding.

Fill the bleeder tank with recommended fluid and purge air from the tank lines before bleeding.

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SERVICE PROCEDURES (Continued)

Do not pressure bleed without a proper master cylinder adapter. The wrong adapter can lead to leakage, or drawing air back into the system.

REMOVAL AND INSTALLATION

CONTROLLER

NOTE: If the CAB needs to be replaced, the rear axle type and tire revolutions per mile must be programed into the new CAB. For axle type refer to Group 3 Differential and Driveline. For tire revolutions per mile refer to Group 22 Tire and Wheels. To program the CAB refer to the Chassis Diagnostic Manual.

REMOVAL

(1) Pull up on the CAB harness connector lock release and remove the connector (Fig. 8) from the controller.

(2) Remove the RWAL valve harness connector (Fig. 8) from the controller.

(3) Remove the controller mounting screws (Fig. 9) and remove the controller from the mounting bracket.

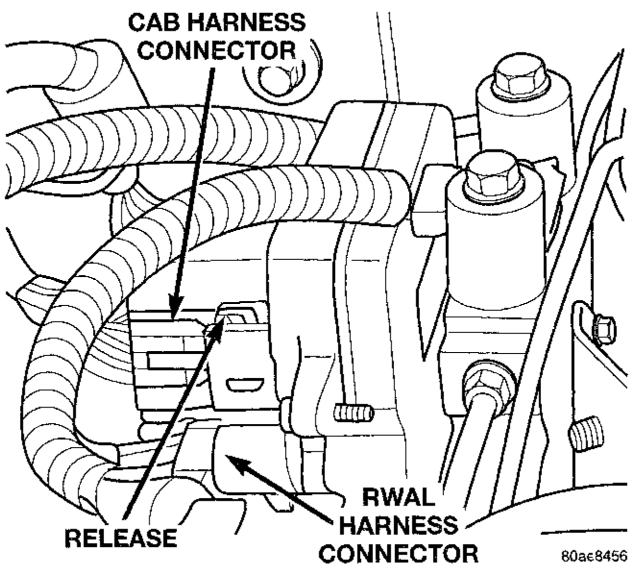

Fig. 8 CAB Harness Connections

INSTALLATION

(1) Position the controller on the bracket and install the mounting screws. Tighten the screws to 2.5-3.5 N·m (22-31 in. lbs.).

(2) Install the RWAL valve harness connector into the controller.

(3) Install the CAB harness connector into the controller and push down on the connector lock.

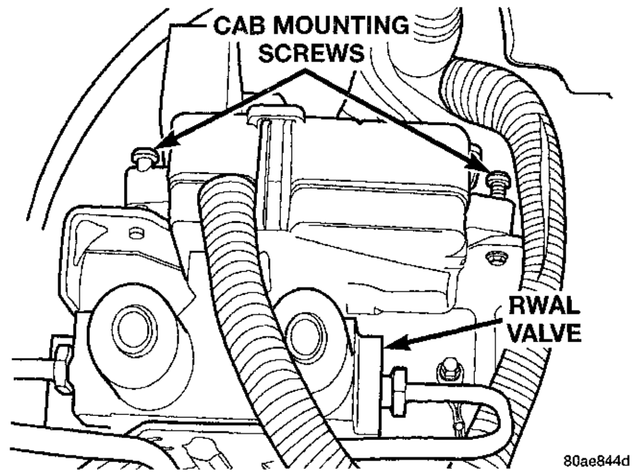

Fig. 9 CAB Mounting Screws

RWAL VALVE

REMOVAL

(1) Remove RWAL valve harness connector (Fig. 10) from the RWAL controller.

(2) Remove the brake lines from the valve.

(3) Remove the valve mounting bolt (Fig. 11) and remove the valve from the bracket.

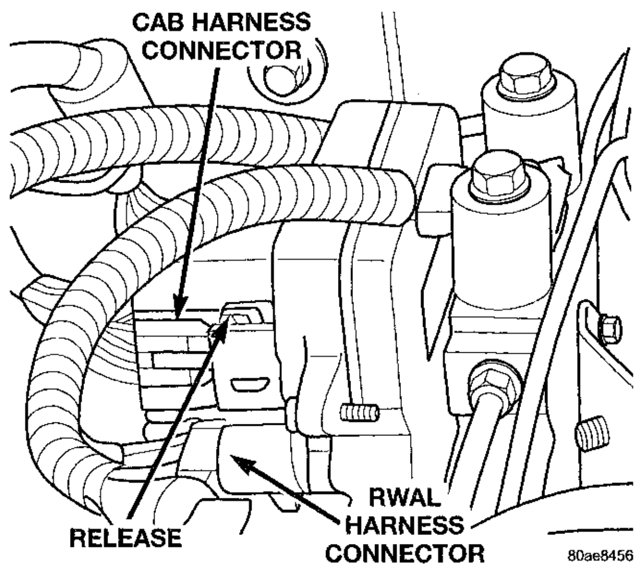

Fig. 10 RWAL Valve Harness Connector

INSTALLATION

(1) Position the valve on the bracket and install the mounting bolt. Tighten the mounting bolt to 20-27 N·m (180-240 in. lbs.).

(2) Install the brake lines and tighten to 19-23 N·m (170-200 in. lbs.).

(3) Install the RWAL valve harness connector into the RWAL controller.

(4) Bleed the brake system.

REMOVAL AND INSTALLATION (Continued)

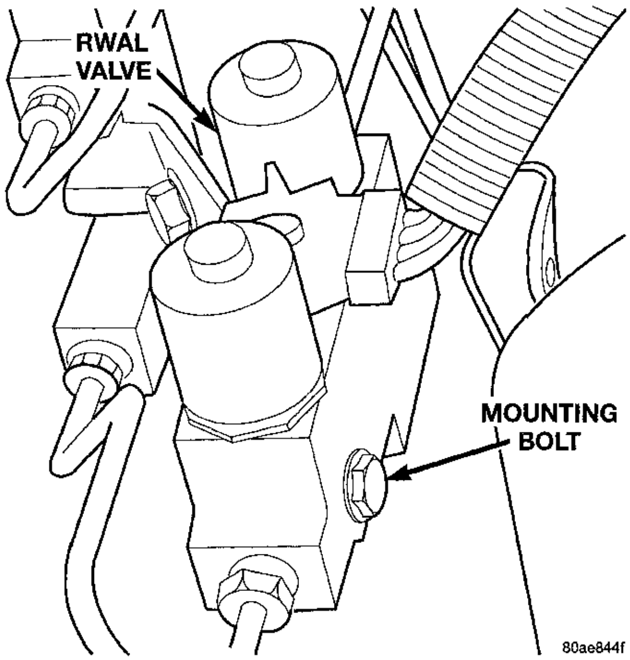

Fig. 11 RWAL Valve

REAR WHEEL SPEED SENSOR

REMOVAL

(1) Raise vehicle on hoist.
(2) Remove brake line mounting nut and remove the brake line from the sensor stud.
(3) Remove mounting stud from the sensor and shield (Fig. 12).
(4) Remove sensor and shield from differential housing.
(5) Disconnect sensor wire harness and remove sensor.

INSTALLATION

(1) Connect harness to sensor. **Be sure seal is securely in place between sensor and wiring connector.**
(2) Install O-ring on sensor (if removed).
(3) Insert sensor in differential housing.
(4) Install sensor shield.
(5) Install the sensor mounting stud and tighten to 24 N·m (18 ft. lbs.).

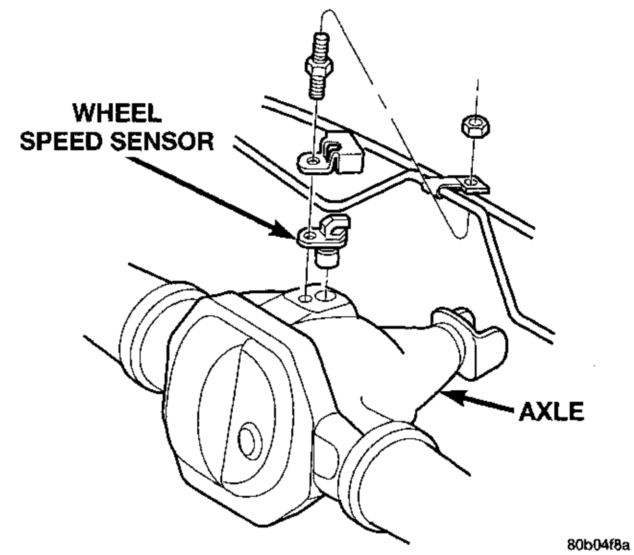

Fig. 12 Rear Speed Sensor Mounting

(6) Install the brake line on the sensor stud and install the nut.
(7) Lower vehicle.

EXCITER RING

The exciter ring is mounted on the differential case. If the ring is damaged refer to Group 3 Differential and Driveline for service procedures.

SPECIFICATIONS

TORQUE CHART

DESCRIPTION	TORQUE
CONTROLLER	
Mounting Screws	2.5-3.5 N·m (22-31 in. lbs.)
RWAL Valve	
Mounting Bolt	20-27 N·m (180-240 in. lbs.)
Brake Line Fittings	19-23 N·m (170-200 in. lbs.)
Wheel Speed Sensor	
Mounting Bolt	24 N·m (18 ft. lbs.)

AUTHENTIC RESTORATION PRODUCT

FOUR WHEEL ANTILOCK BRAKE SYSTEM

INDEX

GENERAL INFORMATION

ANTILOCK BRAKE SYSTEM

The antilock brake system (ABS) is an electronically operated, all wheel brake control system.

The system is designed to prevent wheel lockup and maintain steering control during periods of high wheel slip when braking. Preventing lockup is accomplished by modulating fluid pressure to the wheel brake units.

The hydraulic system is a three channel design. The front wheel brakes are controlled individually and the rear wheel brakes in tandem (Fig. 1). The ABS electrical system is separate from other electrical circuits in the vehicle. A specially programmed controller antilock brake unit operates the system components.

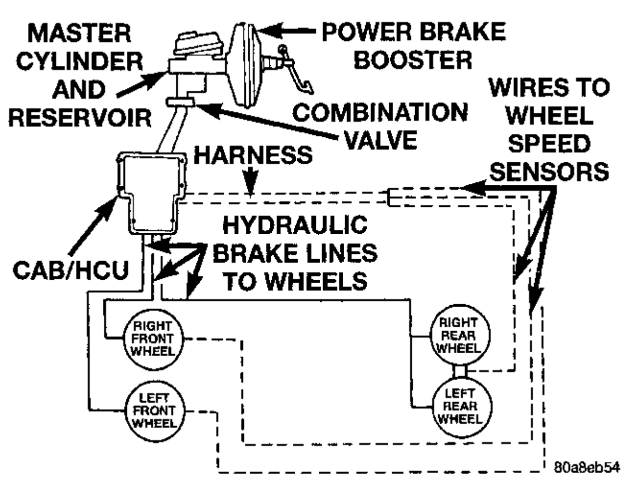

Fig. 1 Antilock Brake System

ABS system major components include:
- Controller Antilock Brakes (CAB)
- Hydraulic Control Unit (HCU)
- Wheel Speed Sensors (WSS)
- ABS Warning Light

DESCRIPTION AND OPERATION

ANTILOCK BRAKE SYSTEM

Battery voltage is supplied to the CAB ignition terminal when the ignition switch is turned to Run position. The CAB performs a system initialization procedure at this point. Initialization consists of a static and dynamic self check of system electrical components.

The static and dynamic checks occurs at ignition start up. During the dynamic check, the CAB briefly cycles the pump and solenoids to verify operation. An audible noise may be heard during this self check. This noise should be considered normal.

If an ABS component exhibits a fault during initialization, the CAB illuminates the amber warning light and registers a fault code in the microprocessor memory.

NORMAL BRAKING

The CAB monitors wheel speed sensor inputs continuously while the vehicle is in motion. However, the CAB will not activate any ABS components as long as sensor inputs indicate normal braking.

During normal braking, the master cylinder, power booster and wheel brake units all function as they would in a vehicle without ABS. The HCU components are not activated.

DESCRIPTION AND OPERATION (Continued)

ANTILOCK BRAKING

The purpose of the antilock system is to prevent wheel lockup during periods of high wheel slip. Preventing lockup helps maintain vehicle braking action and steering control.

The antilock CAB activates the system whenever sensor signals indicate periods of high wheel slip. High wheel slip can be described as the point where wheel rotation begins approaching 20 to 30 percent of actual vehicle speed during braking. Periods of high wheel slip occur when brake stops involve high pedal pressure and rate of vehicle deceleration.

The antilock system prevents lockup during high slip conditions by modulating fluid apply pressure to the wheel brake units.

Brake fluid apply pressure is modulated according to wheel speed, degree of slip and rate of deceleration. A sensor at each wheel converts wheel speed into electrical signals. These signals are transmitted to the CAB for processing and determination of wheel slip and deceleration rate.

The ABS system has three fluid pressure control channels. The front brakes are controlled separately and the rear brakes in tandem. A speed sensor input signal indicating a high slip condition activates the CAB antilock program.

Two solenoid valves are used in each antilock control channel. The valves are all located within the HCU valve body and work in pairs to either increase, hold, or decrease apply pressure as needed in the individual control channels.

The solenoid valves are not static during antilock braking. They are cycled continuously to modulate pressure. Solenoid cycle time in antilock mode can be measured in milliseconds.

CONTROLLER ANTILOCK BRAKES

The CAB is mounted on the top of the hydraulic control unit (Fig. 2).

The CAB operates the ABS system and is separate from other vehicle electrical circuits. CAB voltage source is through the ignition switch in the RUN position.

The CAB contains dual microprocessors. A logic block in each microprocessor receives identical sensor signals. These signals are processed and compared simultaneously.

The CAB contains a self check program that illuminates the ABS warning light when a system fault is detected. Faults are stored in a diagnostic program memory and are accessible with the DRB scan tool.

ABS faults remain in memory until cleared, or until after the vehicle is started approximately 50 times. Stored faults are **not** erased if the battery is disconnected.

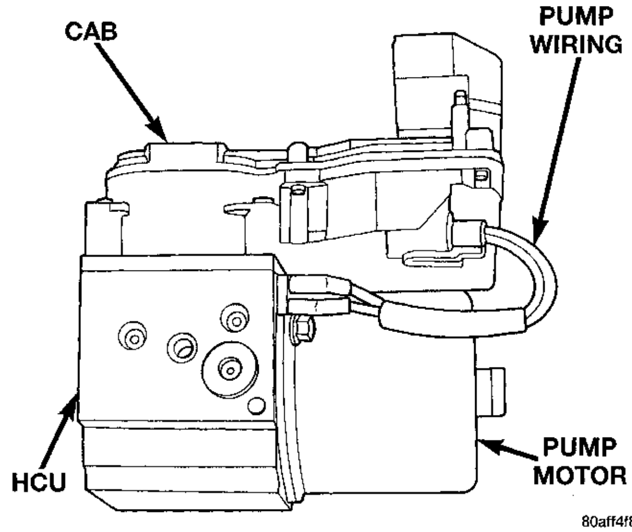

Fig. 2 CAB/HCU

NOTE: If the CAB needs to be replaced, the rear axle type and tire revolutions per mile must be programed into the new CAB. For axle type refer to Group 3 Differential and Driveline. For tire revolutions per mile refer to Group 22 Tire and Wheels. To program the CAB refer to the Chassis Diagnostic Manual.

HYDRAULIC CONTROL UNIT

The hydraulic control unit (HCU) consists of a valve body, pump, accumulator and motor (Fig. 2).

The pump, motor, and accumulator are combined into an assembly attached to the valve body. The accumulator store the extra fluid which had to be dumped from the brakes. This is done to prevent the wheels from locking up. The pump provides the fluid volume needed and is operated by a DC type motor. The motor is controlled by the CAB.

The valve body contains the solenoid valves. The valves modulate brake pressure during antilock braking and are controlled by the CAB.

The HCU provides three channel pressure control to the front and rear brakes. One channel controls the rear wheel brakes in tandem. The two remaining channels control the front wheel brakes individually.

During antilock braking, the solenoid valves are opened and closed as needed. The valves are not static. They are cycled rapidly and continuously to modulate pressure and control wheel slip and deceleration.

During normal braking, the HCU solenoid valves and pump are not activated. The master cylinder and power booster operate the same as a vehicle without an ABS brake system.

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DESCRIPTION AND OPERATION (Continued)

During antilock braking, solenoid valve pressure modulation occurs in three stages, pressure decrease, pressure hold, and pressure increase. The valves are all contained in the valve body portion of the HCU.

Pressure Decrease

The inlet valve is closed and the outlet valve is opened during the pressure decrease cycle.

A pressure decrease cycle is initiated when speed sensor signals indicate high wheel slip at one or more wheels. At this point, the CAB closes the inlet to prevent the driver from further increasing the brake pressure and locking the brakes. The CAB then opens the outlet valve, which also opens the return circuit to the accumulators. Fluid pressure is allowed to bleed off (decrease) as needed to prevent wheel lock.

Once the period of high wheel slip has ended, the CAB closes the outlet valve and begins a pressure increase or hold cycle as needed.

Pressure Hold

Both solenoid valves are closed in the pressure hold cycle. Fluid apply pressure in the control channel is maintained at a constant rate. The CAB maintains the hold cycle until sensor inputs indicate a pressure change is necessary.

Pressure Increase

The inlet valve is open and the outlet valve is closed during the pressure increase cycle. The pressure increase cycle is used to counteract unequal wheel speeds. This cycle controls re-application of fluid apply pressure due to changing road surfaces or wheel speed.

WHEEL SPEED SENSOR

The ABS brake system uses 3 wheel speed sensors. A sensor is mounted to each front steering knuckles. The third sensor is mounted on top of the rear axle differential housing. The sensor is a magnet coil that is mounted over a tone wheel front/exciter ring rear with an air gap between them.

The sensors measure the wheel speed by monitoring the rotation of the tone wheels front/exciter ring rear. As the teeth of the tone wheels front/exciter ring rear move through the magnetic field of the sensor an AC voltage is generated. This signal frequency increases or decreases proportionally to the speed of the wheel. The CAB monitors these signals for changes in wheel deceleration. If the CAB detects a sudden wheel or wheels deceleration within a predetermined amount the CAB will activate the ABS system.

ABS WARNING LAMP

The amber ABS warning lamp is located in the instrument cluster. The lamp illuminates at start-up to perform a self check. The lamp goes out when the self check program determines the system is operating normal. If an ABS component exhibits a fault the CAB will illuminate the lamp and register a trouble code in the microprocessor. The lamp is controlled by the CAB. The CAB controls the lamp by directly grounding the circuit.

DIAGNOSIS AND TESTING

ANTILOCK BRAKES

The ABS brake system performs several self-tests every time the ignition switch is turned on and the vehicle is driven. The CAB monitors the systems input and output circuits to verify the system is operating correctly. If the on board diagnostic system senses that a circuit is malfunctioning the system will set a trouble code in its memory.

NOTE: An audible noise may be heard during the self-test. This noise should be considered normal.

NOTE: The MDS or DRB III scan tool is used to diagnose the ABS system. For additional information refer to the Antilock Brake section in Group 8W. For test procedures refer to the Chassis Diagnostic Manual.

SERVICE PROCEDURES

BLEEDING ABS BRAKE SYSTEM

ABS system bleeding requires conventional bleeding methods plus use of the DRB scan tool. The procedure involves performing a base brake bleeding, followed by use of the scan tool to cycle and bleed the HCU pump and solenoids. A second base brake bleeding procedure is then required to remove any air remaining in the system.

(1) Perform base brake bleeding. Refer to base brake section for procedure.

(2) Connect scan tool to the Data Link Connector.

(3) Select ANTILOCK BRAKES, followed by MISCELLANEOUS, then ABS BRAKES. Follow the instructions displayed. When scan tool displays TEST COMPLETE, disconnect scan tool and proceed.

(4) Perform base brake bleeding a second time. Refer to base brake section for procedure.

(5) Top off master cylinder fluid level and verify proper brake operation before moving vehicle.

REMOVAL AND INSTALLATION

CONTROLLER ANTILOCK BRAKES

NOTE: If the CAB needs to be replaced, the rear axle type and tire revolutions per mile must be programed into the new CAB. For axle type refer to Group 3 Differential and Driveline. For tire revolutions per mile refer to Group 22 Tire and Wheels. To program the CAB refer to the Chassis Diagnostic Manual.

REMOVAL

(1) Disconnect battery negative cable.
(2) Push the harness connector locks to release the locks, (Fig. 3) then remove the connectors from the CAB.
(3) Disconnect the pump motor connector (Fig. 4).
(4) Remove screws attaching CAB to the HCU (Fig. 5).
(5) Remove the CAB.

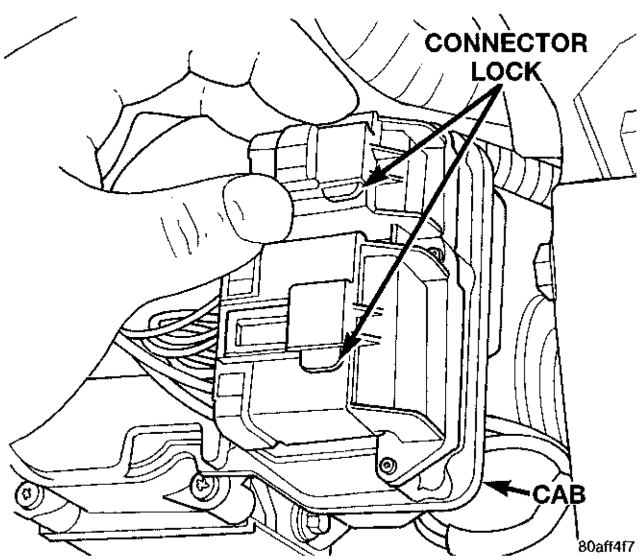

Fig. 3 Harness Connector Locks

INSTALLATION

(1) Place the CAB onto the HCU.

NOTE: Insure the CAB seal is in position before installation.

(2) Install the mounting screws and tighten to 4-4.7 N·m (36-42 in. lbs.).
(3) Connect the pump motor harness.
(4) Connect the harnesses to the CAB and lock the connectors.
(5) Connect battery.

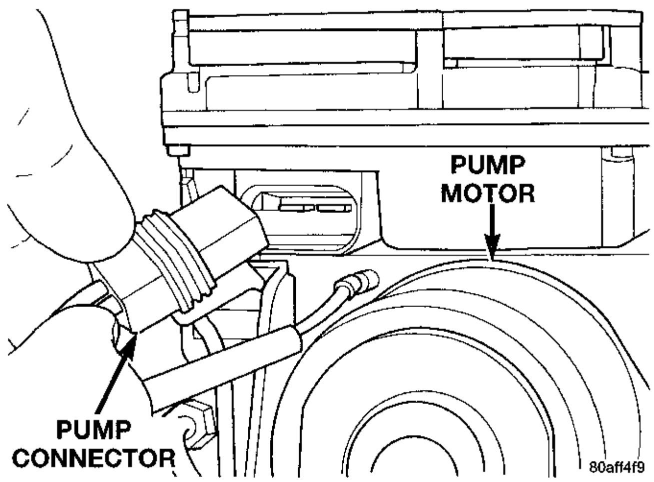

Fig. 4 Pump Motor Connector

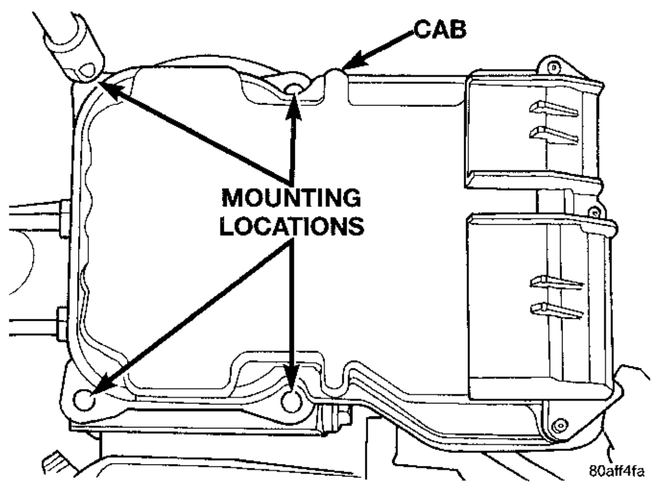

Fig. 5 Controller Mounting Screws

ANTILOCK CONTROL ASSEMBLY

NOTE: If the antilock control assembly needs to be replaced, the rear axle type and tire revolutions per mile must be programed into the new CAB. For axle type refer to Group 3 Differential and Driveline. For tire revolutions per mile refer to Group 22 Tire and Wheels. To program the CAB refer to the Chassis Diagnostic Manual.

REMOVAL

(1) Disconnect battery negative cable.
(2) Push the harness connector locks to release the locks, (Fig. 3) then remove the connectors from the CAB.
(3) Disconnect brake lines from HCU (Fig. 6).
(4) Remove the two mounting bolts on either side of the assembly which attach the assembly to the mounting bracket.
(5) Tilt the assembly upward were the brake lines attach and remove the assembly from the mounting bracket.

AUTHENTIC RESTORATION PRODUCT

REMOVAL AND INSTALLATION (Continued)

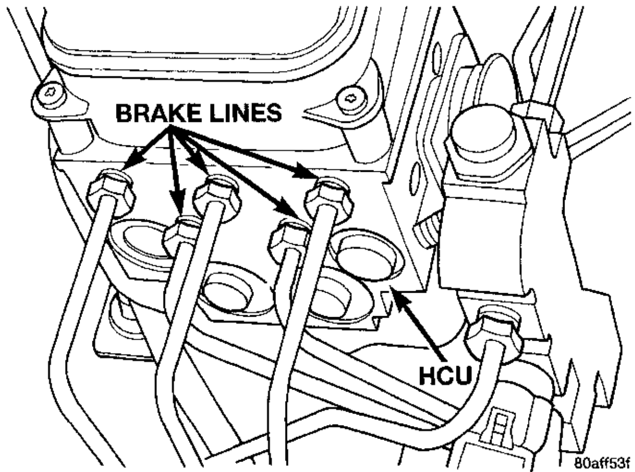

Fig. 6 Brake Lines

INSTALLATION

(1) Install the assembly into the mounting bracket.
(2) Install the mounting bolts and tighten to 12 N·m (102 in. lbs.).
(3) Connect the CAB harnesses.
(4) Connect the brake lines to the HCU. Tighten brake line fittings to 19-23 N·m (170-200 in. lbs.).
(5) Connect battery.
(6) Bleed brake system.

FRONT WHEEL SPEED SENSOR – 2WD

REMOVAL

(1) Raise vehicle and support vehicle front end.
(2) Remove wheel and tire assembly.
(3) Disconnect the ABS wheel speed sensor wire from under the hood. Remove sensor wire from the frame and steering knuckle.
(4) Remove brake caliper.
(5) Remove rotor.
(6) Remove bolts attaching sensor to steering knuckle and remove the sensor (Fig. 7).

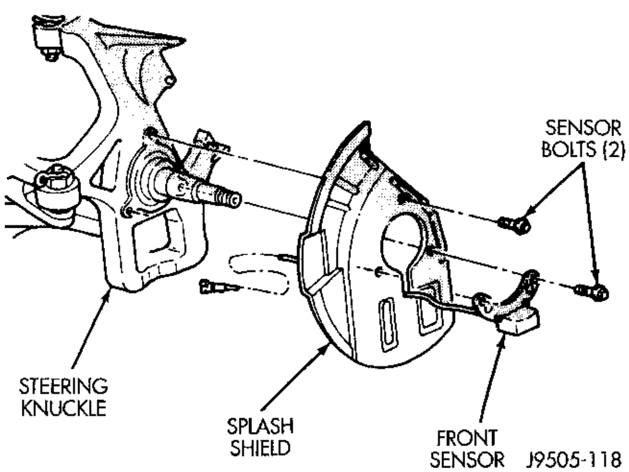

Fig. 7 Front Speed Sensor Mounting – 2WD

INSTALLATION

(1) Position sensor in knuckle.
(2) Install and tighten sensor bolts to 23 N·m (17 ft. lbs.). **Use original or replacement sensor bolts only. The bolts are special and must not be substituted.**
(3) Install sensor wire to the steering knuckle and frame. Connect the wheel speed sensor wire under the hood.
(4) Check sensor wire routing. Be sure wire is clear of all chassis components and is not twisted or kinked at any spot.
(5) Install rotor and brake caliper.
(6) Install wheel and tire assembly.
(7) Remove support and lower the vehicle.
(8) Apply brakes several times to seat brake shoes and caliper piston. Do not move vehicle until firm brake pedal is obtained.
(9) Verify sensor operation with scan tool.

FRONT WHEEL SPEED SENSOR – 4WD

REMOVAL

(1) Raise and support vehicle.
(2) Remove wheel and tire assembly.
(3) Disconnect the ABS wheel speed sensor wire from under the hood. Remove sensor wire from the frame and steering knuckle.
(4) Remove brake caliper.
(5) Remove rotor on models with 5 wheel studs. On models with 8 studs remove rotor hub bearing assembly and separate the rotor from the hub bearing.
(6) Remove bolt attaching sensor to the hub bearing (Fig. 8).
(7) Remove sensor and wire.

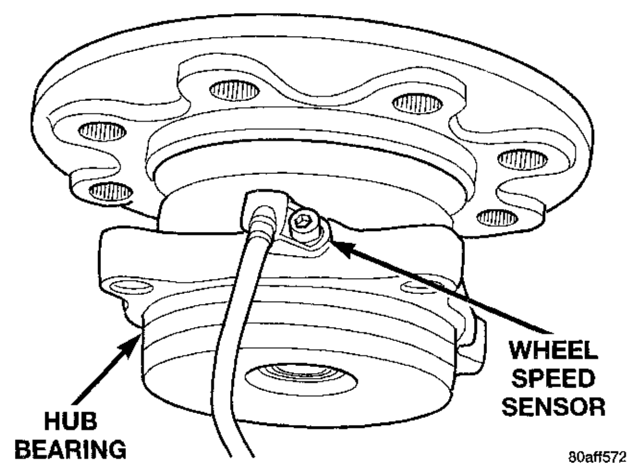

Fig. 8 Wheel Speed Sensor

INSTALLATION

(1) Install the sensor in the hub bearing and tighten the bolt to 14 N·m (11 ft. lbs.). **Use original or replacement sensor bolts only. The bolts are special and must not be substituted.**

REMOVAL AND INSTALLATION (Continued)

(2) Install the rotor on models with 5 wheel studs. On models with 8 studs install the rotor on the hub bearing and install the assembly on the knuckle.

(3) Install sensor wire to the steering knuckle and frame. Connect the wheel speed sensor wire under the hood.

(4) Check sensor wire routing. Be sure wire is clear of all chassis components and is not twisted or kinked at any spot.

(5) Install brake caliper.

(6) Install wheel and tire assemblies.

(7) Remove support and lower the vehicle.

(8) Apply brakes several times to seat brake shoes and caliper piston. Do not move vehicle until firm brake pedal is obtained.

(9) Verify sensor operation with scan tool.

TONE WHEEL

The tone wheel for the front speed sensor is located in the rotor hub on 2-wheel drive models (Fig. 9). On 4-wheel drive models, the tone wheel is located in the hub/bearing housing.

The tone wheel is not a serviceable component. On 2-wheel drive models, the complete rotor and hub assembly will have to be replaced if the tone wheel is damaged. On 4-wheel drive models, the hub/bearing must be replaced, if the tone wheel is damaged.

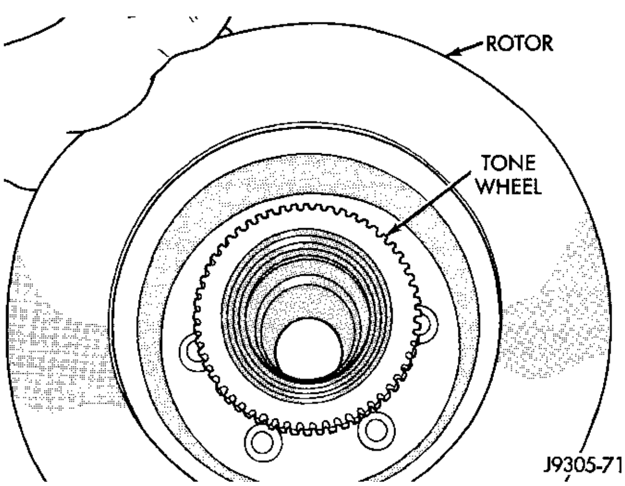

Fig. 9 Tone Wheel 2WD

REAR WHEEL SPEED SENSOR

REMOVAL

(1) Raise vehicle on hoist.

(2) Remove brake line mounting nut and remove the brake line from the sensor stud.

(3) Remove mounting stud from the sensor and shield (Fig. 10).

(4) Remove sensor and shield from differential housing.

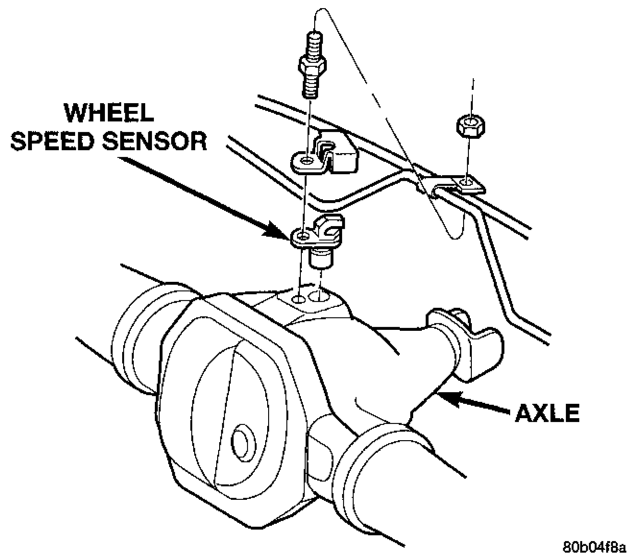

Fig. 10 Rear Speed Sensor Mounting

(5) Disconnect sensor wire harness and remove sensor.

INSTALLATION

(1) Connect harness to sensor. **Be sure seal is securely in place between sensor and wiring connector.**

(2) Install O-ring on sensor (if removed).

(3) Insert sensor in differential housing.

(4) Install sensor shield.

(5) Install the sensor mounting stud and tighten to 24 N·m (18 ft. lbs.).

(6) Install the brake line on the sensor stud and install the nut.

(7) Lower vehicle.

EXCITER RING

The exciter ring is mounted on the differential case. If the ring is damaged refer to Group 3 Differential and Driveline for service procedures.

SPECIFICATIONS

TORQUE CHART

DESCRIPTION	TORQUE
ABS Assembly	
Bracket Bolts	10-16 N·m (120-144 in. lbs.)
Mounting Nuts	12 N·m (102 in. lbs.)
CAB Screws	4-4.7 N·m (36-42 in. lbs.)
Brake Lines	19-23 N·m (170-200 in. lbs.)
Wheel Speed Sensor	
Ft. Bolts (2WD)	23 N·m (17 ft. lbs.)
Ft. Bolt (4WD)	14 N·m (11 ft. lbs.)
Rear Bolt	24 N·m (18 ft. lbs.)

AUTHENTIC RESTORATION PRODUCT

CLUTCH

CONTENTS

GENERAL INFORMATION

CLUTCH COMPONENTS

The clutch mechanism in BR models with a gas or diesel engine consists of a single, dry-type clutch disc and a diaphragm style clutch cover. A hydraulic linkage is used to engage/disengage the clutch disc and cover.

The transmission input shaft is supported in the crankshaft by a bearing. A sleeve type release bearing is used to engage and disengage the clutch cover pressure plate.

The release bearing is operated by a release fork in the clutch housing. The fork pivots on a ball stud mounted inside the housing. The release fork is actuated by a hydraulic slave cylinder mounted in the housing. The slave cylinder is operated by a clutch master cylinder mounted on the dash panel. The cylinder push rod is connected to the clutch pedal.

The clutch disc has damper springs in the disc hub. The clutch disc facing is riveted to the hub. The facing is made from a non-asbestos material. The clutch cover pressure plate is a diaphragm type with a one-piece spring and multiple release fingers. The pressure plate release fingers are preset during manufacture and are not adjustable.

CLUTCH DISC APPLICATION

Two clutch disc diameters and four different thicknesses are used.

A 281 mm (11 in.) diameter clutch disc is used with a 3.9L, 5.2L, or 5.9L gas engines (Fig. 1) and (Fig. 2).

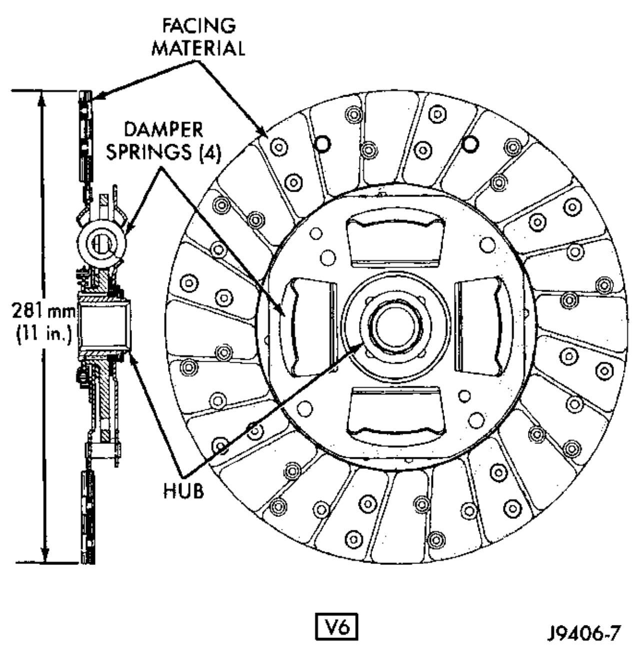

Fig. 1 Clutch Disc—V6 Engine

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GENERAL INFORMATION (Continued)

A 312.5 mm (12.3 in.) diameter clutch disc is used with diesel and V10 engines (Fig. 3) and (Fig. 4).

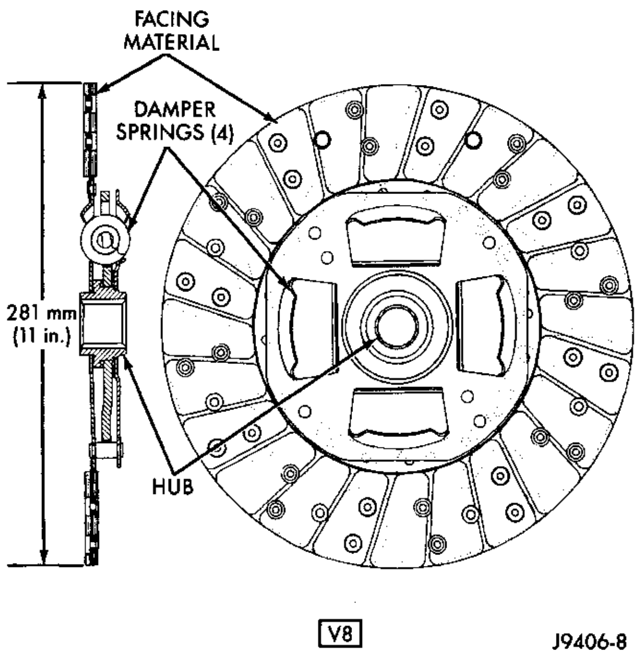


Fig. 2 Clutch Disc—V8 Engine

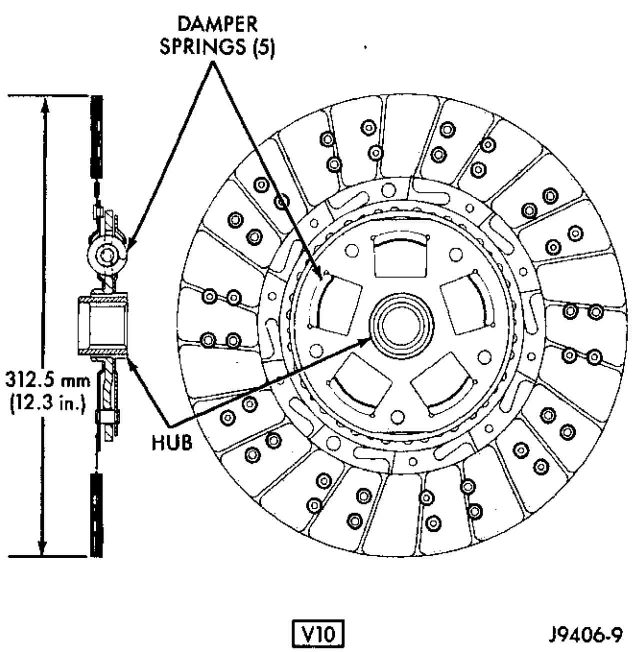


Fig. 3 Clutch Disc—V10 Engine

All the discs have damper springs in the hub. The 281 mm discs have four springs while the 312.5 mm disc has five springs. The damper springs provide smoother torque transfer and disc engagement.

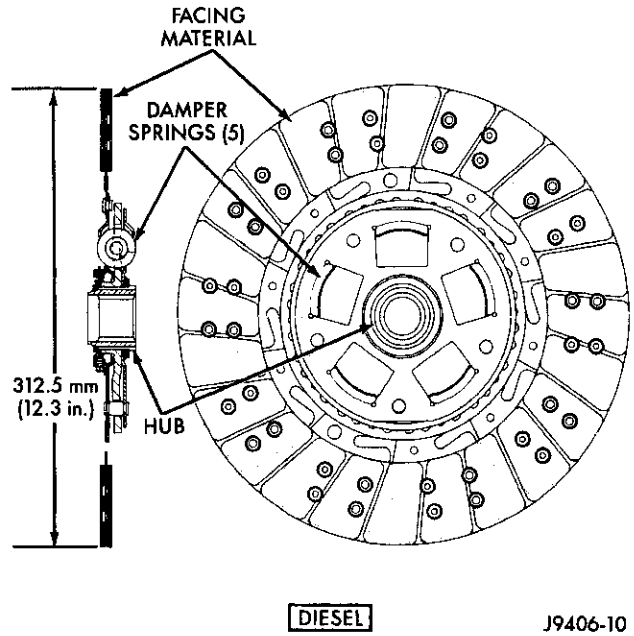


Fig. 4 Clutch Disc—Diesel Engine

CLUTCH COVER APPLICATION

Two clutch covers are used for all applications. The 281 mm cover (Fig. 5) is used for 3.9L, 5.2L and 5.9L gas engine applications.

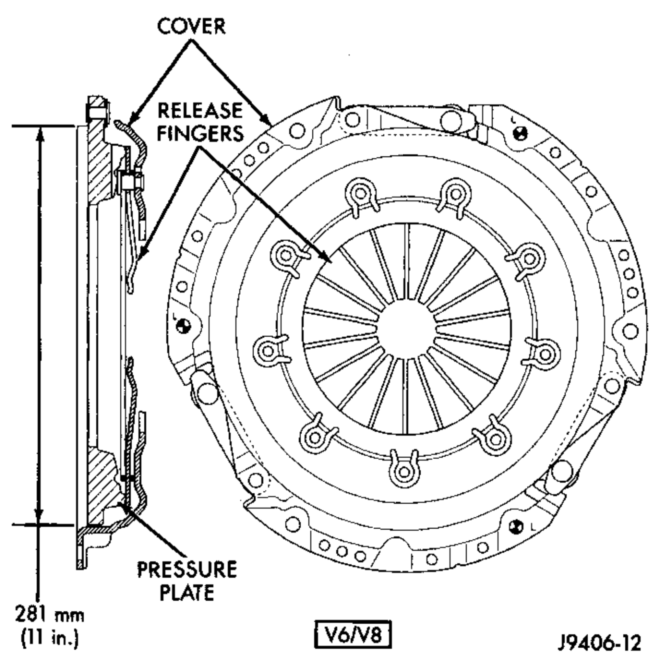


Fig. 5 Clutch Cover—V6/V8 Gas Engine

The 312.5 mm cover (Fig. 6), is used for 5.9L diesel and V10 gas engine applications.

AUTHENTIC RESTORATION PRODUCT

GENERAL INFORMATION (Continued)

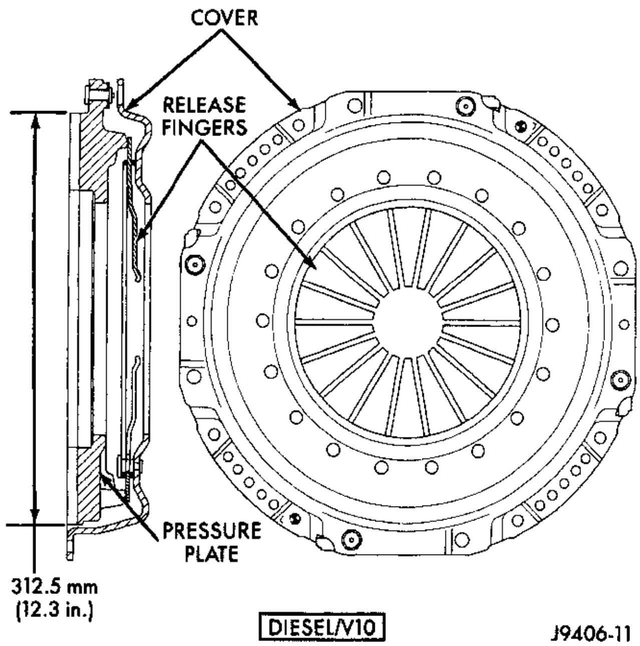


Fig. 6 Clutch Cover—V10 and Diesel Engine

CLUTCH HYDRAULIC LINKAGE

The hydraulic linkage consists of a remote reservoir, clutch master cylinder, clutch slave cylinder and interconnecting fluid lines (Fig. 7).

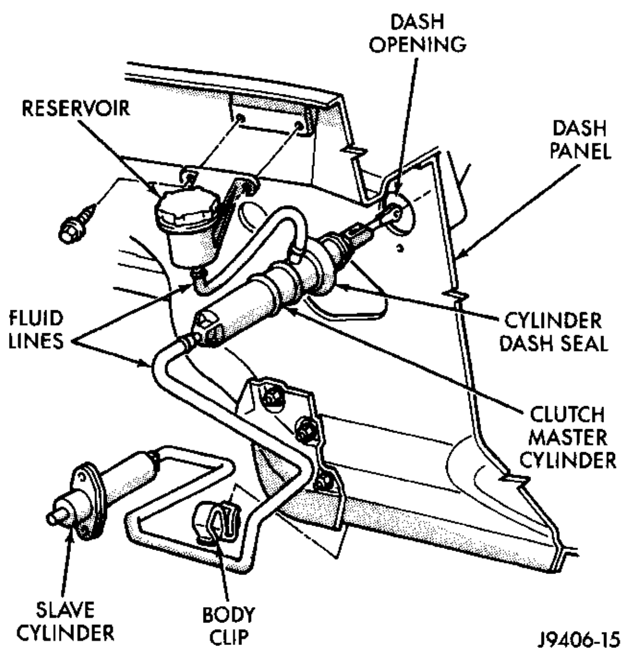


Fig. 7 Clutch Hydraulic Linkage

The clutch master cylinder is connected to the clutch pedal and the slave cylinder is connected to the clutch release fork. The master cylinder is mounted on the drivers' side of the dash panel adjacent to the brake master cylinder.

CLUTCH HYDRAULIC FLUID

The clutch hydraulic linkage cylinders and lines are prefilled with fluid at the factory.

The hydraulic system should not require additional fluid under normal circumstances. In fact, the reservoir fluid level will actually increase as normal clutch wear occurs. For this reason, it is important to avoid overfilling, or removing fluid from the reservoir. This action will cause clutch release problems.

If inspection or diagnosis indicates additional fluid may be needed, it will be necessary to replace the complete hydraulic linkage assembly.

CLUTCH LUBRICATION

Proper clutch component lubrication is important to satisfactory operation. Using the correct lubricant and avoiding over lubrication are also equally important.

During service, apply recommended lubricant sparingly. Do not overlubricate as this could result in clutch disc and pressure plate contamination.

Clutch and transmission components requiring lubrication are:

- pilot bearing.
- release lever pivot ball stud.
- release lever pivot surfaces.
- release bearing bore.
- clutch pedal pivot bore and bushings.
- transmission input shaft splines and pilot hub.
- release bearing slide surface of front bearing retainer.
- master cylinder bushing at the clutch pedal.

Do not apply grease to any part of the clutch cover or disc.

Use Mopar® multi-mileage grease or a silicone grease for the clutch pedal bushings and pivot shaft.

Use Mopar® high temperature bearing grease or equivalent for the pilot bearing, release bearing bore, transmission input shaft and release fork components. Apply recommended amounts only and do not overlubricate.

GENERAL INFORMATION (Continued)

CLUTCH PEDAL POSITION SWITCH

All BR models are equipped with a clutch pedal position switch (Fig. 8). The switch is in circuit with the starter relay and is mounted on the clutch master cylinder push rod. The switch is actuated by clutch pedal movement. The clutch pedal must be fully depressed in order to start the engine.

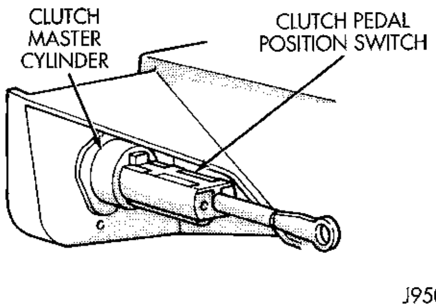


Fig. 8 Clutch Pedal Position (Interlock) Switch

The position switch is an integral part of the clutch master cylinder push rod and is not serviced separately.

Refer to Group 8W, Wiring Diagrams for component locations and circuit information.

DIAGNOSIS AND TESTING

GENERAL INFORMATION

Problem diagnosis will generally require a road test to determine the type of fault. Component inspection will then determine the problem cause after road testing.

Drive the vehicle at normal speeds during the road test. Shift the transmission through all gear ranges and observe clutch action.

If chatter, grab, slip, or improper release is experienced, remove and inspect the clutch components. However, if the problem is noise or hard shifting, further diagnosis may be needed. The transmission or another driveline component may actually be at fault. Careful observation during the test will help narrow the problem area.

CLUTCH CONTAMINATION

Fluid contamination is a frequent cause of clutch malfunctions. Oil, grease, water, or other fluids on the clutch contact surfaces will cause faulty operation. The usual result is chatter, slip and grab.

During inspection, note if any components are contaminated. Look for evidence of oil, grease, clutch hydraulic fluid, or water/road splash on clutch components.

Oil contamination indicates a leak at either the rear main seal or transmission input shaft. Oil leaks produce a residue of oil on the housing interior and on the clutch cover and flywheel. Heat buildup caused by slippage between the clutch cover, disc, and flywheel can sometimes bake the oil residue onto the components. The glaze-like residue ranges in color from amber to black.

Road splash contamination means dirt/water is entering the clutch housing. This may be due to loose bolts, housing cracks, or through the slave cylinder opening. Driving through deep water puddles can force water/road splash into the housing through such openings.

Clutch fluid leaks are from loose or damaged clutch linkage fluid lines or connections. However, most clutch fluid leaks will usually be noted and corrected before severe contamination occurs.

Grease contamination is usually a product of excessive lubrication during clutch service. Apply only a small amount of grease to the input shaft splines, bearing retainer, pilot bearing, release fork and pivot stud. Excess grease can be thrown off during operation and contaminate the disc.

IMPROPER CLUTCH RELEASE OR ENGAGEMENT

Clutch release or engagement problems are caused by wear, or damage to one or more clutch components. A visual inspection of the release components will usually reveal the problem part.

Release problems can result in hard shifting and noise. Items to look for are: leaks at the clutch cylinders and interconnecting line; loose slave cylinder bolts; worn/loose release fork and pivot stud; damaged release bearing; and a worn clutch disc, or pressure plate.

Normal condensation in vehicles that are stored or out of service for long periods of time can generate enough corrosion to make the disc stick to the flywheel, or pressure plate. If this condition is experienced, correction only requires that the disc be loosened manually through the inspection plate opening.

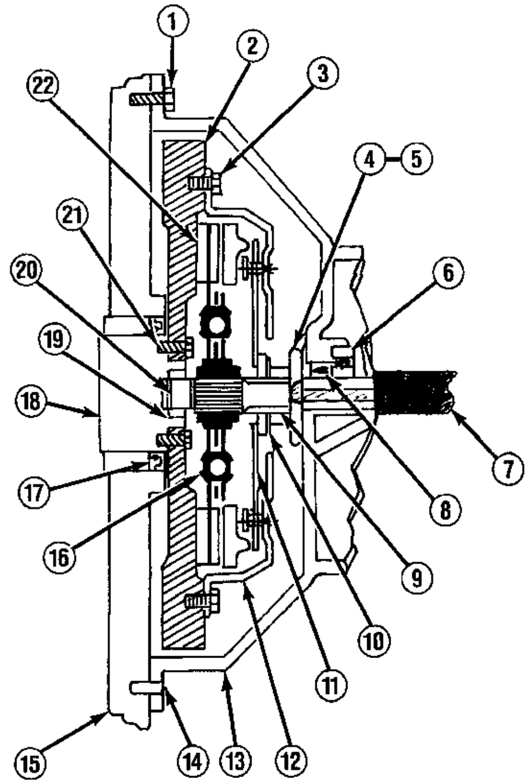
Engagement problems usually result in slip, chatter/shudder, and noisy operation. The primary causes are clutch disc contamination; clutch disc wear; misalignment, or distortion; flywheel damage; or a combination of the foregoing. A visual inspection is required to determine the part actually causing the problem.

CLUTCH RUNOUT

CLUTCH DISC

Check the clutch disc before installation. Axial (face) runout of a new disc should not exceed 0.5 mm (0.020 in.). Measure runout about 6 mm (1/4 in.) from the outer edge of the disc facing. Obtain another disc if runout is excessive.

DIAGNOSIS AND TESTING (Continued)



1 Check clutch housing bolts. Tighten if loose. Be sure housing is fully seated on engine block.

2 Check flywheel. Scuff sand face to remove glaze. Clean surface with wax and grease remover. Replace flywheel if severely scored, worn or cracked. Secure flywheel with new bolts (if removed). Do not reuse old bolts. Use Mopar Lock N'Seal on bolts.

3 Tighten clutch cover bolts 2-3 threads at a time, alternately and evenly (in a star pattern) to specified torque. Failure to do so could warp the cover.

4 Check release fork. Replace fork if bent or worn. Make sure pivot and bearing contact surfaces are lubricated.

5 Check release fork pivot (in housing). Be sure pivot is secure and ball end is lubricated.

6 Transmission input shaft bearing will cause noise, chatter, or improper release if damaged. Check condition before installing transmission.

7 Check slave cylinder. Replace it if leaking. Be sure cylinder is properly secured in housing and cylinder piston is seated in release fork.

8 Check input shaft seal if clutch cover and disc were oil covered. Replace seal if worn, or cut.

9 Inspect release bearing slide surface of trans. front bearing retainer. Surface should be smooth, free of nicks, scores. Replace retainer if necessary. Lubricate slide surface before installing release bearing.

10 Do not replace release bearing unless actually faulty. Replace bearing only if seized, noisy, or damaged.

11 Check clutch cover diaphragm spring and release fingers. Replace cover if spring or fingers are bent, warped, broken, cracked. Do not tamper with factory spring setting as clutch problems will result.

12 Check condition of clutch cover. Replace clutch cover if plate surface is deeply scored, warped, worn, or cracked. Be sure cover is correct size and properly aligned on disc and flywheel.

13 Inspect clutch housing. Be sure bolts are tight. Replace housing if damaged.

14 Verify that housing alignment dowels are in position before installing housing.

15 Clean engine block surface before installing clutch housing. Dirt, grime can produce misalignment.

16 Make sure side of clutch disc marked "flywheel side" is toward flywheel.

17 Check rear main seal if clutch disc and cover were oil covered. Replace seal if necessary.

18 Check crankshaft flange (if flywheel is removed). Be sure flange is clean and flywheel bolt threads are in good condition.

19 Check pilot bearing. Replace bearing if damaged. Lube with Mopar high temp. bearing grease before installation.

20 Check transmission input shaft. Disc must slide freely on shaft splines. Lightly grease splines before installation. Replace shaft if splines or pilot bearing hub are damaged.

21 Check flywheel bolt torque. If bolts are loose, replace them. Use Mopar Lock N'Seal to secure new bolts.

22 Check clutch disc facing. Replace disc if facing is charred, scored, flaking off, or worn. Also check runout of new disc. Runout should not exceed 0.5 mm (0.02 in.).

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Clutch Components

DIAGNOSIS AND TESTING (Continued)

CLUTCH COVER

Check condition of the clutch cover before installation. A warped cover or diaphragm spring will cause grab and incomplete release or engagement. Be careful when handling the cover and disc. Impact can distort the cover, diaphragm spring, release fingers and the hub of the clutch disc.

Use an alignment tool when positioning the disc on the flywheel. The tool prevents accidental misalignment which could result in cover distortion and disc damage.

A frequent cause of clutch cover distortion is improper bolt tightening. To avoid warping the cover, the bolts must be tightened in a diagonal pattern and only 2–3 threads at a time to the specified torque.

FLYWHEEL

Flywheel runout should not exceed 0.08 mm (0.003 in.). Measure runout at the outer edge of the flywheel face with a dial indicator. Mount the indicator on a stud installed in place of one of the clutch housing bolts.

Common causes of runout are:

- heat warpage.
- improper machining.
- incorrect bolt tightening.
- improper seating on crankshaft flange shoulder.
- foreign material on crankshaft flange.

Flywheel machining is not recommended. The flywheel clutch surface is machined to a unique contour and machining will negate this feature. However, minor flywheel scoring can be cleaned up by hand with 180 grit emery, or with surface grinding equipment. Remove only enough material to reduce scoring (approximately 0.001 - 0.003 in.). Heavy stock removal is **not recommended.** Replace the flywheel if scoring is severe and deeper than 0.076 mm (0.003 in.). Excessive stock removal can result in flywheel cracking or warpage after installation; it can also weaken the flywheel and interfere with proper clutch release.

Clean the crankshaft flange before mounting the flywheel. Dirt and grease on the flange surface may cock the flywheel causing excessive runout. Use new bolts when remounting a flywheel and secure the bolts with Mopar® Lock And Seal. Tighten flywheel bolts to specified torque only. Overtightening can distort the flywheel hub causing runout.

NV4500 CLUTCH HOUSING

CHECKING RUNOUT

Only the NV4500 clutch housing can be checked using the following bore and face runout procedures. The NV3500 clutch housing is an integral part of the transmission front case and can only be checked off the vehicle.

MEASURING CLUTCH HOUSING BORE RUNOUT

(1) Remove the clutch housing and strut.

(2) Remove the clutch cover and disc.

(3) Replace one of the flywheel bolts with an appropriate size threaded rod that is 10 in. (25.4 cm) long (Fig. 9). The rod will be used to mount the dial indicator.

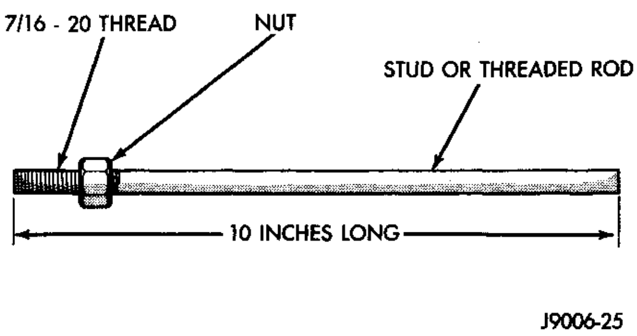

Fig. 9 Dial Indicator Mounting Stud Or Rod

(4) Remove the release fork from the clutch housing.

(5) Reinstall the clutch housing. Tighten the housing bolts nearest the alignment dowels first.

(6) Mount the dial indicator on the threaded rod and position the indicator plunger on the surface of the clutch housing bore (Fig. 10).

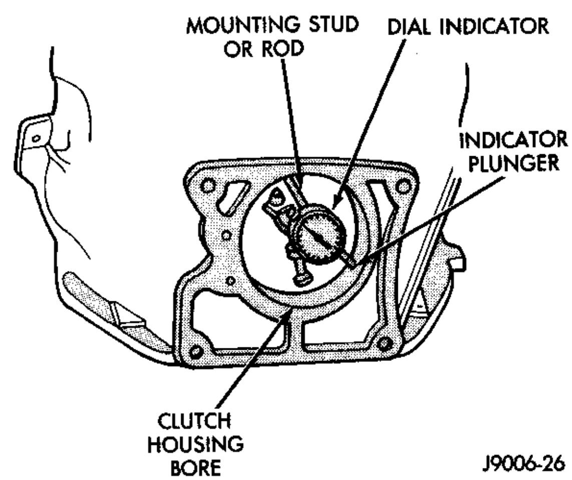

Fig. 10 Checking Clutch Housing Bore Runout

(7) Rotate the crankshaft until the indicator plunger is at the top center of the housing bore. Zero the indicator at this point.

(8) Rotate the crankshaft and record the indicator readings at eight points (45° apart) around the bore (Fig. 10). Repeat the measurement at least twice for accuracy.

(9) Subtract each reading from the one 180° opposite to determine magnitude and direction of runout. Refer to (Fig. 11) and following example.

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DIAGNOSIS AND TESTING (Continued)

Bore runout example:
0.000 – (–0.007) = 0.007 in.
+0.002 – (–0.010) = 0.012 in.
+0.004 – (–0.005) = 0.009 in.
–0.001 – (+0.001) = –0.002 in. (= 0.002 inch)

In the above example, the largest difference is 0.012 in. and is called the total indicator reading (TIR). This means that the housing bore is offset from the crankshaft centerline by 0.006 in. (which is 1/2 of 0.012 in.).

On gas engines, the acceptable maximum TIR for housing bore runout is 0.010 inch. If measured TIR is more than 0.010 in. (as in the example), bore runout will have to be corrected with offset dowels. Offset dowels are available in 0.007, 0.014 and 0.021 in. sizes for this purpose (Fig. 11). Refer to Correcting Housing Bore Runout for dowel installation.

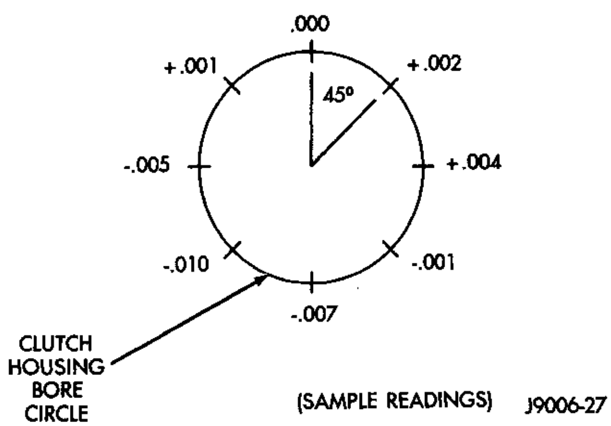


Fig. 11 Housing Bore Measurement Points And Sample Readings

On diesel engines, the acceptable maximum TIR for housing bore runout is 0.015 inch. However, unlike gas engines, offset dowels are not available to correct runout on diesel engines. **If bore runout exceeds the stated maximum on a diesel engine, it may be necessary to replace either the clutch housing, or transmission adapter plate.**

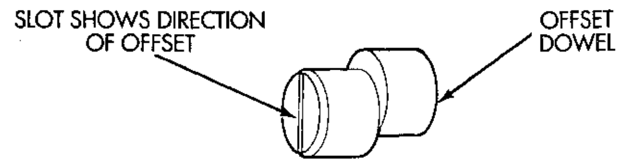
Correcting Clutch Housing Bore Runout— Engine Only

On gas engine vehicles, clutch housing bore runout can be corrected with offset dowels.

The dial indicator reads positive when the plunger moves inward (toward indicator) and negative when it moves outward (away from indicator). As a result, the lowest or most negative reading determines the direction of housing bore offset (runout).

In the sample readings shown (Fig. 12) and in Step 7 above, the bore is offset toward the 0.010 inch reading. To correct this, remove the housing and original dowels. Then install the new offset dowels in the direction needed to center the bore with the crankshaft centerline.

In the example, TIR was 0.012 inch. The dowels needed for correction would have an offset of 0.007 in. (Fig. 12).



DOWEL SELECTION

TIR VALUE	OFFSET DOWEL REQUIRED
0.011 – 0.021 inch	0.007 inch
0.022 – 0.035 inch	0.014 inch
0.036 – 0.052 inch	0.021 inch

J9206-7

Fig. 12 Housing Bore Alignment Dowel Selection

Install the dowels with the slotted side facing out so they can be turned with a screwdriver. Then install the housing, remount the dial indicator and check bore runout again. Rotate the dowels until the TIR is less than 0.010 in. if necessary.

If a TIR of 0.053 in., or greater is encountered, it will be necessary to replace the clutch housing.

Measuring Clutch Housing Face Runout

(1) Reposition the dial indicator plunger on the housing face (Fig. 13). Place the indicator plunger at the rim of the housing bore as shown.

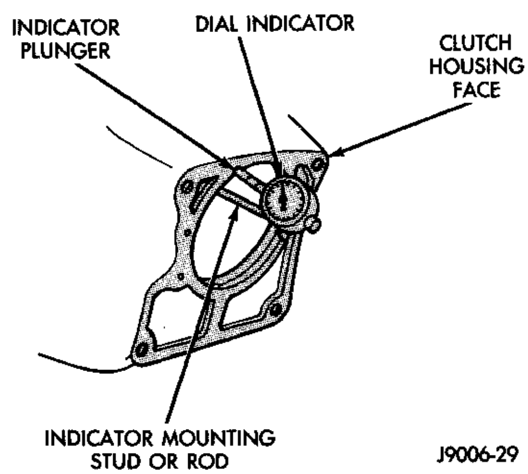


Fig. 13 Measuring Clutch Housing Face Runout

(2) Rotate the crankshaft until the indicator plunger is at the 10 O'clock position on the bore. Then zero the dial indicator.

AUTHENTIC RESTORATION

DIAGNOSIS AND TESTING (Continued)

(3) Measure and record face runout at four points 90° apart around the housing face (Fig. 14). Perform the measurement at least twice for accuracy.

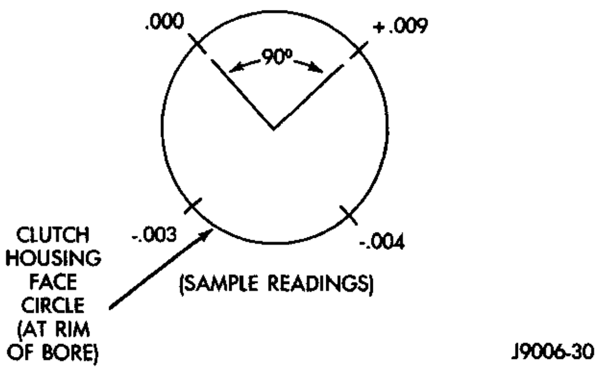


Fig. 14 Housing Face Measurement Points And Sample Readings

(4) Subtract the lowest reading from the highest to determine total runout. As an example, refer to the sample readings shown (Fig. 16). If the low reading was **minus** 0.004 in. and the highest reading was **plus** 0.009 in., total runout is actually 0.013 inch.

(5) Total allowable face runout is 0.010 inch. If runout exceeds this figure, runout will have to be corrected. Refer to Correcting Clutch Housing Face Runout.

CORRECTING CLUTCH HOUSING FACE RUNOUT

Housing face runout, on gas or diesel engines, can be corrected by installing shims between the clutch housing and transmission (Fig. 15). The shims can be made from shim stock or similar materials of the required thickness.

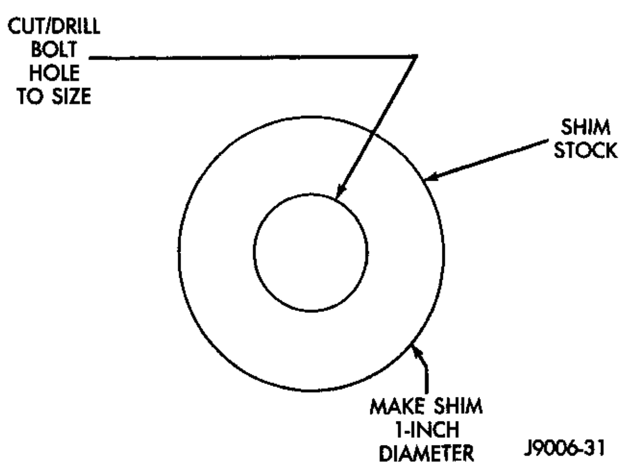


Fig. 15 Housing Face Alignment Shims

As an example, assume that face runout is the same as shown in (Fig. 16) and in Step 4. In this case, three shims will be needed. Shim thicknesses should be 0.009 in. (at the 0.000 corner), 0.012 in. (at the –0.003 corner) and 0.013 in. (at the –0.004 corner).

After installing the clutch assembly and housing, tighten the housing bolts nearest the alignment dowels first.

Clutch housing preferred bolt torques are:

- 41 N·m (30 ft. lbs.) for 3/8 in. diameter bolts
- 68 N·m (50 ft. lbs.) for 7/16 in. diameter bolts
- 47 N·m (35 ft. lbs.) for V10 and diesel clutch housing bolts

During final transmission installation, install the shims between the clutch housing and transmission at the appropriate bolt locations.

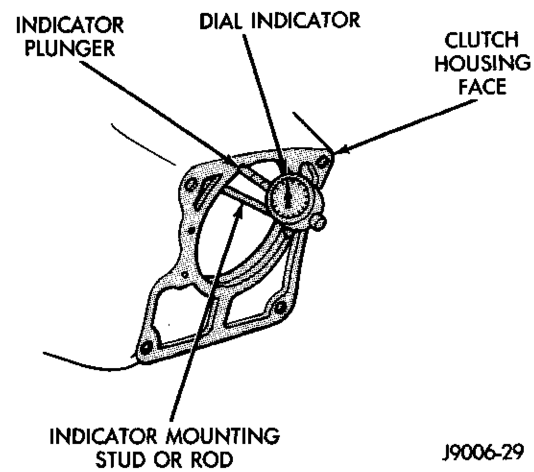


Fig. 16 Measuring Clutch Housing Face Runout

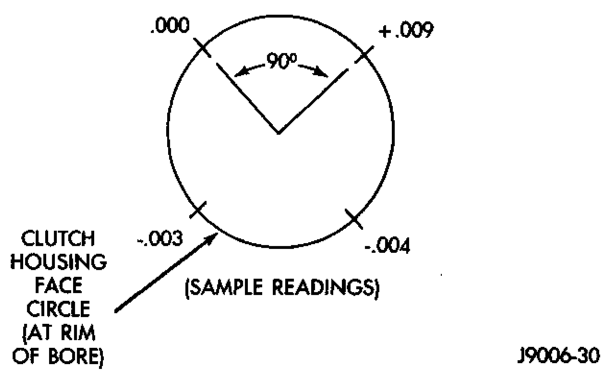


Fig. 17 Housing Face Measurement Points And Sample Readings

MISALIGNMENT

Clutch housing alignment is important to proper clutch operation. The housing maintains alignment between the crankshaft and transmission input

DIAGNOSIS AND TESTING (Continued)

shaft. Misalignment can cause clutch noise, hard shifting, incomplete release and chatter. It can also result in premature wear of the pilot bearing, cover release fingers and clutch disc. In severe cases, misalignment can also cause premature wear of the transmission input shaft and front bearing.

Housing misalignment is generally caused by incorrect seating on the engine or transmission, loose housing bolts, missing alignment dowels, or housing damage. Tighten all the clutch housing bolts to proper torque before installing any struts. Also be sure alignment dowels are in place and seated in the block and housing before bolt tightening. Infrequently, misalignment may also be caused by housing mounting surfaces that are not completely parallel. Misalignment can be corrected with shims.

DIAGNOSTIC CHARTS

The diagnosis charts describe common clutch problems, causes and correction. Fault conditions are listed at the top of each chart. Conditions, causes and corrective action are outlined in the indicated columns

DIAGNOSIS CHARTS

CONDITION	POSSIBLE CAUSES	CORRECTION
Disc facing worn out	1. Normal wear. 2. Driver frequently rides (slips) the clutch. Results in rapid overheating and wear. 3. Insufficient clutch cover diaphragm spring tension.	1. Replace cover and disc. 2. Replace cover and disc. 3. Replace cover and disc.
Clutch disc facing contaminated with oil, grease, or clutch fluid.	1. Leak at rear main engine seal or transmission input shaft seal. 2. Excessive amount of grease applied to the input shaft splines. 3. Road splash, water entering housing. 4. Slave cylinder leaking.	1. Replace appropriate seal. 2. Remove grease and apply the correct amount of grease. 3. Replace clutch disc. Clean clutch cover and reuse if in good condition. 4. Replace hydraulic clutch linkage.
Clutch is running partially disengaged.	1. Release bearing sticking or binding and does not return to the normal running position.	1. Verify failure. Replace the release bearing and transmission front bearing retainer as necessary.
Flywheel below minimum thickness specification.	1. Improper flywheel machining. Flywheel has excessive taper or excessive material removal.	1. Replace flywheel.
Clutch disc, cover and/or diaphragm spring warped or distorted.	1. Rough handling. Impact bent cover, spring, or disc. 2. Improper bolt tightening procedure.	1. Replace disc or cover as necessary. 2. Tighten clutch cover using proper procedure.
Facing on flywheel side of disc torn, gouged, or worn.	1. Flywheel surface scored or nicked. 2. Clutch disc sticking or binding on transmission input shaft.	2. Correct surface condition if possible. Replace flywheel and disc as necessary. 2. Inspect components and correct/replace as necessary.
Clutch disc facing burnt. Flywheel and cover pressure plate surfaces heavily glazed.	1. Frequent operation under high loads or hard acceleration conditions. 2. Driver frequently rides (slips) clutch. Results in rapid wear and overheating of disc and cover.	1. Correct condition of flywheel and pressure plate surface. Replace clutch cover and disc. Alert driver to problem cause. 2. Correct condition of flywheel and pressure plate surface. Replace clutch cover and disc. Alert driver to problem cause.

DIAGNOSIS AND TESTING (Continued)

DIAGNOSIS CHART (CONTINUED)

CONDITION	POSSIBLE CAUSES	CORRECTION
Clutch disc binds on input shaft splines.	1. Clutch disc hub splines damaged during installation.	1. Clean, smooth, and lubricate hub splines if possible. Replace disc if necessary.
	2. Input shaft splines rough, damaged, or corroded.	2. Clean, smooth, and lubricate shaft splines if possible. Replace input shaft if necessary.
Clutch disc rusted to flywheel and/or pressure plate.	1. Clutch not used for and extended period of time (e.g. long term vehicle storage).	1. Sand rusted surfaces with 180 grit sanding paper. Replace clutch cover and flywheel if necessary.
Pilot bearing seized, loose, or rollers are worn.	1. Bearing cocked during installation. 2. Bearing defective. 3. Bearing not lubricated. 4. Clutch misalignment.	1. Install and lubricate a new bearing. 2. Install and lubricate a new bearing. 3. Install and lubricate a new bearing. 4. Inspect clutch and correct as necessary. Install and lubricate a new bearing.
Clutch will not disengage properly.	1. Low clutch fluid level. 2. Clutch cover loose. 3. Clutch disc bent or distorted. 4. Clutch cover diaphragm spring bent or warped. 5. Clutch disc installed backwards. 6. Release fork bent or fork pivot loose or damaged. 7. Clutch master or slave cylinder failure.	1. Replace hydraulic linkage assembly. 2. Follow proper bolt tightening procedure. 3. Replace clutch disc. 4. Replace clutch cover. 5. Remove and install clutch disc correctly. 6. Replace fork or pivot as necessary. 7. Replace hydraulic linkage assembly.
Clutch pedal squeak.	1. Pivot pin loose. 2. Master cylinder bushing not lubricated. 3. Pedal bushings worn out or cracked.	1. Tighten pivot pin if possible. Replace clutch pedal if necessary. 2. Lubricate master cylinder bushing. 3. Replace and lubricate bushings.

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REMOVAL AND INSTALLATION

CLUTCH COVER AND DISC

REMOVAL

(1) Raise and support vehicle.

(2) Support engine with wood block and adjustable jack stand (Fig. 18). Supporting engine is necessary to avoid undue strain on engine mounts.

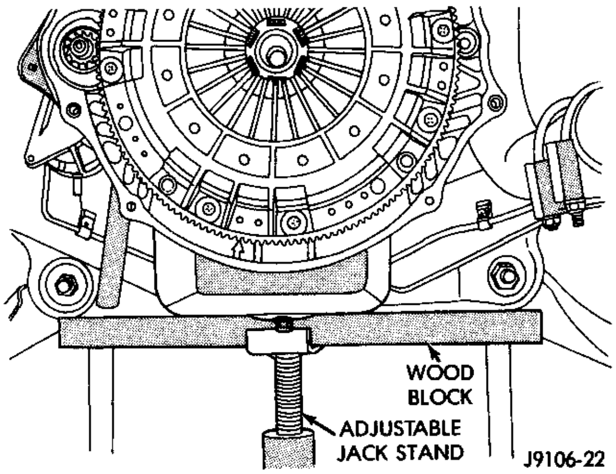

Fig. 18 Supporting Engine With Jack Stand And Wood Block—Diesel Model Shown

(3) Remove transmission and transfer case, if equipped. Refer to Group 21, Transmission and Transfer Case, for proper procedures.

(4) If clutch cover will be reused, mark position of cover on flywheel with paint or scriber (Fig. 19).

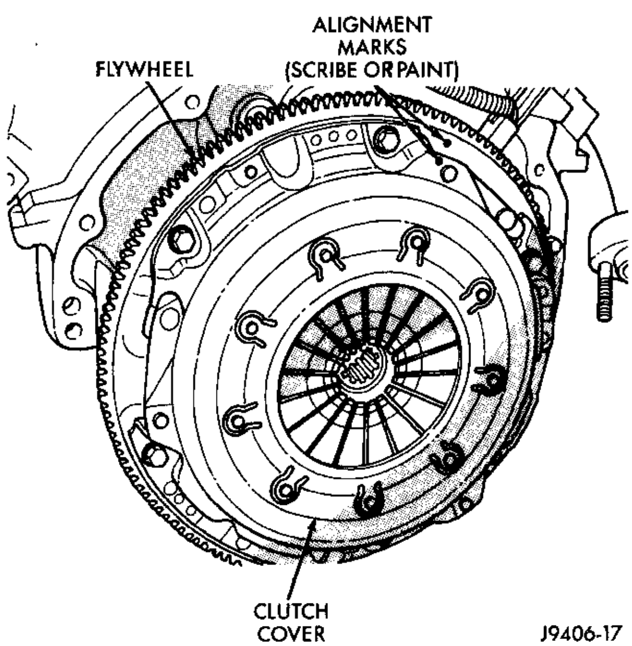

Fig. 19 Marking Clutch Cover Position

(5) Insert clutch alignment tool in clutch disc and into pilot bushing. Tool will hold disc in place when cover bolts are removed.

(6) If clutch cover will be reused, loosen cover bolts evenly, only few threads at a time, and in a diagonal pattern (Fig. 20). This relieves cover spring tension evenly to avoid warping.

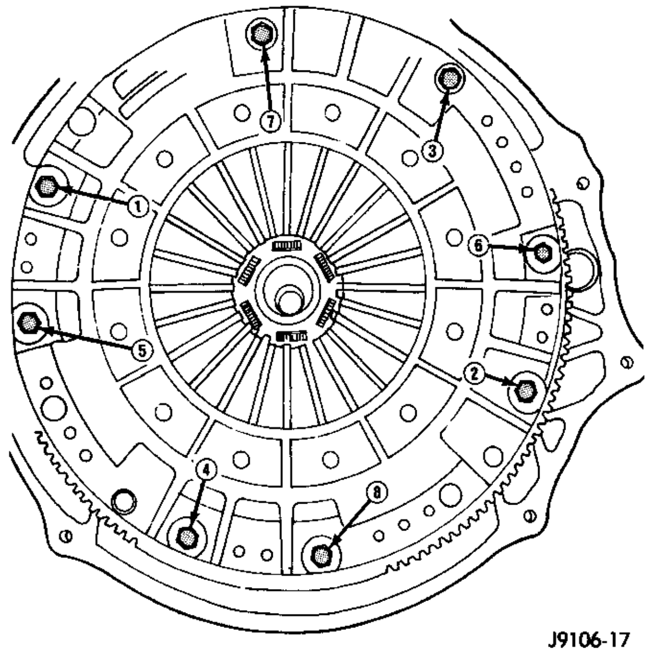

Fig. 20 Clutch Cover Bolt Loosening/Tightening Pattern

(7) Remove cover bolts completely and remove cover, disc and alignment tool.

INSTALLATION

(1) Check runout and free operation of new clutch disc.

(2) Lubricate crankshaft pilot bearing with Mopar® high temperature bearing grease.

(3) Insert clutch alignment tool in clutch disc hub.

(4) Verify that disc hub is positioned correctly. The raised side of hub is installed away from the flywheel.

REMOVAL AND INSTALLATION (Continued)

(5) Insert alignment tool in pilot bearing and position disc on flywheel surface (Fig. 21).

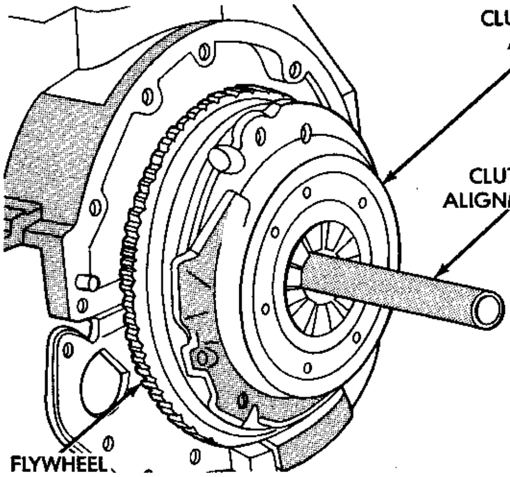

Fig. 21 Clutch Disc And Cover Alignment/ Installation

(6) Position clutch cover over disc and onto flywheel (Fig. 21).

(7) Align and hold clutch cover in position and install cover bolts finger tight.

(8) Tighten cover bolts evenly and a few threads at a time. Cover bolts must be tightened evenly and to specified torque to avoid distorting cover.

(9) Tighten clutch cover bolts to following:

- 5/16 in. diameter bolts to 23 N·m (17 ft. lbs.).
- 3/8 in. diameter bolts to 41 N·m (30 ft. lbs.).

(10) Remove release lever and release bearing from clutch housing. Apply Mopar® high temperature bearing grease to bore of release bearing, release lever contact surfaces and release lever pivot stud (Fig. 22).

(11) Apply light coat of Mopar® high temperature bearing grease to splines of transmission input shaft (or drive gear) and to release bearing slide surface of the transmission front bearing retainer (Fig. 23). Do not over lubricate shaft splines. This can result in grease contamination of disc.

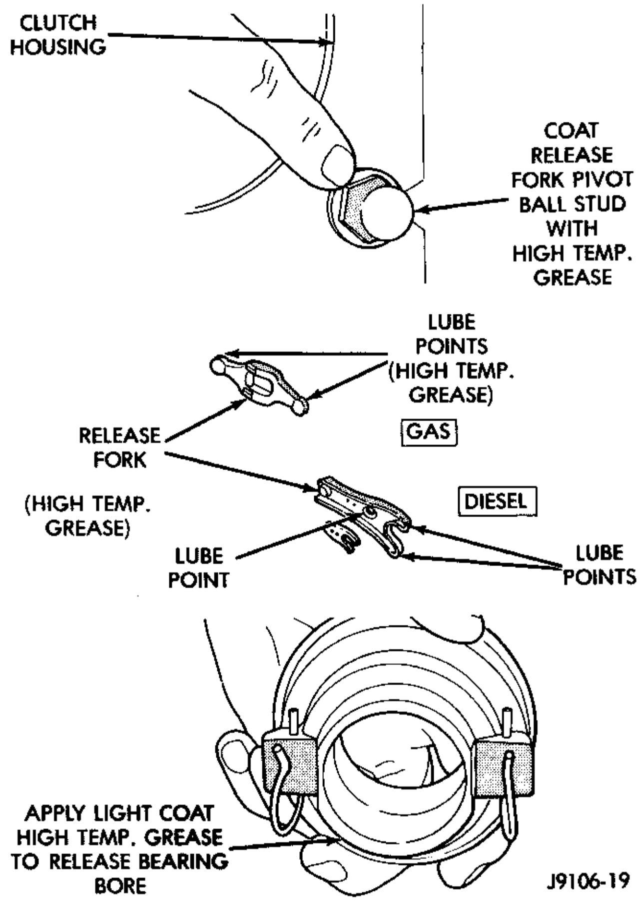

Fig. 22 Clutch Release Component Lubrication Points

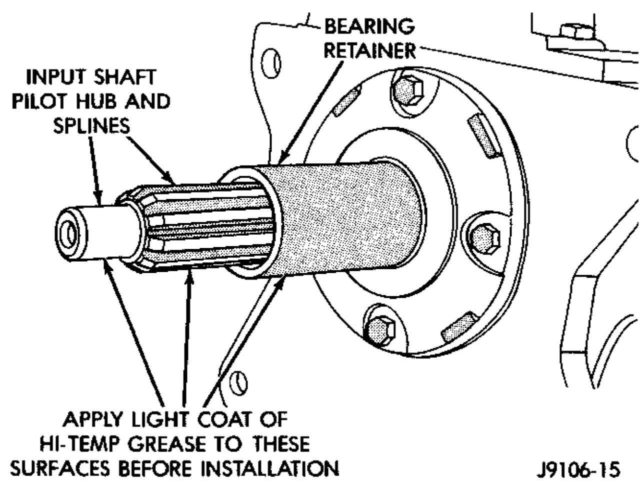

Fig. 23 Input Shaft Lubrication Points—Typical

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REMOVAL AND INSTALLATION (Continued)

(12) Install release lever and bearing in clutch housing. Be sure spring clips that retain fork on pivot ball and release bearing on fork are properly installed and (Fig. 24).

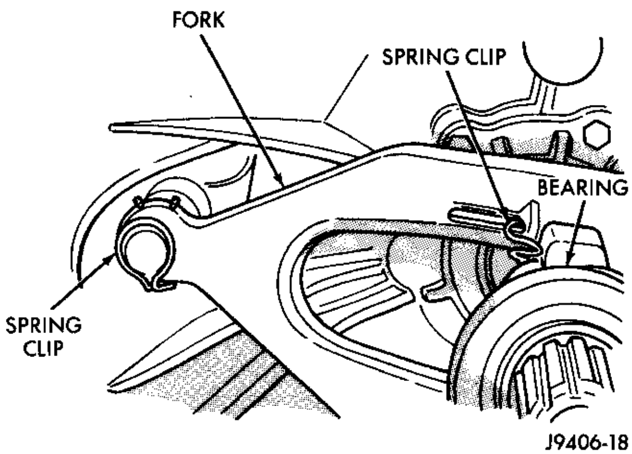

Fig. 24 Release Fork And Bearing Spring Clip Position

(13) Install transmission. Refer to Group 21, Transmission and Transfer Case, for proper procedures.

(14) Check fluid level in clutch master cylinder.

CLUTCH HOUSING—NV4500

REMOVAL

(1) Raise and support vehicle.

(2) Remove transmission and transfer case, if equipped. Refer to Group 21, Transmission and Transfer Case, for proper procedures.

(3) Remove clutch housing bolts and remove housing from engine (Fig. 25) and (Fig. 26).

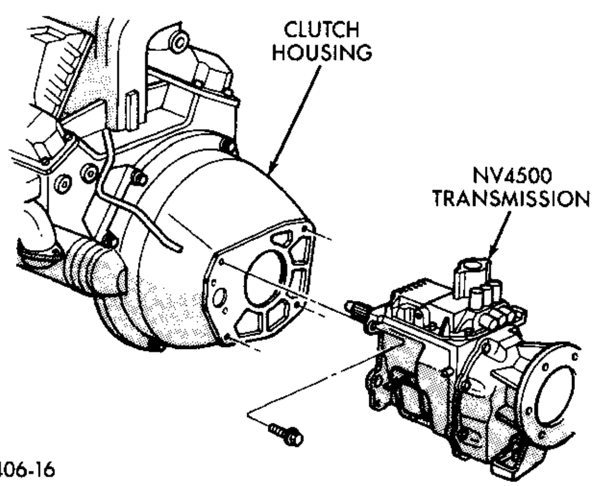

Fig. 25 Transmission/Clutch Housing—NV4500

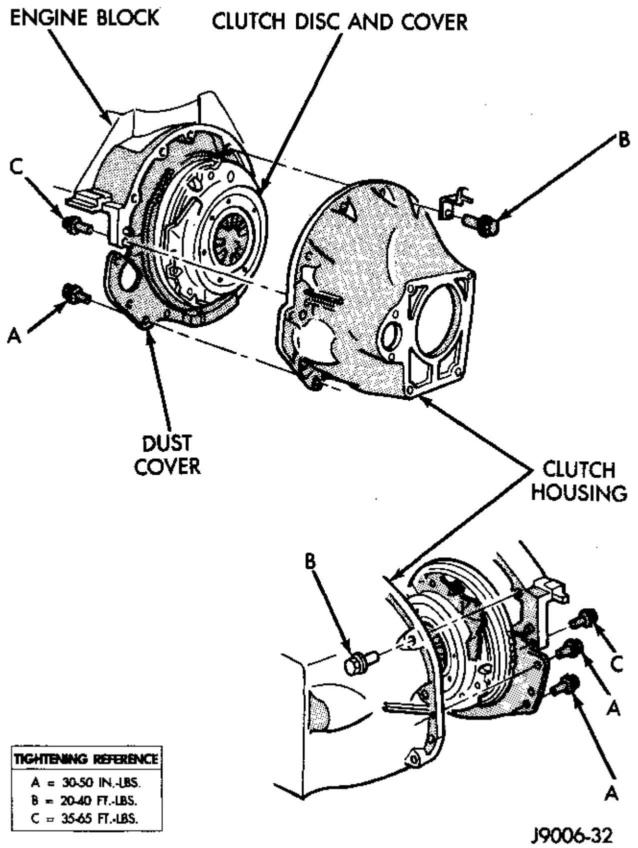

Fig. 26 Clutch Housing Installation—NV4500

INSTALLATION

(1) Clean housing mounting surface of engine block with wax and grease remover.

(2) Verify that clutch housing alignment dowels are in good condition and properly seated.

(3) Transfer slave cylinder, release fork and boot, fork pivot stud, and wire/hose brackets to new housing.

(4) Lubricate release fork and pivot contact surfaces with Mopar® High Temperature wheel bearing grease before installation.

(5) Align and install clutch housing on transmission. Tighten housing bolts closest to alignment dowels first and to torque values indicated (Fig. 25) and (Fig. 26).

(6) Install transmission–to–engine strut after installing clutch housing. Tighten bolt attaching strut to clutch housing first and engine bolt last.

(7) Install transmission and transfer case, if equipped. Refer to Group 21, Transmission and Transfer Case, for proper procedures.

CLUTCH LINKAGE

The clutch master cylinder, remote reservoir, slave cylinder and connecting lines are all serviced as an assembly. These components cannot be serviced separately. The linkage cylinders and connecting lines

REMOVAL AND INSTALLATION (Continued)

are sealed units. They are pre-filled with fluid during manufacture and must not be disassembled nor disconnected.

REMOVAL

(1) Raise and support vehicle.

(2) On diesel models, remove slave cylinder shield from clutch housing, if equipped.

(3) Remove nuts attaching slave cylinder to studs on clutch housing.

(4) Remove slave cylinder from clutch housing.

(5) Disengage slave cylinder fluid line from body retainer clips.

(6) Lower vehicle.

(7) Disconnect clutch pedal interlock switch wires.

(8) Remove locating clip from clutch master cylinder mounting bracket (Fig. 27).

(9) Remove retaining clip, flat washer and wave washer that attach clutch master cylinder push rod to clutch pedal (Fig. 28).

(10) Slide clutch master cylinder push rod off pedal pin.

(11) Inspect condition of bushing on clutch pedal pin (Fig. 28). Remove and replace bushing if worn or damaged.

(12) Verify that cap on clutch master cylinder reservoir is tight. This will avoid spillage during removal.

(13) Remove screws that attach clutch fluid reservoir to dash panel.

(14) Remove reservoir mounting bracket screws and remove reservoir from dash panel.

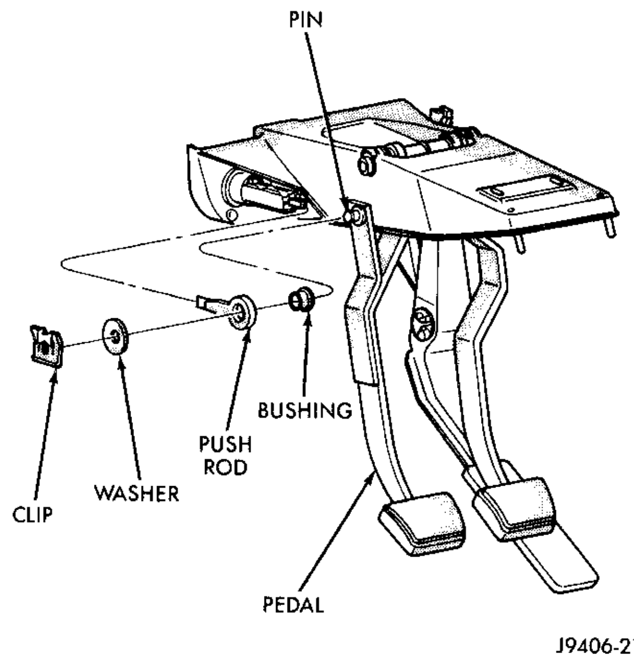

Fig. 28 Clutch Cylinder Push Rod Attachment

(15) Rotate clutch master cylinder 45° counterclockwise to unlock it. Then remove cylinder from dash panel.

(16) Remove clutch master cylinder rubber seal from dash panel (Fig. 27).

(17) Remove clutch cylinders, reservoir and connecting lines from vehicle.

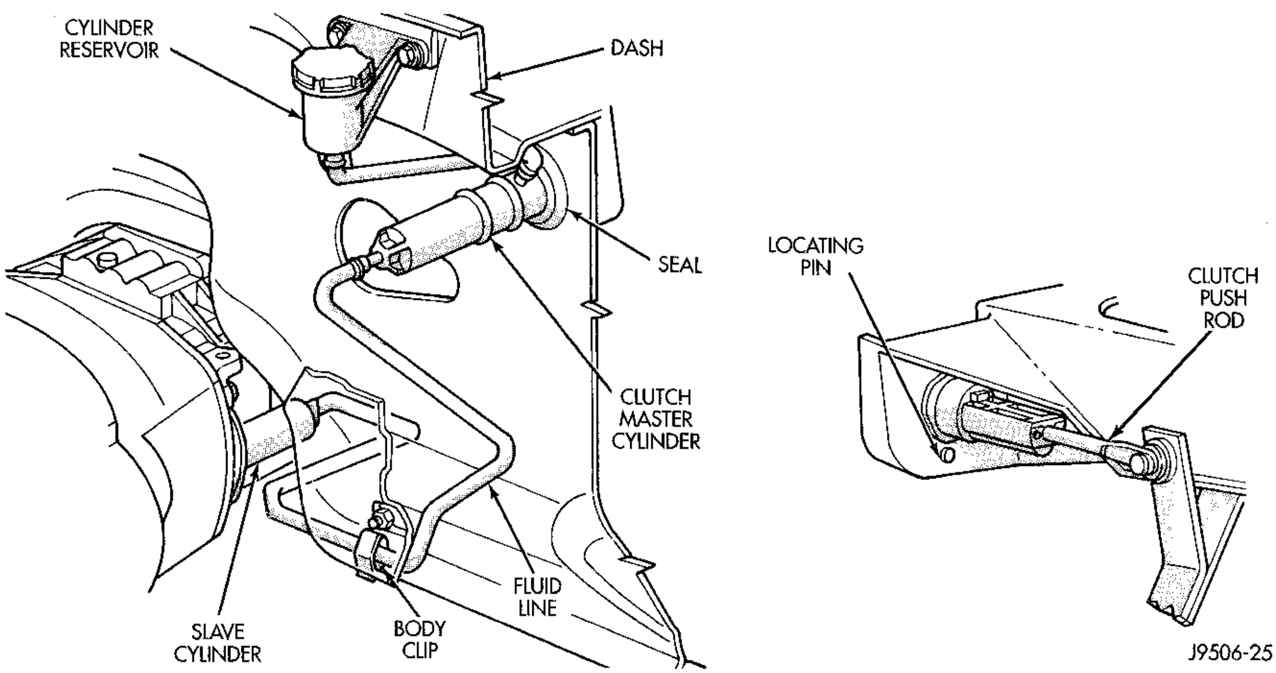

Fig. 27 Clutch Hydraulic Linkage

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REMOVAL AND INSTALLATION (Continued)

INSTALLATION

(1) Tighten cap on clutch fluid reservoir to avoid spillage during installation.

(2) Position cylinders, connecting lines and reservoir in vehicle engine compartment.

(3) Lubricate cylinder seal with liquid dish soap to ease installation. Then seat seal in dash and around cylinder.

(4) Insert clutch master cylinder in dash panel. Rotate cylinder 45° clockwise to lock it in place.

(5) If cylinder seal is hard to seat, unlock cylinder and reseat seal if necessary. Then lock cylinder afterward.

(6) Position clutch fluid reservoir on dash panel and install reservoir screws. Tighten screws to 5 N·m (40 in. lbs.) torque.

(7) Install reservoir mounting bracket on dash panel, if removed.

(8) Apply a light coating of grease to the inside and outside diameter of the master cylinder bushing.

(9) Install bushing on clutch pedal pin.

(10) Install clutch master cylinder push rod on clutch pedal pin. Secure rod with wave washer, flat washer and retainer ring.

(11) Connect clutch pedal position (interlock) switch wires.

(12) Install locating clip in clutch master cylinder mounting bracket.

(13) Raise vehicle.

(14) Install slave cylinder. Be sure cap at end of cylinder rod is seated in release lever. Check this before installing cylinder attaching nuts.

(15) Install and tighten slave cylinder attaching nuts to 23 N·m (200 in. lbs.) torque.

(16) Lower vehicle.

(17) If new linkage has been installed, remove plastic shipping stop from master cylinder push rod. Do this after installing slave cylinder and before operating linkage.

(18) Operate linkage several times to verify proper operation.

RELEASE BEARING

REMOVAL

(1) Remove transmission and transfer case, if equipped. Refer to Group 21, Transmission and Transfer Case, for proper procedures.

(2) On models with gas engine and new style release fork, remove clutch housing for access to release fork and release bearing retainer springs.

(3) Disconnect release bearing from release fork and remove bearing (Fig. 29).

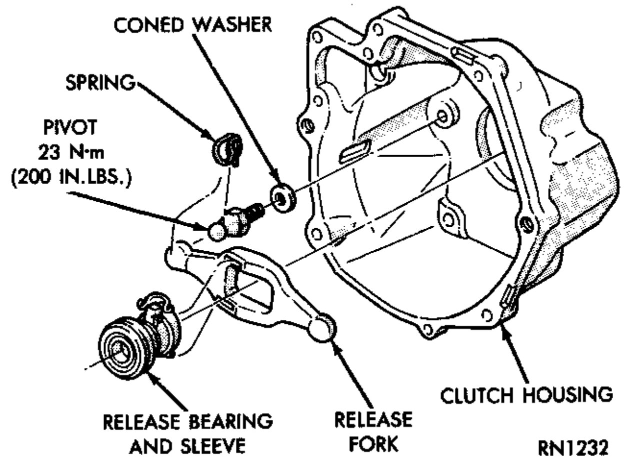

Fig. 29 Clutch Release Components

INSTALLATION

(1) Inspect bearing slide surface on transmission front bearing retainer. Replace retainer if slide surface is scored, worn, or cracked.

(2) Inspect release lever and pivot stud. Be sure stud is secure and in good condition. Be sure fork is not distorted or worn. Replace fork spring clips if bent or damaged.

(3) Lubricate crankshaft pilot bearing, input shaft splines, bearing retainer slide surface, lever pivot ball stud and release lever pivot surface with Mopar® high temperature bearing grease.

(4) Install release fork and release bearing (Fig. 30). Be sure fork and bearing are properly secured by spring clips.

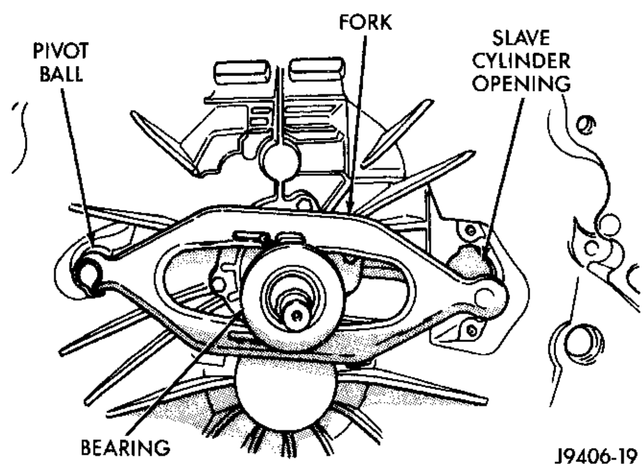

Fig. 30 Clutch Release Fork And Bearing Installation

(5) Install clutch housing, if removed.

(6) Install transmission and transfer case, if equipped. Refer to Group 21, Transmission and Transfer Case, for proper procedures.

REMOVAL AND INSTALLATION (Continued)

PILOT BEARING

REMOVAL

(1) Remove transmission, transfer case, if equipped, and clutch housing. Refer to Group 21, Transmission and Transfer Case, for proper procedures.

(2) Remove clutch cover and disc.

(3) Using a suitable blind hole puller, remove pilot bearing.

INSTALLATION

(1) Clean bearing bore with solvent and wipe dry with shop towel.

(2) Install new bearing with clutch alignment tool (Fig. 31). Keep bearing straight during installation. Do not allow bearing to become cocked. Tap bearing into place until flush with edge of bearing bore. Do not recess bearing.

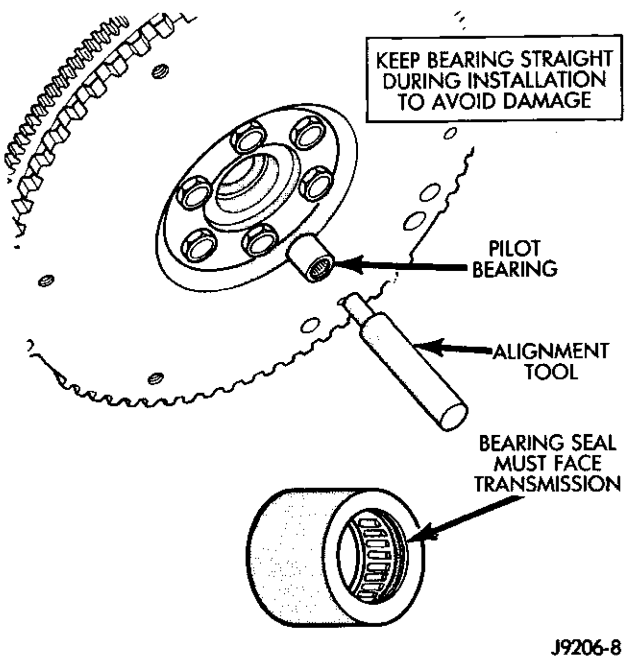

Fig. 31 Typical Method Of Installing Pilot Bearing

(3) Lubricate bearing with Mopar® high temperature grease, or an equivalent quality grease.

(4) Install clutch cover and disc.

(5) Install clutch housing, transmission and transfer case, if equipped. Refer to Group 21, Transmission and Transfer Case, for proper procedures.

CLUTCH PEDAL

REMOVAL

(1) Remove retaining ring, flat washer and wave washer that secure brake and clutch pedals to push rods (Fig. 32).

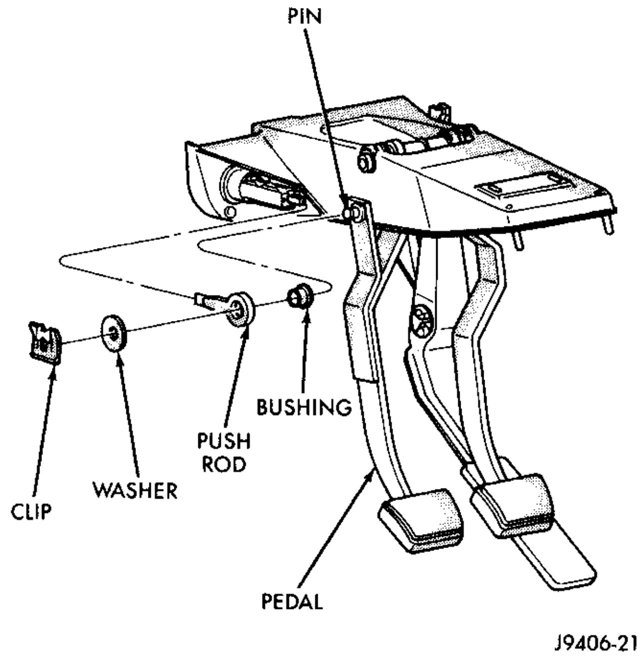

Fig. 32 Clutch Cylinder Push Rod Attachment

(2) Remove knee bolster (Fig. 33) for access to pedal pivot shaft.

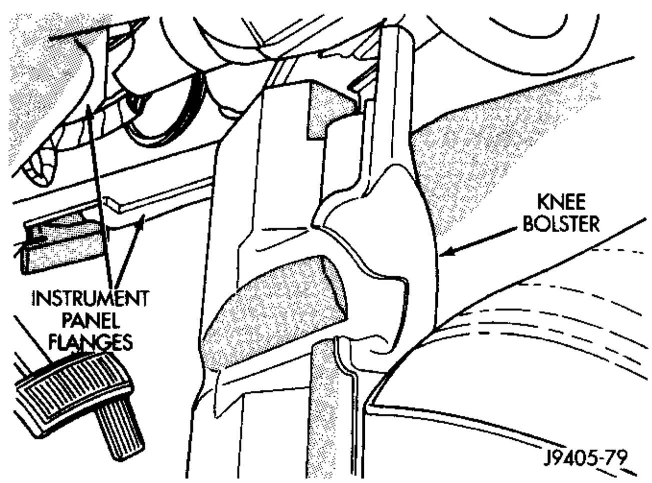

Fig. 33 Knee Bolster Removal

(3) Remove brake light switch. Turn switch clockwise about 30° to release it then remove switch from bracket.

(4) Remove retainer from passenger side of pedal pivot shaft (Fig. 34).

(5) Push pedal pivot shaft toward driver side of support only enough to remove clutch pedal. It is not necessary to remove shaft from pedal support entirely.

(6) Remove clutch pedal.

REMOVAL AND INSTALLATION (Continued)

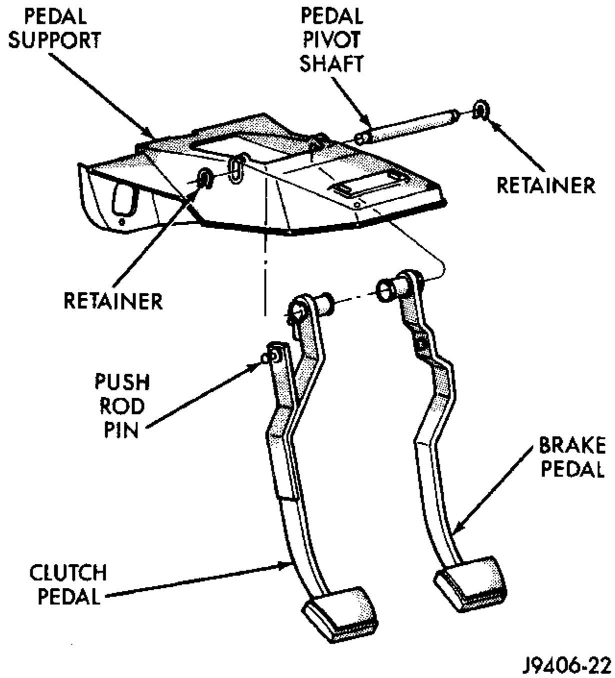

Fig. 34 Clutch/Brake Pedal Mounting

INSTALLATION

(1) Inspect bushings in clutch and brake pedals (Fig. 35). Replace bushings if worn, cracked, or distorted.

(2) Lubricate pedal shaft, pedal shaft bore (Fig. 34) and (Fig. 35) and all bushings with Mopar® Multi Mileage, or high temperature bearing grease.

(3) Position clutch pedal in support. Align pedal with pivot shaft and slide shaft through pedal bushings. Then repeat process for brake pedal.

(4) Slide pedal shaft through support and install shaft retainer.

(5) Secure push rods to clutch and brake pedals.

(6) Install brake light switch in bracket. Rotate switch into place to lock it in bracket.

(7) Install knee bolster.

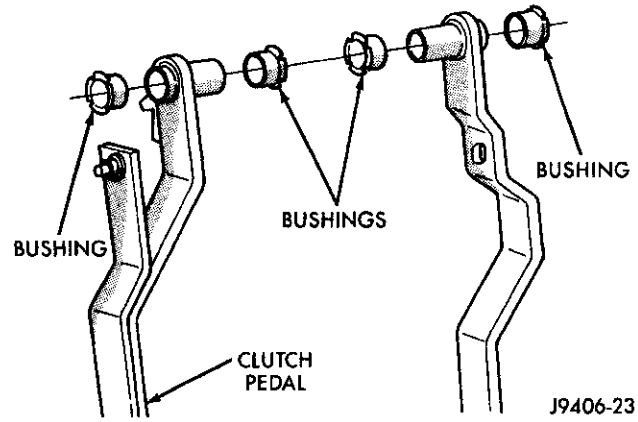

Fig. 35 Clutch/Brake Pedal Bushings

SPECIFICATIONS

TORQUE

DESCRIPTION	TORQUE
Nut, slave cylinder	19-26 N·m (170-230 in. lbs.)
Bolt, clutch cover—5/16 in.	23 N·m (17 ft. lbs.)
Bolt, clutch cover—3/8 in.	41 N·m (30 ft. lbs.)
Pivot, release bearing	23 N·m (17 ft. lbs.)
Bolt, housing to engine—3/8 in.	45 N·m (33 ft. lbs.)
Bolt, housing to engine—7/16 in.	68 N·m (50 ft. lbs.)
Bolt, housing to engine—V-10	47 N·m (35 ft. lbs.)
Screw, fluid reservoir	5 N·m (40 in. lbs.)

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COOLING SYSTEM

CONTENTS

GENERAL INFORMATION

COOLING SYSTEM

The cooling system regulates engine operating temperature. It allows the engine to reach normal operating temperature as quickly as possible. It also maintains normal operating temperature and prevents overheating.

The cooling system also provides a means of heating the passenger compartment and cooling the automatic transmission fluid (if equipped). The cooling system is pressurized and uses a centrifugal water pump on all engines to circulate coolant throughout the system.

An optional factory installed maximum duty cooling package is available for some engines on most models. This package will provide additional cooling capacity for vehicles used under extreme conditions such as trailer towing in high ambient temperatures.

COOLING SYSTEM COMPONENTS AND FLOW—GAS ENGINES

The cooling system consists of:

- A cross-flow radiator
- Thermal viscous fan drive
- Fan shroud
- Radiator pressure cap
- Thermostat
- Coolant reserve/overflow system
- Transmission oil cooler (automatic transmission)
- Coolant
- Water pump (to circulate coolant)
- Hoses and hose clamps

Typical coolant flow circuits for gas powered engines are shown in (Fig. 1).

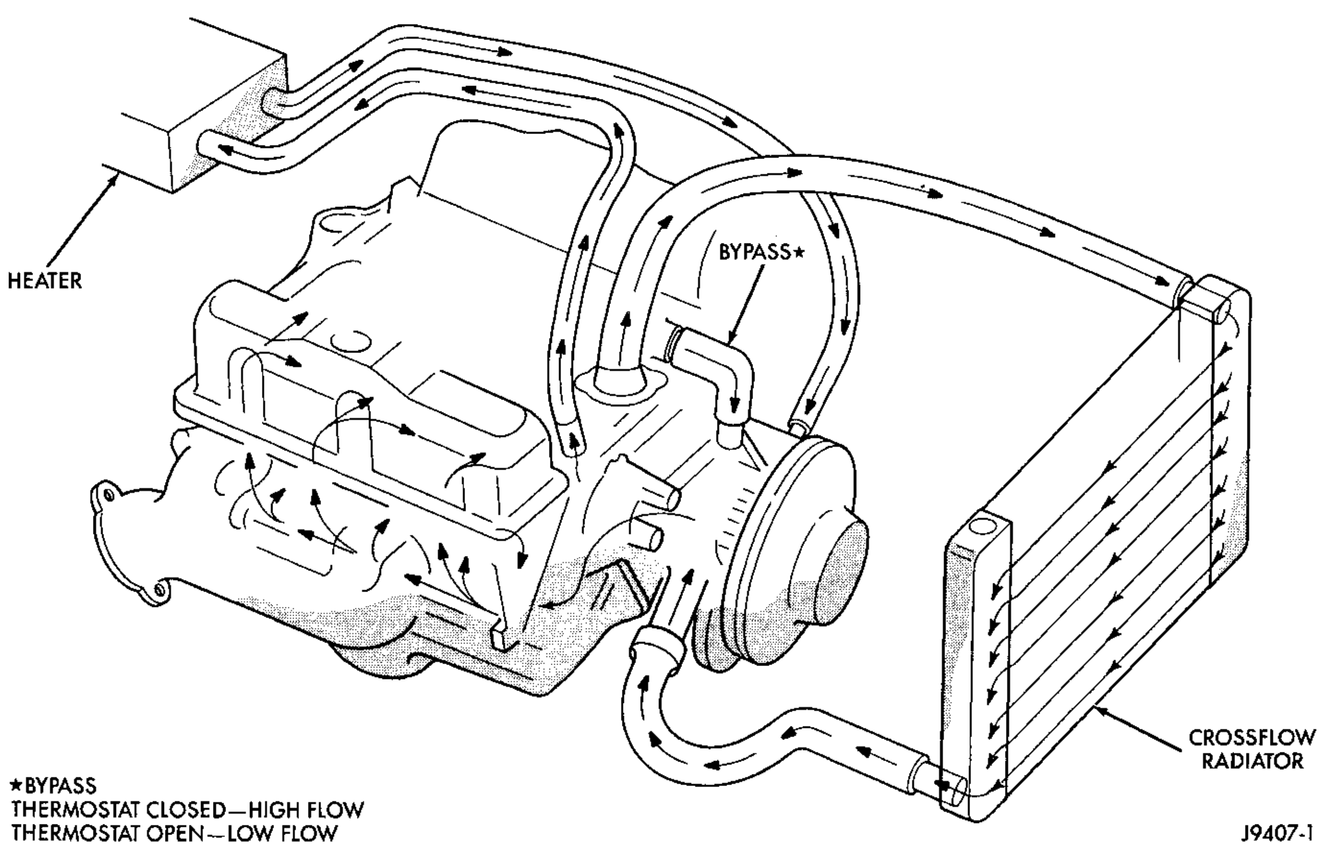

Fig. 1 Typical Cooling System Flow—Gas Powered Engines

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GENERAL INFORMATION (Continued)

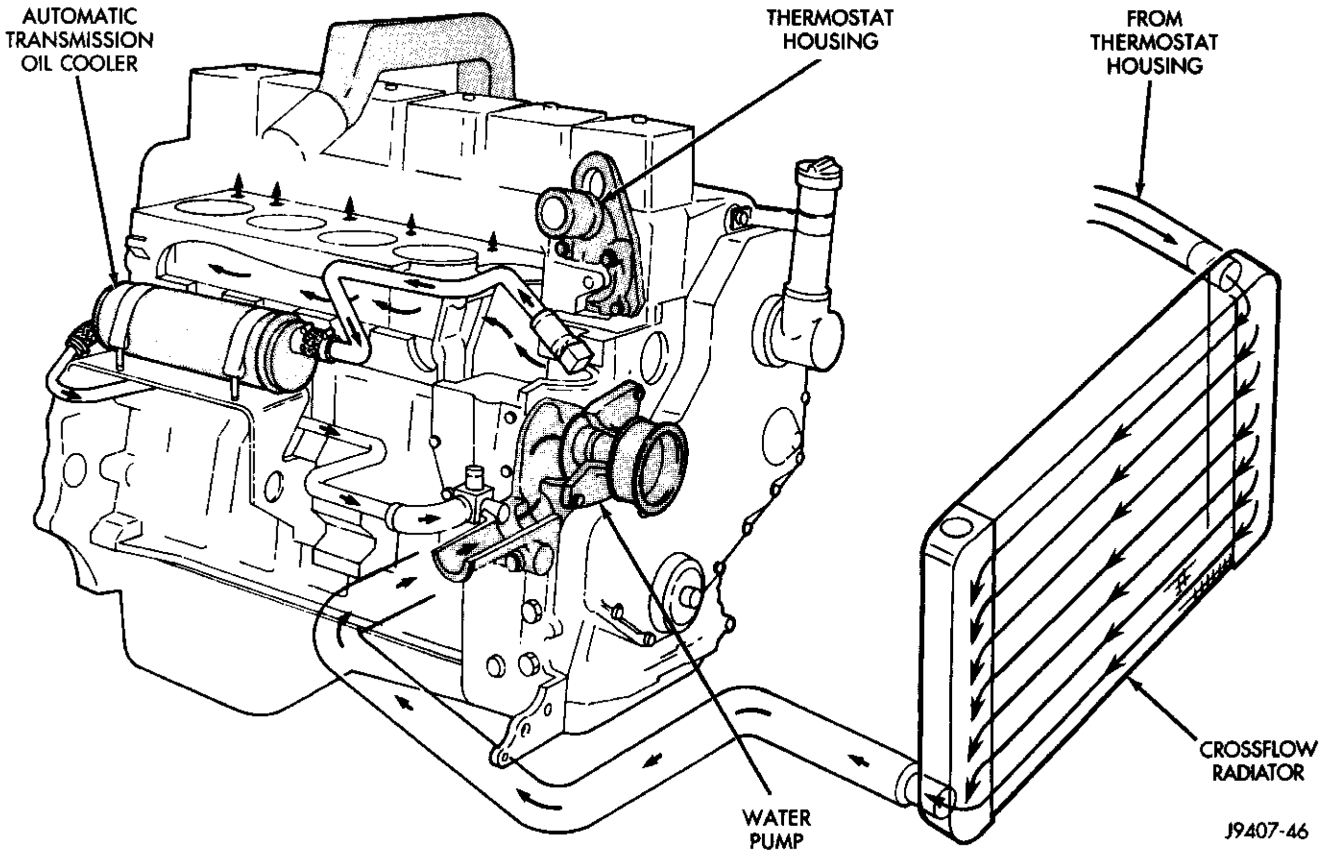

Fig. 2 Typical Cooling System Flow—Diesel Powered Engine

COOLING SYSTEM COMPONENTS AND FLOW—DIESEL

Coolant flow circuits for the 5.9L diesel engine are shown in (Fig. 2).

The diesel cooling system consists of: a cross-flow radiator, engine driven cooling fan, thermal viscous fan drive, fan shroud, radiator pressure cap, thermostat, a vertically mounted one-way check valve (jiggle pin) at cylinder head, a bypass hose at thermostat, coolant reserve/overflow system, transmission oil cooler (if equipped with an automatic transmission), coolant, water pump, hoses and hose clamps.

Coolant is drawn from radiator into the water pump. Water pump output is directed to the engine oil cooler cavity of the cylinder block (Fig. 3).

From the oil cooler cavity, the coolant circulates around each cylinder. It then crosses to the transfer (lift) pump side of the engine where it flows up into the cylinder head through openings in top of the cylinder block (Fig. 3). Coolant flows past the valve bridges (Fig. 4), to exhaust manifold side of engine and to thermostat. As coolant flows toward the thermostat, it provides cooling for the injector nozzle.

Also refer to Thermostat Operation—5.9L Diesel Engine. This can be found in the Thermostat section of this group.

COOLANT RESERVE/OVERFLOW SYSTEM

The coolant reserve/overflow system works in conjunction with the radiator pressure cap. It utilizes thermal expansion and contraction of coolant to keep coolant free of trapped air. It provides a volume for expansion and contraction of coolant. Refer to Description and Operation in this group for more information.

COOLANT

The cooling system is designed around the coolant. Coolant flows through the engine water jacket absorbing heat produced during engine operation. The coolant carries the heat to radiator and heater core. Here it is transferred to the ambient air passing through the radiator and heater core fins. The coolant also removes heat from the automatic transmission fluid in vehicles equipped with an automatic transmission.

RADIATOR PRESSURE CAP

Radiators are equipped with a pressure cap, which releases pressure at some point within a range of 97-124 kPa (14-18 psi). The pressure relief point (in pounds) is engraved on top of cap. See Description and Operation in this group for more information.

GENERAL INFORMATION (Continued)

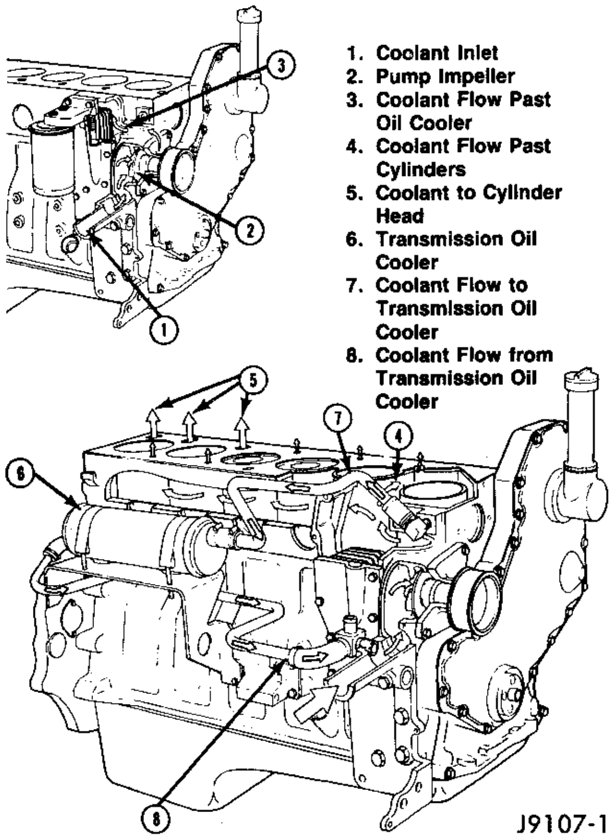

Fig. 3 Cylinder Block Coolant Routing—Diesel Engine

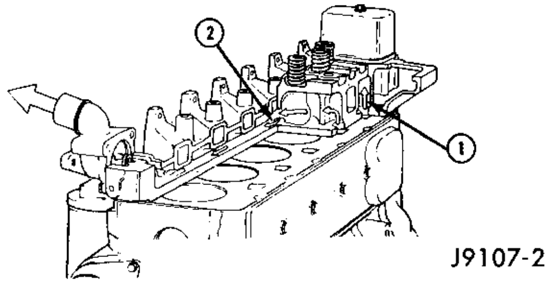

Fig. 4 Cylinder Head Coolant Routing—Diesel Engine

RADIATORS

The radiator used on all engines (both gas powered and diesel) are of a cross-flow design with horizontal tubes through the radiator core and vertical side tanks.

Aluminum cores with plastic side tanks are used on all 3.9L V-6 and 5.2/5.9L V-8 engines. Copper-brass cores are used with the 8.0L V-10 and diesel engines.

The radiator supplies sufficient heat transfer to cool the engine and automatic transmission (if equipped).

THERMOSTAT

The thermostat on all gas powered engines is located beneath the thermostat housing at the front of the intake manifold (Fig. 5) (Fig. 6).

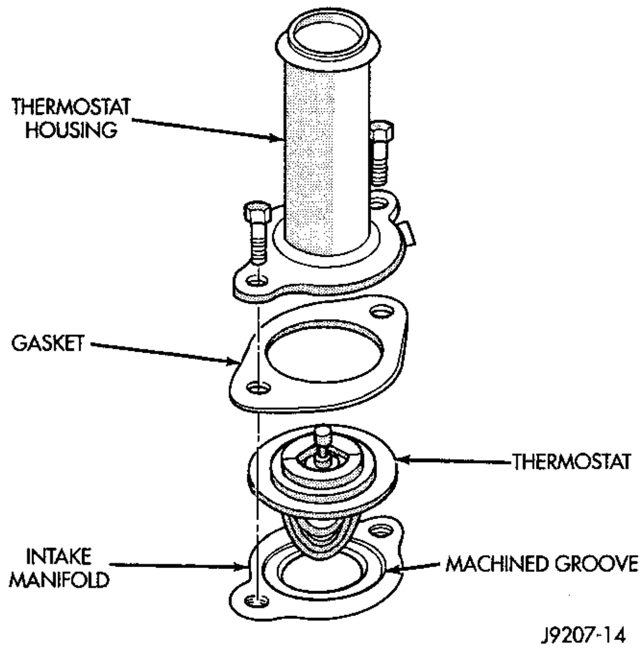

Fig. 5 Thermostat—3.9L V-6 or 5.2/5.9L V-8 Gas Powered Engines

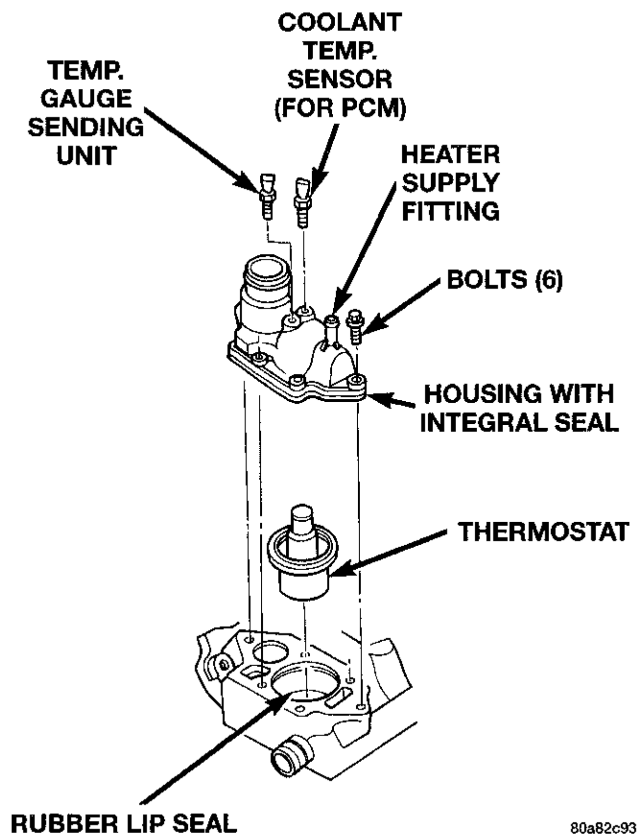

Fig. 6 Thermostat—8.0L V-10 Engine

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GENERAL INFORMATION (Continued)

The thermostat of the 5.9L diesel engine is located in the thermostat housing (Fig. 7). The housing is located behind the generator mounting bracket, at front of cylinder head.

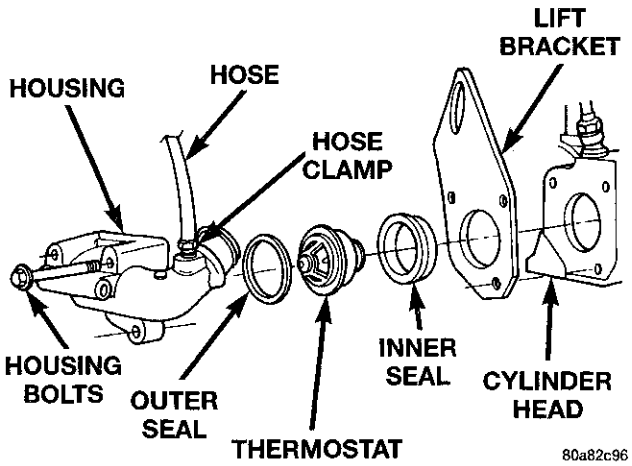

Fig. 7 Thermostat—5.9L Diesel—Typical

Gas powered engines: The thermostat is a wax pellet driven, reverse poppet choke type (3.9L/5.2L/5.9L), or moveable sleeve type (8.0L V-10). The wax pellet is located in a sealed container at the spring end of the thermostat. When heated, the pellet expands, overcoming closing spring tension and water pump pressure to force the valve to open. Coolant leakage into the pellet container will cause the thermostat to fail in the open position. Thermostats very rarely stick. Do not attempt to free a thermostat with a prying device.

The same thermostat is used for winter and summer seasons. An engine should not be operated without a thermostat, except for servicing or testing. Operating without a thermostat causes longer engine warmup time, unreliable warmup performance, increased exhaust emissions and crankcase condensation that can result in sludge formation.

CAUTION: Do not operate an engine without a thermostat, except for servicing or testing.

ENGINE ACCESSORY DRIVE BELTS

All vehicles are available with either a 3.9L V-6, a 5.2L V-8, two different 5.9L V-8 engines, an 8.0L V-10 or a 5.9L in-line 6 cylinder diesel engine.

The accessory drive components are operated by a single, crankshaft driven, serpentine drive belt on all engines. An automatic belt tensioner is also used to maintain correct belt tension at all times. This is used on all engines. Refer to Automatic Belt Tensioner proceeding in this group.

BELT TENSION—ALL ENGINES

Correct accessory drive belt tension is required to be sure of optimum performance of belt driven engine accessories. If specific tension is not maintained, belt slippage may cause; engine overheating, lack of power steering assist, loss of air conditioning capacity, reduced generator output rate and greatly reduced belt life.

It is not necessary to adjust belt tension on any engine. All engines are equipped with an automatic belt tensioner. The tensioner maintains correct belt tension at all times. For other tensioner information and removal/installation procedures, refer to Automatic Belt Tensioner proceeding in this group. Due to use of this belt tensioner, do not attempt to use a belt tension gauge on any engine.

DESCRIPTION AND OPERATION

THERMOSTAT—V-6, V-8, AND V-10

The thermostat controls the operating temperature of the engine by controlling the amount of coolant flow to the radiator. The thermostat is closed below 88°C (192°F). When the coolant reaches this temperature, the thermostat begins to open, allowing coolant flow to the radiator. This provides quick engine warmup and overall temperature control. The thermostat is designed to provide a minimum engine operating temperature of 88 to 93°C (192 to 199°F). It should be fully open for maximum coolant flow during operation in hot ambient temperatures of approximately 104°C (220°F). Above 104°C (220°F), coolant temperature is controlled by the radiator, fan and ambient temperature.

THERMOSTAT—DIESEL

The thermostat controls the operating temperature of the engine by controlling the amount of coolant flow to the radiator. When coolant temperature is below 83°C (181°F), the thermostat is closed (Fig. 8).

When coolant temperature reaches 83°C (181°F), the thermostat begins to open allowing coolant flow to the radiator. This provides quick engine warm-up and overall temperature control. The thermostat is designed to provide a minimum engine operating temperature of 83°C (181°F) and to be fully open for maximum coolant flow at approximately 95°C (203°F). Above 95°C (203°F), coolant temperature is controlled by the radiator, fan and ambient temperature.

The air bleeds (jiggle pins) that were used on the thermostats of diesel engines in previous years are no longer used. They have been replaced by a vertically mounted one-way check valve (jiggle pin) and a rubber bypass hose. The check valve is used as a servicing feature and will vent air when the system is

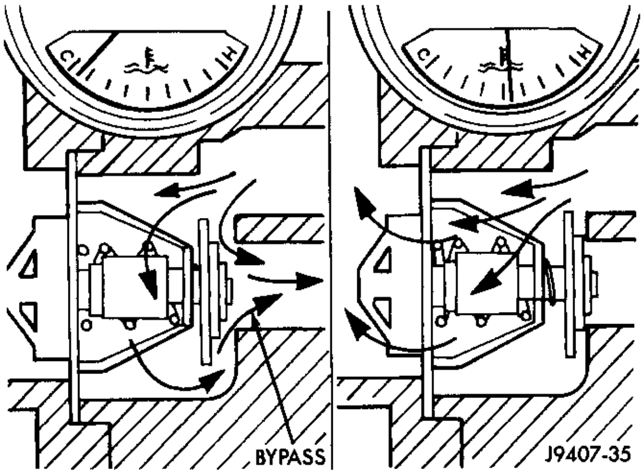

Fig. 8 Thermostat Operation—5.9L Diesel—Typical

being filled. It is also used to block the flow of coolant during engine operation (all coolant will pass through the thermostat).

Water pressure (or flow) will hold the pin closed.

When the engine is off, the check valve will be in the open position. When the engine is operating, the check valve will be in the closed position.

The check valve is located inside of a brass fitting. This fitting is threaded into the front of the cylinder head (Fig. 9). It is connected to the thermostat housing with a rubber hose and screw-type clamps (Fig. 9).

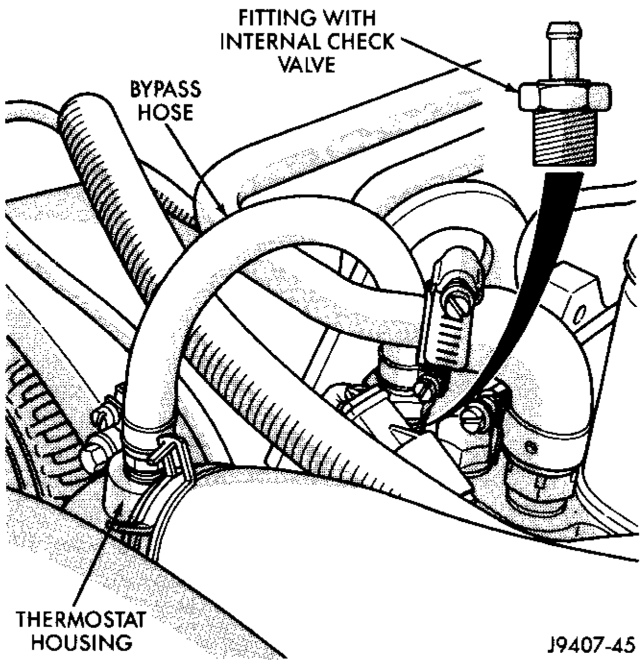

Fig. 9 One-Way Check Valve (Jiggle Pin) Location

AUTOMATIC TRANSMISSION OIL COOLERS—GAS ENGINES

WATER-TO-OIL COOLER

All gas powered models equipped with an automatic transmission are equipped with a transmission oil cooler mounted internally within the radiator side tank. This internal cooler is supplied as standard equipment on all gas powered models equipped with an automatic transmission.

The internal radiator oil cooler **is not used** with the diesel engine.

Transmission oil is cooled when it passes through this separate cooler. In case of a leak in the internal radiator mounted transmission oil cooler, engine coolant may become mixed with transmission fluid or transmission fluid may enter engine cooling system. Both cooling system and transmission should be drained and inspected if the internal radiator mounted transmission cooler is leaking.

Also refer to the section on Transmission Air-to-Oil Coolers. This heavy duty air-to-oil cooler is an option on most engine packages. It is supplied as standard equipment on both the 8.0L V-10 and 5.9L diesel engines.

AUXILIARY TRANSMISSION OIL COOLER

3.9/5.2/5.9L V-8 Gas Powered Engines: An optional air-to-oil transmission oil cooler is available with most engine packages. On the 3.9/5.2/5.9L V-8 engines, this optional cooler is located between the radiator and air conditioning condenser (Fig. 10).

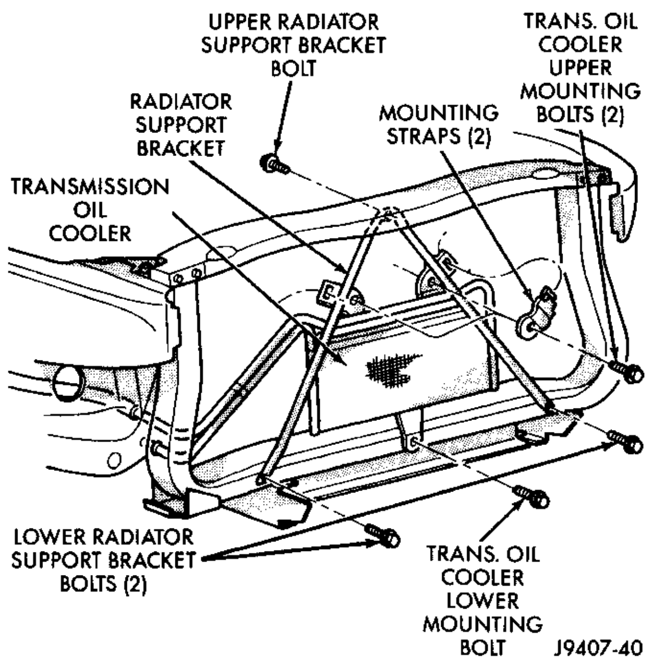

Fig. 10 Auxiliary Transmission Oil Cooler—3.9/5.2/5.9L Engines

AUTHENTIC RESTORATION PRODUCT

DESCRIPTION AND OPERATION (Continued)

8.0L V-10 Engine: The air-to-oil cooler is located in front of and to the left side of the radiator (Fig. 11). This secondary cooler is supplied as standard equipment on models equipped with the 8.0L V-10 engine and an automatic transmission.

The oil coolers on all gas powered engines operate in conjunction with the internal radiator mounted main oil cooler. The transmission oil is routed through the main cooler first, then the optional cooler, before returning to the transmission.

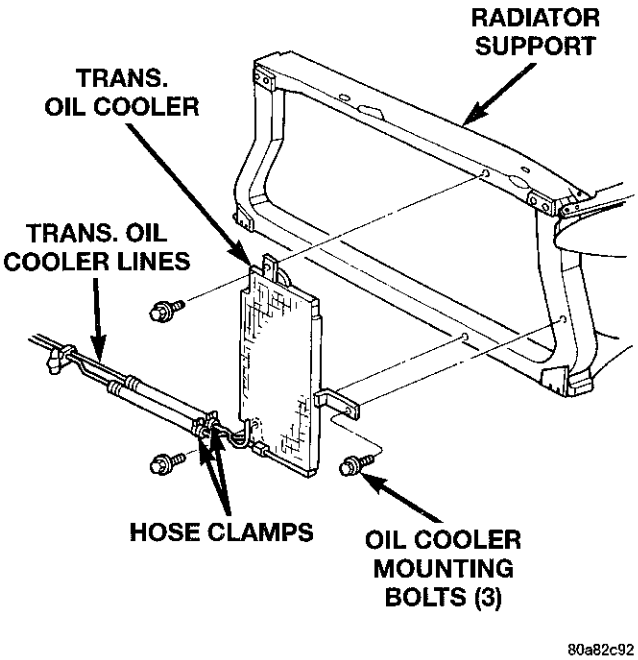

Fig. 11 Auxiliary Transmission Oil Cooler—8.0L Engine

AUTOMATIC TRANSMISSION OIL COOLERS—DIESEL ENGINE

All diesel models equipped with an automatic transmission are equipped with both a main water-to-oil cooler and a separate air-to-oil cooler. Both coolers are supplied as standard equipment on diesel engine powered models when equipped with an automatic transmission.

Transmission oil is cooled when it passes through these coolers.

The main water-to-oil transmission oil cooler is mounted to a bracket on the turbocharger side of the engine (Fig. 12).

The air-to-oil cooler is located in front of and to the left side of the radiator (Fig. 13).

The diesel engine is not equipped with an internal radiator mounted oil cooler.

AUTOMATIC BELT TENSIONER

Drive belts on all engines are equipped with a spring loaded automatic belt tensioner (Fig. 14) (Fig.

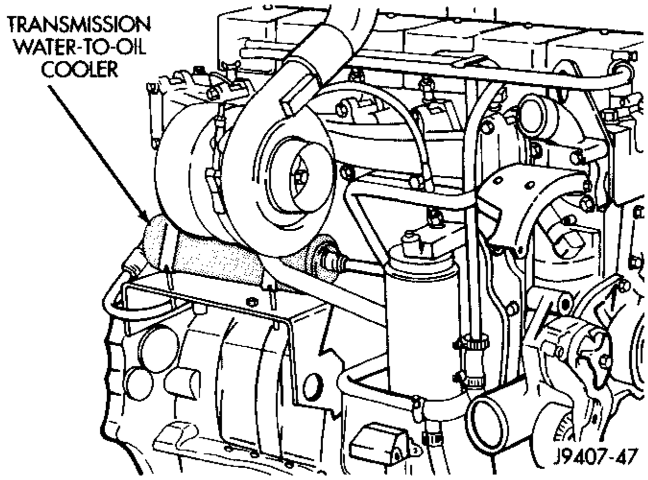

Fig. 12 Transmission Water-To-Oil Cooler—Diesel Engine—Typical

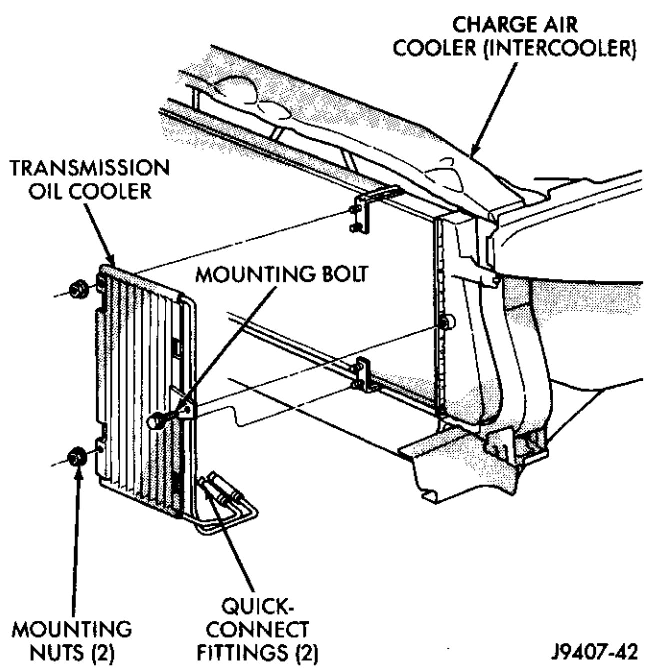

Fig. 13 Auxiliary Transmission Oil Cooler—Diesel Engine

15) (Fig. 16). This belt tensioner will be used with all belt configurations, such as with or without power steering or air conditioning.

CAUTION: Do not attempt to check belt tension with a belt tension gauge on vehicles equipped with an automatic belt tensioner.

On 3.9L V-6 or 5.2/5.9L V-8 LDC-gas engines, the tensioner is equipped with an indexing arrow (Fig. 17) on back of tensioner and an indexing mark on tensioner housing. If a new belt is being installed, arrow must be within approximately 3 mm (1/8 in.) of indexing mark (point B-) (Fig. 17). Belt is consid-

DESCRIPTION AND OPERATION (Continued)

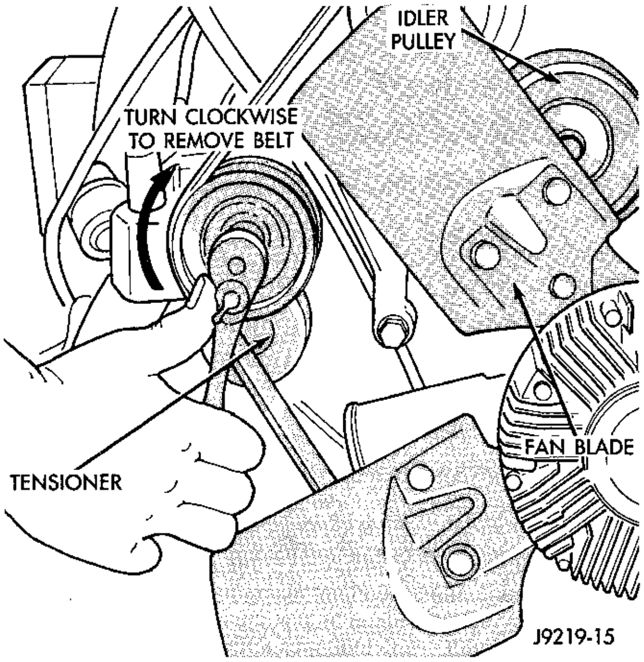

Fig. 14 Belt Tensioner—3.9L V-6 or 5.2/5.9L V-8 LDC-Gas Engines

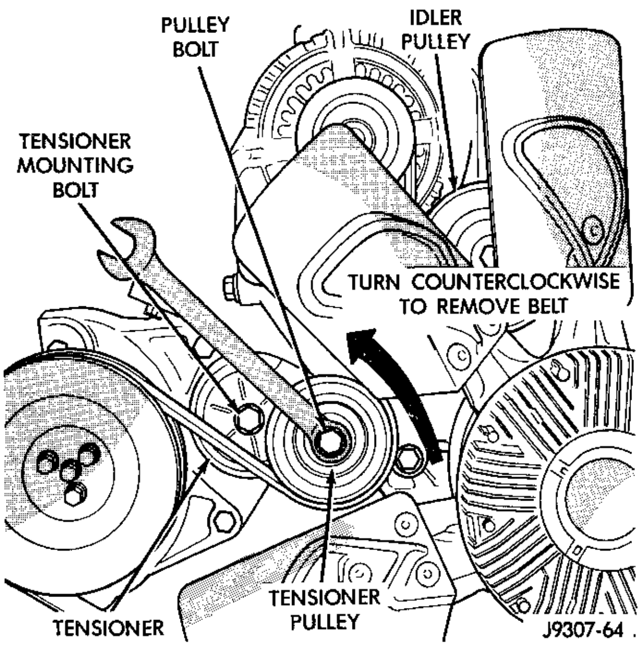

Fig. 15 Belt Tensioner—5.9L HDC-Gas and 8.0L V-10 Engines

ered new if it has been used 15 minutes or less. If this specification cannot be met, check for:

• The wrong belt being installed (incorrect length/ width)

• Worn bearings on an engine accessory (A/C compressor, power steering pump, water pump, idler pulley or generator)

• A pulley on an engine accessory being loose

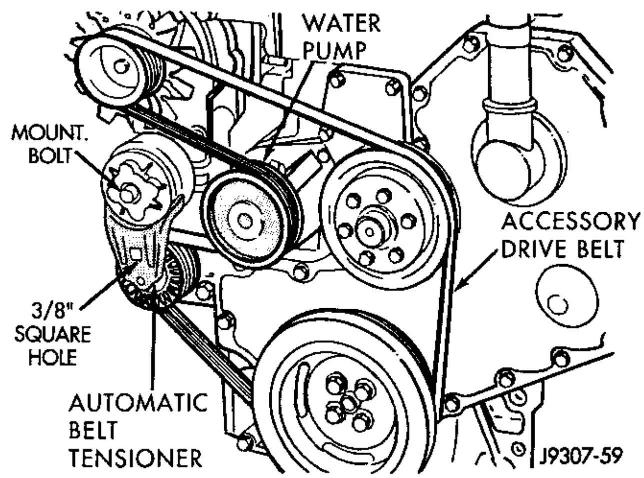

Fig. 16 Belt Tensioner—5.9L Diesel—Typical (non-A/C shown)

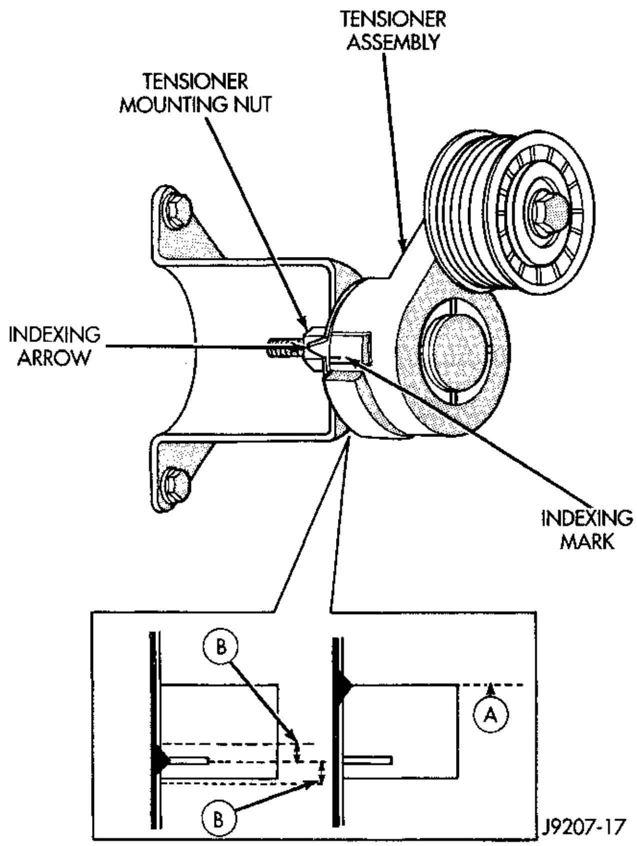

Fig. 17 Indexing Marks—3.9L V-6 or 5.2/5.9L V-8 LDC-Gas Engines

• Misalignment of an engine accessory

• Belt incorrectly routed.

On 3.9L V-6 or 5.2/5.9L V-8 LDC-gas engines, a used belt should be replaced if tensioner indexing arrow has moved to point-A (Fig. 17). Tensioner travel stops at point-A.

AUTHENTIC RESTORATION PRODUCT

DESCRIPTION AND OPERATION (Continued)

BLOCK HEATERS

An optional engine block heater is available on all models. The heater is equipped with a power cord. The cord is attached to an engine compartment component with tie-straps. The heater warms the engine providing easier engine starting and faster warm-up in low temperatures. The heater is mounted in a core hole of the engine cylinder block (in place of a freeze plug) with the heating element immersed in engine coolant. Connect the power cord to a grounded 110-120 volt AC electrical outlet with a grounded three wire extension cord.

WARNING: DO NOT OPERATE ENGINE UNLESS BLOCK HEATER CORD HAS BEEN DISCONNECTED FROM POWER SOURCE AND SECURED IN PLACE. THE POWER CORD MUST BE SECURED IN ITS RETAINING CLIPS AND ROUTED AWAY FROM EXHAUST MANIFOLDS AND MOVING PARTS.

The 3.9L/5.2L/5.9L gas powered engine has the block heater located on the right side of engine next to the oil filter (Fig. 18).

The 8.0L V-10 engine has the block heater located on the right side of engine next to the engine oil dipstick tube (Fig. 19).

The 5.9L diesel engine has the block heater located on the right side of the engine below the exhaust manifold next to the oil cooler (Fig. 20).

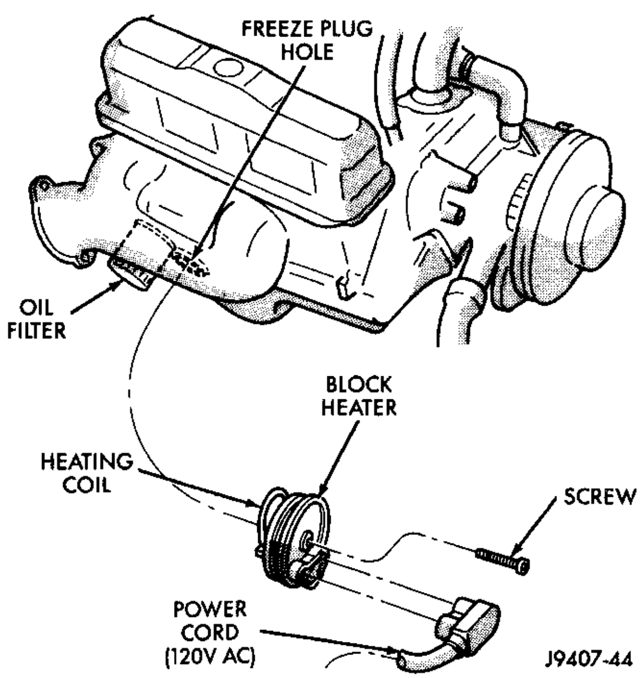

Fig. 18 Engine Block Heater—3.9L/5.2L/5.9L Gas Powered Engine

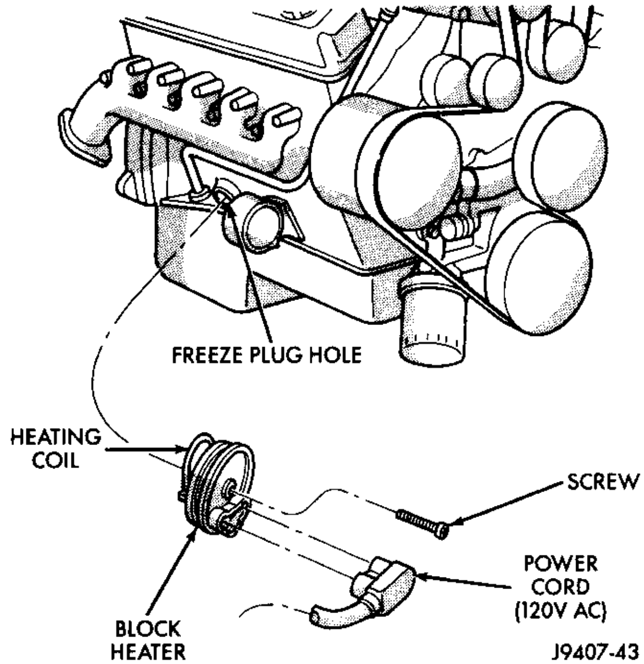

Fig. 19 Engine Block Heater—8.0L V-10 Engine

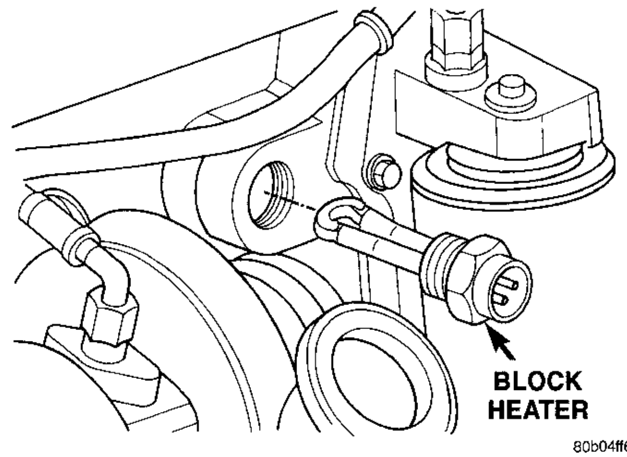

Fig. 20 Engine Block Heater—5.9L Diesel Engine

COOLANT PERFORMANCE

ETHYLENE-GLYCOL MIXTURES

The required ethylene-glycol (antifreeze) and water mixture depends upon the climate and vehicle operating conditions. The recommended mixture of 50/50 ethylene-glycol and water will provide protection against freezing to -37 deg. C (-35 deg. F). The antifreeze concentration **must always** be a minimum of 44 percent, year-round in all climates. **If percentage is lower than 44 percent, engine parts may be eroded by cavitation, and cooling system components may be severely damaged by corrosion.** Maximum protection against freezing is provided with a 68 percent antifreeze concentration, which

DESCRIPTION AND OPERATION (Continued)

prevents freezing down to -67.7 deg. C (-90 deg. F). A higher percentage will freeze at a warmer temperature. Also, a higher percentage of antifreeze can cause the engine to overheat because the specific heat of antifreeze is lower than that of water.

100 Percent Ethylene-Glycol—Should Not Be Used in Chrysler Vehicles

Use of 100 percent ethylene-glycol will cause formation of additive deposits in the system, as the corrosion inhibitive additives in ethylene-glycol require the presence of water to dissolve. The deposits act as insulation, causing temperatures to rise to as high as 149 deg. C (300) deg. F). This temperature is hot enough to melt plastic and soften solder. The increased temperature can result in engine detonation. In addition, 100 percent ethylene-glycol freezes at 22 deg. C (-8 deg. F).

Propylene-glycol Formulations—Should Not Be Used in Chrysler Vehicles

Propylene-glycol formulations do not meet Chrysler coolant specifications. It's overall effective temperature range is smaller than that of ethylene-glycol. The freeze point of 50/50 propylene-glycol and water is -32 deg. C (-26 deg. F). 5 deg. C higher than ethylene-glycol's freeze point. The boiling point (protection against summer boil-over) of propylene-glycol is 125 deg. C (257 deg. F) at 96.5 kPa (14 psi), compared to 128 deg. C (263 deg. F) for ethylene-glycol. Use of propylene-glycol can result in boil-over or freeze-up in Chrysler vehicles, which are designed for ethylene-glycol. Propylene glycol also has poorer heat transfer characteristics than ethylene glycol. This can increase cylinder head temperatures under certain conditions.

Propylene-glycol/Ethylene-glycol Mixtures—Should Not Be Used in Chrysler Vehicles

Propylene-glycol/ethylene-glycol Mixtures can cause the destabilization of various corrosion inhibitors, causing damage to the various cooling system components. Also, once ethylene-glycol and propylene-glycol based coolants are mixed in the vehicle, conventional methods of determining freeze point will not be accurate. Both the refractive index and specific gravity differ between ethylene glycol and propylene glycol.

CAUTION: Richer antifreeze mixtures cannot be measured with normal field equipment and can cause problems associated with 100 percent ethylene-glycol.

COOLANT SELECTION-ADDITIVES

The presence of aluminum components in the cooling system requires strict corrosion protection. Maintain coolant at specified level with a mixture of ethylene glycol based antifreeze and water. Only use an antifreeze containing ALUGARD 340-2 ® such as Mopar Antifreeze. If coolant becomes contaminated or looses color, drain and flush cooling system and fill with correctly mixed solution.

CAUTION: Do not use coolant additives that are claimed to improve engine cooling.

RADIATOR PRESSURE CAP

Radiators are equipped with a pressure cap, which releases pressure at some point within a range of 97-124 kPa (14-18 psi). The pressure relief point (in pounds) is engraved on top of cap.

The cooling system will operate at pressures slightly above atmospheric pressure. This results in a higher coolant boiling point allowing increased radiator cooling capacity. The cap (Fig. 21) contains a spring-loaded pressure relief valve that opens when system pressure reaches release range of 97-124 kPa (14-18 psi).

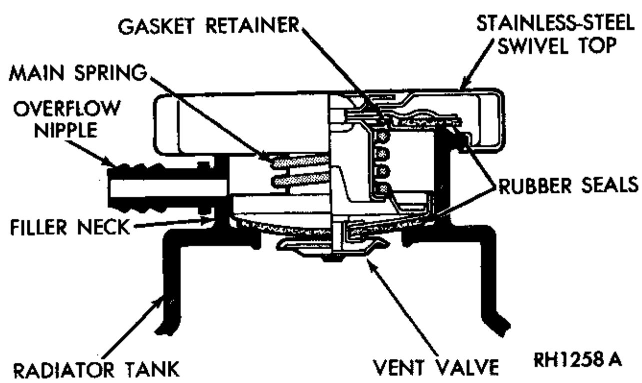

Fig. 21 Radiator Pressure Cap and Filler Neck—Typical

A vent valve in the center of cap allows a small coolant flow through cap when coolant is below boiling temperature. The valve is completely closed when boiling point is reached. As the coolant cools, it contracts and creates a vacuum in the cooling system. This causes the vacuum valve to open and coolant in the reserve/overflow tank to be drawn through its connecting hose into radiator. If the vacuum valve is stuck shut, the radiator hoses will collapse on cool-down. Clean the vent valve (Fig. 21).

A rubber gasket seals radiator filler neck to prevent leakage. This is done to keep system under pressure. It also maintains vacuum during coolant cool-down allowing coolant to return from reserve/overflow tank.

AUTHENTIC RESTORATION PRODUCT

DESCRIPTION AND OPERATION (Continued)

WATER PUMPS—V-6, V-8, AND V-10 ENGINES

A centrifugal water pump circulates coolant through the water jackets, passages, intake manifold, radiator core, cooling system hoses and heater core. The pump is driven from the engine crankshaft by a drive belt.

The water pump impeller is pressed onto the rear of a shaft that rotates in a bearing pressed into the water pump body. The body has a small hole for ventilation. The water pump seals are lubricated by antifreeze in the coolant mixture. Additional lubrication is not necessary.

WATER PUMP—5.9L DIESEL

The diesel engine water pump draws coolant from radiator outlet and circulates it through engine, heater core and back to radiator inlet. The crankshaft pulley drives the water pump with a serpentine drive belt (Fig. 22). An automatic belt tensioner (Fig. 22) is used to prevent the belt from slipping.

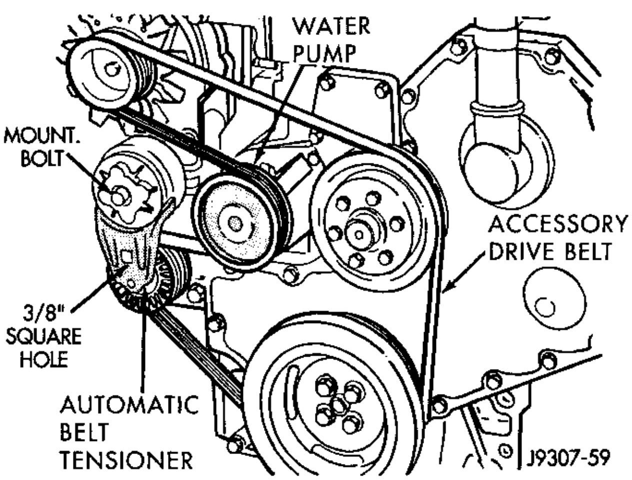

Fig. 22 Water Pump—5.9L Diesel—Typical (non-A/C shown)

COOLING SYSTEM HOSES AND CLAMPS

Rubber hoses route coolant to and from the radiator, intake manifold and heater core. Radiator lower hoses are spring-reinforced to prevent collapse from water pump suction at moderate and high engine speeds.

Inspect the hoses at regular intervals. Replace hoses that are cracked, feel brittle when squeezed or swell excessively when system is pressurized. The use of molded replacement hoses is recommended. When performing a hose inspection, inspect radiator lower hose for proper position and condition of spring.

WARNING: CONSTANT TENSION HOSE CLAMPS ARE USED ON MOST COOLING SYSTEM HOSES. WHEN REMOVING OR INSTALLING, USE ONLY TOOLS DESIGNED FOR SERVICING THIS TYPE OF CLAMP, SUCH AS SPECIAL CLAMP TOOL (NUMBER 6094) (Fig. 23). SNAP-ON CLAMP TOOL (NUMBER HPC-20) MAY BE USED FOR LARGER CLAMPS. ALWAYS WEAR SAFETY GLASSES WHEN SERVICING CONSTANT TENSION CLAMPS.

CAUTION: A number or letter is stamped into the tongue of constant tension clamps (Fig. 24). If replacement is necessary, use only an original equipment clamp with a matching number or letter.

Ordinary worm gear type hose clamps (when equipped) can be removed with a straight screwdriver or a hex socket. **To prevent damage to hoses or clamps, the hose clamps should be tightened to 4 N·m (34 in. lbs.) torque. Do not over tighten hose clamps.**

For all vehicles: In areas where specific routing clamps are not provided, be sure that hoses are positioned with sufficient clearance. Check clearance from exhaust manifolds and pipe, fan blades, drive belts and sway bars. Improperly positioned hoses can be damaged, resulting in coolant loss and engine overheating.

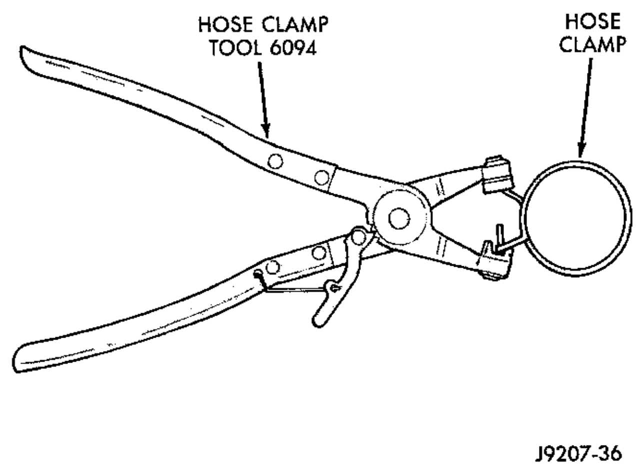

Fig. 23 Hose Clamp Tool—Typical

COOLANT RESERVE/OVERFLOW SYSTEM

The coolant reserve/overflow system works in conjunction with the radiator pressure cap. It utilizes thermal expansion and contraction of coolant to keep coolant free of trapped air. It provides a volume for expansion and contraction of coolant. It also provides a convenient and safe method for checking coolant level and adjusting level at atmospheric pressure. This is done without removing the radiator pressure cap. The system also provides some reserve coolant to the radiator to cover minor leaks and evaporation or boiling losses.

DESCRIPTION AND OPERATION (Continued)

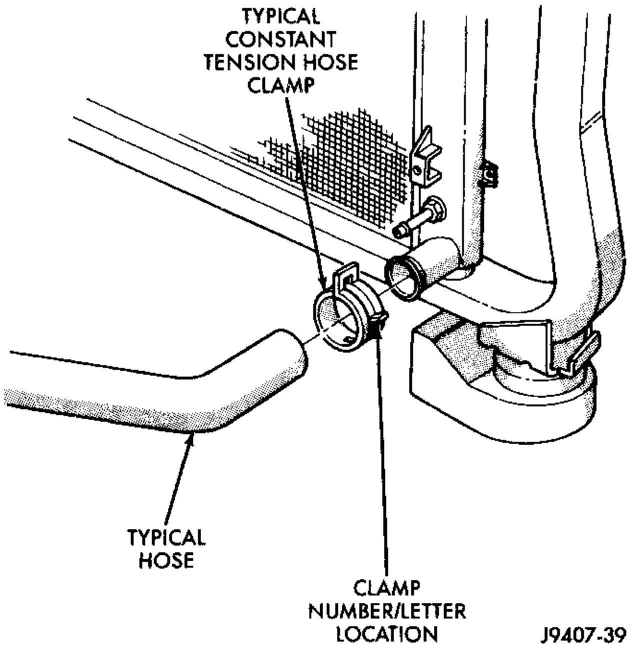

Fig. 24 Clamp Number/Letter Location

As the engine cools, a vacuum is formed in the cooling system of both the radiator and engine. Coolant will then be drawn from the coolant tank and returned to a proper level in the radiator.

On 3.9L/5.2L/5.9L gas engines and the 5.9L diesel engine, the coolant reserve/overflow tank is mounted to the side of the fan shroud (Fig. 25). On the 8.0L V-10 engine the tank is mounted to right inner fender (Fig. 26).

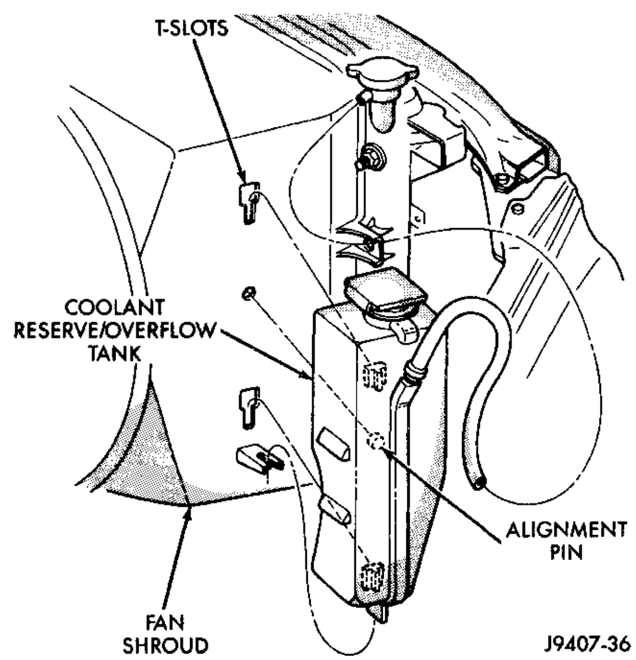

Fig. 25 Coolant Reserve/Overflow Tank—All Except 8.0L V-10 Engine

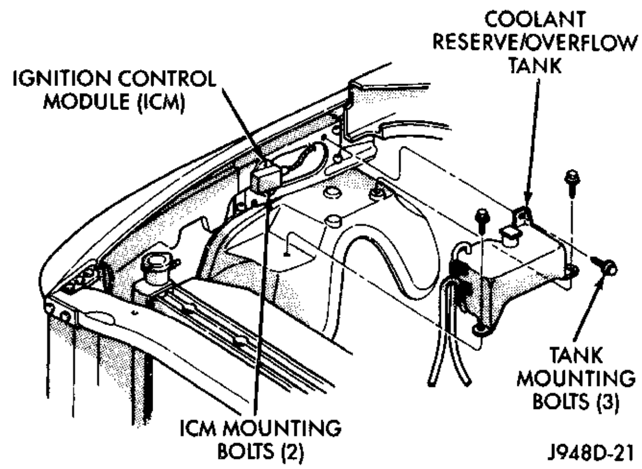

Fig. 26 Coolant Reserve/Overflow Tank—8.0L V-10 Engine

Refer to Coolant Level Check—Service, Deaeration and Radiator Pressure Cap sections in this group for coolant reserve/overflow system operation and service.

Should the reserve/overflow tank become coated with corrosion, it can be cleaned with detergent and water. Rinse tank thoroughly before refilling cooling system as described in the Coolant section of this group.

VISCOUS FAN DRIVE

The thermal viscous fan drive (Fig. 27) (Fig. 28)is a silicone-fluid- filled coupling used to connect the fan blades to the water pump shaft. The coupling allows the fan to be driven in a normal manner. This is done at low engine speeds while limiting the top speed of the fan to a predetermined maximum level at higher engine speeds.

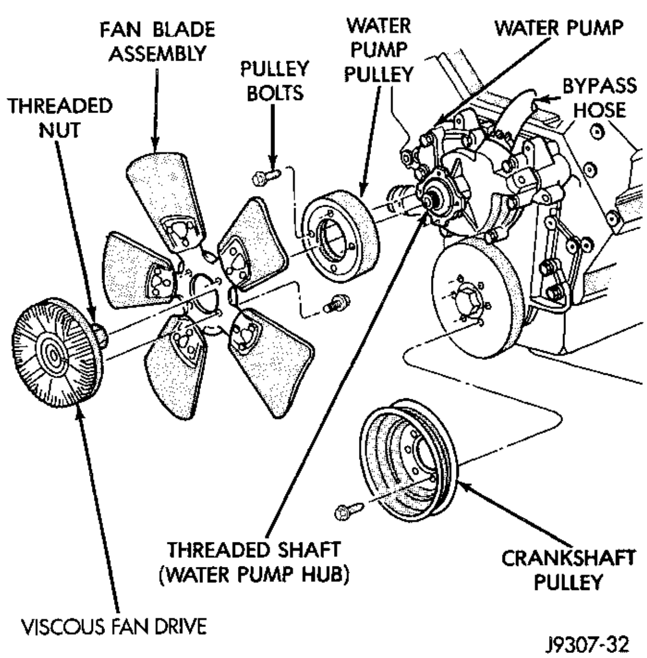

Fig. 27 Viscous Fan Drive—Gas Engines

DESCRIPTION AND OPERATION (Continued)

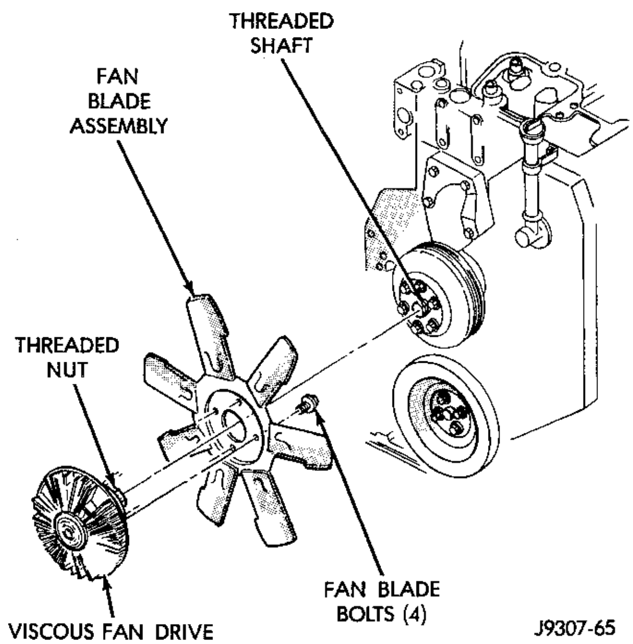

Fig. 28 Viscous Fan Drive—Diesel Engine

A thermostatic bimetallic spring coil is located on the front face of the viscous fan drive unit (a typical viscous unit is shown in (Fig. 29). This spring coil reacts to the temperature of the radiator discharge air. It engages the viscous fan drive for higher fan speed if the air temperature from the radiator rises above a certain point. Until additional engine cooling is necessary, the fan will remain at a reduced rpm regardless of engine speed.

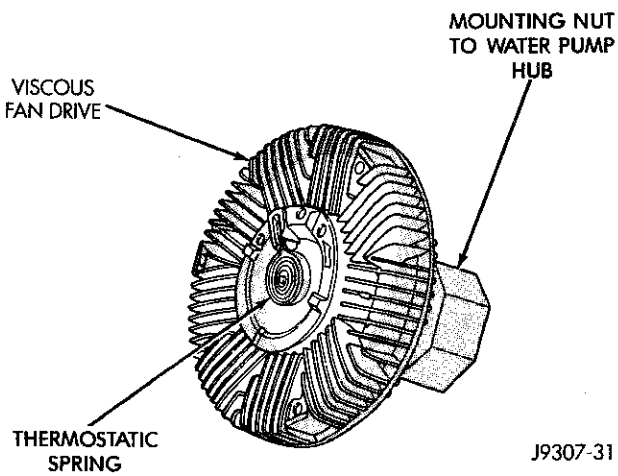

Fig. 29 Viscous Fan Drive—Typical

Only when sufficient heat is present, will the viscous fan drive engage. This is when the air flowing through the radiator core causes a reaction to the bimetallic coil. It then increases fan speed to provide the necessary additional engine cooling.

Once the engine has cooled, the radiator discharge temperature will drop. The bimetallic coil again reacts and the fan speed is reduced to the previous disengaged speed.

CAUTION: Some engines equipped with serpentine drive belts have reverse rotating fans and viscous fan drives. They are marked with the word REVERSE to designate their usage. Installation of the wrong fan or viscous fan drive can result in engine overheating.

CAUTION: If the viscous fan drive is replaced because of mechanical damage, the cooling fan blades should also be inspected. Inspect for fatigue cracks, loose blades, or loose rivets that could have resulted from excessive vibration. Replace fan blade assembly if any of these conditions are found. Also inspect water pump bearing and shaft assembly for any related damage due to a viscous fan drive malfunction.

DIAGNOSIS AND TESTING

ON-BOARD DIAGNOSTICS (OBD)

COOLING SYSTEM RELATED DIAGNOSTICS

The Powertrain Control Module (PCM) has been programmed to monitor the certain following cooling system components:

- If the engine has remained cool for too long a period, such as with a stuck open thermostat, a Diagnostic Trouble Code (DTC) can be set.
- If an open or shorted condition has developed in the relay circuit controlling the electric radiator fan, a Diagnostic Trouble Code (DTC) can be set.

If the problem is sensed in a monitored circuit often enough to indicate an actual problem, a DTC is stored. The DTC will be stored in the PCM memory for eventual display to the service technician. (Refer to Group 25, Emission Control Systems for proper procedures)

ACCESSING DIAGNOSTIC TROUBLE CODES

To read DTC's and to obtain cooling system data, refer to Group 25, Emission Control Systems for proper procedures.

DRB SCAN TOOL

For operation of the DRB scan tool, refer to the appropriate Powertrain Diagnostic Procedures service manual.

DIAGNOSIS AND TESTING (Continued)

PRELIMINARY CHECKS

ENGINE COOLING SYSTEM OVERHEATING

Establish what driving conditions caused the complaint. Abnormal loads on the cooling system such as the following may be the cause:

(1) PROLONGED IDLE, VERY HIGH AMBIENT TEMPERATURE, SLIGHT TAIL WIND AT IDLE, SLOW TRAFFIC, TRAFFIC JAMS, HIGH SPEED OR STEEP GRADES.

Driving techniques that avoid overheating are:

- Idle with A/C off when temperature gauge is at end of normal range.
- Increasing engine speed for more air flow is recommended.

(2) TRAILER TOWING:

Consult Trailer Towing section of owners manual. Do not exceed limits.

(3) AIR CONDITIONING; ADD-ON OR AFTER MARKET:

A maximum cooling package should have been ordered with vehicle if add-on or after market A/C is installed. If not, maximum cooling system components should be installed for model involved per manufacturer's specifications.

(4) RECENT SERVICE OR ACCIDENT REPAIR:

Determine if any recent service has been performed on vehicle that may effect cooling system. This may be:

- Engine adjustments (incorrect timing)
- Slipping engine accessory drive belt(s)
- Brakes (possibly dragging)
- Changed parts. Incorrect water pump or pump rotating in wrong direction due to belt not correctly routed
- Reconditioned radiator or cooling system refilling (possibly under filled or air trapped in system).

NOTE: If investigation reveals none of the previous items as a cause for an engine overheating complaint, refer to following Cooling System Diagnosis charts.

COOLING SYSTEM DIAGNOSIS—DIESEL ENGINE

CONDITION	POSSIBLE CAUSES	CORRECTION
TEMPERATURE GAUGE READS LOW	1. Has a Diagnostic Trouble Code (DTC) been set indicating a stuck open thermostat?	1. Refer to Group 25, Emission Systems for On-Board Diagnostics and DTC information. Replace thermostat if necessary.
	2. Is the temperature sending unit connected?	2. Check the temperature sensor connector. Refer to Group 8E. Repair connector if necessary.
	3. Is the temperature gauge operating OK?	3. Check gauge operation. Refer to Group 8E. Repair as necessary.
	4. Coolant level low in cold ambient temperatures accompanied with poor heater performance.	4. Check coolant level in the coolant reserve/overflow tank and the radiator. Inspect system for leaks. Repair leaks as necessary. Refer to the Coolant section of the manual text for WARNINGS and CAUTIONS associated with removing the radiator cap.
	5. Improper operation of internal heater doors or heater controls.	5. Inspect heater and repair as necessary. Refer to Group 24, Heating and Air Conditioning for procedures.

AUTHENTIC RESTORATION PRODUCT Mopar

DIAGNOSIS AND TESTING (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
TEMPERATURE GAUGE READS HIGH OR THE COOLANT WARNING LAMP ILLUMINATES. COOLANT MAY OR MAY NOT BE LOST OR LEAKING FROM THE COOLING SYSTEM	1. Trailer is being towed, a steep hill is being climbed, vehicle is operated in slow moving traffic, or engine is being idled with very high ambient (outside) temperatures and the air conditioning is on. Higher altitudes could aggravate these conditions.	1. This may be a temporary condition and repair is not necessary. Turn off the air conditioning and attempt to drive the vehicle without any of the previous conditions. Observe the temperature gauge. The gauge should return to the normal range. If the gauge does not return to the normal range, determine the cause for overheating and repair. Refer to Possible Causes (2-20).
	2. Is the temperature gauge reading correctly?	2. Check gauge. Refer to Group 8E. Repair as necessary.
	3. Is the temperature warning illuminating unnecessarily?	3. Check warning lamp operation. Refer to Group 8E. Repair as necessary.
	4. Coolant low in coolant reserve/ overflow tank and radiator?	4. Check for coolant leaks and repair as necessary. Refer to Testing Cooling System for Leaks in this Group.
	5. Pressure cap not installed tightly. If cap is loose, boiling point of coolant will be lowered. Also refer to the following Step 6.	5. Tighten cap
	6. Poor seals at the radiator cap.	6. (a) Check condition of cap and cap seals. Refer to Radiator Cap. Replace cap if necessary. (b) Check condition of radiator filler neck. If neck is bent or damaged, replace radiator.
	7. Coolant level low in radiator but not in coolant reserve/overflow tank. This means the radiator is not drawing coolant from the coolant reserve/overflow tank as the engine cools	7. (a) Check condition of radiator cap and cap seals. Refer to Radiator Cap in this Group. Replace cap if necessary. (b) Check condition of radiator filler neck. If neck is bent or damaged, replace radiator. (c) Check condition of the hose from the radiator to the coolant tank. It should fit tight at both ends without any kinks or tears. Replace hose if necessary. (d) Check coolant reserve/overflow tank and tanks hoses for blockage. Repair as necessary.

DIAGNOSIS AND TESTING (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
	8. Incorrect coolant concentration	8. Check coolant. Refer to Coolant section in this Group for correct coolant/water mixture ratio.
	9. Coolant not flowing through system	9. Check for coolant flow at radiator filler neck with some coolant removed, engine warm and thermostat open. Coolant should be observed flowing through radiator. If flow is not observed, determine area of obstruction and repair as necessary.
	10. Radiator or A/C condenser fins are dirty or clogged.	10. Remove insects and debris. Refer to Radiator Cleaning in this Group.
	11. Radiator core is corroded or plugged.	11. Have radiator re-cored or replaced.
	12. Aftermarket A/C installed without proper radiator.	12. Install proper radiator.
	13. Fuel or ignition system problems.	13. Refer to Fuel and Ignition System Groups for diagnosis.
	14. Dragging brakes.	14. Check and correct as necessary. Refer to Group 5, Brakes for correct procedures.
	15. Bug screen or cardboard is being used, reducing airflow.	15. Remove bug screen or cardboard.
	16. Thermostat partially or completely shut.	16. Check thermostat operation and replace as necessary. Refer to Thermostats in this Group.
	17. Viscous fan drive not operating properly.	17. Check fan drive operation and replace as necessary. Refer to Viscous Fan Drive in this Group.
	18. Cylinder head gasket leaking.	18. Check for cylinder head gasket leaks. Refer to Cooling System-Testing For Leaks in this Group. For repair, refer to Group 9, Engines.
	19. Heater core leaking.	19. Check heater core for leaks. Refer to Group 24, Heating and Air Conditioning. Repair as necessary.
TEMPERATURE GAUGE READING IS INCONSISTENT (FLUCTUATES, CYCLES OR IS ERRATIC)	1. During cold weather operation, with the heater blower in the high position, the gauge reading may drop slightly.	1. A normal condition. No correction is necessary.
	2. Temperature gauge or engine mounted gauge sensor defective or shorted. Also, corroded or loose wiring in this circuit.	2. Check operation of gauge and repair if necessary. Refer to Group 8E, Instrument Panel and Gauges.
	3. Gauge reading rises when vehicle is brought to a stop after heavy use (engine still running)	3. A normal condition. No correction is necessary. Gauge should return to normal range after vehicle is driven.

AUTHENTIC RESTORATION PRODUCT

DIAGNOSIS AND TESTING (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
	4. Gauge reading high after re-starting a warmed up (hot) engine.	4. A normal condition. No correction is necessary. The gauge should return to normal range after a few minutes of engine operation.
	5. Coolant level low in radiator (air will build up in the cooling system causing the thermostat to open late).	5. Check and correct coolant leaks. Refer to Cooling System-Testing for leaks in this group.
	6. Cylinder head gasket leaking allowing exhaust gas to enter cooling system causing a thermostat to open late.	6. (a) Check for cylinder head gasket leaks. Refer to Cooling System-Testing for Leaks in this group. (b) Check for coolant in the engine oil. Inspect for white steam emitting from the exhaust system. Repair as necessary.
	7. Water pump impeller loose on shaft.	7. Check water pump and replace as necessary. Refer to water Pumps in this group.
	8. Loose accessory drive belt. (water pump slipping)	8. Refer to Accessory Drive Belts in this group. Check and correct as necessary.
	9. Air leak on the suction side of the water pump allows air to build up in cooling system causing thermostat to open late.	9. Locate leak and repair as necessary.
PRESSURE CAP IS BLOWING OFF STEAM AND/OR COOLANT TO COOLANT TANK. TEMPERATURE GAUGE READING MAY BE ABOVE NORMAL BUT NOT HIGH. COOLANT LEVEL MAY BE HIGH IN COOLANT RESERVE/ OVERFLOW TANK	1. Pressure relief valve in radiator cap is defective.	1. Check condition of radiator cap and cap seals. Refer to Radiator Caps in this group. Replace cap as necessary.
COOLANT LOSS TO THE GROUND WITHOUT PRESSURE CAP BLOWOFF. GAUGE READING HIGH OR HOT	1. Coolant leaks in radiator, cooling system hoses, water pump or engine.	1. Pressure test and repair as necessary. Refer to Cooling System-Testing For Leaks in this group.
DETONATION OR PRE-IGNITION (NOT CAUSED BY IGNITION SYSTEM). GAUGE MAY OR MAY NOT BE READING HIGH	1. engine overheating. 2. Freeze point of coolant not correct. Mixture is too rich or too lean.	1. Check reason for overheating and repair as necessary. 2. Check coolant concentration. Refer to the Coolant section of this group and adjust ratio as required.

DIAGNOSIS AND TESTING (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
HOSE OR HOSES COLLAPSE WHILE ENGINE IS RUNNING	1. Vacuum created in cooling system on engine cool-down is not being relieved through coolant reserve/overflow system.	1. (a) Radiator cap relief valve stuck. Refer to Radiator Cap in this group. Replace if necessary (b) Hose between coolant reserve/overflow tank and radiator is kinked. Repair as necessary. (c) Vent at coolant reserve/overflow tank is plugged. Clean vent and repair as necessary. (d) Reserve/overflow tank is internally blocked or plugged. Check for blockage and repair as necessary.
NOISY VISCOUS FAN/DRIVE	1. Fan blades loose.	1. Replace fan blade assembly. Refer to Cooling System Fans in this Group
	2. Fan blades striking a surrounding object.	2. Locate point of fan blade contact and repair as necessary.
	3. Air obstructions at radiator or air conditioning condenser.	3. Remove obstructions and/or clean debris or insects from radiator or A/C condenser.
	4. Thermal viscous fan drive has defective bearing.	4. Replace fan drive. Bearing is not serviceable. Refer to Viscous Fan Drive in this group.
	5. A certain amount of fan noise may be evident on models equipped with a thermal viscous fan drive. Some of this noise is normal.	5. Refer to Viscous Fan Drive in this group for an explanation of normal fan noise.
INADEQUATE HEATER PERFORMANCE. THERMOSTAT FAILED IN OPEN POSITION	1. Has a Diagnostic trouble Code (DTC) been set?	1. Refer to Group 25, Emissions for correct procedures and replace thermostat if necessary
	2. Coolant level low	2. Refer to Cooling System-Testing For Leaks in this group.
	3. Obstructions in heater hose/ fittings	3. Remove heater hoses at both ends and check for obstructions
	4. Heater hose kinked	4. Locate kinked area and repair as necessary
	5. Water pump is not pumping water to/through the heater core. When the engine is fully warmed up, both heater hoses should be hot to the touch. If only one of the hoses is hot, the water pump may not be operating correctly or the heater core may be plugged. Accessory drive belt may be slipping causing poor water pump operation.	5. Refer to Water Pump in this group. If a slipping belt is detected, refer to Accessory Drive Belts in this group. If heater core obstruction is detected, refer to Group 24, Heating and Air Conditioning.

AUTHENTIC RESTORATION

DIAGNOSIS AND TESTING (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
STEAM IS COMING FROM THE FRONT OF VEHICLE NEAR THE GRILL AREA WHEN WEATHER IS WET, ENGINE IS WARMED UP AND RUNNING, AND VEHICLE IS STATIONARY. TEMPERATURE GAUGE IS IN NORMAL RANGE	1. During wet weather, moisture (snow, ice or rain condensation) on the radiator will evaporate when the thermostat opens. This opening allows heated water into the radiator. When the moisture contacts the hot radiator, steam may be emitted. This usually occurs in cold weather with no fan or airflow to blow it away.	1. Occasional steam emitting from this area is normal. No repair is necessary.
COOLANT COLOR	1. Coolant color is not necessarily an indication of adequate corrosion or temperature protection. Do not rely on coolant color for determining condition of coolant.	1. Refer to Coolant in this group for coolant concentration information. Adjust coolant mixture as necessary.
COOLANT LEVEL CHANGES IN COOLANT RESERVE/OVERFLOW TANK. TEMPERATURE GAUGE IS IN NORMAL RANGE	1. Level changes are to be expected as coolant volume fluctuates with engine temperature. If the level in the tank was between the FULL and ADD marks at normal operating temperature, the level should return to within that range after operation at elevated temperatures.	1. A normal condition. No repair is necessary.

RADIATOR COOLANT FLOW TEST

Use the following procedure to determine if coolant is flowing through the cooling system.

(1) Idle engine until operating temperature is reached. If the upper radiator hose is warm to the touch, the thermostat is opening and coolant is flowing to the radiator.

WARNING: HOT, PRESSURIZED COOLANT CAN CAUSE INJURY BY SCALDING. USING A RAG TO COVER THE RADIATOR PRESSURE CAP, OPEN RADIATOR CAP SLOWLY TO THE FIRST STOP. THIS WILL ALLOW ANY BUILT-UP PRESSURE TO VENT TO THE RESERVE/OVERFLOW TANK. AFTER PRESSURE BUILD-UP HAS BEEN RELEASED, REMOVE CAP FROM FILLER NECK.

(2) Drain a small amount of coolant from the radiator until the ends of the radiator tubes are visible through the filler neck. Idle the engine at normal operating temperature. If coolant is flowing past the exposed tubes, the coolant is circulating.

TESTING COOLING SYSTEM FOR LEAKS

PRESSURE TESTER METHOD

The engine should be at normal operating temperature. Recheck the system cold if cause of coolant loss is not located during the warm engine examination.

WARNING: HOT, PRESSURIZED COOLANT CAN CAUSE INJURY BY SCALDING.

Carefully remove radiator pressure cap from filler neck and check coolant level. Push down on cap to disengage it from stop tabs. Wipe inside of filler neck and examine lower inside sealing seat for nicks, cracks, paint, dirt and solder residue. Inspect radiator-to- reserve/overflow tank hose for internal obstructions. Insert a wire through the hose to be sure it is not obstructed.

Inspect cams on outside of filler neck. If cams are bent, seating of pressure cap valve and tester seal will be affected. Replace cap if cams are bent.

Attach pressure tester (7700 or an equivalent) to radiator filler neck (Fig. 30).

Operate tester pump to apply 103.4 kPa (15 psi) pressure to system. If hoses enlarge excessively or bulges while testing, replace as necessary. Observe gauge pointer and determine condition of cooling system according to following criteria:

Holds Steady: If pointer remains steady for two minutes, serious coolant leaks are not present in system. However, there could be an internal leak that does not appear with normal system test pressure. If

DIAGNOSIS AND TESTING (Continued)

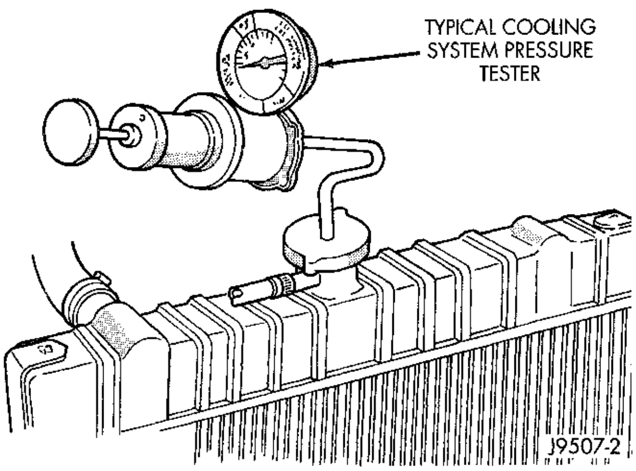

Fig. 30 Pressure Testing Cooling System—Typical

it is certain that coolant is being lost and leaks cannot be detected, inspect for interior leakage or perform Internal Leakage Test.

Drops Slowly: Indicates a small leak or seepage is occurring. Examine all connections for seepage or slight leakage with a flashlight. Inspect radiator, hoses, gasket edges and heater. Seal small leak holes with a sealer lubricant (or equivalent). Repair leak holes and inspect system again with pressure applied.

Drops Quickly: Indicates that serious leakage is occurring. Examine system for external leakage. If leaks are not visible, inspect for internal leakage. Large radiator leak holes should be repaired by a reputable radiator repair shop.

ULTRAVIOLET LIGHT METHOD

A leak detection additive is available through the parts department that can be added to cooling system. The additive is highly visible under ultraviolet light (black light). Pour one ounce of additive into cooling system. Place heater control unit in HEAT position. Start and operate engine until radiator upper hose is warm to touch. Aim the commercially available black light tool at components to be checked. If leaks are present, black light will cause additive to glow a bright green color.

The black light can be used in conjunction with a pressure tester to determine if any external leaks exist (Fig. 31).

INTERNAL LEAKAGE TEST

Remove engine oil pan drain plug and drain a small amount of engine oil. If coolant is present in the pan, it will drain first because it is heavier than oil. An alternative method is to operate engine for a short period to churn the oil. After this is done, remove engine dipstick and inspect for water glob-

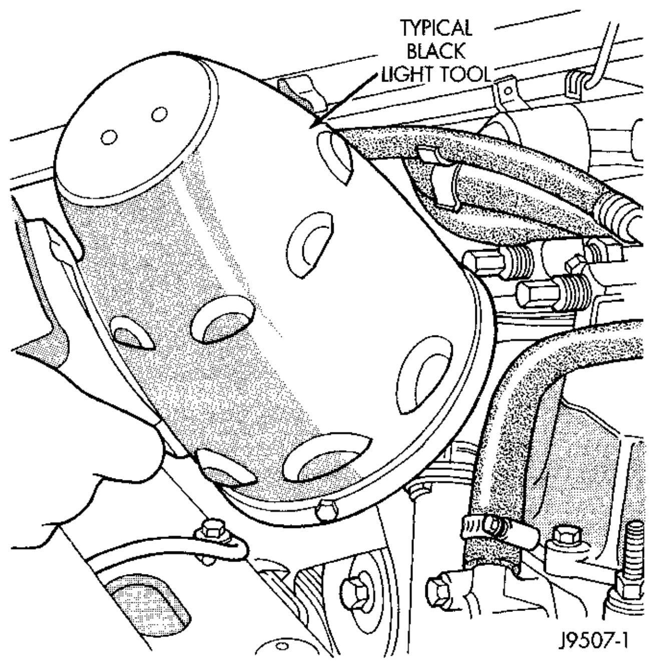

Fig. 31 Leak Detection Using Black Light—Typical

ules. Also inspect transmission dipstick for water globules and transmission fluid cooler for leakage.

WARNING: WITH COOLING SYSTEM PRESSURE TESTER TOOL INSTALLED ON RADIATOR, DO NOT ALLOW PRESSURE TO EXCEED 110 KPA (20 PSI). PRESSURE WILL BUILD UP QUICKLY IF A COMBUSTION LEAK IS PRESENT. TO RELEASE PRESSURE, ROCK TESTER FROM SIDE TO SIDE. WHEN REMOVING TESTER, DO NOT TURN TESTER MORE THAN 1/2 TURN IF SYSTEM IS UNDER PRESSURE.

Operate engine without pressure cap on radiator until thermostat opens. Attach a pressure tester to filler neck. If pressure builds up quickly it indicates a combustion leak exists. This is usually the result of a cylinder head gasket leak or crack in engine. Repair as necessary.

If there is not an immediate pressure increase, pump the pressure tester. Do this until indicated pressure is within system range of 110 kPa (16 psi). Fluctuation of gauge pointer indicates compression or combustion leakage into cooling system.

Because the vehicle is equipped with a catalytic converter, **do not** remove spark plug cables or short out cylinders (non-diesel engines) to isolate compression leak.

If the needle on dial of pressure tester does not fluctuate, race engine a few times to check for an abnormal amount of coolant or steam. This would be emitting from exhaust pipe. Coolant or steam from exhaust pipe may indicate a faulty cylinder head gasket, cracked engine cylinder block or cylinder head.

DIAGNOSIS AND TESTING (Continued)

A convenient check for exhaust gas leakage into cooling system is provided by a commercially available Block Leak Check tool. Follow manufacturers instructions when using this product.

COMBUSTION LEAKAGE TEST—WITHOUT PRESSURE TESTER

DO NOT WASTE reusable coolant. If solution is clean, drain coolant into a clean container for reuse.

WARNING: DO NOT REMOVE CYLINDER BLOCK DRAIN PLUGS OR LOOSEN RADIATOR DRAINCOCK WITH SYSTEM HOT AND UNDER PRESSURE. SERIOUS BURNS FROM COOLANT CAN OCCUR.

Drain sufficient coolant to allow thermostat removal. Refer to Thermostat Replacement. Disconnect water pump drive belt.

Add coolant to radiator to bring level to within 6.3 mm (1/4 in) of top of thermostat housing.

CAUTION: Avoid overheating. Do not operate engine for an excessive period of time. Open draincock immediately after test to eliminate boil over.

Start engine and accelerate rapidly three times, to approximately 3000 rpm (2000 rpm for diesel) while observing coolant. If internal engine combustion gases are leaking into cooling system, bubbles will appear in coolant. If bubbles do not appear, internal combustion gas leakage is not present.

VISCOUS FAN DRIVE

NOISE

NOTE: It is normal for fan noise to be louder (roaring) when:

- The underhood temperature is above the engagement point for the viscous drive coupling. This may occur when ambient (outside air temperature) is very high.
- Engine loads and temperatures are high such as when towing a trailer.
- Cool silicone fluid within the fan drive unit is being redistributed back to its normal disengaged (warm) position. This can occur during the first 15 seconds to one minute after engine start-up on a cold engine.

LEAKS

Viscous fan drive operation is not affected by small oil stains near the drive bearing. If leakage appears excessive, replace the fan drive unit.

TESTING

If the fan assembly free-wheels without drag (the fan blades will revolve more than five turns when spun by hand), replace the fan drive. This spin test must be performed when the engine is cool.

For the following test, the cooling system must be in good condition. It also will ensure against excessively high coolant temperature.

WARNING: BE SURE THAT THERE IS ADEQUATE FAN BLADE CLEARANCE BEFORE DRILLING.

(1) Drill a 3.18-mm (1/8-in) diameter hole in the top center of the fan shroud.

(2) Obtain a dial thermometer with an 8 inch stem (or equivalent). It should have a range of -18°-to-105°C (0°-to-220° F). Insert thermometer through the hole in the shroud. Be sure that there is adequate clearance from the fan blades.

(3) Connect a tachometer and an engine ignition timing light. The timing light is to be used as a strobe light. This step cannot be used on the diesel engine.

(4) Block the air flow through the radiator. Secure a sheet of plastic in front of the radiator (or air conditioner condenser). Use tape at the top to secure the plastic and be sure that the air flow is blocked.

(5) Be sure that the air conditioner (if equipped) is turned off.

WARNING: USE EXTREME CAUTION WHEN THE ENGINE IS OPERATING. DO NOT STAND IN A DIRECT LINE WITH THE FAN. DO NOT PUT YOUR HANDS NEAR THE PULLEYS, BELTS OR FAN. DO NOT WEAR LOOSE CLOTHING.

(6) Start the engine and operate at 2400 rpm. Within ten minutes the air temperature (indicated on the dial thermometer) should be up to 88° C (190° F). Fan drive **engagement** should start to occur at/between:

- 3.9L/5.2L/5.9L gas engines — 79° C (175° F)
- 8.0L engine — 88° to 96° C (190° to 205° F)
- 5.9L diesel engine — 71° to 82° C (160° to 179° F)

Engagement is distinguishable by a definite **increase** in fan flow noise (roaring). The timing light also will indicate an increase in the speed of the fan (non-diesel only).

(7) When viscous drive engagement is verified, remove the plastic sheet. Fan drive **disengagement** should start to occur at between 57° to 79° C (135° to 175° F). A definite **decrease** of fan flow noise (roaring) should be noticed. If not, replace the defective viscous fan drive unit.

DIAGNOSIS AND TESTING (Continued)

CAUTION: Some engines equipped with serpentine drive belts have reverse rotating fans and viscous fan drives. They are marked with the word REVERSE to designate their usage. Installation of the wrong fan or viscous fan drive can result in engine overheating.

CAUTION: If the viscous fan drive is replaced because of mechanical damage, the cooling fan blades should also be inspected. Inspect for fatigue cracks, loose blades, or loose rivets that could have resulted from excessive vibration. Replace fan blade assembly if any of these conditions are found. Also inspect water pump bearing and shaft assembly for any related damage due to a viscous fan drive malfunction.

ACCESSORY DRIVE BELT DIAGNOSIS

VISUAL DIAGNOSIS

When diagnosing serpentine accessory drive belts, small cracks that run across the ribbed surface of the belt from rib to rib (Fig. 32), are considered normal. These are not a reason to replace the belt. However, cracks running along a rib (not across) are **not** normal. Any belt with cracks running along a rib must be replaced (Fig. 32). Also replace the belt if it has excessive wear, frayed cords or severe glazing.

Refer to the Accessory Drive Belt Diagnosis charts for further belt diagnosis.

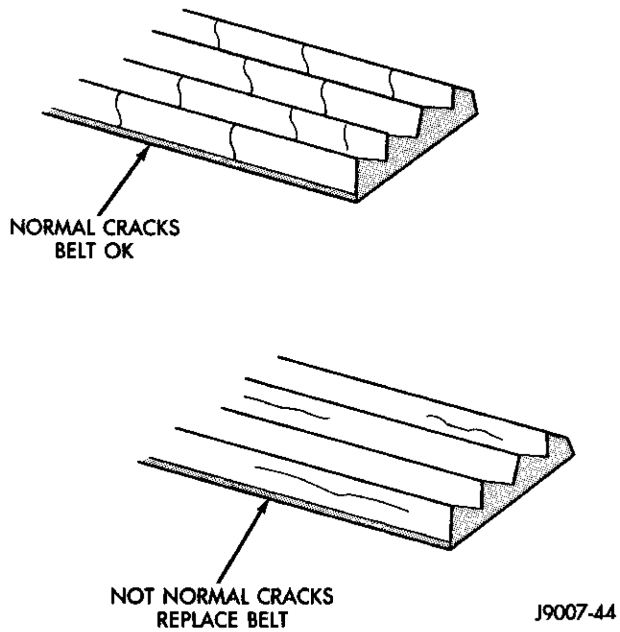

Fig. 32 Belt Wear Patterns

NOISE DIAGNOSIS

Noises generated by the accessory drive belt are most noticeable at idle. Before replacing a belt to resolve a noise condition, inspect all of the accessory drive pulleys for alignment, glazing, or excessive end play.

ACCESSORY DRIVE BELT DIAGNOSIS CHART

CONDITION	POSSIBLE CAUSES	CORRECTION
RIB CHUNKING (One or more ribs has separated from belt body)	1. Foreign objects imbedded in pulley grooves. 2. Installation damage	1. Remove foreign objects from pulley grooves. Replace belt. 2. Replace belt
RIB OR BELT WEAR	1. Pulley misaligned 2. Abrasive environment 3. Rusted pulley(s) 4. Sharp or jagged pulley groove tips 5. Belt rubber deteriorated	1. Align pulley(s) 2. Clean pulley(s). Replace belt if necessary 3. Clean rust from pulley(s) 4. Replace pulley. Inspect belt. 5. Replace belt
BELT SLIPS	1. Belt slipping because of insufficient tension 2. Belt or pulley exposed to substance that has reduced friction (belt dressing, oil, ethylene glycol)	1. Inspect/Replace tensioner if necessary 2. Replace belt and clean pulleys

AUTHENTIC RESTORATION PRODUCT

DIAGNOSIS AND TESTING (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
	3. Driven component bearing failure (seizure) 4. Belt glazed or hardened from heat and excessive slippage	3. Replace faulty component or bearing 4. Replace belt.
LONGITUDAL BELT CRACKING	1. Belt has mistracked from pulley groove 2. Pulley groove tip has worn away rubber to tensile member	1. Replace belt 2. Replace belt
"GROOVE JUMPING" (Belt does not maintain correct position on pulley)	1. Incorrect belt tension 2. Pulley(s) not within design tolerance 3. Foreign object(s) in grooves 4. Pulley misalignment 5. Belt cordline is broken	1. Inspect/Replace tensioner if necessary 2. Replace pulley(s) 3. Remove foreign objects from grooves 4. Align component 5. Replace belt
BELT BROKEN (Note: Identify and correct problem before new belt is installed)	1. Incorrect belt tension 2. Tensile member damaged during belt installation 3. Severe misalignment 4. Bracket, pulley, or bearing failure	1. Replace Inspect/Replace tensioner if necessary 2. Replace belt 3. Align pulley(s) 4. Replace defective component and belt
	1. Incorrect belt tension 2. Bearing noise 3. Belt misalignment 4. Belt to pulley mismatch 5. Driven component induced vibration	1. Inspect/Replace tensioner if necessary 2. Locate and repair 3. Align belt/pulley(s) 4. Install correct belt 5. Locate defective driven component and repair
TENSION SHEETING FABRIC FAILURE (Woven fabric on outside, circumference of belt has cracked or separated from body of belt)	1. Tension sheeting contacting stationary object 2. Excessive heat causing woven fabric to age 3. Tension sheeting splice has fractured	1. Correct rubbing condition 2. Replace belt 3. Replace belt
CORD EDGE FAILURE (Tensile member exposed at edges of belt or separated from belt body)	1. Incorrect belt tension 2. Belt contacting stationary object 3. Pulley(s) out of tolerance 4. Insufficient adhesion between tensile member and rubber matrix	1. Inspect/Replace tensioner if necessary 2. Replace belt 3. Replace pulley 4. Replace belt

DIAGNOSIS AND TESTING (Continued)

THERMOSTAT—DIESEL

The cooling system used with the diesel engine provides the extra coolant capacity and extra cooling protection needed for higher GVWR (Gross Vehicle Weight Rating) and GCWR (Gross Combined Weight Rating) vehicles.

This system capacity will not effect warm up or cold weather operating characteristics if the thermostat is operating properly. This is because coolant will be held in the engine until it reaches the thermostat "set" temperature.

Diesel engines, due to their inherent efficiency are slower to warm up than gasoline powered engines, and will operate at lower temperatures when the vehicle is unloaded. Because of this, lower temperature gauge readings for diesel versus gasoline engines may, at times be normal.

Typically, complaints of low engine coolant temperature are observed as low heater output when combined with cool or cold outside temperatures.

To help promote faster engine warm-up, the electric engine block heater must be used with cool or cold outside temperatures. This will help keep the engine coolant warm when the vehicle is parked. Use the block heater if the outside temperature is below 4°C (40°F). **Do not use the block heater if the outside temperature is above 4°C (40°F).**

A "Cold Weather Cover" is available from the parts department through the Mopar Accessories product line. This accessory cover is designed to block airflow entering the radiator and engine compartment to promote faster engine warm-up. It attaches to the front of the vehicle at the grill opening. **The cover is to be used with cool or cold temperatures only. If used with high outside temperatures, serious engine damage could result.** Refer to the literature supplied with the cover for additional information.

TESTING

The following test procedure is to be used for the **diesel engine only.**

NOTE: The DRB scan tool cannot be used to monitor engine coolant temperature on the diesel engine.

(1) To determine if the thermostat is defective, it must be removed from the vehicle. Refer to Thermostats for removal and installation procedures.

(2) After the thermostat has been removed, examine the thermostat and inside of thermostat housing for contaminants. If contaminants are found, the thermostat may already be in a "stuck open" position. Flush the cooling system before replacing thermostat. Refer to Cooling System Cleaning/Reverse Flushing in this group for additional information.

(3) Place the thermostat into a container filled with water.

(4) Place the container on a hot plate or other suitable heating device.

(5) Place a commercially available radiator thermometer into the water.

(6) Apply heat to the water while observing the thermostat and thermometer.

(7) When the water temperature reaches 83°C (181°F) the thermostat should start to open (valve will start to move). If the valve starts to move before this temperature is reached, it is opening too early. Replace thermostat. The thermostat should be fully open (valve will stop moving) at 95°C (203°F).

(8) If the valve is still moving when the water temperature reaches 203°, it is opening too late. Replace thermostat.

(9) If the valve refuses to move at any time, replace thermostat.

THERMOSTAT—GAS ENGINES

ON-BOARD DIAGNOSTICS

All **gasoline powered models** are equipped with On-Board Diagnostics for certain cooling system components. Refer to On-Board Diagnostics (OBD) in the Diagnosis section of this group for additional information. If the powertrain control module (PCM) detects low engine coolant temperature, it will record a Diagnostic Trouble Code (DTC) in the PCM memory. Do not change a thermostat for lack of heat as indicated by the instrument panel gauge or by poor heater performance unless a DTC is present. Refer to the Diagnosis section of this group for other probable causes. For other DTC numbers, refer to On-Board Diagnostics in the General Diagnosis section of Group 25, Emission Systems.

The DTC can also be accessed through the DRB scan tool. Refer to the appropriate Powertrain Diagnostic Procedures manual for diagnostic information and operation of the DRB scan tool.

WATER PUMP

A quick test to determine if pump is working is to check if heater warms properly. A defective water pump will not be able to circulate heated coolant through the long heater hose to the heater core.

RADIATOR CAP-TO-FILLER NECK SEAL—PRESSURE RELIEF CHECK

The pressure cap upper gasket (seal) pressure relief can be tested by removing overflow hose from radiator filler neck nipple. Attach hose of pressure tester tool 7700 (or equivalent) to nipple. It will be necessary to disconnect hose from its adapter for filler neck. Pump air into radiator. The pressure cap

AUTHENTIC RESTORATION PRODUCT

DIAGNOSIS AND TESTING (Continued)

upper gasket should relieve at 69-124 kPa (10-18 psi) and hold pressure at a minimum of 55 kPa (8 psi).

WARNING: THE WARNING WORDS —DO NOT OPEN HOT— ON RADIATOR PRESSURE CAP, ARE A SAFETY PRECAUTION. WHEN HOT, PRESSURE BUILDS UP IN COOLING SYSTEM. TO PREVENT SCALDING OR INJURY, RADIATOR CAP SHOULD NOT BE REMOVED WHILE SYSTEM IS HOT AND/OR UNDER PRESSURE.

Do not remove radiator cap at any time **except** for the following purposes:

- Check and adjust antifreeze freeze point
- Refill system with new antifreeze
- Conducting service procedures
- Checking for vacuum leaks

WARNING: IF VEHICLE HAS BEEN RUN RECENTLY, WAIT AT LEAST 15 MINUTES BEFORE REMOVING RADIATOR CAP. WITH A RAG, SQUEEZE RADIATOR UPPER HOSE TO CHECK IF SYSTEM IS UNDER PRESSURE. PLACE A RAG OVER CAP AND WITHOUT PUSHING CAP DOWN, ROTATE IT COUNTER-CLOCKWISE TO FIRST STOP. ALLOW FLUID TO ESCAPE THROUGH THE COOLANT RESERVE/OVERFLOW HOSE INTO RESERVE/OVERFLOW TANK. SQUEEZE RADIATOR UPPER HOSE TO DETERMINE WHEN PRESSURE HAS BEEN RELEASED. WHEN COOLANT AND STEAM STOP BEING PUSHED INTO TANK AND SYSTEM PRESSURE DROPS, REMOVE RADIATOR CAP COMPLETELY.

PRESSURE TESTING RADIATOR CAPS

Remove cap from radiator. Be sure that sealing surfaces are clean. Moisten rubber gasket with water and install cap on pressure tester 7700 or an equivalent (Fig. 33).

Operate tester pump to bring pressure to 104 kPa (15 psi) on gauge. If pressure cap fails to hold pressure of at least 97 kPa (14 psi) replace cap. Refer to **CAUTION** below.

The pressure cap may test properly while positioned on tool 7700 (or equivalent). It may not hold pressure or vacuum when installed on radiator. If so, inspect radiator filler neck and cap's top gasket for damage. Also inspect for dirt or distortion that may prevent cap from sealing properly.

CAUTION: Radiator pressure testing tools are very sensitive to small air leaks, which will not cause cooling system problems. A pressure cap that does not have a history of coolant loss should not be replaced just because it leaks slowly when tested with this tool. Add water to tool. Turn tool upside down and recheck pressure cap to confirm that cap needs replacement.

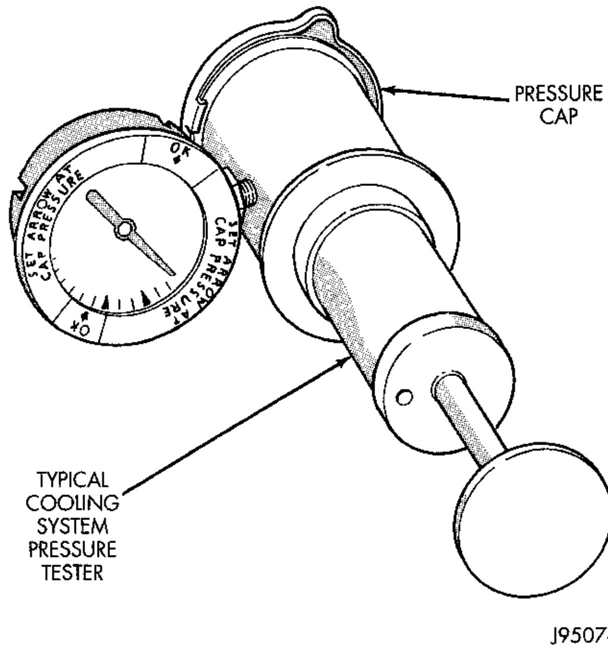

Fig. 33 Pressure Testing Radiator Cap—Typical Tester

LOW COOLANT LEVEL—AERATION

If the coolant level in the radiator drops below the top of the radiator core tubes, air will enter the system.

Low coolant level can cause the thermostat pellet to be suspended in air instead of coolant. This will cause the thermostat to open later, which in turn causes higher coolant temperature. Air trapped in cooling system also reduces the amount of coolant circulating in the heater core. This may result in low heat output.

DEAERATION

As the engine operates, air trapped in the cooling system gathers under the radiator cap. The next time engine is operated, thermal expansion of coolant will push trapped air past radiator cap into coolant reserve/overflow tank. Here it escapes to atmosphere in the tank. When engine cools down the coolant, it will be drawn from reserve/overflow tank into radiator to replace removed air.

SERVICE PROCEDURES

COOLANT LEVEL CHECK—ROUTINE

NOTE: Do not remove radiator cap for routine coolant level inspections. The coolant level can be checked at the coolant reserve/overflow tank.

The coolant reserve/overflow system provides a quick visual method for determining the coolant level without removing the radiator pressure cap. With engine idling and at normal operating temperature, observe coolant level in coolant reserve/overflow tank. The coolant level should be between the ADD and FULL marks.

COOLANT SERVICE—V-6, V-8, AND V-10 ENGINES

It is recommended that the cooling system be drained and flushed at 84,000 kilometers (52,500 miles) or 3 years, whichever occurs first. Then every two years or 48,000 kilometers (30,000 miles), whichever occurs first.

COOLANT SERVICE—DIESEL ENGINE

It is recommended that the cooling system be drained and flushed every 36 months or 77,000 kilometers (48,000 miles), whichever occurs first.

ADDING ADDITIONAL COOLANT—ROUTINE

Do not remove the radiator cap to add coolant to the system. When adding coolant to maintain the correct level, do so at the coolant reserve/overflow tank with a 50/50 mixture of ethylene glycol antifreeze (containing Alugard 340-2 ®) and water. Remove the radiator cap only for testing or when refilling the system after service. Removing cap unnecessarily can cause loss of coolant and allow air to enter system. This produces corrosion.

COOLANT LEVEL CHECK—SERVICE

The cooling system is closed and designed to maintain coolant level to the top of the radiator.

WARNING: DO NOT OPEN RADIATOR DRAINCOCK WITH ENGINE RUNNING OR WHILE ENGINE IS HOT AND COOLING SYSTEM IS UNDER PRESSURE.

When vehicle servicing requires a coolant level check in the radiator, drain several ounces of coolant from the radiator drain cock. Do this while observing the coolant reserve/overflow system tank. The coolant level in the reserve/overflow tank should drop slightly. If not, inspect for a leak between radiator and coolant reserve/overflow system connection. Remove radiator cap. The coolant level should be to the top of the radiator. If not and if coolant level in reserve/overflow tank is at the ADD mark, check for:

- An air leak in the coolant reserve/overflow tank
- An air leak in the radiator filler neck
- Leak in the pressure cap seal to the radiator filler neck

DRAINING COOLING SYSTEM

WARNING: DO NOT REMOVE THE CYLINDER BLOCK DRAIN PLUGS OR LOOSEN THE RADIATOR DRAIN PLUG WITH SYSTEM HOT AND UNDER PRESSURE. SERIOUS BURNS FROM COOLANT CAN OCCUR.

DO NOT WASTE reusable coolant. If the solution is clean, drain the coolant into a clean container for reuse.

(1) Start the engine and place the heater control temperature selector in the Full-On position. Engine vacuum is needed to actuate the heater controls.

(2) Turn the ignition off.

(3) Do not remove radiator cap when draining coolant from reserve/overflow tank. Open radiator drain plug and when tank is empty, remove radiator cap. If the coolant reserve/overflow tank does not drain, refer to the Testing Cooling System for Leaks section in this group. The coolant need not be removed from tank unless the system is being refilled with fresh mixture.

(4) On vehicles equipped with gas powered engines, remove the cylinder block drain plugs. These are located on the sides of the block just above the oil pan (Fig. 34).

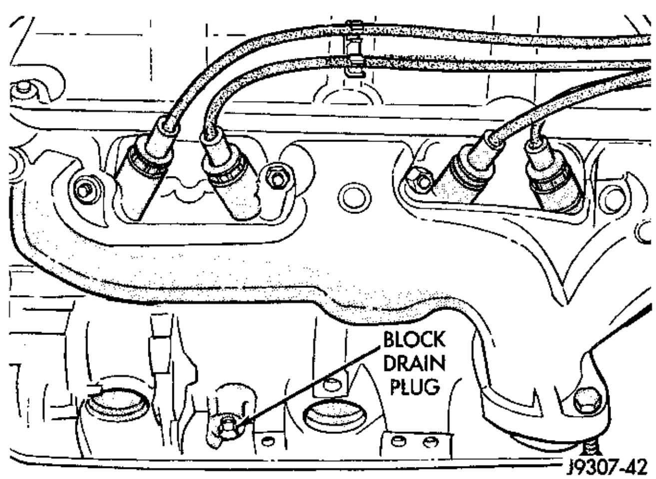

Fig. 34 Drain Plugs—Gas Powered Engines—Typical

(5) Remove radiator pressure cap.

REFILLING COOLING SYSTEM

Clean cooling system prior to refilling. Refer to Cooling System Cleaning section of this group.

(1) Install the cylinder block drain plugs (Fig. 34).

(2) Close radiator drain plug.

SERVICE PROCEDURES (Continued)

(3) Fill the cooling system with a 50/50 mixture of water and antifreeze. **5.9L Diesel Engine Only:** The diesel engine is equipped with a one-way check valve (jiggle pin). The check valve is used as a servicing feature and will vent air when the system is being filled. Water pressure (or flow) will hold the valve closed. **Due to the use of this valve, the engine must not be operating when refilling the cooling system.** Refer to Thermostat Operation—5.9L Diesel Engine in the Thermostat section of this group for more information.

(4) Fill coolant reserve/overflow tank to the FULL mark.

(5) Start and operate engine until thermostat opens. Upper radiator hose should be warm to touch.

(6) If necessary, add 50/50 water and antifreeze mixture to the coolant reserve/overflow tank to maintain coolant level. This level should be between the ADD and FULL marks. The level in the reserve/overflow tank may drop below the ADD mark after three or four warm-up and cool-down cycles.

COOLING SYSTEM CLEANING/REVERSE FLUSHING

CLEANING

Drain cooling system and refill with water. Run engine with radiator cap installed until upper radiator hose is hot. Stop engine and drain water from system. If water is dirty, fill system with water, run engine and drain system. Repeat until water drains clean.

REVERSE FLUSHING

Reverse flushing of cooling system is the forcing of water through the cooling system. This is done using air pressure in the opposite direction of normal coolant flow. It is usually only necessary with very dirty systems with evidence of partial plugging.

REVERSE FLUSHING RADIATOR

Disconnect radiator hoses from radiator inlet and outlet. Attach a section of radiator hose to radiator bottom outlet fitting and insert flushing gun. Connect a water supply hose and air supply hose to flushing gun.

CAUTION: Internal radiator pressure must not exceed 138 kPa (20 psi) as damage to radiator may result.

Allow radiator to fill with water. When radiator is filled, apply air in short blasts. Allow radiator to refill between blasts. Continue this reverse flushing until clean water flows out through rear of radiator cooling tube passages. Have radiator cleaned more extensively by a radiator repair shop.

REVERSE FLUSHING ENGINE—V-6, V-8, AND V-10

Drain cooling system. Remove thermostat housing and thermostat. Install thermostat housing. Disconnect radiator upper hose from radiator and attach flushing gun to hose. Disconnect radiator lower hose from water pump and attach a lead-away hose to water pump inlet fitting.

Connect water supply hose and air supply hose to flushing gun. Allow engine to fill with water. When engine is filled, apply air in short blasts, allowing system to fill between air blasts. Continue until clean water flows through the lead away hose.

Remove lead away hose, flushing gun, water supply hose and air supply hose. Remove thermostat housing and install thermostat. Install thermostat housing with a replacement gasket. Refer to Thermostat Replacement. Connect radiator hoses. Refill cooling system with correct antifreeze/water mixture. Refer to Refilling the Cooling System.

REVERSE FLUSHING ENGINE—DIESEL

(1) Drain the cooling system.

(2) Disconnect the radiator lower hose from the water inlet connection.

(3) Remove the heater core inlet hose from tube (Fig. 35).

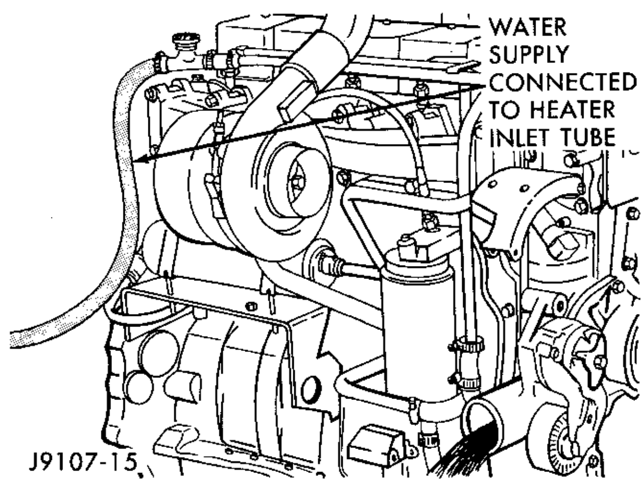

Fig. 35 Typical Reverse-flushing—5.9L Diesel

(4) Attach water supply hose to heater tube.

(5) Back-flush the engine until clean water exits the water pump inlet.

CHEMICAL CLEANING

In some instances, use a radiator cleaner (Mopar Radiator Kleen or equivalent) before flushing. This will soften scale and other deposits and aid flushing operation.

CAUTION: Follow manufacturers instructions when using these products.

REMOVAL AND INSTALLATION

COOLANT RESERVE/OVERFLOW TANK

TANK REMOVAL—ALL EXCEPT 8.0L V-10 ENGINE

(1) Remove overflow hose from radiator.

(2) Unsnap the coolant reserve/overflow tank from fan shroud. Lift straight up. The fan shroud is equipped with T-shaped slots (Fig. 36) to attach the tank. An alignment pin is located on the side of tank.

INSTALLATION

(1) Snap the tank into the two T-slots and the alignment pin on fan shroud.

(2) Connect overflow hose to radiator.

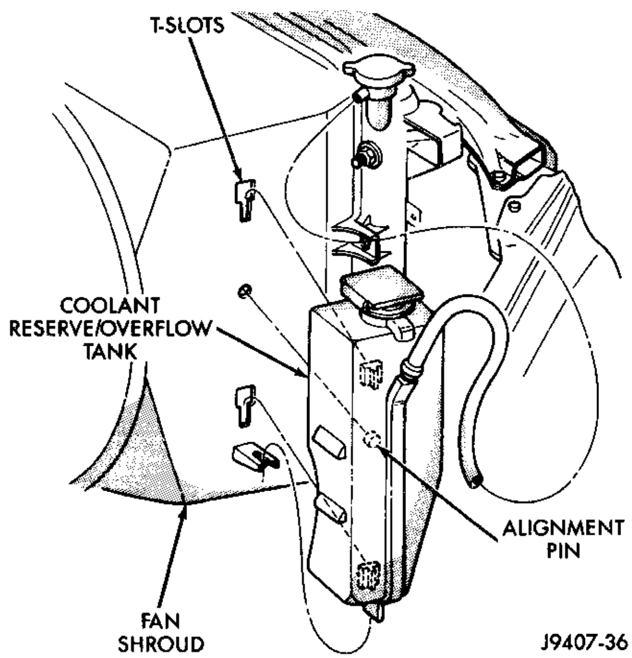

Fig. 36 COOLANT RESERVE/OVERFLOW TANK—ALL EXCEPT 8.0L V-10 ENGINE

TANK REMOVAL—8.0L V-10 ENGINE

(1) Remove overflow hose from radiator.

(2) Remove three tank mounting bolts (Fig. 37) and remove tank.

INSTALLATION

(1) Position tank to inner fender.

(2) Install bolts and tighten to 6 N·m (50 in. lbs.) torque.

(3) Connect overflow hose to radiator.

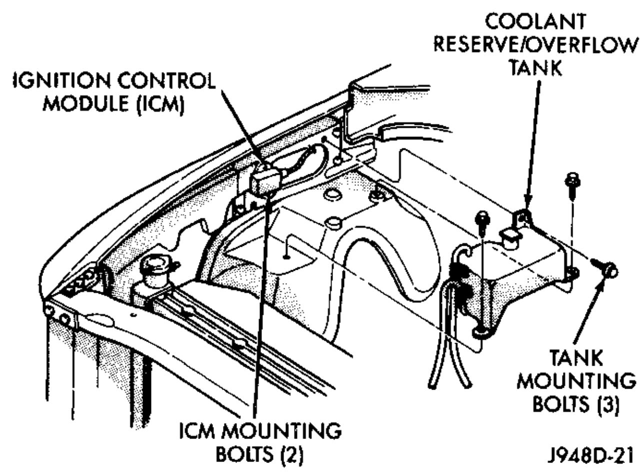

Fig. 37 COOLANT RESERVE/OVERFLOW TANK—V-10 ENGINE

WATER PUMP—V-6 AND V-8 ENGINES

REMOVAL

The water pump on all models can be removed without discharging the air conditioning system (if equipped).

The water pump on all gas powered engines is bolted directly to the engine timing chain case/cover.

On all 3.9L/5.2L/5.9L gas powered engines, a gasket is used as a seal between the water pump and timing chain case/cover.

If water pump is replaced because of bearing/shaft damage or leaking shaft seal, the mechanical cooling fan assembly should also be inspected. Inspect for fatigue cracks, loose blades or loose rivets that could have resulted from excessive vibration. Replace fan if any of these conditions are found. Also check condition of the thermal viscous fan drive. Refer to Viscous Fan Drive in this group.

(1) Disconnect negative battery cable from battery.

(2) Drain cooling system. Refer to Draining Cooling System in this group.

Do not waste reusable coolant. If solution is clean, drain coolant into a clean container for reuse.

(3) Remove windshield washer reservoir tank from radiator fan shroud. Refer to Group 8K, Windshield Wiper and Washer Systems.

(4) Disconnect the coolant reserve/overflow tank-to-radiator hose at the tank.

(5) Remove the four fan shroud mounting bolts at the radiator (Fig. 38). Do not attempt to remove shroud from vehicle at this time.

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REMOVAL AND INSTALLATION (Continued)

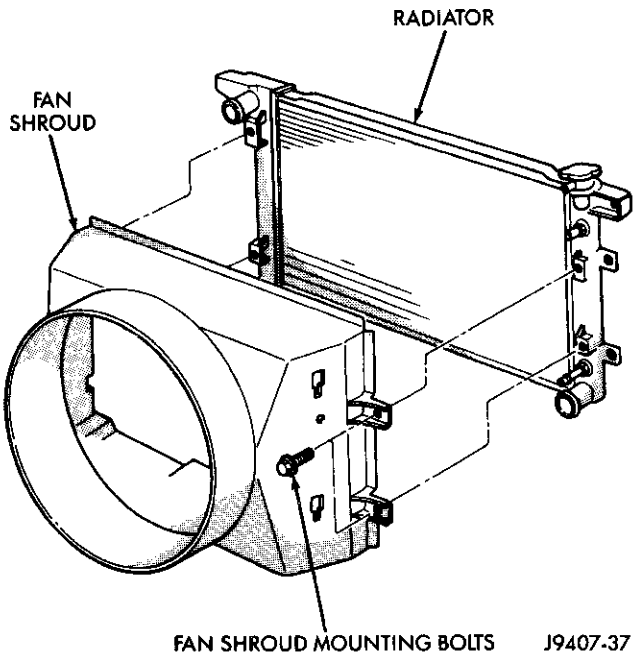

Fig. 38 Typical Fan Shroud Mounting

WARNING: CONSTANT TENSION HOSE CLAMPS ARE USED ON MOST COOLING SYSTEM HOSES. WHEN REMOVING OR INSTALLING, USE ONLY TOOLS DESIGNED FOR SERVICING THIS TYPE OF CLAMP, SUCH AS SPECIAL CLAMP TOOL (NUMBER 6094). SNAP-ON CLAMP TOOL (NUMBER HPC-20) MAY BE USED FOR LARGER CLAMPS. ALWAYS WEAR SAFETY GLASSES WHEN SERVICING CONSTANT TENSION CLAMPS.

CAUTION: A number or letter is stamped into the tongue of constant tension clamps. If replacement is necessary, use only an original equipment clamp with a matching number or letter.

(6) Remove upper radiator hose at radiator.

(7) The thermal viscous fan drive is attached (threaded) to the water pump hub shaft (Fig. 39). Remove the fan/fan drive assembly from water pump by turning the mounting nut counterclockwise (as viewed from front). Threads on the fan drive are **RIGHT-HAND.** A Snap-On 36 MM Fan Wrench (number SP346 from Snap-On Cummins Diesel Tool Set number 2017DSP) can be used. Place a bar or screwdriver between the water pump pulley bolts (Fig. 39) to prevent the pulley from rotating.

(8) If water pump is being replaced, do not unbolt fan blade assembly (Fig. 39) from the thermal control fan drive.

(9) Remove fan blade/fan drive and fan shroud as an assembly from vehicle.

(10) After removing fan blade/fan drive assembly, **do not** place the thermal viscous fan drive in the horizontal position. If stored horizontally, the silicone fluid in the viscous drive could drain into its bearing assembly and contaminate the bearing lubricant.

(11) **Do not** remove the water pump pulley bolts at this time.

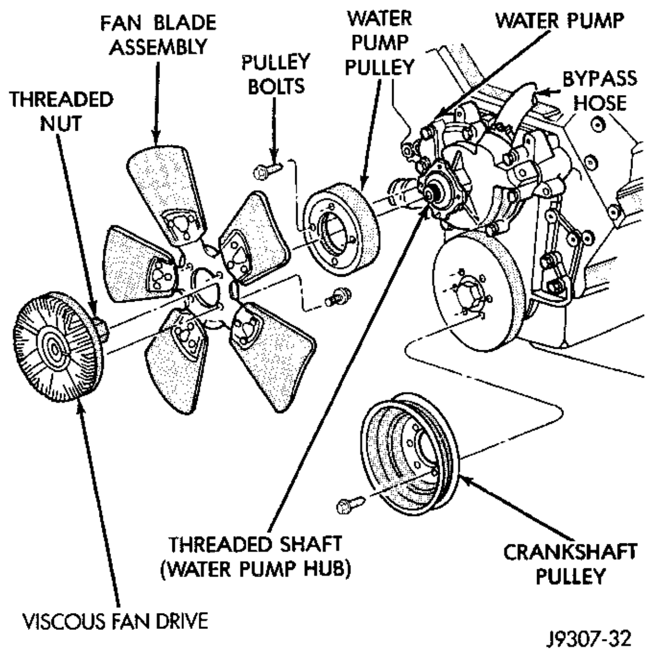

Fig. 39 Fan Blade and Viscous Fan Drive—Typical

(12) Remove accessory drive belt as follows: The drive belt is equipped with a spring loaded automatic tensioner (Fig. 40) (Fig. 41).

(13) 3.9L V-6 or 5.2/5.9L V-8 LDC-Gas Engines: Relax the tension from the belt by rotating the tensioner clockwise (as viewed from front) (Fig. 40). When all belt tension has been relaxed, remove accessory drive belt.

(14) 5.9L HDC-Gas Engine: Relax the tension from the belt by rotating the tensioner counterclockwise (as viewed from front) (Fig. 41). When all belt tension has been relaxed, remove accessory drive belt.

(15) Remove the four water pump pulley-to-water pump hub bolts (Fig. 39) and remove pulley from vehicle.

(16) Remove the lower radiator hose and heater hose from water pump.

(17) Loosen heater hose coolant return tube mounting bolt (Fig. 42) (Fig. 43)and remove tube from water pump. Discard the old tube O-ring.

(18) Remove the seven water pump mounting bolts (Fig. 44).

(19) Loosen the clamp at the water pump end of bypass hose (Fig. 39). Slip the bypass hose from the water pump while removing pump from vehicle. Do not remove the clamp from the bypass hose.

(20) Discard old gasket.

REMOVAL AND INSTALLATION (Continued)

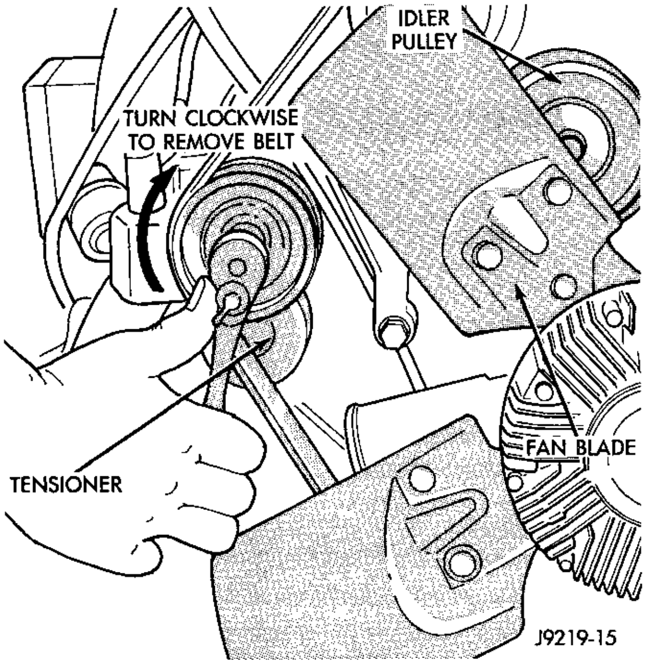

Fig. 40 Belt Tensioner—3.9L V-6 or 5.2/5.9L V-8 LDC-Gas Engines

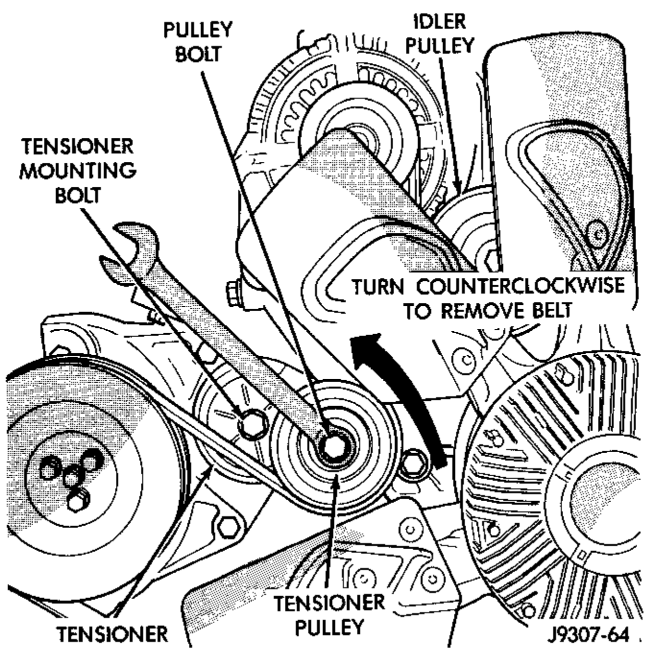

Fig. 41 Belt Tensioner—5.9L HDC-Gas Engine

CAUTION: Do not pry the water pump at timing chain case/cover. The machined surfaces may be damaged resulting in leaks.

INSTALLATION

(1) Clean gasket mating surfaces.

(2) Using a new gasket, install water pump to engine as follows: Guide water pump nipple into bypass hose as pump is being installed. Install water pump bolts (Fig. 44). Tighten water pump mounting bolts to 40 N·m (30 ft. lbs.) torque.

(3) Position bypass hose clamp to bypass hose.

(4) Spin water pump to be sure that pump impeller does not rub against timing chain case/cover.

(5) Install a new o-ring to the heater hose coolant return tube (Fig. 42) (Fig. 43). Coat the new o-ring with antifreeze before installation.

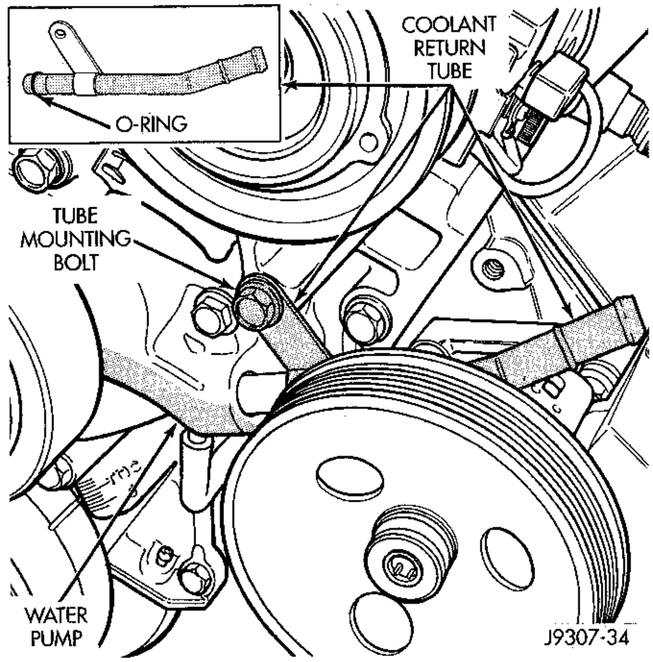

Fig. 42 Coolant Return Tube—3.9L V-6 or 5.2/5.9L V-8 LDC-Gas Engines

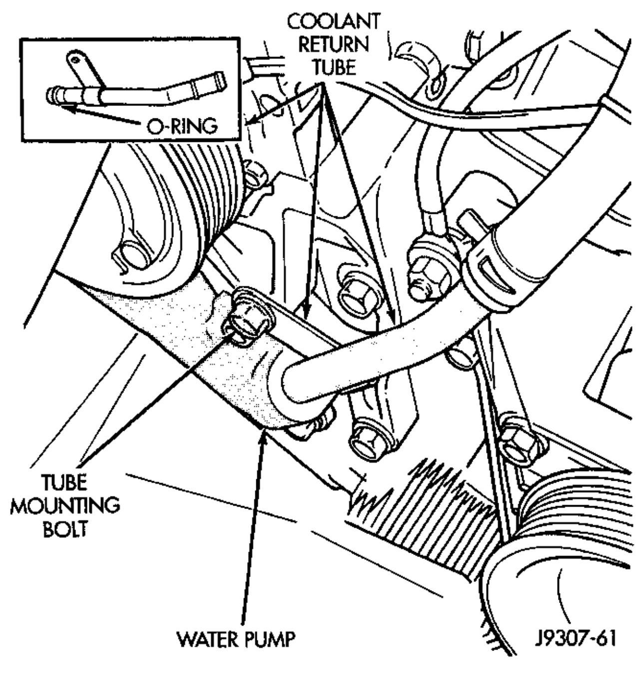

Fig. 43 Coolant Return Tube—5.9L HDC-Gas Engine

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REMOVAL AND INSTALLATION (Continued)

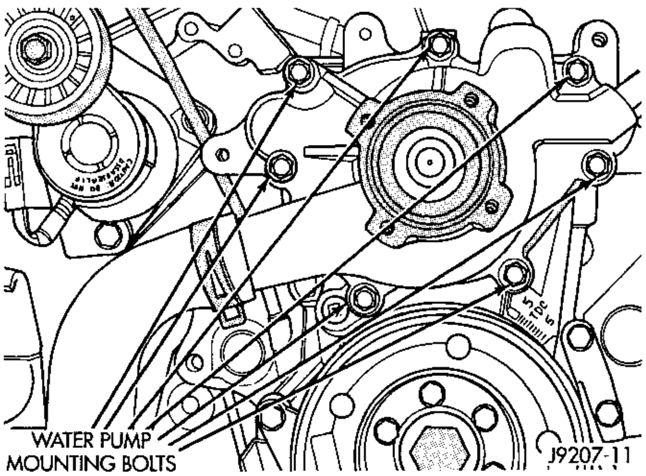


Fig. 44 Water Pump Bolts—3.9L V-6 or 5.2/5.9L V-8 Gas Engines—Typical

(6) Install coolant return tube and its mounting bolt to engine (Fig. 42) (Fig. 43). Be sure the slot in tube bracket is bottomed to mounting bolt. This will properly position return tube.

(7) Connect radiator lower hose to water pump.

(8) Connect heater hose and hose clamp to coolant return tube.

(9) Install water pump pulley. Tighten bolts to 27 N·m (20 ft. lbs.) torque. Place a bar or screwdriver between water pump pulley bolts (Fig. 39) to prevent pulley from rotating.

(10) Relax tension from automatic belt tensioner (Fig. 40) (Fig. 41). Install drive belt.

CAUTION: When installing the serpentine accessory drive belt, the belt must be routed correctly. If not, engine may overheat due to water pump rotating in wrong direction. Refer to (Fig. 45) (Fig. 46) (Fig. 47) for correct belt routing. The correct belt with correct length must be used.

(11) Position fan shroud and fan blade/viscous fan drive assembly to vehicle as a complete unit.

(12) Install fan shroud.

(13) Install fan blade/viscous fan drive assembly to water pump shaft.

(14) Fill cooling system. Refer to Refilling Cooling System in this group.

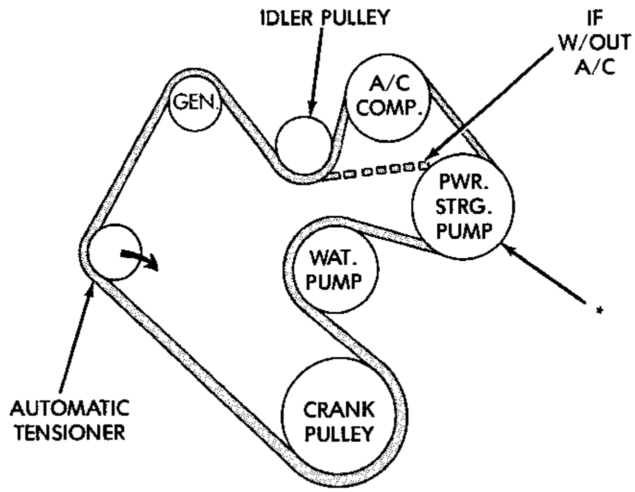
(15) Connect negative battery cable.

(16) Start and warm the engine. Check for leaks.

WATER PUMP—8.0L V-10 ENGINE

REMOVAL

The water pump on all models can be removed without discharging the air conditioning system (if equipped).



*IF VEHICLE IS NOT EQUIPPED WITH POWER STEERING, THIS WILL BE AN IDLER PULLEY. J9307-26

Fig. 45 Belt Routing—3.9L V-6 or 5.2/5.9L V-8 LDC-Gas Engines

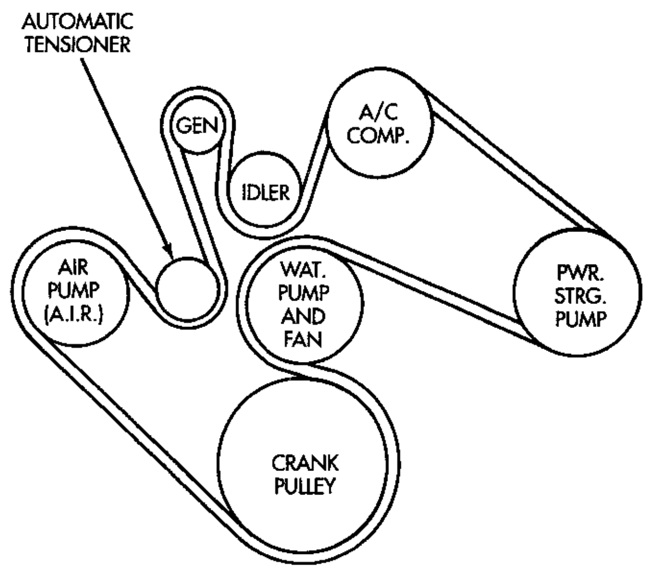


Fig. 46 Belt Routing—5.9L HDC-Gas Engine—With A/C

The water pump on all gas powered engines is bolted directly to the engine timing chain case/cover.

On the 8.0L V-10 engine, a rubber o-ring (instead of a gasket) is used as a seal between the water pump and timing chain case/cover.

If water pump is replaced because of bearing/shaft damage or leaking shaft seal, the mechanical cooling fan assembly should also be inspected. Inspect for

REMOVAL AND INSTALLATION (Continued)

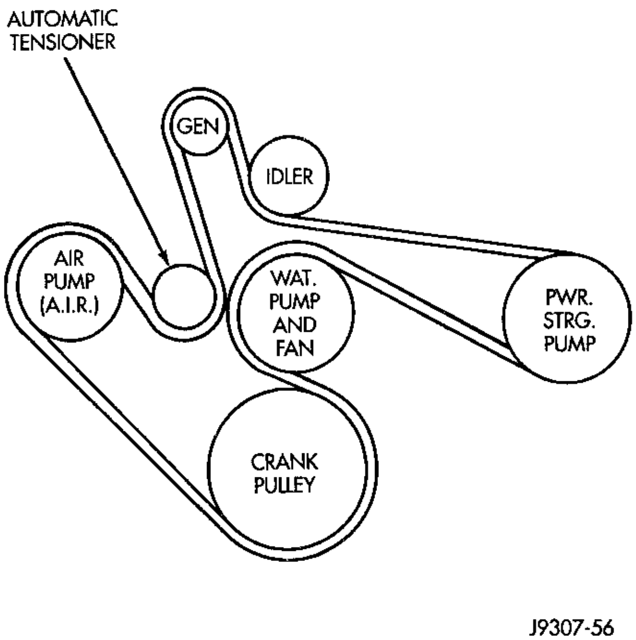


Fig. 47 Belt Routing—5.9L HDC-Gas Engine—Without A/C

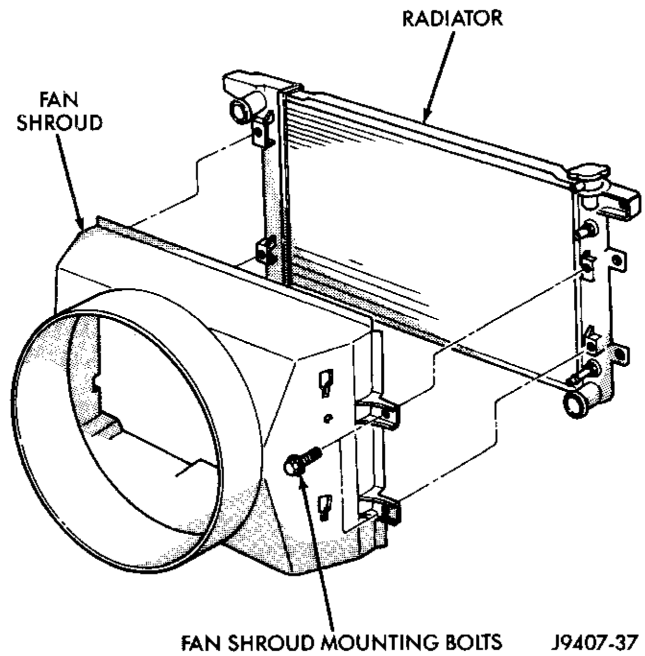


Fig. 48 Typical Fan Shroud Mounting

fatigue cracks, loose blades or loose rivets that could have resulted from excessive vibration. Replace fan if any of these conditions are found. Also check condition of the thermal viscous fan drive. Refer to Viscous Fan Drive in this group.

(1) Disconnect negative battery cable from battery.

(2) Drain cooling system. Refer to Draining Cooling System in this group.

Do not waste reusable coolant. If solution is clean, drain coolant into a clean container for reuse.

(3) Remove windshield washer reservoir tank from radiator fan shroud. Refer to Group 8K, Windshield Wiper and Washer Systems.

(4) Remove the four fan shroud mounting bolts at the radiator (Fig. 48). Do not attempt to remove shroud from vehicle at this time.

WARNING: CONSTANT TENSION HOSE CLAMPS ARE USED ON MOST COOLING SYSTEM HOSES. WHEN REMOVING OR INSTALLING, USE ONLY TOOLS DESIGNED FOR SERVICING THIS TYPE OF CLAMP, SUCH AS SPECIAL CLAMP TOOL (NUMBER 6094). SNAP-ON CLAMP TOOL (NUMBER HPC-20) MAY BE USED FOR LARGER CLAMPS. ALWAYS WEAR SAFETY GLASSES WHEN SERVICING CONSTANT TENSION CLAMPS.

CAUTION: A number or letter is stamped into the tongue of constant tension clamps. If replacement is necessary, use only an original equipment clamp with a matching number or letter.

(5) Remove upper radiator hose at radiator.

(6) The thermal viscous fan drive is attached (threaded) to the water pump hub shaft (Fig. 49). Remove the fan/fan drive assembly from water pump by turning the mounting nut counterclockwise (as viewed from front). Threads on the fan drive are **RIGHT-HAND.** A Snap-On 36 MM Fan Wrench (number SP346 from Snap-On Cummins Diesel Tool Set number 2017DSP) can be used. Place a bar or screwdriver between the water pump pulley bolts (Fig. 49) to prevent the pulley from rotating.

(7) If water pump is being replaced, do not unbolt fan blade assembly (Fig. 49) from the thermal control fan drive.

(8) Remove fan blade/fan drive and fan shroud as an assembly from vehicle.

After removing fan blade/fan drive assembly, **do not** place the thermal viscous fan drive in the horizontal position. If stored horizontally, the silicone fluid in the viscous drive could drain into its bearing assembly and contaminate the bearing lubricant.

Do not remove the water pump pulley bolts at this time.

(9) Remove accessory drive belt by placing a wrench or socket on the accessory drive belt tensioner pulley bolt (Fig. 50). Rotate the tensioner pulley counter-clockwise until belt tension is relieved and slip the belt off of the alternator pulley.

NOTE: The belt tensioner pulley bolt will not loosen because it has left-handed threads.

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REMOVAL AND INSTALLATION (Continued)

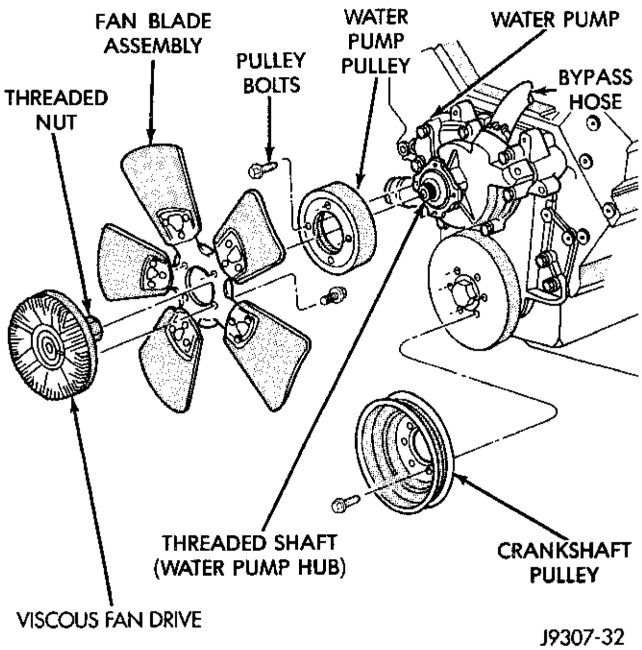

Fig. 49 Fan Blade and Viscous Fan Drive—Typical

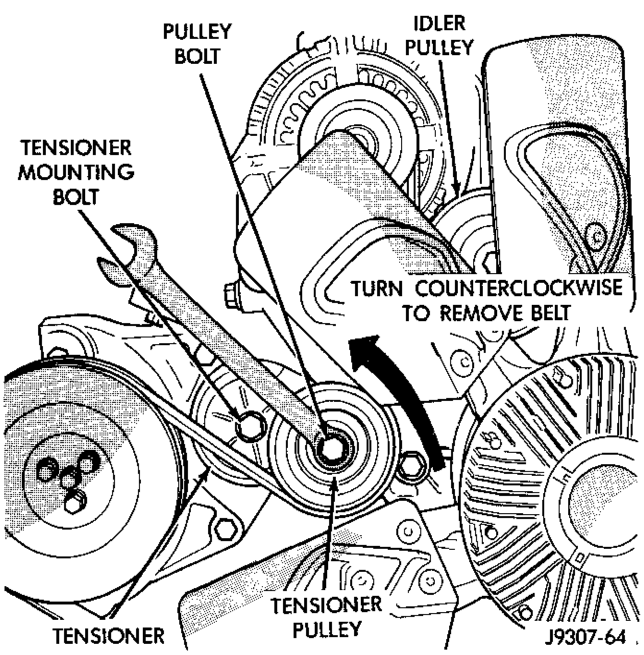

Fig. 50 Belt Tensioner—8.0L V-10 Engine

(10) Remove the four water pump pulley-to-water pump hub bolts (Fig. 49) and remove pulley from vehicle.

(11) Remove the lower radiator hose at water pump.

(12) Remove heater hose at water pump fitting.

(13) Remove the seven water pump mounting bolts (Fig. 51).

(14) Loosen the clamp at the water pump end of bypass hose. Slip the bypass hose from the water pump while removing pump from vehicle. Do not remove the clamp from the bypass hose.

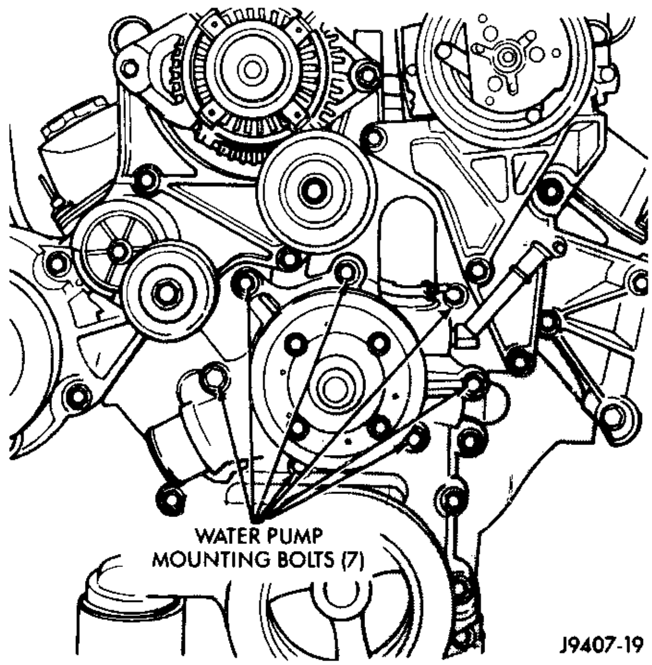

Fig. 51 Water Pump Bolts—8.0L V-10—Typical

(15) Discard the water pump-to-timing chain/case cover o-ring seal (Fig. 52).

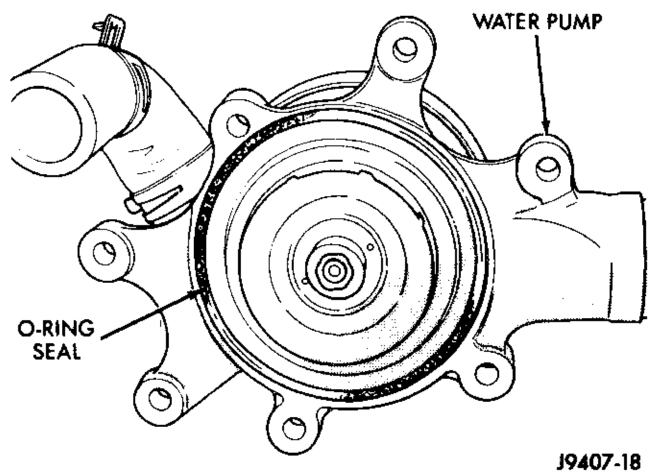

Fig. 52 Water Pump O-Ring Seal—8.0L V-10

(16) Remove the heater hose fitting from water pump if pump replacement is necessary. Note position (direction) of fitting before removal. Fitting must be re-installed to same position.

CAUTION: Do not pry the water pump at timing chain case/cover. The machined surfaces may be damaged resulting in leaks.

REMOVAL AND INSTALLATION (Continued)

INSTALLATION

(1) If water pump is being replaced, install the heater hose fitting to the pump. Tighten fitting to 16 N·m (144 in. lbs.) torque. After fitting has been torqued, position fitting as shown in (Fig. 53). When positioning fitting, do not back off (rotate counterclockwise). Use a sealant on the fitting such as Mopar® Thread Sealant With Teflon. Refer to the directions on the package.

CAUTION: This heater hose fitting must be installed to pump before pump is installed to engine.

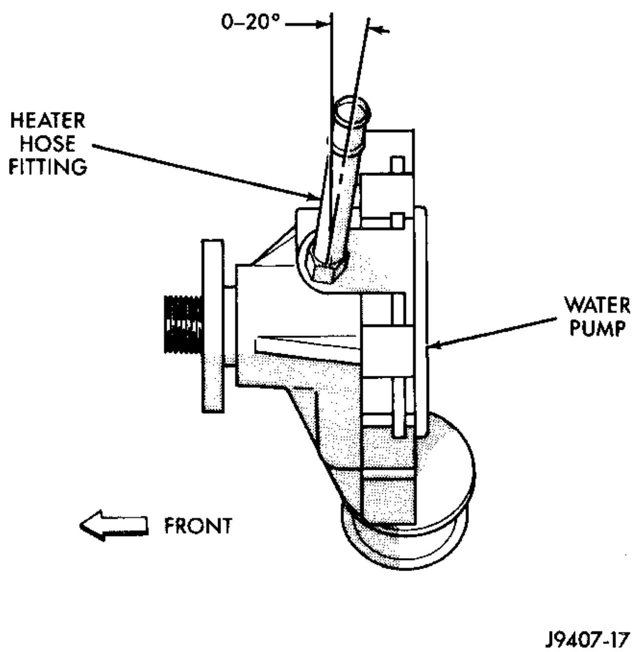

Fig. 53 Heater Hose Fitting Position—8.0L V-10

(2) Clean the o-ring mating surfaces at rear of water pump and front of timing chain/case cover.

(3) Apply a small amount of petroleum jelly to o-ring (Fig. 52). This will help retain o-ring to water pump.

(4) Install water pump to engine as follows: Guide water pump fitting into bypass hose as pump is being installed. Install water pump bolts (Fig. 51). Tighten water pump mounting bolts to 40 N·m (30 ft. lbs.) torque.

(5) Position bypass hose clamp to bypass hose.

(6) Spin water pump to be sure that pump impeller does not rub against timing chain case/cover.

(7) Connect radiator lower hose to water pump.

(8) Connect heater hose and hose clamp to heater hose fitting.

(9) Install water pump pulley. Tighten bolts to 22 N·m (16 ft. lbs.) torque. Place a bar or screwdriver between water pump pulley bolts (Fig. 49) to prevent pulley from rotating.

(10) Relax tension from automatic belt tensioner (Fig. 50). Install drive belt.

CAUTION: When installing the serpentine accessory drive belt, the belt must be routed correctly. If not, engine may overheat due to water pump rotating in wrong direction. Refer to (Fig. 54) (Fig. 55)for correct belt routing. The correct belt with correct length must be used.

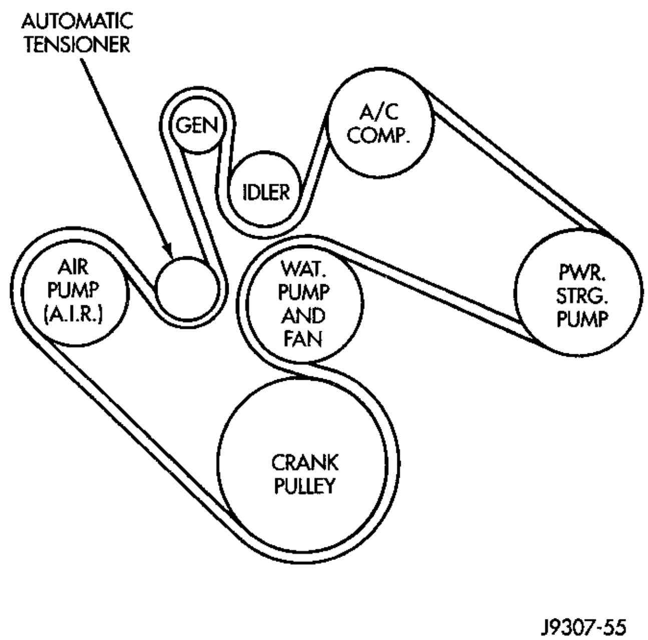

Fig. 54 Belt Routing—8.0L V-10 Engine—With A/C

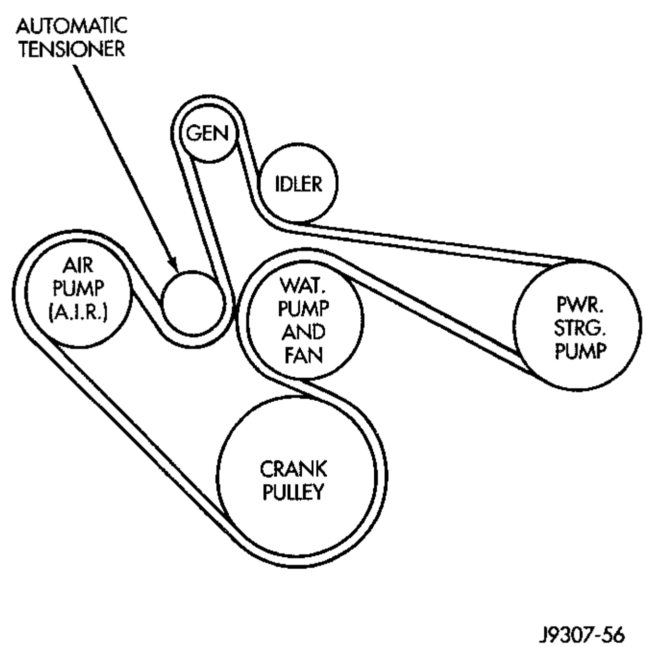

Fig. 55 Belt Routing—8.0L V-10 Engine—Without A/C

REMOVAL AND INSTALLATION (Continued)

(11) Position fan shroud and fan blade/viscous fan drive assembly to vehicle as a complete unit.
(12) Install fan shroud to radiator. Tighten bolts to 6 N·m (50 in. lbs.) torque.
(13) Install fan blade/viscous fan drive assembly to water pump shaft.
(14) Fill cooling system. Refer to Refilling Cooling System in this group.
(15) Connect negative battery cable.
(16) Start and warm the engine. Check for leaks.

WATER PUMP—5.9L DIESEL

REMOVAL

(1) Disconnect the negative battery cables from both batteries.
(2) Drain cooling system. Refer to Draining Cooling System in this section.
(3) Remove the bolt retaining the wiring harness near the top of water pump. Position wire harness to the side.
(4) Remove the accessory drive belt. Refer to the Engine Accessory Drive Belt section of this group.
(5) Remove water pump mounting bolts (Fig. 56).

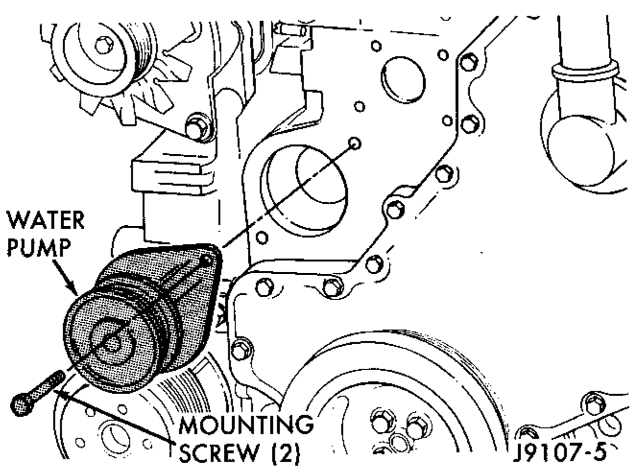

Fig. 56 Pump Removal/Installation—5.9L Diesel

(6) Clean water pump sealing surface on cylinder block.

INSTALLATION

(1) Install new O-ring seal in groove on water pump (Fig. 57).
(2) Install water pump. Tighten mounting bolts to 24 N·m (18 ft. lbs.) torque.
(3) Install accessory drive belt. Refer to the Engine Accessory Drive Belt section of this group.
(4) Install the bolt retaining the wiring harness near top of water pump.
(5) Fill cooling system. Refer to Refilling Cooling System in this section.
(6) Connect both battery cables.

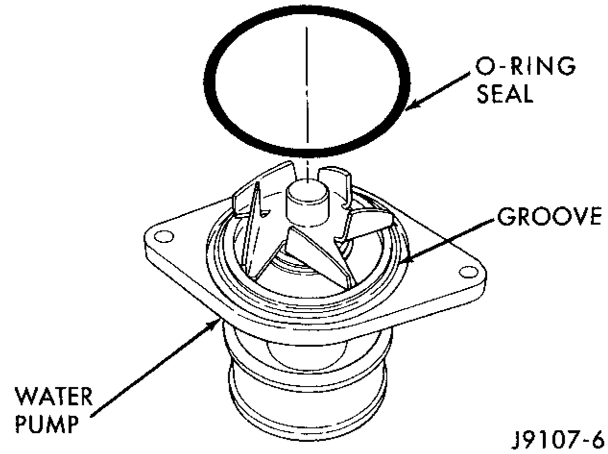

Fig. 57 Pump O-ring Seal—5.9L Diesel

(7) Start and warm the engine. Check for leaks.

WATER PUMP BYPASS HOSE

REMOVAL—3.9L V-6 OR 5.2/5.9L V-8 ENGINES WITHOUT AIR CONDITIONING

A water pump bypass hose (Fig. 58) is used between the intake manifold and water pump on all gas powered engines. To test for leaks, refer to Testing Cooling System for Leaks in this group.

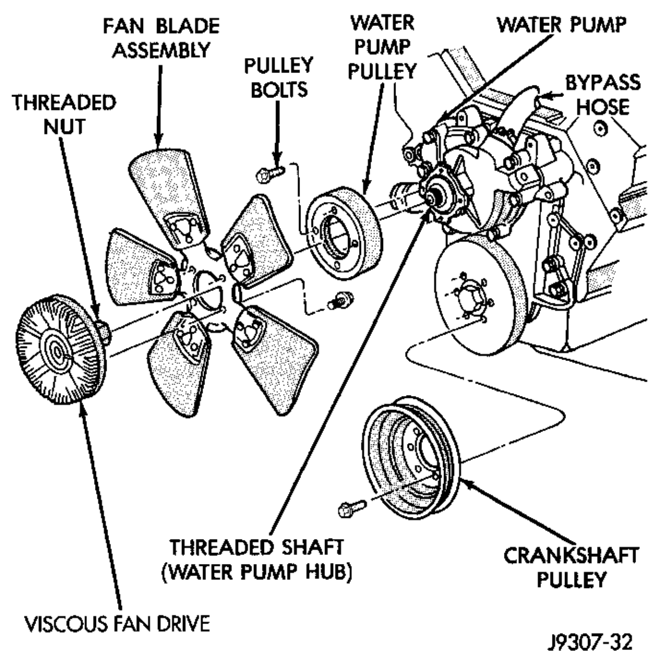

Fig. 58 Water Pump Bypass Hose—Typical

(1) Partially drain cooling system. Refer to Draining Cooling System in this group.
(2) Do not waste reusable coolant. If the solution is clean, drain the coolant into a clean container for reuse.

REMOVAL AND INSTALLATION (Continued)

WARNING: CONSTANT TENSION HOSE CLAMPS ARE USED ON MOST COOLING SYSTEM HOSES. WHEN REMOVING OR INSTALLING, USE ONLY TOOLS DESIGNED FOR SERVICING THIS TYPE OF CLAMP, SUCH AS SPECIAL CLAMP TOOL (NUMBER 6094). SNAP-ON CLAMP TOOL (NUMBER HPC-20) MAY BE USED FOR LARGER CLAMPS. ALWAYS WEAR SAFETY GLASSES WHEN SERVICING CONSTANT TENSION CLAMPS.

CAUTION: A number or letter is stamped into the tongue of constant tension clamps. If replacement is necessary, use only an original equipment clamp with a matching number or letter.

(3) Loosen both bypass hose clamps and position to the center of hose.
(4) Remove hose from vehicle.

INSTALLATION

(1) Position bypass hose clamps to the center of hose.
(2) Install bypass hose to engine.
(3) Secure both hose clamps.
(4) Fill cooling system. Refer to Refilling Cooling System in this group.
(5) Start and warm the engine. Check for leaks.

REMOVAL—3.9L V-6 OR 5.2/5.9L V-8 ENGINE—WITH AIR CONDITIONING

If equipped with A/C, the generator and A/C compressor along with their common mounting bracket (Fig. 59) must be partially removed. Removing the generator or A/C compressor from their mounting bracket is not necessary. Also, discharging the A/C system is not necessary. **Do not** remove any refrigerant lines from A/C compressor.

WARNING: THE A/C SYSTEM IS UNDER PRESSURE EVEN WITH THE ENGINE OFF. REFER TO REFRIGERANT WARNINGS IN GROUP 24, HEATING AND AIR CONDITIONING.

(1) Disconnect negative battery cable from battery.
(2) Partially drain cooling system. Refer to Draining Cooling System in this group.
(3) Do not waste reusable coolant. If the solution is clean, drain the coolant into a clean container for reuse.
(4) Remove upper radiator hose clamp at radiator. A special clamp tool must be used to remove the constant tension clamps. Remove hose at radiator.
(5) Disconnect throttle cable from clip at radiator fan shroud.
(6) Unplug wiring harness from A/C compressor.
(7) Remove the air cleaner assembly.

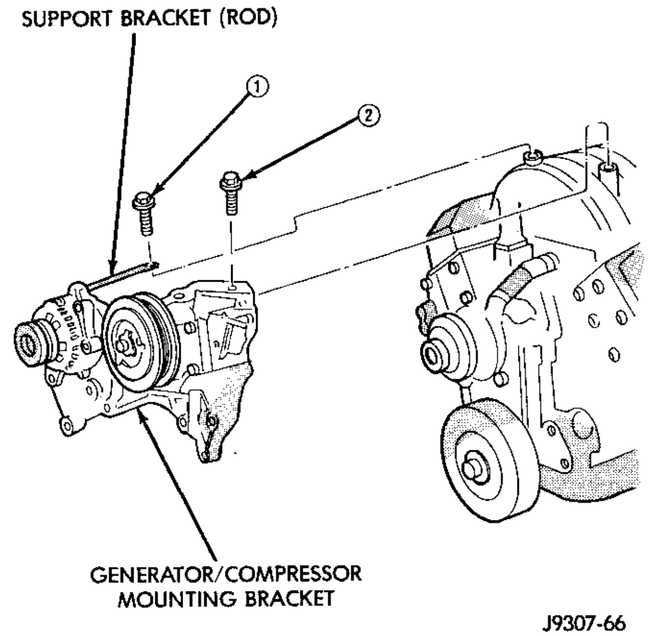

Fig. 59 Generator—A/C Compressor Mounting Bracket—Typical

(8) Remove accessory drive belt. Refer to Belt Removal/Installation in the Engine Accessory Drive Belt section of this group.
(9) (8) **3.9L V-6 or 5.2/5.9L V-8 LDC-Gas:** The drive belt idler pulley must be removed to gain access to one of the A/C compressor/generator bracket mounting bolts. Remove the idler pulley bolt and remove idler pulley (Fig. 60).

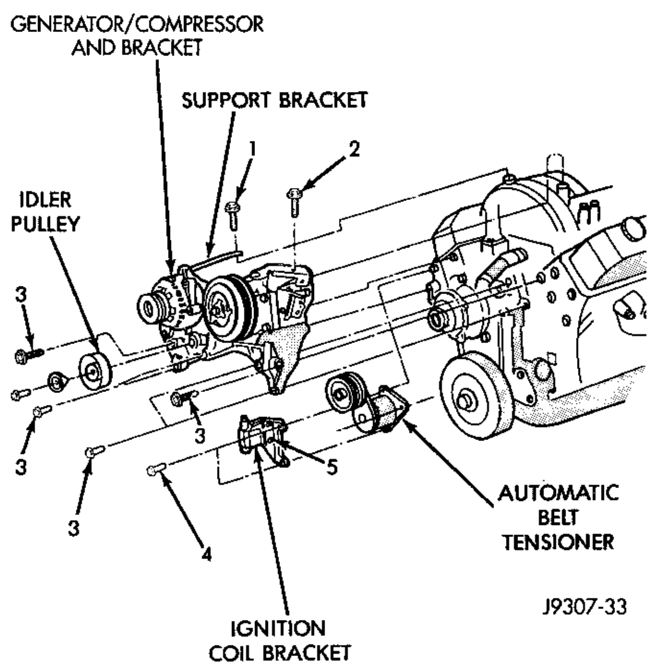

Fig. 60 Idler Pulley—3.9L V-6 or 5.2/5.9L V-8 LDC-Gas Engines

REMOVAL AND INSTALLATION (Continued)

(10) **5.9L HDC-Gas:** The automatic belt tensioner/ pulley assembly must be removed to gain access to one of the A/C compressor/generator bracket mounting bolts. Remove the tensioner mounting bolt (Fig. 61) and remove tensioner.

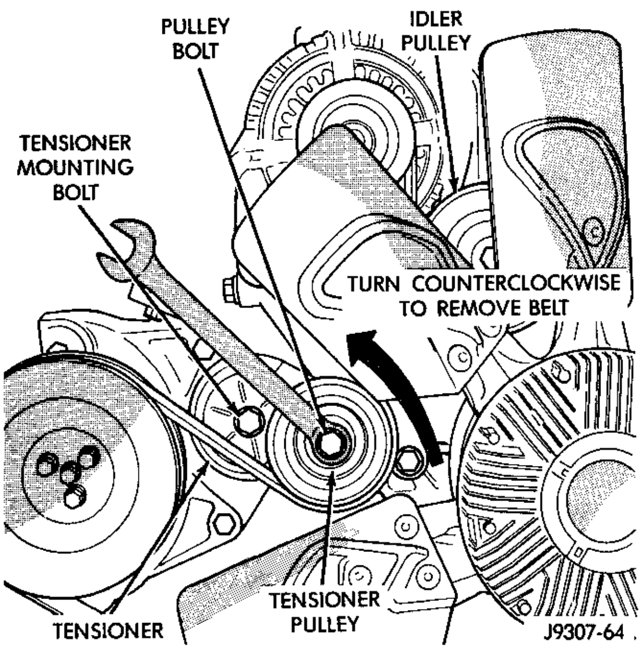

Fig. 61 Belt Tensioner—5.9L HDC-Gas Engine

(11) Remove the engine oil dipstick tube mounting bolt at the side of the A/C-generator mounting bracket.

(12) Disconnect throttle body control cables. Refer to Accelerator Pedal and Throttle Cable in Group 14, Fuel System.

(13) Remove heater hose coolant return tube mounting bolt (Fig. 62) (Fig. 63)and remove tube from engine. Discard the old tube O-ring.

(14) Remove bracket-to-intake manifold bolts (number 1 and 2 (Fig. 59).

(15) Remove remaining bracket-to-engine bolts (Fig. 64) (Fig. 65).

(16) Lift and position generator and A/C compressor (along with their common mounting bracket) to gain access to bypass hose. A block of wood may be used to hold assembly in position.

(17) Loosen and position both hose clamps to the center of bypass hose. A special clamp tool must be used to remove the constant tension clamps. Remove hose from vehicle.

INSTALLATION

(1) Position bypass hose clamps to the center of hose.

(2) Install bypass hose to engine.

(3) Secure both hose clamps.

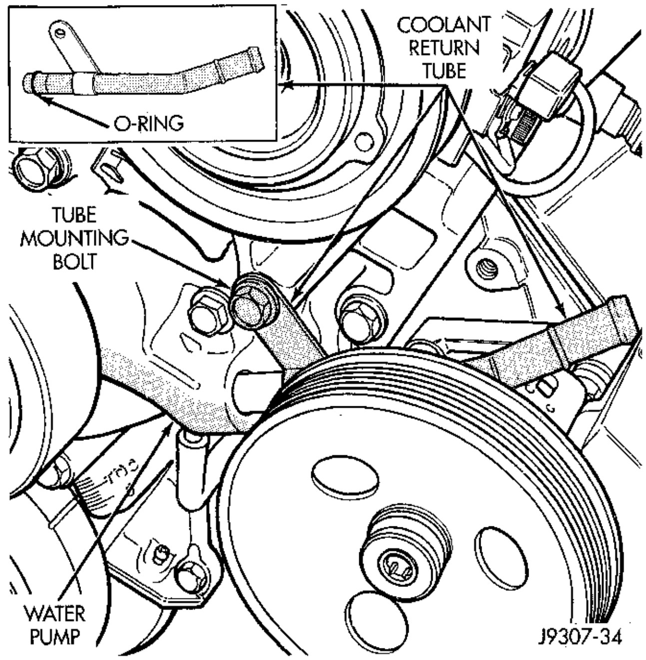

Fig. 62 Coolant Return Tube—3.9L V-6 or 5.2/5.9L V-8 LDC-Gas Engines

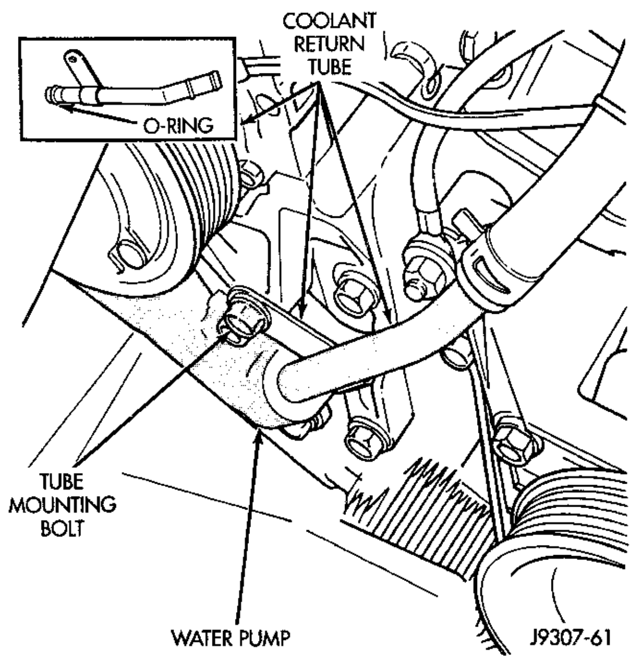

Fig. 63 Coolant Return Tube—5.9L HDC-Gas Engine

(4) Install generator-A/C mounting bracket assembly to engine. Tighten bolt number 1 (Fig. 59) to 41 N·m (30 ft. lbs.) torque. Tighten bolt number 2 (Fig. 59) to 28 N·m (20 ft. lbs.) torque. Tighten bracket mounting bolts (Fig. 64) (Fig. 65)to 40 N·m (30 ft. lbs.) torque.

(5) Install a new O-ring to the heater hose coolant return tube (Fig. 62) (Fig. 63). Coat the new O-ring with antifreeze before installation.

REMOVAL AND INSTALLATION (Continued)

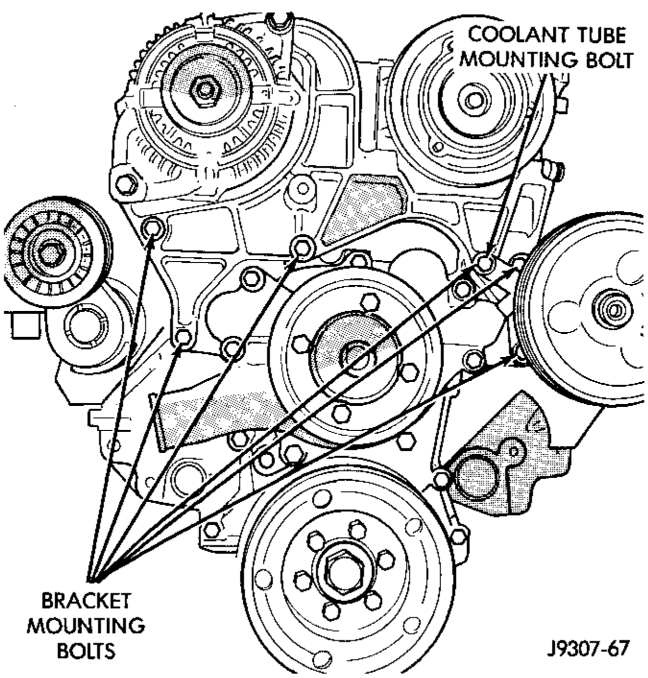

Fig. 64 Bracket Bolts—3.9L V-6 or 5.2/5.9L V-8 LDC-Gas Engines

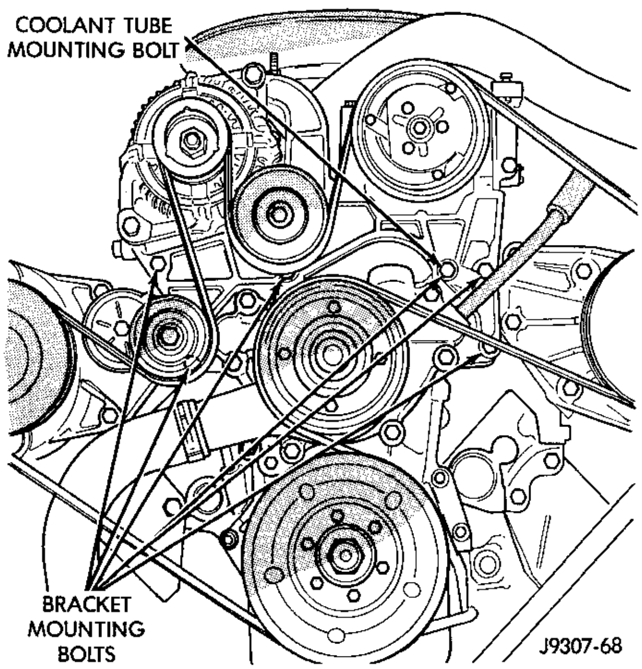

Fig. 65 Bracket Bolts—5.9L HDC-Gas Engine

(6) Install coolant return tube and its mounting bolt to engine (Fig. 62) (Fig. 63).

(7) Connect throttle body control cables.

(8) Install oil dipstick mounting bolt.

(9) **3.9L V-6 or 5.2/5.9L V-8 LDC-Gas Engines:** Install idler pulley. Tighten bolt to 41 N·m (30 ft. lbs.) torque.

(10) **5.9L HDC-Gas:** Install automatic belt tensioner assembly to mounting bracket. A dowel pin is located on back of tensioner (Fig. 66). Align this to dowel hole (Fig. 67) in tensioner mounting bracket. Tighten bolt to 41 N·m (30 ft. lbs.) torque.

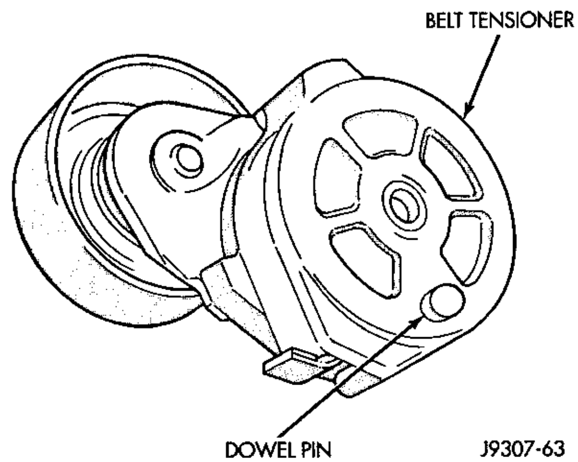

Fig. 66 Tensioner Dowel Pin—5.9L HDC-Gas Engine

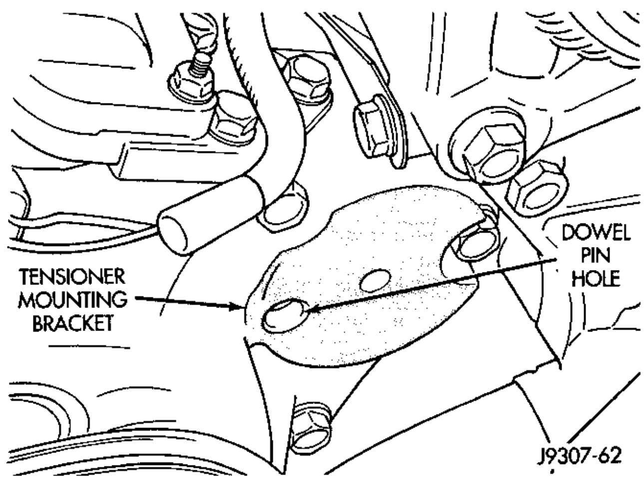

Fig. 67 Tensioner Mounting Bracket Dowel Hole—5.9L HDC-Gas Engine

(11) Install drive belt. Refer to Belt Removal/Installation in the Engine Accessory Drive Belt section of this group.

CAUTION: When installing the serpentine accessory drive belt, the belt must be routed correctly. If not, the engine may overheat due to the water pump rotating in the wrong direction. Refer to Belt Schematics in the Engine Accessory Drive Belt section of this group for correct belt routing. The correct belt with the correct length must be used.

(12) Install air cleaner assembly.

(13) Install upper radiator hose to radiator.

AUTHENTIC RESTORATION PRODUCT

REMOVAL AND INSTALLATION (Continued)

(14) Connect throttle cable to clip at radiator fan shroud.

(15) Connect wiring harness to A/C compressor.

(16) Fill cooling system. Refer to Refilling Cooling System in this group.

(17) Start and warm the engine. Check for leaks.

THERMOSTAT—3.9L V-6 OR 5.2/5.9L V-8

REMOVAL

WARNING: DO NOT LOOSEN THE RADIATOR DRAINCOCK WITH THE SYSTEM HOT AND PRESSURIZED. SERIOUS BURNS FROM THE COOLANT CAN OCCUR.

Do not waste reusable coolant. If the solution is clean, drain the coolant into a clean container for reuse.

If the thermostat is being replaced, be sure that the replacement is the specified thermostat for the vehicle model and engine type.

Factory installed thermostat housings on 3.9L V-6 or 5.2/5.9L V-8 engines are installed on a gasket with an anti-stick coating. This will aid in gasket removal and cleanup.

(1) Disconnect negative battery cable at battery.

(2) Drain cooling system until coolant level is below thermostat. Refer to Draining Cooling System in this group. If not equipped with air conditioning, proceed to step number 4.

(3) If equipped with air conditioning:

(a) Remove the support bracket (rod) located near the rear of generator (Fig. 68).

(b) The drive belt must be removed. Refer to Belt Removal/Installation in the Engine Accessory Drive Belt section of this group.

(c) The generator must be partially removed. Remove the two generator mounting bolts. Do not remove any wiring at generator. If equipped with 4WD, unplug the 4WD indicator lamp wiring harness (located near rear of generator).

(d) Remove generator. Position generator to gain access for thermostat gasket removal.

WARNING: CONSTANT TENSION HOSE CLAMPS ARE USED ON MOST COOLING SYSTEM HOSES. WHEN REMOVING OR INSTALLING, USE ONLY TOOLS DESIGNED FOR SERVICING THIS TYPE OF CLAMP, SUCH AS SPECIAL CLAMP TOOL (NUMBER 6094). SNAP-ON CLAMP TOOL (NUMBER HPC-20) MAY BE USED FOR LARGER CLAMPS. ALWAYS WEAR SAFETY GLASSES WHEN SERVICING CONSTANT TENSION CLAMPS.

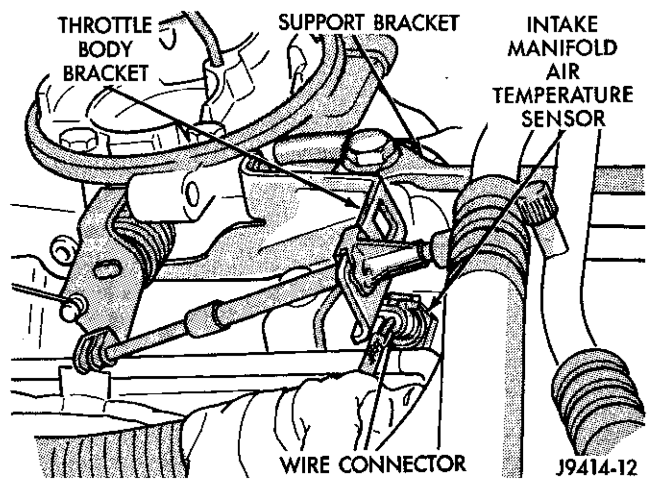

Fig. 68 Support Bracket—Generator Mounting Bracket-to-Intake Manifold—Typical

CAUTION: A number or letter is stamped into the tongue of constant tension clamps. If replacement is necessary, use only an original equipment clamp with a matching number or letter.

(4) Remove upper radiator hose clamp. Remove upper radiator hose at thermostat housing.

(5) Position the wiring harness (behind the thermostat housing) to gain access to thermostat housing.

(6) Remove thermostat housing mounting bolts, thermostat housing, gasket and thermostat (Fig. 69). Discard old gasket.

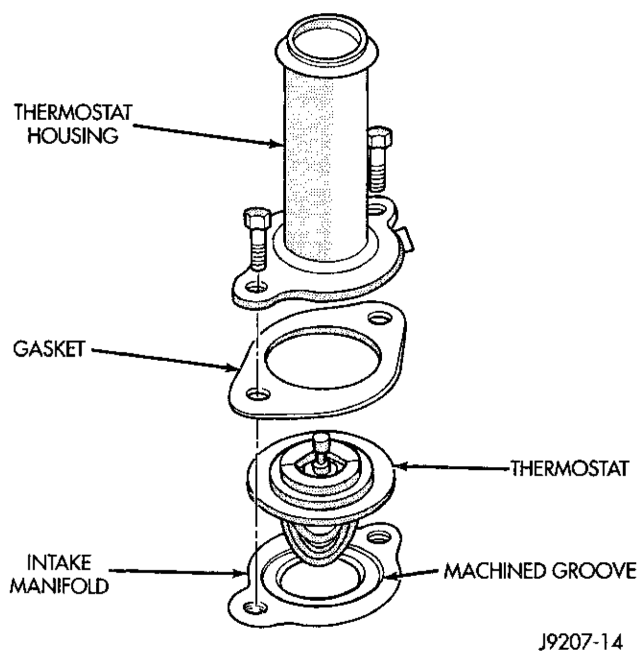

Fig. 69 Thermostat—3.9L V-6 or 5.2/5.9L V-8 Gas Engines

REMOVAL AND INSTALLATION (Continued)

INSTALLATION

(1) Clean mating areas of intake manifold and thermostat housing.

(2) Install thermostat (spring side down) into recessed machined groove on intake manifold (Fig. 69).

(3) Install gasket on intake manifold and over thermostat (Fig. 69).

(4) Position the thermostat housing to the intake manifold. Note the word FRONT stamped on the housing (Fig. 70). For adequate clearance, this **must** be placed towards the front of vehicle. The housing should be slightly angled forward after installation to intake manifold.

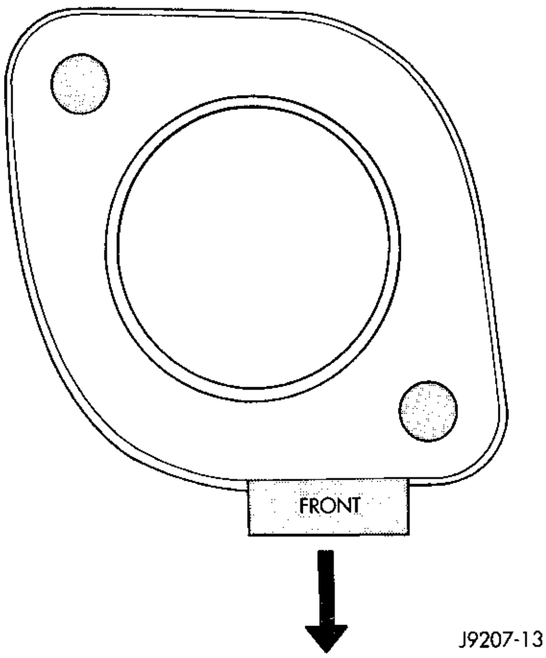

Fig. 70 Thermostat Position—3.9L V-6 or 5.2/5.9L V-8 Gas Engines

(5) Install two housing-to-intake manifold bolts. Tighten bolts to 23 N·m (200 in. lbs.) torque.

CAUTION: Housing must be tightened evenly and thermostat must be centered into recessed groove in intake manifold. If not, it may result in a cracked housing, damaged intake manifold threads or coolant leak.

(6) Install upper radiator hose to thermostat housing.

(7) Air conditioned vehicles:

(a) Install generator. Tighten bolts to 41 N·m (30 ft. lbs.) torque.

(b) Install support bracket (generator mounting bracket-to-intake manifold) (Fig. 68). Tighten bolts to 54 N·m (40 ft. lbs.) torque.

CAUTION: When installing the serpentine accessory drive belt, the belt must be routed correctly. If not, the engine may overheat due to the water pump rotating in the wrong direction. Refer to Belt Schematics in the Engine Accessory Drive Belt section of this group for correct engine belt routing. The correct belt with the correct length must be used.

(8) Fill cooling system. Refer to Refilling Cooling System in this group.

(9) Connect negative battery cable to battery.

(10) Start and warm engine. Check for leaks.

THERMOSTAT—8.0L V-10

REMOVAL

WARNING: DO NOT LOOSEN THE RADIATOR DRAINCOCK WITH THE SYSTEM HOT AND PRESSURIZED. SERIOUS BURNS FROM THE COOLANT CAN OCCUR.

Do not waste reusable coolant. If the solution is clean, drain the coolant into a clean container for reuse.

If the thermostat is being replaced, be sure that the replacement is the specified thermostat for the vehicle model and engine type.

A rubber lip-type seal with a metal shoulder is pressed into the intake manifold beneath the thermostat (Fig. 71).

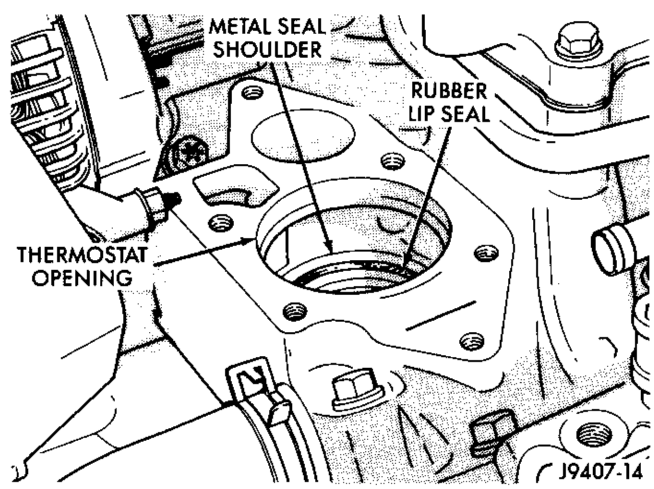

Fig. 71 Thermostat Seal—8.0L V-10 Engine

(1) Disconnect negative battery cable at battery.

(2) Drain cooling system until coolant level is below thermostat. Refer to Draining Cooling System in this group.

(3) Remove the two support rod mounting bolts and remove support rod (intake manifold-to-generator mount) (Fig. 72).

AUTHENTIC RESTORATION PRODUCT

REMOVAL AND INSTALLATION (Continued)

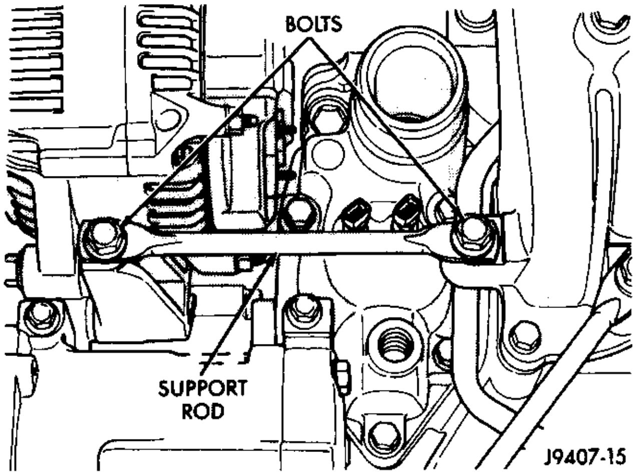

Fig. 72 Support Rod—8.0L V-10 Engine

WARNING: CONSTANT TENSION HOSE CLAMPS ARE USED ON MOST COOLING SYSTEM HOSES. WHEN REMOVING OR INSTALLING, USE ONLY TOOLS DESIGNED FOR SERVICING THIS TYPE OF CLAMP, SUCH AS SPECIAL CLAMP TOOL (NUMBER 6094). SNAP-ON CLAMP TOOL (NUMBER HPC-20) MAY BE USED FOR LARGER CLAMPS. ALWAYS WEAR SAFETY GLASSES WHEN SERVICING CONSTANT TENSION CLAMPS.

CAUTION: A number or letter is stamped into the tongue of constant tension clamps. If replacement is necessary, use only an original equipment clamp with a matching number or letter.

(4) Remove upper radiator hose clamp. Remove upper radiator hose at thermostat housing.

(5) Disconnect the wiring connectors at both of the sensors located on thermostat housing.

(6) Remove six thermostat housing mounting bolts, thermostat housing and thermostat.

INSTALLATION

(1) Clean mating areas of intake manifold and thermostat housing.

(2) Check the condition (for tears or cracks) of the rubber thermostat seal located in the intake manifold (Fig. 71) (Fig. 73). The thermostat should fit snugly into the rubber seal.

(3) If seal replacement is necessary, coat the outer (metal) portion of the seal with Mopar® Gasket Maker. Install the seal into the manifold using Special Seal Tool number C-3995-A with handle tool number C-4171.

(4) Install thermostat into recessed machined groove on intake manifold (Fig. 73).

(5) Install thermostat housing (Fig. 73).

(6) Install housing-to-intake manifold bolts. Tighten bolts to 25 N·m (220 in. lbs.) torque.

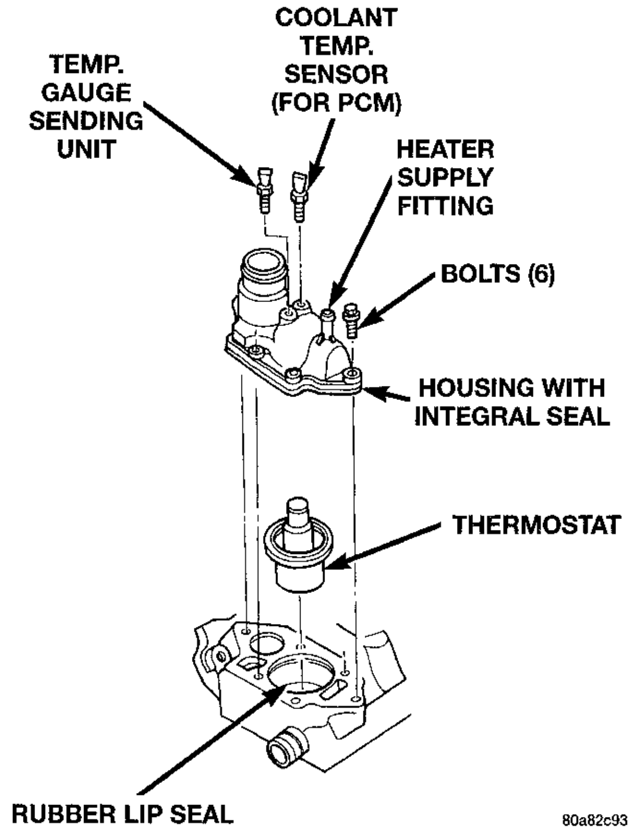

Fig. 73 Thermostat—8.0L V-10 Engine

CAUTION: Housing bolts should be tightened evenly to prevent damage to housing and to prevent leaks.

(7) Connect the wiring to both sensors.

(8) Install the upper radiator hose and hose clamp to thermostat housing.

(9) Install support rod.

(10) Fill cooling system. Refer to Refilling Cooling System in this group.

(11) Connect negative battery cable to battery.

(12) Start and warm engine. Check for leaks.

THERMOSTAT—DIESEL ENGINE

REMOVAL

WARNING: DO NOT LOOSEN THE RADIATOR DRAINCOCK WITH THE SYSTEM HOT AND PRESSURIZED. SERIOUS BURNS FROM THE COOLANT CAN OCCUR.

Do not waste reusable coolant. If the solution is clean, drain the coolant into a clean container for reuse.

(1) Disconnect both negative battery cables from both batteries.

AUTHENTIC RESTORATION PRODUCT

REMOVAL AND INSTALLATION (Continued)

(2) Remove accessory drive belt. Refer to Belt Removal/Installation in the Engine Accessory Drive Belt section in this group.

(3) Drain cooling system until coolant level is below thermostat. Refer to Draining Cooling System in this section.

WARNING: CONSTANT TENSION HOSE CLAMPS ARE USED ON MOST COOLING SYSTEM HOSES. WHEN REMOVING OR INSTALLING, USE ONLY TOOLS DESIGNED FOR SERVICING THIS TYPE OF CLAMP, SUCH AS SPECIAL CLAMP TOOL (NUMBER 6094). SNAP-ON CLAMP TOOL (NUMBER HPC-20) MAY BE USED FOR LARGER CLAMPS. ALWAYS WEAR SAFETY GLASSES WHEN SERVICING CONSTANT TENSION CLAMPS.

CAUTION: A number or letter is stamped into the tongue of constant tension clamps. If replacement is necessary, use only an original equipment clamp with a matching number or letter.

(4) Remove radiator hose clamp and hose from thermostat housing. A special clamp tool must be used to remove the constant tension clamps.

(5) Remove the hose clamp and check valve hose at thermostat housing (Fig. 74).

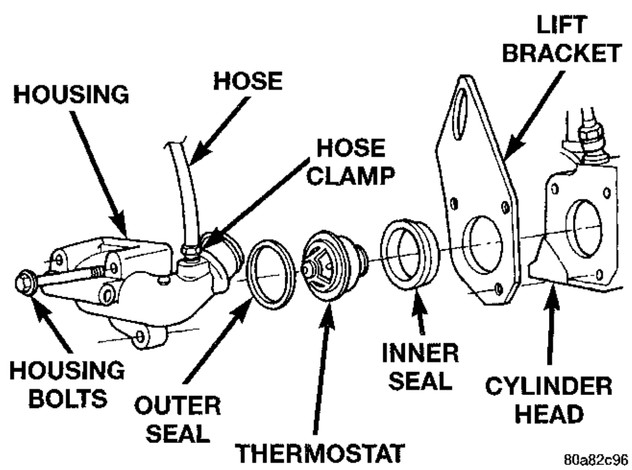

Fig. 74 Thermostat Removal—5.9L Diesel

(6) Remove the two upper generator bracket mounting bolts (Fig. 75).

(7) Remove the upper generator mounting bracket (Fig. 75).

(8) Loosen but do not remove the generator lower pivot bolt.

(9) Position the generator to gain access to thermostat housing and housing bolts.

(10) Remove thermostat housing mounting bolts.

(11) Remove the thermostat housing, thermostat, inner and outer seals and lift bracket (Fig. 74).

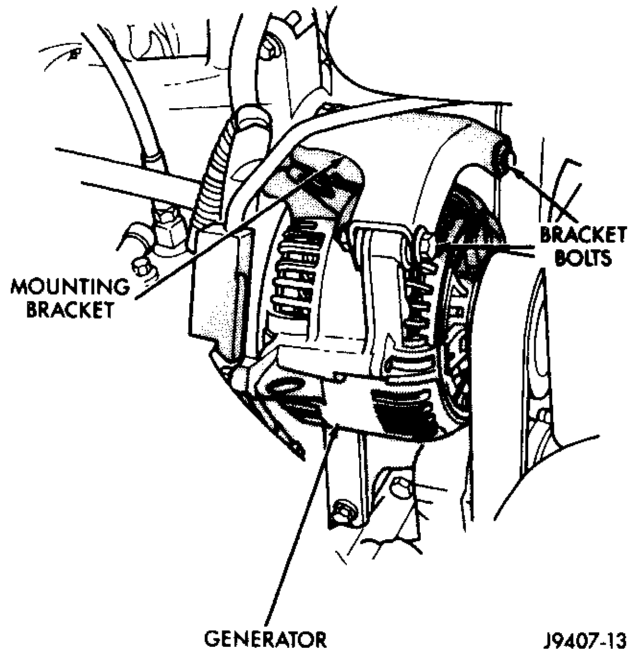

Fig. 75 Generator Mounting Bracket Bolts—Diesel

(12) Clean the mating surfaces of the thermostat housing and the cylinder head.

INSTALLATION

(1) Install the outer seal (Fig. 74) (Fig. 76)into the machined shoulder on the thermostat housing.

(2) Install the thermostat into the machined shoulder next to the outer seal. Note direction of thermostat in (Fig. 74) (Fig. 76).

(3) Position the inner thermostat seal with the shoulder towards the thermostat housing (Fig. 76).

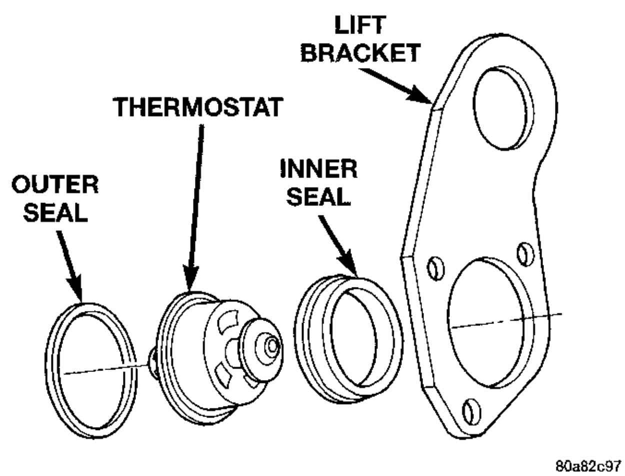

Fig. 76 Thermostat Seals—5.9L Diesel—Typical

(4) Install thermostat, lift bracket, seals and housing to the engine as an assembly. Install and tighten mounting bolts to 24 N·m (18 ft. lbs.) torque.

AUTHENTIC RESTORATION PRODUCT

REMOVAL AND INSTALLATION (Continued)

(5) Position generator to thermostat housing. Install and tighten mounting bolt to 24 N·m torque. Tighten pivot bolt to 43 N·m (32 ft. lbs.) torque.

(6) Install the check valve hose and hose clamp at thermostat housing (Fig. 74).

(7) Install accessory drive belt. Refer to Belt Removal/Installation in the Engine Accessory Drive Belt section of this group.

(8) Connect negative battery cables to both batteries.

(9) Fill cooling system and check for leaks. Refer to Refilling Cooling System in this group.

REPLACING WATER-TO-OIL COOLER IN RADIATOR SIDE TANK

The internal transmission oil cooler located within the radiator is not serviceable. If it requires service, the radiator must be replaced.

Once the repaired or replacement radiator has been installed, fill the cooling system and inspect for leaks. Refer to the Refilling Cooling System and Testing Cooling System For Leaks sections in this group. If the transmission operates properly after repairing the leak, drain the transmission and remove the transmission oil pan. Inspect for sludge and/or rust. Inspect for a dirty or plugged inlet filter. If none of these conditions are found, the transmission and torque convertor may not require reconditioning. Refer to Group 21 for automatic transmission servicing.

AUXILIARY TRANSMISSION OIL COOLER—3.9L/5.2L/5.9L ENGINES

REMOVAL

(1) Disconnect battery negative cable.

(2) Recover refrigerant and remove the a/c condenser (if equipped). Refer to Group 24, Heating and Air Conditioning for the correct procedure.

(3) Place a drain pan under the oil cooler lines.

(4) Disconnect the auxiliary transmission oil cooler line quick-connect fitting at the cooler outlet using the quick connect release tool 6935. Loosen clamp from inlet connection and slide hose off of nipple. Plug cooler lines to prevent oil leakage.

(5) Remove the oil cooler lower mounting bolt (oil cooler-to- vehicle body) (Fig. 77).

(6) Remove three bolts (radiator support bracket-to-body). Remove this A-shaped support bracket and the transmission oil cooler as an assembly from the vehicle. Take care not to damage the radiator core or A/C condenser fins with the cooling lines when removing.

(7) Remove oil cooler from A-shaped support bracket by removing two upper mounting strap bolts and mounting straps at support bracket (Fig. 77).

(8) Remove oil cooler from the A-shaped radiator support bracket.

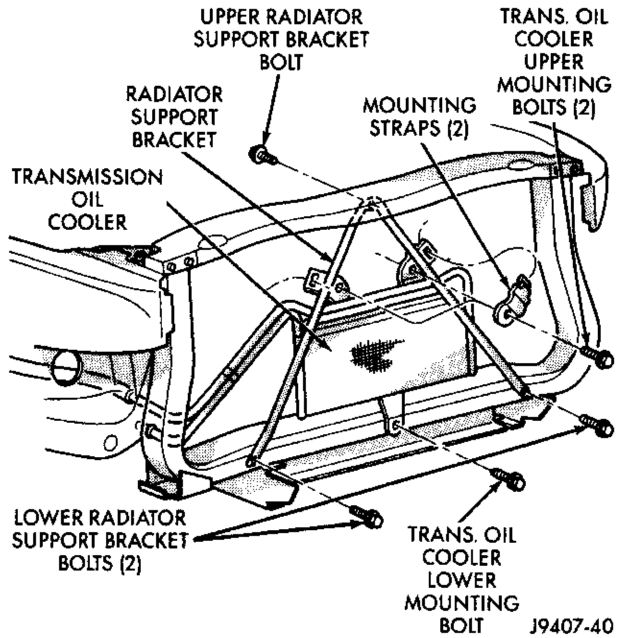

Fig. 77 Auxiliary Transmission Oil Cooler—3.9/5.2/5.9L Engines

INSTALLATION

(1) Install the oil cooler assembly to the A-shaped radiator support bracket using the two upper mounting bolts and mounting straps. Install the bolts but do not tighten at this time.

(2) Install the radiator support bracket and oil cooler (as an assembly) to the vehicle.

(3) Install the two lower radiator A-shaped support bracket bolts. Do not tighten bolts at this time.

(4) Slide and position the oil cooler on the A-shaped bracket until its lower mounting hole lines up with the bolt hole on the vehicle body. Tighten the oil cooler mounting strap bolts to 6 N·m (50 in. lbs.) torque.

(5) Install the upper radiator A-shaped support bracket bolt. Tighten all three radiator support bracket mounting bolts to 11 N·m (95 in. lbs.) torque.

(6) Inspect quick connect fitting for debris and install the quick-connect fitting on the auxiliary cooler outler tube until an audible "click" is heard. Pull apart to verify connection.

(7) Connect battery negative cable.

(8) Start the engine and check all fittings for leaks.

(9) Check the fluid level in the automatic transmission. Refer to Group 21, Transmissions for procedures.

REMOVAL AND INSTALLATION (Continued)

AUXILIARY TRANSMISSION OIL COOLER—8.0L ENGINE

REMOVAL

(1) Place a drain pan under the oil cooler lines.

(2) Disconnect the two transmission lines from the oil cooler by loosening the two worm gear clamps and pulling the rubber hoses off of the oil cooler tubes (Fig. 78). Plug all oil cooler lines to prevent oil leakage.

(3) Remove three oil cooler-to-radiator support mounting bolts (Fig. 78).

(4) Remove the oil cooler and line assembly from the vehicle.

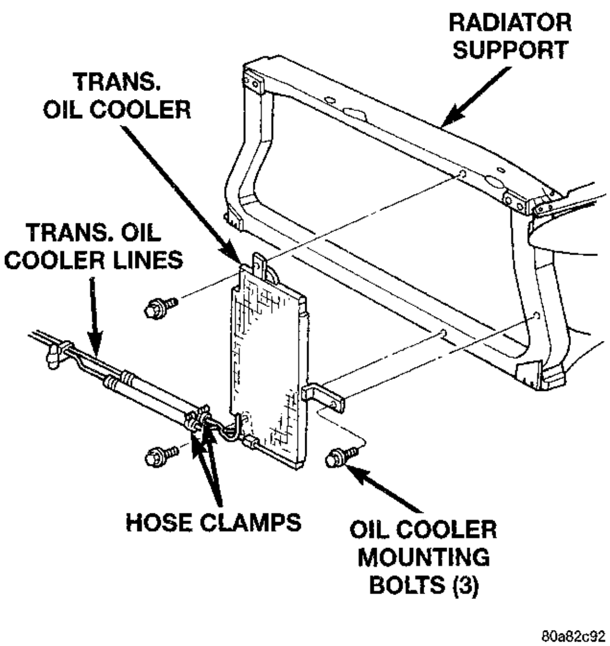

Fig. 78 Auxiliary Transmission Oil Cooler—8.0L Engine

INSTALLATION

(1) Install the oil cooler and cooler line assembly to the vehicle.

(2) Install three mounting bolts and tighten to 6 N·m (50 in. lbs.) torque.

(3) Connect the transmission cooling lines to the oil cooler by pushing the rubber hoses onto the oil cooler tubes. Tighten the worm gear clomps to 2 N·m (18 in. lbs.)

(4) Start the engine and check all fittings for leaks.

(5) Check the fluid level in the automatic transmission. Refer to Group 21, Transmissions for procedures.

WATER-TO-OIL COOLER—5.9L DIESEL ENGINE

REMOVAL

CAUTION: If a leak should occur in the water-to-oil cooler mounted to the side of the engine block, engine coolant may become mixed with transmission fluid. Transmission fluid may also enter engine cooling system. Both cooling system and transmission should be drained and inspected in case of oil cooler leakage.

(1) Disconnect both battery negative cables.

(2) Remove air cleaner assembly and air cleaner intake hoses. Refer to Group 14, Fuel System for procedures.

(3) Drain cooling system. Refer to Draining Cooling System in this group.

(4) Disconnect coolant lines from cooler.

(5) Disconnect transmission oil lines from cooler. Plug cooler lines to prevent oil leakage.

(6) Remove oil cooler mounting straps (Fig. 79).

(7) Lift oil cooler off of mounting bracket.

(8) If replacing cooler, make sure to transfer converter drain back valve to new cooler.

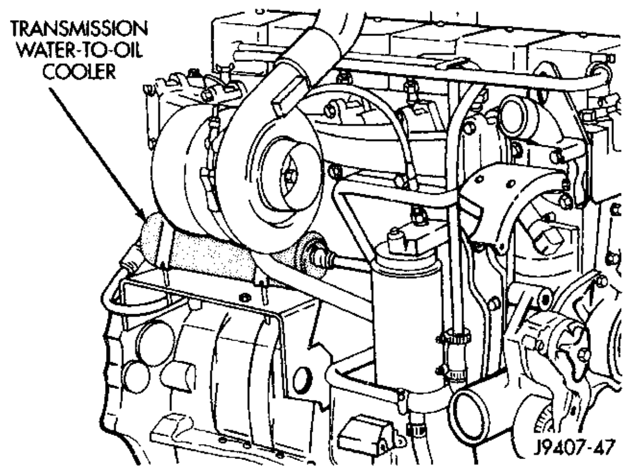

Fig. 79 Transmission Water-To- Oil Cooler—Diesel

INSTALLATION

(1) Position oil cooler on bracket.

(2) Install mounting straps.

(3) Connect transmission oil lines to cooler.

(4) Connect coolant hoses to cooler.

(5) Connect battery negative cables.

(6) Fill cooling system. Refer to Refilling Cooling System in this section.

(7) Check transmission oil level and fill as necessary.

(8) Install air cleaner assembly and air cleaner intake hoses. Refer to Group 14, Fuel System for procedures.

REMOVAL AND INSTALLATION (Continued)

AUXILIARY TRANSMISSION OIL COOLER—5.9L DIESEL ENGINE

REMOVAL

(1) Remove front bumper. Refer to Group 23, Body.

(2) Place a drain pan under the oil cooler.

(3) Raise the vehicle.

(4) Disconnect the oil cooler quick-connect fittings from the transmission lines. These are located near the power steering gearbox. Refer to Group 21, Transmissions for procedures.

(5) Remove the charge air cooler-to-oil cooler bolt (Fig. 80).

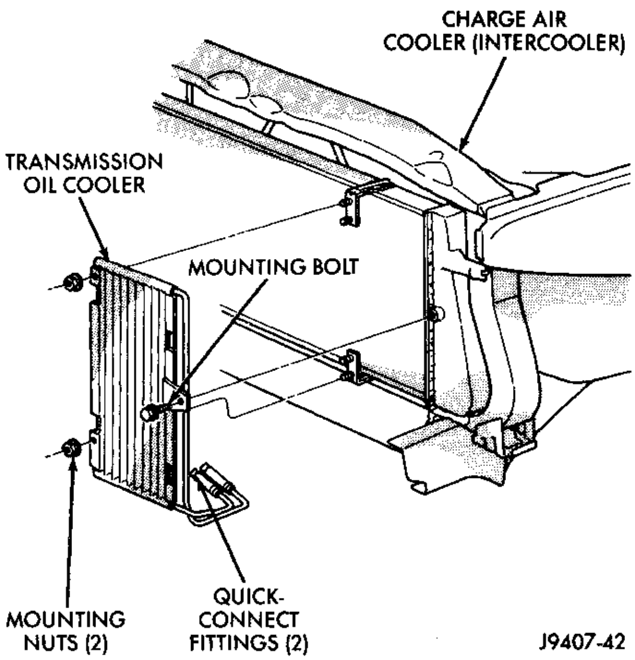

Fig. 80 Auxiliary Transmission Oil Cooler—Diesel Engine

(6) Remove two mounting nuts.

(7) Remove the oil cooler and line assembly towards the front of vehicle. Cooler must be rotated and tilted into position while removing.

INSTALLATION

(1) Carefully position the oil cooler assembly to the vehicle.

(2) Install two nuts and one bolt. Tighten to 11 N·m (95 in. lbs.) torque.

(3) Connect the quick-connect fittings to the transmission cooler lines. Refer to Group 21, Transmissions for procedures.

(4) Install front bumper. Refer to Group 23, Body.

(5) Start the engine and check all fittings for leaks.

(6) Check the fluid level in the automatic transmission. Refer to Group 21, Transmissions for procedures.

RADIATOR

REMOVAL—ALL ENGINES

(1) **All Engines Except Diesel:** Disconnect battery negative cables.

(2) **Diesel engine:** Disconnect both battery negative cables. Remove the nuts retaining the positive cable to the top of radiator. Position positive battery cable to rear of vehicle.

WARNING: DO NOT REMOVE THE CYLINDER BLOCK DRAIN PLUGS OR LOOSEN THE RADIATOR DRAINCOCK WITH THE SYSTEM HOT AND UNDER PRESSURE. SERIOUS BURNS FROM COOLANT CAN OCCUR.

(3) Drain the cooling system. Refer to Draining Cooling System in this group.

WARNING: CONSTANT TENSION HOSE CLAMPS ARE USED ON MOST COOLING SYSTEM HOSES. WHEN REMOVING OR INSTALLING, USE ONLY TOOLS DESIGNED FOR SERVICING THIS TYPE OF CLAMP, SUCH AS SPECIAL CLAMP TOOL (NUMBER 6094). SNAP-ON CLAMP TOOL (NUMBER HPC-20) MAY BE USED FOR LARGER CLAMPS. ALWAYS WEAR SAFETY GLASSES WHEN SERVICING CONSTANT TENSION CLAMPS.

CAUTION: A number or letter is stamped into the tongue of constant tension clamps. If replacement is necessary, use only an original equipment clamp with a matching number or letter.

(4) Remove hose clamps and hoses from radiator.

(5) All engines: Remove coolant reserve/overflow tank hose from radiator filler neck nipple.

(6) All engines **except 8.0L V-10:** Remove the coolant reserve/overflow tank from the fan shroud (pull straight up). The tank slips into T-slots on the fan shroud.

(7) Disconnect electrical connectors at windshield washer reservoir tank and remove tank. Refer to Group 8K, Windshield Wiper and Washer Systems for procedures.

(8) If equipped with an automatic transmission (all engines except diesel), disconnect oil cooler lines (hoses) at radiator tank, using quick connect fitting release tool 6935 on 3.9/5.2/5.9L models, and tool 6931 on 8.0L models.

(9) **Diesel Engine Only:** Remove the two metal clips retaining the upper part of fan shroud to the top of radiator.

REMOVAL AND INSTALLATION (Continued)

(10) Remove the four fan shroud mounting bolts (Fig. 81). Position shroud rearward over the fan blades towards engine.

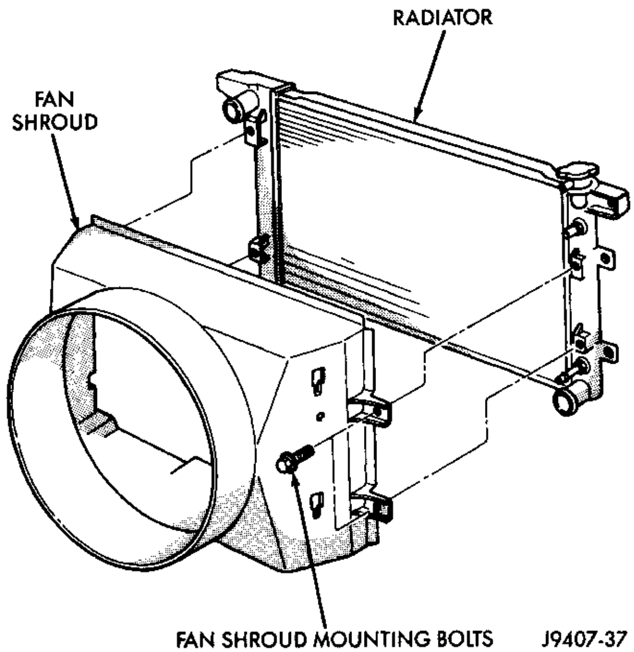

Fig. 81 Typical Fan Shroud Mounting

(11) All Engines **Except 8.0L V-10 and Diesel:** Except 8.0L V-10 and Diesel: Remove the plastic clips retaining the rubber shields to the sides of radiator. Position rubber shields to the side.

(12) Remove the two radiator upper mounting bolts (Fig. 82).

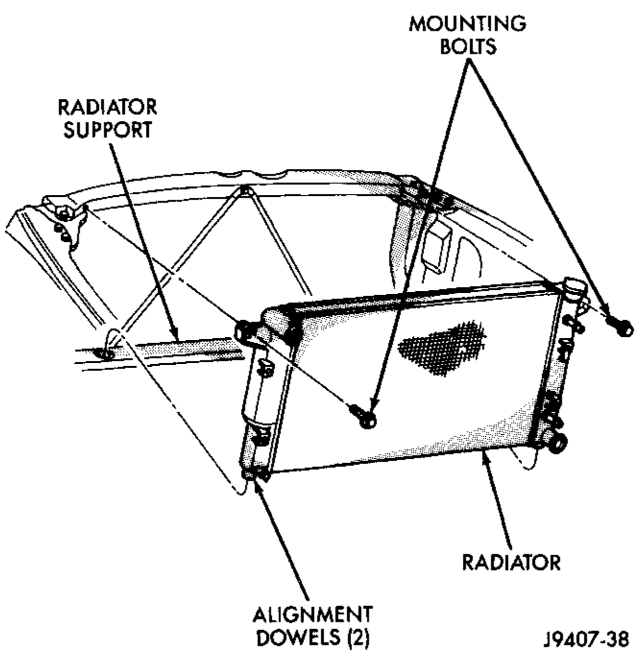

Fig. 82 Typical Radiator Mounting

(13) Lift radiator straight up and out of engine compartment. The bottom of the radiator is equipped with two alignment dowels that fit into holes in the lower radiator support panel (Fig. 82). Rubber biscuits (insulators) are installed to these dowels. Take care not to damage cooling fins or tubes on the radiator and air conditioning condenser when removing.

INSTALLATION

(1) Position fan shroud over the fan blades rearward towards engine.

(2) Install rubber insulators to alignment dowels at lower part of radiator.

(3) Lower the radiator into position while guiding the two alignment dowels into lower radiator support. Different alignment holes are provided in the lower radiator support for each engine application.

(4) Install two upper radiator mounting bolts. Tighten bolts to 11 N·m (95 in. lbs.) torque.

(5) 3.9L V-6 or 5.2L/5.9L V-8 Engines: Position the rubber shields to the sides of radiator. Install the plastic clips retaining the rubber shields to the sides of radiator.

(6) Connect both radiator hoses. Refer to previous **CAUTION** and install hose clamps.

(7) Connect transmission cooler lines to radiator tank. Inspect quick connect fittings for debris and install until an audible “click” is heard. Pull apart to verify connection.

(8) Install windshield washer reservoir tank. Refer to Group 8K.

(9) Position fan shroud to flanges on sides of radiator. Install fan shroud mounting bolts (Fig. 81). Tighten bolts to 6 N·m (50 in. lbs.) torque.

(10) **Diesel Engines:** Install metal clips to top of fan shroud.

(11) All engines: Install coolant reserve/overflow tank hose to radiator filler neck nipple.

(12) All Engines **Except 8.0L V-10:** Install coolant reserve/overflow tank to fan shroud (fits into T-slots on shroud).

(13) Install battery negative cables..

(14) **Diesel Engine:** Install positive battery cable to top of radiator. Tighten radiator-to-battery cable mounting nuts.

(15) Position heater controls to **full heat** position.

(16) Fill cooling system with coolant. Refer to Refilling Cooling System in this group.

(17) Operate engine until it reaches normal temperature. Check cooling system and automatic transmission (if equipped) fluid levels.

AUTHENTIC RESTORATION PRODUCT

REMOVAL AND INSTALLATION (Continued)

BLOCK HEATER—GASOLINE ENGINES

WARNING: DO NOT REMOVE THE CYLINDER BLOCK DRAIN PLUGS OR LOOSEN THE RADIATOR DRAINCOCK WITH THE SYSTEM HOT AND UNDER PRESSURE. SERIOUS BURNS FROM COOLANT CAN OCCUR.

REMOVAL

(1) Disconnect battery negative cable.
(2) Drain coolant from radiator and cylinder block.
(3) Remove power cord from heater by unplugging (Fig. 83) (Fig. 84).
(4) Loosen (but do not completely remove) the screw at center of block heater (Fig. 83) (Fig. 84).
(5) Remove block heater by carefully prying from side-to-side. Note direction of heating element coil (up or down). Element coil must be installed correctly to prevent damage.

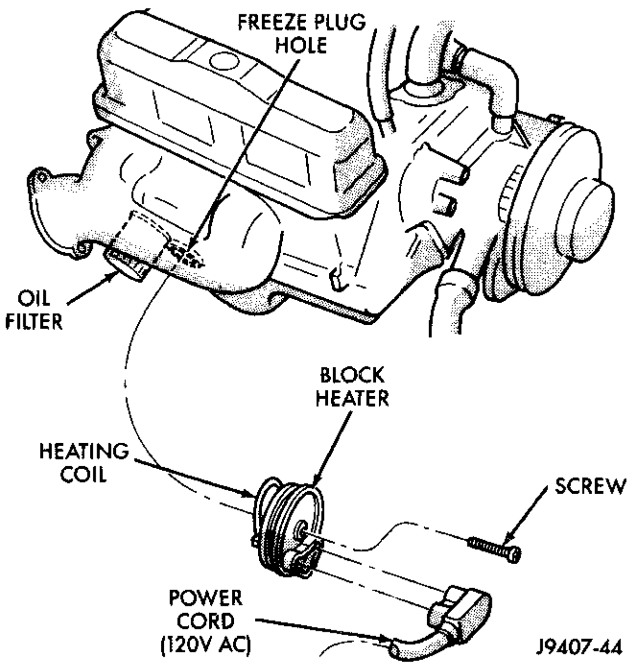

Fig. 83 Block Heater—3.9L/5.2L/5.9L Gasoline Engine

INSTALLATION

(1) Clean and inspect the block heater hole.
(2) Install new O-ring seal(s) to heater in gasoline engines.
(3) Insert block heater into cylinder block.
(4) With heater fully seated, tighten center screw to 2 N·m (17 in. lbs.).
(5) Fill cooling system with recommended coolant. Refer to Refilling Cooling System section in this group.
(6) Start and warm the engine.
(7) Check block heater for leaks.

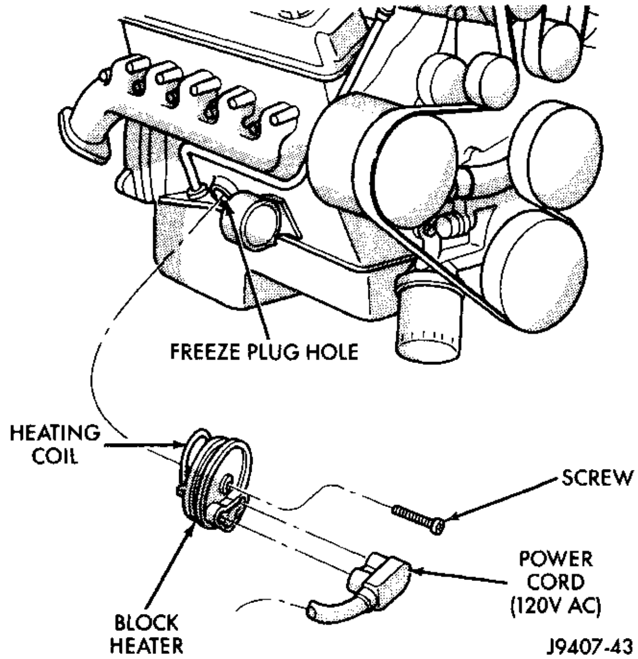

Fig. 84 Block Heater—8.0L V-10 Engine

BLOCK HEATER—DIESEL ENGINE

WARNING: DO NOT REMOVE THE CYLINDER BLOCK DRAIN PLUGS OR LOOSEN THE RADIATOR DRAINCOCK WITH THE SYSTEM HOT AND UNDER PRESSURE. SERIOUS BURNS FROM COOLANT CAN OCCUR.

REMOVAL

(1) Disconnect negative battery cable(s) from battery(s).
(2) Drain coolant from radiator and cylinder block.
(3) Unscrew the power cord retaining cap and disconnect cord from heater element.
(4) Using a suitable size socket, loosen and remove the block heater element (Fig. 85).

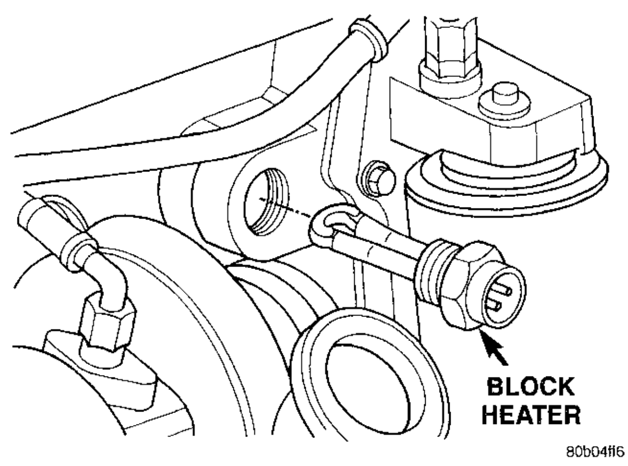

Fig. 85 Block Heater—Diesel Engine

REMOVAL AND INSTALLATION (Continued)

INSTALLATION

(1) Clean and inspect the threads in the cylinder block.

(2) Coat heater element threads with Mopar Thread Sealer with Teflon.

(3) Screw block heater into cylinder block and tighten to 43 N·m (32 ft. lbs.).

(4) Connect block heater cord and tighten retaining cap.

(5) Fill cooling system with recommended coolant. Refer to Refilling Cooling System section in this group.

(6) Start and warm the engine.

(7) Check block heater for leaks.

ACCESSORY DRIVE BELTS

NOTE: The belt routing schematics are published from the latest information available at the time of publication. If anything differs between these schematics and the Belt Routing Label, use the schematics on Belt Routing Label.This label is located in the engine compartment.

CAUTION: Do not attempt to check belt tension with a belt tension gauge on vehicles equipped with an automatic belt tensioner. Refer to Automatic Belt Tensioner in this group.

3.9L V-6 OR 5.2/5.9L V-8 LDC-GAS ENGINES

REMOVAL

Drive belts on these engines are equipped with a spring loaded automatic belt tensioner (Fig. 86). This belt tensioner will be used on all belt configurations, such as with or without power steering or air conditioning. For more information, refer to Automatic Belt Tensioner, proceeding in this group.

(1) Attach a socket/wrench to pulley mounting bolt of automatic tensioner (Fig. 86).

(2) Rotate tensioner assembly clockwise (as viewed from front) until tension has been relieved from belt.

(3) Remove belt from idler pulley first.

(4) Remove belt from vehicle.

INSTALLATION

CAUTION: When installing the accessory drive belt, the belt must be routed correctly. If not, engine may overheat due to water pump rotating in wrong direction. Refer to (Fig. 87) for correct engine belt routing. The correct belt with correct length must be used.

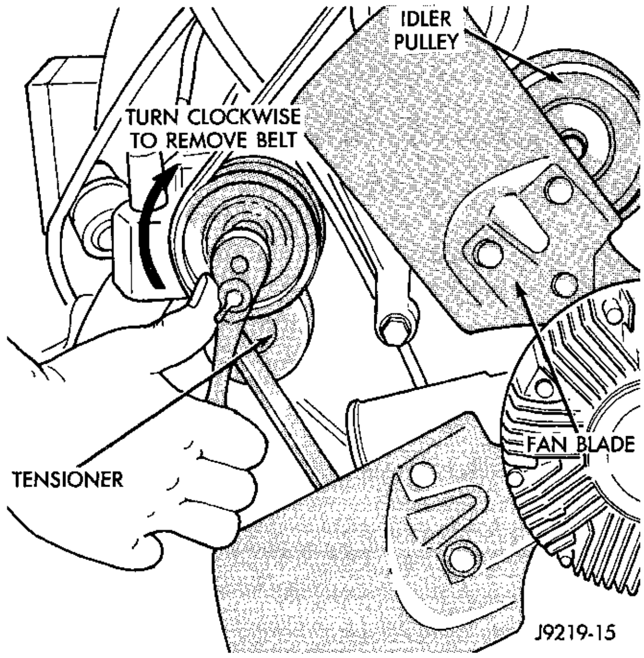

Fig. 86 Belt Tensioner—3.9L V-6 or 5.2/5.9L V-8 LDC-Gas Engines

(1) Position drive belt over all pulleys **except** idler pulley. This pulley is located between generator and A/C compressor.

(2) Attach a socket/wrench to pulley mounting bolt of automatic tensioner (Fig. 86).

(3) Rotate socket/wrench clockwise. Place belt over idler pulley. Let tensioner rotate back into place. Remove wrench. Be sure belt is properly seated on all pulleys.

(4) Check belt indexing marks. Refer to the proceeding Automatic Belt Tensioner for more belt information.

5.9L HDC-GAS AND 8.0L V-10 ENGINES

REMOVAL

Drive belts are equipped with a spring loaded automatic belt tensioner (Fig. 88). This belt tensioner will be used on all belt configurations, such as with or without power steering or air conditioning. For more information, refer to Automatic Belt Tensioner, proceeding in this group.

(1) Attach a socket/wrench to pulley mounting bolt of automatic tensioner (Fig. 88). The threads on the pulley mounting bolt are left- hand.

(2) Relax the tension from the belt by rotating the tensioner counterclockwise (as viewed from front) (Fig. 88). When all belt tension has been relaxed, remove belt from tensioner pulley first and other pulleys last.

REMOVAL AND INSTALLATION (Continued)

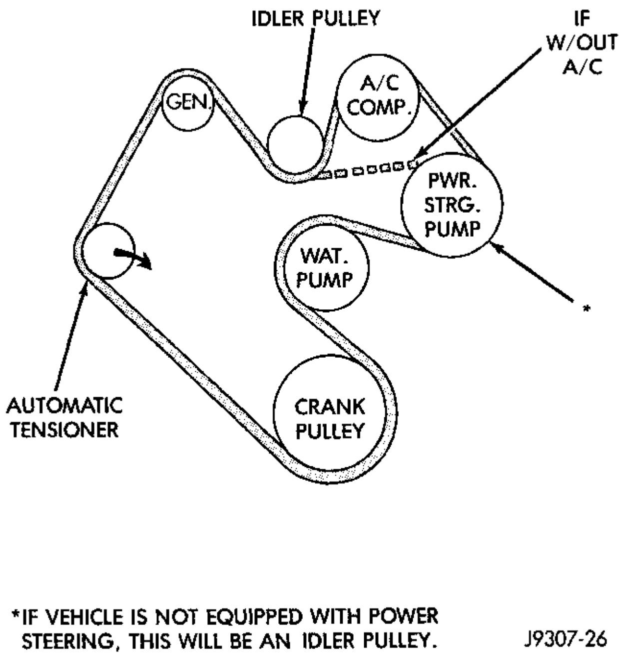

Fig. 87 Belt Routing—3.9L V-6 or 5.2/5.9L V-8 LDC-Gas Engines

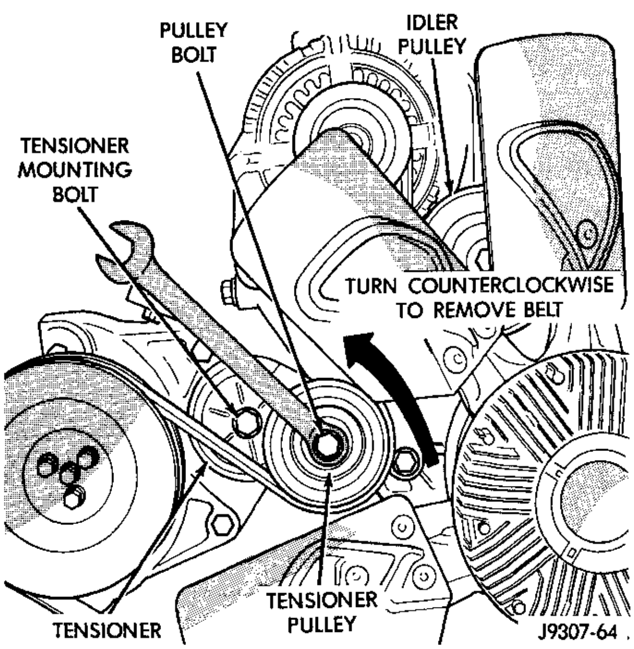

Fig. 88 Belt Tensioner—5.9L HDC-Gas and 8.0L V-10 Engines—Typical

INSTALLATION

CAUTION: When installing the accessory drive belt, the belt must be routed correctly. If not, engine may overheat due to water pump rotating in wrong direction. Refer to (Fig. 89) (Fig. 90)for correct engine belt routing. The correct belt with correct length must be used.

CAUTION: If the pulley is to be removed from the tensioner, its mounting bolt has left-hand threads.

(1) Position drive belt over all pulleys **except** tensioner pulley.

(2) Attach a socket/wrench to pulley mounting bolt of automatic tensioner (Fig. 88).

(3) Rotate socket/wrench counterclockwise. Install belt over tensioner pulley. Let tensioner rotate back into place. Remove wrench. Be sure belt is properly seated on all pulleys.

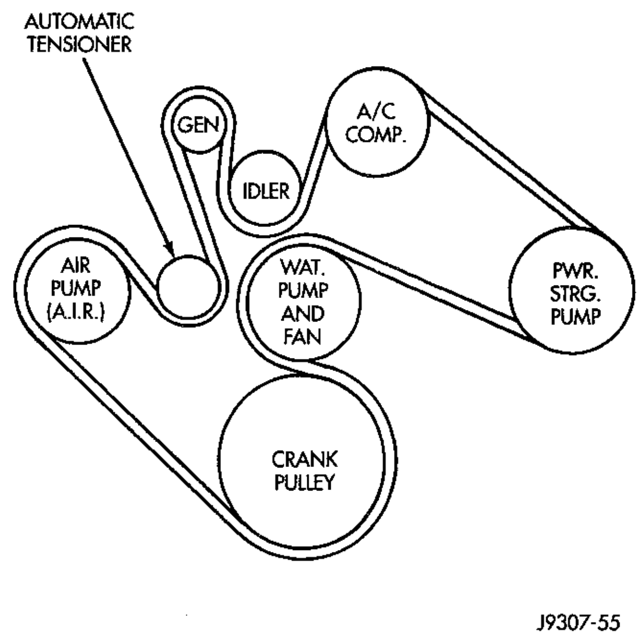

Fig. 89 Belt Routing—5.9L HDC-Gas Engine and 8.0 L V-10—With A/C

5.9L DIESEL ENGINE

REMOVAL

Drive belts on diesel engines are equipped with a spring loaded automatic belt tensioner (Fig. 91). **(Fig. 91) displays the tensioner for vehicles without air conditioning.**

This belt tensioner will be used on all belt configurations, such as with or without air conditioning. For more information, refer to Automatic Belt Tensioner, proceeding in this group.

(1) A 3/8 inch square hole is provided in the automatic belt tensioner (Fig. 91). Attach a 3/8 inch drive-long handle ratchet to this hole.

(2) Rotate ratchet and tensioner assembly counterclockwise (as viewed from front) until tension has been relieved from belt.

(3) Remove belt from water pump pulley first.

(4) Remove belt from vehicle.

REMOVAL AND INSTALLATION (Continued)

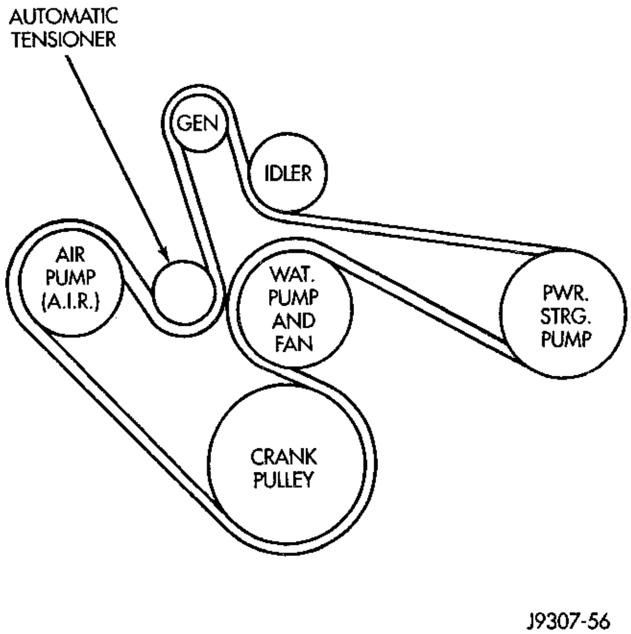

Fig. 90 Belt Routing—5.9L HDC-Gas Engine and 8.0 L V-10—Without A/C

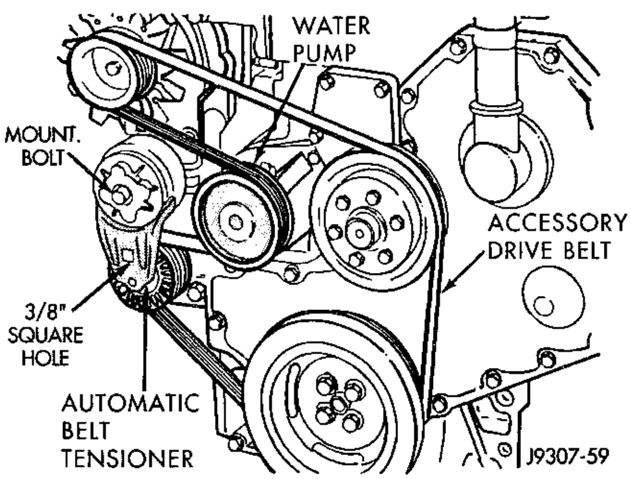

Fig. 91 Belt Tensioner—5.9L Diesel—Typical (non-A/C shown)

INSTALLATION

CAUTION: When installing the accessory drive belt, the belt must be routed correctly. If not, engine may overheat due to water pump rotating in wrong direction. Refer to (Fig. 92) (Fig. 93)for correct engine belt routing. The correct belt with correct length must be used.

(1) Position drive belt over all pulleys **except** water pump pulley.

(2) Attach a 3/8 inch ratchet to tensioner.

(3) Rotate ratchet and belt tensioner counterclockwise. Place belt over water pump pulley. Let tensioner rotate back into place. Remove ratchet. Be sure belt is properly seated on all pulleys.

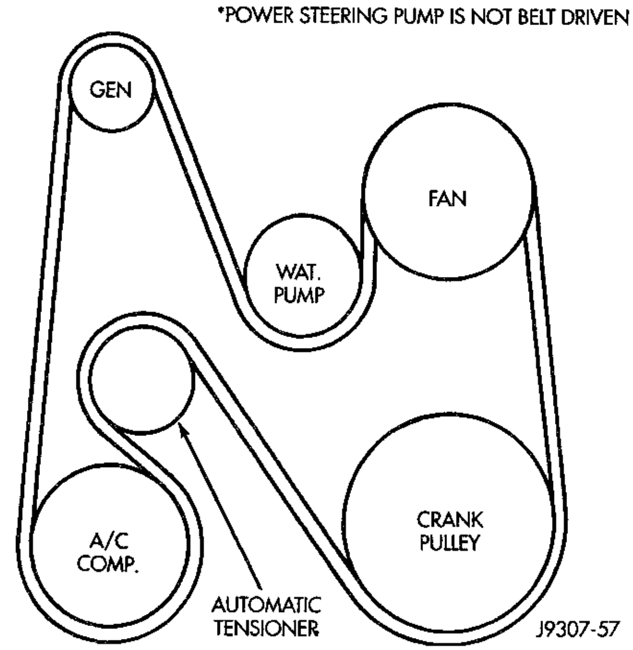

Fig. 92 Belt Routing—5.9L Diesel Engine—With A/C

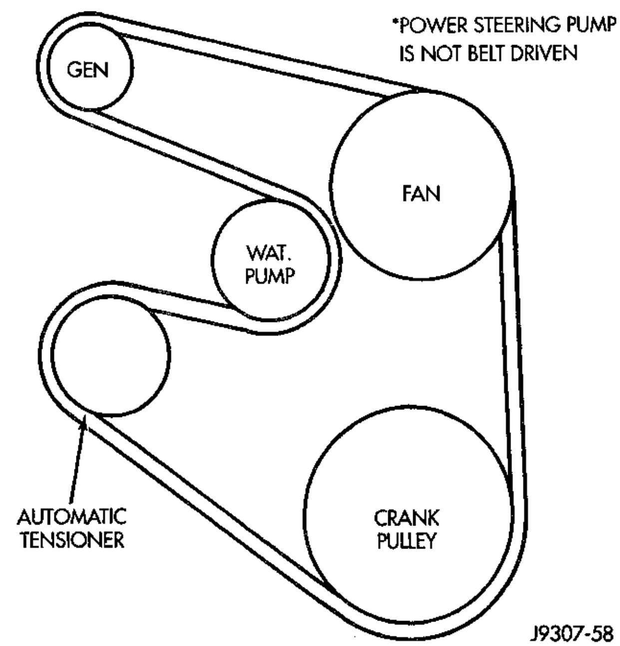

Fig. 93 Belt Routing—5.9L Diesel Engine—Without A/C

REMOVAL AND INSTALLATION (Continued)

AUTOMATIC BELT TENSIONER

NOTE: On 3.9L V-6 or 5.2/5.9L V-8 LDC-gas engines, the tensioner is equipped with an indexing arrow (Fig. 94) on back of tensioner and an indexing mark on tensioner housing. If a new belt is being installed, arrow must be within approximately 3 mm (1/8 in.) of indexing mark (point B-) (Fig. 94). Belt is considered new if it has been used 15 minutes or less. If this specification cannot be met, check for:

- **The wrong belt being installed (incorrect length/width)**
- **Worn bearings on an engine accessory (A/C compressor, power steering pump, water pump, idler pulley or generator)**
- **A pulley on an engine accessory being loose**
- **Misalignment of an engine accessory**
- **Belt incorrectly routed.**

On 3.9L V-6 or 5.2/5.9L V-8 LDC-gas engines, a used belt should be replaced if tensioner indexing arrow has moved to point-A (Fig. 94). Tensioner travel stops at point-A.

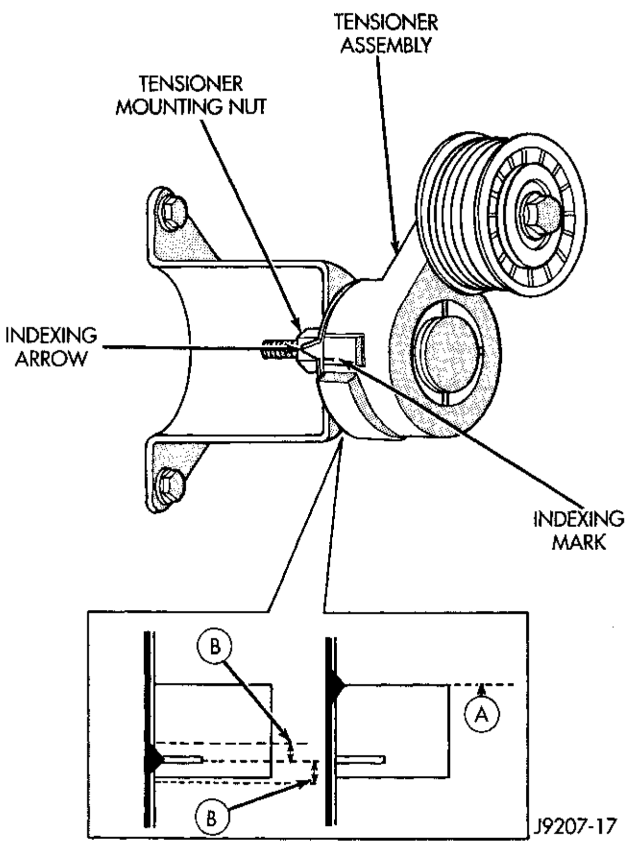

Fig. 94 Indexing Marks—3.9L V-6 or 5.2/5.9L V-8 LDC-Gas Engines

3.9L V-6 OR 5.2/5.9L V-8 LDC-GAS ENGINES

REMOVAL

(1) Remove accessory drive belt. Refer to Belt Removal/Installation in this group.

(2) Disconnect wiring and secondary cable from ignition coil.

(3) Remove ignition coil from coil mounting bracket (two bolts). Do not remove coil mounting bracket from cylinder head.

(4) Remove tensioner assembly from mounting bracket (one nut) (Fig. 94).

WARNING: BECAUSE OF HIGH SPRING PRESSURE, DO NOT ATTEMPT TO DISASSEMBLE AUTOMATIC TENSIONER. UNIT IS SERVICED AS AN ASSEMBLY (EXCEPT FOR PULLEY).

(5) Remove pulley bolt. Remove pulley from tensioner.

INSTALLATION

(1) Install pulley and pulley bolt to tensioner. Tighten bolt to 61 N·m (45 ft. lbs.) torque.

(2) Install tensioner assembly to mounting bracket. An indexing tab is located on back of tensioner. Align this tab to slot in mounting bracket. Tighten nut to 67 N·m (50 ft. lbs.) torque.

(3) Connect all wiring to ignition coil.

(4) Install coil to coil bracket. If nuts and bolts are used to secure coil to coil bracket, tighten to 11 N·m (100 in. lbs.) torque. If coil mounting bracket has been tapped for coil mounting bolts, tighten bolts to 5 N·m (50 in. lbs.) torque.

CAUTION: To prevent damage to coil case, coil mounting bolts must be torqued.

(5) Install drive belt. Refer to Belt Removal/Installation in this group.

(6) Check belt indexing marks (Fig. 94).

5.9L HDC-GAS AND 8.0L V-10 ENGINES

REMOVAL

(1) Remove accessory drive belt. Refer to Belt Removal/Installation in this group.

(2) Remove tensioner mounting bolt (Fig. 95) and remove tensioner.

CAUTION: If the pulley is to be removed from the tensioner, its mounting bolt has left-hand threads.

WARNING: BECAUSE OF HIGH SPRING PRESSURE, DO NOT ATTEMPT TO DISASSEMBLE AUTOMATIC TENSIONER. UNIT IS SERVICED AS AN ASSEMBLY (EXCEPT FOR PULLEY).

REMOVAL AND INSTALLATION (Continued)

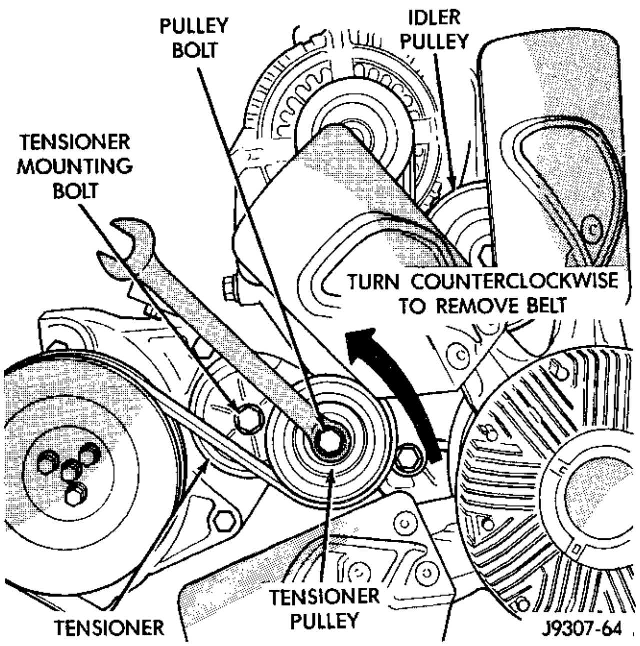

Fig. 95 Belt Tensioner—5.9L HDC-Gas and 8.0L v-10

INSTALLATION

(1) Install pulley and pulley bolt to tensioner (observe the previous CAUTION). Tighten bolt to 88 N·m (65 ft. lbs.) torque.

(2) Install tensioner assembly to mounting bracket. A dowel pin is located on back of tensioner (Fig. 96). Align this to dowel hole (Fig. 97) in tensioner mounting bracket. Tighten bolt to 41 N·m (30 ft. lbs.) torque.

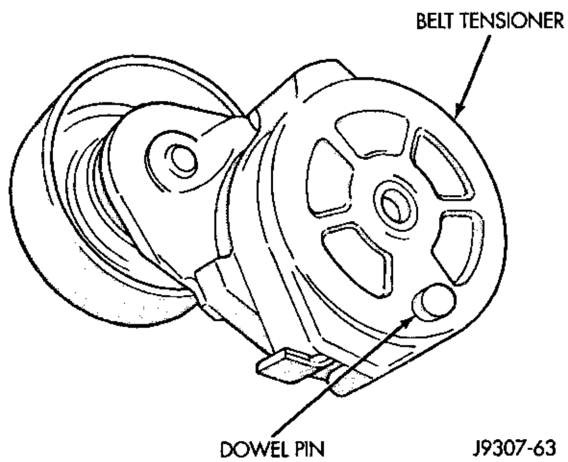

Fig. 96 Tensioner Dowel Pin—5.9L HDC-Gas and 8.0L V-10 Engines

(3) Install drive belt. Refer to Belt Removal/Installation in this group.

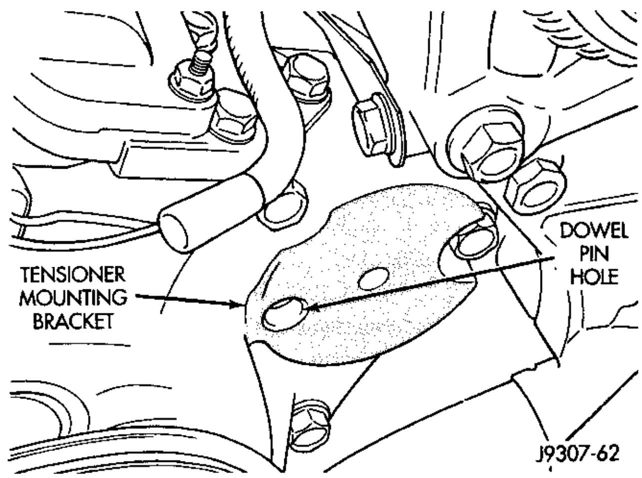

Fig. 97 Tensioner Dowel Hole—5.9L HDC-Gas and 8.0L V-10 Engines

5.9L DIESEL ENGINE

REMOVAL

(1) Remove accessory drive belt. Refer to Belt Removal/Installation in this group.

(2) Remove tensioner mounting bolt (Fig. 95) and remove tensioner.

WARNING: BECAUSE OF HIGH SPRING PRESSURE, DO NOT ATTEMPT TO DISASSEMBLE AUTOMATIC TENSIONER. UNIT IS SERVICED AS AN ASSEMBLY.

INSTALLATION

(1) Install tensioner assembly to mounting bracket. A dowel is located on back of tensioner. Align this dowel to hole in tensioner mounting bracket. Tighten bolt to 41 N·m (30 ft. lbs.) torque.

(2) Install drive belt. Refer to Belt Removal/Installation in this group.

COOLING SYSTEM FAN—GAS ENGINES

REMOVAL

CAUTION: If the viscous fan drive is replaced because of mechanical damage, the cooling fan blades should also be inspected. Inspect for fatigue cracks, loose blades, or loose rivets that could have resulted from excessive vibration. Replace fan blade assembly if any of these conditions are found. Also inspect water pump bearing and shaft assembly for any related damage due to a viscous fan drive malfunction.

(1) Disconnect negative battery cable from battery.

(2) Remove throttle cable at top of fan shroud.

REMOVAL AND INSTALLATION (Continued)

(3) All Except 8.0L V-10 Engine: Unsnap coolant reserve/overflow tank from fan shroud and lay aside. The tank is held to shroud with T- shaped slots. Do not disconnect hose or drain coolant from tank.

(4) The thermal viscous fan drive/fan blade assembly is attached (threaded) to water pump hub shaft (Fig. 98). Remove fan blade/viscous fan drive assembly from water pump by turning mounting nut counterclockwise as viewed from front. Threads on viscous fan drive are **RIGHT-HAND.** A Snap-On 36 MM Fan Wrench (number SP346 from Snap-On Cummins Diesel Tool Set number 2017DSP) can be used. Place a bar or screwdriver between water pump pulley bolts (Fig. 98) to prevent pulley from rotating.

(5) Do not attempt to remove fan/viscous fan drive assembly from vehicle at this time.

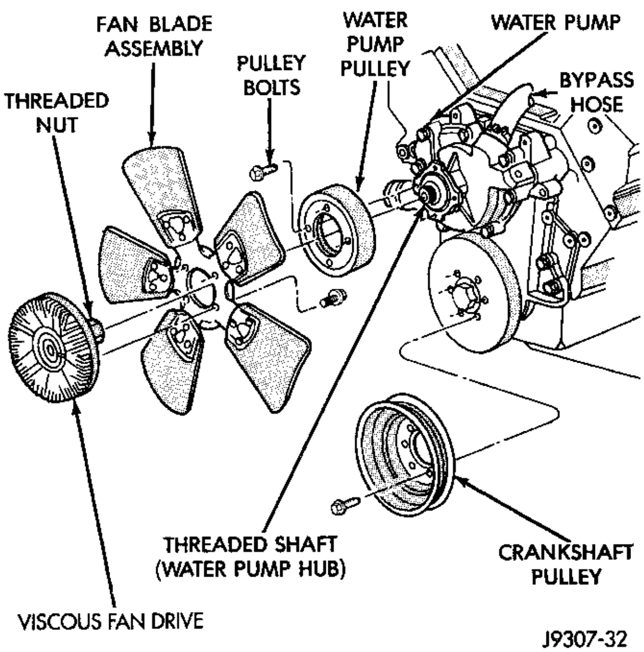

Fig. 98 Fan Blade/Viscous Fan Drive—Gas Engines—Typical

(6) Do not unbolt fan blade assembly (Fig. 98) from viscous fan drive at this time.

(7) Remove four fan shroud-to-radiator mounting bolts.

(8) Remove fan shroud and fan blade/viscous fan drive assembly as a complete unit from vehicle.

(9) After removing fan blade/viscous fan drive assembly, **do not** place viscous fan drive in horizontal position. If stored horizontally, silicone fluid in the viscous fan drive could drain into its bearing assembly and contaminate lubricant.

CAUTION: Do not remove water pump pulley-to-water pump bolts (Fig. 68). This pulley is under spring tension.

(10) Remove four bolts securing fan blade assembly to viscous fan drive (Fig. 98).

CAUTION: Some engines equipped with serpentine drive belts have reverse rotating fans and viscous fan drives. They are marked with the word REVERSE to designate their usage. Installation of the wrong fan or viscous fan drive can result in engine overheating.

INSTALLATION

(1) Install fan blade assembly to viscous fan drive. Tighten bolts (Fig. 98) to 23 N·m (17 ft. lbs.) torque.

(2) Position fan shroud and fan blade/viscous fan drive assembly to vehicle as a complete unit.

(3) Install fan shroud.

(4) Install fan blade/viscous fan drive assembly to water pump shaft (Fig. 98).

(5) Except 8.0L V-10 Engine: Install coolant reserve/overflow tank to fan shroud. Snaps into position.

(6) Install throttle cable to fan shroud.

(7) Connect negative battery cable.

NOTE: Viscous Fan Drive Fluid Pump Out Requirement: After installing a new viscous fan drive, bring the engine speed up to approximately 2000 rpm and hold for approximately two minutes. This will ensure proper fluid distribution within the drive.

COOLING SYSTEM FAN DRIVE—DIESEL ENGINE

REMOVAL

CAUTION: If the viscous fan drive is replaced because of mechanical damage, the cooling fan blades should also be inspected. Inspect for fatigue cracks, loose blades, or loose rivets that could have resulted from excessive vibration. Replace fan blade assembly if any of these conditions are found. Also inspect water pump bearing and shaft assembly for any related damage due to a viscous fan drive malfunction.

(1) Disconnect both negative battery cables at both batteries.

(2) Remove the fan shroud mounting bolts. Position fan shroud towards engine.

CAUTION: Do not remove the fan pulley bolts. This pulley is under spring tension.

(3) The thermal viscous fan drive/fan blade assembly is attached (threaded) to the fan hub shaft (Fig. 99). Remove the fan blade/fan drive assembly from fan pulley by turning the mounting nut clockwise (as

REMOVAL AND INSTALLATION (Continued)

viewed from front). Threads on the viscous fan drive are **LEFT-HAND.** A Snap-On 36 MM Fan Wrench (number SP346 from Snap-On Cummins Diesel Tool Set number 2017DSP) can be used. Place a bar or screwdriver between the fan pulley bolts to prevent pulley from rotating.

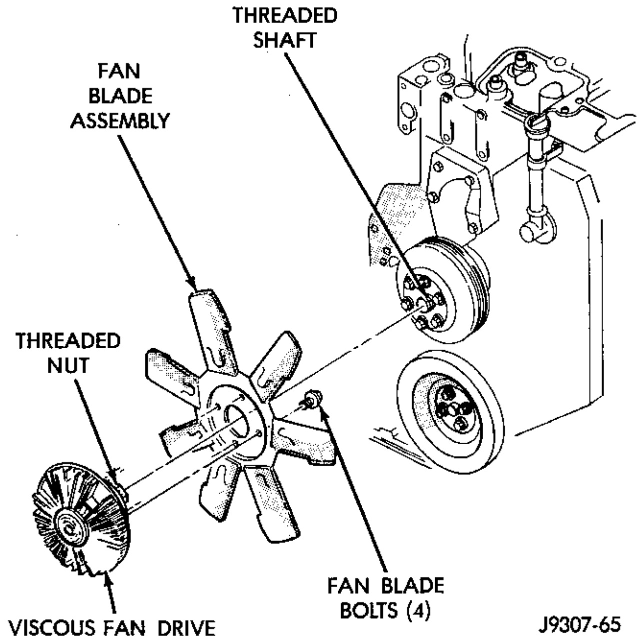

Fig. 99 Fan Blades/Viscous Fan Drive—5.9L Diesel

(4) Remove the fan shroud and the fan blade/viscous drive as an assembly from vehicle.

(5) Remove fan blade-to-viscous fan drive mounting bolts.

(6) Inspect the fan for cracks, loose rivets, loose or bent fan blades.

CAUTION: Some engines equipped with serpentine drive belts have reverse rotating fans and viscous fan drives. They are marked with the word REVERSE to designate their usage. Installation of the wrong fan or viscous fan drive can result in engine overheating.

INSTALLATION

(1) Install fan blade assembly to viscous fan drive. Tighten mounting bolts to 23 N·m (17 ft. lbs.) torque.

(2) Position the fan shroud and fan blade/viscous fan drive to the vehicle as an assembly.

(3) Install viscous fan drive assembly on fan hub shaft. Tighten mounting nut to 57 N·m (42 ft. lbs.) torque.

(4) Install fan shroud bolts.

(5) Install battery cables to batteries.

NOTE: Viscous Fan Drive Fluid Pump Out Requirement: After installing a new viscous fan drive, bring the engine speed up to approximately 2000 rpm and hold for approximately two minutes. This will ensure proper fluid distribution within the drive.

CLEANING AND INSPECTION

RADIATOR CAP

INSPECTION

Hold cap at eye level, right side up. The vent valve (Fig. 100) at bottom of cap should open. If rubber gasket has swollen and prevents vent valve from opening, replace cap.

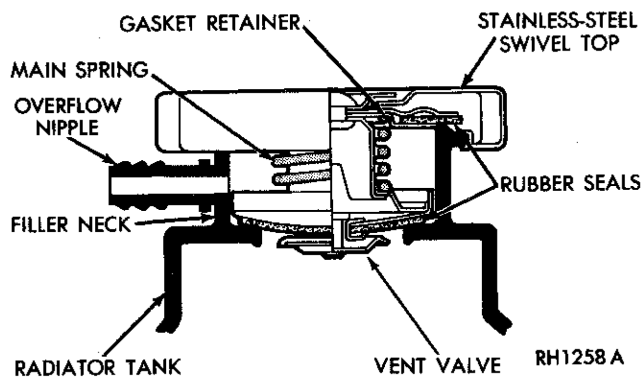

Fig. 100 Radiator Pressure Cap

Hold cap at eye level, upside down. If any light can be seen between vent valve and rubber gasket, replace cap. **Do not use a replacement cap that has a spring to hold vent shut.** A replacement cap must be the type designed for a coolant reserve/overflow system with a completely sealed diaphragm spring and a rubber gasket. This gasket is used to seal to radiator filler neck top surface. Use of proper cap will allow coolant return to radiator.

RADIATOR

CLEANING

The radiator and air conditioning fins should be cleaned when an accumulation of bugs, leaves etc. has occurred. Clean radiator fins are necessary for good heat transfer. With the engine cold, apply cold water and compressed air to the back (engine side) of the radiator to flush the radiator and/or A/C condenser of debris.

WATER PUMP INSPECTION

Replace water pump assembly if it has any of the following conditions:

- The body is cracked or damaged

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CLEANING AND INSPECTION (Continued)

• Water leaks from the shaft seal. This is evident by traces of coolant below the vent hole
• Loose or rough turning bearing. Also inspect thermal fan drive
• Impeller rubs either the pump body or timing chain case/cover

FAN

INSPECTION

The fan cannot be repaired. If fan is damaged, it must be replaced. Inspect fan as follows:

(1) Remove fan blade and viscous fan drive as an assembly from the engine. Refer to preceding Removal procedure.

(2) Remove fan blade assembly from viscous fan drive unit (four bolts).

(3) Lay fan on a flat surface with leading edge facing down. With tip of blade touching flat surface, replace fan if clearance between opposite blade and surface is greater than 2.0 mm (.090 inch). Rocking motion of opposite blades should not exceed 2.0 mm (.090 inch). Test all blades in this manner.

WARNING: DO NOT ATTEMPT TO BEND OR STRAIGHTEN FAN BLADES IF NOT WITHIN SPECIFICATIONS.

(4) Inspect fan assembly for cracks, bends, loose rivets or broken welds. Replace fan if any damage is found.

CAUTION: If fan blade assembly is replaced because of mechanical damage, water pump and viscous fan drive should also be inspected. These components could have been damaged due to excessive vibration.

Also refer to the proceeding Viscous Fan Drive section for additional information.

SPECIFICATIONS

COOLANT CAPACITIES

COOLANT CAPACITY CHART

ENGINE	CAPACITY*
3.9L/5.2L/5.9L GAS	19 L (20 Qts.)
8.0L	25L (26Qts.)
5.9L DIESEL	23L (24 Qts.)
Nominal refill capacities are shown. A variation may be observed due to manufacturing tolerances and refill procedures.	
Capacities shown include vehicles with air conditioning and/or heavy duty cooling systems.	

TORQUE

DESCRIPTION — **TORQUE**

Belt Tensioner Pulley-(3.9/5.2/5.9L LDC Gas Engine)
Bolt . . . . .61 N·m (45 ft. lbs.)
Belt Tensioner Pulley-(5.9L HDC Gas and 8.0L Engine)
Bolt . . . . .88 N·m (65 ft. lbs.)
Belt Tensioner to Mounting Bracket-(3.9/5.2/5.9L LDC Gas Engine)
Bolt . . . . .67 N·m (50 ft. lbs.)
Belt Tensioner to Mounting Bracket-(5.9L HDC Gas and 8.0L Engine)
Bolt . . . . .41 N·m (30 ft. lbs.)
Block Heater—Gasoline Engines
Screw . . . . .2 N·m (17 in. lbs.)
Block Heater—Diesel Engines
Hex . . . . .43 N·m (32 ft. lbs.)
Fan Shroud to Radiator Mounting
Bolts . . . . .6 N·m (50 in. lbs.)
Heater Hose Fitting at Water Pump-(8.0L)
Fitting .16 N·m (44 ft. lbs.)
Idler Pulley Mounting-(All Gas Engines)
Bolt . . . . .61 N·m (45 ft. lbs.)
Radiator Mounting
Bolts . . . . .11 N·m (95 in. lbs.)
Thermal Viscous Fan to Hub-(Diesel)
Nut . . . . .57 N·m (42 ft. lbs.)
Thermostat Housing-(3.9/5.2/5.9L)
Bolts . . . . .23 N·m (200 in. lbs.)
Thermostat Housing-(8.0L)
Bolts . . . . .25 N·m (220 in. lbs.)
Thermostat Housing-(Diesel)
Bolts . . . . .24 N·m (18 ft. lbs.)
Water Pump Mounting-(All Gas Engines)
Bolts . . . . .40 N·m (30 ft. lbs.)
Water Pump Pulley-(All Gas Engines)
Bolts . . . . .22 N·m (16 ft. lbs.)
Water Pump Mounting-(Diesel)
Bolts . . . . .24 N·m (18 ft. lbs.)

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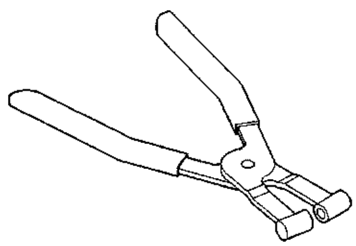
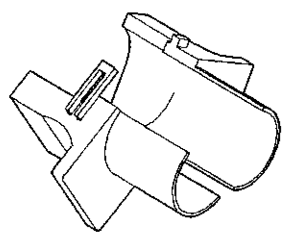
SPECIAL TOOLS

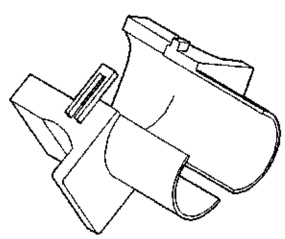
COOLING



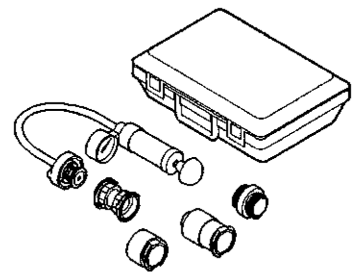
Pliers 6094



1/2" Disconnect Tool (8.0L/Diesel Engines)—6931



3/8" Disconnect Tool (3.9/5.2/5.9L Engines)—6935



Pressure Tester 7700–A

BATTERY

CONTENTS

GENERAL INFORMATION

OVERVIEW

The battery, starting, and charging systems operate with one another, and must be tested as a complete system. In order for the vehicle to start and charge properly, all of the components involved in these systems must perform within specifications.

Group 8A covers the battery, Group 8B covers the starting system, and Group 8C covers the charging system. Refer to Group 8W - Wiring Diagrams for complete circuit descriptions and diagrams. We have separated these systems to make it easier to locate the information you are seeking within this Service Manual. However, when attempting to diagnose any of these systems, it is important that you keep their interdependency in mind.

The diagnostic procedures used in these groups include the most basic conventional diagnostic methods, to the more sophisticated On-Board Diagnostics (OBD) built into the Powertrain Control Module (PCM). Use of a induction milliampere ammeter, volt/ohmmeter, battery charger, carbon pile rheostat (load tester), and 12-volt test lamp may be required.

All OBD-sensed systems are monitored by the PCM. Each monitored circuit is assigned a Diagnostic Trouble Code (DTC). The PCM will store a DTC in electronic memory for any failure it detects. Refer to the On-Board Diagnostics Test in Group 8C - Charging System for more information.

INTRODUCTION

This section covers only battery diagnostic and service procedures. For battery maintenance procedures, refer to Group 0 - Lubrication and Maintenance. While battery charging can be considered a maintenance procedure, battery charging information is located in this group. This was done because the battery must be fully-charged before any diagnosis can be performed.

The factory-installed maintenance-free battery has non-removable battery vent caps (Fig. 1). Water cannot be added to this battery. The chemical composition within the maintenance-free battery reduces battery gassing and water loss, at normal charge and discharge rates. Therefore, the battery should not require additional water in normal service.

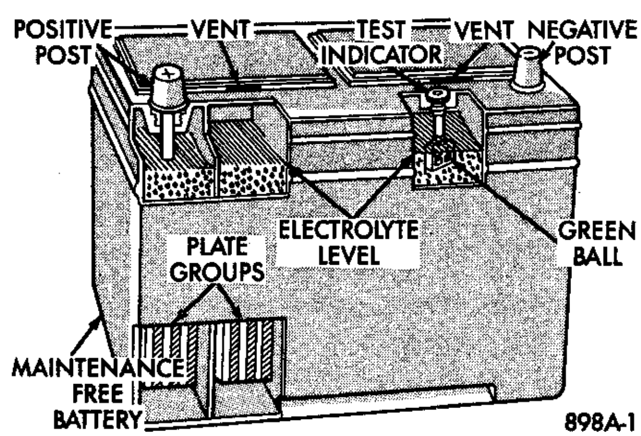


Fig. 1 Maintenance-Free Battery - Typical

If the battery electrolyte level becomes low, the battery must be replaced. However, rapid loss of electrolyte can be caused by an overcharging condition. Be certain to diagnose the charging system before

GENERAL INFORMATION (Continued)

returning the vehicle to service. Refer to Group 8C - Charging System for more information.

The factory-installed battery also has a built-in test indicator (hydrometer). The color visible in the sight glass of the indicator will reveal the battery condition. See Built-In Test Indicator in the Diagnosis and Testing section of this group for more information.

It is important that the battery, starting, and charging systems be thoroughly tested and inspected any time a battery needs to be charged or replaced. The cause of abnormal discharge, overcharging, or early battery failure must be diagnosed and corrected before a battery is replaced or returned to service.

DESCRIPTION AND OPERATION

BATTERY

The storage battery is a device used to store electrical energy potential in a chemical form. When an electrical load is applied to the battery terminals, an electrochemical reaction occurs within the battery. This reaction causes the battery to discharge electrical current.

The battery is made up of six individual cells that are connected in series. Each cell contains positively charged plate groups made of lead oxide, and negatively charged plate groups made of sponge lead. These dissimilar metal plates are submerged in a sulfuric acid and water solution called an electrolyte.

As the battery discharges, a gradual chemical change takes place within each cell. The sulfuric acid in the electrolyte combines with the plate materials, causing both plates to slowly change to lead sulfate. At the same time, oxygen from the positive plate material combines with hydrogen from the sulfuric acid, causing the electrolyte to become mainly water.

The chemical changes within the battery are caused by the movement of excess or free electrons between the positive and negative plate groups. This movement of electrons produces a flow of electrical current through the load device attached to the battery terminals.

As the plate materials become more similar chemically, and the electrolyte becomes less acid, the voltage potential of each cell is reduced. However, by charging the battery with a voltage higher than that of the battery, the battery discharging process is reversed.

Charging the battery gradually changes the sulfated lead plates back into sponge lead and lead oxide, and the water back into sulfuric acid. This action restores the difference in the electron charges deposited on the plates, and the voltage potential of the battery cells.

For a battery to remain useful, it must be able to produce high-amperage current over an extended period. A battery must also be able to accept a charge, so that its voltage potential may be restored.

In addition to producing and storing electrical energy, the battery serves as a capacitor, or voltage stabilizer, for the electrical system of the vehicle. It absorbs most abnormal or transient voltages caused by the switching of any of the electrical components in the vehicle.

The battery is vented to release excess hydrogen gas that is created when the battery is being charged or discharged. However, even with these vents, the hydrogen gas can collect in or around the battery. If hydrogen gas is exposed to flame or sparks, it may ignite.

If the electrolyte level is low, the battery may arc internally and explode. If the battery is equipped with removable cell caps, add distilled water whenever the electrolyte level is below the top of the plates. If the battery cell caps cannot be removed, the battery must be replaced if the electrolyte level becomes low.

BATTERY SIZE AND RATINGS

The battery Group Size number, the Cold Cranking Amperage (CCA) rating, and the Reserve Capacity (RC) rating or Ampere-Hours (AH) rating can be found on the original equipment battery label. Be certain that a replacement battery has the correct Group Size number, as well as CCA, and RC or AH ratings that equal or exceed the original equipment specification for the vehicle being serviced.

See the Battery Classifications and Ratings chart in the Specifications section at the back of this group for more information. Battery sizes and ratings are discussed in more detail below.

GROUP SIZE

The outside dimensions and terminal placement of the battery conform to standards established by the Battery Council International (BCI). Each battery is assigned a BCI Group Size number to help identify a correctly-sized replacement.

COLD CRANKING AMPERAGE

The Cold Cranking Amperage (CCA) rating specifies how much current (in amperes) the battery can deliver for thirty seconds at -18° C (0° F). Terminal voltage must not fall below 7.2 volts during or after the thirty second discharge period. The CCA required is generally higher as engine displacement increases, depending also upon the starter current draw requirements.

RESERVE CAPACITY

The Reserve Capacity (RC) rating specifies the time (in minutes) it takes for battery terminal voltage to fall below 10.5 volts, at a discharge rate of 25 amperes. RC is determined with the battery fully-charged at 26.7° C (80° F). This rating estimates how long the battery might last after a charging system failure, under minimum electrical load.

AMPERE-HOURS

The Ampere-Hours (AH) rating specifies the current (in amperes) that a battery can deliver steadily for twenty hours, with the voltage in the battery not falling below 10.5 volts. This rating is also sometimes referred to as the twenty-hour discharge rating.

BATTERY MOUNTING

The battery is mounted in a molded plastic tray located in the left front corner of the engine compartment. A U-nut is held in a formation on each side of the battery tray. A holddown strap fits across the top of the battery case. To secure the battery in the tray, a bolt passes through the holddown strap on each side of the battery, and is threaded into the U-nut on each side of the battery tray.

The battery tray is secured to the inner fender shield with two bolts. The tray is also secured to the inner wheelhouse panel. A plate in the front of the tray has two studs, which pass through the wheelhouse panel from the top. A second plate in the wheelhouse has two studs that pass through the wheelhouse and into the rear of the tray from underneath. Nuts are used to secure each of the four exposed studs.

Models with the diesel engine option have a second battery tray located in the right front corner of the engine compartment. This tray, and its mounting method and hardware, is a mirror image of the standard equipment left battery tray.

A hole in the bottom of the left battery tray is fitted with a battery temperature sensor. Refer to Group 8C - Charging System for more information on the battery temperature sensor.

Models with an optional vehicle speed control system have a speed control servo mounting bracket secured to the battery tray bracket underneath the left battery tray. Refer to Group 8H - Vehicle Speed Control System for more information on the speed control servo and mounting.

When installing a battery, be certain that the holddown fasteners are tightened to the proper specifications. Improper holddown fastener tightness, whether too loose or too tight, can result in damage to the battery. See Battery in the Removal and Installation section of this group for the correct holddown fastener tightness specifications.

DIAGNOSIS AND TESTING

BATTERY

The battery must be completely charged and the top, posts, and terminal clamps should be properly cleaned before diagnostic procedures are performed. See Battery Charging in the Service Procedures section of this group for the proper charging procedures.

NOTE: Models equipped with the diesel engine option are equipped with two 12-volt batteries, connected in parallel (positive-to-positive/negative-to-negative). In order to ensure accurate diagnostic results, these batteries MUST be disconnected from each other, as well as from the vehicle electrical system, while being tested.

WARNING:

- **IF THE BATTERY SHOWS SIGNS OF FREEZING, LEAKING, LOOSE POSTS, OR LOW ELECTROLYTE LEVEL, DO NOT TEST, ASSIST-BOOST, OR CHARGE. THE BATTERY MAY ARC INTERNALLY AND EXPLODE. PERSONAL INJURY AND/OR VEHICLE DAMAGE MAY RESULT.**
- **EXPLOSIVE HYDROGEN GAS FORMS IN AND AROUND THE BATTERY. DO NOT SMOKE, USE FLAME, OR CREATE SPARKS NEAR THE BATTERY. PERSONAL INJURY AND/OR VEHICLE DAMAGE MAY RESULT.**
- **THE BATTERY CONTAINS SULFURIC ACID, WHICH IS POISONOUS AND CAUSTIC. AVOID CONTACT WITH THE SKIN, EYES, OR CLOTHING. IN THE EVENT OF CONTACT, FLUSH WITH WATER AND CALL A PHYSICIAN IMMEDIATELY. KEEP OUT OF THE REACH OF CHILDREN.**
- **IF THE BATTERY IS EQUIPPED WITH REMOVABLE CELL CAPS, BE CERTAIN THAT EACH OF THE CELL CAPS IS IN PLACE AND TIGHT BEFORE THE BATTERY IS RETURNED TO SERVICE. PERSONAL INJURY AND/OR VEHICLE DAMAGE MAY RESULT FROM LOOSE OR MISSING CELL CAPS.**

The condition of a battery is determined by two criteria:

1. **State-Of-Charge** - This can be determined by viewing the built-in test indicator, by checking the specific gravity of the electrolyte (hydrometer test), or by checking the battery voltage (open-circuit voltage test).
2. **Cranking Capacity** - This can be determined by performing a battery load test, which measures the ability of the battery to supply high-amperage current.

First, determine the battery state-of-charge. This can be done in one of three ways. If the battery has a built-in test indicator, view the test indicator to

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DIAGNOSIS AND TESTING (Continued)

determine the state-of-charge. If the battery has no test indicator, but has removable cell caps, perform the hydrometer test to determine the state-of-charge. If the cell caps are not removable, or a hydrometer is not available, perform the open-circuit voltage test to determine the state-of-charge.

The battery must be charged before proceeding with a load test if:

- The built-in test indicator has a black or dark color visible.
- The temperature corrected specific gravity is less than 1.235.
- The open-circuit voltage is less than 12.4 volts.

A battery that will not accept a charge is faulty, and must be replaced. Further testing is not required. A fully-charged battery must be load tested to determine its cranking capacity. A battery that is fully-charged, but does not pass the load test, is faulty and must be replaced.

NOTE: Completely discharged batteries may take several hours to accept a charge. See Charging A Completely Discharged Battery in the Service Procedures section of this group for more information.

A battery is fully-charged when:

- All cells are gassing freely during charging.
- A green color is visible in the sight glass of the built-in test indicator.
- Three corrected specific gravity tests, taken at one-hour intervals, indicate no increase in the specific gravity.
- Open-circuit voltage is 12.4 volts or greater.

BATTERY DIAGNOSIS

CONDITION	POSSIBLE CAUSES	CORRECTION
The battery seems weak or dead when attempting to start the engine.	1. The battery has an incorrect size or rating for this vehicle. 2. The battery is physically damaged. 3. The battery terminal connections are loose or corroded. 4. The battery is discharged. 5. The electrical system ignition-off draw is excessive. 6. The battery is faulty. 7. The starting system is faulty. 8. The charging system is faulty.	1. See the Specifications section of this group. Replace an incorrect battery with the correct battery. 2. Inspect the battery for loose terminal posts or a cracked and leaking case. Replace the battery, if damaged. 3. See Voltage Drop Test in the Diagnosis and Testing section of this group. Clean and tighten the battery terminal connections, if required. 4. Determine the battery state-of-charge. See Built-In Test Indicator, Hydrometer Test, or Open-Circuit Voltage Test in the Diagnosis and Testing section of this group. Charge the battery, if required. 5. See Ignition-Off Draw Test in the Diagnosis and Testing section of this group. Repair the electrical system, if required. 6. Determine the battery cranking capacity. See Load Test in the Diagnosis and Testing section of this group. Replace the battery, if required. 7. Determine if the starting system is performing to specifications. Refer to Group 8B - Starting Systems for more information. Repair the starting system, if required. 8. Determine if the charging system is performing to specifications. Refer to Group 8C - Charging Systems for more information. Repair the charging system, if required.

AUTHENTIC RESTORATION PRODUCT

DIAGNOSIS AND TESTING (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
The battery state-of-charge cannot be maintained.	1. The battery has an incorrect size or rating for this vehicle. 2. The battery terminal connections are loose or corroded. 3. The generator drive belt is loose or worn. 4. The electrical system ignition-off draw is excessive. 5. The battery is faulty. 6. The starting system is faulty. 7. The charging system is faulty. 8. Electrical loads exceed the output of the charging system. 9. Slow driving or prolonged idling with high-amperage draw systems in use.	1. See the Specifications section of this group. Replace an incorrect battery with the correct battery. 2. See Voltage Drop Test in the Diagnosis and Testing section of this group. Clean and tighten the battery terminal connections, if required. 3. Refer to Group 7 - Cooling Systems for more information. Replace or adjust the generator drive belt, if required. 4. See Ignition-Off Draw Test in the Diagnosis and Testing section of this group. Repair the electrical system, if required. 5. Determine the battery cranking capacity. See Load Test in the Diagnosis and Testing section of this group. Replace the battery, if required. 6. Determine if the starting system is performing to specifications. Refer to Group 8B - Starting Systems for more information. Repair the starting system, if required. 7. Determine if the charging system is performing to specifications. Refer to Group 8C - Charging Systems for more information. Repair the charging system, if required. 8. Inspect the vehicle for aftermarket electrical equipment which might cause excessive electrical loads. 9. Advise the vehicle operator, as required.
The battery will not accept a charge.	1. The battery is faulty.	1. See Battery Charging in the Service Procedures section of this group. Replace the faulty battery, if required.

ABNORMAL BATTERY DISCHARGING

Any of the following conditions can result in abnormal battery discharging:

1. Corroded or loose battery posts and terminal clamps.
2. A loose or worn generator drive belt.
3. Electrical loads that exceed the output of the charging system. This can be due to equipment installed after manufacture, or repeated short trip use.
4. Slow driving speeds (heavy traffic conditions) or prolonged idling, with high-amperage draw systems in use.
5. A faulty circuit or component causing excessive ignition-off draw. See Ignition-Off Draw Test in the Diagnosis and Testing section of this group for more information.
6. A faulty or incorrect charging system component. Refer to Group 8C - Charging System for more information.
7. A faulty or incorrect battery.

BUILT-IN TEST INDICATOR

A test indicator (hydrometer) built into the top of the battery case provides visual information for battery testing (Fig. 2). Like a hydrometer, the built-in test indicator measures the specific gravity of the electrolyte. The test indicator reveals the battery state-of-charge; however, it will not reveal the cranking capacity of the battery. A load test must be performed to determine the battery cranking capacity. See Load Test in the Diagnosis and Testing section of this group for more information.

DIAGNOSIS AND TESTING (Continued)

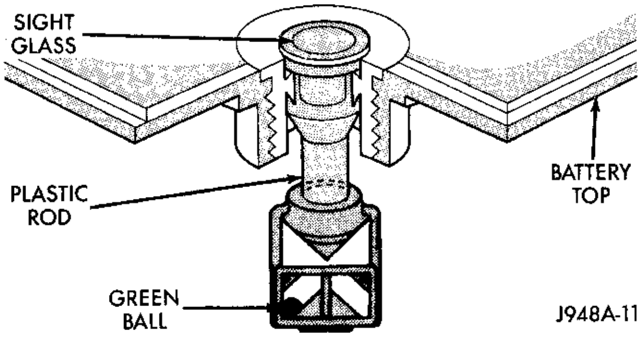

Fig. 2 Built-In Test Indicator

WARNING:

- **IF THE BATTERY SHOWS SIGNS OF FREEZING, LEAKING, LOOSE POSTS, OR LOW ELECTROLYTE LEVEL, DO NOT TEST, ASSIST-BOOST, OR CHARGE. THE BATTERY MAY ARC INTERNALLY AND EXPLODE. PERSONAL INJURY AND/OR VEHICLE DAMAGE MAY RESULT.**
- **EXPLOSIVE HYDROGEN GAS FORMS IN AND AROUND THE BATTERY. DO NOT SMOKE, USE FLAME, OR CREATE SPARKS NEAR THE BATTERY. PERSONAL INJURY AND/OR VEHICLE DAMAGE MAY RESULT.**
- **THE BATTERY CONTAINS SULFURIC ACID, WHICH IS POISONOUS AND CAUSTIC. AVOID CONTACT WITH THE SKIN, EYES, OR CLOTHING. IN THE EVENT OF CONTACT, FLUSH WITH WATER AND CALL A PHYSICIAN IMMEDIATELY. KEEP OUT OF THE REACH OF CHILDREN.**
- **IF THE BATTERY IS EQUIPPED WITH REMOVABLE CELL CAPS, BE CERTAIN THAT EACH OF THE CELL CAPS IS IN PLACE AND TIGHT BEFORE THE BATTERY IS RETURNED TO SERVICE. PERSONAL INJURY AND/OR VEHICLE DAMAGE MAY RESULT FROM LOOSE OR MISSING CELL CAPS.**

Before testing, visually inspect the battery for any damage (a cracked case or cover, loose posts, etc.) that would cause the battery to be faulty. In order to obtain correct indications from the built-in test indicator, it is important that the battery be level and have a clean sight glass. Additional light may be required to view the indicator. **Do not use open flame as a source of additional light.**

To read the built-in test indicator, look into the sight glass and note the color of the indicator (Fig. 3). Refer to the following description, as the color indicates:

- **Green** - indicates 75% to 100% state-of-charge. The battery is adequately charged for further testing or return to use. If the starter will not crank for a minimum of fifteen seconds with a fully-charged battery, the battery must be load tested. See Load Test in the Diagnosis and Testing section of this group for more information.
- **Black or Dark** - indicates 0% to 75% state-of-charge. The battery is inadequately charged and must be charged until a green indication is visible in the sight glass (12.4 volts or more), before the battery is tested further or returned to service. See Battery Charging in the Service Procedures section of this group for more information. Also see Abnormal Battery Discharging in the Diagnosis and Testing section of this group for possible causes of the discharged condition.
- **Clear or Bright** - indicates a low electrolyte level. The electrolyte level in the battery is below the test indicator. A maintenance-free battery with non-removable cell caps must be replaced if the electrolyte level is low. Water must be added to a low-maintenance battery with removable cell caps before it is charged. See Battery Charging in the Service Procedures section of this group for more information. A low electrolyte level may be caused by an overcharging condition. Refer to Group 8C - Charging System to diagnose an overcharging condition.

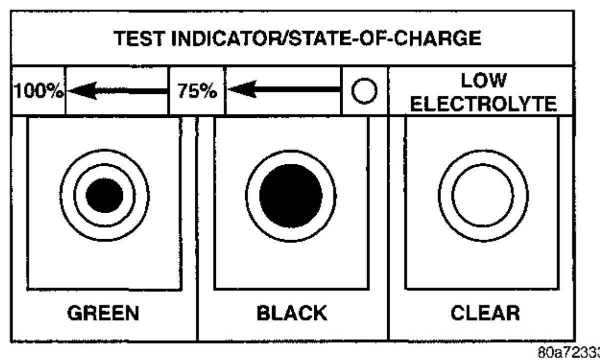

Fig. 3 Built-In Test Indicator Sight Glass

HYDROMETER TEST

The hydrometer test reveals the battery state-of-charge by measuring the specific gravity of the electrolyte. **This test cannot be performed on maintenance-free batteries with non-removable cell caps.** If the battery has non-removable cell caps, see Built-In Test Indicator or Open-Circuit Voltage Test in the Diagnosis and Testing section of this group.

Specific gravity is a comparison of the density of the electrolyte to the density of pure water. Pure water has a specific gravity of 1.000, and sulfuric acid has a specific gravity of 1.835. Sulfuric acid makes up approximately 35% of the electrolyte by weight, or 24% by volume.

In a fully-charged battery the electrolyte will have a temperature-corrected specific gravity of 1.260 to 1.290. However, a specific gravity of 1.235 or above is

DIAGNOSIS AND TESTING (Continued)

satisfactory for battery load testing and/or return to service.

WARNING:
• IF THE BATTERY SHOWS SIGNS OF FREEZING, LEAKING, LOOSE POSTS, OR LOW ELECTROLYTE LEVEL, DO NOT TEST, ASSIST-BOOST, OR CHARGE. THE BATTERY MAY ARC INTERNALLY AND EXPLODE. PERSONAL INJURY AND/OR VEHICLE DAMAGE MAY RESULT.
• EXPLOSIVE HYDROGEN GAS FORMS IN AND AROUND THE BATTERY. DO NOT SMOKE, USE FLAME, OR CREATE SPARKS NEAR THE BATTERY. PERSONAL INJURY AND/OR VEHICLE DAMAGE MAY RESULT.
• THE BATTERY CONTAINS SULFURIC ACID, WHICH IS POISONOUS AND CAUSTIC. AVOID CONTACT WITH THE SKIN, EYES, OR CLOTHING. IN THE EVENT OF CONTACT, FLUSH WITH WATER AND CALL A PHYSICIAN IMMEDIATELY. KEEP OUT OF THE REACH OF CHILDREN.
• IF THE BATTERY IS EQUIPPED WITH REMOVABLE CELL CAPS, BE CERTAIN THAT EACH OF THE CELL CAPS IS IN PLACE AND TIGHT BEFORE THE BATTERY IS RETURNED TO SERVICE. PERSONAL INJURY AND/OR VEHICLE DAMAGE MAY RESULT FROM LOOSE OR MISSING CELL CAPS.

Before testing, visually inspect the battery for any damage (a cracked case or cover, loose posts, etc.) that would cause the battery to be faulty. Then remove the cell caps and check the electrolyte level. Add distilled water if the electrolyte level is below the top of the battery plates.

Refer to the instructions supplied with the hydrometer for recommendations on the correct use of the hydrometer. Remove only enough electrolyte from the battery cell so that the float is off the bottom of the hydrometer barrel with pressure on the bulb released.

CAUTION: Exercise care when inserting the tip of the hydrometer into a cell to avoid damaging the plate separators. Damaged plate separators can cause early battery failure.

To read the hydrometer correctly, hold it with the top surface of the electrolyte at eye level (Fig. 4). Hydrometer floats are generally calibrated to indicate the specific gravity correctly only at 26.7° C (80° F). When testing the specific gravity at any other temperature, a correction factor is required.

The correction factor is approximately a specific gravity value of 0.004, referred to as four points of specific gravity. For each 5.5° C above 26.7° C (10° F above 80° F), add four points. For each 5.5° C below 26.7° C (10° F below 80° F), subtract four points.

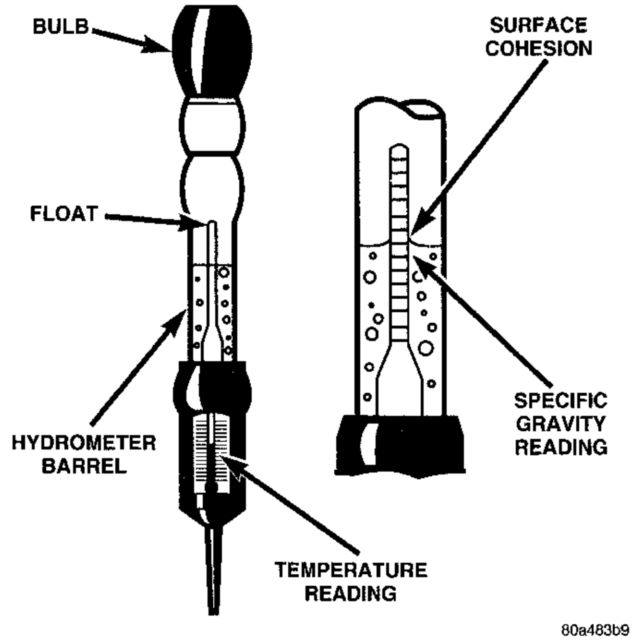

Fig. 4 Hydrometer - Typical

Always correct the specific gravity for temperature variation. Test the specific gravity of the electrolyte in each battery cell.

EXAMPLE: A battery is tested at -12.2° C (10° F) and has a specific gravity of 1.240. Determine the actual specific gravity as follows:

(1) Determine the number of degrees above or below 26.7° C (80° F):

`26.6° C - -12.2° C = 38.8° C (80° F - 10° F = 70° F)`

(2) Divide the result from Step 1 by 5.5 (10):

`38.8° C ÷ 5.5 = 7 (70° F ÷ 10 = 7)`

(3) Multiply the result from Step 2 by the temperature correction factor (0.004):

`7 X 0.004 = 0.028`

(4) The temperature at testing was below 26.7° C (80° F); therefore, the temperature correction factor is subtracted:

`1.240 - 0.028 = 1.212`

The corrected specific gravity of the battery in this example is 1.212.

If the specific gravity of all cells is above 1.235, but the variation between cells is more than fifty points (0.050), the battery should be replaced. If the specific gravity of one or more cells is less than 1.235, charge the battery at a rate of approximately five amperes.

Continue charging the battery until three consecutive specific gravity tests, taken at one-hour intervals, are constant. If the cell specific gravity variation is more than fifty points (0.050) at the end of the charge period, replace the battery.

When the specific gravity of all cells is above 1.235, and the cell variation is less than fifty points (0.050),

AUTHENTIC RESTORATION

DIAGNOSIS AND TESTING (Continued)

the battery may be load tested to determine its cranking capacity. See Load Test in the Diagnosis and Testing section of this group for more information.

OPEN-CIRCUIT VOLTAGE TEST

A battery open-circuit voltage (no load) test will show the state-of-charge of a battery. This test can be used in place of the hydrometer test when a hydrometer is not available, or for maintenance-free batteries with non-removable cell caps.

WARNING:

- **IF THE BATTERY SHOWS SIGNS OF FREEZING, LEAKING, LOOSE POSTS, OR LOW ELECTROLYTE LEVEL, DO NOT TEST, ASSIST-BOOST, OR CHARGE. THE BATTERY MAY ARC INTERNALLY AND EXPLODE. PERSONAL INJURY AND/OR VEHICLE DAMAGE MAY RESULT.**
- **EXPLOSIVE HYDROGEN GAS FORMS IN AND AROUND THE BATTERY. DO NOT SMOKE, USE FLAME, OR CREATE SPARKS NEAR THE BATTERY. PERSONAL INJURY AND/OR VEHICLE DAMAGE MAY RESULT.**
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- **IF THE BATTERY IS EQUIPPED WITH REMOVABLE CELL CAPS, BE CERTAIN THAT EACH OF THE CELL CAPS IS IN PLACE AND TIGHT BEFORE THE BATTERY IS RETURNED TO SERVICE. PERSONAL INJURY AND/OR VEHICLE DAMAGE MAY RESULT FROM LOOSE OR MISSING CELL CAPS.**

Before proceeding with this test, completely charge the battery. See Battery Charging in the Service Procedures section of this group for the proper charging procedures.

(1) Before measuring the open-circuit voltage, the surface charge must be removed from the battery. Turn on the head lamps for fifteen seconds, then allow up to five minutes for the battery voltage to stabilize.

NOTE: Models equipped with the diesel engine option are equipped with two 12-volt batteries, connected in parallel (positive-to-positive/negative-to-negative). In order to ensure accurate diagnostic results, these batteries MUST be disconnected from each other, as well as from the vehicle electrical system, when being tested.

(2) Disconnect and isolate both battery cables, negative cable first.

(3) Using a voltmeter connected to the battery posts (refer to the instructions provided with the voltmeter), measure the open-circuit voltage (Fig. 5).

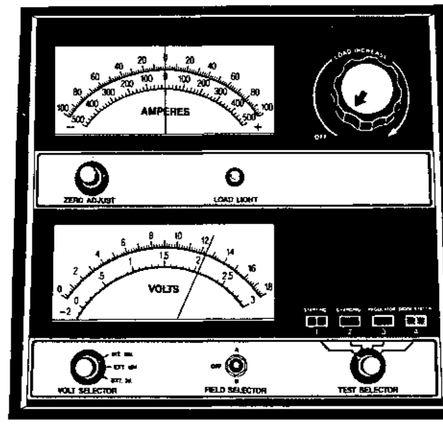

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Fig. 5 Testing Open-Circuit Voltage - Typical

See the Open-Circuit Voltage chart. This voltage reading will indicate the battery state-of-charge, but will not reveal its cranking capacity. If a battery has an open-circuit voltage reading of 12.4 volts or greater, it may be load tested to reveal its cranking capacity. See Load Test in the Diagnosis and Testing section of this group for more information.

Open Circuit Voltage	
Open Circuit Volts	Charge Percentage
11.7 volts or less	0%
12.0 volts	25%
12.2 volts	50%
12.4 volts	75%
12.6 volts or more	100%

LOAD TEST

A battery load test will verify the battery cranking capacity. The test is based on the Cold Cranking Amperage (CCA) rating of the battery. Refer to the battery label, or see the Battery Classifications and Ratings chart in the Specifications section of this group for the CCA rating of the factory-installed battery.

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DIAGNOSIS AND TESTING (Continued)

WARNING:

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• EXPLOSIVE HYDROGEN GAS FORMS IN AND AROUND THE BATTERY. DO NOT SMOKE, USE FLAME, OR CREATE SPARKS NEAR THE BATTERY. PERSONAL INJURY AND/OR VEHICLE DAMAGE MAY RESULT.

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• IF THE BATTERY IS EQUIPPED WITH REMOVABLE CELL CAPS, BE CERTAIN THAT EACH OF THE CELL CAPS IS IN PLACE AND TIGHT BEFORE THE BATTERY IS RETURNED TO SERVICE. PERSONAL INJURY AND/OR VEHICLE DAMAGE MAY RESULT FROM LOOSE OR MISSING CELL CAPS.

Before proceeding with this test, completely charge the battery. See Battery Charging in the Service Procedures section of this group for the proper charging procedures.

NOTE: Models equipped with the diesel engine option are equipped with two 12-volt batteries, connected in parallel (positive-to-positive/negative-to-negative). In order to ensure accurate diagnostic results, these batteries MUST be disconnected from each other, as well as from the vehicle electrical system, when being tested.

(1) Disconnect and isolate both battery cables, negative cable first. The battery top and posts should be clean.

(2) Connect a suitable volt-ammeter-load tester (Fig. 6) to the battery posts (Fig. 7). Refer to the operating instructions provided with the tester being used. Check the open-circuit voltage (no load) of the battery. See Open-Circuit Voltage Test in the Diagnosis and Testing section of this group for the procedures. The battery open-circuit voltage must be 12.4 volts or greater.

(3) Rotate the load control knob (carbon pile rheostat) to apply a 300 ampere load to the battery for fifteen seconds, then return the control knob to the Off position (Fig. 8). This will remove the surface charge from the battery.

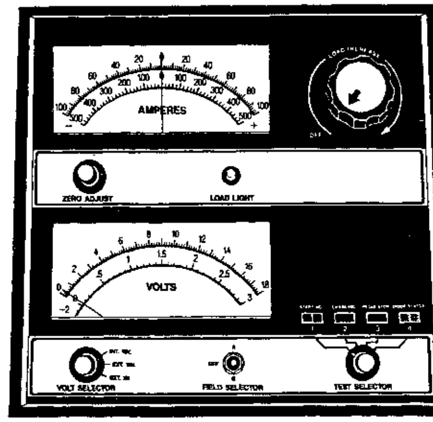

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Fig. 6 Volt-Ammeter-Load Tester - Typical

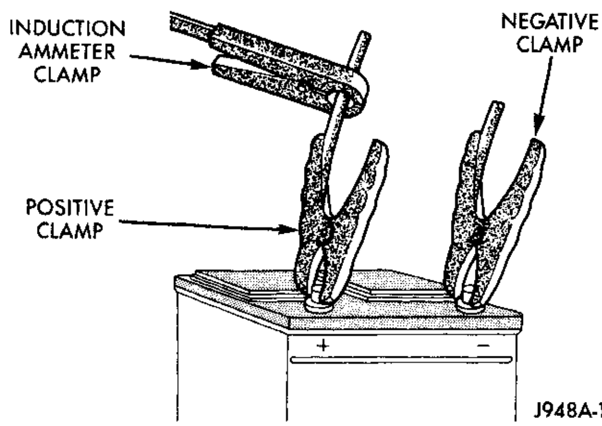

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Fig. 7 Volt-Ammeter-Load Tester Connections - Typical

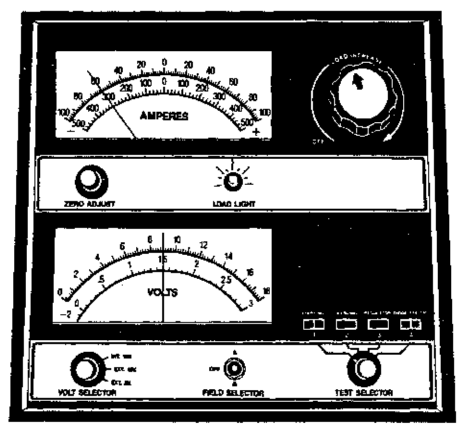

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Fig. 8 Remove Surface Charge from Battery - Typical

(4) Allow the battery to stabilize to open-circuit voltage. It may take up to five minutes for the battery voltage to stabilize.

DIAGNOSIS AND TESTING (Continued)

(5) Rotate the load control knob to maintain a load equal to 50% of the CCA rating of the battery (Fig. 9). After fifteen seconds, record the loaded voltage reading, then return the load control knob to the Off position.

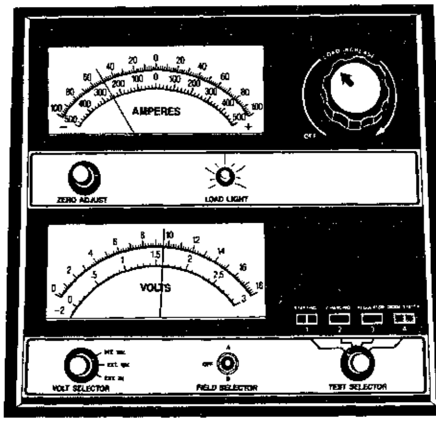

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Fig. 9 Load 50% CCA Rating - Note Voltage - Typical

(6) The voltage drop will vary with the battery temperature at the time of the load test. The battery temperature can be estimated by using the ambient temperature during the past several hours. If the battery has been charged, boosted, or loaded a few minutes prior to the test, the battery will be somewhat warmer. See the Load Test Temperature chart for the proper loaded voltage reading.

Load Test Temperature		
Minimum Voltage	Temperature	
	°F	°C
9.6 volts	70° and above	21° and above
9.5 volts	60°	16°
9.4 volts	50°	10°
9.3 volts	40°	4°
9.1 volts	30°	-1°
8.9 volts	20°	-7°
8.7 volts	10°	-12°
8.5 volts	0°	-18°

(7) If the voltmeter reading falls below 9.6 volts, at a minimum battery temperature of 21° C (70° F), the battery is faulty and must be replaced.

IGNITION-OFF DRAW TEST

Ignition-Off Draw (IOD) refers to power being drained from the battery with the ignition switch in the Off position. A normal vehicle electrical system will draw from five to twenty-five milliamperes (0.005 to 0.025 ampere) with the ignition switch in the Off position, and all non-ignition controlled circuits in proper working order. The twenty-five milliamperes are needed to enable the memory functions for the Powertrain Control Module (PCM), digital clock, electronically tuned radio, and other modules which may vary with the vehicle equipment.

A vehicle that has not been operated for approximately twenty days, may discharge the battery to an inadequate level. When a vehicle will not be used for twenty days or more (stored), remove the IOD fuse from the fuseblock module. This will reduce battery discharging.

Excessive IOD can be caused by:

- Electrical items left on
- Faulty or improperly adjusted switches
- Faulty or shorted electronic modules and components
- An internally shorted generator
- Intermittent shorts in the wiring.

If the IOD is over twenty-five milliamperes, the problem must be found and corrected before replacing a battery. In most cases, the battery can be charged and returned to service after the excessive IOD condition has been corrected.

DIAGNOSIS

NOTE: When testing a diesel engine-equipped vehicle (dual batteries), do not check the IOD between batteries. One battery may be at a higher state-of-charge than the other, which will cause a high IOD between the batteries. Remove the negative cable from the passenger side battery negative terminal post prior to performing the IOD diagnosis.

(1) Verify that all electrical accessories are off. Turn off all lamps, remove the ignition key, and close all doors. If the vehicle is equipped with a illuminated entry system or electronically tuned radio, allow the electronic timer function of these systems to automatically shut off (time out). This may take up to three minutes.

(2) Determine that the underhood lamp is operating properly, then unplug the lamp wire harness connector or remove the lamp bulb.

(3) Disconnect the battery negative cable.

(4) Set an electronic digital multi-meter to its highest amperage scale. Connect the multi-meter between the disconnected battery negative cable clamp and the battery negative terminal post. Make sure that the doors remain closed so that the illuminated entry system is not activated. The multi-meter amperage reading may remain high for up to three minutes, or may not give any reading at all while set in the highest amperage scale, depending upon the electrical equipment on the vehicle. The multi-meter leads must be securely clamped to the battery negative cable clamp and the battery negative terminal

DIAGNOSIS AND TESTING (Continued)

post. If continuity between the battery negative terminal post and the negative cable clamp is lost during any part of the IOD test, the electronic timer function will be activated and all of the tests will have to be repeated.

(5) After about three minutes, the high-amperage IOD reading on the multi-meter should become very low or nonexistent, depending upon the electrical equipment on the vehicle. If the amperage reading remains high, remove each fuse or circuit breaker (refer to Group 8W - Wiring Diagrams for more information) until the amperage reading becomes very low, or nonexistent. This will isolate each circuit and identify the source of the high-amperage IOD. If the amperage reading remains high after disconnecting each fuse and circuit breaker, unplug the wire harness connector from the generator. If the amperage reading now becomes very low or nonexistent, refer to Group 8C - Charging System to diagnose the faulty charging system. After the high-amperage IOD has been corrected, switch the multi-meter to progressively lower amperage scales and, if necessary, repeat the fuse and circuit breaker removal process to identify and correct the sources of excessive IOD. It is now safe to select the lowest milliampere scale of the multi-meter to check the low-amperage IOD.

CAUTION: Do not open any doors, or turn on any electrical accessories with the lowest milliampere scale selected, or the multi-meter may be damaged.

(6) Observe the multi-meter reading. The low-amperage IOD should not exceed twenty-five milliamperes (0.025 ampere). If the draw exceeds twenty-five milliamperes, isolate each circuit by removing the circuit breakers and fuses. The multi-meter reading will drop to within the acceptable limit when the source of the excessive draw is disconnected. Repair this circuit as required; whether a wiring short, incorrect switch adjustment, or a component failure is at fault.

VOLTAGE DROP TEST

The voltage drop test will determine if there is excessive resistance in the battery terminal connections or the battery cables. When performing these tests, it is important to remember that the voltage drop is giving an indication of the resistance between the two points at which the voltmeter probes are attached.

Example: When testing the resistance of the battery positive cable, touch the voltmeter leads to the battery positive cable clamp and the cable connector at the starter solenoid. If you probe the battery positive terminal post and the cable connector at the starter solenoid, you are reading the combined voltage drop in the battery positive cable clamp-to-terminal post connection and the battery positive cable.

WARNING:

- **IF THE BATTERY SHOWS SIGNS OF FREEZING, LEAKING, LOOSE POSTS, OR LOW ELECTROLYTE LEVEL, DO NOT TEST, ASSIST-BOOST, OR CHARGE. THE BATTERY MAY ARC INTERNALLY AND EXPLODE. PERSONAL INJURY AND/OR VEHICLE DAMAGE MAY RESULT.**
- **EXPLOSIVE HYDROGEN GAS FORMS IN AND AROUND THE BATTERY. DO NOT SMOKE, USE FLAME, OR CREATE SPARKS NEAR THE BATTERY. PERSONAL INJURY AND/OR VEHICLE DAMAGE MAY RESULT.**
- **THE BATTERY CONTAINS SULFURIC ACID, WHICH IS POISONOUS AND CAUSTIC. AVOID CONTACT WITH THE SKIN, EYES, OR CLOTHING. IN THE EVENT OF CONTACT, FLUSH WITH WATER AND CALL A PHYSICIAN IMMEDIATELY. KEEP OUT OF THE REACH OF CHILDREN.**
- **IF THE BATTERY IS EQUIPPED WITH REMOVABLE CELL CAPS, BE CERTAIN THAT EACH OF THE CELL CAPS IS IN PLACE AND TIGHT BEFORE THE BATTERY IS RETURNED TO SERVICE. PERSONAL INJURY AND/OR VEHICLE DAMAGE MAY RESULT FROM LOOSE OR MISSING CELL CAPS.**

The following operation will require a voltmeter accurate to 1/10 (0.10) volt. Before performing the tests, be certain the following procedures are accomplished:

WARNING: MODELS EQUIPPED WITH THE DIESEL ENGINE OPTION ALSO HAVE AN AUTOMATIC SHUTDOWN (ASD) RELAY LOCATED IN THE POWER DISTRIBUTION CENTER (PDC). HOWEVER, REMOVAL OF THE ASD RELAY MAY NOT PREVENT THE DIESEL ENGINE FROM STARTING. BE CERTAIN TO UNPLUG THE FUEL SHUTDOWN SOLENOID WIRE HARNESS CONNECTOR. FAILURE TO DO SO MAY RESULT IN PERSONAL INJURY.

- Battery is fully-charged. See Battery in the Diagnosis and Testing section of this group for more information.
- Fully engage the parking brake.
- If the vehicle is equipped with an automatic transmission, place the gearshift selector lever in the Park position. If the vehicle is equipped with a manual transmission, place the gearshift selector lever in the Neutral position and fully depress the clutch pedal.
- Unplug the Automatic ShutDown (ASD) relay to prevent a gasoline engine from starting. The ASD relay is located in the Power Distribution Center (PDC). Refer to the PDC label for ASD relay identification and location. To prevent a diesel engine from starting, unplug the fuel shutdown solenoid wire harness connector (Fig. 10).

DIAGNOSIS AND TESTING (Continued)

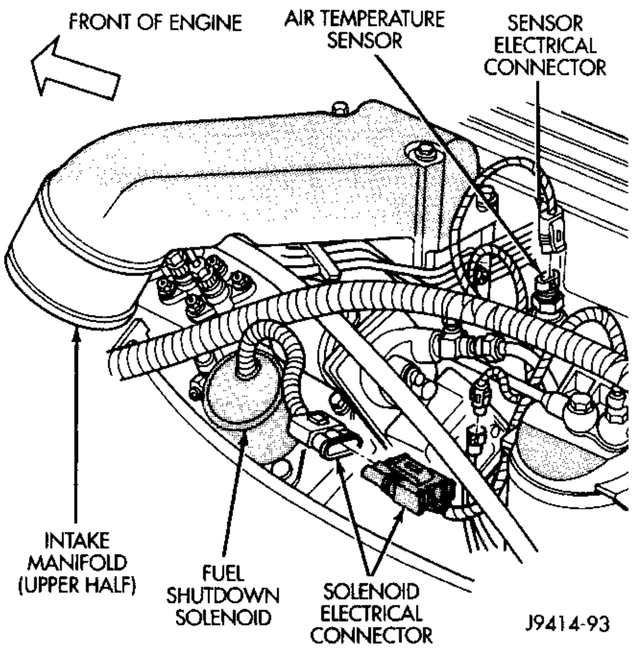

Fig. 10 Fuel Shutdown Solenoid Connector - Diesel Engine

(1) Connect the positive lead of the voltmeter to the battery negative terminal post. Connect the negative lead of the voltmeter to the battery negative cable clamp (Fig. 11). Rotate and hold the ignition switch in the Start position. Observe the voltmeter. If voltage is detected, correct the poor contact between the cable clamp and the terminal post.

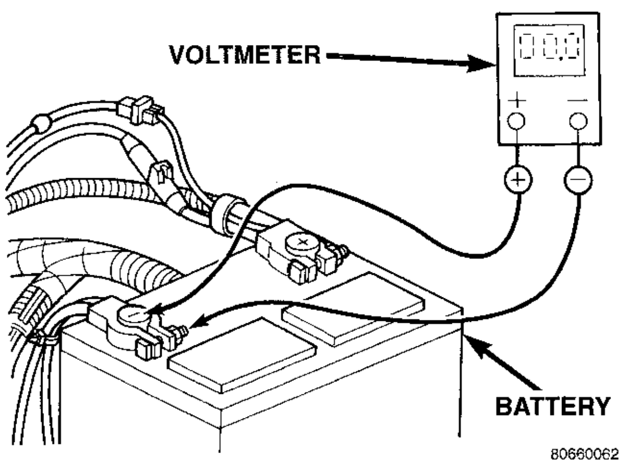

Fig. 11 Test Battery Negative Connection Resistance - Typical

(2) Connect the positive lead of the voltmeter to the battery positive terminal post. Connect the negative lead of the voltmeter to the battery positive cable clamp (Fig. 12). Rotate and hold the ignition switch in the Start position. Observe the voltmeter. If voltage is detected, correct the poor contact between the cable clamp and the terminal post.

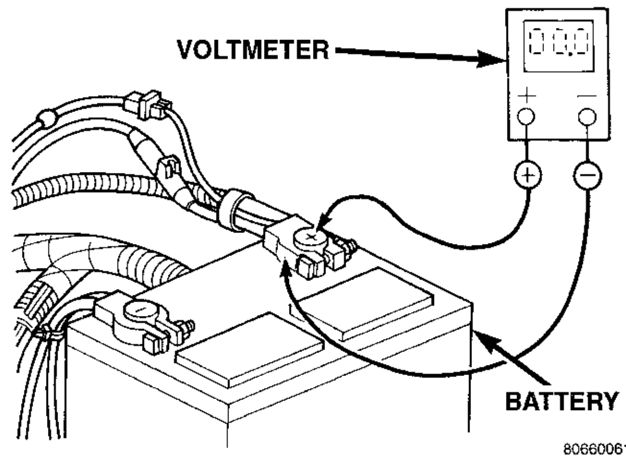

Fig. 12 Test Battery Positive Connection Resistance - Typical

(3) Connect the voltmeter to measure between the battery positive terminal post and the starter solenoid battery terminal stud (Fig. 13). Rotate and hold the ignition switch in the Start position. Observe the voltmeter. If the reading is above 0.2 volt, clean and tighten the battery cable connection at the solenoid. Repeat the test. If the reading is still above 0.2 volt, replace the faulty battery positive cable.

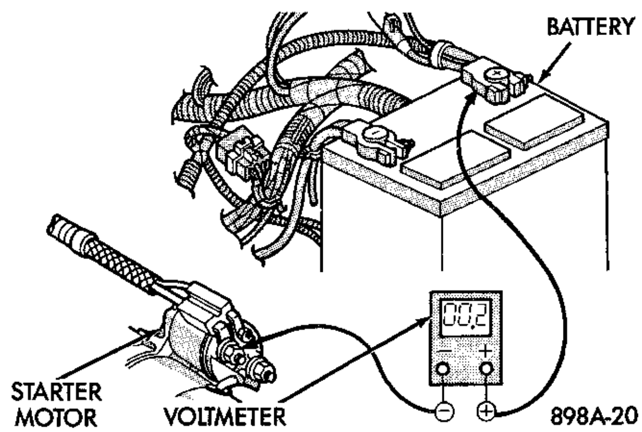

Fig. 13 Test Battery Positive Cable Resistance - Typical

(4) Connect the voltmeter to measure between the battery negative terminal post and a good clean ground on the engine block (Fig. 14). Rotate and hold the ignition switch in the Start position. Observe the voltmeter. If the reading is above 0.2 volt, clean and tighten the battery negative cable attachment on the engine block. Repeat the test. If the reading is still above 0.2 volt, replace the faulty battery negative cable.

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DIAGNOSIS AND TESTING (Continued)

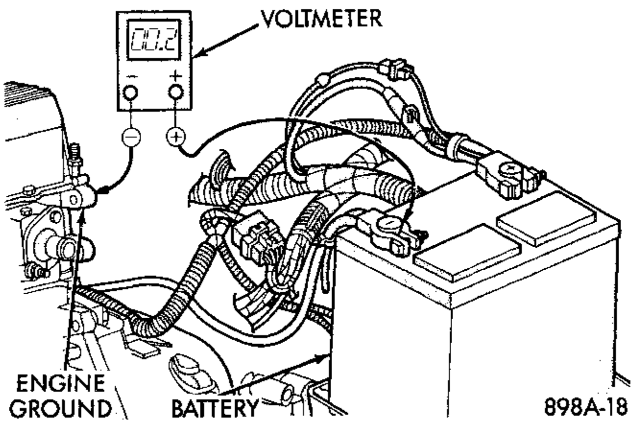


Fig. 14 Test Ground Circuit Resistance - Typical

SERVICE PROCEDURES

BATTERY CHARGING

A battery is fully-charged when:

- All cells are gassing freely during battery charging.
- A green color is visible in the sight glass of the built-in test indicator.
- Three corrected specific gravity tests, taken at one-hour intervals, indicate no increase in the specific gravity.
- Open-circuit voltage is 12.4 volts or above.

WARNING:

- **IF THE BATTERY SHOWS SIGNS OF FREEZING, LEAKING, LOOSE POSTS, OR LOW ELECTROLYTE LEVEL, DO NOT TEST, ASSIST-BOOST, OR CHARGE. THE BATTERY MAY ARC INTERNALLY AND EXPLODE. PERSONAL INJURY AND/OR VEHICLE DAMAGE MAY RESULT.**
- **EXPLOSIVE HYDROGEN GAS FORMS IN AND AROUND THE BATTERY. DO NOT SMOKE, USE FLAME, OR CREATE SPARKS NEAR THE BATTERY. PERSONAL INJURY AND/OR VEHICLE DAMAGE MAY RESULT.**
- **THE BATTERY CONTAINS SULFURIC ACID, WHICH IS POISONOUS AND CAUSTIC. AVOID CONTACT WITH THE SKIN, EYES, OR CLOTHING. IN THE EVENT OF CONTACT, FLUSH WITH WATER AND CALL A PHYSICIAN IMMEDIATELY. KEEP OUT OF THE REACH OF CHILDREN.**
- **IF THE BATTERY IS EQUIPPED WITH REMOVABLE CELL CAPS, BE CERTAIN THAT EACH OF THE CELL CAPS IS IN PLACE AND TIGHT BEFORE THE BATTERY IS RETURNED TO SERVICE. PERSONAL INJURY AND/OR VEHICLE DAMAGE MAY RESULT FROM LOOSE OR MISSING CELL CAPS.**

CAUTION:

- **Always disconnect and isolate the battery negative cable before charging a battery. Do not exceed sixteen volts while charging a battery. Damage to the vehicle electrical system components may result.**
- **Battery electrolyte will bubble inside the battery case during normal battery charging. Electrolyte boiling or being discharged from the battery vents indicates a battery overcharging condition. Immediately reduce the charging rate or turn off the charger to evaluate the battery condition. Damage to the battery may result from overcharging.**
- **The battery should not be hot to the touch. If the battery feels hot to the touch, turn off the charger and let the battery cool before continuing the charging operation. Damage to the battery may result.**

NOTE: Models equipped with the diesel engine option are equipped with two 12-volt batteries, connected in parallel (positive-to-positive/negative-to-negative). The secondary battery, on the passenger side, is dedicated to providing current for the operation of the intake manifold air heater. The primary battery, on the driver side, is dedicated to all other vehicle electrical requirements. In order to ensure proper charging of each battery, these batteries MUST be disconnected from each other, as well as from the vehicle electrical system, while being charged.

Some battery chargers are equipped with polarity-sensing circuitry. This circuitry protects the charger and/or the battery from being damaged if they are improperly connected. If the battery state-of-charge is too low for the polarity-sensing circuitry to detect, the charger will not operate. This makes it appear that the battery will not accept charging current. Refer to the instructions provided with the battery charger to bypass the polarity-sensing circuitry.

After the battery has been charged to 12.4 volts or greater, perform a load test to determine the battery cranking capacity. If the battery will endure a load test, return the battery to use. If the battery will not endure a load test, it is faulty and must be replaced.

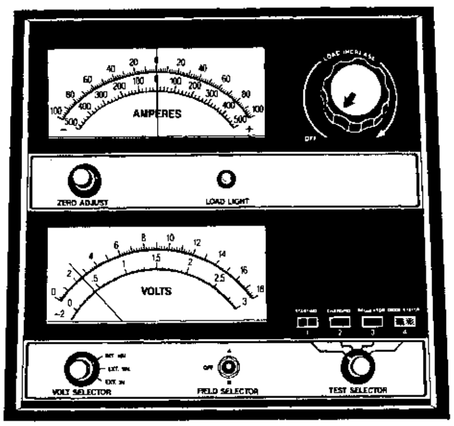
Clean and inspect the battery holddowns, tray, terminals, posts, and top before completing service. See Battery in the Removal and Installation section of this group for the cleaning and inspection procedures.

SERVICE PROCEDURES (Continued)

CHARGING A COMPLETELY DISCHARGED BATTERY

The following procedure should be used to recharge a completely discharged battery. Unless this procedure is properly followed, a good battery may be needlessly replaced.

(1) Measure the voltage at the battery posts with a voltmeter, accurate to 1/10 (0.10) volt (Fig. 15). If the reading is below ten volts, the charge current will be low. It could take some time before the battery accepts a current greater than a few milliamperes. Such low current may not be detectable on the ammeters built into many chargers.



898A-12

Fig. 15 Voltmeter Accurate to 1/10 Volt Connected - Typical

(2) Disconnect and isolate the battery negative cable. Connect the battery charger leads. Some battery chargers are equipped with polarity-sensing circuitry. This circuitry protects the charger and/or the battery from being damaged if they are improperly connected. If the battery state-of-charge is too low for the polarity-sensing circuitry to detect, the charger will not operate. This makes it appear that the battery will not accept charging current. Refer to the instructions provided with the battery charger to bypass the polarity-sensing circuitry.

(3) Battery chargers vary in the amount of voltage and current they provide. The amount of time required for a battery to accept measurable charger current at various voltages is shown in the Charge Rate chart. If the charge current is still not measurable at the end of the charging time, the battery is faulty and must be replaced. If the charge current is measurable during the charging time, the battery may be good and the charging should be completed in the normal manner.

Charge Rate	
Voltage	**Hours**
16.0 volts maximum	up to 4 hours
14.0 to 15.9 volts	up to 8 hours
13.9 volts or less	up to 16 hours

CHARGING TIME REQUIRED

The time required to charge a battery will vary, depending upon the following factors:

- **Battery Capacity** - A completely discharged heavy-duty battery requires twice the charging time of a small capacity battery.
- **Temperature** - A longer time will be needed to charge a battery at -18° C (0° F) than at 27° C (80° F). When a fast charger is connected to a cold battery, the current accepted by the battery will be very low at first. As the battery warms, it will accept a higher charging current rate (amperage).
- **Charger Capacity** - A charger that supplies only five amperes will require a longer charging time. A charger that supplies twenty amperes or more will require a shorter charging time.
- **State-Of-Charge** - A completely discharged battery requires more charging time than a partially discharged battery. Electrolyte is nearly pure water in a completely discharged battery. At first, the charging current (amperage) will be low. As the battery charges, the specific gravity of the electrolyte will gradually rise.

WARNING: NEVER EXCEED TWENTY AMPERES WHEN CHARGING A COLD (-1° C/30° F) BATTERY. THE BATTERY MAY ARC INTERNALLY AND EXPLODE. PERSONAL INJURY AND/OR VEHICLE DAMAGE MAY RESULT.

BATTERY CHARGING TIMETABLE

CHARGING AMPERAGE	5 AMPERES	10 AMPERES	20 AMPERES
OPEN CIRCUIT VOLTAGE	HOURS CHARGING AT 21° C (70° F)		
12.25 to 12.39	6 hours	3 hours	1.5 hours
12.00 to 12.24	8 hours	4 hours	2 hours
11.95 to 11.99	12 hours	6 hours	3 hours
10.00 to 11.94	14 hours	7 hours	3.5 hours
less than 10.00	See Charging Completely Discharged Battery		

REMOVAL AND INSTALLATION

BATTERY

(1) Turn the ignition switch to the Off position. Make sure all electrical accessories are turned off.

(2) Loosen the cable terminal clamps and disconnect both battery cables, negative cable first. If necessary, use a puller to remove the terminal clamps from the battery posts (Fig. 16).

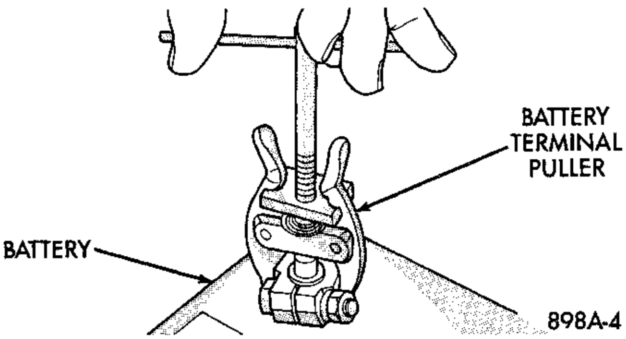


Fig. 16 Remove Battery Cable Terminal Clamp - Typical

(3) Inspect the cable terminal clamps for corrosion and damage. Remove any corrosion using a wire brush or a post and terminal cleaning tool, and a sodium bicarbonate (baking soda) and warm water cleaning solution (Fig. 17). Replace any cable that has damaged or deformed terminal clamps.

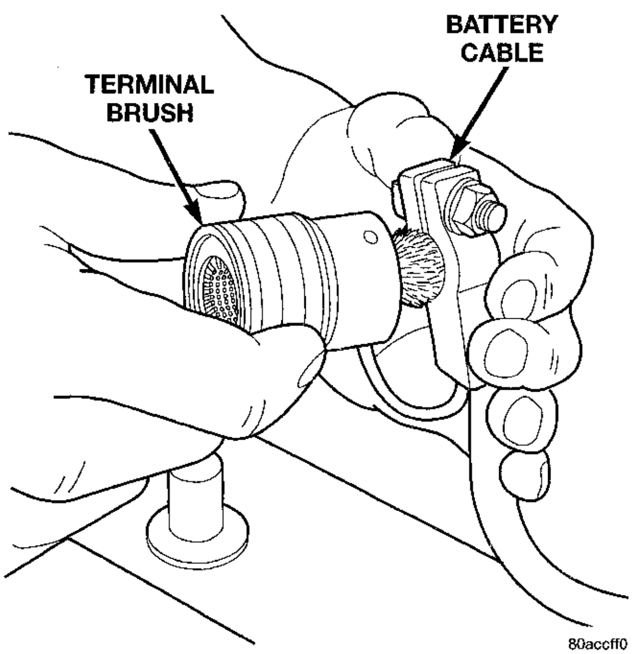


Fig. 17 Clean Battery Cable Terminal Clamp - Typical

WARNING: WEAR A SUITABLE PAIR OF RUBBER GLOVES (NOT THE HOUSEHOLD TYPE) WHEN REMOVING A BATTERY BY HAND. SAFETY GLASSES SHOULD ALSO BE WORN. IF THE BATTERY IS CRACKED OR LEAKING, THE ELECTROLYTE CAN BURN THE SKIN AND EYES.

(4) Remove the battery holddowns and remove the battery from the vehicle (Fig. 18) or (Fig. 19).

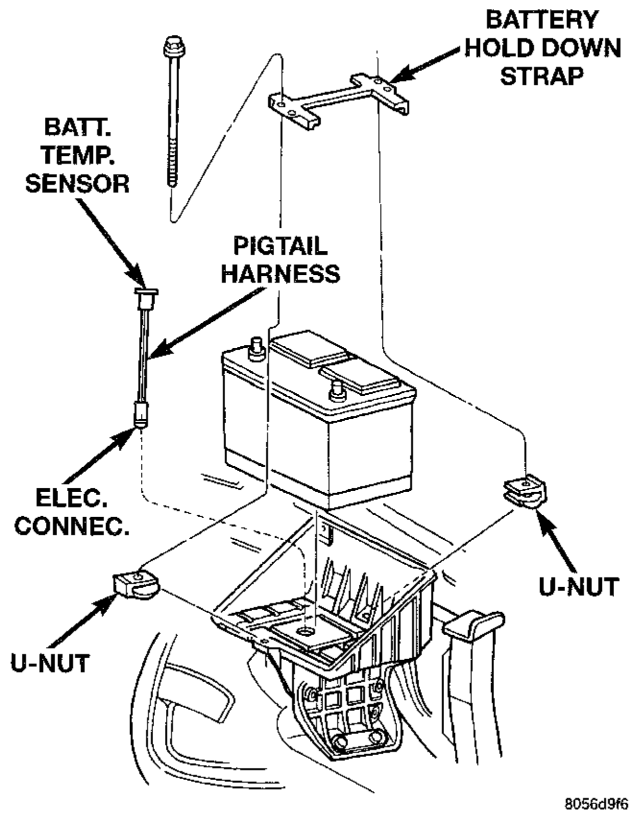


Fig. 18 Left Battery Holddowns

REMOVAL AND INSTALLATION (Continued)

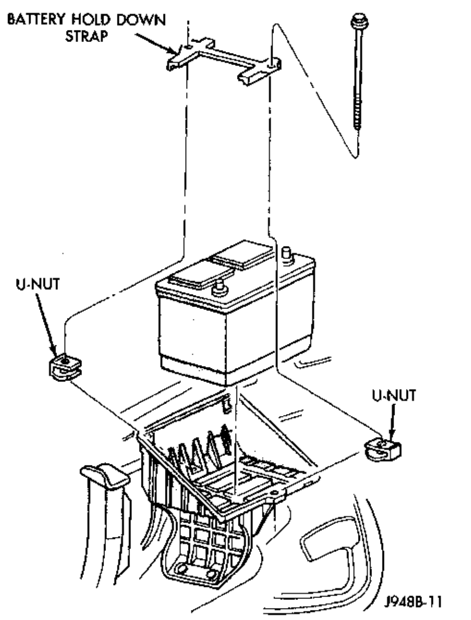


Fig. 19 Right Battery Holddowns - Diesel Engine

(5) Inspect the battery tray and holddowns for corrosion or damage (Fig. 20), (Fig. 21) or (Fig. 22). Remove any corrosion using a wire brush and a sodium bicarbonate (baking soda) and warm water cleaning solution. Paint any exposed bare metal and replace any damaged parts.

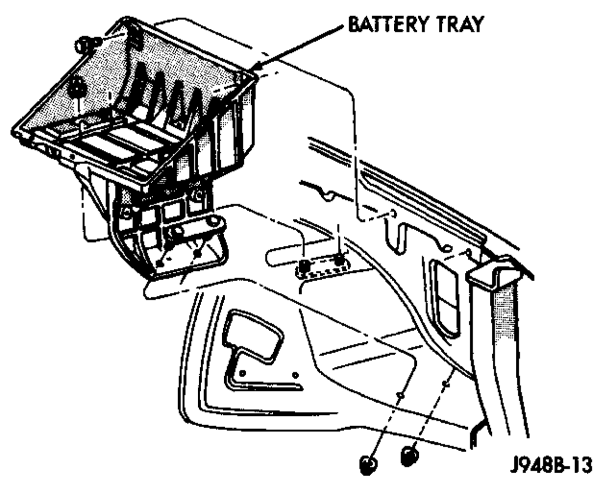


Fig. 20 Left Battery Tray - w/o Speed Control

(6) Inspect the battery case for cracks or other damage that could result in electrolyte leaks. Also, check the battery terminal posts for looseness. Batteries with damaged cases or loose posts must be replaced.

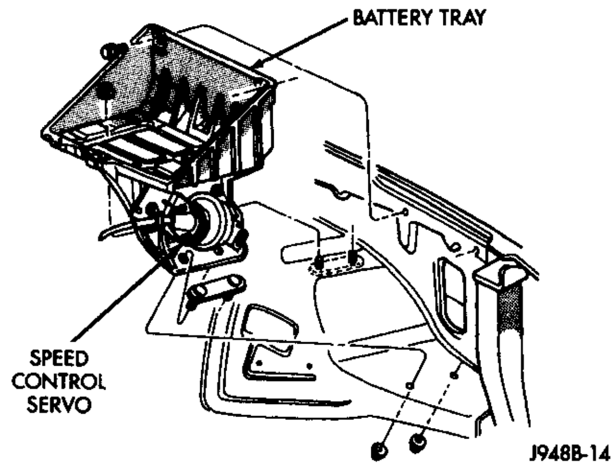


Fig. 21 Left Battery Tray - w/Speed Control

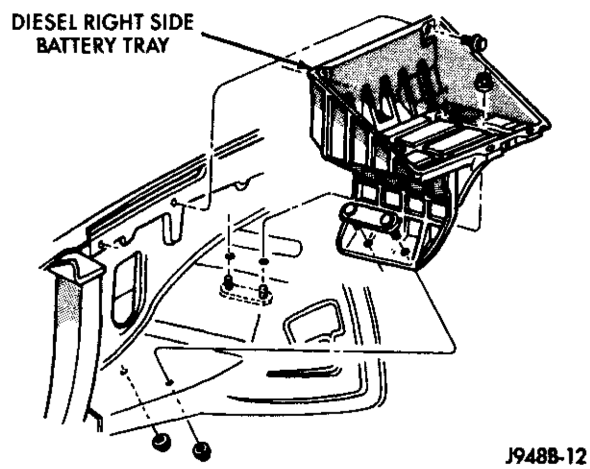


Fig. 22 Right Battery Tray - Diesel Engine

(7) Inspect the battery built-in test indicator sight glass for an indication of the battery condition. If the electrolyte level is low, the battery must be replaced. If the battery is discharged, charge as required. See Built-In Test Indicator in the Diagnosis and Testing section, and Battery Charging in the Service Procedures section of this group for more information.

(8) If the battery is to be reinstalled, clean the outside of the battery case and the top cover with a sodium bicarbonate (baking soda) and warm water cleaning solution to remove any acid film (Fig. 23). Rinse the battery with clean water. Ensure that the cleaning solution does not enter the battery cells through the vent holes. If the battery is being replaced, see the Battery Ratings and Classifications chart in the Specifications section of this group. Confirm that the replacement battery is the correct size and has the correct ratings for the vehicle.

REMOVAL AND INSTALLATION (Continued)

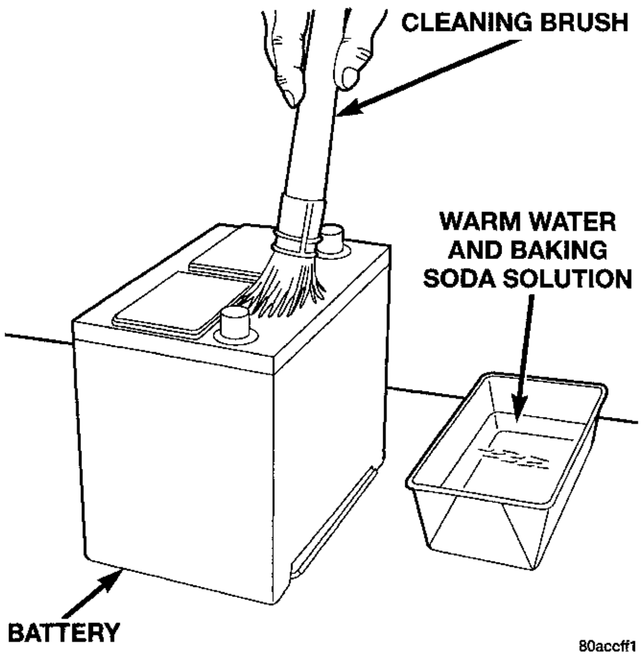


Fig. 23 Clean Battery - Typical

(9) Clean any corrosion from the battery terminal posts with a wire brush or a post and terminal cleaner, and a sodium bicarbonate (baking soda) and warm water cleaning solution (Fig. 24).

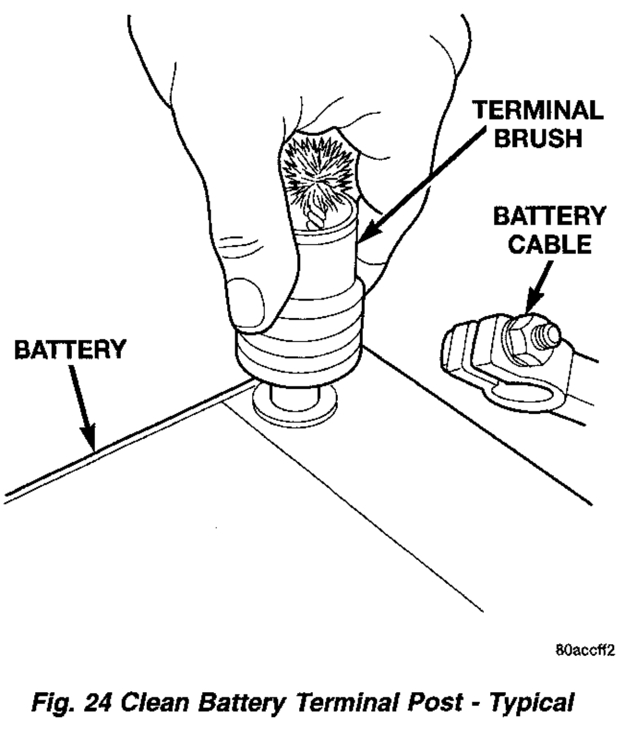


Fig. 24 Clean Battery Terminal Post - Typical

(10) Position the battery in the tray. Ensure that the positive and negative terminal posts are correctly positioned. The cable terminal clamps must reach the correct battery post without stretching the cables (Fig. 25).

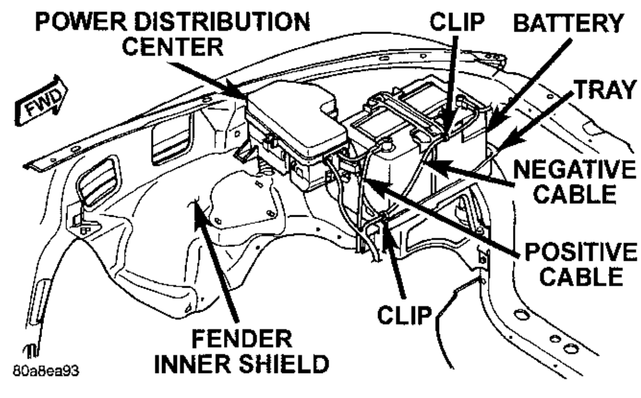


Fig. 25 Battery Cables - Typical

(11) Loosely install the battery holddown hardware. Ensure that the battery base is correctly positioned in the tray, then tighten the holddowns to 12 N·m (100 in. lbs.).

CAUTION: Be certain that the battery cables are connected to the correct battery terminals. Reverse polarity may damage electrical components.

(12) Install and tighten the battery positive cable terminal clamp. Then install and tighten the battery negative cable terminal clamp. Tighten both battery cable terminal clamp bolts to 4 N·m (35 in. lbs.).

(13) Apply a thin coating of petroleum jelly or chassis grease to the exposed surfaces of the battery cable terminal clamps and battery terminal posts.

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SPECIFICATIONS

BATTERY

Battery Classifications and Ratings					
Part Number	BCI Group Size Classification	Cold Cranking Amperage	Reserve Capacity	Ampere-Hours	Load Test Amperage
56027100	27	600	120 Minutes	66	300
56027302	27	750	150 Minutes	75	375

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STARTING SYSTEMS

CONTENTS

GENERAL INFORMATION

OVERVIEW

The battery, starting, and charging systems operate with one another, and must be tested as a complete system. In order for the vehicle to start and charge properly, all of the components involved in these systems must perform within specifications.

Group 8A covers the battery, Group 8B covers the starting system, and Group 8C covers the charging system. Refer to Group 8W - Wiring Diagrams for complete circuit descriptions and diagrams. We have separated these systems to make it easier to locate the information you are seeking within this Service Manual. However, when attempting to diagnose any of these systems, it is important that you keep their interdependency in mind.

The diagnostic procedures used in these groups include the most basic conventional diagnostic methods, to the more sophisticated On-Board Diagnostics (OBD) built into the Powertrain Control Module (PCM). Use of a induction milliampere ammeter, volt/ohmmeter, battery charger, carbon pile rheostat (load tester), and 12-volt test lamp may be required.

All OBD-sensed systems are monitored by the PCM. Each monitored circuit is assigned a Diagnostic Trouble Code (DTC). The PCM will store a DTC in electronic memory for any failure it detects. Refer to On-Board Diagnostics Test in Group 8C - Charging System for more information.

INTRODUCTION

The starting system consists of:

- Battery
- Starter relay
- Starter with an integral solenoid
- Ignition switch
- Clutch pedal position switch (manual transmission)
- Park/neutral position switch (automatic transmission)
- Wire harness and connections.

This group covers diagnosis of the complete starting system, except the battery. However, this group only covers service procedures for the starter and starter relay. Service procedures for other starting system components can be located as follows:

- Battery - refer to Group 8A - Battery for the diagnostic and service procedures
- Ignition switch - refer to Group 8D - Ignition Systems for the service procedures
- Clutch pedal position switch - refer to Group 6 - Clutch for the service procedures
- Park/neutral position switch - refer to Group 21 - Transmission for the service procedures
- Wire harness and connections - refer to Group 8W - Wiring Diagrams for the service procedures.

STARTING SYSTEM

The starting system components form two separate circuits. A high-amperage feed circuit that feeds the starter between 150 and 350 amperes (700 amperes - diesel engine), and a low-amperage control circuit that operates on less than 20 amperes.

If the vehicle is equipped with an automatic transmission, battery voltage is supplied through the low-amperage control circuit to the coil battery terminal of the starter relay when the ignition switch is turned to the Start position. The park/neutral position switch is installed in series between the starter relay coil ground terminal and ground. This normally open switch prevents the starter relay from being energized unless the automatic transmission gear selector is in the Neutral or Park positions.

GENERAL INFORMATION (Continued)

If the vehicle is equipped with a manual transmission, it has a clutch pedal position switch installed in series between the ignition switch and the coil battery terminal of the starter relay. This normally open switch prevents the starter relay from being energized unless the clutch pedal is depressed, preventing starter operation while the clutch disc and the flywheel are engaged. The starter relay coil ground terminal is always grounded on vehicles with a manual transmission.

When the starter relay coil is energized, the normally open relay contacts close. The relay contacts connect the relay common feed terminal to the relay normally open terminal. The closed relay contacts energize the starter solenoid coil windings.

The energized solenoid pull-in coil pulls in the solenoid plunger. The solenoid plunger pulls the shift lever in the starter. This engages the starter overrunning clutch and pinion gear with the starter ring gear on the manual transmission flywheel, or on the automatic transmission torque converter.

As the solenoid plunger reaches the end of its travel, the solenoid contact disc completes the high-amperage starter feed circuit and energizes the solenoid plunger hold-in coil. Current now flows between the solenoid battery terminal and the starter motor, energizing the starter.

Once the engine starts, the overrunning clutch protects the starter from damage by allowing the starter pinion gear to spin faster than the pinion shaft. When the driver releases the ignition switch to the On position, the starter relay coil is de-energized. This causes the relay contacts to open. When the relay contacts open, the starter solenoid plunger hold-in coil is de-energized.

When the solenoid plunger hold-in coil is de-energized, the solenoid plunger return spring returns the plunger to its relaxed position. This causes the contact disc to open the starter feed circuit, and the shift lever to disengage the overrunning clutch and pinion gear from the starter ring gear.

DESCRIPTION AND OPERATION

STARTER

The starter motor incorporates several features to create a reliable, efficient, compact, and lightweight unit. A planetary gear system (intermediate transmission) is used between the electric motor and the pinion gear. This feature makes it possible to reduce the dimensions of the starter. At the same time, it allows higher armature rotational speed and delivers increased torque through the pinion gear to the starter ring gear on the manual transmission flywheel or the automatic transmission torque converter.

The starter motors for all engines are activated by a solenoid mounted to the overrunning clutch housing. However, the starter motor and solenoid are serviced only as a complete assembly. If either component is faulty or damaged, the entire starter assembly must be replaced.

STARTER RELAY

The starter relay is a International Standards Organization (ISO)-type relay. The starter relay is a electromechanical device that switches battery current to the pull-in coil of the starter solenoid when the ignition switch is turned to the Start position. See Starter Relay in the Diagnosis and Testing section of this group for more information.

The starter relay is located in the Power Distribution Center (PDC), in the engine compartment. Refer to the PDC label for relay identification and location.

The starter relay cannot be repaired and, if faulty or damaged, it must be replaced.

DIAGNOSIS AND TESTING

STARTING SYSTEM

For circuit descriptions and diagrams, refer to 8W-21 - Starting System in Group 8W - Wiring Diagrams.

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

INSPECTION

Before removing any unit from the starting system for repair or diagnosis, perform the following inspections:

- **Battery** - Visually inspect the battery for indications of physical damage and loose or corroded cable connections. Determine the state-of-charge and cranking capacity of the battery. Charge or replace the battery, if required. Refer to Group 8A - Battery for more information.
- **Ignition Switch** - Visually inspect the ignition switch for indications of physical damage and loose or corroded wire harness connections.
- **Clutch Pedal Position Switch** - Visually inspect the clutch pedal position switch for indications of physical damage and loose or corroded wire harness connections.

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DIAGNOSIS AND TESTING (Continued)

• **Park/Neutral Position Switch** - Visually inspect the park/neutral position switch for indications of physical damage and loose or corroded wire harness connections.

• **Starter Relay** - Visually inspect the starter relay for indications of physical damage and loose or corroded wire harness connections.

• **Starter** - Visually inspect the starter for indications of physical damage and loose or corroded wire harness connections.

• **Starter Solenoid** - Visually inspect the starter solenoid for indications of physical damage and loose or corroded wire harness connections.

• **Wiring** - Visually inspect the wire harness for damage. Repair or replace any faulty wiring, as required.

COLD CRANKING TEST

For circuit descriptions and diagrams, refer to 8W-21 - Starting System in Group 8W - Wiring Diagrams. The battery must be fully-charged and load-tested before proceeding. Refer to Group 8A - Battery for more information.

(1) Connect a suitable volt-ampere tester to the battery terminals (Fig. 1). Refer to the operating instructions provided with the tester being used.

(2) Fully engage the parking brake.

(3) If the vehicle is equipped with an automatic transmission, place the gearshift selector lever in the Park position. If the vehicle is equipped with a manual transmission, place the gearshift selector lever in the Neutral position and fully depress the clutch pedal.

(4) Verify that all lamps and accessories are turned off.

WARNING: MODELS EQUIPPED WITH THE DIESEL ENGINE OPTION ALSO HAVE AN AUTOMATIC SHUTDOWN (ASD) RELAY LOCATED IN THE POWER DISTRIBUTION CENTER (PDC). HOWEVER, REMOVAL OF THE ASD RELAY MAY NOT PREVENT THE DIESEL ENGINE FROM STARTING. BE CERTAIN TO UNPLUG THE FUEL SHUTDOWN SOLENOID WIRE HARNESS CONNECTOR. FAILURE TO DO SO MAY RESULT IN PERSONAL INJURY.

(5) To prevent the gasoline engine from starting, unplug the Automatic ShutDown (ASD) relay. The ASD relay is located in the Power Distribution Center (PDC). Refer to the PDC label for ASD relay identification and location. To prevent the diesel engine from starting, unplug the fuel shutdown solenoid wire harness connector (Fig. 2).

(6) Rotate and hold the ignition switch in the Start position. Note the cranking voltage and current (amperage) draw.

(a) If the voltage reads below 9.6 volts, remove the starter for bench testing. If the starter bench test is OK, refer to Group 9 - Engine for further diagnosis of the engine. If the starter bench test is not OK, replace the faulty starter.

(b) If the voltage reads above 9.6 volts and the current (amperage) draw reads below specifications, see Feed Circuit Test in the Diagnosis and Testing section of this group.

(c) If the voltage reads 12.5 volts or greater and the starter does not turn, see Control Circuit Test in the Diagnosis and Testing section of this group.

(d) If the voltage reads 12.5 volts or greater and the starter turns very slowly, see Feed Circuit Test in the Diagnosis and Testing section of this group.

NOTE: A cold engine will increase the starter current (amperage) draw reading, and reduce the battery voltage reading.

FEED CIRCUIT TEST

The starter feed circuit test (voltage drop method) will determine if there is excessive resistance in the high-amperage circuit. For circuit descriptions and diagrams, refer to 8W-21 - Starting System in Group 8W - Wiring Diagrams.

When performing these tests, it is important to remember that the voltage drop is giving an indication of the resistance between the two points at which the voltmeter probes are attached.

Example: When testing the resistance of the battery positive cable, touch the voltmeter leads to the battery positive cable clamp and the cable connector at the starter solenoid. If you probe the battery positive terminal post and the cable connector at the starter solenoid, you are reading the combined voltage drop in the battery positive cable clamp-to-terminal post connection and the battery positive cable.

The following operation will require a voltmeter accurate to 1/10 (0.10) volt. Before performing the tests, be certain that the following procedures are accomplished:

WARNING: MODELS EQUIPPED WITH THE DIESEL ENGINE OPTION ALSO HAVE AN AUTOMATIC SHUTDOWN (ASD) RELAY LOCATED IN THE POWER DISTRIBUTION CENTER (PDC). HOWEVER, REMOVAL OF THE ASD RELAY MAY NOT PREVENT THE DIESEL ENGINE FROM STARTING. BE CERTAIN TO UNPLUG THE FUEL SHUTDOWN SOLENOID WIRE HARNESS CONNECTOR. FAILURE TO DO SO MAY RESULT IN PERSONAL INJURY.

• Battery is fully-charged and load-tested. Refer to Group 8A - Battery for more information.

• Fully engage the parking brake.

DIAGNOSIS AND TESTING (Continued)

Starting System Diagnosis		
CONDITION	**POSSIBLE CAUSE**	**CORRECTION**
STARTER FAILS TO ENGAGE.	1. Battery discharged or faulty. 2. Starting circuit wiring faulty. 3. Starter relay faulty. 4. Ignition switch faulty. 5. Park/Neutral position switch (automatic transmission) faulty or misadjusted. 6. Clutch pedal position switch (manual transmission) faulty. 7. Starter solenoid faulty. 8. Starter assembly faulty.	1. Refer to Group 8A - Battery. Charge or replace the battery, if required. 2. See Cold Cranking Test in the Diagnosis and Testing section of this group. Test and repair the starter feed and/or control circuits, if required. 3. See Relay Test in the Diagnosis and Testing section of this group. Replace the starter relay, if required. 4. See Ignition Switch Test in the Diagnosis and Testing section of this group. Replace the ignition switch, if required. 5. See Park/Neutral Position Switch Test in the Diagnosis and Testing section of this group. Replace the park/neutral position switch, if required. 6. See Clutch Pedal Position Switch Test in the Diagnosis and Testing section of this group. Replace the clutch pedal position switch, if required. 7. See Solenoid Test in the Diagnosis and Testing section of this group. Replace the starter assembly, if required. 8. If all other starting system components and circuits test OK, replace the starter assembly.
STARTER ENGAGES, FAILS TO TURN ENGINE.	1. Battery discharged or faulty. 2. Starting circuit wiring faulty. 3. Starter assembly faulty. 4. Engine seized.	1. Refer to Group 8A - Battery. Charge or replace the battery, if required. 2. See Cold Cranking Test in the Diagnosis and Testing section of this group. Test and repair the starter feed and/or control circuits, if required. 3. If all other starting system components and circuits test OK, replace the starter assembly. 4. Refer to Group 9 - Engine for the diagnostic and service procedures.
STARTER ENGAGES, SPINS OUT BEFORE ENGINE STARTS.	1. Broken teeth on starter ring gear. 2. Starter assembly faulty.	1. See Starter in the Removal and Installation section of this group. Remove the starter to inspect the starter ring gear. Replace the starter ring gear, if required. 2. If all other starting system components and circuits test OK, replace the starter assembly.
STARTER DOES NOT DISENGAGE.	1. Starter improperly installed. 2. Starter relay faulty. 3. Ignition switch faulty. 4. Starter assembly faulty.	1. See Starter in the Removal and Installation section of this group. Tighten the starter mounting hardware to correct torque specifications. 2. See Relay Test in the Diagnosis and Testing section of this group. Replace the starter relay, if required. 3. See Ignition Switch Test in the Diagnosis and Testing section of this group. Replace the ignition switch, if required. 4. If all other starting system components and circuits test OK, replace the starter assembly.

- If the vehicle is equipped with an automatic transmission, place the gearshift selector lever in the Park position. If the vehicle is equipped with a manual transmission, place the gearshift selector lever in the Neutral position and fully depress the clutch pedal.
- Verify that all lamps and accessories are turned off.

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DIAGNOSIS AND TESTING (Continued)

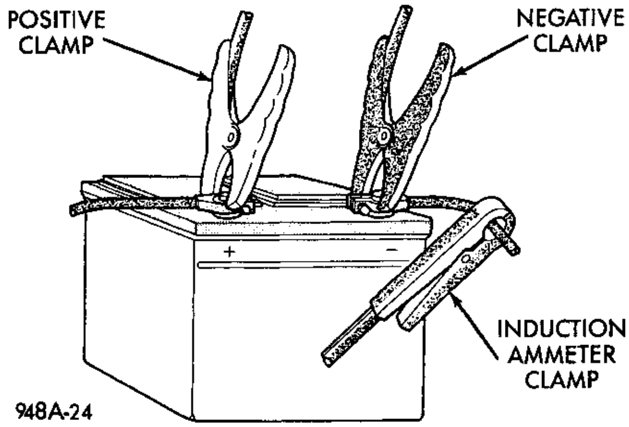

Fig. 1 Volts-Amps Tester Connections - Typical

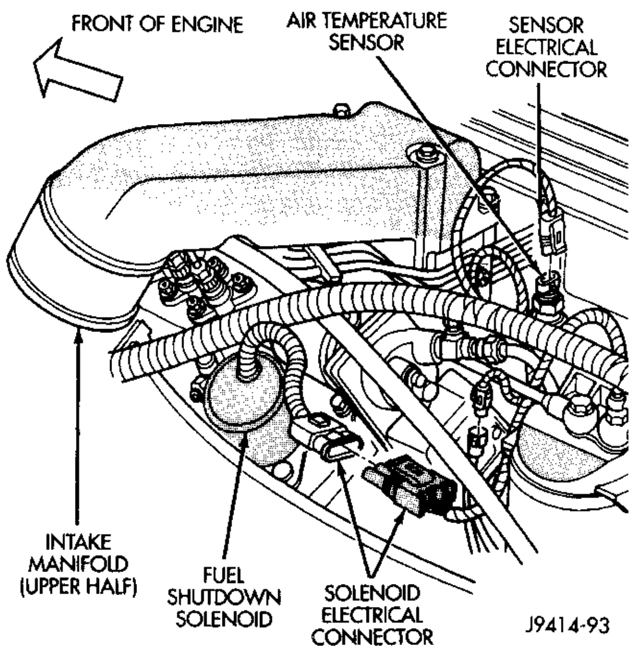

Fig. 2 Fuel Shutdown Solenoid Connector - Diesel Engine

• To prevent the gasoline engine from starting, unplug the Automatic ShutDown (ASD) relay. The ASD relay is located in the Power Distribution Center (PDC). Refer to the PDC label for ASD relay identification and location. To prevent the diesel engine from starting, unplug the fuel shutdown solenoid wire harness connector (Fig. 3).

(1) Connect the positive lead of the voltmeter to the battery negative terminal post. Connect the negative lead of the voltmeter to the battery negative cable clamp (Fig. 4). Rotate and hold the ignition switch in the Start position. Observe the voltmeter. If voltage is detected, correct the poor contact between the cable clamp and the terminal post.

(2) Connect the positive lead of the voltmeter to the battery positive terminal post. Connect the negative lead of the voltmeter to the battery positive cable clamp (Fig. 5). Rotate and hold the ignition switch in the Start position. Observe the voltmeter. If voltage is detected, correct the poor contact between the cable clamp and the terminal post.

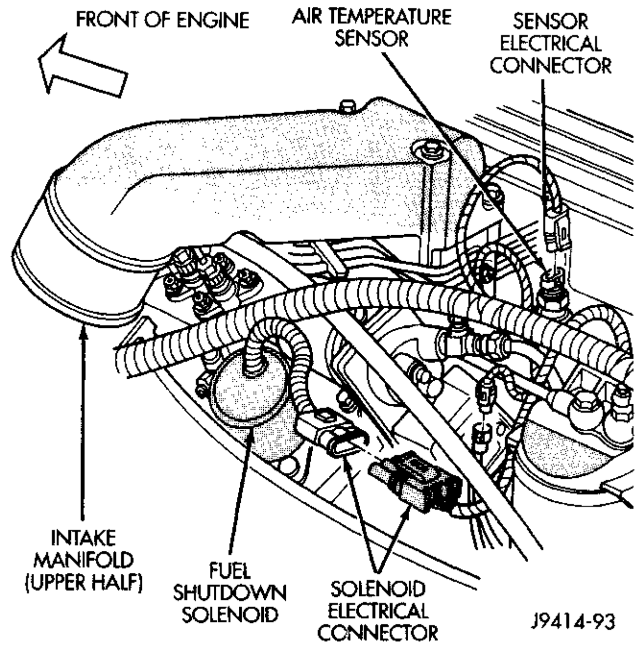

Fig. 3 Fuel Shutdown Solenoid Connector - Diesel Engine

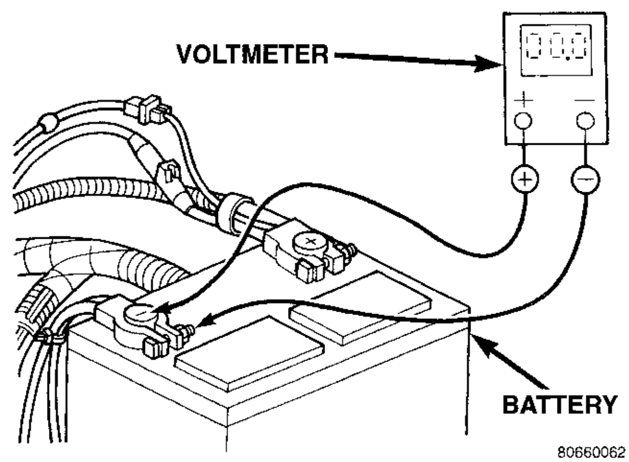

Fig. 4 Test Battery Negative Connection Resistance - Typical

(3) Connect the voltmeter to measure between the battery positive terminal post and the starter solenoid battery terminal stud (Fig. 6). Rotate and hold the ignition switch in the Start position. Observe the voltmeter. If the reading is above 0.2 volt, clean and tighten the battery cable connection at the solenoid. Repeat the test. If the reading is still above 0.2 volt, replace the faulty battery positive cable.

DIAGNOSIS AND TESTING (Continued)

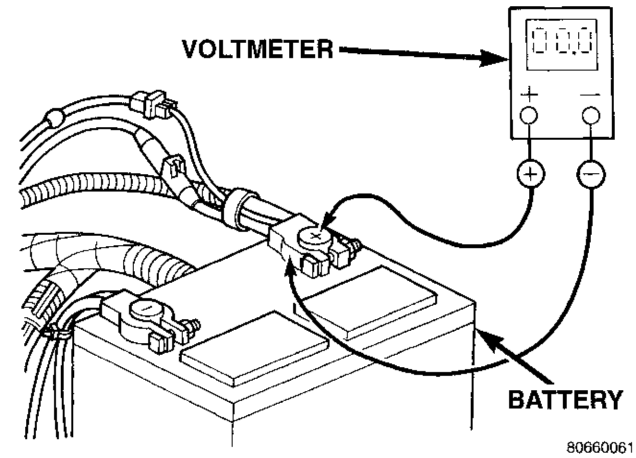

Fig. 5 Test Battery Positive Connection Resistance - Typical

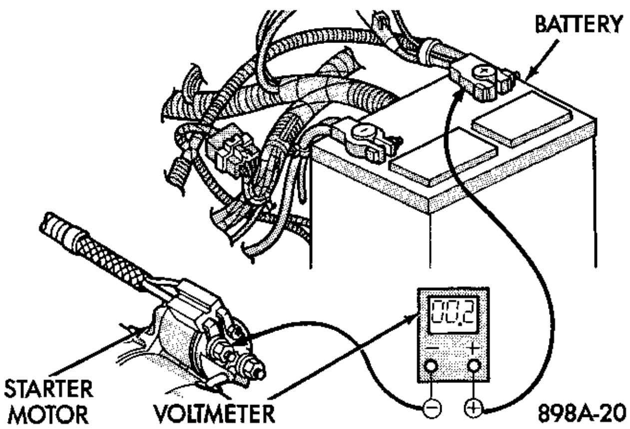

Fig. 6 Test Battery Positive Cable Resistance - Typical

(4) Connect the voltmeter to measure between the battery negative terminal post and a good clean ground on the engine block (Fig. 7). Rotate and hold the ignition switch in the Start position. Observe the voltmeter. If the reading is above 0.2 volt, clean and tighten the battery negative cable attachment on the engine block. Repeat the test. If the reading is still above 0.2 volt, replace the faulty battery negative cable.

(5) Connect the positive lead of the voltmeter to the starter housing. Connect the negative lead of the voltmeter to the battery negative terminal post (Fig. 8). Rotate and hold the ignition switch in the Start position. Observe the voltmeter. If the reading is above 0.2 volt, correct the poor starter to engine block ground contact.

If the resistance tests detect no feed circuit problems, remove the starter from the vehicle and see Solenoid Test in the Diagnosis and Testing section of this group.

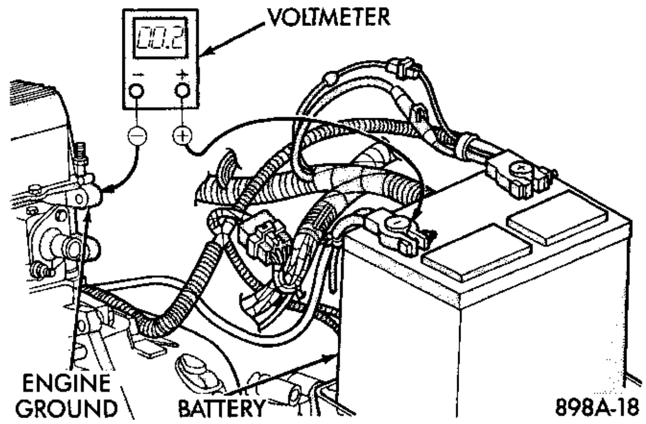

Fig. 7 Test Ground Circuit Resistance - Typical

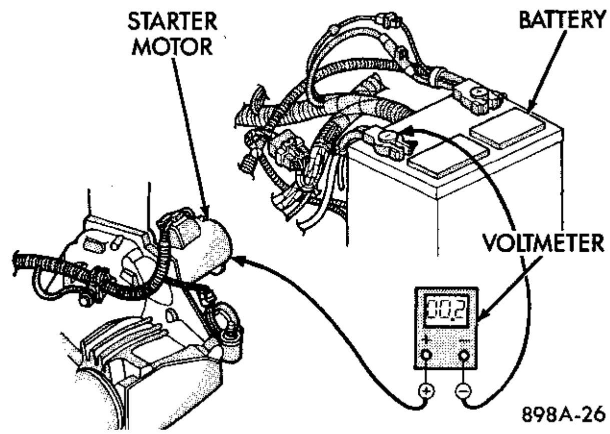

Fig. 8 Test Starter Ground - Typical

CONTROL CIRCUIT TEST

For circuit descriptions and diagrams, refer to 8W-21 - Starting System in Group 8W - Wiring Diagrams. The starter control circuit consists of:

- Battery
- Starter relay
- Starter solenoid
- Ignition switch
- Park/neutral position switch (automatic transmission)
- Clutch pedal position switch (manual transmission)
- Wire harness and connections.

Test procedures for these components should be performed in the order in which they are listed, as follows:

SOLENOID TEST

Remove the starter from the vehicle. See Starter in the Removal and Installation section of this group for the procedures. Then proceed as follows:

(1) Remove the wire from the solenoid field coil terminal.

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DIAGNOSIS AND TESTING (Continued)

(2) Check for continuity between the solenoid terminal and the field coil terminal with a continuity tester (Fig. 9). There should be continuity. If OK, go to Step 3. If not OK, replace the faulty starter assembly.

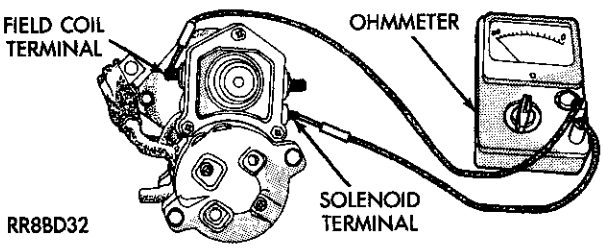


Fig. 9 Continuity Test Between Solenoid Terminal and Field Coil Terminal

(3) Check for continuity between the solenoid terminal and the solenoid case (Fig. 10). There should be continuity. If OK, go to Step 4. If not OK, replace the faulty starter assembly.

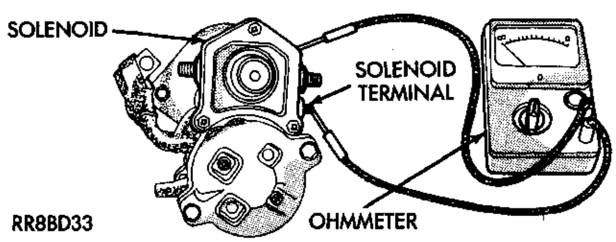


Fig. 10 Continuity Test Between Solenoid Terminal and Solenoid Case

(4) Connect the solenoid field coil wire to the field coil terminal.

(5) Reinstall the starter. See Starter in the Removal and Installation section of this group for the procedures.

RELAY TEST

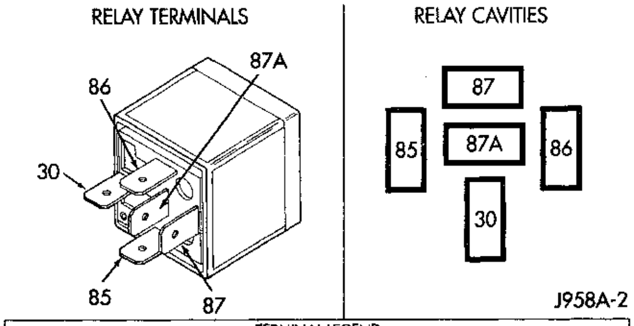
The starter relay (Fig. 11) is located in the Power Distribution Center (PDC) in the engine compartment. Refer to the PDC label for starter relay identification and location.

Remove the starter relay from the PDC to perform the following tests. See Starter Relay in the Removal and Installation section of this group for the procedures.

(1) A relay in the de-energized position should have continuity between terminals 87A and 30, and no continuity between terminals 87 and 30. If OK, go to Step 2. If not OK, replace the faulty relay.

(2) Resistance between terminals 85 and 86 (electromagnet) should be 75 ± 5 ohms. If OK, go to Step 3. If not OK, replace the faulty relay.

(3) Connect a battery to terminals 85 and 86. There should now be continuity between terminals 30 and 87, and no continuity between terminals 87A and 30. If OK, see Relay Circuit Test in the Diagnosis and Testing section of this group. If not OK, replace the faulty relay.



TERMINAL LEGEND	
NUMBER	IDENTIFICATION
30	COMMON FEED
85	COIL GROUND
86	COIL BATTERY
87	NORMALLY OPEN
87A	NORMALLY CLOSED

Fig. 11 Starter Relay

RELAY CIRCUIT TEST

(1) The relay common feed terminal cavity (30) is connected to battery voltage and should be hot at all times. If OK, go to Step 2. If not OK, repair the open circuit to the PDC fuse as required.

(2) The relay normally closed terminal (87A) is connected to terminal 30 in the de-energized position, but is not used for this application. Go to Step 3.

(3) The relay normally open terminal (87) is connected to the common feed terminal (30) in the energized position. This terminal supplies battery voltage to the starter solenoid field coils. There should be continuity between the cavity for relay terminal 87 and the starter solenoid terminal at all times. If OK, go to Step 4. If not OK, repair the open circuit to the starter solenoid as required.

(4) The coil battery terminal (86) is connected to the electromagnet in the relay. It is energized when the ignition switch is held in the Start position. On vehicles with a manual transmission, the clutch pedal must be fully depressed for this test. Check for battery voltage at the cavity for relay terminal 86 with the ignition switch in the Start position, and no voltage when the ignition switch is released to the On position. If OK, go to Step 5. If not OK with an automatic transmission, check for an open or short circuit to the ignition switch and repair, if required. If the circuit to the ignition switch is OK, see Ignition Switch Test in the Diagnosis and Testing section of this group. If not OK with a manual transmission, check the circuit between the relay and the clutch pedal position switch for an open or a short. If the circuit is OK, see Clutch Pedal Position Switch Test in the Diagnosis and Testing section of this group.

(5) The coil ground terminal (85) is connected to the electromagnet in the relay. On vehicles with an

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DIAGNOSIS AND TESTING (Continued)

automatic transmission, it is grounded through the park/neutral position switch only when the gearshift selector lever is in the Park or Neutral positions. On vehicles with a manual transmission, it is grounded at all times. Check for continuity to ground at the cavity for relay terminal 85. If not OK with an automatic transmission, check for an open or short circuit to the park/neutral position switch and repair, if required. If the circuit is OK, see Park/Neutral Position Switch Test in the Diagnosis and Testing section of this group. If not OK with a manual transmission, repair the circuit to ground as required.

PARK/NEUTRAL POSITION SWITCH TEST

The park/neutral position switch is used only on models equipped with an automatic transmission.

(1) Place the transmission gear selector lever in the Park position.

(2) Disconnect and isolate the battery negative cable.

(3) Raise and support the vehicle.

(4) Unplug the park/neutral position switch wire harness connector.

(5) Check for continuity between the center switch terminal and a good chassis ground. There should be continuity. If OK, go to Step 6. If not OK, replace the faulty switch.

(6) Move the transmission gear selector lever to the Reverse position and check for continuity between the center switch terminal and a good chassis ground. There should be no continuity. If not OK, replace the faulty switch.

CLUTCH PEDAL POSITION SWITCH TEST

The clutch pedal position switch is used only on models equipped with a manual transmission. The clutch pedal position switch is integral to the clutch pedal pushrod. It is located near the dash panel under the instrument panel. The wire harness connector for the switch is wrapped with foam tape.

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(1) Disconnect and isolate the battery negative cable.

(2) Unplug the clutch pedal position switch wire harness connector.

(3) Check for continuity between the two cavities in the switch half of the wire harness connector with the clutch pedal released. There should be no continuity. If OK, go to Step 4. If not OK, replace the faulty switch.

(4) Check for continuity between the two cavities in the switch half of the wire harness connector again with the clutch pedal depressed. There should now be continuity. If OK, see Ignition Switch Test in the Diagnosis and Testing section of this group. If not OK, replace the faulty switch.

IGNITION SWITCH TEST

WARNING: ON VEHICLES EQUIPPED WITH AN AIRBAG, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(1) Disconnect and isolate the battery negative cable.

(2) Remove the steering column shrouds and unplug the ignition switch wire harness connector. Refer to Group 8D - Ignition Systems for the procedures.

(3) With the ignition switch in the On position, check for continuity between the two fused B(+) terminals of the ignition switch (terminals 1 and 7). These are the terminals at each end of the switch connector receptacle. There should be no continuity. If OK, go to Step 4. If not OK, replace the faulty switch.

(4) With the ignition switch held in the Start position, check for continuity between the two fused B (+) terminals of the ignition switch (terminals 1 and 7) again. There should now be continuity. If not OK, replace the faulty switch.

REMOVAL AND INSTALLATION

STARTER

GASOLINE ENGINE

(1) Disconnect and isolate the battery negative cable.

(2) Raise and support the vehicle.

(3) Remove the two nuts that secure the starter battery cable and solenoid wire harness connectors to the starter solenoid terminal studs (Fig. 12) or (Fig. 13). Remove the starter solenoid wire harness connector from the solenoid terminals.

(4) Remove the hardware that secures the starter motor to the bellhousing (Fig. 13) or (Fig. 14).

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REMOVAL AND INSTALLATION (Continued)

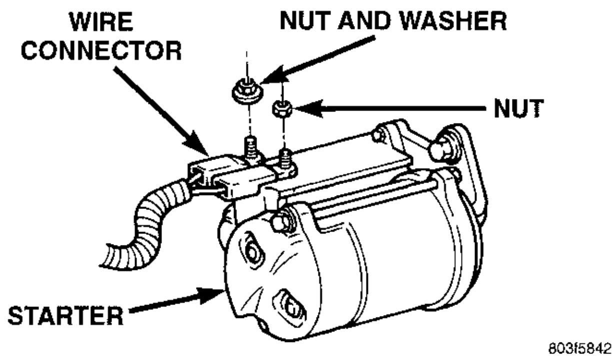

Fig. 12 Starter Connector Remove/Install - V-6/V-8 Engine

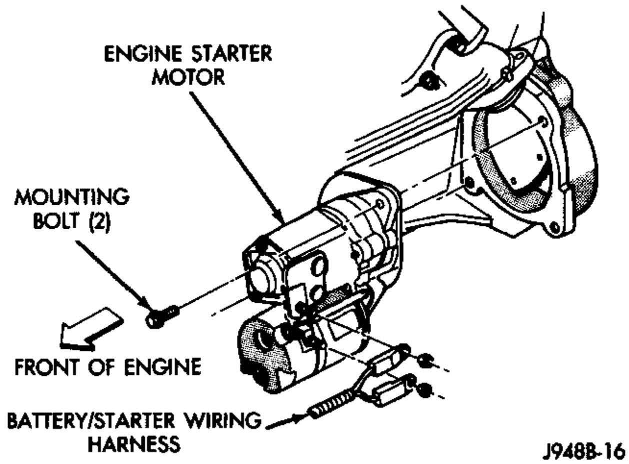

Fig. 13 Starter Remove/Install - V-10 Engine

(5) Move the starter towards the front of the vehicle until the starter gear housing nose clears the bellhousing. Then tilt the nose downwards and lower the starter past the exhaust pipe (Fig. 13) or (Fig. 15).

(6) Reverse the removal procedures to install. Tighten the starter hardware as follows:

- Starter mounting bolts to 68 N·m (50 ft. lbs.)
- Starter mounting nut - 68 N·m (50 ft. lbs.)
- Battery cable terminal nut - 14 N·m (120 in. lbs.)
- Solenoid wire harness terminal nut - 6 N·m (55 in. lbs.).

DIESEL ENGINE

(1) Disconnect and isolate both of the battery negative cables.

(2) Raise and support the vehicle.

(3) Pull back the protective rubber boot from the solenoid battery terminal far enough to access the battery cable wire harness connector (Fig. 16).

(4) Remove the nut that secures the battery cable wire harness connector to the solenoid battery terminal stud.

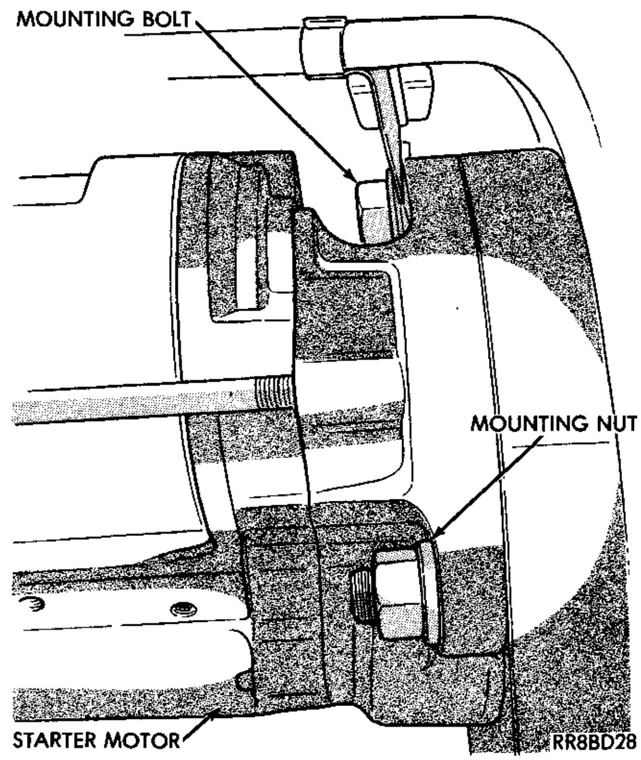

Fig. 14 Starter Mounting Hardware Remove/Install - V-6/V-8 Engine

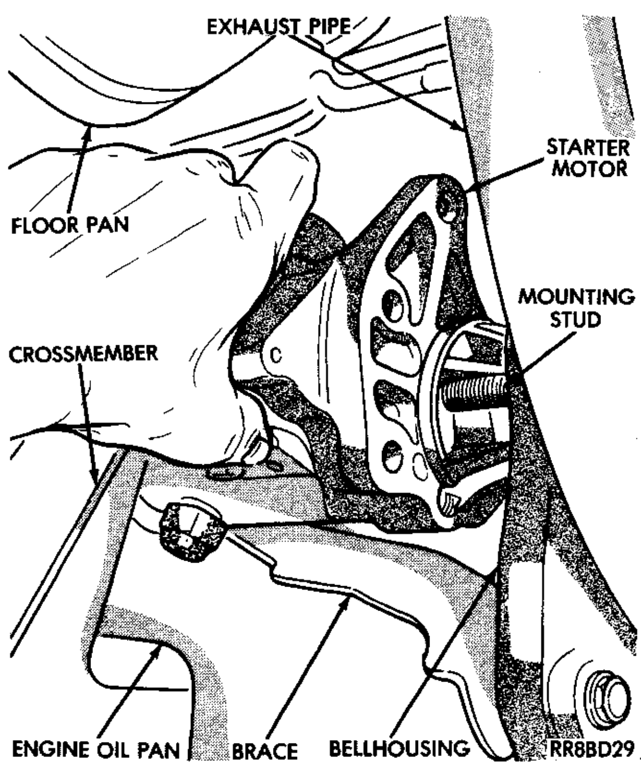

Fig. 15 Starter Remove/Install - V-6/V-8 Engine

(5) Remove the nut that secures the solenoid wire harness connector to the solenoid terminal stud.

REMOVAL AND INSTALLATION (Continued)

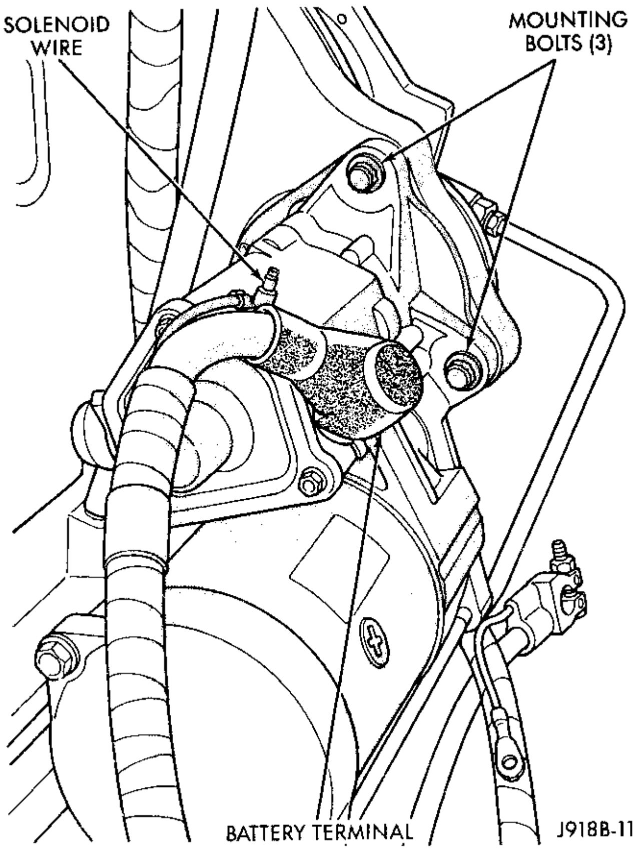

Fig. 16 Starter Connectors Remove/Install - Diesel Engine

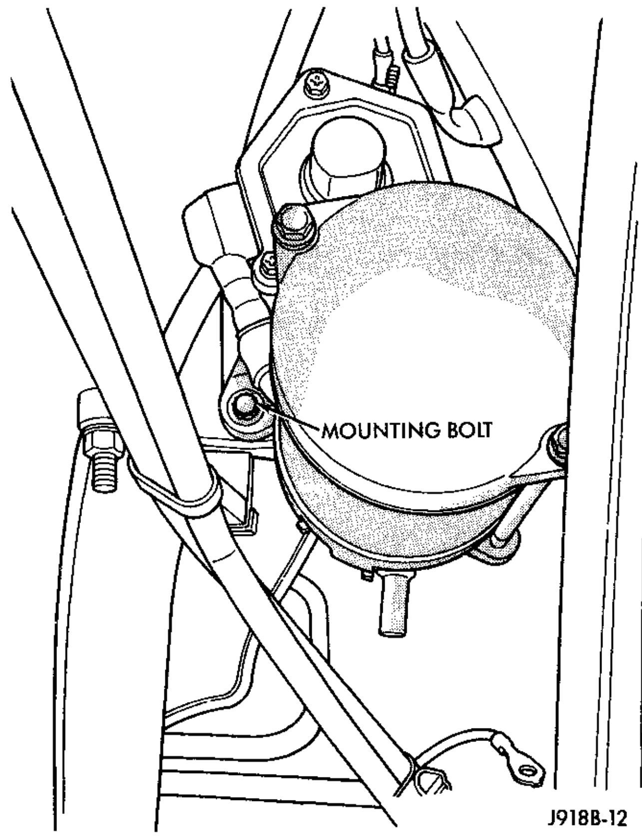

Fig. 17 Starter Mounting Bolt - Diesel Engine

(6) Remove hardware that secures the starter motor to the bellhousing (Fig. 16) and (Fig. 17).

(7) Remove the starter motor from the bellhousing.

(8) Reverse the removal procedures to install. Tighten the starter hardware as follows:

- Starter mounting bolts - 43 N·m (32 ft. lbs.)
- Solenoid wire harness terminal nut - 6 N·m (55 in. lbs.)
- Battery cable terminal nut - 14 N·m (120 in. lbs.).

STARTER RELAY

(1) Disconnect and isolate the battery negative cable(s).

(2) Remove the cover from the Power Distribution Center (PDC) (Fig. 18).

(3) Refer to the label on the PDC for starter relay identification and location.

(4) Unplug the starter relay from the PDC.

(5) Install the starter relay by aligning the relay terminals with the cavities in the PDC and pushing the relay firmly into place.

(6) Install the PDC cover.

(7) Connect the battery negative cable(s).

(8) Test the relay operation.

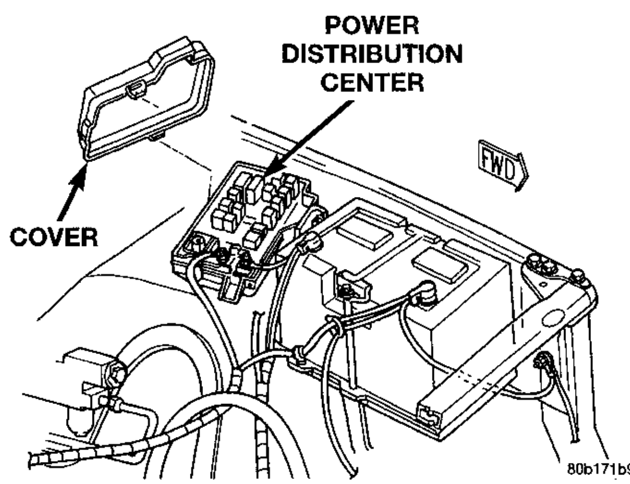

Fig. 18 Power Distribution Center

SPECIFICATIONS

STARTING SYSTEM

Starter and Solenoid			
Engine Application	3.9L, 5.2L, 5.9L (Gas)	8.0L	5.9L (Diesel)
Manufacturer	Nippon Denso	Nippon Denso	Nippon Denso
Part Number	56027702	56027703	4741012
Power Rating	1.4 Kilowatt	1.4 Kilowatt	2.7 Kilowatt
Voltage	12 Volts	12 Volts	12 Volts
Number of Fields	4	4	4
Number of Poles	4	4	4
Number of Brushes	4	4	4
Drive Type	Reduction Gear Train	Reduction Gear Train	Conventional Gear Train
Free Running Test Voltage	11 Volts	11 Volts	11 Volts
Free Running Test Amperage Draw	73 Amperes	73 Amperes	200 Amperes
Free Running Test Minimum Speed	3601 rpm	3601 rpm	3000 rpm
Solenoid Closing Voltage	7.5 Volts	7.5 Volts	8.0 Volts
Cranking Amperage Draw Test*	125 - 250 Amperes	125 - 250 Amperes	450 - 700 Amperes
*Test at operating temperature. Cold engine, tight (new) engine, or heavy oil will increase starter amperage draw.			

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CHARGING SYSTEM

CONTENTS

GENERAL INFORMATION

OVERVIEW

The battery, starting, and charging systems operate with one another, and must be tested as a complete system. To allow the vehicle to start and charge properly, all of the components involved in these three systems must perform within specifications.

Group 8A in this service manual covers the battery, Group 8B covers the starting system, and Group 8C covers the charging system. Refer to Group 8W, Wiring Diagrams for complete circuit descriptions and diagrams. When attempting to diagnose any of these systems, it is important to keep their interdependency in mind.

Certain charging system circuits are monitored by On-Board Diagnostics (OBD) built into the Powertrain Control Module (PCM). Each monitored circuit is assigned a Diagnostic Trouble Code (DTC). The PCM will store a DTC in electronic memory for certain failures it detects. Refer to On-Board Diagnostics in Group 25, Emission Control System for a complete list of DTC's and for information necessary to access a DTC. For charging system diagnostic information, refer to the appropriate Powertrain Diagnostic Procedures service manual.

DESCRIPTION AND OPERATION

CHARGING SYSTEM OPERATION

The charging system consists of:

- Generator
- Electronic Voltage Regulator (EVR) circuitry within the Powertrain Control Module (PCM)
- Ignition switch (refer to Group 8D, Ignition System for information)
- Battery (refer to Group 8A, Battery for information)
- Battery temperature sensor
- Generator Lamp (if equipped)
- Check Gauges Lamp (if equipped)
- Voltmeter (refer to Group 8E, Instrument Panel and Gauges for information)
- Wiring harness and connections (refer to Group 8W, Wiring for information)

The charging system is turned on and off with the ignition switch. When the ignition switch is turned to the ON position, battery voltage from the powertrain control module (PCM) is supplied to the generator rotor to produce a magnetic field. This is done through one of the two field terminals at the rear of generator.

The amount of DC current produced by the generator is controlled by the EVR (field control) circuitry contained within the PCM. This circuitry is connected in series with the second rotor field terminal and ground.

A battery temperature sensor, located in the battery tray housing, is used to sense battery temperature. This temperature data, along with data from monitored line voltage, is used by the PCM to vary the battery charging rate. This is done by cycling the ground path to control the strength of the rotor magnetic field. The PCM then compensates and regulates generator current output accordingly.

All vehicles are equipped with On-Board Diagnostics (OBD). All OBD-sensed systems, including EVR (field control) circuitry, are monitored by the PCM. Each monitored circuit is assigned a Diagnostic Trouble Code (DTC). The PCM will store a DTC in elec-

DESCRIPTION AND OPERATION (Continued)

tronic memory for certain failures it detects. Refer to On-Board Diagnostics in Group 25, Emission Control System for more DTC information.

The Check Gauges Lamp (if equipped) monitors: **charging system voltage,** engine coolant temperature and engine oil pressure. If an extreme condition is indicated, the lamp will be illuminated. This is done as reminder to check the three gauges. The signal to activate the lamp is sent via the CCD bus circuits. The lamp is located on the instrument panel. Refer to Group 8E, Instrument Panel and Gauges for additional information.

GENERATOR

The generator is belt-driven by the engine using a serpentine type drive belt. It is serviced only as a complete assembly. If the generator fails for any reason, the entire assembly must be replaced.

As the energized rotor begins to rotate within the generator, the spinning magnetic field induces a current into the windings of the stator coil. Once the generator begins producing sufficient current, it also provides the current needed to energize the rotor.

The Y type stator winding connections deliver the induced AC current to 3 positive and 3 negative diodes for rectification. From the diodes, rectified DC current is delivered to the vehicle electrical system through the generator battery and ground terminals.

Although the generators appear the same externally, different generators with different output ratings are used on this vehicle. Be certain that the replacement generator has the same output rating and part number as the original unit. Refer to Generator Ratings in the Specifications section at the back of this group for amperage ratings and part numbers.

Noise emitting from the generator may be caused by: worn, loose or defective bearings; a loose or defective drive pulley; incorrect, worn, damaged or misadjusted fan drive belt; loose mounting bolts; a misaligned drive pulley or a defective stator or diode.

BATTERY TEMPERATURE SENSOR

The battery temperature sensor is used to determine the battery temperature and control battery charging rate. This temperature data, along with data from monitored line voltage, is used by the PCM to vary the battery charging rate. System voltage will be higher at colder temperatures and is gradually reduced at warmer temperatures.

ELECTRONIC VOLTAGE REGULATOR

The Electronic Voltage Regulator (EVR) is not a separate component. It is actually a voltage regulating circuit located within the Powertrain Control Module (PCM). The EVR is not serviced separately. If replacement is necessary, the PCM must be replaced.

Operation: The amount of DC current produced by the generator is controlled by EVR circuitry contained within the PCM. This circuitry is connected in series with the generators second rotor field terminal and its ground.

Voltage is regulated by cycling the ground path to control the strength of the rotor magnetic field. The EVR circuitry monitors system line voltage and battery temperature (refer to Battery Temperature Sensor for more information). It then compensates and regulates generator current output accordingly. Also refer to Charging System Operation for additional information.

DIAGNOSIS AND TESTING

CHARGING SYSTEM

The following procedures may be used to diagnose the charging system if:

- the generator lamp (if equipped) is illuminated with the engine running
- the voltmeter (if equipped) does not register properly
- an undercharged or overcharged battery condition occurs.

Remember that an undercharged battery is often caused by:

- accessories being left on with the engine not running
- a faulty or improperly adjusted switch that allows a lamp to stay on. See Ignition-Off Draw Test in Group 8A, Battery for more information.

INSPECTION

To perform a complete test of the charging system, refer to the appropriate Powertrain Diagnostic Procedures service manual and the DRB scan tool. Perform the following inspections before attaching the scan tool.

(1) Inspect the battery condition. Refer to Group 8A, Battery for procedures.

(2) Inspect condition of battery cable terminals, battery posts, connections at engine block, starter solenoid and relay. They should be clean and tight. Repair as required.

(3) Inspect all fuses in both the fuseblock and Power Distribution Center (PDC) for tightness in receptacles. They should be properly installed and tight. Repair or replace as required.

(4) Inspect generator mounting bolts for tightness. Replace or tighten bolts if required. Refer to the Generator Removal/Installation section of this group for torque specifications.

DIAGNOSIS AND TESTING (Continued)

(5) Inspect generator drive belt condition and tension. Tighten or replace belt as required. Refer to Belt Tension Specifications in Group 7, Cooling System.

(6) Inspect automatic belt tensioner (if equipped). Refer to Group 7, Cooling System for information.

(7) Inspect connections at generator field, battery output, and ground terminals. Also check ground connection at engine. They should all be clean and tight. Repair as required.

CHARGING SYSTEM RESISTANCE TESTS

These tests will show the amount of voltage drop across the generator output wire, from the generator output (B+) terminal to the battery positive post. They will also show the amount of voltage drop from the ground (-) terminal on the generator to the battery negative post. Typical generator wiring harnesses are shown in (Fig. 1) or (Fig. 2). Wiring harness routing as shown may be slightly different depending on vehicle model and/or engine. Refer to Group 8W, Wiring Diagrams for additional information.

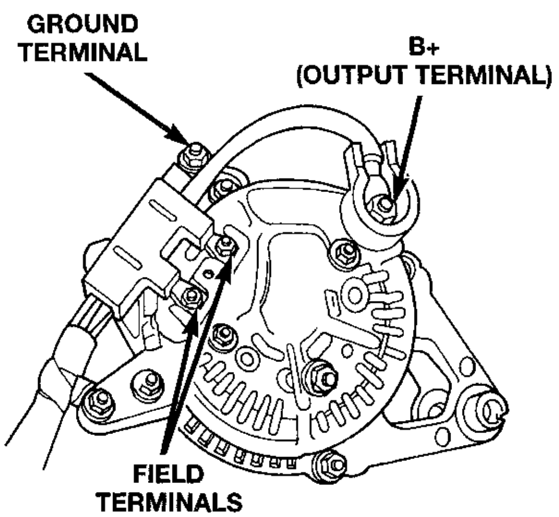

Fig. 1 Generator Terminals (Typical Wiring Harness Shown)

A voltmeter with a 0–18 volt DC scale should be used for these tests. By repositioning the voltmeter test leads, the point of high resistance (voltage drop) can easily be found.

PREPARATION

(1) Before starting test, make sure battery is in good condition and is fully-charged. See Group 8A, Battery for more information.

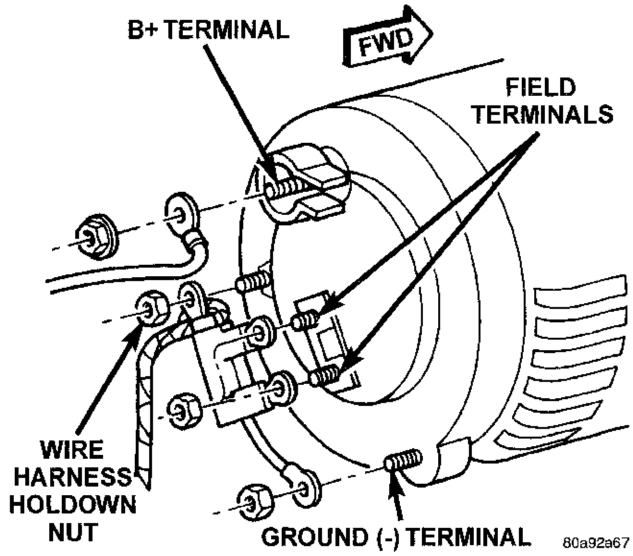

Fig. 2 Generator Terminals (Typical Wiring Harness Shown)

(2) Check condition of battery cables at battery. Clean if necessary.

(3) Start the engine and allow it to reach normal operating temperature.

(4) Shut engine off.

(5) Connect an engine tachometer.

(6) Fully engage the parking brake.

TEST

(1) Start engine.

(2) Place heater blower in high position.

(3) Turn on headlamps and place in high-beam position.

(4) Turn vehicle interior lamps on.

(5) Bring engine speed up to 2400 rpm and hold.

(6) Testing (+) circuitry:

(a) Touch the negative lead of voltmeter directly to battery positive post.

(b) Touch the positive lead of voltmeter to the B+ output terminal stud on the generator (not the terminal mounting nut). Voltage should be no higher than 0.6 volts. If voltage is higher than 0.6 volts, touch test lead to terminal mounting stud nut and then to the wiring connector. If voltage is now below 0.6 volts, look for dirty, loose or poor connection at this point. Also check condition of the generator output wire-to-battery bullet connector (if equipped). Refer to Group 8, Wiring for connector location. A voltage drop test may be performed at each (+) connection in this circuit to locate the excessive resistance.

(7) Testing (-) circuitry:

(a) Touch the negative lead of voltmeter directly to battery negative post.

DIAGNOSIS AND TESTING (Continued)

(b) Touch the positive lead of voltmeter to the ground terminal stud on the generator case (not the terminal mounting nut). Voltage should be no higher than 0.3 volts. If voltage is higher than 0.3 volts, touch test lead to terminal mounting stud nut and then to the wiring connector. If voltage is now below 0.3 volts, look for dirty, loose or poor connection at this point. A voltage drop test may be performed at each (-) connection in this circuit to locate the excessive resistance. This test can also be performed between the generator case and the engine. If test voltage is higher than 0.3 volts, check for corrosion at generator mounting points or loose generator mounting.

CURRENT OUTPUT TEST

The current output test will determine if the charging system can deliver its minimum test current (amperage) output. Refer to the Specifications section at the end of this group for minimum test current (amperage) requirements.

The first part of this test (Test 1) will determine the combined amperage output of both the generator and the Electronic Voltage Regulator (EVR) circuitry. The second part of this test (Test 2) will determine only generator amperage and **will not** include analysis of EVR circuitry. EVR circuitry is located within the Powertrain Control Module (PCM). To test voltage regulator circuitry, refer to the appropriate Powertrain Diagnostic Procedures service manual.

PREPARATION

(1) Determine if any Diagnostic Trouble Codes (DTC's) exist. To determine a DTC, refer to On-Board Diagnostics in this group. For repair, refer to the appropriate Powertrain Diagnostic Procedures manual.

(2) Before starting test, make sure battery is in good condition and is fully-charged. See Group 8A, Battery for more information.

(3) Check condition of battery cables at battery. Clean if necessary.

(4) Perform the previous Charging System Resistance Tests (voltage drop tests). This will ensure clean and tight generator/battery electrical connections.

(5) Be sure the generator drive belt is properly tensioned. Refer to Group 7, Cooling System for information.

(6) A volt/amp tester equipped with both a battery load control (carbon pile rheostat) and an inductive-type pickup clamp (ammeter probe) will be used for this test. Refer to operating instructions supplied with tester. When using a tester equipped with an inductive-type clamp, removal of wiring at the generator will not be necessary.

(7) Start the engine and allow it to reach operating temperature.

(8) Shut engine off.

(9) Turn off all electrical accessories and all vehicle lighting.

(10) Connect the volt/amp tester leads to the battery. Be sure the carbon pile rheostat control is in the OPEN or OFF position before connecting leads. See Load Test in Group 8A, Battery for more information. Also refer to the operating instructions supplied with test equipment.

(11) Connect the inductive clamp (ammeter probe). Refer to the operating instructions supplied with test equipment.

(12) If volt/amp tester is not equipped with an engine tachometer, connect a separate tachometer to the engine.

TEST 1

(1) Perform the previous test Preparation.

(2) Fully engage the parking brake.

(3) Start engine.

(4) Bring engine speed to 2500 rpm.

(5) With engine speed held at 2500 rpm, slowly adjust the rheostat control (load) on the tester to obtain the highest amperage reading. Do not allow voltage to drop below 12 volts. Record the reading. **This load test must be performed within 15 seconds to prevent damage to test equipment.** On certain brands of test equipment, this load will be applied automatically. Refer to the operating manual supplied with test equipment.

(6) The ammeter reading must meet the Minimum Test Amps specifications as displayed in the Generator Ratings chart. This can be found in the Specifications section at the end of this group. A label stating a part reference number is attached to the generator case. On some engines this label may be located on the bottom of the case. Compare this reference number to the Generator Ratings chart.

(7) Rotate the load control to the OFF position.

(8) Continue holding engine speed at 2500. If EVR circuitry is OK, amperage should drop below 15–20 amps. With all electrical accessories and vehicle lighting off, this could take several minutes of engine operation. If amperage did not drop, refer to the appropriate Powertrain Diagnostic Procedures manual for testing.

(9) Remove volt/amp tester.

If minimum amperage could not be met, proceed to Test 2. This test will determine if the generator is faulty, or if EVR circuitry is defective.

TEST 2

(1) Perform the previous test preparation.

(2) Fully engage the parking brake.

DIAGNOSIS AND TESTING (Continued)

(3) Connect one end of a jumper wire to a good ground. Connect the other end of jumper wire to the generator field driver (-) terminal. The 2 field terminals (+ and -) are located on the back of the generator (Fig. 1) or (Fig. 2). To locate and identify the (-) terminal and circuit, refer to Group 8W, Wiring Diagrams. Another way to identify the (-) terminal is to start the engine and measure voltage at both field terminals. The (+) terminal will show battery voltage (12.5–14.5 volts). The (-) terminal will show 3–5 volts less than battery voltage.

CAUTION: Do not connect the jumper ground wire to the generator field source (+) field terminal. Damage to electrical system components may result.

Connecting the jumper wire will remove the voltage regulator circuitry from the test. It will also generate a Diagnostic Trouble Code (DTC).

(4) Start engine. **Immediately** after starting, reduce engine speed to idle. This will prevent any electrical accessory damage from high voltage.

(5) Adjust carbon pile rheostat (load) and engine speed in slow increments until a speed of 1250 rpm, and a voltmeter reading of 15 volts is obtained. Immediately record ammeter reading. Do not apply load to system longer than 15 seconds as damage to test equipment may result.

CAUTION: When adjusting rheostat load, do not allow voltage to rise above 16 volts. Damage to the battery and electrical system components may result.

(6) The ammeter reading must meet the Minimum Test Amps specifications as displayed in the Generator Ratings chart. This can be found in the Specifications section at the end of this group. A label stating a part reference number is attached to the generator case. On some engines this label may be located on the bottom of the case. Compare this reference number to the Generator Rating chart.

(7) Remove volt/amp tester.

(8) Remove jumper wire.

(9) Use the DRB scan tool to erase the DTC. Refer to the DRB screen for procedures.

RESULTS

- If amp reading meets specifications in Test 2, generator is OK.
- If amp reading is less than specified in Test 2, and wire resistance (voltage drop) tests were OK, the generator should be replaced. Refer to Removal and Installation in this group for procedures.
- If Test 2 results were OK, but Test 1 results were not, the problem is in EVR circuitry. Refer to appropriate Powertrain Diagnostic Procedures manual for diagnosis.

BATTERY TEMPERATURE SENSOR

To perform a complete test of this sensor and its circuitry, refer to the appropriate Powertrain Diagnostic Procedures manual. To test the sensor only, refer to the following:

(1) The sensor is located under the battery and is attached (snapped into) the battery tray (Fig. 3). On models equipped with a diesel engine (dual batteries), only one sensor is used. Location is under battery on drivers side of vehicle. A two-wire pigtail harness is attached directly to the sensor. The opposite end of this harness connects the sensor to the engine wiring harness.

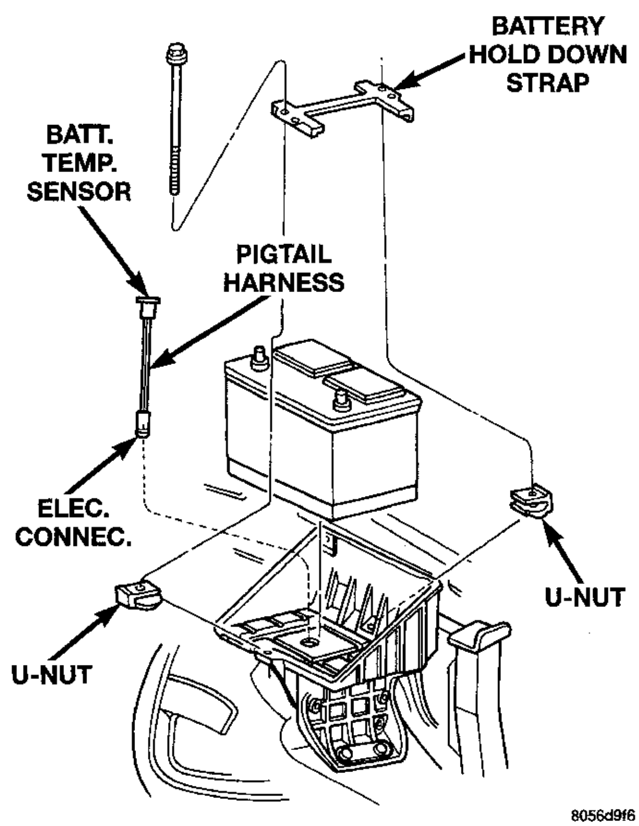

Fig. 3 Battery Temperature Sensor Location

(2) Disconnect the two-wire pigtail harness from the engine harness.

(3) Attach ohmmeter leads to the wire terminals of the pigtail harness.

(4) At room temperature of 25° C (75–80° F), an ohmmeter reading of 9,000 (9K) to 11,000 (11K) ohms should be observed.

(5) If reading is above or below the specification, replace the sensor.

(6) Refer to the Removal and Installation section for procedures.

DIAGNOSIS AND TESTING (Continued)

ON-BOARD DIAGNOSTIC TEST FOR CHARGING SYSTEM

The Powertrain Control Module (PCM) monitors critical input and output circuits of the charging system, making sure they are operational. A Diagnostic Trouble Code (DTC) is assigned to each input and output circuit monitored by the On-Board Diagnostic (OBD) system. Some circuits are checked continuously and some are checked only under certain conditions.

For DTC information, refer to Diagnostic Trouble Codes in Group 25, Emission Control System. This will include a complete list of DTC's including DTC's for the charging system.

REMOVAL AND INSTALLATION

GENERATOR

REMOVAL

WARNING: DISCONNECT NEGATIVE CABLE FROM BATTERY BEFORE REMOVING BATTERY OUTPUT WIRE (B+ WIRE) FROM GENERATOR. FAILURE TO DO SO CAN RESULT IN INJURY OR DAMAGE TO ELECTRICAL SYSTEM.

(1) Disconnect negative battery cable at battery. Diesel Engines: Disconnect both negative battery cables at both batteries.

(2) Remove generator drive belt. Refer to Group 7, Cooling System for procedure.

(3) Remove generator pivot and mounting bolts/nut (Fig. 4) or (Fig. 5). The diesel engine uses a bolt at top mounting and a bolt/nut at lower mounting. Position generator for access to wire connectors.

(4) Remove nuts from harness holddown, battery terminal, ground terminal and 2 field terminals. Remove wire connectors. A typical generator wiring harness is shown in (Fig. 6). Wiring harness routing as shown may be slightly different depending on vehicle model and/or engine. Refer to Group 8W, Wiring Diagrams for additional information.

(5) Remove generator from vehicle.

INSTALLATION

(1) Position generator to engine and install wiring to rear of generator. Tighten all wiring fasteners as follows:

- Battery terminal nut—8.5 N·m (75 in. lbs.)
- Ground terminal nut—8.5 N·m (75 in. lbs.)
- Harness holddown nut—8.5 N·m (75 in. lbs.)
- Field terminal nuts—2.8 N·m (25 in. lbs.)

(2) Install generator mounting fasteners and tighten as follows:

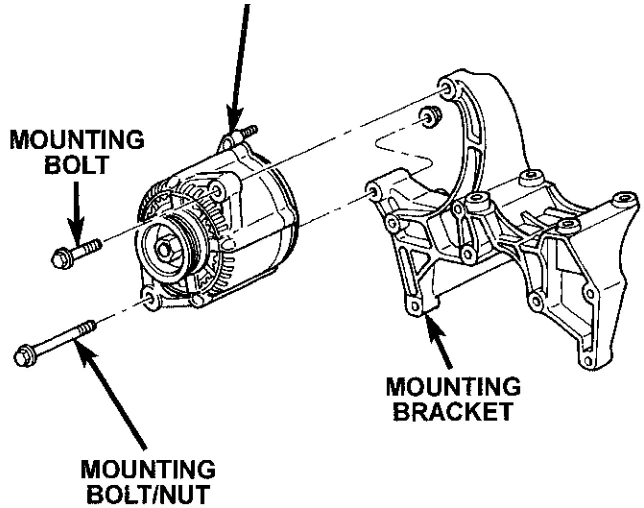

Fig. 4 Remove/Install Generator—3.9L/5.2L/5.9L Engines

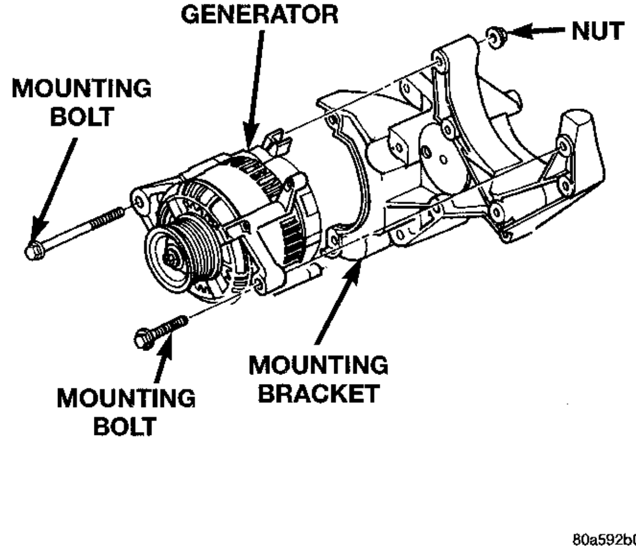

Fig. 5 Remove/Install Generator—8.0L Engine

- Generator mounting bolt—All gas powered engines—41 N·m (30 ft. lbs.)
- Generator pivot bolt/nut—All gas powered engines—41 N·m (30 ft. lbs.)
- Generator mounting bolt—Diesel powered engines—54 N·m (40 ft. lbs.)
- Generator pivot bolt/nut—Diesel powered engines—54 N·m (40 ft. lbs.)

CAUTION: Never force a belt over a pulley rim using a screwdriver. The synthetic fiber of the belt can be damaged.

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REMOVAL AND INSTALLATION (Continued)

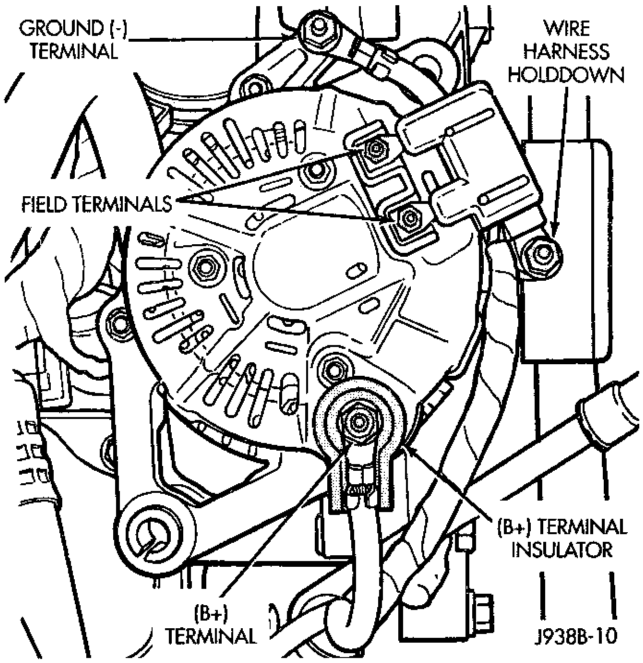

Fig. 6 Remove/Install Generator Connectors—Typical

CAUTION: When installing a serpentine accessory drive belt, the belt MUST be routed correctly. The water pump will be rotating in the wrong direction if the belt is installed incorrectly, causing the engine to overheat. Refer to belt routing label in engine compartment, or refer to Belt Schematics in Group 7, Cooling System.

(3) Install generator drive belt. Refer to Group 7, Cooling System for procedure.

(4) Install negative battery cable(s) to battery(s).

BATTERY TEMPERATURE SENSOR

The battery temperature sensor is located under the vehicle battery (Fig. 7) and is attached (snapped into) a mounting hole on battery tray. On models equipped with a diesel engine (dual batteries), only one sensor is used. The sensor is located under the battery on drivers side of vehicle.

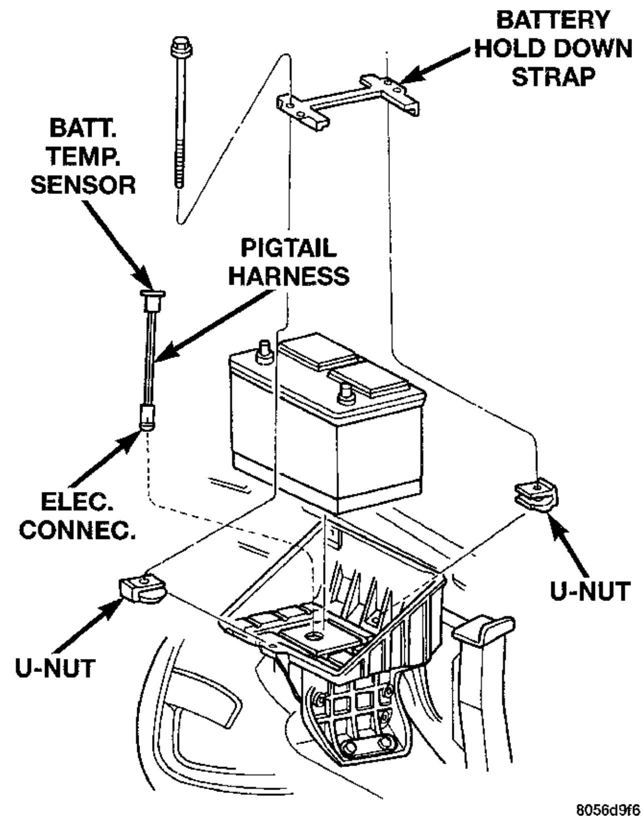

Fig. 7 Battery Temperature Sensor Location

REMOVAL

(1) Remove battery. Refer to Group 8A, Battery for procedures.

(2) Disconnect sensor pigtail harness from engine wire harness.

(3) Pry sensor straight up from battery tray mounting hole.

INSTALLATION

(1) Feed pigtail harness through mounting hole in top of battery tray and press sensor into top of tray (snaps in).

(2) Connect pigtail harness.

(3) Install battery. Refer to Group 8A, Battery for procedures.

SPECIFICATIONS

GENERATOR RATINGS

TYPE	PART NUMBER	RATED SAE AMPS	ENGINES	MINIMUM TEST AMPS
DENSO	52067912	117	3.9L/5.2L/5.9L GAS	90
DENSO	52067913	136	3.9L/5.2L/5.9L GAS	100
DENSO	56027221	136	5.9L DIESEL	120

TORQUE CHART

DESCRIPTION	TORQUE
Generator Mounting Bolt—All Gas Powered Engines	41 N·m (30 ft. lbs.)
Generator Pivot Bolt/Nut—All Gas Powered Engines	41 N·m (30 ft. lbs.)
Generator Mounting Bolt—Diesel Engine	54 N·m (40 ft. lbs.)
Generator Pivot Bolt/Nut—Diesel Engine	54 N·m (40 ft. lbs.)
Battery Terminal Nut	8.5 N·m (75 in. lbs.)
Ground Terminal Nut	8.5 N·m (75 in. lbs.)
Harness Hold-down Nut	8.5 N·m (75 in. lbs.)
Field Terminal Nuts	2.8 N·m (25 in. lbs.)

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IGNITION SYSTEM

CONTENTS

GENERAL INFORMATION

INTRODUCTION

This group describes the ignition systems for 3.9L V-6, 5.2L/5.9L V-8, and 8.0L V-10 engines.

The 3.9L V-6 and 5.2L V-8 engines will be referred to in this Ignition Group as: Light Duty Cycle (LDC) engines. The 5.9L V-8 gas powered engine will be referred to as either: Light Duty Cycle (LDC) or Heavy Duty Cycle (HDC) engines. The 8.0L V-10 engine will be referred to as either: Medium Duty Cycle (MDC) or Heavy Duty Cycle (HDC) engines.

Either of the HDC gas powered engines can be easily identified by the use of an engine mounted air injection pump. The 3.9L V-6 engine, the 5.2/5.9L V-8 LDC or the 8.0L V-10 MDC gas engines will not use an air injection pump.

On Board Diagnostics is described in Group 25, Emission Control Systems.

Group 0, Lubrication and Maintenance, contains general maintenance information (in time or mileage intervals) for ignition related items. The Owner's Manual also contains maintenance information.

DESCRIPTION AND OPERATION

IGNITION SYSTEM—V-6/V–8 ENGINES

The ignition systems used on the 3.9L V-6, the 5.2L V-8 and the 5.9L V-8 are basically identical. Similarities and differences between the systems will be discussed.

The ignition system is controlled by the powertrain control module (PCM) on all engines.

The ignition system consists of:

- Spark Plugs
- Ignition Coil
- Secondary Ignition Cables
- Distributor (contains rotor and camshaft position sensor)
- Powertrain Control Module (PCM)
- Also to be considered part of the ignition system are certain inputs from the Crankshaft Position, Camshaft Position, Throttle Position and MAP Sensors

IGNITION SYSTEM—8.0L V-10 ENGINE

The ignition system used on the 8.0L V–10 engine does not use a conventional mechanical distributor. The system will be referred to as a distributor-less ignition system. The ignition coils are individually fired, but each coil is a dual output. Refer to Ignition Coil Pack for additional information.

The ignition system is controlled by the powertrain control module (PCM) on all engines.

The ignition system consists of:

- Spark Plugs
- Ignition Coil Packs containing individual coils
- Secondary Ignition Cables
- Powertrain Control Module (PCM)
- Also to be considered part of the ignition system are certain inputs from the Crankshaft Position, Camshaft Position, Throttle Position and MAP Sensors

POWERTRAIN CONTROL MODULE

The Powertrain Control Module (PCM) is located in the engine compartment (Fig. 1).

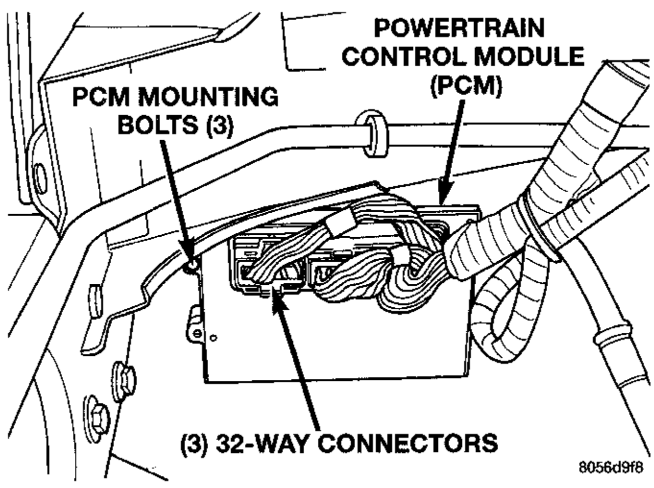

Fig. 1 Powertrain Control Module (PCM)

The ignition system is controlled by the PCM.

NOTE: On 3.9L/5.2L/5.9L engines, base ignition timing by rotation of distributor is not adjustable.

DESCRIPTION AND OPERATION (Continued)

The PCM opens and closes the ignition coil ground circuit (or circuits) to operate the ignition coil (or coil packs). This is done to adjust ignition timing, both initial (base) and advance, and for changing engine operating conditions.

The amount of electronic spark advance provided by the PCM is determined by five input factors: engine coolant temperature, engine rpm, intake manifold temperature, manifold absolute pressure and throttle position.

DISTRIBUTOR

All 3.9L V-6 and 5.2L/5.9L V-8 engines are equipped with a conventional camshaft driven mechanical distributor containing a shaft driven distributor rotor. The distributor is equipped with the camshaft position (fuel sync) sensor (Fig. 2). This sensor provides fuel injection synchronization and cylinder identification.

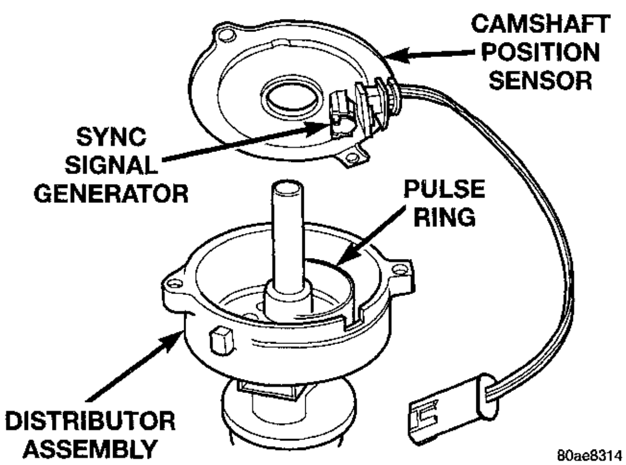

Fig. 2 Distributor and Camshaft Position Sensor-Typical

The distributor does not have built in centrifugal or vacuum assisted advance. Base ignition timing and all timing advance is controlled by the Powertrain Control Module (PCM). Because ignition timing is controlled by the PCM, **base ignition timing is not adjustable.**

The distributor is held to the engine in the conventional method using a holddown clamp and bolt. **Although the distributor can be rotated, it will have no effect on ignition timing.**

All distributors contain an internal oil seal that prevents oil from entering the distributor housing. The seal is not serviceable.

SPARK PLUGS

The 3.9L V-6 and 5.2L/5.9L V-8 engines use resistor type spark plugs. The 8.0L V-10 engine uses inductive type spark plugs. Remove the spark plugs and examine them for burned electrodes and fouled, cracked or broken porcelain insulators. Keep plugs arranged in the order in which they were removed from the engine. A single plug displaying an abnormal condition indicates that a problem exists in the corresponding cylinder. Replace spark plugs at the intervals recommended in Group O, Lubrication and Maintenance

Spark plugs that have low mileage may be cleaned and reused if not otherwise defective, carbon or oil fouled. Refer to the Spark Plug Condition section of this group.

SPARK PLUG CABLES

Spark plug cables are sometimes referred to as secondary ignition wires. These cables transfer electrical current from the ignition coil(s) and/or distributor, to individual spark plugs at each cylinder. The resistive spark plug cables are of nonmetallic construction. The cables provide suppression of radio frequency emissions from the ignition system.

IGNITION COIL—3.9L/5.2L/5.9L ENGINES

Battery voltage is supplied to the ignition coil positive terminal from the ASD relay.

The Powertrain Control Module (PCM) opens and closes the ignition coil ground circuit for ignition coil operation.

Base ignition timing is not adjustable on any engine. By controlling the coil ground circuit, the PCM is able to set the base timing and adjust the ignition timing advance. This is done to meet changing engine operating conditions.

The ignition coil is not oil filled. The windings are embedded in an epoxy compound. This provides heat and vibration resistance that allows the ignition coil to be mounted on the engine.

IGNITION COIL PACKS—8.0L ENGINE

The ignition system used on the 8.0L V-10 engine does not use a conventional mechanical distributor. It will be referred to as a distributor-less ignition system. **Ignition timing is not adjustable on any 8.0L V-10 engine.**

Two separate coil packs containing a total of five independent coils are attached to a common mounting bracket located above the right engine valve cover (Fig. 3). The coil packs are not oil filled. The front coil pack contains three independent epoxy filled coils. The rear coil pack contains two independent epoxy filled coils.

When one of the 5 independent coils discharges, it fires two paired cylinders at the same time (one cylinder on compression stroke and the other cylinder on exhaust stroke).

Coil firing is paired together on cylinders:

- Number 5 and 10

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DESCRIPTION AND OPERATION (Continued)

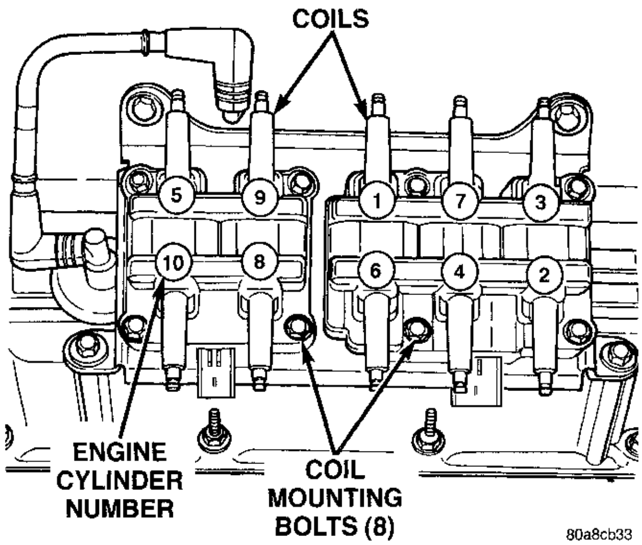

Fig. 3 Ignition Coil Packs—8.0L V-10 Engine

- Number 9 and 8
- Number 1 and 6
- Number 7 and 4
- Number 3 and 2

The ignition system is controlled by the powertrain control module (PCM) on all engines. The PCM was formerly referred to as the SBEC or engine controller.

The automatic shutdown (ASD) relay, after receiving signals from the crankshaft and camshaft position sensors, will supply battery voltage to all of the ignition coil positive terminals. If these signals are not received by the PCM after approximately one second of engine cranking (start-up), the ASD relay will shut off positive voltage to all of the coils. Coil operation (firing) is then controlled by switching ground circuits (off-and-on) through the PCM. The PCM will determine cylinder identification after receiving signals from the crankshaft and camshaft position sensors.

The PCM adjusts ignition timing based on inputs it receives from:

- The engine coolant temperature sensor
- The crankshaft position sensor (engine speed)
- The manifold absolute pressure (MAP) sensor
- The throttle position sensor
- Transmission gear selection

AUTOMATIC SHUTDOWN (ASD) RELAY—3.9L/5.2L/5.9L ENGINES

As one of its functions, the ASD relay will supply battery voltage to the ignition coil. The ground circuit for the ASD relay is controlled by the Powertrain Control Module (PCM). The PCM regulates ASD relay operation by switching the ground circuit on-and-off.

AUTOMATIC SHUTDOWN (ASD) RELAY—8.0L V-10 ENGINE

As one of its functions, the ASD relay will supply battery voltage to each of the 5 independent ignition coils. The ground circuit for the ASD relay is controlled by the Powertrain Control Module (PCM). The PCM regulates ASD relay operation by switching the ground circuit on-and-off.

CRANKSHAFT POSITION SENSOR—3.9L V-6 ENGINE

Engine speed and crankshaft position are provided through the crankshaft position sensor. The sensor generates pulses that are the input sent to the Powertrain Control Module (PCM). The PCM interprets the sensor input to determine the crankshaft position. The PCM then uses this position, along with other inputs, to determine injector sequence and ignition timing.

The sensor is a hall effect device combined with an internal magnet. It is also sensitive to steel within a certain distance from it.

The flywheel/drive plate has groups of notches at its outer edge. On 3.9L V-6 engines, there are three sets of double notches and three sets of single notches (Fig. 4).

The notches cause a pulse to be generated when they pass under the sensor. The pulses are the input to the PCM.

The engine will not operate if the PCM does not receive a crankshaft position sensor input.

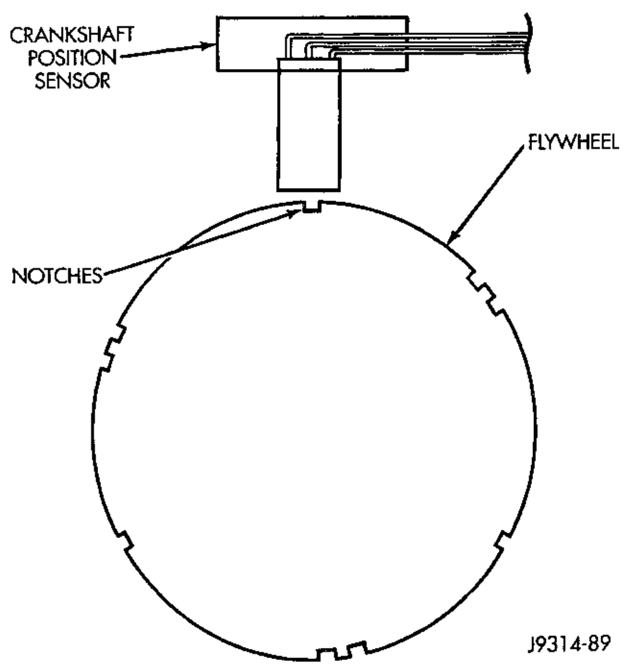

Fig. 4 Sensor Operation—3.9L Engine

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DESCRIPTION AND OPERATION (Continued)

CRANKSHAFT POSITION SENSOR—5.2L/5.9L V-8 ENGINES

Engine speed and crankshaft position are provided through the crankshaft position sensor. The sensor generates pulses that are the input sent to the Powertrain Control Module (PCM). The PCM interprets the sensor input to determine the crankshaft position. The PCM then uses this position, along with other inputs, to determine injector sequence and ignition timing.

The sensor is a hall effect device combined with an internal magnet. It is also sensitive to steel within a certain distance from it.

On 5.2L and 5.9L V-8 engines, the flywheel/drive plate has 8 single notches, spaced every 45 degrees, at its outer edge (Fig. 5).

The notches cause a pulse to be generated when they pass under the sensor. The pulses are the input to the PCM. For each engine revolution, there are 8 pulses generated on V-8 engines.

The engine will not operate if the PCM does not receive a crankshaft position sensor input.

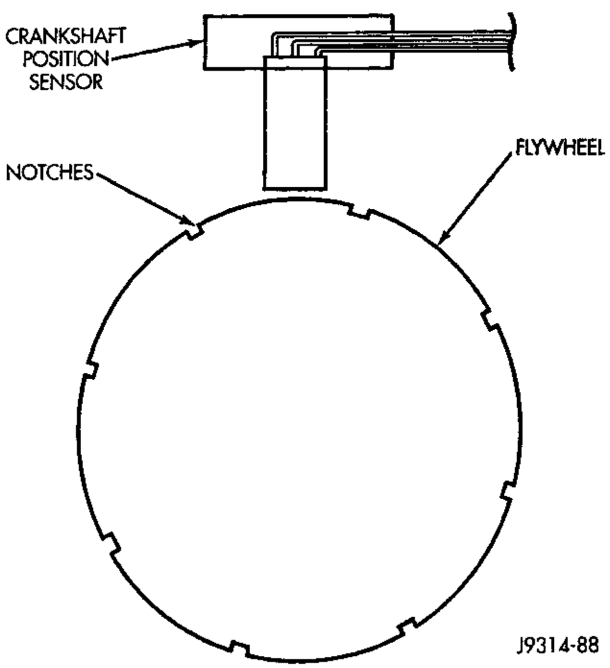

Fig. 5 Sensor Operation—5.2L/5.9L Engine

CRANKSHAFT POSITION SENSOR—8.0L V-10 ENGINE

The crankshaft position sensor is located on the right-lower side of the cylinder block, forward of the right engine mount, just above the oil pan rail (Fig. 6).

The crankshaft position sensor detects notches machined into the middle of the crankshaft (Fig. 7).

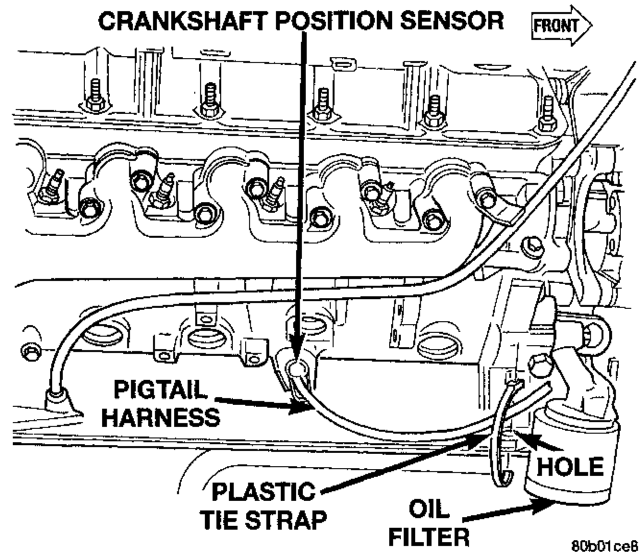

Fig. 6 Crankshaft Position Sensor Location—8.0L V-10 Engine

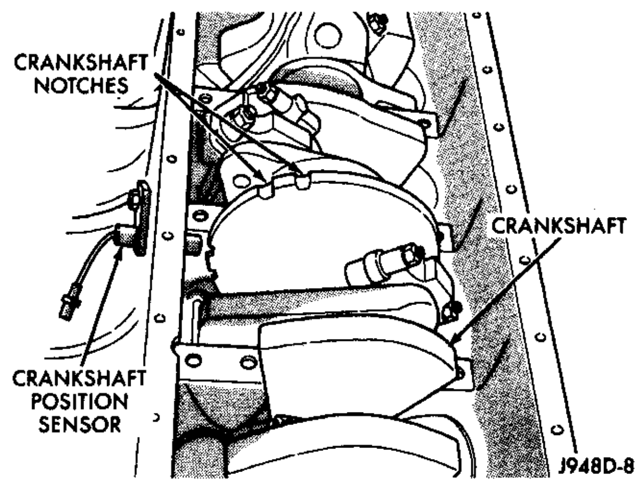

Fig. 7 Crankshaft Position Sensor Operation—8.0L V-10 Engine

There are five sets of notches. Each set contains two notches. Basic ignition timing is determined by the position of the last notch in each set of notches. Once the powertrain control module (PCM) senses the last notch, it will determine crankshaft position (which piston will next be at Top Dead Center). An input from the camshaft position sensor is also needed. It may take the module up to one complete engine revolution to determine crankshaft position during engine cranking.

The PCM uses the signal from the camshaft position sensor to determine fuel injector sequence. Once crankshaft position has been determined, the PCM begins energizing a ground circuit to each fuel injector to provide injector operation.

DESCRIPTION AND OPERATION (Continued)

CAMSHAFT POSITION SENSOR—3.9L/5.2L/5.9L ENGINES

The camshaft position sensor is located in the distributor on all engines.

The sensor contains a hall effect device called a sync signal generator to generate a fuel sync signal. This sync signal generator detects a rotating pulse ring (shutter) on the distributor shaft. The pulse ring rotates 180 degrees through the sync signal generator. Its signal is used in conjunction with the crankshaft position sensor to differentiate between fuel injection and spark events. It is also used to synchronize the fuel injectors with their respective cylinders.

When the leading edge of the pulse ring (shutter) enters the sync signal generator, the following occurs: The interruption of magnetic field causes the voltage to switch high resulting in a sync signal of approximately 5 volts.

When the trailing edge of the pulse ring (shutter) leaves the sync signal generator, the following occurs: The change of the magnetic field causes the sync signal voltage to switch low to 0 volts.

CAMSHAFT POSITION SENSOR—8.0L V-10 ENGINE

The camshaft position sensor is located on the timing chain case/cover on the left-front side of the engine (Fig. 8).

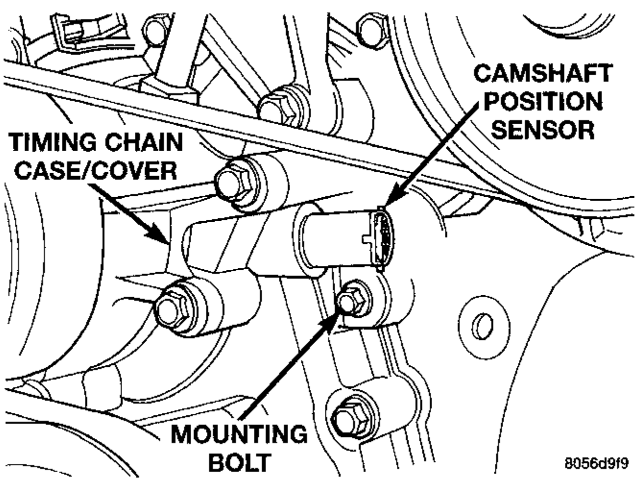

Fig. 8 Camshaft Position Sensor Location—8.0L V-10 Engine

The camshaft position sensor is used in conjunction with the crankshaft position sensor to differentiate between fuel injection and spark events. It is also used to synchronize the fuel injectors with their respective cylinders. The sensor generates electrical pulses. These pulses (signals) are sent to the powertrain control module (PCM). The PCM will then determine crankshaft position from both the camshaft position sensor and crankshaft position sensor.

A low and high area are machined into the camshaft drive gear (Fig. 9). The sensor is positioned in the timing gear cover so that a small air gap (Fig. 9) exists between the face of sensor and the high machined area of cam gear.

When the cam gear is rotating, the sensor will detect the machined low area. Input voltage from the sensor to the PCM will then switch from a low (approximately 0.3 volts) to a high (approximately 5 volts). When the sensor detects the high machined area, the input voltage switches back low to approximately 0.3 volts.

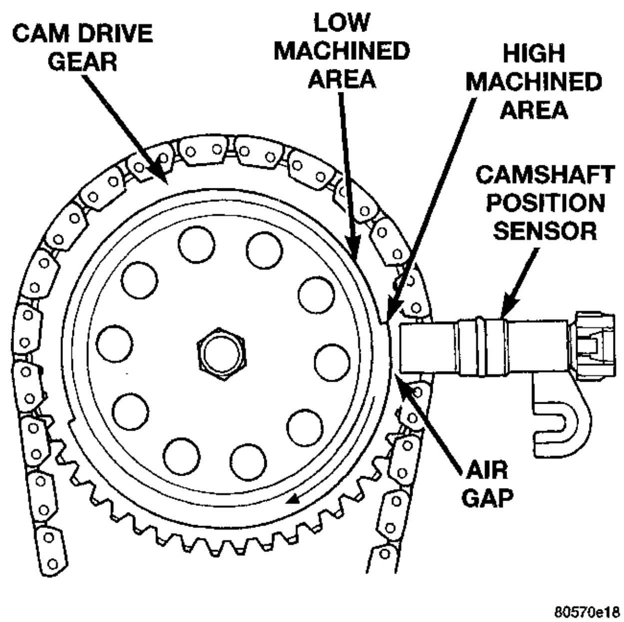

Fig. 9 Sensor Operation—8.0L V-10 Engine

MANIFOLD ABSOLUTE PRESSURE (MAP) SENSOR

For an operational description, diagnosis and removal/installation procedures, refer to Group 14, Fuel System.

ENGINE COOLANT TEMPERATURE SENSOR

For an operational description, diagnosis and removal/installation procedures, refer to Group 14, Fuel System.

THROTTLE POSITION SENSOR

For an operational description, diagnosis and removal/installation procedures, refer to Group 14, Fuel System.

INTAKE MANIFOLD AIR TEMPERATURE SENSOR

For an operational description, diagnosis and removal/installation procedures, refer to Group 14, Fuel System.

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DESCRIPTION AND OPERATION (Continued)

IGNITION SWITCH AND KEY LOCK CYLINDER

The ignition switch is located on the steering column. The Key-In-Switch is located in the ignition switch module. For electrical diagnosis of the Key-In-Switch, refer to Group 8U, Chime/Buzzer Warning Systems. For removal/installation of either the key lock cylinder or ignition switch, refer to Ignition Switch and Key Cylinder Removal/Installation in this group.

On vehicles equipped with an automatic transmission, a cable connects an interlock device within the steering column assembly to the transmission floor shift lever. This interlock device is used to lock the transmission shifter in the PARK position when the key is in the LOCKED or ACCESSORY position. The interlock device is not serviceable. If repair is necessary, the steering column assembly must be replaced. Refer to Group 19, Steering for procedures. The shifter interlock cable can be adjusted or replaced. Refer to Group 21, Transmissions for procedures.

DIAGNOSIS AND TESTING

AUTOMATIC SHUTDOWN (ASD) RELAY TEST

To perform a complete test of this relay and its circuitry, refer to the DRB scan tool. Also refer to the appropriate Powertrain Diagnostics Procedures manual. To test the relay only, refer to Relays—Operation/Testing in the Group 14, Fuel Systems section.

TESTING FOR SPARK AT COIL—3.9L/5.2L/5.9L ENGINES

CAUTION: When disconnecting a high voltage cable from a spark plug or from the distributor cap, twist the rubber boot slightly (1/2 turn) to break it loose (Fig. 10). Grasp the boot (not the cable) and pull it off with a steady, even force.

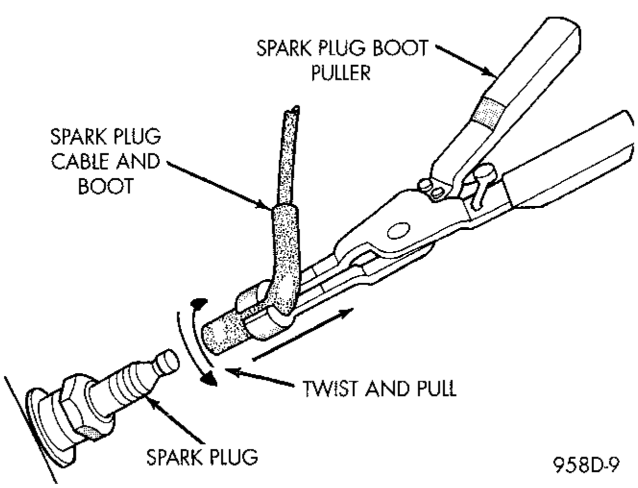

Fig. 10 Cable Removal

(1) Disconnect the ignition coil secondary cable from center tower of the distributor cap. Hold the cable terminal approximately 12 mm (1/2 in.) from a good engine ground (Fig. 11).

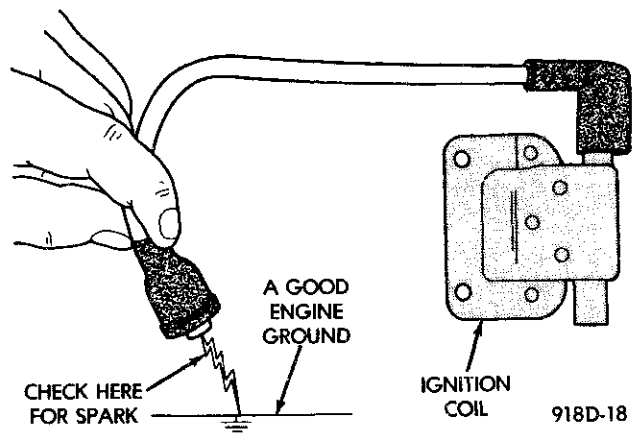

Fig. 11 Checking for Spark—Typical

WARNING: BE VERY CAREFUL WHEN THE ENGINE IS CRANKING. DO NOT PUT YOUR HANDS NEAR THE PULLEYS, BELTS OR THE FAN. DO NOT WEAR LOOSE FITTING CLOTHING.

(2) Rotate (crank) the engine with the starter motor and observe the cable terminal for a steady arc. If steady arcing does not occur, inspect the secondary coil cable. Refer to Spark Plug Cables in this group. Also inspect the distributor cap and rotor for cracks or burn marks. Repair as necessary. If steady arcing occurs, connect ignition coil cable to the distributor cap.

(3) Remove a cable from one spark plug.

(4) Using insulated pliers, hold the cable terminal approximately 12 mm (1/2 in.) from the engine cylinder head or block while rotating the engine with the starter motor. Observe the spark plug cable terminal for an arc. If steady arcing occurs, it can be expected that the ignition secondary system is operating correctly. **(If the ignition coil cable is removed for this test, instead of a spark plug cable, the spark intensity will be much higher).** If steady arcing occurs at the spark plug cables, but the engine will not start, connect the DRB scan tool. Refer to the appropriate Powertrain Diagnostic Procedures service manual.

IGNITION COIL TEST—3.9L/5.2L/5.9L ENGINES

To perform a complete test of the ignition coil and its circuitry, refer to the DRB scan tool. Also refer to the appropriate Powertrain Diagnostics Procedures manual. To test the coil only, refer to the following:

The ignition coil (Fig. 12) is designed to operate without an external ballast resistor.

DIAGNOSIS AND TESTING (Continued)

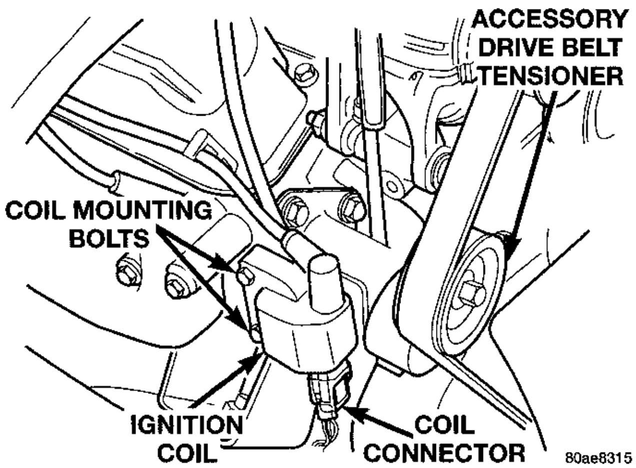

Fig. 12 Ignition Coil (5.2L Shown)

Inspect the ignition coil for arcing. Test the coil according to coil tester manufacturer's instructions. Test the coil primary and secondary resistance. Replace any coil that does not meet specifications. Refer to the IGNITION COIL RESISTANCE chart.

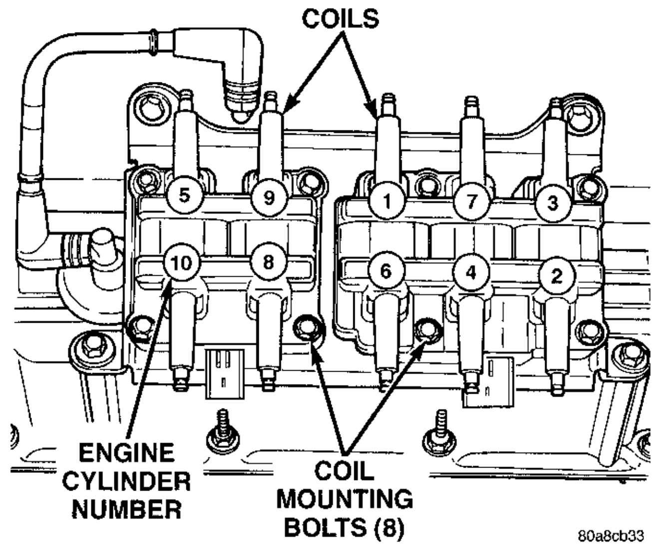

Fig. 13 Ignition Coil Packs—8.0L V-10 Engine

To test the secondary resistance of each individual paired coil, attach an ohmmeter across the coil towers (Fig. 14) or (Fig. 15). This must be done between corresponding cylinders number 3/2, 7/4, 1/6, 9/8 or 5/10 (Fig. 13). Refer to the IGNITION COIL RESISTANCE—8.0L V-10 ENGINE chart for specifications.

IGNITION COIL RESISTANCE—V-6/V-8

COIL MANUFACTURER	PRIMARY RESISTANCE 21-27°C (70-80°F)	SECONDARY RESISTANCE 21-27°C (70-80°F)
Diamond	0.97 - 1.18 Ohms	11,300 - 15,300 Ohms
Toyodenso	0.95 - 1.20 Ohms	11,300 - 13,300 Ohms

If the ignition coil is being replaced, the secondary spark plug cable must also be checked. Replace cable if it has been burned or damaged.

Arcing at the tower will carbonize the cable boot, which if it is connected to a new ignition coil, will cause the coil to fail.

If the secondary coil cable shows any signs of damage, it should be replaced with a new cable and new terminal. Carbon tracking on the old cable can cause arcing and the failure of a new ignition coil.

IGNITION COIL PACK TESTS—8.0L V-10 ENGINE

To perform a complete test of the ignition coil packs and their circuitry, refer to the DRB scan tool. Also refer to the appropriate Powertrain Diagnostics Procedures manual. To test the coil packs only, refer to the following procedure:

Two separate coil packs containing a total of five independent coils are attached to a common mounting bracket located above the right engine valve cover (Fig. 13). The coil packs are not oil filled. The front coil pack contains three independent epoxy filled coils that will fire six cylinders. The rear coil pack contains two independent epoxy filled coils that will fire four cylinders.

To test the primary resistance of the front coil pack, attach an ohmmeter between the B+ coil terminal and either the right (cylinders 3/2), center (cylinders 7/4) or left coil (cylinders 1/6) terminals (Fig. 16). Refer to the IGNITION COIL RESISTANCE—8.0L V-10 ENGINE chart for specifications.

To test the primary resistance of the rear coil pack, attach an ohmmeter between the B+ coil terminal and either the right (cylinders 9/8) or left (cylinders 5/10) coil terminals (Fig. 17). Refer to the IGNITION COIL RESISTANCE—8.0L V-10 ENGINE chart for specifications.

FAILURE TO START TEST—3.9L/5.2L/5.9L ENGINES

To prevent unnecessary diagnostic time and wrong test results, the Testing For Spark At Coil test should be performed prior to this test.

WARNING: SET PARKING BRAKE OR BLOCK THE DRIVE WHEELS BEFORE PROCEEDING WITH THIS TEST.

DIAGNOSIS AND TESTING (Continued)

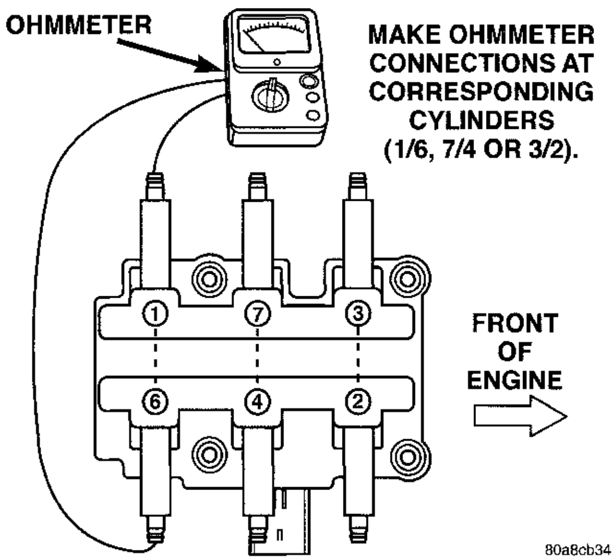

Fig. 14 Checking Coil Secondary Resistance—Front Coils—8.0L V-10 Engine

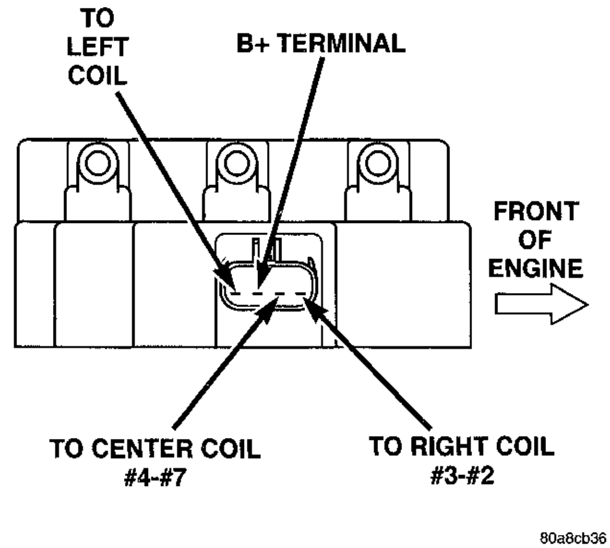

Fig. 16 Checking Coil Primary Resistance—Front Coils—8.0L V-10 Engine

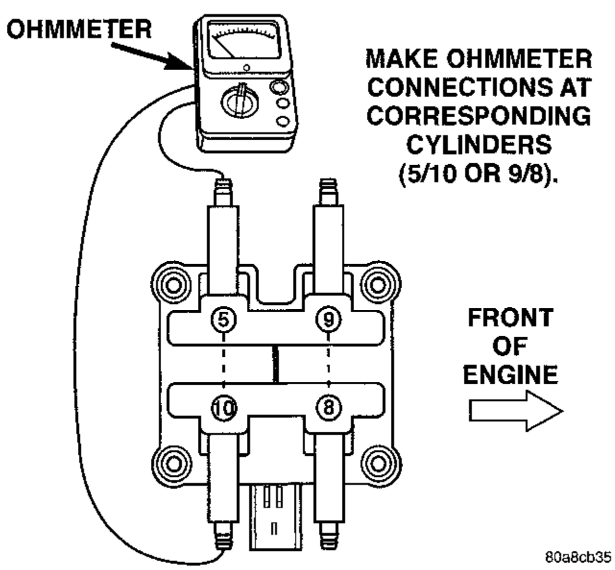

Fig. 15 Checking Coil Secondary Resistance—Rear Coils—8.0L V-10 Engine

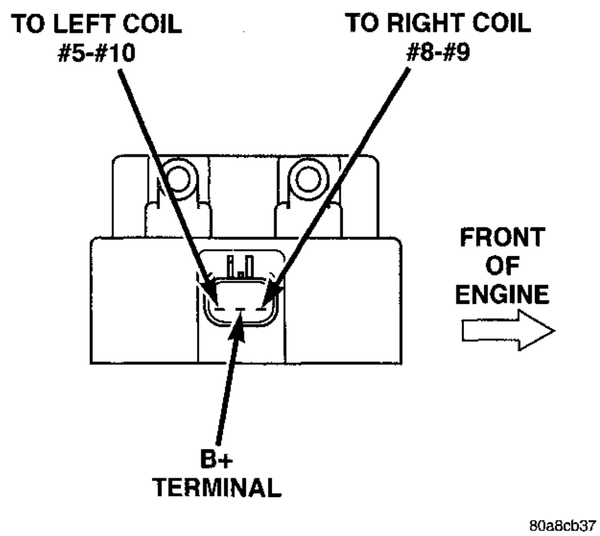

Fig. 17 Checking Coil Primary Resistance—Rear Coils—8.0L V-10 Engine

(1) Unplug the ignition coil harness connector at the coil (Fig. 12).

(2) Connect a set of small jumper wires (18 gauge or smaller) between the disconnected harness terminals and the ignition coil terminals. To determine polarity at connector and coil, refer to the Wiring Diagrams section.

(3) Attach one lead of a voltmeter to the positive (12 volt) jumper wire. Attach the negative side of voltmeter to a good ground. Determine that sufficient battery voltage (12.4 volts) is present for the starting and ignition systems.

IGNITION COIL RESISTANCE—8.0L V-10 ENGINE

Primary Resistance: 0.53-0.65 Ohms. Test across the primary connector. Refer to text for test procedures.
Secondary Resistance: 10.9-14.7K Ohms. Test across the individual coil towers. Refer to text for test procedures.

DIAGNOSIS AND TESTING (Continued)

* Primary Resistance: 0.53 to 0.65 ohms
** Secondary Resistance: 10.9 to 14.7 K ohms

* Test across the primary connector. Refer to text for test procedures.
** Test across the individual coil towers. Refer to text for test procedures.

J948D-13

Fig. 18 Ignition Coil Resistance—8.0L V-10 Engine

(4) Determine that sufficient battery voltage (12.4 volts) is present for the starting and ignition systems.

(5) Crank the engine for 5 seconds while monitoring the voltage at the coil positive terminal:

- If the voltage remains near zero during the entire period of cranking, refer to On-Board Diagnostics in Group 14, Fuel Systems. Check the Powertrain Control Module (PCM) and auto shutdown relay.
- If voltage is at or near battery voltage and drops to zero after 1-2 seconds of cranking, check the powertrain control module circuit. Refer to On-Board Diagnostics in Group 14, Fuel Systems.
- If voltage remains at or near battery voltage during the entire 5 seconds, turn the key off. Remove the three 32-way connectors (Fig. 19) from the PCM. Check 32-way connectors for any spread terminals or corrosion.

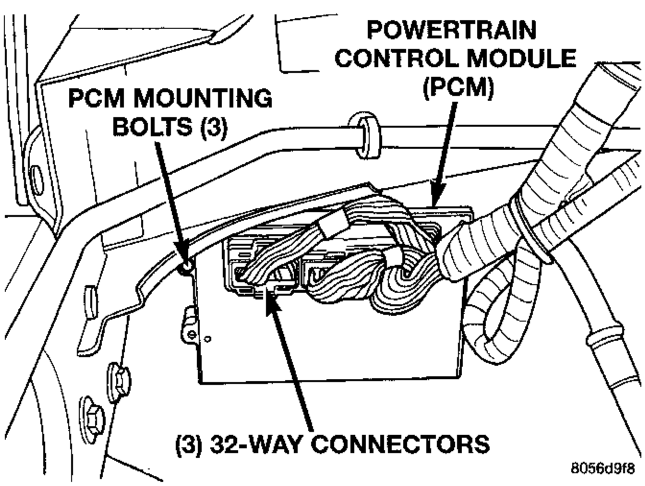

Fig. 19 PCM and Three 32–Way Connectors

(6) Remove test lead from the coil positive terminal. Connect an 18 gauge jumper wire between the battery positive terminal and the coil positive terminal.

(7) Make the special jumper shown in (Fig. 20). Using the jumper, **momentarily** ground the ignition coil driver circuit at the PCM connector (cavity A-7). For cavity/terminal location of this circuit, refer to Group 8W, Wiring. A spark should be generated at the coil cable when the ground is removed.

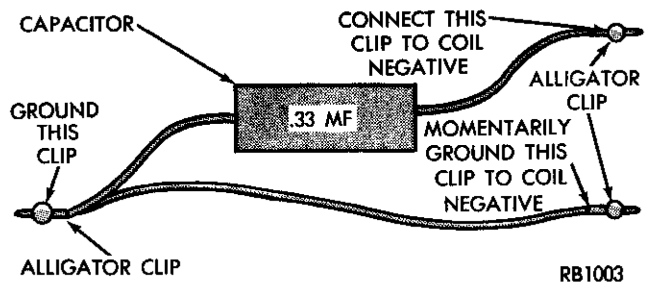

Fig. 20 Special Jumper Ground-to-Coil Negative Terminal

(8) If spark is generated, replace the PCM.

(9) If spark is not seen, use the special jumper to ground the coil negative terminal directly.

(10) If spark is produced, repair wiring harness for an open condition.

(11) If spark is not produced, replace the ignition coil.

DISTRIBUTOR CAP—3.9L/5.2L/5.9L ENGINES

Remove the distributor cap and wipe it clean with a dry lint free cloth. Visually inspect the cap for cracks, carbon paths, broken towers or damaged rotor button (Fig. 21) or (Fig. 22). Also check for white deposits on the inside (caused by condensation entering the cap through cracks). Replace any cap that displays charred or eroded terminals. The machined surface of a terminal end (faces toward rotor) will indicate some evidence of erosion from normal operation. Examine the terminal ends for evidence of mechanical interference with the rotor tip.

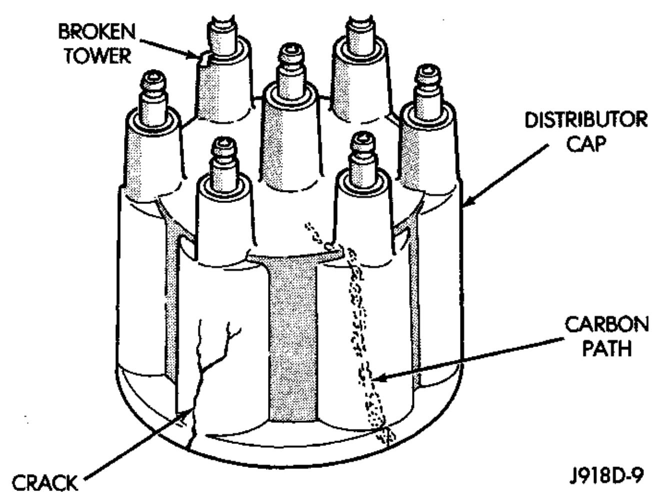

Fig. 21 Cap Inspection—External—Typical

DISTRIBUTOR ROTOR—3.9L/5.2L/5.9L ENGINES

Visually inspect the rotor (Fig. 23) for cracks, evidence of corrosion or the effects of arcing on the

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DIAGNOSIS AND TESTING (Continued)

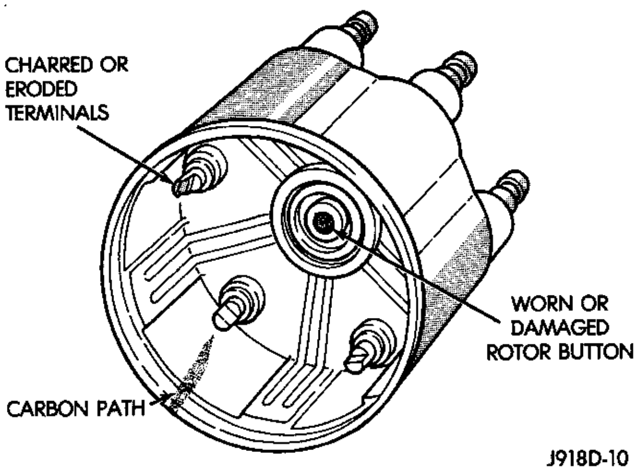

Fig. 22 Cap Inspection—Internal—Typical

metal tip. Also check for evidence of mechanical interference with the cap. Some charring is normal on the end of the metal tip. The silicone-dielectric-varnish-compound applied to the rotor tip for radio interference noise suppression, will appear charred. This is normal. **Do not remove the charred compound.** Test the spring for insufficient tension. Replace a rotor that displays any of these adverse conditions.

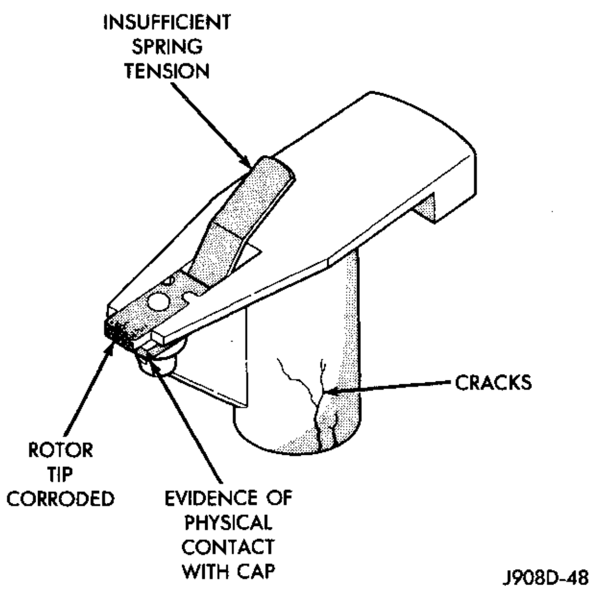

Fig. 23 Rotor Inspection—Typical

IGNITION TIMING

NOTE: Base (initial) ignition timing is NOT adjustable on any engine. On 3.9L/5.2L/5.9L engines, do not attempt to adjust ignition timing by rotating the distributor.

All ignition timing functions are controlled by the Powertrain Control Module (PCM). The DRB scan tool may be used to verify base timing and electronic timing advance. Refer to the appropriate Powertrain Diagnostics Procedures service manual for operation of the DRB Scan Tool.

Fuel synchronization can be verified and set by rotating the distributor. Refer to the Distributor Removal/Installation section of this group. See Checking Distributor Position. This operation can be performed on 3.9L/5.2L/5.9L engines only.

MAP SENSOR

For an operational description, diagnosis or removal/ installation procedures, refer to Group 14, Fuel Systems.

CRANKSHAFT POSITION SENSOR

To perform a complete test of this sensor and its circuitry, refer to the DRB scan tool. Also refer to the appropriate Powertrain Diagnostics Procedures manual.

CAMSHAFT POSITION SENSOR—3.9L/5.2L/5.9L ENGINES

The camshaft position sensor is located in the distributor (Fig. 24) on all engines.

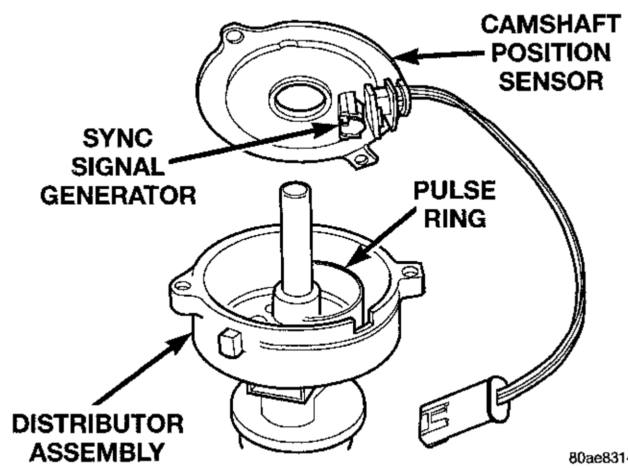

Fig. 24 Camshaft Position Sensor—3.9/5.2/5.9L Engines—Typical

To perform a complete test of this sensor and its circuitry, refer to the appropriate Powertrain Diagnostics Procedures service manual. To test the sensor only, refer to the following:

For this test, an analog (non-digital) voltmeter is needed. Do not remove the distributor connector from the distributor. Using small paper clips, insert them into the backside of the distributor wire harness connector to make contact with the terminals. Be sure that the connector is not damaged

DIAGNOSIS AND TESTING (Continued)

when inserting the paper clips. Attach voltmeter leads to these paper clips.

(1) Connect the positive (+) voltmeter lead into the sensor output wire. This is at done the distributor wire harness connector. For wire identification, refer to Group 8W, Wiring Diagrams.

(2) Connect the negative (-) voltmeter lead into the ground wire. For wire identification, refer to Group 8W, Wiring Diagrams.

(3) Set the voltmeter to the 15 Volt DC scale.

(4) Remove distributor cap from distributor (two screws). Rotate (crank) the engine until the distributor rotor is pointed towards the rear of vehicle. The movable pulse ring should now be within the sensor pickup.

(5) Turn ignition key to ON position. Voltmeter should read approximately 5.0 volts.

(6) If voltage is not present, check the voltmeter leads for a good connection.

(7) If voltage is still not present, check for voltage at the supply wire. For wire identification, refer to Group 8W, Wiring Diagrams.

(8) If 5 volts is not present at supply wire, check for voltage at PCM 32-way connector (cavity A-17). Refer to Group 8W, Wiring for location of connector/terminal. Leave the PCM connector connected for this test.

(9) If voltage is still not present, perform vehicle test using the DRB scan tool.

(10) If voltage is present at cavity A-17, but not at the supply wire:

(a) Check continuity between the supply wire. This is checked between the distributor connector and cavity A-17 at the PCM. If continuity is not present, repair the harness as necessary.

(b) Check for continuity between the camshaft position sensor output wire and cavity A-18 at the PCM. If continuity is not present, repair the harness as necessary.

(c) Check for continuity between the ground circuit wire at the distributor connector and ground. If continuity is not present, repair the harness as necessary.

(11) While observing the voltmeter, crank the engine with ignition switch. The voltmeter needle should fluctuate between 0 and 5 volts while the engine is cranking. This verifies that the camshaft position sensor in the distributor is operating properly and a sync pulse signal is being generated.

If sync pulse signal is not present, replacement of the camshaft position sensor is necessary

CAMSHAFT POSITION SENSOR TEST—8.0L V-10 ENGINE

The camshaft position sensor is located in the timing chain case/cover on the left-front side of the engine (Fig. 25).

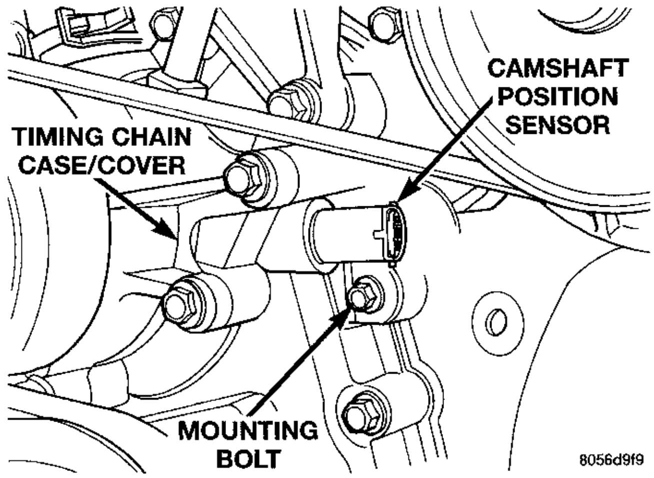

Fig. 25 Camshaft Position Sensor—8.0L V-10 Engine

To perform a complete test of this sensor and its circuitry, refer to the DRB scan tool. Also refer to the appropriate Powertrain Diagnostics Procedures manual. To test the sensor only, refer to the following:

(1) Disconnect the sensor connector at sensor.

(2) Place an ohmmeter across terminals B and C (Fig. 26). **Ohmmeter should be set to 1K-to-10K scale for this test.** The meter reading should be open (no resistance). Replace sensor if a low resistance is indicated.

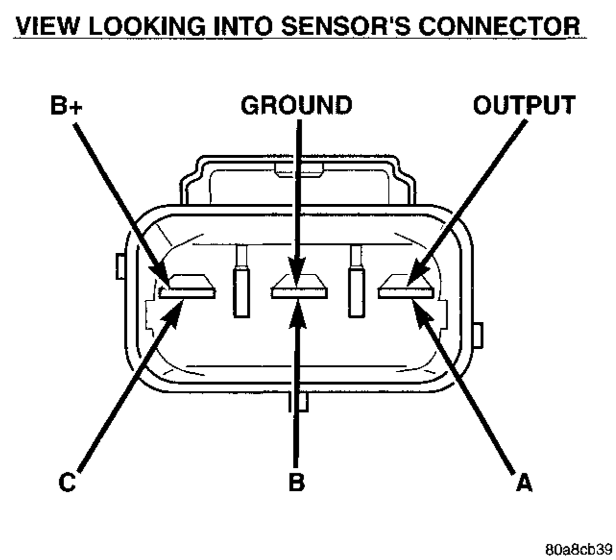

Fig. 26 Sensor Connector—8.0L Engine

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DIAGNOSIS AND TESTING (Continued)

ENGINE COOLANT TEMPERATURE SENSOR

For an operational description, diagnosis and removal/installation procedures, refer to Group 14, Fuel System.

INTAKE MANIFOLD AIR TEMPERATURE SENSOR

For an operational description, diagnosis and removal/installation procedures, refer to Group 14, Fuel System.

SPARK PLUG CABLES

Check the spark plug cable connections for good contact at the coil(s), distributor cap towers, and spark plugs. Terminals should be fully seated. The insulators should be in good condition and should fit tightly on the coil, distributor and spark plugs. Spark plug cables with insulators that are cracked or torn must be replaced.

Clean high voltage ignition cables with a cloth moistened with a non-flammable solvent. Wipe the cables dry. Check for brittle or cracked insulation.

On 3.9L/5.2L/5.9L engines, spark plug cable heat shields are pressed into the cylinder head to surround each spark plug cable boot and spark plug (Fig. 27). These shields protect the spark plug boots from damage (due to intense engine heat generated by the exhaust manifolds) and should not be removed. After the spark plug cable has been installed, the lip of the cable boot should have a small air gap to the top of the heat shield (Fig. 27).

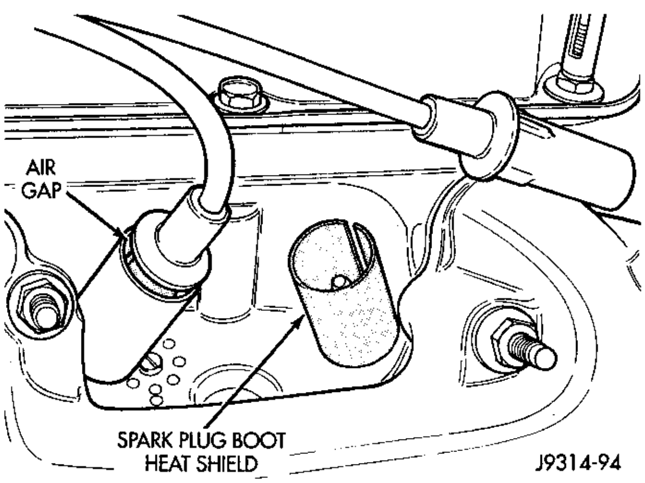

Fig. 27 Heat Shields—3.9L/5.2L/5.9L Engines

TESTING

When testing secondary cables for damage with an oscilloscope, follow the instructions of the equipment manufacturer.

If an oscilloscope is not available, spark plug cables may be tested as follows:

CAUTION: Do not leave any one spark plug cable disconnected for longer than necessary during testing. This may cause possible heat damage to the catalytic converter. Total test time must not exceed ten minutes.

With the engine running, remove spark plug cable from spark plug (one at a time) and hold next to a good engine ground. If the cable and spark plug are in good condition, the engine rpm should drop and the engine will run poorly. If engine rpm does not drop, the cable and/or spark plug may not be operating properly and should be replaced. Also check engine cylinder compression.

With the engine not running, connect one end of a test probe to a good ground. Start the engine and run the other end of the test probe along the entire length of all spark plug cables. If cables are cracked or punctured, there will be a noticeable spark jump from the damaged area to the test probe. The cable running from the ignition coil to the distributor cap can be checked in the same manner. Cracked, damaged or faulty cables should be replaced with resistance type cable. This can be identified by the words ELECTRONIC SUPPRESSION printed on the cable jacket.

Use an ohmmeter to test for open circuits, excessive resistance or loose terminals. If equipped, remove the distributor cap from the distributor. **Do not remove cables from cap.** Remove cable from spark plug. Connect ohmmeter to spark plug terminal end of cable and to corresponding electrode in distributor cap. Resistance should be 250 to 1000 Ohms per inch of cable. If not, remove cable from distributor cap tower and connect ohmmeter to the terminal ends of cable. If resistance is not within specifications as found in the SPARK PLUG CABLE RESISTANCE chart, replace the cable. Test all spark plug cables in this manner.

SPARK PLUG CABLE RESISTANCE

MINIMUM	MAXIMUM
250 Ohms Per Inch	1000 Ohms Per Inch
3000 Ohms Per Foot	12,000 Ohms Per Foot

To test ignition coil-to-distributor cap cable, do not remove the cable from the cap. Connect ohmmeter to rotor button (center contact) of distributor cap and terminal at ignition coil end of cable. If resistance is not within specifications as found in the Spark Plug Cable Resistance chart, remove the cable from the distributor cap. Connect the ohmmeter to the terminal ends of the cable. If resistance is not within specifications as found in the Spark Plug Cable Resistance chart, replace the cable. Inspect the ignition coil tower for cracks, burns or corrosion.

DIAGNOSIS AND TESTING (Continued)

SPARK PLUG CONDITIONS

NORMAL OPERATING

The few deposits present on the spark plug will probably be light tan or slightly gray in color. This is evident with most grades of commercial gasoline (Fig. 28). There will not be evidence of electrode burning. Gap growth will not average more than approximately 0.025 mm (.001 in) per 1600 km (1000 miles) of operation. Spark plugs that have normal wear can usually be cleaned, have the electrodes filed, have the gap set and then be installed.

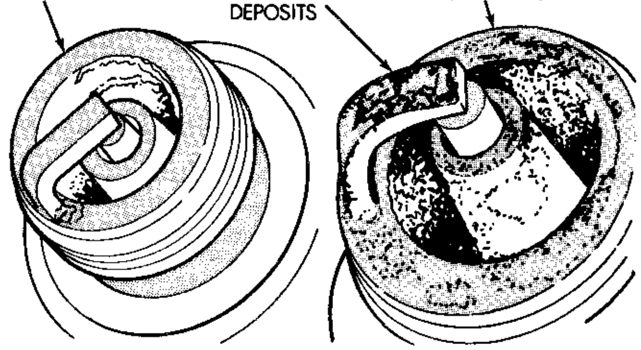

Fig. 28 Normal Operation and Cold (Carbon) Fouling

Some fuel refiners in several areas of the United States have introduced a manganese additive (MMT) for unleaded fuel. During combustion, fuel with MMT causes the entire tip of the spark plug to be coated with a rust colored deposit. This rust color can be misdiagnosed as being caused by coolant in the combustion chamber. Spark plug performance is not affected by MMT deposits.

COLD FOULING/CARBON FOULING

Cold fouling is sometimes referred to as carbon fouling. The deposits that cause cold fouling are basically carbon (Fig. 28). A dry, black deposit on one or two plugs in a set may be caused by sticking valves or defective spark plug cables. Cold (carbon) fouling of the entire set of spark plugs may be caused by a clogged air cleaner element or repeated short operating times (short trips).

WET FOULING OR GAS FOULING

A spark plug coated with excessive wet fuel or oil is wet fouled. In older engines, worn piston rings, leaking valve guide seals or excessive cylinder wear can cause wet fouling. In new or recently overhauled engines, wet fouling may occur before break-in (normal oil control) is achieved. This condition can usually be resolved by cleaning and reinstalling the fouled plugs.

OIL OR ASH ENCRUSTED

If one or more spark plugs are oil or oil ash encrusted (Fig. 29), evaluate engine condition for the cause of oil entry into that particular combustion chamber.

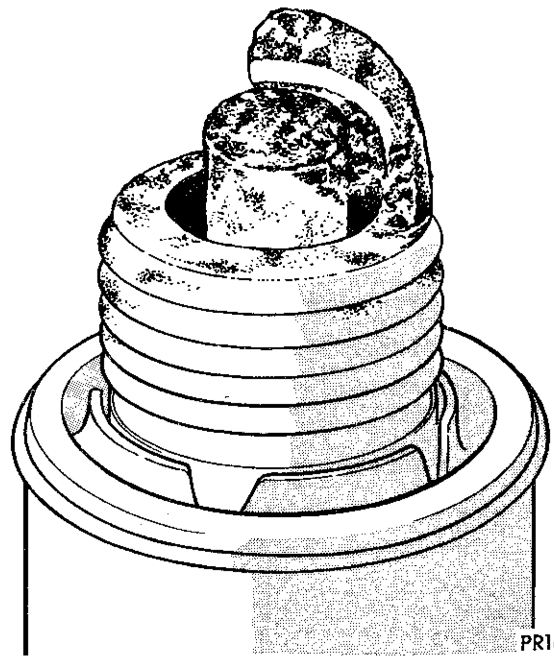

Fig. 29 Oil or Ash Encrusted

ELECTRODE GAP BRIDGING

Electrode gap bridging may be traced to loose deposits in the combustion chamber. These deposits accumulate on the spark plugs during continuous stop-and-go driving. When the engine is suddenly subjected to a high torque load, deposits partially liquefy and bridge the gap between electrodes (Fig. 30). This short circuits the electrodes. Spark plugs with electrode gap bridging can be cleaned using standard procedures.

SCAVENGER DEPOSITS

Fuel scavenger deposits may be either white or yellow (Fig. 31). They may appear to be harmful, but this is a normal condition caused by chemical additives in certain fuels. These additives are designed to change the chemical nature of deposits and decrease spark plug misfire tendencies. Notice that accumulation on the ground electrode and shell area may be heavy, but the deposits are easily removed. Spark plugs with scavenger deposits can be considered normal in condition and can be cleaned using standard procedures.

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DIAGNOSIS AND TESTING (Continued)

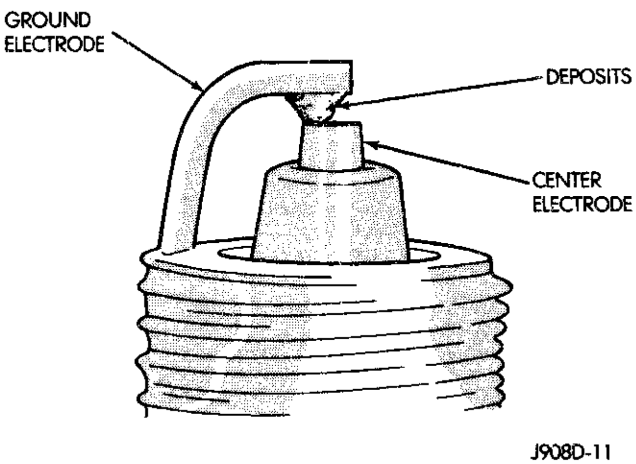

Fig. 30 Electrode Gap Bridging

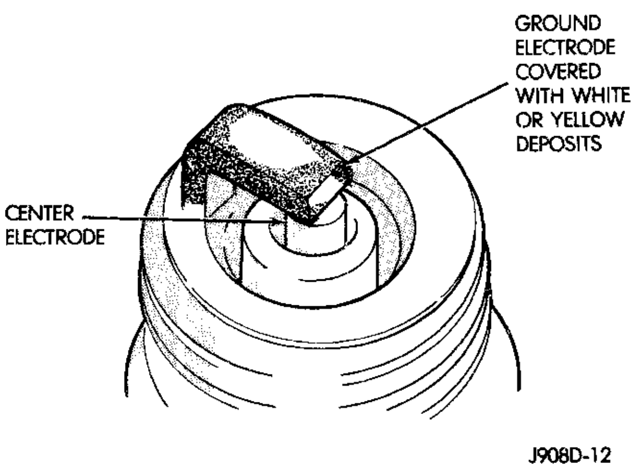

Fig. 31 Scavenger Deposits

CHIPPED ELECTRODE INSULATOR

A chipped electrode insulator usually results from bending the center electrode while adjusting the spark plug electrode gap. Under certain conditions, severe detonation can also separate the insulator from the center electrode (Fig. 32). Spark plugs with this condition must be replaced.

PREIGNITION DAMAGE

Preignition damage is usually caused by excessive combustion chamber temperature. The center electrode dissolves first and the ground electrode dissolves somewhat latter (Fig. 33). Insulators appear relatively deposit free. Determine if the spark plug has the correct heat range rating for the engine. Determine if ignition timing is over advanced or if other operating conditions are causing engine overheating. (The heat range rating refers to the operating temperature of a particular type spark plug. Spark plugs are designed to operate within specific temperature ranges. This depends upon the thickness and length of the center electrodes porcelain insulator.)

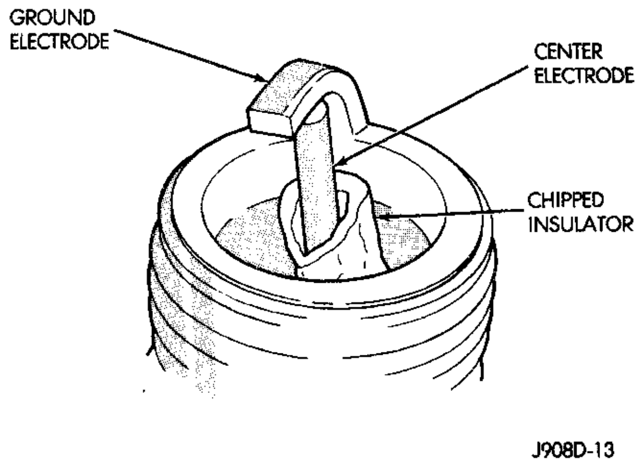

Fig. 32 Chipped Electrode Insulator

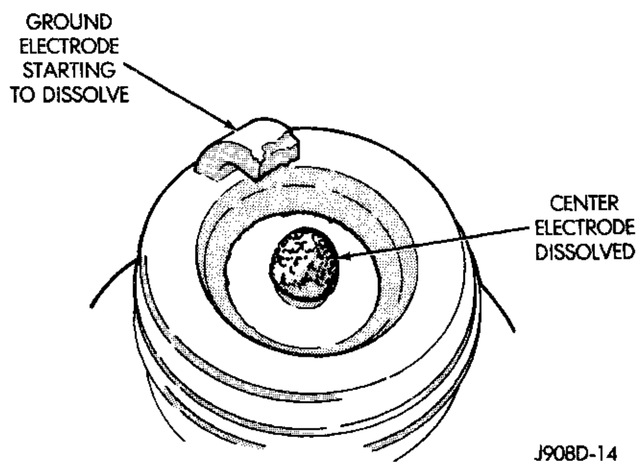

Fig. 33 Preignition Damage

SPARK PLUG OVERHEATING

Overheating is indicated by a white or gray center electrode insulator that also appears blistered (Fig. 34). The increase in electrode gap will be considerably in excess of 0.001 inch per 1000 miles of operation. This suggests that a plug with a cooler heat range rating should be used. Over advanced ignition timing, detonation and cooling system malfunctions can also cause spark plug overheating.

REMOVAL AND INSTALLATION

SPARK PLUG CABLES

CAUTION: When disconnecting a high voltage cable from a spark plug or from the distributor cap, twist the rubber boot slightly (1/2 turn) to break it loose (Fig. 35). Grasp the boot (not the cable) and pull it off with a steady, even force.

REMOVAL AND INSTALLATION (Continued)

Fig. 34 Spark Plug Overheating

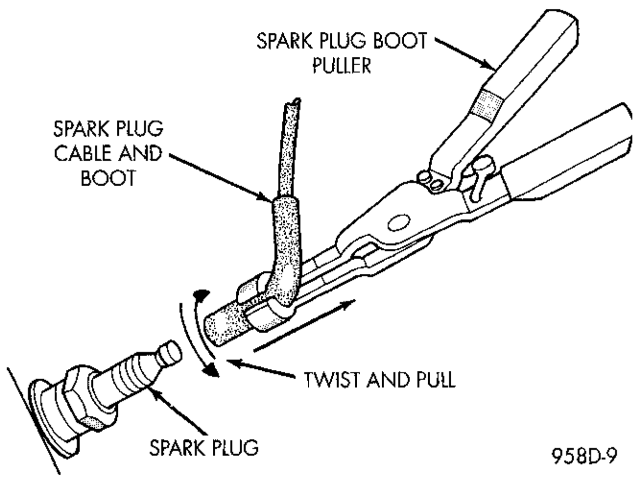

Fig. 35 Cable Removal

Install cables into the proper engine cylinder firing order (Fig. 36), (Fig. 37) or (Fig. 38).

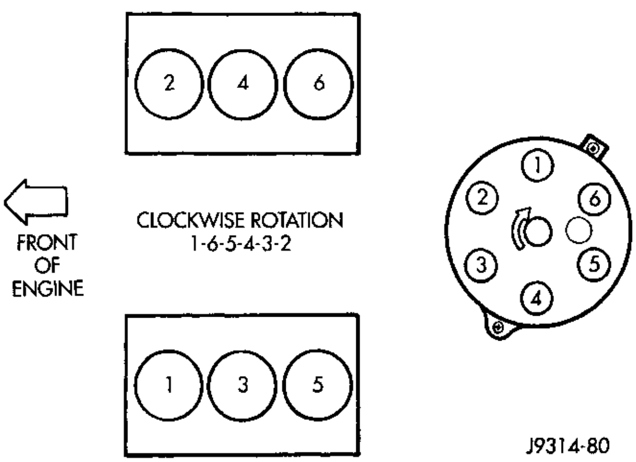

Fig. 36 Engine Firing Order—3.9L V-6 Engine

When replacing the spark plug and coil cables, route the cables correctly and secure in the proper

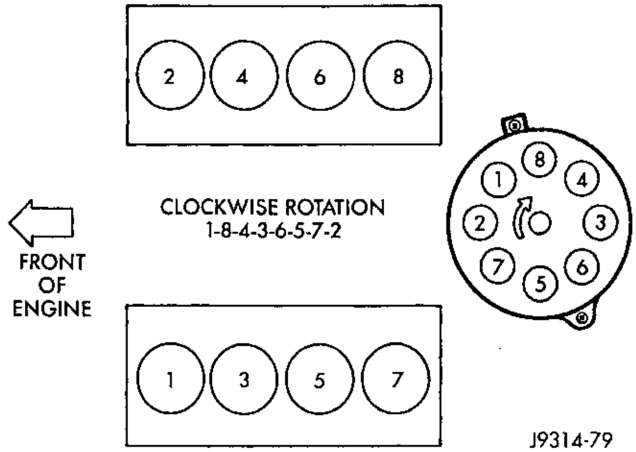

Fig. 37 Engine Firing Order—5.2L/5.9L V-8 Engines

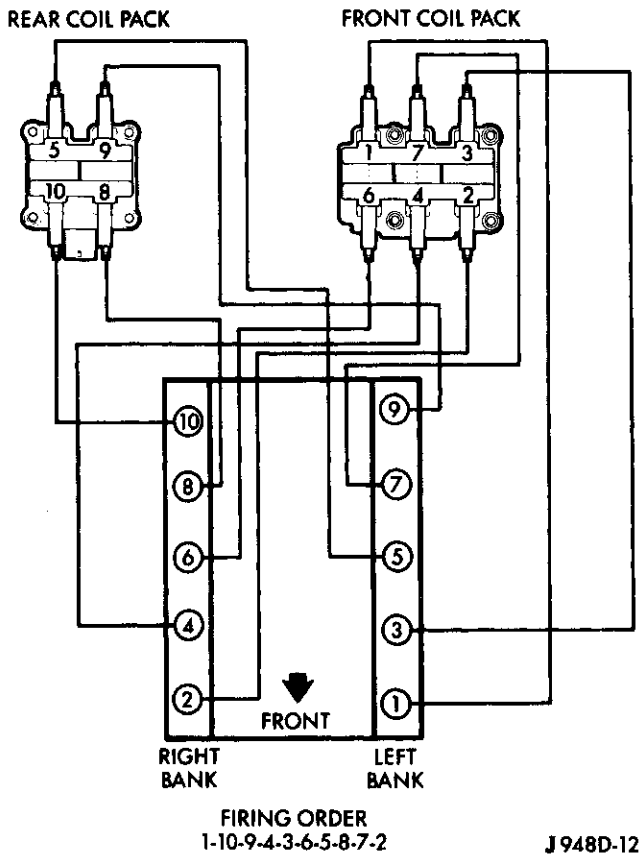

Fig. 38 Spark Plug Cable Order—8.0L V-10 Engine

retainers. Failure to route the cables properly can cause the radio to reproduce ignition noise. It could also cause cross ignition of the plugs or short circuit the cables to ground.

When installing new cables, make sure a positive connection is made. A snap should be felt when a good connection is made between the plug cable and the distributor cap tower.

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REMOVAL AND INSTALLATION (Continued)

SPARK PLUGS

On 3.9L/5.2L/5.9L engines, spark plug cable heat shields are pressed into the cylinder head to surround each cable boot and spark plug (Fig. 39).

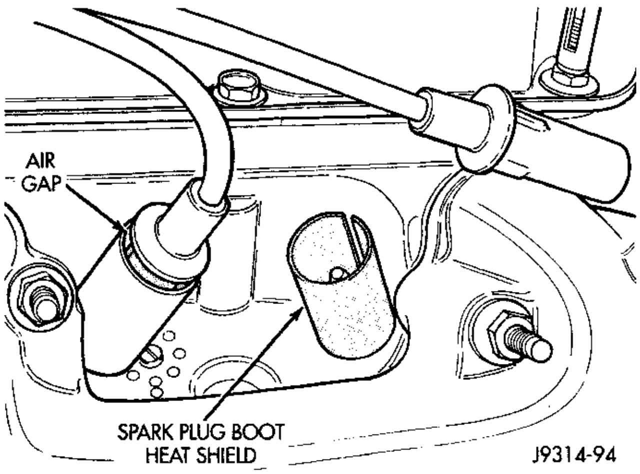

Fig. 39 Heat Shields—3.9L/5.2L/5.9L Engines

If removal of the heat shield(s) is necessary, remove the spark plug cable and compress the sides of shield for removal. Each shield is slotted to allow for compression and removal. To install the shields, align shield to machined opening in cylinder head and tap into place with a block of wood.

PLUG REMOVAL

(1) Always remove spark plug or ignition coil cables by grasping at the cable boot (Fig. 35). Turn the cable boot 1/2 turn and pull straight back in a steady motion. Never pull directly on the cable. Internal damage to cable will result.

(2) Prior to removing the spark plug, spray compressed air around the spark plug hole and the area around the spark plug. This will help prevent foreign material from entering the combustion chamber.

(3) Remove the spark plug using a quality socket with a rubber or foam insert.

(4) Inspect the spark plug condition. Refer to Spark Plug Condition in the Diagnostics and Testing section of this group.

PLUG CLEANING

The plugs may be cleaned using commercially available spark plug cleaning equipment. After cleaning, file the center electrode flat with a small point file or jewelers file before adjusting gap.

CAUTION: Never use a motorized wire wheel brush to clean the spark plugs. Metallic deposits will remain on the spark plug insulator and will cause plug misfire.

PLUG GAP ADJUSTMENT

Check the spark plug gap with a gap gauge tool. If the gap is not correct, adjust it by bending the ground electrode (Fig. 40). **Never attempt to adjust the gap by bending the center electrode.**

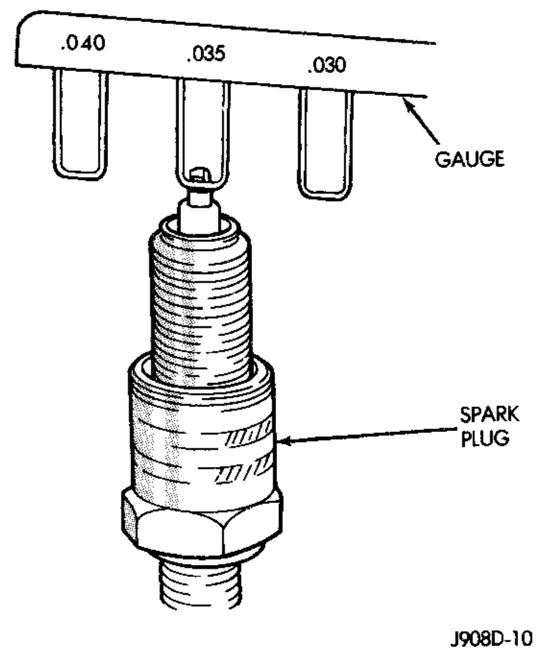

Fig. 40 Setting Spark Plug Gap—Typical

SPARK PLUG GAP

3.9L/5.2L/5.9L Engines: 1.01 mm (.040 in).

8.0L Engine: 1.14 mm (.045 in).

PLUG INSTALLATION

Special care should be taken when installing spark plugs into the cylinder head spark plug wells. Be sure the plugs do not drop into the plug wells as electrodes can be damaged.

Always tighten spark plugs to the specified torque. Over tightening can cause distortion resulting in a change in the spark plug gap or a cracked porcelain insulator.

When replacing the spark plug and ignition coil cables, route the cables correctly and secure them in the appropriate retainers. Failure to route the cables properly can cause the radio to reproduce ignition noise. It could cause cross ignition of the spark plugs or short circuit the cables to ground.

(1) Start the spark plug into the cylinder head by hand to avoid cross threading.

(2) Tighten spark plugs to 35-41 N·m (26-30 ft. lbs.) torque.

(3) Install spark plug cables over spark plugs.

IGNITION COIL—3.9L/5.2L/5.9L ENGINES

The ignition coil is an epoxy filled type. If the coil is replaced, it must be replaced with the same type.

REMOVAL AND INSTALLATION (Continued)

REMOVAL

3.9L V-6 or 5.2/5.9L V-8 LDC-Gas Engines: The coil is mounted to a bracket that is bolted to the front of the right engine cylinder head (Fig. 41). This bracket is mounted on top of the automatic belt tensioner bracket using common bolts.

5.9L V-8 HDC-Gas Engine: The coil is mounted to a bracket that is bolted to the air injection pump (AIR pump) mounting bracket (Fig. 42).

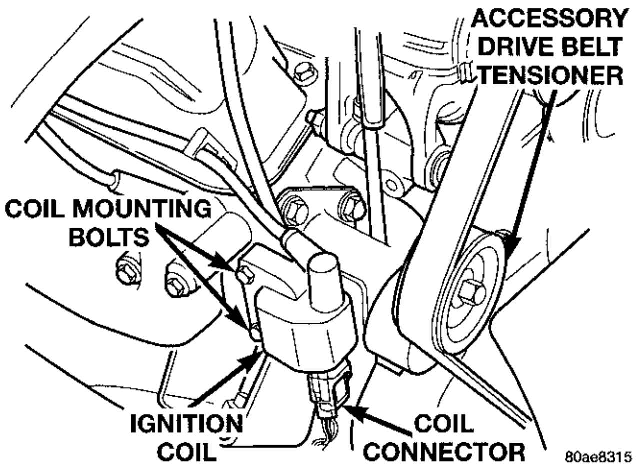

Fig. 41 Ignition Coil—3.9L V-6 or 5.2/5.9L V-8 LDC-Gas Engines

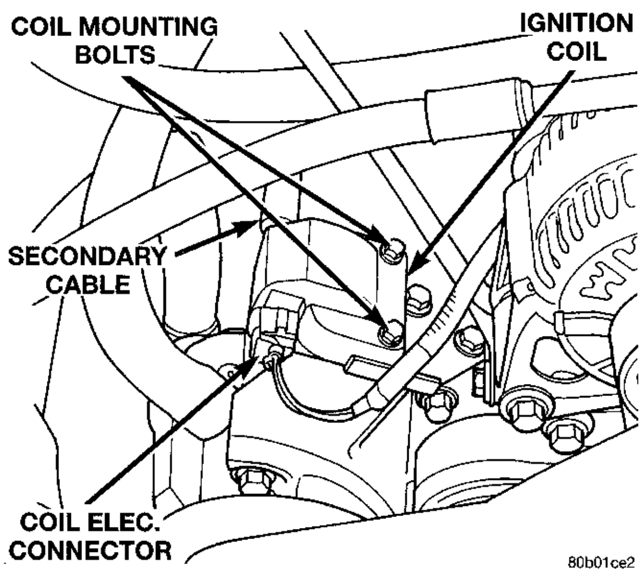

Fig. 42 Ignition Coil—5.9L V-8 HDC-Gas Engine

(1) Disconnect the primary wiring from the ignition coil.

(2) Disconnect the secondary spark plug cable from the ignition coil.

WARNING: 3.9L V-6 OR 5.2/5.9L V-8 LDC-GAS ENGINES: DO NOT REMOVE THE COIL MOUNTING BRACKET-TO-CYLINDER HEAD MOUNTING BOLTS. THE COIL MOUNTING BRACKET IS UNDER ACCESSORY DRIVE BELT TENSION. IF THIS BRACKET IS TO BE REMOVED FOR ANY REASON, ALL BELT TENSION MUST FIRST BE RELIEVED. REFER TO THE BELT SECTION OF GROUP 7, COOLING SYSTEM.

(3) Remove ignition coil from coil mounting bracket (two bolts).

INSTALLATION

(1) Install the ignition coil to coil bracket. If nuts and bolts are used to secure coil to coil bracket, tighten to 11 N·m (100 in. lbs.) torque. If the coil mounting bracket has been tapped for coil mounting bolts, tighten bolts to 5 N·m (50 in. lbs.) torque.

(2) Connect all wiring to ignition coil.

IGNITION COIL PACKS—8.0L V-10 ENGINE

REMOVAL

Two separate coil packs containing a total of five independent coils are attached to a common mounting bracket located above the right engine valve cover (Fig. 43). The front and rear coil packs can be serviced separately.

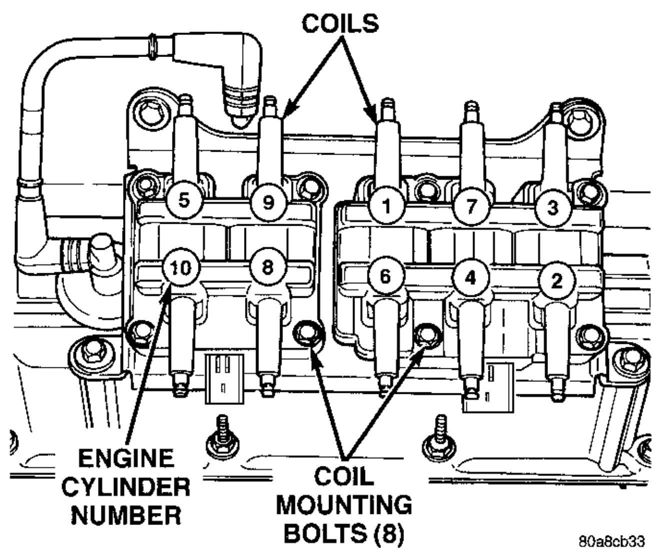

Fig. 43 Ignition Coil Packs—8.0L V-10 Engine

(1) Remove the secondary spark plug cables from the coil packs. Note position of cables before removal.

(2) Disconnect the primary wiring harness connectors at coil packs.

(3) Remove the four (4) coil pack-to-coil mounting bracket bolts for the coil pack being serviced (Fig. 43).

(4) Remove coil(s) from mounting bracket.

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REMOVAL AND INSTALLATION (Continued)

INSTALLATION

(1) Position coil packs to mounting bracket (primary wiring connectors face downward).

(2) Install coil pack mounting bolts. Tighten bolts to 10 N·m (90 in. lbs.) torque.

(3) Install coil pack-to-engine mounting bracket (if necessary).

(4) Connect primary wiring connectors to coil packs (four wire connector to front coil pack and three wire connector to rear coil pack).

(5) Connect secondary spark plug cables to coil packs. Refer to (Fig. 44) for correct cable order.

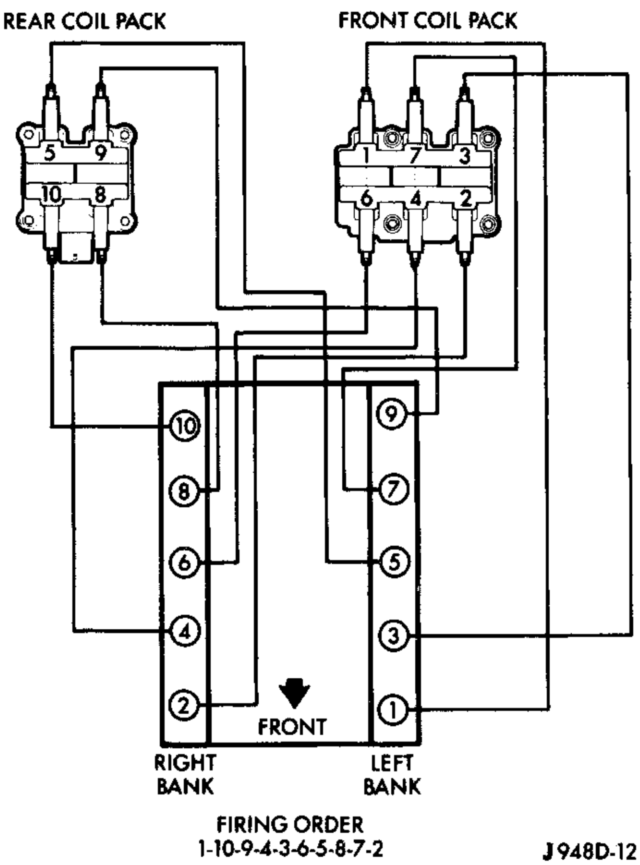

Fig. 44 Spark Plug Cable Order—8.0L V-10 Engine

AUTOMATIC SHUTDOWN (ASD) RELAY

The Automatic Shutdown (ASD) relay is located in the Power Distribution Center (PDC). The PDC is located in the engine compartment (Fig. 45). Refer to label on PDC cover for relay location.

REMOVAL

(1) Remove the PDC cover.

(2) Remove the relay by lifting straight up.

INSTALLATION

(1) Check condition of relay terminals at PDC for corrosion or damage. Also check the heights of relay terminal pins at PDC. Pin height should be same for all pins. Repair as necessary before installing relay.

(2) Push the relay into the connector.

(3) Install the relay cover.

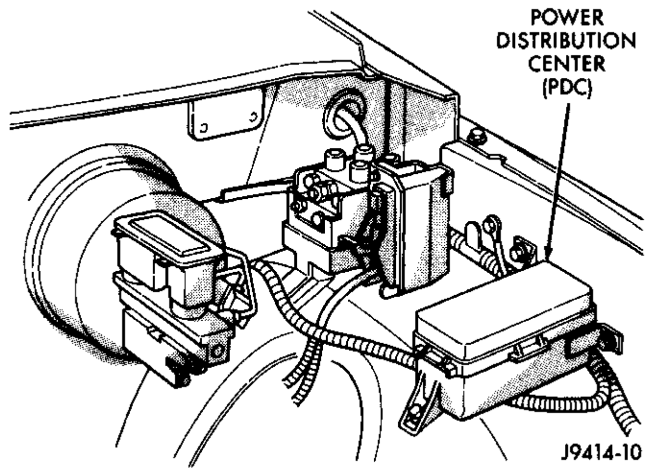

Fig. 45 Power Distribution Center

CRANKSHAFT POSITION SENSOR—3.9L/5.2L/5.9L ENGINES

REMOVAL

The sensor is bolted to the top of the cylinder block near the rear of right cylinder head (Fig. 46).

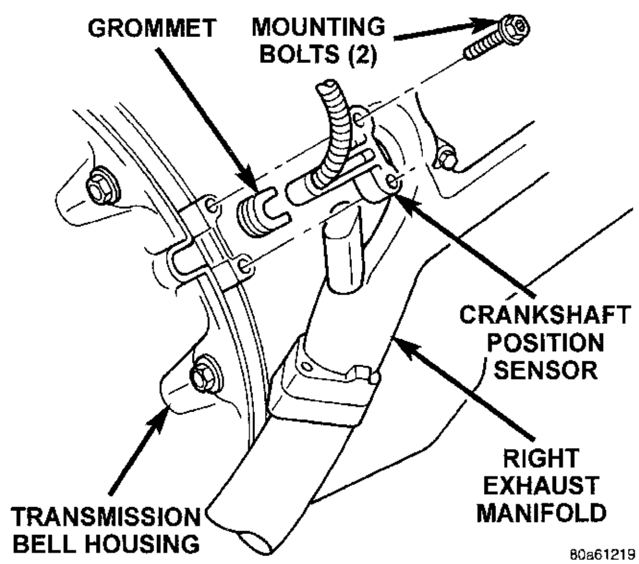

Fig. 46 Crankshaft Position Sensor

(1) Remove the air cleaner intake tube.

(2) Disconnect crankshaft position sensor pigtail harness from main wiring harness.

(3) Remove two sensor (recessed hex head) mounting bolts (Fig. 46).

(4) Remove sensor from engine.

REMOVAL AND INSTALLATION (Continued)

INSTALLATION

(1) Position crankshaft position sensor to engine.

(2) Install mounting bolts and tighten to 8 N·m (70 in. lbs.) torque.

(3) Connect main harness electrical connector to sensor.

(4) Install air cleaner tube.

CRANKSHAFT POSITION SENSOR—8.0L V-10 ENGINE

The crankshaft position sensor is located on the right-lower side of the cylinder block, forward of the right engine mount, just above the oil pan rail (Fig. 47).

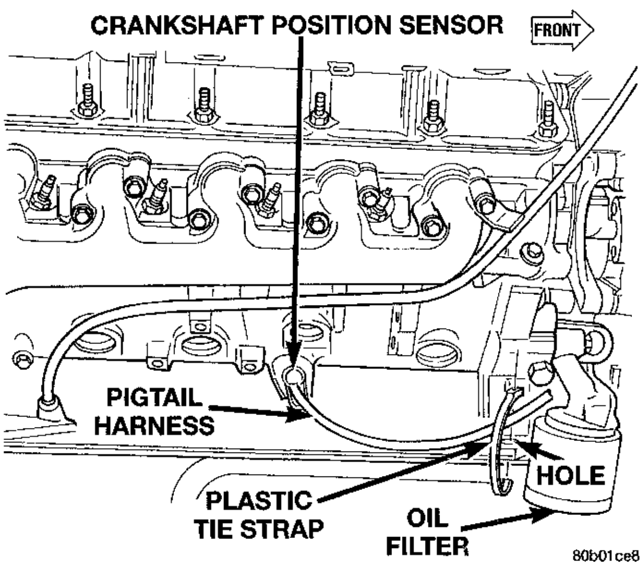

Fig. 47 Crankshaft Position Sensor Location—8.0L V-10 Engine

REMOVAL

(1) Raise and support vehicle.

(2) Disconnect sensor pigtail harness from main engine wiring harness.

(3) Remove sensor mounting bolt (Fig. 48).

(4) Cut plastic tie strap (Fig. 47) securing sensor pigtail harness to side of engine block.

(5) Carefully pry sensor from cylinder block in a rocking action with two small screwdrivers.

(6) Remove sensor from vehicle.

(7) Check condition of sensor o-ring (Fig. 49).

INSTALLATION

(1) Apply a small amount of engine oil to sensor o-ring (Fig. 49).

(2) Install sensor into cylinder block with a slight rocking action. Do not twist sensor into position as damage to o-ring may result.

CAUTION: Before tightening sensor mounting bolt, be sure sensor is completely flush to cylinder block

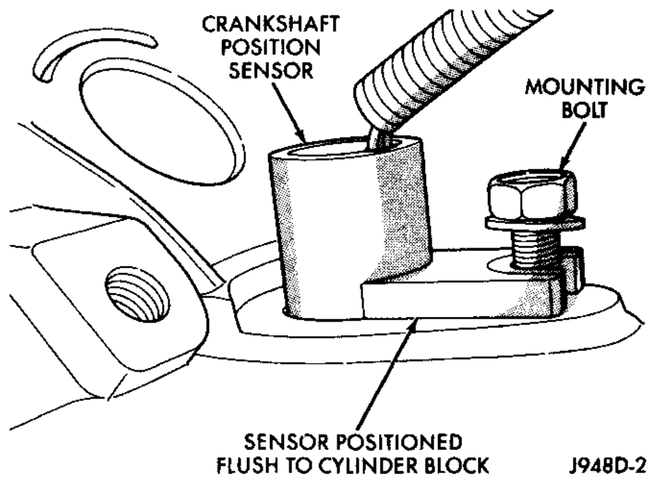

Fig. 48 Sensor Removal/Installation—8.0L V-10 Engine

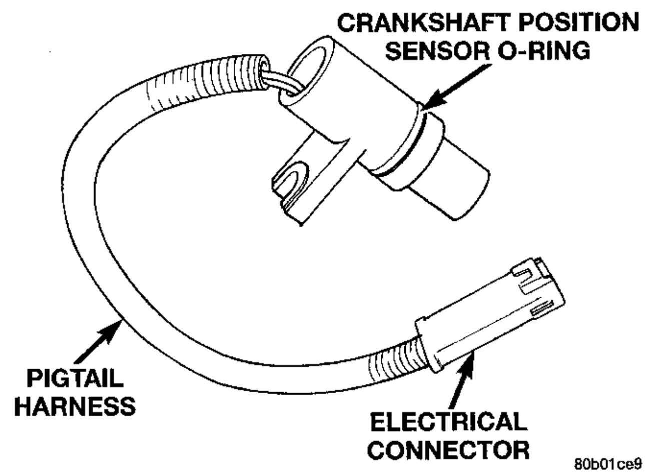

Fig. 49 Sensor O-Ring—8.0L V-10 Engine

(Fig. 48). If sensor is not flush, damage to sensor mounting tang may result.

(3) Install mounting bolt and tighten to 8 N·m (70 in. lbs.) torque.

(4) Connect sensor pigtail harness to main engine wiring harness

(5) Install new plastic tie strap (Fig. 47) to secure sensor pigtail harness to side of engine block. Thread tie strap through casting hole on cylinder block.

CAMSHAFT POSITION SENSOR—3.9L/5.2L/5.9L ENGINES

The camshaft position sensor is located in the distributor (Fig. 50).

REMOVAL

Distributor removal is not necessary to remove camshaft position sensor.

(1) Remove air cleaner assembly.

(2) Disconnect negative cable from battery.

REMOVAL AND INSTALLATION (Continued)

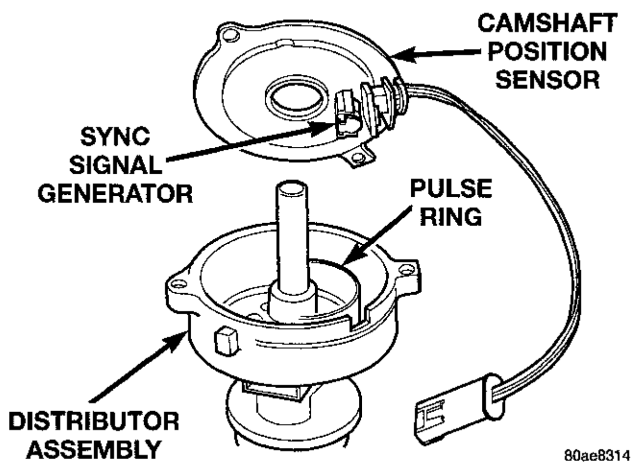

Fig. 50 Camshaft Position Sensor—Typical

(3) Remove distributor cap from distributor (two screws).

(4) Disconnect camshaft position sensor wiring harness from main engine wiring harness.

(5) Remove distributor rotor from distributor shaft.

(6) Lift the camshaft position sensor assembly from the distributor housing (Fig. 50).

INSTALLATION

(1) Install camshaft position sensor to distributor. Align sensor into notch on distributor housing.

(2) Connect wiring harness.

(3) Install rotor.

(4) Install distributor cap. Tighten mounting screws.

(5) Install air cleaner assembly.

CAMSHAFT POSITION SENSOR—8.0L V-10 ENGINE

The camshaft position sensor is located on the timing chain case/cover on the left-front side of the engine (Fig. 51).

A thin plastic rib is molded into the face of the sensor (Fig. 52) to position the depth of sensor to the upper cam gear (sprocket). This rib can be found on both the new replacement sensors and sensors that were originally installed to the engine. The first time the engine has been operated, part of this rib may be sheared (ground) off. Depending on parts tolerances, some of the rib material may still be observed after removal.

Refer to either of the following procedures, Sensor Removal—Replacing Old Sensor With Original, or Sensor Removal—Replacing With New Sensor:

SENSOR REMOVAL—REPLACING OLD SENSOR WITH ORIGINAL

If the original camshaft position sensor is to be removed and ins'alled, such as when servicing the

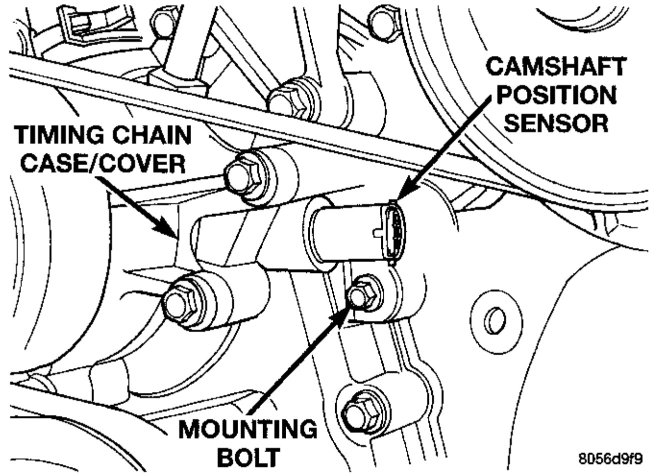

Fig. 51 Camshaft Position Sensor Location—8.0L V-10 Engine

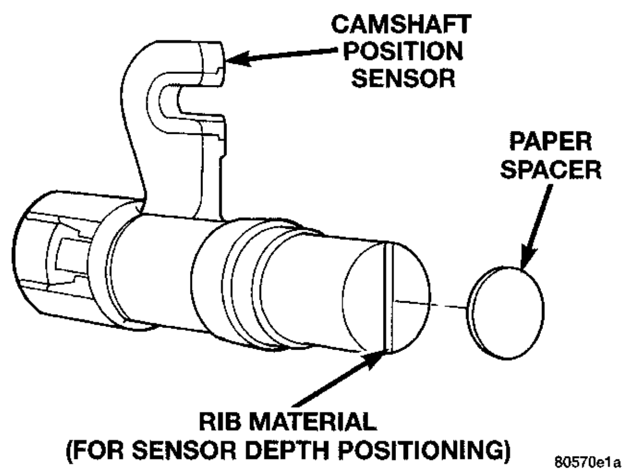

Fig. 52 Sensor Depth Positioning Rib—8.0L V-10 Engine

timing chain, timing gears or timing chain cover, use this procedure.

(1) Disconnect the sensor harness connector from the sensor.

(2) Remove the sensor mounting bolt (Fig. 51).

(3) Carefully pry the sensor from the timing chain case/cover in a rocking action with two small screwdrivers.

(4) Remove the sensor from vehicle.

(5) Check condition of sensor o-ring (Fig. 53).

INSTALLATION

When installing a used camshaft position sensor, the sensor depth must be adjusted to prevent contact with the camshaft gear (sprocket).

(1) Observe the face of the sensor. If any of the original rib material remains (Fig. 52), it must be cut down flush to the face of the sensor with a razor knife. Remove only enough of the rib material until the face of the sensor is flat. Do not remove more

REMOVAL AND INSTALLATION (Continued)

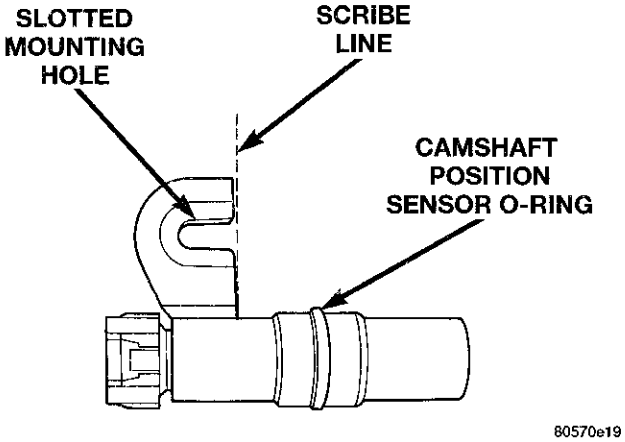

Fig. 53 Camshaft Sensor O-Ring—8.0L V-10 Engine

material than necessary as damage to sensor may result. Due to a high magnetic field and possible electrical damage to the sensor, never use an electric grinder to remove material from sensor.

(2) From the parts department, obtain a peel-and-stick paper spacer (Fig. 52). These special paper spacers are of a certain thickness and are to be used as a tool to set sensor depth.

(3) Clean the face of sensor and apply paper spacer (Fig. 52).

(4) Apply a small amount of engine oil to the sensor o-ring (Fig. 53).

A low and high area are machined into the camshaft drive gear (Fig. 54). The sensor is positioned in the timing gear cover so that a small air gap (Fig. 54) exists between the face of sensor and the high machined area of cam gear.

Before the sensor is installed, the cam gear may have to be rotated. This is to allow the high machined area on the gear to be directly in front of the sensor mounting hole opening on the timing gear cover.

Do not install sensor with gear positioned at low area (Fig. 55) or (Fig. 54). When the engine is started, the sensor will be broken.

(5) Using a 1/2 in. wide metal ruler, measure the distance from the cam gear to the face of the sensor mounting hole opening on the timing gear cover (Fig. 55).

(6) If the dimension is approximately 1.818 inches, it is OK to install sensor. Proceed to step Step 9.

(7) If the dimension is approximately 2.018 inches, the cam gear will have to be rotated.

(8) Attach a socket to the vibration damper mounting bolt and rotate engine until the 1.818 inch dimension is attained.

(9) Install the sensor into the timing case/cover with a slight rocking action until the paper spacer contacts the camshaft gear. Do not install the sensor

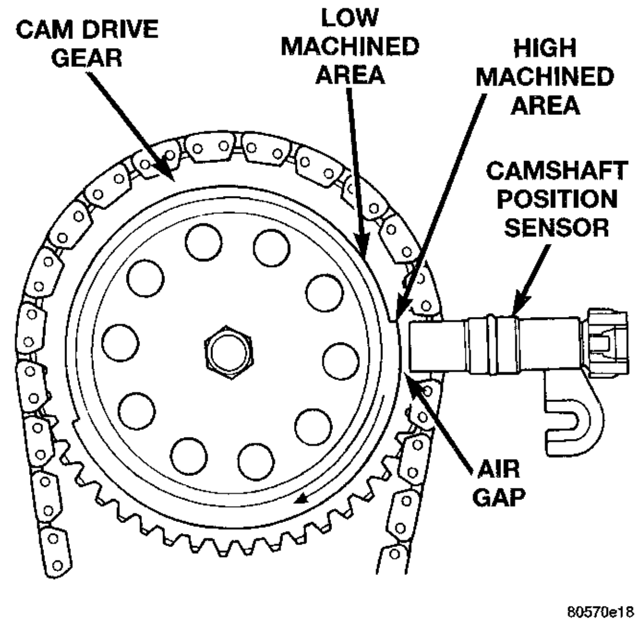

Fig. 54 Sensor Operation—8.0L V-10 Engine

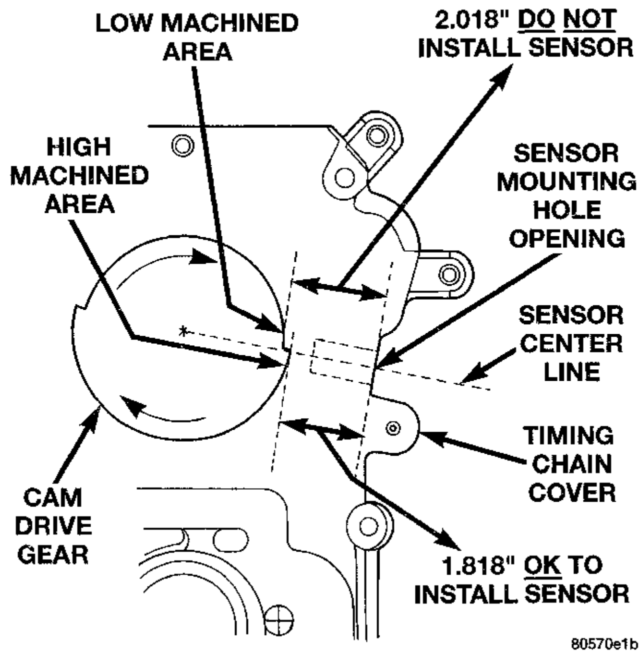

Fig. 55 Sensor Depth Dimensions

mounting bolt. Do not twist the sensor into position as damage to the o-ring or tearing of the paper spacer may result.

(10) Scratch a scribe line into the timing chain case/cover to indicate depth of sensor (Fig. 53).

(11) Remove the sensor from timing chain case/cover.

(12) Remove the paper spacer from the sensor. This step must be followed to prevent the paper

AUTHENTIC RESTORATION PRODUCT

REMOVAL AND INSTALLATION (Continued)

spacer from getting into the engine lubrication system.

(13) Again, apply a small amount of engine oil to sensor o-ring.

(14) Again, install the sensor into the timing case/cover with a slight rocking action until the sensor is aligned to scribe line.

(15) Install sensor mounting bolt and tighten to 6 N·m (50 in. lbs.) torque.

(16) Connect engine wiring harness to sensor.

SENSOR REMOVAL—REPLACING WITH NEW SENSOR

If a new replacement camshaft position sensor is to be installed, use this procedure.

(1) Disconnect the sensor wiring harness connector from sensor.

(2) Remove the sensor mounting bolt (Fig. 51).

(3) Carefully pry the sensor from the timing chain case/cover in a rocking action with two small screwdrivers.

(4) Remove the sensor from vehicle.

INSTALLATION

(1) Apply a small amount of engine oil to the sensor o-ring (Fig. 53).

A low and high area are machined into the camshaft drive gear (Fig. 54). The sensor is positioned in the timing gear cover so that a small air gap (Fig. 54) exists between the face of sensor and the high machined area of cam gear.

Before the sensor is installed, the cam gear may have to be rotated. This is to allow the high machined area on the gear to be directly in front of the sensor mounting hole opening on the timing gear cover.

Do not install sensor with gear positioned at low area (Fig. 55) or (Fig. 54). When the engine is started, the sensor will be broken.

(2) Using a 1/2 in. wide metal ruler, measure the distance from the cam gear to the face of the sensor mounting hole opening on the timing gear cover (Fig. 55).

(3) If the dimension is approximately 1.818 inches, it is OK to install sensor. Proceed to step Step 9.

(4) If the dimension is approximately 2.018 inches, the cam gear will have to be rotated.

(5) Attach a socket to the vibration damper mounting bolt and rotate engine until the 1.818 inch dimension is attained.

(6) Install the sensor into the timing case/cover with a slight rocking action. Do not twist the sensor into position as damage to the o-ring may result. Push the sensor all the way into the cover until the rib material on the sensor (Fig. 52) contacts the camshaft gear.

(7) Install the mounting bolt and tighten to 6 N·m (50 in. lbs.) torque.

(8) Connect sensor wiring harness to engine harness.

When the engine is started, the rib material will be sheared off the face of sensor. This will automatically set sensor air gap.

MANIFOLD ABSOLUTE PRESSURE (MAP) SENSOR

For removal and installation, refer to Manifold Absolute Pressure Sensor in group 14, Fuel Systems.

ENGINE COOLANT TEMPERATURE SENSOR

For an operational description, diagnosis and removal/installation procedures, refer to Group 14, Fuel System.

THROTTLE POSITION SENSOR

For an operational description, diagnosis and removal/installation procedures, refer to Group 14, Fuel System.

INTAKE MANIFOLD AIR TEMPERATURE SENSOR

For an operational description, diagnosis and removal/installation procedures, refer to Group 14, Fuel System.

DISTRIBUTORS

REMOVAL

CAUTION: Base ignition timing is not adjustable on any engine. Distributors do not have built in centrifugal or vacuum assisted advance. Base ignition timing and timing advance are controlled by the Powertrain Control Module (PCM). Because a conventional timing light can not be used to adjust distributor position after installation, note position of distributor before removal.

(1) Remove air cleaner assembly.

(2) Disconnect negative cable from battery.

(3) Remove distributor cap from distributor (two screws).

(4) Mark the position of distributor housing in relationship to engine or dash panel. This is done to aid in installation.

(5) Before distributor is removed, the number one cylinder must be brought to the Top Dead Center (TDC) firing position.

(6) Attach a socket to the Crankshaft Vibration Damper mounting bolt.

(7) Slowly rotate engine clockwise, as viewed from front, until indicating mark on crankshaft vibration damper is aligned to 0 degree (TDC) mark on timing chain cover (Fig. 56).

REMOVAL AND INSTALLATION (Continued)

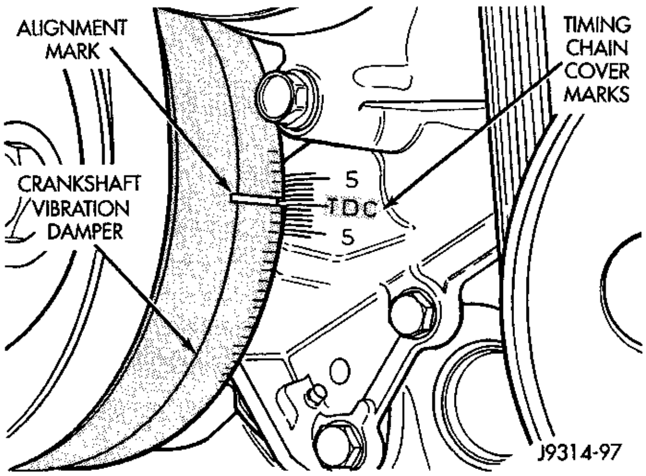

Fig. 56 Damper-To-Cover Alignment Marks—Typical

(8) The distributor rotor should now be aligned to the CYL. NO. 1 alignment mark (stamped) into the camshaft position sensor (Fig. 57). If not, rotate the crankshaft through another complete 360 degree turn. Note the position of the number one cylinder spark plug cable (on the cap) in relation to rotor. Rotor should now be aligned to this position.

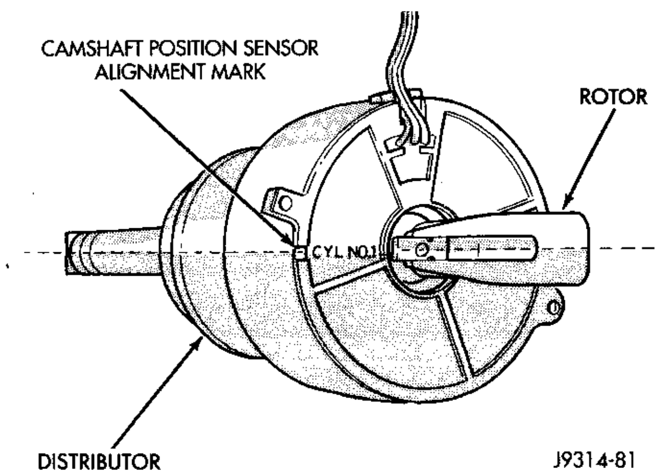

Fig. 57 Rotor Alignment Mark

(9) Disconnect camshaft position sensor wiring harness from main engine wiring harness.

(10) Remove distributor rotor from distributor shaft.

(11) Remove distributor holddown clamp bolt and clamp (Fig. 58). Remove distributor from vehicle.

CAUTION: Do not crank engine with distributor removed. Distributor/crankshaft relationship will be lost.

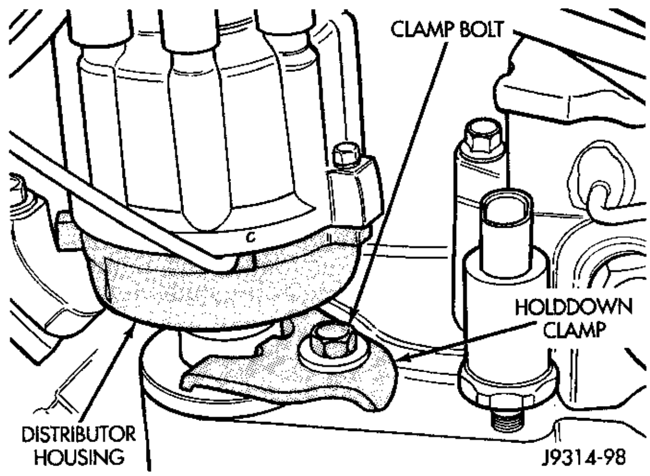

Fig. 58 Distributor Holddown Clamp

INSTALLATION

If engine has been cranked while distributor is removed, establish the relationship between distributor shaft and number one piston position as follows:

Rotate crankshaft in a clockwise direction, as viewed from front, until number one cylinder piston is at top of compression stroke (compression should be felt on finger with number one spark plug removed). Then continue to slowly rotate engine clockwise until indicating mark (Fig. 56) is aligned to 0 degree (TDC) mark on timing chain cover.

(1) Clean top of cylinder block for a good seal between distributor base and block.

(2) Lightly oil the rubber o-ring seal on the distributor housing.

(3) Install rotor to distributor shaft.

(4) Position distributor into engine to its original position. Engage tongue of distributor shaft with slot in distributor oil pump drive gear. Position rotor to the number one spark plug cable position.

(5) Install distributor holddown clamp and clamp bolt. Do not tighten bolt at this time.

(6) Rotate the distributor housing until rotor is aligned to CYL. NO. 1 alignment mark on the camshaft position sensor (Fig. 57).

(7) Tighten clamp holddown bolt (Fig. 58) to 22.5 N·m (200 in. lbs.) torque.

(8) Connect camshaft position sensor wiring harness to main engine harness.

(9) Install distributor cap. Tighten mounting screws.

(10) Refer to the following, Checking Distributor Position.

CHECKING DISTRIBUTOR POSITION

To verify correct distributor rotational position, the DRB scan tool must be used.

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REMOVAL AND INSTALLATION (Continued)

WARNING: WHEN PERFORMING THE FOLLOWING TEST, THE ENGINE WILL BE RUNNING. BE CAREFUL NOT TO STAND IN LINE WITH THE FAN BLADES OR FAN BELT. DO NOT WEAR LOOSE CLOTHING.

(1) Connect DRB scan tool to data link connector. The data link connector is located in passenger compartment, below and to left of steering column.

(2) Gain access to SET SYNC screen on DRB.

(3) Follow directions on DRB screen and start engine. Bring to operating temperature (engine must be in "closed loop" mode).

(4) With engine running at **idle speed**, the words IN RANGE should appear on screen along with 0°. This indicates correct distributor position.

(5) If a plus (+) or a minus (-) is displayed next to degree number, and/or the degree displayed is not zero, loosen but do not remove distributor holddown clamp bolt. Rotate distributor until IN RANGE appears on screen. Continue to rotate distributor until achieving as close to 0° as possible. After adjustment, tighten clamp bolt to 22.5 N·m (200 in. lbs.) torque.

The degree scale on SET SYNC screen of DRB is referring to fuel synchronization only. **It is not referring to ignition timing.** Because of this, do not attempt to adjust ignition timing using this method. Rotating distributor will have no effect on ignition timing. All ignition timing values are controlled by powertrain control module (PCM).

After testing, install air cleaner assembly.

POWERTRAIN CONTROL MODULE (PCM)

Refer to Group 14, Fuel System for procedures.

IGNITION SWITCH AND KEY CYLINDER

The ignition key must be in the key cylinder for cylinder removal.

KEY CYLINDER REMOVAL

(1) Disconnect negative cable from battery.

(2) If equipped with tilt column, remove tilt lever by turning it counterclockwise.

(3) Remove upper and lower covers (shrouds) from steering column (Fig. 59).

(4) If equipped with automatic transmission, place shifter in PARK position.

(5) A retaining pin (Fig. 60) is located at side of key cylinder assembly.

(a) Rotate key to RUN position.

(b) Press in on retaining pin while pulling key cylinder from ignition switch.

IGNITION SWITCH REMOVAL

(1) Remove key lock cylinder. Refer to previous steps.

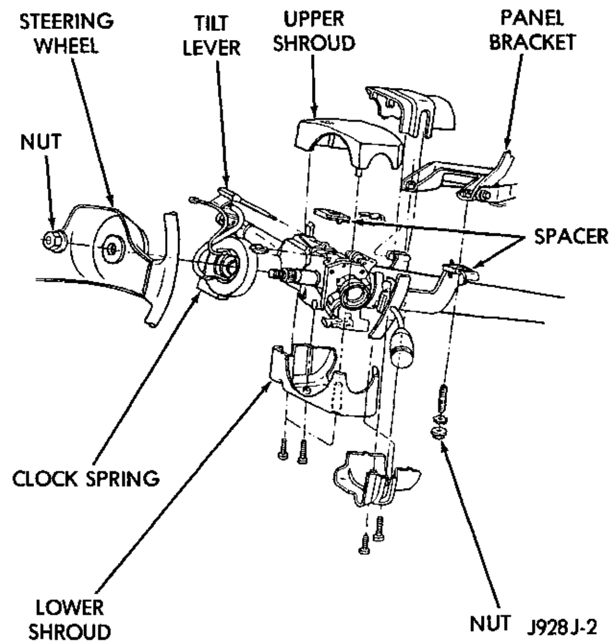

Fig. 59 Shroud Removal/Installation—Typical

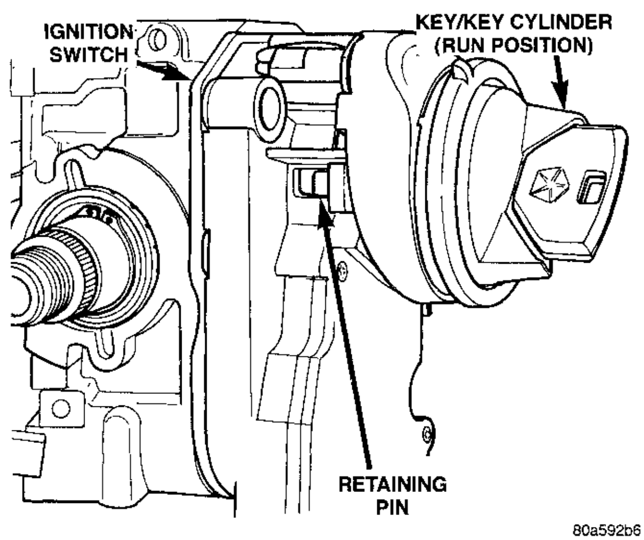

Fig. 60 Retaining Pin

(2) Remove 3 ignition switch mounting screws (Fig. 61). Use tamper proof torx bit (Snap-On® SDMTR10 or equivalent) to remove screws.

(3) Gently pull switch away from column. Release connector locks on 7-terminal wiring connector at ignition switch and remove connector (Fig. 62).

(4) Release connector lock on 4-terminal halo lamp wiring connector and remove connector (Fig. 62).

IGNITION SWITCH AND KEY CYLINDER INSTALLATION

If installing **ignition key lock cylinder only,** proceed to following steps 2, 3 and 4. Also refer to fol-

REMOVAL AND INSTALLATION (Continued)

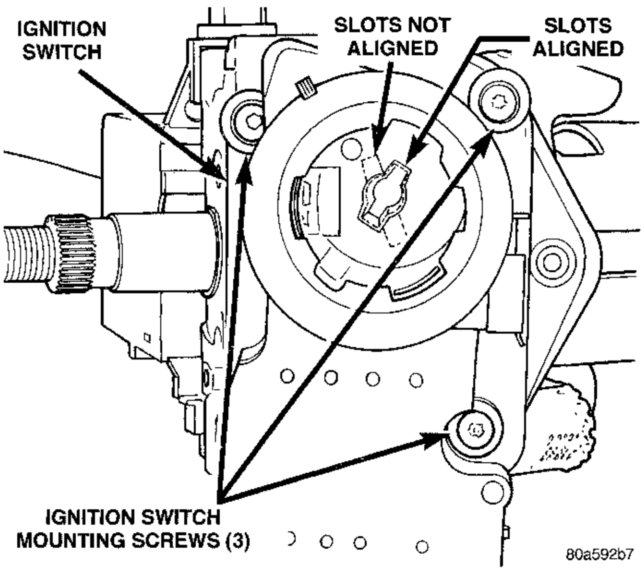

Fig. 61 Switch Mounting Screws

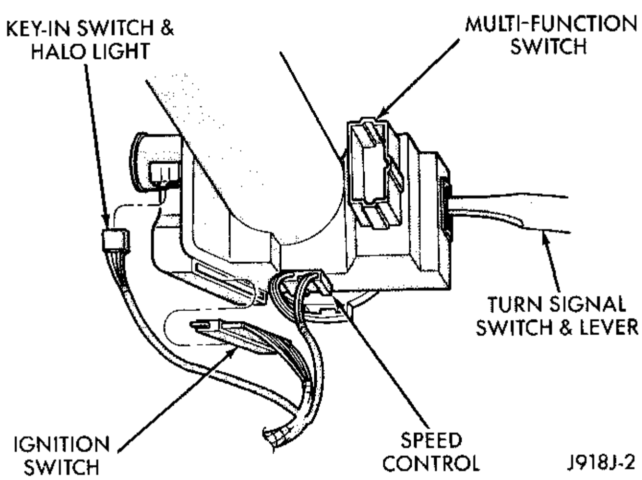

Fig. 62 Ignition Switch and Halo Lamp Connectors

lowing steps 12 through 18. If installing both switch and key cylinder, refer to steps 1 through 18.

(1) Rotate flag (Fig. 63) on rear of ignition switch until in RUN position. This step must be done to allow tang (Fig. 64) on key cylinder to fit into slots (Fig. 61) within ignition switch.

(2) With key into ignition key cylinder, rotate key clockwise until retaining pin can be depressed (Fig. 64) or (Fig. 65).

(3) Install key cylinder into ignition switch by aligning retaining pin into retaining pin slot (Fig. 65). Push key cylinder into switch until retaining pin engages. After pin engages, rotate key to OFF or LOCK position.

(4) Check for proper retention of key cylinder by attempting to pull cylinder from switch.

(5) Automatic Transmission Only: Before attaching ignition switch to steering column, the transmission

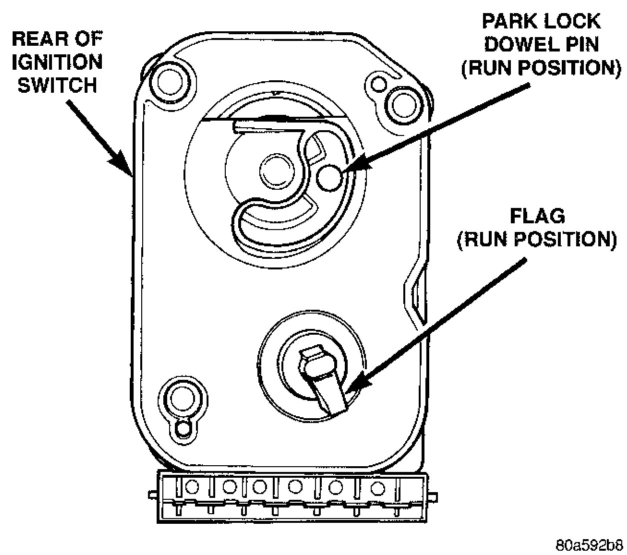

Fig. 63 Flag in RUN Position

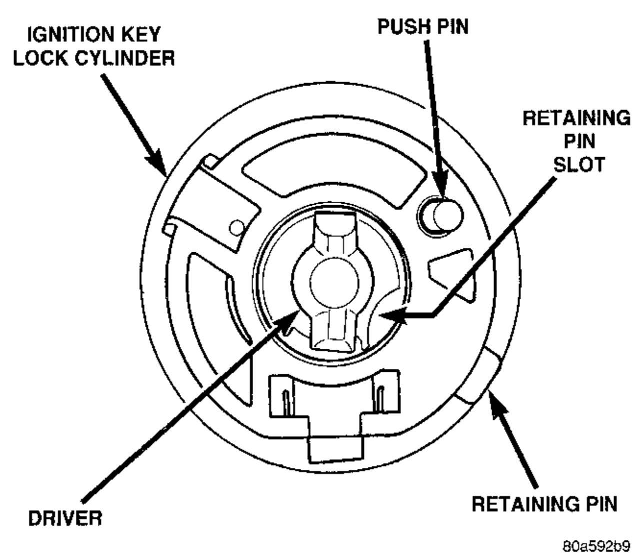

Fig. 64 Key Cylinder—Rear View

shifter must be in PARK position. The park lock dowel pin on rear of ignition switch (Fig. 66) must also be properly indexed into the park lock linkage (Fig. 67) before installing switch.

(6) The flag at rear of ignition switch (Fig. 66) must be properly indexed into steering column before installing switch. This flag is used to operate the steering wheel lock lever in steering column (Fig. 68). This lever allows steering wheel position to be locked when key switch is in LOCK position.

(7) Place ignition switch in LOCK position. The switch is in the LOCK position when column lock flag is parallel to ignition switch terminals (Fig. 66).

(8) Automatic Transmission Only: Apply a light coating of grease to park lock dowel pin and park lock slider linkage. Before installing switch, push the

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REMOVAL AND INSTALLATION (Continued)

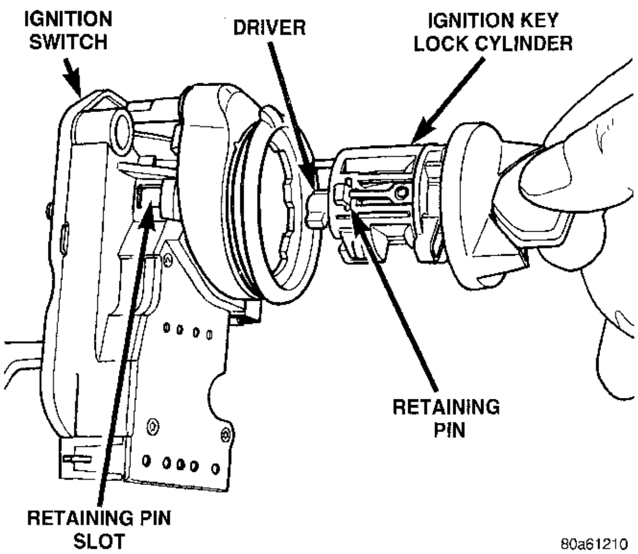

Fig. 65 Installing Key Cylinder Into Switch

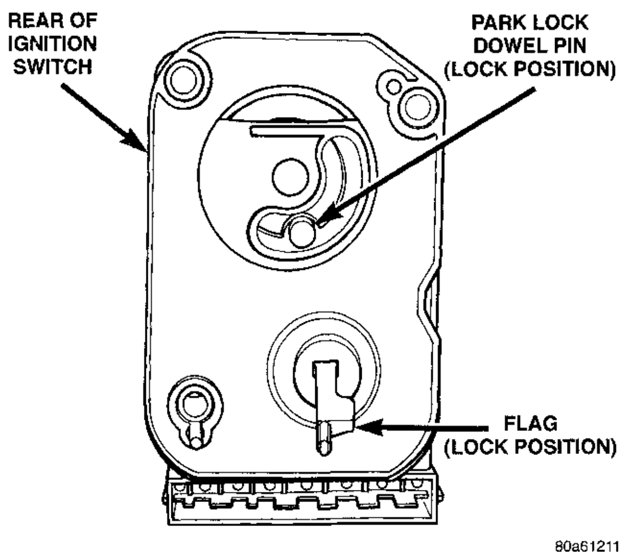

Fig. 66 Ignition Switch View From Column

park lock slider linkage (Fig. 67) forward until it bottoms. Do a final positioning by pulling it rearward about one-quarter inch.

(9) Apply a light coating of grease to both column lock flag and shaft at end of flag.

(10) Place ignition switch into openings on steering column.

(a) Automatic Transmission Only: Be sure park lock dowel pin on rear of ignition switch enters slot in park lock slider linkage (Fig. 67).

(b) Be sure flag on rear of switch is positioned above steering wheel lock lever (Fig. 68).

(c) Align dowel pins on rear of switch into holes on side of steering column.

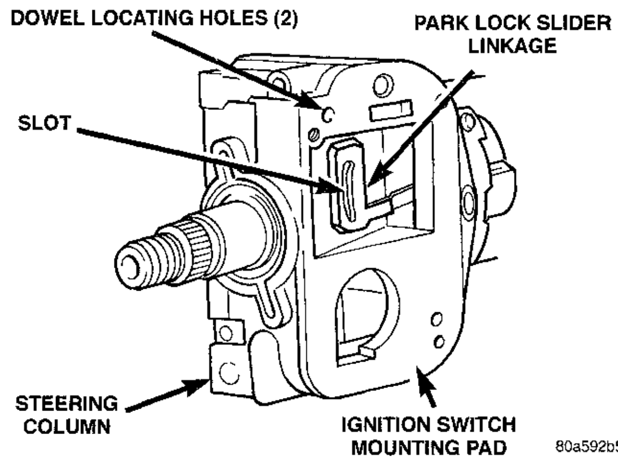

Fig. 67 Park Lock Linkage—Automatic Transmission—Typical

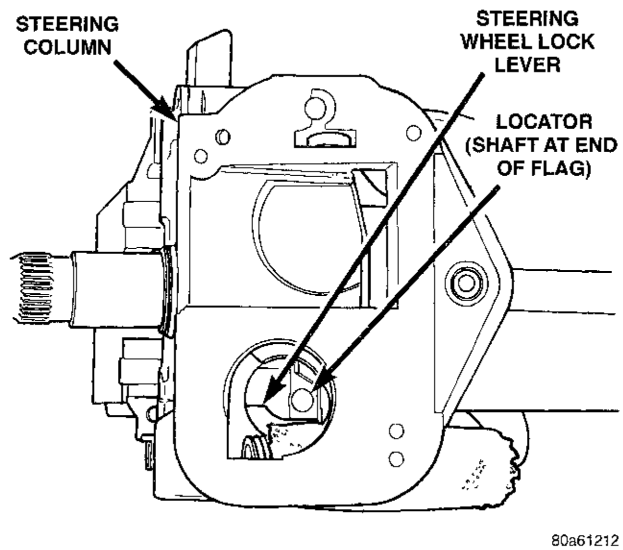

Fig. 68 Steering Wheel Lock Lever

(d) Install 3 ignition switch mounting screws. Tighten screws to 3 N·m ± .5 N·m (26 in. lbs. ± 4 in. lbs.) torque.

(11) Connect electrical connectors to ignition switch and halo lamp. Make sure that switch locking tabs are fully seated in wiring connectors.

(12) Install steering column covers (shrouds). Tighten screws to 2 N·m (17 in. lbs.) torque.

(13) Install tilt column lever (if equipped).

(14) Connect negative cable to battery.

(15) Check for proper operation of halo light.

(16) Automatic Transmission Only: Shifter should lock in PARK position when key is in LOCK position (if equipped with shift lock device). Shifter should unlock when key rotated to ON position.

(17) Check for proper operation of ignition switch in ACCESSORY, LOCK, OFF, ON, RUN, and START positions.

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REMOVAL AND INSTALLATION (Continued)

(18) Steering wheel should lock when key is in LOCK position. Rotate steering wheel to verify. Steering wheel should unlock when key is rotated to ON position.

COLUMN SHIFT INTERLOCK

The column shift interlock is used to lock the transmission shifter in the Park position when the key is in the Off position. The interlock device is located within the steering column assembly and is not servicable. If repair is necessary, the steering column assembly must be replaced. Refer to Group 19, Steering for procedures.

SPECIFICATIONS

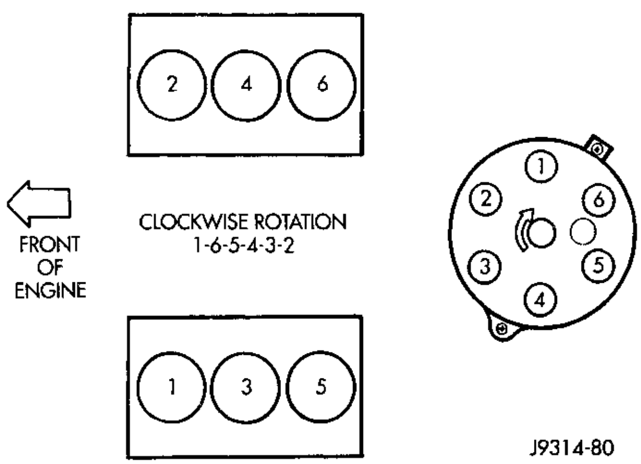
VECI LABEL

If anything differs between the specifications found on the Vehicle Emission Control Information (VECI) label and the following specifications, use specifications on VECI label. The VECI label is located in the engine compartment.

IGNITION TIMING

Ignition timing is not adjustable on any engine. Refer to Ignition Timing in the Diagnostics/Service Procedures section of this group for more information.

ENGINE FIRING ORDER—3.9L V-6 ENGINE



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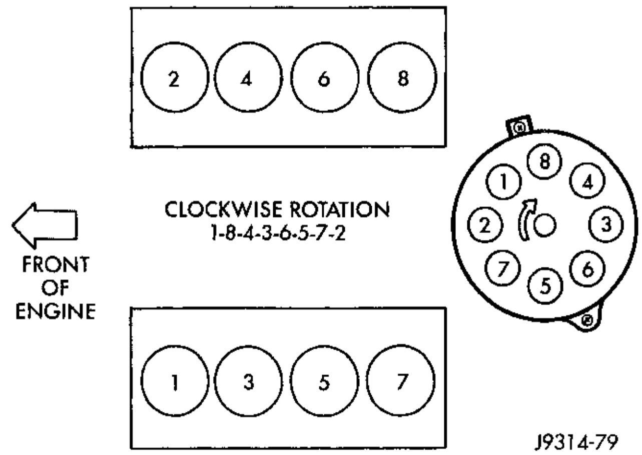
ENGINE FIRING ORDER—5.2L/5.9L V-8 ENGINES



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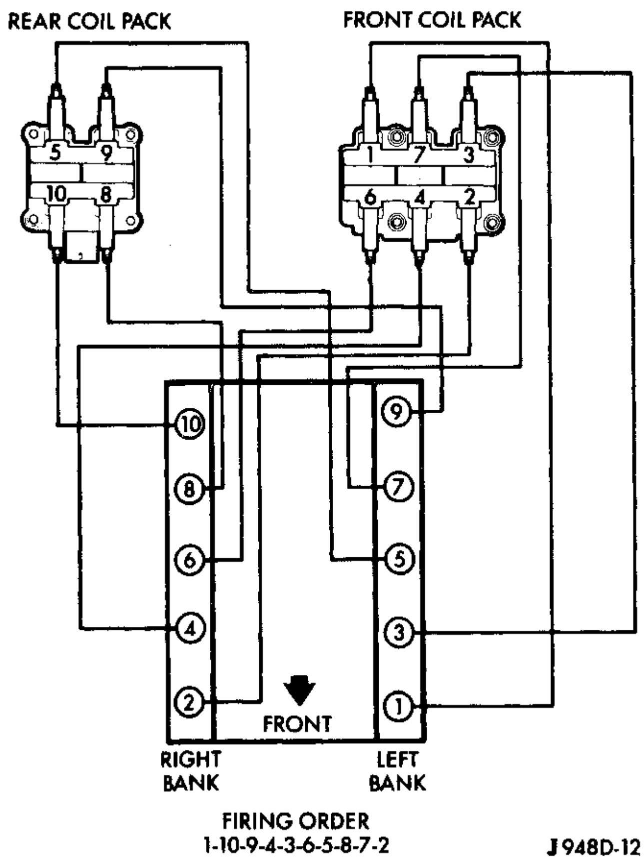
SPARK PLUG CABLE ORDER—8.0L V-10 ENGINE



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SPECIFICATIONS (Continued)

SPARK PLUGS

ENGINE	PLUG TYPE	ELECTRODE GAP
3.9L V-6	RC12LC4	1.01 mm (.040 in.)
5.2L/5.9L V-8	RC12LC4	1.01 mm (.040 in.)
8.0L V-10	QC9MC4	1.14 mm (.045 in.)

SPARK PLUG CABLE RESISTANCE

MINIMUM	MAXIMUM
250 Ohms Per Inch	1000 Ohms Per Inch
3000 Ohms Per Foot	12,000 Ohms Per Foot

IGNITION COIL RESISTANCE—3.9L/5.2L/5.9L ENGINES

COIL MANUFACTURER	PRIMARY RESISTANCE 21-27°C (70-80°F)	SECONDARY RESISTANCE 21-27°C (70-80°F)
Diamond	0.97 - 1.18 Ohms	11,300 - 15,300 Ohms
Toyodenso	0.95 - 1.20 Ohms	11,300 - 13,300 Ohms

IGNITION COIL RESISTANCE—8.0L V-10 ENGINE

Primary Resistance: 0.53-0.65 Ohms. Test across the primary connector. Refer to text for test procedures.
Secondary Resistance: 10.9-14.7K Ohms. Test across the individual coil towers. Refer to text for test procedures.

TORQUE CHART

DESCRIPTION **TORQUE**

Camshaft Position Sensor—
8.0L Engine . . . . .6 N·m (50 in. lbs.)
Crankshaft Position Sensor—
All Engines . . . . .8 N·m (70 in. lbs.)
Distributor Hold Down Bolt . . . . .23 N·m (17 ft. lbs.)
Ignition Coil Mounting—
3.9L/5.2L/5.9L Engines—
if tapped bolts are used . . . . . . .5 N·m (50 in. lbs.)
Ignition Coil Mounting—
3.9L/5.2L/5.9L Engines—
if nuts/bolts are used . . . . . . .11 N·m (100 in. lbs.)
Ignition Coil Mounting—
8.0L Engine . . . . .10 N·m (90 in. lbs.)
Powertrain Control Module
(PCM) Mounting Screws . . . . . . .1 N·m (9 in. lbs.)
Spark Plugs (all engines) . . . . . . .41 N·m (30 ft. lbs.)

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INSTRUMENT PANEL SYSTEMS

CONTENTS

GENERAL INFORMATION

INTRODUCTION

This group is responsible for covering the vehicle instrument panel. However, because the instrument panel serves as the command center of the vehicle, it is a very complex unit. The instrument panel is designed to house the controls and monitors for standard and optional powertrains, climate control systems, audio systems, lighting systems, safety systems and many other comfort or convenience items. It is also designed so that all of the controls and monitors can be safely reached and viewed by the vehicle operator, while still allowing relative ease of access to these items for service.

Complete service information coverage for all of the systems and components housed in the instrument panel in this section of the service manual would not be practical. It would result in a great deal of duplication and make this group too large for the information to be easily accessed and used. Therefore, the information found in this group has been limited as follows:

- General Information - Covers non-electrical components and features of the instrument panel that are not related to other systems.
- Description and Operation - Covers gauges and their sending units, warning lamps and their switches, and instrument panel illumination lamps.
- Diagnosis and Testing - Covers gauges and their inputs, warning lamps and their inputs, and instrument panel illumination lamps.
- Removal and Installation - Covers all components installed on or in the instrument panel that require removal for diagnosis or service of any other instrument panel components covered in this group.

For more information on components or systems not covered above, refer to the proper group in this manual. If you are uncertain as to the proper group, refer to the Component and System Index at the back of this manual. Refer to Group 8W - Wiring Diagrams for complete circuit descriptions and diagrams.

INSTRUMENT PANEL

This instrument panel is molded from a blend of various plastics that are mechanically attached to the vehicle. Colors are molded into the plastic components to minimize appearance degradation from scratches or abrasions. The panel components are internally ribbed and riveted to steel reinforcements for additional structural integrity and dimensional stability.

The instrument panel surface components are designed to deform upon impact without breaking. This type of construction provides improved energy absorption which, in conjunction with the dual airbag modules and seat belts, helps to improve occupant protection.

Modular instrument panel construction allows all of the gauges and controls to be serviced from the front of the panel. In addition, most of the instrument panel electrical or heating and air conditioning components can be accessed without complete instrument panel removal. If necessary, the instrument panel can be rolled-down and removed from the vehicle as an assembly.

Removal of the instrument cluster bezel allows access to the instrument cluster, the heating and air conditioning controls, and the radio. Removal of the instrument cluster assembly allows access to the individual illumination and indicator lamp bulbs, and the instrument cluster wiring.

Removal of the steering column opening cover and knee blocker provides access to the steering column mounts, the steering column wiring, the junction block (removal of a snap-fit fuse access panel on the left end of the instrument panel allows access to the fuses and circuit breakers), the Central Timer Module (CTM), the Infinity speaker filter choke and relay unit, much of the instrument panel wiring, and the gear selector indicator cable (automatic transmission).

Removal of the glove box provides access to the passenger side airbag module, the glove box lamp and switch, the radio antenna coaxial cable, the heating and air conditioning vacuum harness connector, and additional instrument panel wiring.

INSTRUMENT CLUSTER

Two basic instrument cluster options are offered on this model. One is referred to as a low-line cluster, and the other is referred to as a high-line cluster. Both clusters are electromechanical units that utilize integrated circuitry and information carried on the Chrysler Collision Detection (CCD) data bus network

AUTHENTIC RESTORATION PRODUCT

GENERAL INFORMATION (Continued)

for control of all gauges and many of the indicator lamps. These clusters also incorporate a Liquid Crystal Display (LCD) for the digital odometer/trip odometer display functions. Some variations of these clusters exist due to optional equipment and regulatory requirements.

Both of these clusters include the following analog gauges:

- Coolant temperature gauge
- Fuel gauge
- Oil pressure gauge
- Speedometer
- Voltmeter.

These clusters also include provisions for the following indicator lamps:

- Airbag indicator lamp
- Anti-lock Brake System (ABS) lamp
- Brake warning lamp
- Check gauges lamp
- Cruise-on indicator lamp
- Four-wheel drive indicator lamp
- Headlamp high beam indicator lamp
- Low fuel warning lamp
- Low washer fluid warning lamp
- Malfunction indicator (Check Engine) lamp
- Overdrive-off indicator lamp (automatic transmission)
- Seat belt reminder lamp
- Security lamp
- Service Reminder Indicator (SRI) lamp (Maintenance Required - for certain heavy-duty emissions cycle engines)
- Transmission oil temperature warning lamp (automatic transmission)
- Turn signal indicator lamps
- Upshift indicator lamp (manual transmission)
- Wait-to-start indicator lamp (diesel engine)
- Water-in-fuel indicator lamp (diesel engine)

The high-line cluster includes all of the gauges and indicator lamps found in the low-line cluster, but adds an analog tachometer. Some of the low-line cluster gauges have different positions or sizes in the high-line cluster in order to accommodate the tachometer.

Both instrument clusters also have a provision for mounting the automatic transmission gear selector indicator in the lower right corner of the cluster. Models equipped with a manual transmission have a block-out plate installed in place of this indicator.

The instrument cluster circuitry has a self-diagnostic actuator test capability, which will test each of the CCD bus message-controlled functions of the cluster by lighting the appropriate indicator lamps and positioning the gauge needles at several predetermined locations on the gauge faces in a prescribed sequence. For more information on this function, see Instrument Cluster in the Diagnosis and Testing section of this group.

The instrument cluster circuitry also sends chime tone requests over a hard-wired circuit to the Central Timer Module (CTM) when it monitors certain conditions or inputs. The CTM replaces the chime or buzzer module. Refer to Group 8U - Chime/Buzzer Warning Systems for more information on this cluster circuitry function.

The instrument cluster for this model is serviced only as a complete unit. If a cluster gauge or the cluster circuit board are faulty, the entire cluster must be replaced. Each of the red indicators in the cluster are illuminated by a Light-Emitting Diode (LED). If an LED fails, the entire instrument cluster must be replaced. The cluster lens, the cluster hood, the rear cluster housing cover, and the incandescent lamp bulbs and holders are available for service replacement.

GAUGE

With the ignition switch in the On or Start positions, voltage is supplied to all gauges through the instrument cluster electronic circuit board. With the ignition switch in the Off position, voltage is not supplied to the gauges. The gauges do not accurately indicate any vehicle condition unless the ignition switch is in the On or Start positions.

All of the instrument cluster gauges, except the odometer, are air core magnetic units. Two fixed electromagnetic coils are located within the gauge. These coils are wrapped at right angles to each other around a movable permanent magnet. The movable magnet is suspended within the coils on one end of a shaft. The gauge needle is attached to the other end of the shaft.

One of the coils has a fixed current flowing through it to maintain a constant magnetic field strength. Current flow through the second coil changes, which causes changes in its magnetic field strength. The current flowing through the second coil is changed by the instrument cluster electronic circuitry in response to messages received on the Chrysler Collision Detection (CCD) data bus network.

The gauge needle moves as the movable permanent magnet aligns itself to the changing magnetic fields created around it by the electromagnets. The instrument cluster circuitry is programmed to move all of the gauge needles back to the low end of their respective scales after the ignition switch is turned to the Off position.

INDICATOR LAMP

Indicator lamps are located in the instrument cluster and are served by the cluster circuit board and connectors. Many of the indicator lamps in the instrument cluster are controlled by the instrument cluster circuitry in response to messages received over the Chrysler Collision Detection (CCD) data bus network.

The four-wheel drive indicator lamp, headlamp high beam indicator lamp, low washer fluid warning lamp, overdrive off indicator lamp, security lamp, turn signal indicator lamps, and wait-to-start indicator lamp are hard-wired. The seat belt reminder lamp is controlled by the instrument cluster programming and by CCD data bus messages from the Airbag Control Module (ACM). The brake warning lamp is controlled by a hard-wired input from the parking brake switch and by CCD data bus messages from the Controller Anti-lock Brake (CAB). The instrument cluster circuitry uses CCD data bus messages from the Powertrain Control Module (PCM), ACM, and CAB to control all of the remaining indicator lamps.

Each of the red indicator lamps in the instrument cluster is illuminated by a dedicated Light-Emitting Diode (LED). If an LED should fail, the entire instrument cluster must be replaced. The remaining lamps in the instrument cluster use incandescent bulbs and holders, which are available for individual service replacement.

CENTRAL TIMER MODULE

Two versions of the Central Timer Module (CTM) are available on this vehicle, a base version and a high-line version. The base version of the CTM is used on base models of the vehicle. It is also sometimes referred to as the Integrated Electronic Module (IEM). The base version of the CTM combines the functions of a chime/buzzer module, an intermittent wipe module, and an ignition lamp time delay relay in a single unit.

The high-line version of the CTM is used on high-line vehicles. The high-line CTM provides all of the functions of the base version CTM, but also is used to control and integrate many of the additional electronic functions and features included on the high-line models. The high-line version of the CTM contains a central processing unit and interfaces with other modules in the vehicle on the Chrysler Collision Detection (CCD) data bus network.

The CCD data bus network allows the sharing of sensor information. This helps to reduce wire harness complexity, reduce internal controller hardware, and reduce component sensor current loads. At the same time, this system provides increased reliability, enhanced diagnostics, and allows the addition of many new feature capabilities.

Some of the functions and features that the CTM supports or controls include:

- Chimes for the following conditions:
- Headlamps on with ignition off and driver door open warning
- Key in ignition with ignition off and driver door open warning
- ABS lamp warning (if the vehicle is so equipped)
- Airbag lamp warning
- Check engine lamp warning
- Check gauges lamp warning
- Low fuel lamp warning
- Low washer fluid lamp warning
- Seat belt reminder lamp warning
- Transmission oil temperature lamp warning
- Ignition key lamp timer
- Intermittent wipe control
- Courtesy lamp time-out (high-line only)
- Enhanced accident response (high-line only)
- Horn chirp upon door lock with RKE (programmable) (high-line only)
- Illuminated entry (high-line only)
- Power door lock control (high-line only)
- Power lock inhibit (high-line only)
- Remote Keyless Entry (RKE) (high-line only)
- Rolling door locks (programmable) (high-line only)
- Speed sensitive intermittent wipe (high-line only)
- Vehicle Theft Security System (VTSS) (high-line only) (if the vehicle is so equipped).

Both versions of the CTM are mounted under the driver side end of the instrument panel, inboard of the instrument panel steering column opening.

Refer to Central Timer Module in the Diagnosis and Testing section of Group 8U - Chime/Buzzer Warning Systems for diagnosis of the base version of the CTM. For diagnosis of the high-line version of the CTM or the CCD data bus, the use of a DRB scan tool and the proper Diagnostic Procedures manual are recommended. The CTM cannot be repaired and, if faulty or damaged, it must be replaced.

JUNCTION BLOCK

The junction block is mounted on the left instrument panel end reinforcement on the left outboard end of the instrument panel. It is concealed behind the left end of the instrument panel cover. The junction block serves to simplify and centralize numerous electrical components.

The junction block combines the functions previously provided by a separate fuseblock module and relay center. It contains fuses, circuit breakers and relays. It also eliminates the need for numerous splice connections and serves in place of a bulkhead connector between many of the engine compartment, instrument panel, and body wire harnesses.

The left end of the instrument panel cover has a snap-fit fuse access panel that can be removed for

GENERAL INFORMATION (Continued)

service of the junction block fuses. A fuse puller and spare fuse holders are located on the back of the fuse access panel. A label on the back of the fuse access panel identifies the fuse cavity assignments.

The junction block cannot be repaired and, if faulty or damaged, it must be replaced.

DESCRIPTION AND OPERATION

COOLANT TEMPERATURE GAUGE

The coolant temperature gauge gives an indication of the engine coolant temperature. The instrument cluster circuitry controls the gauge pointer position. The instrument cluster circuitry calculates the proper gauge pointer position based upon engine coolant temperature messages received from the Powertrain Control Module (PCM) on the Chrysler Collision Detection (CCD) data bus.

The PCM uses an input from the engine coolant temperature sensor and internal programming to decide what engine coolant temperature messages are required. The PCM then sends the proper messages to the instrument cluster on the CCD data bus.

If the PCM messages indicate that coolant temperature is too high, the instrument cluster circuitry moves the gauge needle to the high end of the scale on the gauge face, turns on the Check Gauges lamp, and sends a chime tone request to the Central Timer Module (CTM).

The engine coolant temperature sensor is installed in a threaded hole that penetrates a coolant passage of the engine. It is a thermistor-type sensor that changes its internal resistance with changes in engine coolant temperature. Refer to Group 14 - Fuel Systems for more information on the PCM and the coolant temperature sensor.

FUEL GAUGE

The fuel gauge gives an indication of the level of fuel in the fuel tank. The instrument cluster circuitry controls the gauge pointer position. The instrument cluster circuitry calculates the proper gauge pointer position based upon fuel level messages received from the Powertrain Control Module (PCM) on the Chrysler Collision Detection (CCD) data bus.

The PCM uses an input from the fuel gauge sending unit and internal programming to decide what fuel level messages are required. The PCM then sends the proper messages to the instrument cluster on the CCD data bus. If the PCM messages indicate that the fuel level is below one-eighth of a full tank for more than ten seconds, the instrument cluster circuitry turns on the low fuel warning lamp and sends a chime tone request to the Central Timer Module (CTM).

The fuel gauge sending unit is mounted to the electric fuel pump module located inside the fuel tank. The sending unit has a float attached to the end of a swing-arm. The float moves up or down within the fuel tank as the fuel level changes. As the float moves, an electrical contact on the pivot end of the swing-arm wipes across a resistor coil, which changes the internal electrical resistance of the sending unit. Refer to Group 14 - Fuel Systems for more information on the PCM and the fuel gauge sending unit service procedures.

ODOMETER AND TRIP ODOMETER

The odometer and the trip odometer share the same Liquid Crystal Display (LCD) on the instrument cluster circuit board. Each gives an indication of the distance the vehicle has travelled. However, by depressing the reset knob on the face of the instrument cluster, the display mode can be switched from odometer to trip odometer. Depressing the reset knob for longer than two seconds while in the trip odometer mode will reset the trip odometer to zero. The odometer and trip odometer display values are based upon odometer and trip odometer messages received from the Powertrain Control Module (PCM) on the Chrysler Collision Detection (CCD) data bus.

The PCM uses a speed pulse input received from the Controller Anti-lock Brake (CAB) and internal programming to decide what vehicle speed and distance messages are required. The PCM then sends the proper messages to the instrument cluster circuitry on the CCD data bus. The CAB uses an input from the rear wheel speed sensor and internal programming, which includes a programmable pinion factor to compensate for different axle gear ratios and tire sizes, to determine what speed pulse output is required. The CAB then sends the proper speed pulse to the PCM on a hard-wired circuit.

The instrument cluster stores both the last odometer and last trip odometer distance messages it receives from the PCM, and displays the proper value based upon ignition key-on and trip odometer reset knob inputs. If the instrument cluster stops receiving distance messages from the PCM during its current ignition key-on cycle, the odometer or trip odometer will display the last distance value that was received. If the instrument cluster has not received any distance messages from the PCM during its current ignition key-on cycle, the odometer or trip odometer display will blink.

The rear wheel speed sensor is excited by an exciter ring on the differential case within the rear axle housing. Incorrect tire size, incorrect axle ratio, an incorrect pinion factor, a faulty or improperly installed rear wheel speed sensor, a faulty rear axle exciter ring, or a faulty CAB can each result in inaccurate odometer readings. For diagnosis of the odometer and trip odometer inputs, a DRB scan tool and the proper Diagnostic Procedures manual are recommended. Refer to Group 5 - Brakes for more information on the CAB, the rear wheel speed sensor and the rear axle exciter ring. Refer to Group 14 - Fuel Systems for more information on the PCM.

OIL PRESSURE GAUGE

The oil pressure gauge gives an indication of the engine oil pressure. The instrument cluster circuitry controls the gauge pointer position. The instrument cluster circuitry calculates the proper gauge pointer position based upon engine oil pressure messages received from the Powertrain Control Module (PCM) on the Chrysler Collision Detection (CCD) data bus.

The PCM uses an input from the engine oil pressure sensor and internal programming to decide what engine oil pressure messages are required. The PCM then sends the proper messages to the instrument cluster on the CCD data bus. If the PCM messages indicate that oil pressure is too low, the instrument cluster circuitry moves the gauge needle to the 0 PSI graduation on the gauge face, turns on the Check Gauges lamp, and sends a chime tone request to the Central Timer Module (CTM). If the PCM messages indicate that oil pressure is too high, the instrument cluster circuitry moves the gauge needle to the 110 PSI graduation on the gauge face.

The engine oil pressure sensor is installed in a threaded hole that penetrates an oil passage of the engine. The engine oil pressure sensor contains a flexible diaphragm and a variable resistor coil. The diaphragm moves in response to changes in the engine oil pressure, which changes the internal electrical resistance of the sensor. Refer to Group 14 - Fuel Systems for more information on the PCM and the engine oil pressure sensor.

SPEEDOMETER

The speedometer gives an indication of the current vehicle speed. The instrument cluster circuitry controls the gauge pointer position. The instrument cluster circuitry calculates the proper gauge pointer position based upon vehicle speed messages received from the Powertrain Control Module (PCM) on the Chrysler Collision Detection (CCD) data bus.

The PCM uses a speed pulse input received from the Controller Anti-lock Brake (CAB) and internal programming to decide what vehicle speed and distance messages are required. The PCM then sends the proper messages to the instrument cluster circuitry on the CCD data bus. The CAB uses an input from the rear wheel speed sensor and internal programming, which includes a programmable pinion factor to compensate for different axle gear ratios and tire sizes, to determine what speed pulse output is required. The CAB then sends the proper speed pulse to the PCM on a hard-wired circuit.

The rear wheel speed sensor is excited by an exciter ring on the differential case within the rear axle housing. Incorrect tire size, incorrect axle ratio, an incorrect pinion factor, a faulty or improperly installed rear wheel speed sensor, a faulty rear axle exciter ring, or a faulty CAB can each result in inaccurate speedometer readings. For diagnosis of the speedometer inputs, a DRB scan tool and the proper Diagnostic Procedures manual are recommended. Refer to Group 5 - Brakes for more information on the CAB, the rear wheel speed sensor and the rear axle exciter ring. Refer to Group 14 - Fuel Systems for more information on the PCM.

TACHOMETER

The tachometer gives an indication of the engine speed in revolutions-per-minute (RPM). The instrument cluster circuitry controls the gauge pointer position. The instrument cluster circuitry calculates the proper gauge pointer position based upon engine speed messages received from the Powertrain Control Module (PCM) on the Chrysler Collision Detection (CCD) data bus.

The PCM uses an input from the crankshaft position sensor and internal programming to calculate what engine speed messages are required. The PCM then sends the proper messages to the instrument cluster on the CCD data bus. The crankshaft position sensor is a hall-effect sensor installed near the rear of the engine, where it is aimed at the trigger wheel attached to the rear flange of the crankshaft.

Refer to Group 14 - Fuel Systems for more information on the PCM. Refer to Group 8D - Ignition Systems for more information on the crankshaft position sensor.

VOLTMETER

The voltmeter gives an indication of the electrical system voltage. The instrument cluster circuitry controls the gauge pointer position. The instrument cluster circuitry calculates the proper gauge pointer position based upon system voltage messages received from the Powertrain Control Module (PCM) on the Chrysler Collision Detection (CCD) data bus.

The PCM uses an input from the electrical system and internal programming to decide what system voltage messages are required. The PCM then sends the proper messages to the instrument cluster on the CCD data bus. If the PCM messages indicate that the charging system has failed, the electrical system voltage is less than 11 volts or greater than 16.6 volts, the instrument cluster circuitry turns on the

AUTHENTIC RESTORATION PRODUCTS

DESCRIPTION AND OPERATION (Continued)

Check Gauges lamp and sends a chime tone request to the Central Timer Module (CTM).

Refer to Group 14 - Fuel Systems for more information on the PCM. Refer to Group 8C - Charging Systems for more information on the charging system components and their diagnosis.

AIRBAG INDICATOR LAMP

The airbag indicator lamp gives an indication when the airbag system is faulty or inoperative. The lamp is controlled by the instrument cluster circuitry based upon messages received from the Airbag Control Module (ACM) on the Chrysler Collision Detection (CCD) data bus. The lamp is turned on by the ACM for about seven seconds when the ignition switch is turned to the On position as a bulb test.

The ACM continually monitors the airbag system circuits and sensors to decide whether the system is in good operating condition. The ACM then sends the proper messages to the instrument cluster on the CCD data bus to turn the lamp on or off. If the ACM turns the lamp on after the bulb test, it indicates the ACM has detected a system malfunction and/or that the airbag system has become inoperative. The instrument cluster circuitry will also send a chime request to the Central Timer Module (CTM) when a lamp-on message is received from the ACM. A lamp-on message does not mean that either or both airbags will not deploy upon an impact, only that they might not deploy, depending upon the nature of the detected malfunction. Each time that the instrument cluster circuitry receives a lamp-on message from the ACM, it will light the lamp for three seconds or the duration of the airbag system malfunction, whichever is longer.

The airbag indicator lamp also has a lamp backup feature. About ten seconds after the ignition switch is turned to the On position, if an inoperative airbag warning lamp circuit was detected during the bulb test sequence, the instrument cluster circuitry will flash the seat belt reminder lamp on and off for about thirty seconds. If the seat belt reminder lamp stays on after flashing for thirty seconds, or comes on at any time other than about ten seconds after the initial ignition-on sequence, it may indicate that an airbag system fault has been detected and that the airbag indicator lamp is inoperative.

See Seat Belt Reminder Lamp in the Description and Operation section of this group for more information on the airbag lamp backup feature. Refer to Airbag System in Group 8M - Passive Restraint Systems for more information on the airbag system.

ANTI-LOCK BRAKE SYSTEM LAMP

The Anti-Lock Brake System (ABS) lamp gives an indication when the ABS system is faulty or inoperative. The lamp is controlled by the instrument cluster circuitry based upon messages received from the Controller Anti-lock Brake (CAB) on the Chrysler Collision Detection (CCD) data bus. The lamp is turned on by the CAB for about two seconds when the ignition switch is turned to the On position as a bulb test.

After the bulb test, the CAB turns the lamp on or off based upon the results of the ABS self-tests. The CAB continually monitors the ABS circuits and sensors to decide whether the system is in good operating condition. The CAB then sends the proper messages to the instrument cluster on the CCD data bus to turn the lamp on or off. If the CAB turns the lamp on after the bulb test, it indicates that the CAB has detected a system malfunction and/or that the ABS system has become inoperative. If only the amber ABS lamp is illuminated, and the red brake warning lamp remains off, the base brake system will operate normally.

Each time the instrument cluster circuitry receives a lamp-on message from the CAB, it will light the lamp for the duration of the ABS malfunction. The CAB will also flash this lamp during the diagnostic mode, unless a hard fault is present. If a hard fault is present, the ABS lamp will illuminate without flashing. Refer to Group 5 - Brakes for more information on the ABS systems.

BRAKE WARNING LAMP

The brake warning lamp gives an indication when the parking brake is applied, when the pressures in the two halves of the split brake hydraulic system are unequal, if the Anti-lock Brake System (ABS) lamp has failed and an ABS fault occurs, and during ABS diagnostics. The lamp is turned on by the instrument cluster circuitry for about two seconds when the ignition switch is moved to the Start position as a bulb test. After the bulb test, the lamp is controlled by a hard-wired input from the parking brake switch and/or by the instrument cluster circuitry based upon messages received from the Controller Anti-lock Brake (CAB) on the Chrysler Collision Detection (CCD) data bus.

The CAB turns the lamp on or off based upon the results of the ABS self-tests. The CAB continually monitors the ABS circuits and sensors, including the brake warning switch and the ABS lamp, to decide whether the system is in good operating condition. The CAB then sends the proper messages to the instrument cluster on the CCD data bus to turn the lamp on or off. If the CAB turns the lamp on after the bulb test, it indicates that the CAB has detected a system malfunction.

The parking brake switch is hard-wired to the instrument cluster and closes to ground when the parking brake is applied. The brake warning switch is hard-wired to the CAB and closes to ground when it senses unequal hydraulic pressures in the two halves of the split brake hydraulic system, possibly due to low brake fluid level or brake fluid leakage.

After the bulb test, if the red brake warning lamp remains illuminated with the parking brake released, the base brake system may not be operational. The vehicle should never be operated while the red brake warning lamp is illuminated. Refer to Group 5 - Brakes for more information.

CHECK GAUGES LAMP

The check gauges lamp gives an indication when certain gauges reflect a condition requiring immediate attention. The lamp is turned on by the instrument cluster circuitry for about three seconds after the ignition switch is turned to the On position as a bulb test. After the bulb test, the lamp is controlled by the instrument cluster circuitry based upon gauge data messages received from the Powertrain Control Module (PCM) on the Chrysler Collision Detection (CCD) data bus.

The PCM uses several inputs to decide what gauge data messages are required. The PCM then sends the proper message to the instrument cluster on the CCD data bus. When the instrument cluster circuitry receives a gauge data message that requires the check gauges lamp to be turned on, it also sends a chime tone request to the Central Timer Module (CTM).

The gauge data messages for which the instrument cluster is programmed to turn on the check gauges lamp are:

- Engine coolant temperature is high
- Engine oil pressure is low
- System voltage is high or low.

CIGAR LIGHTER

A cigar lighter is standard equipment on this model. The cigar lighter is installed in the instrument panel next to the ash receiver near the center of the instrument panel, below the radio. The cigar lighter receives battery voltage from a fuse in the junction block only when the ignition switch is in the Accessory or On positions.

The cigar lighter consists of two major components: a knob and heating element unit, and the cigar lighter base or receptacle shell. The receptacle shell is connected to ground, and an insulated contact in the bottom of the shell is connected to battery current. The cigar lighter base is secured by a snap fit within the instrument panel.

The knob and heating element are encased within a spring-loaded housing, which also features a sliding protective heat shield. When the knob and heating element are inserted in the receptacle shell, the heating element resistor coil is grounded through its housing to the receptacle shell. If the cigar lighter knob is pushed inward, the heat shield slides up toward the knob exposing the heating element, and the heating element extends from the housing toward the insulated contact in the bottom of the receptacle shell.

Two small spring-clip retainers are located on either side of the insulated contact inside the bottom of the receptacle shell. These clips engage and hold the heating element against the insulated contact long enough for the resistor coil to heat up. When the heating element is engaged with the contact, battery current can flow through the resistor coil to ground, causing the resistor coil to heat.

When the resistor coil becomes sufficiently heated, excess heat radiates from the heating element causing the spring-clips to expand. Once the spring-clips expand far enough to release the heating element, the spring-loaded housing forces the knob and heating element to pop back outward to their relaxed position. When the cigar lighter knob and element are pulled out of the receptacle shell, the protective heat shield slides downward on the housing so that the heating element is recessed and shielded around its circumference for safety.

The cigar lighter knob and heating element unit, and the cigar lighter receptacle unit are available for service. These components cannot be repaired and, if faulty or damaged, they must be replaced.

CLUSTER ILLUMINATION LAMP

The cluster illumination lamps are hard-wired in the instrument cluster. When the park or head lamps are turned on, the cluster illumination lamps light. Illumination brightness is adjusted by rotating the headlamp switch knob (clockwise to dim, counterclockwise to brighten). The instrument cluster illumination lamps receive battery feed from the panel dimmer rheostat in the headlamp switch through a fuse in the junction block.

The instrument cluster circuitry monitors the cluster illumination lamp dimming level and responds by sending dimming level messages over the Chrysler Collision Detection (CCD) data bus network. These dimming level messages are then used by the overhead console display module to coordinate the dimming level of its Vacuum Fluorescent Display (VFD) with that of the instrument cluster.

Each of the cluster illumination lamps is located on the instrument cluster circuit board. Each lamp has a replaceable bulb and bulb holder. Refer to Group 8L - Lamps for more information.

AUTHENTIC RESTORATION PRODUCT

DESCRIPTION AND OPERATION (Continued)

CRUISE-ON INDICATOR LAMP

The cruise-on indicator lamp gives an indication when the vehicle speed control system is turned on, even when the system is not currently engaged. The lamp is turned on by the instrument cluster circuitry for about two seconds when the ignition switch is turned to the On position as a bulb test. After the bulb test, the lamp is controlled by the instrument cluster circuitry based upon messages received from the Powertrain Control Module (PCM) on the Chrysler Collision Detection (CCD) data bus.

The PCM uses an input from the analog resistor-multiplexed vehicle speed control switches in the steering wheel to decide whether to turn the lamp on or off. The PCM then sends the proper messages to the instrument cluster on the CCD data bus. Refer to Group 8H - Vehicle Speed Control System for more information.

FOUR-WHEEL DRIVE INDICATOR LAMP

On vehicles equipped with the optional four-wheel drive system, a four-wheel drive indicator lamp is located in the instrument cluster. This lamp lights any time the front axle is engaged in a four-wheel drive operating mode.

When the ignition switch is in the On position, battery voltage is supplied to one side of the indicator lamp bulb. A normally-open, plunger-type, four-wheel drive switch threaded into the front axle disconnect housing is hard-wired in series between the other side of the indicator lamp bulb and ground.

When the transfer case is shifted into the 4L or 4H positions, a vacuum switch on the transfer case directs engine vacuum to a vacuum motor on the front axle disconnect housing. The vacuum motor actuates a shift fork within the front axle, which engages or disengages the inner and outer halves of the front axle shaft. The shift fork movement also actuates the plunger of the four-wheel drive switch, opening or closing the ground path for the indicator lamp.

Refer to Group 3 - Differential and Driveline for more information on the front axle disconnect mechanism. Refer to Group 21 - Transmission for more information on the transfer case shift mechanism.

GEAR SELECTOR INDICATOR

The gear selector indicator gives an indication of the position of the automatic transmission gear selector lever. The indicator is mounted to the rear of the instrument cluster housing.

The indicator is mechanically actuated by a cable connected to the gear selector indicator driver lever of the gear selector lever mechanism on the steering column. This group covers only the removal and installation of the gear selector indicator. Refer to Group 19 - Steering for the gear selector indicator cable adjustment procedures.

HEADLAMP HIGH BEAM INDICATOR LAMP

The headlamp high beam indicator lamp gives an indication when the headlamp high beams are turned on. The lamp is controlled by a hard-wired input from the headlamp dimmer (multi-function) switch.

One side of the high beam indicator lamp bulb is grounded at all times. The other side of the bulb receives a battery feed through the contacts of the dimmer switch when the multi-function switch stalk is actuated to turn on the headlamp high beams. Refer to Group 8L - Lamps for more information.

LOW FUEL WARNING LAMP

The low fuel warning lamp gives an indication when the fuel level in the fuel tank has fallen below about one-eighth of a full tank, as registered on the fuel gauge. The instrument cluster circuitry lights the lamp for about two seconds when the ignition switch is turned to the On position as a bulb test. After the bulb test, the instrument cluster circuitry controls the lamp based upon fuel level and vehicle speed messages received from the Powertrain Control Module (PCM) on the Chrysler Collision Detection (CCD) data bus.

The PCM uses inputs from the fuel gauge sending unit, the Controller Anti-lock Brake (CAB), and internal programming to decide what messages are required. The PCM then sends the proper messages to the instrument cluster on the CCD data bus.

If the PCM messages indicate that the fuel level is below one-eighth of a full tank for more than ten seconds, and that the vehicle is not moving, the instrument cluster circuitry turns on the low fuel warning lamp and sends a chime tone request to the Central Timer Module (CTM). To reduce the effects of fuel sloshing, if the vehicle speed message indicates that the vehicle is moving, the fuel level message must remain below one-eighth of a full tank for more than sixty seconds before the lamp will be illuminated.

The fuel gauge sending unit is mounted to the electric fuel pump module inside the fuel tank. The sending unit has a float attached to the end of a swing-arm. The float moves up or down within the fuel tank as the fuel level changes. As the float moves, an electrical contact on the pivot end of the swing-arm wipes across a resistor coil, which changes the resistance of the sending unit. Refer to Group 14 - Fuel Systems for more information on the PCM and its inputs.

LOW WASHER FLUID WARNING LAMP

The low washer fluid warning lamp gives an indication when the fluid level in the washer fluid reser-

DESCRIPTION AND OPERATION (Continued)

voir is too low. The instrument cluster circuitry lights the lamp for about two seconds when the ignition switch is turned to the On position as a bulb test. After the bulb test, the instrument cluster circuitry controls the lamp based upon a hard-wired input from the washer fluid level sensor.

The washer fluid level sensor uses a float in the washer fluid reservoir to monitor the fluid level. The up and down action of the float opens or closes the switch within the washer fluid level sensor that provides a ground signal to the instrument cluster circuitry.

If the instrument cluster circuitry senses a ground input from the washer fluid level sensor for more than about sixty seconds, it turns on the low washer fluid warning lamp and sends a chime tone request to the Central Timer Module (CTM). This helps to reduce the effects of fluid sloshing within the reservoir. This lamp also latches. Once the lamp has been turned on, it will remain on until washer fluid is added to the reservoir and the ignition switch is cycled.

Refer to Washer Fluid Level Sensor in Group 8K - Wiper and Washer Systems for more information.

MALFUNCTION INDICATOR LAMP

The Check Engine or Malfunction Indicator Lamp (MIL) gives an indication when the Powertrain Control Module (PCM) has recorded a Diagnostic Trouble Code (DTC) for an On-Board Diagnostics II (OBDII) emissions-related circuit or component malfunction. The lamp is controlled by the instrument cluster circuitry based upon messages received from the PCM on the Chrysler Collision Detection (CCD) data bus. The PCM sends lamp-on messages for about two seconds when the ignition switch is turned to the On position as a bulb test.

Following the bulb test, the PCM uses inputs from many emissions-related circuits and sensors, along with its internal programming, to decide whether a condition exists that requires the MIL lamp to be turned on. The PCM then sends the proper messages to the instrument cluster on the CCD data bus to turn the lamp on or off.

Refer to Group 14 - Fuel Systems for more information on the PCM or the PCM inputs. Refer to Group 25 - Emission Control Systems for more information on DTCs and their retrieval.

OVERDRIVE-OFF INDICATOR LAMP

The overdrive-off indicator lamp gives the driver an indication that the automatic transmission overdrive has been locked out. The lamp is controlled by the Powertrain Control Module (PCM) on a hard-wired circuit to instrument cluster.

The PCM receives an input from the momentary overdrive lockout switch, which is located on the end of the automatic transmission gearshift selector lever. The PCM uses the overdrive lockout switch input, along with numerous other sensor inputs and its internal programming to decide whether the overdrive-off indicator lamp should be on or off. The PCM then turns the lamp on or off by controlling the ground path for the lamp control circuit.

Refer to Group 14 - Fuel Systems for more information on the PCM and its inputs.

POWER OUTLET

An accessory power outlet is standard equipment on this model. The power outlet is installed in the inboard upper corner of the instrument cluster bezel, next to the instrument panel center panel outlets of the heating and air conditioning system. The power outlet base is secured by a snap fit within the instrument cluster bezel. A hinged flip-up door that is integral to the cluster bezel conceals the power outlet base when the power outlet is not being used.

The power outlet base or receptacle shell is connected to ground, and an insulated contact in the bottom of the shell is connected to battery current. The power outlet receives battery voltage from a fuse in the Power Distribution Center (PDC) at all times. While the power outlet is very similar to a cigar lighter base unit, it does not include the two small spring-clip retainers inside the bottom of the receptacle shell that are used to secure the cigar lighter heating element to the insulated contact.

The power outlet receptacle unit is available for service. The power outlet door is serviced only as a unit with the cluster bezel. The power outlet receptacle cannot be repaired and, if faulty or damaged, it must be replaced.

SEAT BELT REMINDER LAMP

The seat belt reminder lamp gives a visual reminder to the vehicle occupants to fasten their seat belts. The lamp is turned on by the instrument cluster circuitry for about six seconds when the ignition switch is turned to the On position.

The instrument cluster also receives a hard wired input from the driver seat belt switch. However, this input is used only for the chime function and has no effect on the seat belt reminder lamp operation. If the driver seat belt switch is closed (seat belt is not buckled), the instrument cluster will send a chime request to the Central Timer Module (CTM) lasting the duration of the seat belt reminder lamp illumination. The chime warning will stop when the driver seat belt switch is open (seat belt is buckled).

On club cab and quad cab models with the seat belts integrated into the structural seat unit, the seat

DESCRIPTION AND OPERATION (Continued)

belt reminder lamp is also used to indicate a fault with the outboard seat belt retractor latch solenoid control system. The Seatbelt Control Timer Module (SCTM) monitors the door jamb switches and the ignition switch through hard wired inputs. The SCTM uses these inputs and internal programming to control hard wired outputs to the seat belt retractor latch solenoids and the Airbag Control Module (ACM). The ACM sends messages to the instrument cluster on the Chrysler Collision Detection (CCD) data bus network to turn the seat belt reminder lamp on or off based upon its input from the SCTM.

The seat belt reminder lamp also serves as a backup for the airbag indicator lamp. About ten seconds after the ignition switch is turned to the On position, if an inoperative airbag indicator lamp circuit was detected during the bulb test sequence, the instrument cluster circuitry will flash the seat belt reminder lamp on and off for about thirty seconds. If the seat belt reminder lamp stays on after flashing for thirty seconds, or comes on at any time other than about ten seconds after the initial ignition-on sequence; it indicates an airbag system fault has been detected and that the airbag indicator lamp is inoperative, or that a fault has occurred in the seat belt retractor latch solenoid control system.

Refer to Airbag System and Structural Seat Belt Control System in Group 8M - Passive Restraint Systems, and Driver Seat Belt Switch in Group 8U - Chime/Buzzer Warning Systems for more information.

SECURITY LAMP

The security lamp gives an indication of the status of the optional Vehicle Theft Security System (VTSS). The lamp is controlled by a hard-wired input to the instrument cluster from the high-line Central Timer Module (CTM). The lamp is turned on by the instrument cluster circuitry for about two seconds when the ignition switch is turned to the On position as a bulb test.

After the bulb test, the CTM turns the lamp on or off based upon the arming status of the VTSS. If the security lamp stays on for about thirty seconds after the ignition switch is turned to the On position, it indicates that Chrysler Collision Detection (CCD) data bus communication with the Powertrain Control Module (PCM) is inoperative, and that the next attempt to arm the VTSS may not be successful.

Refer to Group 8Q - Vehicle Theft/Security Systems for more information on the VTSS and the security lamp.

SERVICE REMINDER INDICATOR LAMP

The Maintenance Required or Service Reminder Indicator (SRI) lamp is used on certain vehicles equipped with a heavy-duty emissions cycle package. This lamp is intended to provide a reminder that certain scheduled vehicle emissions services and maintenance must be performed, as required by federal emissions laws.

The SRI lamp is turned on for about two seconds when the ignition switch is turned to the On position as a bulb test. After the bulb test, the instrument cluster circuitry controls the lamp based upon status messages received from the Powertrain Control Module (PCM) on the Chrysler Collision Detection (CCD) data bus. The PCM uses a distance pulse input received from the Controller Anti-lock Brake (CAB) and internal programming to decide what status messages are required. The PCM then sends the proper messages to the instrument cluster circuitry on the CCD data bus.

This lamp is not intended to indicate a warning, or that a state of emergency exists. However, when the lamp has been activated, the required services and maintenance must be performed before the lamp can be legally reset. For a list of the required emission control system services and maintenance, stated in time or mileage, refer to Group 0 - Lubrication and Maintenance. Also refer to Group 25 - Emission Control Systems for more information.

TRANSMISSION OIL TEMPERATURE WARNING LAMP

The transmission oil temperature warning lamp gives an indication when the Powertrain Control Module (PCM) has detected that the automatic transmission oil is overheated. The lamp is controlled by the instrument cluster circuitry based upon messages received from the PCM on the Chrysler Collision Detection (CCD) data bus. The PCM sends lamp-on messages for about two seconds when the ignition switch is turned to the On position as a bulb test.

Following the bulb test, the PCM uses an input from the automatic transmission oil temperature sensor located within the transmission, along with its internal programming, to decide whether a condition exists that requires the transmission oil temperature warning lamp to be turned on. The PCM then sends the proper messages to the instrument cluster on the CCD data bus to turn the lamp on or off. When the instrument cluster receives a message to turn the transmission oil temperature warning lamp on, it also sends a chime tone request to the Central Timer Module (CTM).

Refer to Group 21 - Transmission for more information on the oil temperature sensor. Refer to Group 14 - Fuel Systems for more information on the PCM and the PCM inputs.

DESCRIPTION AND OPERATION (Continued)

TURN SIGNAL INDICATOR LAMP

The left and right turn signal indicator lamps give an indication when the turn signal circuits are activated. The lamps are hard-wired in the instrument cluster, and are completely controlled by the turn signal and hazard warning (multi-function) switches.

The indicator lamps are grounded at all times and receive battery feed through the contacts of the multi-function switch when the turn signal lever (multi-function switch stalk) or the hazard warning button are actuated to their On positions. The instrument cluster circuitry does not perform a bulb test of these lamps. Refer to Group 8J - Turn Signal and Hazard Warning Systems for more information.

UPSHIFT INDICATOR LAMP

Vehicles equipped with a manual transmission have an upshift indicator lamp. The upshift indicator lamp gives an indication when the driver should shift to the next highest gear for the best fuel economy. The lamp is turned on by the instrument cluster circuitry for about three seconds when the ignition switch is turned to the On position as a bulb test. After the bulb test, the lamp is controlled by the instrument cluster circuitry based upon messages received from the Powertrain Control Module (PCM) on the Chrysler Collision Detection (CCD) data bus.

The PCM uses inputs from many sensors and its internal programming to decide whether the engine speed and load conditions are correct for a transmission upshift. The PCM then sends the proper messages to the instrument cluster on the CCD data bus to turn the lamp on or off. The PCM will send lamp-off messages three to five seconds after a lamp-on message, if an upshift is not performed. The lamp will then remain off until the vehicle stops accelerating and is brought back into the range of lamp operation, or until the transmission is shifted into another gear.

Refer to Group 14 - Fuel Systems for more information on the PCM and the PCM inputs.

WAIT-TO-START LAMP

Vehicles equipped with an optional diesel engine have a wait-to-start lamp. The wait-to-start lamp gives an indication that the conditions for easiest starting of the diesel engine have not yet been achieved. The wait-to-start lamp bulb in the instrument cluster is lighted by the Powertrain Control Module (PCM) after the ignition switch is turned to the On position.

One side of the wait-to-start lamp bulb receives battery voltage when the ignition switch is turned to the On position. The PCM switches the ground path for the other side of the bulb based upon several inputs and its internal programming.

The wait-to-start lamp lets the driver know that the intake manifold air heater grid has had sufficient time to warm the intake air for a good quality start. The intake manifold air preheat cycle is controlled by an electronic air heater control module. The lamp will be turned off by the PCM when the heater control module cycle is completed, or if the driver turns the ignition switch to the Start position prior to the end of the heater control module cycle. Refer to Group 14 - Fuel Systems for more information.

WATER-IN-FUEL LAMP

Vehicles equipped with an optional diesel engine have a water-in-fuel lamp. The water-in-fuel lamp gives an indication when the water contamination in the diesel fuel exceeds a certain level. The lamp is controlled by the instrument cluster circuitry based upon messages received from the PCM on the Chrysler Collision Detection (CCD) data bus. The PCM sends lamp-on messages for about two seconds when the ignition switch is turned to the On position as a bulb test.

Following the bulb test, the PCM uses an input from the water-in-fuel sensor located within the fuel filter/water separator, along with its internal programming, to decide whether a condition exists that requires the water-in-fuel lamp to be turned on. The PCM then sends the proper messages to the instrument cluster on the CCD data bus to turn the lamp on or off. The PCM will send messages to turn the lamp off when the excess water has been drained.

Refer to Group 14 - Fuel Systems for more information on the PCM or the water-in-fuel sensor.

DIAGNOSIS AND TESTING

INSTRUMENT CLUSTER

If all of the gauges and/or indicator lamps are inoperative, perform the Preliminary Diagnosis. If an individual gauge or Chrysler Collision Detection (CCD) data bus message-controlled indicator lamp is inoperative, go directly to the Self-Diagnostic Test. If an individual hard-wired indicator lamp is inoperative, go directly to the diagnosis for that lamp. For circuit descriptions and diagrams, refer to 8W-40 - Instrument Cluster in Group 8W - Wiring Diagrams.

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

AUTHENTIC RESTORATION PRODUCT

DIAGNOSIS AND TESTING (Continued)

PRELIMINARY DIAGNOSIS

(1) If the indicator lamps operate, but none of the gauges operate, go to Step 2. If all of the gauges and the data bus message-controlled indicator lamps are inoperative, go to Step 5.

(2) Check the fuse in the junction block. If OK, go to Step 3. If not OK, repair the shorted circuit or component as required and replace the faulty fuse.

(3) Check for battery voltage at the fuse in the junction block. If OK, go to Step 4. If not OK, repair the open circuit as required.

(4) Disconnect and isolate the battery negative cable. Remove the instrument cluster. Connect the battery negative cable. Check for battery voltage at the fused B(+) circuit cavity of the instrument cluster wire harness connector (connector A). If OK, go to the Self-Diagnostic Test. If not OK, repair the open circuit to the junction block fuse as required.

(5) Check the fused ignition switch output (run/start) fuse in the junction block. If OK, go to Step 6. If not OK, repair the shorted circuit or component as required and replace the faulty fuse.

(6) Turn the ignition switch to the On position and check for battery voltage at the fused ignition switch output (run/start) fuse in the junction block. If OK, go to Step 7. If not OK, repair the open circuit to the ignition switch as required.

(7) Turn the ignition switch to the Off position. Disconnect and isolate the battery negative cable. Reinstall the instrument cluster. Connect the battery negative cable. Turn the ignition switch to the On position. Set the parking brake. The red brake warning lamp should light. If OK, go to Step 8. If not OK, go to Step 9.

(8) Turn the ignition switch to the Off position. Turn on the park lamps and adjust the panel lamps dimmer rheostat to the full bright position. The cluster illumination lamps should light. If OK, go to Step 10. If not OK, repair the power ground circuit from the instrument cluster wire harness connector (connector A) to ground as required.

(9) Turn the ignition switch to the Off position. Disconnect and isolate the battery negative cable. Remove the instrument cluster. Connect the battery negative cable. Turn the ignition switch to the On position. Check for battery voltage at the fused ignition switch output (run/start) circuit cavity of the instrument cluster wire harness connector (connector A). If OK, go to the Self-Diagnostic Test. If not OK, repair the open circuit to the junction block fuse as required.

(10) Disconnect and isolate the battery negative cable. Remove the instrument cluster. Check for continuity between the logic ground circuit cavity of the instrument cluster wire harness connector (connector A) and a good ground. There should be continuity. If OK, go to the Self-Diagnostic Test. If not OK, repair the open circuit to ground as required.

SELF-DIAGNOSTIC TEST

The instrument cluster self-diagnostic test will put the instrument cluster into its self-diagnostic mode. In this mode the instrument cluster can perform a self-diagnostic test that will confirm that the instrument cluster circuitry, the gauges, and the CCD data bus message-controlled indicator lamps are capable of operating as designed.

However, there may still be a problem with the CCD data bus, the Powertrain Control Module (PCM), the Airbag Control Module (ACM), the Controller Anti-lock Brake (CAB), or the inputs to one of these electronic control modules. Use a DRB scan tool and the proper Diagnostic Procedures manual for testing of these components.

(1) Begin the test with the ignition switch in the Off position.

(2) Depress the trip odometer reset button.

(3) While holding the trip odometer reset button depressed, turn the ignition switch to the On position, but do not start the engine.

(4) Keep the trip odometer reset button depressed for about ten seconds, until CHEC appears in the odometer display, then release the odometer reset button.

(5) A series of three-digit numeric failure messages may appear in the odometer display, depending upon the failure mode. If a failure message appears, see the Instrument Cluster Failure Message chart for the description and proper correction. If no failure message appears, the Self-Diagnostics will proceed as described in Step 6.

(6) The instrument cluster will begin the odometer walking segment test. This test will require the operator to visually inspect each odometer segment as it is displayed to determine a pass or fail condition. First, all of the segments will be illuminated at once; then, each individual segment of the odometer display will be illuminated in sequence. If any segment in the display fails to illuminate, repeat the test to confirm the failure. If the failure is confirmed, replace the faulty instrument cluster. Following the odometer walking segment test, the instrument cluster Self-Diagnostic Test will automatically proceed as described in Step 7.

(7) The instrument cluster will perform a bulb check of each indicator lamp that the instrument cluster circuitry controls. If an individual amber indicator lamp does not illuminate during this test, the instrument cluster should be removed. However, check that the incandescent lamp bulb is not faulty and that the bulb holder is properly installed on the instrument cluster circuit board before considering instrument cluster replacement. If the bulb and bulb

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DIAGNOSIS AND TESTING (Continued)

INSTRUMENT CLUSTER FAILURE MESSAGE		
Message	**Description**	**Correction**
110	A failure has been identified in the cluster CPU, RAM, or EEPROM.	1. Replace the faulty cluster.
900	The CCD data bus is not operational.	1. Check the CCD data bus connections at the cluster. 2. Check the cluster fuses. 3. Check the CCD data bus bias. 4. Check the CCD data bus voltage. 5. Check the CCD data bus terminations.
920	The cluster is not receiving a vehicle speed message from the PCM.	1. Check the PCM software level and reflash if required. 2. Use a DRB scan tool to verify that the vehicle speed message is being sent by the PCM.
921	The cluster is not receiving a distance pulse message from the PCM.	1. Check the PCM software level and reflash if required. 2. Use a DRB scan tool to verify that the distance pulse message is being sent by the PCM.
940	The cluster is not receiving an airbag lamp-on message from the ACM.	1. Check the CCD data bus connections at the ACM. 2. Check the ACM fuse.
950	The cluster is not receiving an ABS lamp-on message from the CAB.	1. Check the CCD data bus connections at the CAB. 2. Check the CAB fuse.
999	An error has been discovered.	1. Record the failure message. 2. Depress the trip odometer reset button to continue the Self-Diagnostic Test.

holder check OK, replace the faulty instrument cluster. Each of the red indicators are illuminated by a Light Emitting Diode (LED). If an LED fails to illuminate during this test, the instrument cluster must be replaced. Following the bulb check test, the instrument cluster Self-Diagnostic Test will automatically proceed as described in Step 8.

(8) The instrument cluster will perform a gauge actuator test. In this test the instrument cluster circuitry positions each of the gauge needles at three different calibration points, then returns the gauge needles to their relaxed positions. If an individual gauge does not respond properly, or does not respond at all during the gauge actuator test, the instrument cluster should be removed. However, check that the gauge terminal pins are properly inserted through the spring-clip terminal pin receptacles on the instrument cluster circuit board before considering instrument cluster replacement. If the gauge terminal connections are OK, replace the faulty instrument cluster.

(9) The Self-Diagnostic Test is now completed. The instrument cluster will automatically exit the self-diagnostic mode and return to normal operation at the completion of the test, if the ignition switch is turned to the Off position during the test, or if a vehicle speed message indicating that the vehicle is moving is received from the PCM on the CCD data bus during the test.

(10) Go back to Step 1 to repeat the test, if required.

COOLANT TEMPERATURE GAUGE

If the problem being diagnosed is related to coolant temperature gauge accuracy, be certain to confirm that the problem is with the gauge and not with cooling system performance. The actual engine coolant temperature should be checked with a test gauge or thermometer and compared to the instrument cluster coolant temperature gauge readings before you proceed with gauge diagnosis. Refer to Group 7 - Cooling System for more information. Refer to Group 8W -

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DIAGNOSIS AND TESTING (Continued)

Wiring Diagrams for circuit descriptions and diagrams.

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

Diagnosis of the coolant temperature sensor and circuit, the Chrysler Collision Detection (CCD) data bus, and/or the Powertrain Control Module (PCM) should be performed with a DRB scan tool as described in the proper Diagnostic Procedures manual. For further diagnosis of the coolant temperature gauge and the instrument cluster circuitry, see Instrument Cluster in the Diagnosis and Testing section of this group.

FUEL GAUGE

If the problem being diagnosed is related to fuel gauge accuracy, be certain to confirm that the problem is with the gauge or sending unit and not with the fuel tank. Inspect the fuel tank for signs of damage or distortion that could affect the sending unit performance before you proceed with fuel gauge diagnosis. Refer to Group 8W - Wiring Diagrams for circuit descriptions and diagrams.

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

Diagnosis of the fuel gauge sending unit and circuit, the Chrysler Collision Detection (CCD) data bus, and/or the Powertrain Control Module (PCM) should be performed with a DRB scan tool as described in the proper Diagnostic Procedures manual. For further diagnosis of the fuel gauge and the instrument cluster circuitry, see Instrument Cluster in the Diagnosis and Testing section of this group.

ODOMETER AND TRIP ODOMETER

If the problem being diagnosed is related to odometer and/or trip odometer accuracy, be certain to confirm that the problem is with the display and not with an incorrect pinion factor, axle ratio, or tire size. Refer to Group 5 - Brakes for more information on the Controller Anti-lock Brake (CAB) pinion factor. Refer to Group 8W - Wiring Diagrams for circuit descriptions and diagrams.

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

Diagnosis of the rear wheel speed sensor and circuit, the CAB, the Chrysler Collision Detection (CCD) data bus, and/or the Powertrain Control Module (PCM) should be performed with a DRB scan tool as described in the proper Diagnostic Procedures manual. For further diagnosis of the odometer and/or trip odometer and the instrument cluster circuitry, see Instrument Cluster in the Diagnosis and Testing section of this group.

OIL PRESSURE GAUGE

If the problem being diagnosed is related to oil pressure gauge accuracy, be certain to confirm that the problem is with the gauge and not with the engine oiling system performance. The actual engine oil pressure should be checked with a test gauge and compared to the instrument cluster oil pressure gauge readings before you proceed with gauge diagnosis. Refer to Group 9 - Engines for more information. Refer to Group 8W - Wiring Diagrams for circuit descriptions and diagrams.

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

Diagnosis of the oil pressure sensor and circuit, the Chrysler Collision Detection (CCD) data bus, and/or the Powertrain Control Module (PCM) should be performed with a DRB scan tool as described in the proper Diagnostic Procedures manual. For further diagnosis of the oil pressure gauge and the instrument cluster circuitry, see Instrument Cluster in the Diagnosis and Testing section of this group.

DIAGNOSIS AND TESTING (Continued)

SPEEDOMETER

If the problem being diagnosed is related to speedometer accuracy, be certain to confirm that the problem is with the speedometer gauge and not with an incorrect pinion factor, axle ratio, or tire size. Refer to Group 5 - Brakes for more information on the Controller Anti-lock Brake (CAB) pinion factor. Refer to Group 8W - Wiring Diagrams for circuit descriptions and diagrams.

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

Diagnosis of the rear wheel speed sensor and circuit, the CAB, the Chrysler Collision Detection (CCD) data bus, and/or the Powertrain Control Module (PCM) should be performed with a DRB scan tool as described in the proper Diagnostic Procedures manual. For further diagnosis of the speedometer and the instrument cluster circuitry, see Instrument Cluster in the Diagnosis and Testing section of this group.

TACHOMETER

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

Refer to Group 8W - Wiring Diagrams for circuit descriptions and diagrams. Diagnosis of the crankshaft position sensor and circuit, the Chrysler Collision Detection (CCD) data bus, and/or the Powertrain Control Module (PCM) should be performed with a DRB scan tool as described in the proper Diagnostic Procedures manual. For further diagnosis of the tachometer and the instrument cluster circuitry, see Instrument Cluster in the Diagnosis and Testing section of this group.

VOLTMETER

If the problem being diagnosed is related to voltmeter gauge accuracy, be certain to confirm proper charging system operation before considering instrument cluster replacement. Refer to Group 8C - Charging System for more information. Refer to Group 8W - Wiring Diagrams for circuit descriptions and diagrams.

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

Diagnosis of the system voltage input circuit, the Chrysler Collision Detection (CCD) data bus, and/or the Powertrain Control Module (PCM) should be performed with a DRB scan tool as described in the proper Diagnostic Procedures manual. For further diagnosis of the voltmeter and the instrument cluster circuitry, see Instrument Cluster in the Diagnosis and Testing section of this group.

AIRBAG INDICATOR LAMP

The diagnosis found here addresses an inoperative airbag indicator lamp condition. If the airbag indicator lamp stays on with the ignition switch in the On position, or comes on and stays on while driving, refer to Airbag System in Group 8M - Passive Restraint Systems for diagnosis. For circuit descriptions and diagrams, refer to 8W-40 - Instrument Cluster, and 8W-43 - Airbag System in Group 8W - Wiring Diagrams.

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

The airbag indicator lamp has a lamp backup feature. Ten seconds after the ignition switch is turned to the On position, if the instrument cluster circuitry has detected an inoperative airbag warning lamp circuit it will flash the seat belt reminder lamp on and off for thirty seconds. Once the instrument cluster circuitry has detected an inoperative airbag warning lamp circuit, if a lamp-on message is received from the Airbag Control Module (ACM) on the Chrysler Collision Detection (CCD) data bus, the seat belt reminder lamp will remain on for the duration of the airbag system malfunction.

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DIAGNOSIS AND TESTING (Continued)

If the airbag indicator lamp fails to light when the ignition switch is turned to the On position, and the seat belt reminder lamp flashes following its normal display function (about six seconds after the ignition switch is turned to the On position), diagnosis of the airbag system and/or the CCD data bus should be performed with a DRB scan tool as described in the proper Diagnostic Procedures manual. For further diagnosis of the airbag indicator lamp and the instrument cluster circuitry, see Instrument Cluster in the Diagnosis and Testing section of this group.

ANTI-LOCK BRAKE SYSTEM LAMP

The diagnosis found here addresses an inoperative Anti-lock Brake System (ABS) lamp condition. If the ABS lamp stays on with the ignition switch in the On position, or comes on and stays on while driving, refer to Group 5 - Brakes for diagnosis. For circuit descriptions and diagrams, refer to 8W-34 - Rear-Wheel Anti-Lock Brakes, 8W-35 - All-Wheel Anti-Lock Brakes, and 8W-40 - Instrument Cluster in Group 8W - Wiring Diagrams.

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

If the ABS lamp fails to light when the ignition switch is turned to the On position, replace the ABS lamp bulb with a known good unit. If the ABS lamp still fails to operate, diagnosis of the ABS system and the Chrysler Collision Detection (CCD) data bus should be performed with a DRB scan tool as described in the proper Diagnostic Procedures manual. For further diagnosis of the ABS lamp and the instrument cluster circuitry, see Instrument Cluster in the Diagnosis and Testing section of this group.

BRAKE WARNING LAMP

The diagnosis found here addresses an inoperative brake warning lamp condition. If the brake warning lamp stays on with the ignition switch in the On position and the parking brake released, or comes on while driving, refer to Group 5 - Brakes for diagnosis. If no service brake, parking brake or Anti-Lock Brake System (ABS) problem is found, the following procedure will help locate a faulty parking brake switch or circuit. Refer to 8W-40 - Instrument Cluster in Group 8W - Wiring Diagrams for circuit descriptions and diagrams.

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(1) Check the fuse in the junction block. If OK, go to Step 2. If not OK, repair the shorted circuit or component and replace the faulty fuse.

(2) Turn the ignition switch to the On position. Check for battery voltage at the fuse in the junction block. If OK, go to Step 3. If not OK, repair the open circuit to the ignition switch as required.

(3) Turn the ignition switch to the Off position. Disconnect and isolate the battery negative cable. Unplug the wire harness connector at the park brake switch. With the park brake released, check for continuity between the park brake switch terminal and a good ground. There should be no continuity. If OK, go to Step 4. If not OK, adjust or replace the faulty park brake switch.

(4) Remove the instrument cluster. With the park brake switch wire harness connector still unplugged, check for continuity between the park brake switch wire harness connector cavity and a good ground. There should be no continuity. If OK, go to Step 5. If not OK, repair the short circuit as required.

(5) Check for continuity between the park brake switch sense circuit cavities of the instrument cluster wire harness connector (connector A) and the park brake switch wire harness connector. There should be continuity. If OK, see Instrument Cluster in the Diagnosis and Testing section of this group to test the brake warning lamp and the instrument cluster circuitry. If not OK, repair the open circuit as required.

CHECK GAUGES LAMP

The diagnosis found here addresses an inoperative check gauges lamp condition. If the check gauges lamp stays on with the ignition switch in the On position, or comes on while driving with no unusual gauge readings evident, diagnosis of the Powertrain Control Module (PCM) and the Chrysler Collision Detection (CCD) data bus should be performed with a DRB scan tool as described in the proper Diagnostic Procedures manual. For circuit descriptions and diagrams, refer to 8W-40 - Instrument Cluster in Group 8W - Wiring Diagrams.

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DIAGNOSIS AND TESTING (Continued)

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

If the coolant temperature gauge, oil pressure gauge, or voltmeter are giving an indication that should trigger the check gauges lamp, but the check gauges lamp still fails to operate, see Instrument Cluster in the Diagnosis and Testing section of this group for further diagnosis of the check gauges lamp and the instrument cluster circuitry.

CIGAR LIGHTER

For circuit descriptions and diagrams, refer to 8W-41 - Horns/Cigar Lighter in Group 8W - Wiring Diagrams.

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(1) Check the fuse in the junction block. If OK, go to Step 2. If not OK, repair the shorted circuit or component as required and replace the faulty fuse.

(2) Turn the ignition switch to the On position. Check for battery voltage at the fuse in the junction block. If OK, go to Step 3. If not OK, repair the open circuit to the ignition switch as required.

(3) Turn the ignition switch to the Off position. Remove the cigar lighter knob and element from the cigar lighter receptacle. Check for continuity between the inside circumference of the cigar lighter receptacle and a good ground. There should be continuity. If OK, go to Step 4. If not OK, go to Step 5.

(4) Turn the ignition switch to the On position. Check for battery voltage at the insulated contact located at the back of the cigar lighter receptacle. If OK, replace the faulty cigar lighter knob and element. If not OK, go to Step 5.

(5) Turn the ignition switch to the Off position. Disconnect and isolate the battery negative cable. Remove the cigar lighter receptacle from the instrument panel and unplug the wire harness connector. Check for continuity between the ground circuit cavity of the cigar lighter wire harness connector and a good ground. There should be continuity. If OK, go to Step 6. If not OK, repair the open circuit to ground as required.

(6) Connect the battery negative cable. Turn the ignition switch to the On position. Check for battery voltage at the fused ignition switch output (run/accessory) circuit cavity of the cigar lighter wire harness connector. If OK, replace the faulty cigar lighter receptacle. If not OK, repair the open circuit to the junction block fuse as required.

CLUSTER ILLUMINATION LAMP

The diagnosis found here addresses an inoperative instrument cluster illumination lamp condition. If the problem being diagnosed includes inoperative exterior lighting controlled by the headlamp switch, that system needs to be repaired first. If the exterior lamps controlled by the headlamp switch are inoperative, refer to Group 8L - Lamps for diagnosis. If no exterior lighting system problems are found, the following procedure will help locate a short or open in the cluster illumination lamp circuit. For circuit descriptions and diagrams, refer to 8W-40 - Instrument Cluster in Group 8W - Wiring Diagrams.

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(1) Check the fuse in the junction block. If OK, go to Step 2. If not OK, repair the shorted circuit or component as required and replace the faulty fuse.

(2) Turn the park lamps on with the headlamp switch. Rotate the headlamp switch knob counterclockwise to just before the interior lamps detent. Check for battery voltage at the fuse in the junction block. Rotate the headlamp switch knob clockwise while observing the test voltmeter. The reading should go from battery voltage to zero volts. If OK, go to Step 3. If not OK, repair the open circuit to the headlamp switch or refer to Group 8L - Lamps to diagnose the headlamp switch.

(3) Disconnect and isolate the battery negative cable. Remove the instrument cluster. Turn the headlamp switch off. Remove the fuse from the junction block. Probe the fused panel lamp dimmer switch signal circuit cavity of the instrument cluster wire harness connector (connector B). Check for continuity to a good ground. There should be no continuity. If OK, go to Step 4. If not OK, repair the short circuit as required.

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DIAGNOSIS AND TESTING (Continued)

(4) Reinstall the fuse in the junction block. Connect the battery negative cable. Turn the park lamps on with the headlamp switch. Rotate the headlamp switch knob counterclockwise to just before the interior lamps detent. Check for battery voltage at the fused panel lamp dimmer switch signal circuit cavity of the instrument cluster wire harness connector (connector B). If OK, replace the faulty bulb(s) and bulb holder(s). If not OK, repair the open circuit as required.

CRUISE-ON INDICATOR LAMP

The diagnosis found here addresses an inoperative cruise-on indicator lamp condition. If the problem being diagnosed is an inaccurate cruise-on indicator lamp, refer to Group 8H - Vehicle Speed Control for diagnosis of the vehicle speed control system. For circuit descriptions and diagrams, refer to 8W-33 - Vehicle Speed Control and 8W-40 - Instrument Cluster in Group 8W - Wiring Diagrams.

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

If the cruise-on indicator lamp fails to light during the bulb test (about two seconds after the ignition switch is turned to the On position), replace the cruise-on indicator lamp bulb with a known good unit. If the cruise-on lamp still fails to operate, diagnosis of the Powertrain Control Module (PCM) and the Chrysler Collision Detection (CCD) data bus should be performed with a DRB scan tool as described in the proper Diagnostic Procedures manual. For further diagnosis of the cruise-on indicator lamp and the instrument cluster circuitry, see Instrument Cluster in the Diagnosis and Testing section of this group.

FOUR-WHEEL DRIVE INDICATOR LAMP

The diagnosis found here addresses an inoperative four-wheel drive indicator lamp condition. If the problem being diagnosed is related to lamp accuracy, be certain to confirm that the problem is with the lamp or switch and not with a damaged or inoperative front axle disconnect mechanism. Refer to Group 3 - Differential and Driveline for more information. If no front axle disconnect problem is found, the following procedure will help locate a short or open in the indicator lamp circuit. For circuit diagrams and descriptions, refer to 8W-40 - Instrument Cluster in Group 8W - Wiring Diagrams.

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(1) Check the fuse in the junction block. If OK, go to Step 2. If not OK, repair the shorted circuit or component as required and replace the faulty fuse.

(2) Turn the ignition switch to the On position. Check for battery voltage at the fuse in the junction block. If OK, go to Step 3. If not OK, repair the open circuit to the ignition switch as required.

(3) Turn the ignition switch to the Off position. Disconnect and isolate the battery negative cable. Unplug the four-wheel drive switch wire harness connector. Check for continuity between the ground circuit cavity of the four-wheel drive switch wire harness connector and a good ground. There should be continuity. If OK, go to Step 4. If not OK, repair the open circuit to ground as required.

(4) Connect the battery negative cable. Turn the ignition switch to the On position. Install a jumper wire between the four wheel drive indicator lamp driver circuit cavity of the four-wheel drive switch wire harness connector and a good ground. The four-wheel drive indicator lamp should light. If OK, replace the faulty four-wheel drive switch. If not OK, go to Step 5.

(5) Turn the ignition switch to the Off position. Disconnect and isolate the battery negative cable. Unplug the wire harness connector at the Controller Anti-Lock Brake (CAB). Remove the instrument cluster. With the four-wheel drive switch wire harness connector still unplugged, check for continuity between the four wheel drive indicator lamp driver circuit cavity of the instrument cluster wire harness connector (connector B) and a good ground. There should be no continuity. If OK, go to Step 6. If not OK, repair the short circuit as required.

(6) Check for continuity between the four wheel drive indicator lamp driver circuit cavities of the instrument cluster wire harness connector (connector B) and the four-wheel drive switch wire harness connector. There should be continuity. If OK, replace the faulty bulb. If not OK, repair the open circuit as required.

DIAGNOSIS AND TESTING (Continued)

HEADLAMP HIGH BEAM INDICATOR LAMP

The diagnosis found here addresses an inoperative headlamp high beam indicator lamp condition. If the problem being diagnosed is related to inoperative headlamp high beams, refer to Group 8L - Lamps for diagnosis of the headlamp system. If no headlamp system problems are found, the following procedure will help locate an open in the high beam indicator lamp circuit. For circuit descriptions and diagrams, refer to 8W-40 - Instrument Cluster and 8W-50 - Front Lighting in Group 8W - Wiring Diagrams.

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(1) Disconnect and isolate the battery negative cable. Remove the instrument cluster.

(2) Connect the battery negative cable. Turn the headlamps on and select the high beams with the multi-function switch stalk. Check for battery voltage at the high beam indicator driver circuit cavity of the instrument cluster wire harness connector (connector B). If OK, replace the faulty bulb. If not OK, repair the open circuit to the headlamp dimmer (multi-function) switch as required.

LOW FUEL WARNING LAMP

The diagnosis found here addresses an inoperative low fuel warning lamp condition. If the problem being diagnosed is related to lamp accuracy, be certain to confirm the problem is the with the low fuel warning lamp and not with the fuel gauge circuit. See Fuel Gauge in the Diagnosis and Testing section of this group. If no fuel gauge problem is found, see Instrument Cluster in the Diagnosis and Testing section of this group. For circuit descriptions and diagrams, refer to 8W-40 - Instrument Cluster in Group 8W - Wiring Diagrams.

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

If the low fuel warning lamp fails to light during the bulb test (about two seconds after the ignition switch is turned to the On position), replace the low fuel warning lamp bulb with a known good unit. If the indicator lamp still fails to operate, diagnosis of the fuel gauge sending unit and circuit, the Powertrain Control Module (PCM), and the Chrysler Collision Detection (CCD) data bus should be performed with a DRB scan tool as described in the proper Diagnostic Procedures manual. For further diagnosis of the low fuel warning lamp and the instrument cluster circuitry, see Instrument Cluster in the Diagnosis and Testing section of this group.

LOW WASHER FLUID WARNING LAMP

The diagnosis found here addresses an inoperative low washer fluid warning lamp condition. If the problem being diagnosed is related to lamp accuracy, be certain to confirm that the problem is with the lamp or washer fluid level sensor and not with a damaged or empty washer fluid reservoir. Inspect the reservoir for proper fluid level and signs of damage or distortion that could affect sensor performance before you proceed with lamp diagnosis. Refer to Group 8K - Wiper and Washer Systems for more information. For circuit descriptions and diagrams, refer to 8W-40 - Instrument Cluster in Group 8W - Wiring Diagrams.

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(1) Check the fuse in the junction block. If OK, go to Step 2. If not OK, repair the shorted circuit or component as required and replace the faulty fuse.

(2) Turn the ignition switch to the On position. Check for battery voltage at the fuse in the junction block. If OK, go to Step 3. If not OK, repair the open circuit to the ignition switch as required.

(3) Turn the ignition switch to the Off position. Unplug the wire harness connector from the washer fluid level sensor. Install a jumper wire between the two cavities of the sensor wire harness connector. Turn the ignition switch to the On position. The low washer fluid warning lamp should light. Remove the jumper wire and the lamp should go off. If OK, replace the faulty washer fluid level sensor. If not OK, go to Step 4.

(4) Turn the ignition switch to the Off position. Check for continuity between the ground circuit cavity of the washer fluid level sensor wire harness con-

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nector and a good ground. There should be continuity. If OK, go to Step 5. If not OK, repair the open circuit as required.

(5) Disconnect and isolate the battery negative cable. Remove the instrument cluster. The washer fluid level sensor wire harness connector is still unplugged. Check for continuity between the washer fluid level sense circuit cavity of the instrument cluster wire harness connector (connector B) and a good ground. There should be no continuity. If OK, go to Step 6. If not OK, repair the short circuit as required.

(6) Check for continuity between the washer fluid level sense circuit cavities of the instrument cluster wire harness connector (connector B) and the washer fluid level sensor wire harness connector. There should be continuity. If OK, replace the faulty bulb. If not OK, repair the open circuit as required.

MALFUNCTION INDICATOR LAMP

The diagnosis found here addresses an inoperative malfunction indicator (Check Engine) lamp condition. If the lamp comes on and stays on with the engine running, refer to Group 14 - Fuel Systems for diagnosis. For circuit descriptions and diagrams, refer to 8W-40 - Instrument Cluster in Group 8W - Wiring Diagrams.

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

If the malfunction indicator lamp fails to light during the bulb test (about two seconds after the ignition switch is turned to the On position), replace the malfunction indicator lamp bulb with a known good unit. If the indicator lamp still fails to operate, diagnosis of the Powertrain Control Module (PCM) and the Chrysler Collision Detection (CCD) data bus should be performed with a DRB scan tool as described in the proper Diagnostic Procedures manual. For further diagnosis of the malfunction indicator lamp and the instrument cluster circuitry, see Instrument Cluster in the Diagnosis and Testing section of this group.

OVERDRIVE-OFF INDICATOR LAMP

The diagnosis found here addresses an inoperative overdrive-off indicator lamp condition. If the overdrive-off indicator lamp comes on and stays on with the engine running, refer to the proper Diagnostic Procedures manual for diagnosis of the Powertrain Control Module (PCM) and the transmission control system circuits. For circuit descriptions and diagrams, refer to 8W-31 - Transmission Control System and 8W-40 - Instrument Cluster in Group 8W - Wiring Diagrams.

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(1) Check the fuse in the junction block. If OK, go to Step 2. If not OK, repair the shorted circuit or component as required and replace the faulty fuse.

(2) Turn the ignition switch to the On position. Check for battery voltage at the fuse in the junction block. If OK, go to Step 3. If not OK, repair the open circuit to the ignition switch as required.

(3) Disconnect and isolate the battery negative cable. Unplug the gray PCM wire harness connector. Install a jumper wire between the overdrive lamp driver circuit cavity of the gray PCM wire harness connector and a good ground. Connect the battery negative cable. Turn the ignition switch to the On position. The overdrive-off indicator lamp should light. Remove the jumper wire and the lamp should turn off. If OK, refer to the proper Diagnostic Procedures manual for diagnosis of the Powertrain Control Module (PCM) and the transmission control system circuits. If not OK, go to Step 4.

(4) Turn the ignition switch to the Off position. Disconnect and isolate the battery negative cable. Remove the instrument cluster. Check for continuity between the overdrive lamp driver circuit cavity of the gray PCM wire harness connector and a good ground. There should be no continuity. If OK, go to Step 5. If not OK, repair the short circuit as required.

(5) Check for continuity between the overdrive lamp driver circuit cavities of the gray PCM wire harness connector and the instrument cluster wire harness connector (connector A). There should be continuity. If OK, replace the faulty bulb. If not OK, repair the open circuit as required.

POWER OUTLET

For circuit descriptions and diagrams, refer to 8W-41 - Horns/Cigar Lighter in Group 8W - Wiring Diagrams.

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(1) Check the fuse in the Power Distribution Center (PDC). If OK, go to Step 2. If not OK, repair the shorted circuit or component as required and replace the faulty fuse.

(2) Check for battery voltage at the fuse in the PDC. If OK, go to Step 3. If not OK, repair the open circuit to the battery as required.

(3) Check for continuity between the inside circumference of the power outlet receptacle and a good ground. There should be continuity. If OK, go to Step 4. If not OK, go to Step 5.

(4) Check for battery voltage at the insulated contact located at the back of the power outlet receptacle. If not OK, go to Step 5.

(5) Disconnect and isolate the battery negative cable. Remove the instrument cluster bezel from the instrument panel. Unplug the wire harness connector from the power outlet receptacle. Check for continuity between the ground circuit cavity of the power outlet wire harness connector and a good ground. There should be continuity. If OK, go to Step 6. If not OK, repair the open circuit to ground as required.

(6) Connect the battery negative cable. Check for battery voltage at the fused B(+) circuit cavity of the power outlet wire harness connector. If OK, replace the faulty power outlet receptacle. If not OK, repair the open circuit to the PDC fuse as required.

SEAT BELT REMINDER LAMP

The diagnosis found here addresses an inoperative seat belt reminder lamp condition. If the lamp comes on and flashes following its display function (about ten seconds after the ignition switch is turned to the On position), it indicates an inoperative airbag indicator lamp. See Airbag Indicator Lamp in the Diagnosis and Testing section of this group for further diagnosis. On club cab and quad cab models with the seat belts integrated into the seat unit, if the seat belt reminder lamp comes on and stays on following its display function, it indicates a fault with the structural seat belt control system. Refer to Structural Seat Belt Control System in Group 8M - Passive Restraint Systems for further diagnosis. For circuit descriptions and diagrams, refer to 8W-40 - Instrument Cluster in Group 8W - Wiring Diagrams.

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

If the seat belt reminder lamp fails to light during its normal display function (about six seconds after the ignition switch is turned to the On position), see Instrument Cluster in the Diagnosis and Testing section of this group for further diagnosis. This lamp is completely controlled by the instrument cluster circuitry. The hard wired driver seat belt switch input to the instrument cluster has no control over the seat belt reminder lamp function and is only used by the instrument cluster circuitry as a reference for its chime request function. Refer to Driver Seat Belt Switch in Group 8U - Chime/Buzzer Warning Systems for more information on this input to the instrument cluster.

SECURITY LAMP

The diagnosis found here addresses an inoperative security lamp condition. If the problem being diagnosed is an inaccurate security lamp, refer to Group 8Q - Vehicle Theft/Security Systems for diagnosis of the Vehicle Theft Security System (VTSS). For circuit descriptions and diagrams, refer to 8W-39 - Vehicle Security System and 8W-40 - Instrument Cluster in Group 8W - Wiring Diagrams.

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(1) Check the fuse in the Power Distribution Center (PDC). If OK, go to Step 2. If not OK, repair the shorted circuit or component as required and replace the faulty fuse.

(2) Check for battery voltage at the fuse in the PDC. If OK, go to Step 3. If not OK, repair the open circuit to the battery as required.

(3) Disconnect and isolate the battery negative cable. Remove the Central Timer Module (CTM). Unplug the CTM wire harness connectors. Connect the battery negative cable. Install a jumper wire between the security indicator control circuit cavity

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DIAGNOSIS AND TESTING (Continued)

of the 18-way CTM wire harness connector and a good ground. The security lamp should light. If OK, use a DRB scan tool and the proper Diagnostic Procedures manual to diagnose the Vehicle Theft Security System (VTSS) and the CTM. If not OK, go to Step 4.

(4) Disconnect and isolate the battery negative cable. Remove the instrument cluster. Check for continuity between the fused B(+) circuit cavity of the instrument cluster wire harness connector (connector A) and the fuse in the PDC. There should be continuity. If OK, go to Step 5. If not OK, repair the open circuit to the PDC as required.

(5) Check for continuity between the security indicator control circuit cavities of the instrument cluster wire harness connector (connector A) and the 18-way CTM wire harness connector. There should be continuity. If OK, replace the faulty bulb. If not OK, repair the open circuit as required.

SERVICE REMINDER INDICATOR LAMP

The diagnosis found here addresses an inoperative Service Reminder (Maintenance Required) Indicator (SRI) lamp condition. If the SRI lamp comes on and stays on while driving, refer to Group 25 - Emission Control Systems for diagnosis. If the required emission control systems maintenance has been completed, use a DRB scan tool and the proper Diagnostic Procedures manual to reset the Powertrain Control Module (PCM) lamp mileage counter. For circuit descriptions and diagrams, refer to 8W-40 - Instrument Cluster in Group 8W - Wiring Diagrams.

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

If the SRI lamp fails to light during the bulb test (about two seconds after the ignition switch is turned to the On position), diagnosis of the Powertrain Control Module (PCM) and the Chrysler Collision Detection (CCD) data bus should be performed with a DRB scan tool as described in the proper Diagnostic Procedures manual. For further diagnosis of the SRI lamp and the instrument cluster circuitry, see Instrument Cluster in the Diagnosis and Testing section of this group.

TRANSMISSION OIL TEMPERATURE WARNING LAMP

The diagnosis found here addresses an inoperative transmission oil temperature warning lamp condition. If the transmission oil temperature warning lamp comes on and stays on with the engine running, refer to Group 21 - Transmission for diagnosis of a transmission overheating condition. For circuit descriptions and diagrams, refer to 8W-40 - Instrument Cluster in Group 8W - Wiring Diagrams.

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

If the transmission oil temperature warning lamp fails to light during the bulb test (about two seconds after the ignition switch is turned to the On position), diagnosis of the Powertrain Control Module (PCM) and the Chrysler Collision Detection (CCD) data bus should be performed with a DRB scan tool as described in the proper Diagnostic Procedures manual. For further diagnosis of the transmission oil temperature warning lamp and the instrument cluster circuitry, see Instrument Cluster in the Diagnosis and Testing section of this group.

TURN SIGNAL INDICATOR LAMP

The diagnosis found here addresses an inoperative turn signal indicator lamp condition. For any other turn signal problem, refer to Group 8J - Turn Signal and Hazard Warning Systems for diagnosis. If no turn signal or hazard warning system problem is found, the following procedure will help locate a short or open in the indicator lamp circuit. For circuit descriptions and diagrams, refer to 8W-40 - Instrument Cluster and 8W-50 - Front Lighting in Group 8W - Wiring Diagrams.

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(1) Disconnect and isolate the battery negative cable. Remove the instrument cluster.

DIAGNOSIS AND TESTING (Continued)

(2) Connect the battery negative cable. Activate the hazard warning system by moving the hazard warning switch button to the On position. Check for battery voltage at the inoperative (right or left) turn signal circuit cavity of the instrument cluster wire harness connector (connector B). There should be a switching (on and off) battery voltage signal. If OK, replace the faulty (right or left) turn signal indicator lamp bulb. If not OK, repair the open circuit to the turn signal/hazard warning (multi-function) switch as required.

UPSHIFT INDICATOR LAMP

The diagnosis found here addresses an inoperative upshift indicator lamp condition. If lamp accuracy is suspect, diagnosis should be performed with a DRB scan tool as described in the proper Diagnostic Procedures manual. For circuit descriptions and diagrams, refer to 8W-40 - Instrument Cluster in Group 8W - Wiring Diagrams.

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

If the upshift indicator lamp fails to light during the bulb test (about three seconds after the ignition switch is turned to the On position), replace the upshift indicator lamp bulb with a known good unit. If the indicator lamp still fails to operate, diagnosis of the Powertrain Control Module (PCM) and the Chrysler Collision Detection (CCD) data bus should be performed with a DRB scan tool as described in the proper Diagnostic Procedures manual. For further diagnosis of the upshift indicator lamp and the instrument cluster circuitry, see Instrument Cluster in the Diagnosis and Testing section of this group.

WAIT-TO-START LAMP

The diagnosis found here addresses an inoperative wait-to-start lamp condition. If the problem being diagnosed is an inaccurate wait-to-start lamp, use a DRB scan tool and the proper Diagnostic Procedures manual to diagnose the Powertrain Control Module (PCM) and its inputs. If no problem is found with the PCM, the following procedure will help locate a short or open in the lamp circuit. For circuit descriptions and diagrams, refer to 8W-40 - Instrument Cluster in Group 8W - Wiring Diagrams.

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(1) Check the fuse in the junction block. If OK, go to Step 2. If not OK, repair the shorted circuit or component as required and replace the faulty fuse.

(2) Turn the ignition switch to the On position. Check for battery voltage at the fuse in the junction block. If OK, go to Step 3. If not OK, repair the open circuit to the ignition switch as required.

(3) Turn the ignition switch to the Off position. Disconnect and isolate the battery negative cable. Remove the instrument cluster from the instrument panel. Connect the battery negative cable. Turn the ignition switch to the On position. Check for battery voltage at the fused ignition switch output circuit cavity of the instrument cluster wire harness connector (connector A). If OK, turn the ignition switch to the Off position and go to Step 4. If not OK, repair the open circuit to the junction block as required.

(4) Disconnect and isolate the battery negative cable. Unplug the white PCM wire harness connector (connector B). Check for continuity between the wait-to-start warning lamp driver circuit cavity of the instrument cluster wire harness connector and a good ground. There should be no continuity. If OK, go to Step 5. If not OK, repair the short circuit as required.

(5) Reinstall the instrument cluster. Connect the battery negative cable. Install a jumper wire between the wait-to-start warning lamp driver circuit cavity of the white PCM wire harness connector (connector B) and a good ground. Turn the ignition switch to the On position. The wait-to-start lamp should light. If OK, use a DRB scan tool and the proper Diagnostic Procedures manual to diagnose the PCM and its inputs. If not OK, see Instrument Cluster in the Diagnosis and Testing section of this group for further diagnosis of the instrument cluster circuitry.

WATER-IN-FUEL LAMP

The diagnosis found here addresses an inoperative water-in-fuel lamp condition. If the lamp comes on and stays on with the ignition switch in the On position or while driving, be certain to check for excess water accumulation in the fuel filter/water separator before attempting further diagnosis. Refer to Group 14 - Fuel Systems for diagnosis and service of the water-in-fuel sensor. For circuit descriptions and dia-

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DIAGNOSIS AND TESTING (Continued)

grams, refer to 8W-40 - Instrument Cluster in Group 8W - Wiring Diagrams.

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

If the water-in-fuel lamp fails to light during the bulb test (about two seconds after the ignition switch is turned to the On position), diagnosis of the Powertrain Control Module (PCM) and the Chrysler Collision Detection (CCD) data bus should be performed with a DRB scan tool as described in the proper Diagnostic Procedures manual. For further diagnosis of the water-in-fuel lamp and the instrument cluster circuitry, see Instrument Cluster in the Diagnosis and Testing section of this group.

REMOVAL AND INSTALLATION

CIGAR LIGHTER AND POWER OUTLET

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(1) Disconnect and isolate the battery negative cable.

(2) Pull the cigar lighter knob and element out of the cigar lighter receptacle base, or open the power outlet door in the upper inboard corner of the instrument cluster bezel (Fig. 1).

(3) Look inside the cigar lighter or power outlet receptacle base and note the position of the rectangular retaining bosses of the mount that secures the receptacle base to the instrument panel or the instrument cluster bezel (Fig. 2).

(4) Insert a pair of external snap ring pliers into the cigar lighter or power outlet receptacle base and engage the tips of the pliers with the retaining bosses of the mount.

(5) Squeeze the pliers to disengage the mount retaining bosses from the receptacle base and, using a gentle rocking motion, pull the pliers and the receptacle base out of the mount.

(6) Pull the receptacle base away from the instrument panel or the instrument cluster bezel far enough to access and unplug the wire harness connector.

(7) Remove the cigar lighter or power outlet mount from the instrument panel or the instrument cluster bezel.

(8) Reverse the removal procedures to install.

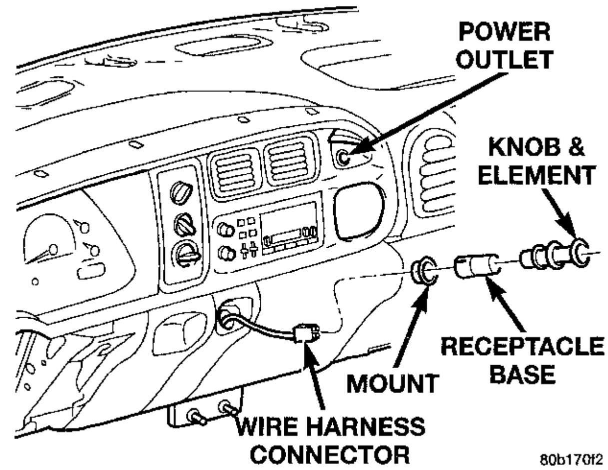

Fig. 1 Cigar Lighter and Power Outlet

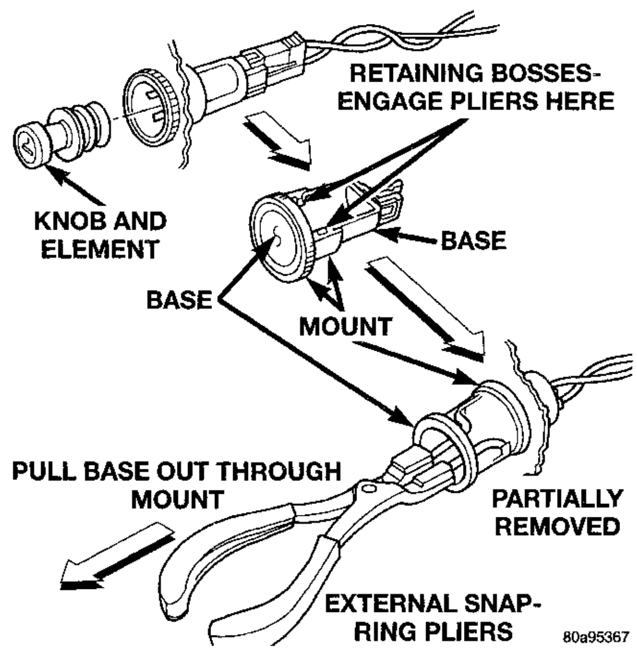

Fig. 2 Cigar Lighter and Power Outlet Remove/Install

REMOVAL AND INSTALLATION (Continued)

CLUSTER BEZEL

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(1) Disconnect and isolate the battery negative cable.

(2) If the vehicle is equipped with an automatic transmission, turn the ignition switch to the Unlock position, set the parking brake, and place the automatic transmission gear selector lever in the Low position.

(3) If the vehicle is so equipped, set the tilt steering column in its lowest position.

(4) Open the door for the power outlet and remove the one screw that secures the cluster bezel to the instrument panel.

(5) Using a trim stick or another suitable wide flat-bladed tool, gently pry around the perimeter of the cluster bezel to disengage the snap clip retainers that secure the cluster bezel to the instrument panel (Fig. 3).

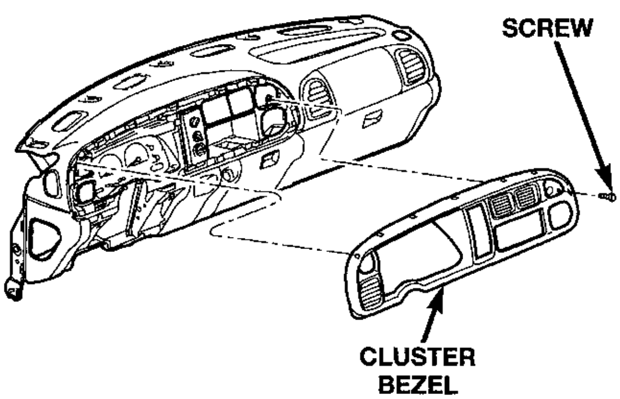

Fig. 3 Cluster Bezel Remove/Install

(6) Pull the cluster bezel away from the instrument panel far enough to access and unplug the wire harness connector from the back of the power outlet receptacle base.

(7) Remove the cluster bezel from the instrument panel.

(8) Reverse the removal procedures to install. Tighten the mounting screw to 2.2 N·m (20 in. lbs.).

INSTRUMENT CLUSTER

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(1) Remove the cluster bezel from the instrument panel. See Cluster Bezel in the Removal and Installation section of this group for the procedures.

(2) Remove the four screws that secure the instrument cluster to the instrument panel (Fig. 4).

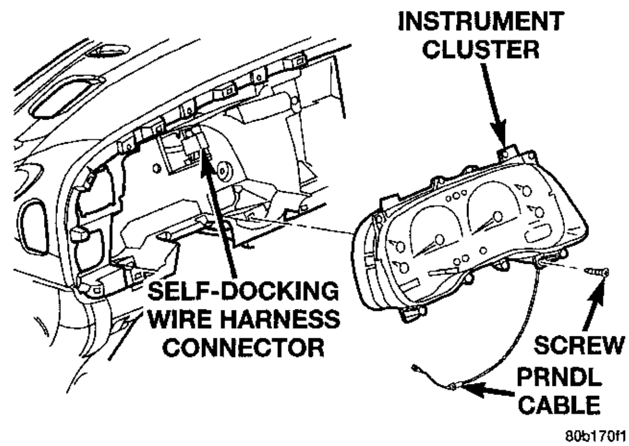

Fig. 4 Instrument Cluster Remove/Install

(3) Pull the instrument cluster rearward to disengage the two self-docking wire harness connectors.

NOTE: The instrument cluster has two self-docking wire harness connectors that will be automatically aligned with, and connected to the instrument panel wire harness when the cluster is installed in the instrument panel.

(4) If the vehicle is equipped with an automatic transmission, pull the instrument cluster rearward far enough to access and remove the gear selector indicator from the back of the cluster housing. See Gear Selector Indicator in the Removal and Installation section of this group for the procedures.

(5) Remove the instrument cluster from the instrument panel.

(6) Reverse the removal procedures to install. Tighten the mounting screws to 2.2 N·m (20 in. lbs.).

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REMOVAL AND INSTALLATION (Continued)

CLUSTER COMPONENTS

CLUSTER LENS AND HOOD

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(1) Disconnect and isolate the battery negative cable.
(2) Remove the instrument cluster from the instrument panel. See Instrument Cluster in the Removal and Installation section of this group for the procedures.
(3) Remove the seven screws that secure the cluster lens and hood to the cluster housing (Fig. 5).

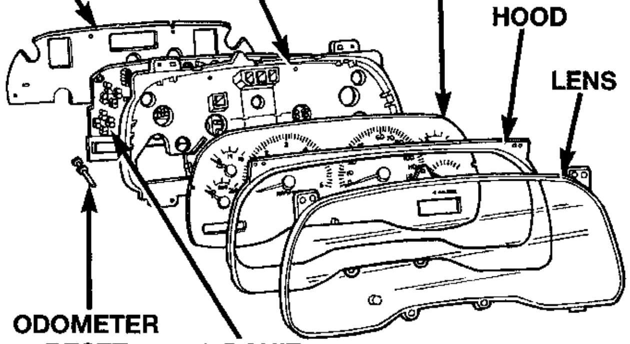

Fig. 5 Instrument Cluster Components

(4) Remove the cluster lens and the cluster hood from the cluster housing.

CAUTION: Do not touch the face of the gauge mask or the back of the cluster lens with your finger. It will leave a permanent finger print.

(5) Reverse the removal procedures to install. Tighten the mounting screws to 2.2 N·m (20 in. lbs.).

CLUSTER HOUSING REAR COVER

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(1) Disconnect and isolate the battery negative cable.
(2) Remove the instrument cluster from the instrument panel. See Instrument Cluster in the Removal and Installation section of this group for the procedures.
(3) Remove the six screws that secure the rear cover to the cluster housing (Fig. 6).

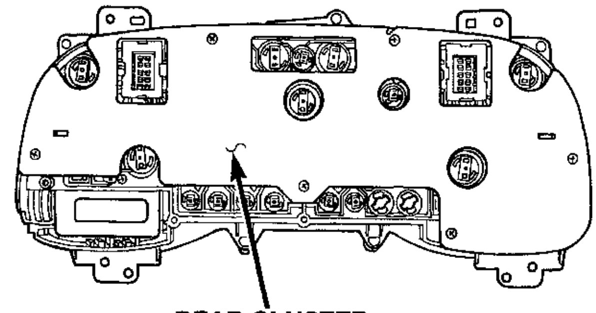

Fig. 6 Cluster Housing Rear Cover Remove/Install

(4) Remove the rear cover from the cluster housing.
(5) Reverse the removal procedures to install. Tighten the mounting screws to 2.2 N·m (20 in. lbs.).

GEAR SELECTOR INDICATOR

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(1) Disconnect and isolate the battery negative cable.
(2) Remove the instrument cluster from the instrument panel. See Instrument Cluster in the Removal and Installation section of this group for the procedures.
(3) Remove the two screws that secure the gear selector indicator mechanism to the rear of the instrument cluster housing (Fig. 7).
(4) Remove the gear selector indicator mechanism from the cluster housing.
(5) Remove the steering column opening cover and knee blocker from the instrument panel. See Steering

REMOVAL AND INSTALLATION (Continued)

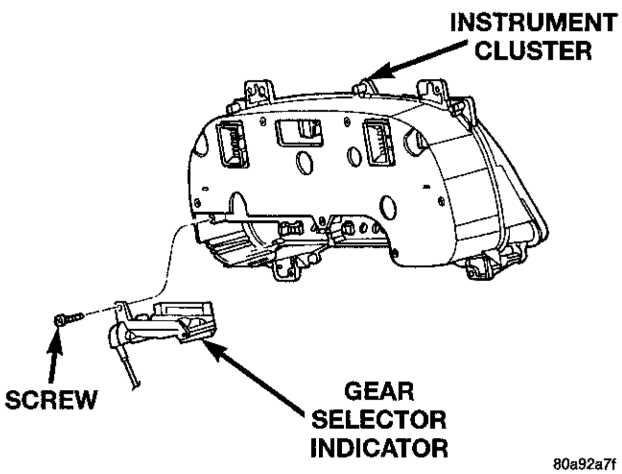

Fig. 7 Gear Selector Indicator Remove/Install

Column Opening Cover and Knee Blocker in the Removal and Installation section of this group for the procedures.

(6) Disengage the loop end of the gear selector indicator cable from the lever on the left side of the steering column (Fig. 8).

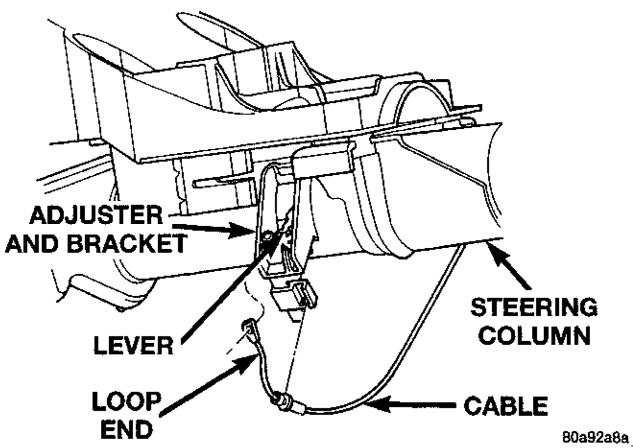

Fig. 8 Gear Selector Indicator Cable Remove/Install

(7) Squeeze the sides of the plastic adjuster bracket to disengage the tabs that secure it to the sides of the steering column window.

(8) Reverse the removal procedures to install. Tighten the gear selector indicator mounting screws to 2.2 N·m (20 in. lbs.). Refer to Group 19 - Steering for the gear selector indicator cable adjustment procedure.

CLUSTER BULB

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(1) Remove the instrument cluster from the instrument panel. See Instrument Cluster in the Removal and Installation section of this group for the procedures.

(2) Remove the bulb and bulb holder from the circuit board on the rear of the instrument cluster housing by turning the holder counterclockwise (Fig. 9).

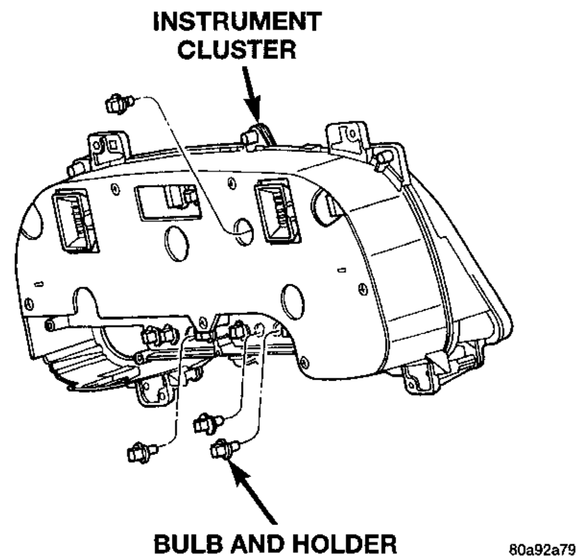

Fig. 9 Cluster Bulb Remove/Install

CAUTION: Always use the correct bulb size and type for replacement. An incorrect bulb size or type may overheat and cause damage to the instrument cluster circuit board and/or the gauges.

(3) Reverse the removal procedures to install.

HEADLAMP SWITCH

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

AUTHENTIC RESTORATION PRODUCT

REMOVAL AND INSTALLATION (Continued)

WARNING: IF THE HEADLAMP SWITCH WAS ON, WAIT FIVE MINUTES TO ALLOW THE CERAMIC DIMMER RESISTOR TO COOL. IF THE CERAMIC DIMMER RESISTOR IS NOT ALLOWED TO COOL, IT CAN BURN YOUR FINGERS.

(1) Disconnect and isolate the battery negative cable.

(2) Remove the cluster bezel from the instrument panel. See Cluster Bezel in the Removal and Installation section of this group for the procedures.

(3) Remove the three screws that secure the headlamp switch bezel to the instrument panel (Fig. 10).

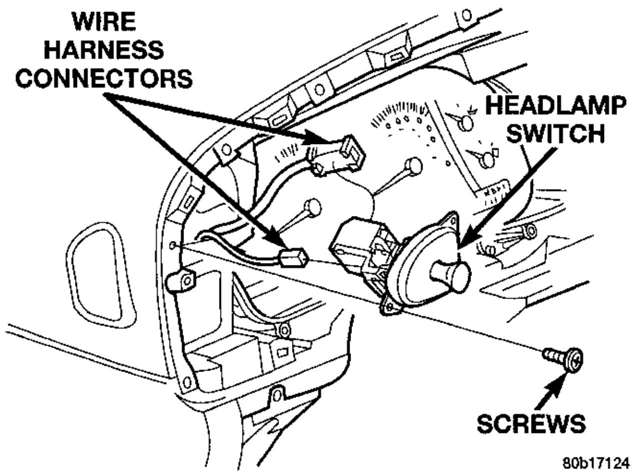

Fig. 10 Headlamp Switch and Bezel Remove/Install

(4) Pull the headlamp switch and bezel out from the instrument panel far enough to access the wire harness connectors.

(5) Unplug the two wire harness connectors from the headlamp switch.

(6) Pull the headlamp switch control knob out to the On position stop.

(7) Depress the headlamp switch knob and shaft release button on the top of the switch.

(8) While holding the release button depressed, pull the knob and shaft out of the headlamp switch.

(9) Remove the two push nut retainers that secure the headlamp switch bezel to the switch mounting bracket.

(10) Remove the headlamp switch bezel from the switch mounting bracket.

(11) Remove the spanner nut that secures the headlamp switch mounting bracket to the switch.

(12) Remove the headlamp switch mounting bracket from the switch.

(13) Reverse the removal procedures to install. Tighten the headlamp switch and bezel mounting screws to 2.2 N·m (20 in. lbs.).

FOG LAMP SWITCH

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(1) Disconnect and isolate the battery negative cable.

(2) Remove the cluster bezel from the instrument panel. See Cluster Bezel in the Removal and Installation section of this group for the procedures.

(3) Remove the three screws that secure the switch mounting plate to the instrument panel (Fig. 11).

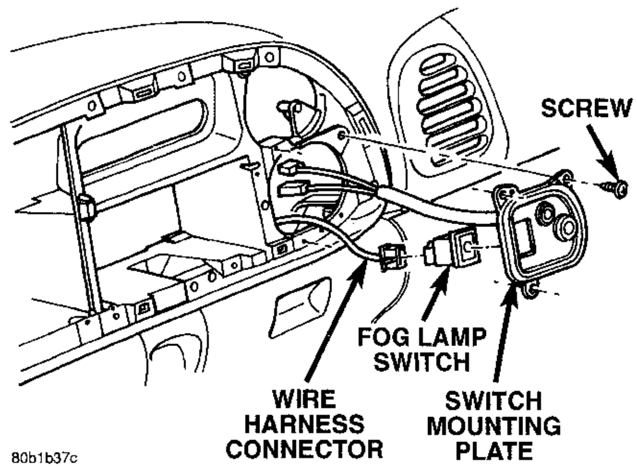

Fig. 11 Fog Lamp Switch Remove/Install

(4) Pull the switch mounting plate away from the instrument panel far enough to access and unplug the wire harness connector from the back of the fog lamp switch.

(5) Squeeze the tabs on the back of the fog lamp switch that secure it in the receptacle on the back of the switch mounting plate.

(6) Pull the fog lamp switch out of the receptacle on the back of the switch mounting plate.

(7) Reverse the removal procedures to install. Be certain that the fog lamp switch latches are fully engaged in the switch mounting plate receptacle. Tighten the mounting screws to 2.2 N·m (20 in. lbs.).

REMOVAL AND INSTALLATION (Continued)

PARK BRAKE RELEASE HANDLE

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(1) Disconnect and isolate the battery negative cable.

(2) Reach under the driver side outboard end of the instrument panel to access and unsnap the plastic retainer clip from the park brake release linkage rod at the park brake mechanism on the left cowl side inner panel.

(3) Disengage the park brake release linkage rod end from the park brake mechanism.

(4) Lift the park brake release handle to access and unsnap the plastic retainer clip from the park brake release linkage rod at the park brake release handle on the instrument panel.

(5) Lower the park brake release handle and reach under the instrument panel to disengage the park brake release linkage rod end from the park brake release handle.

(6) Lift the park brake release handle to access the handle mounting bracket. Using a trim stick or another suitable wide flat-bladed tool, gently pry each of the park brake release handle mounting bracket latch tabs away from the retaining notches in the instrument panel receptacle (Fig. 12).

(7) With both of the park brake release handle mounting bracket latches released, slide the handle and bracket assembly down and out of the instrument panel receptacle.

(8) Reverse the removal procedures to install.

STEERING COLUMN OPENING COVER AND KNEE BLOCKER

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(1) Disconnect and isolate the battery negative cable.

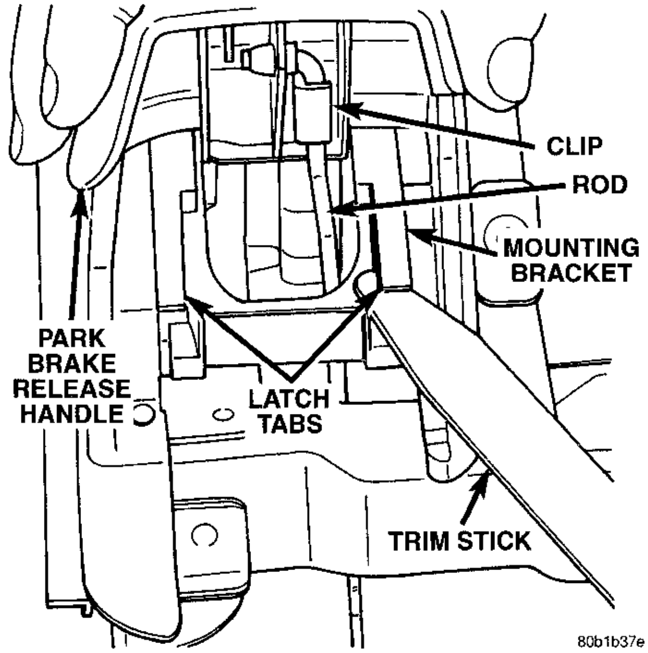

Fig. 12 Park Brake Release Handle Remove/Install

(2) Remove the three screws that secure the bottom of the steering column opening cover and knee blocker to the lower instrument panel reinforcement (Fig. 13).

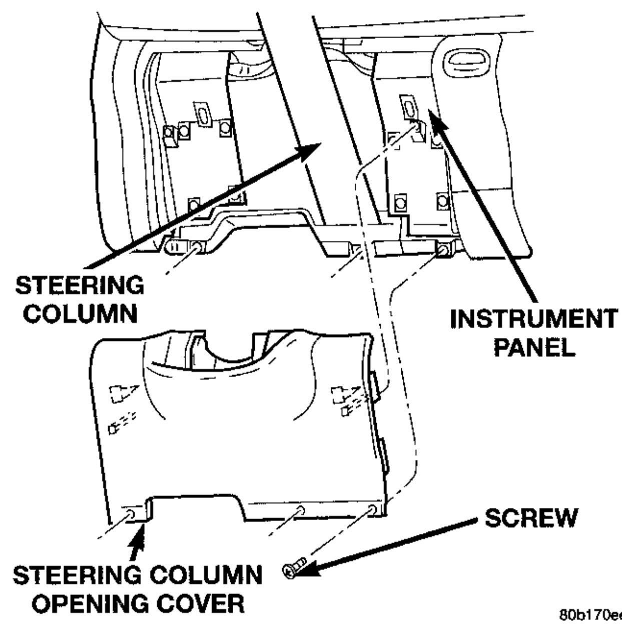

Fig. 13 Steering Column Opening Cover and Knee Blocker Remove/Install

(3) Using a trim stick or another suitable wide flat-bladed tool, gently pry the upper edges of the steering column opening cover and knee blocker to release the snap clip retainers that secure it to the

REMOVAL AND INSTALLATION (Continued)

instrument panel on each side of the steering column.

(4) Remove the steering column opening cover and knee blocker from the instrument panel.

(5) Reverse the removal procedures to install. Tighten the mounting screws to 2.2 N·m (20 in. lbs.).

CENTRAL TIMER MODULE

Before replacing a high-line Central Timer Module (CTM), use a DRB scan tool to determine the current settings for the CTM programmable features. These settings should be duplicated in the replacement CTM using the DRB scan tool, before returning the vehicle to service.

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(1) Disconnect and isolate the battery negative cable.

(2) Remove the steering column opening cover and knee blocker from the instrument panel. See Steering Column Opening Cover and Knee Blocker in the Removal and Installation section of this group for the procedures.

(3) Remove the two screws that secure the Central Timer Module (CTM) to the bracket on the inboard side of the instrument panel steering column opening (Fig. 14) or (Fig. 15).

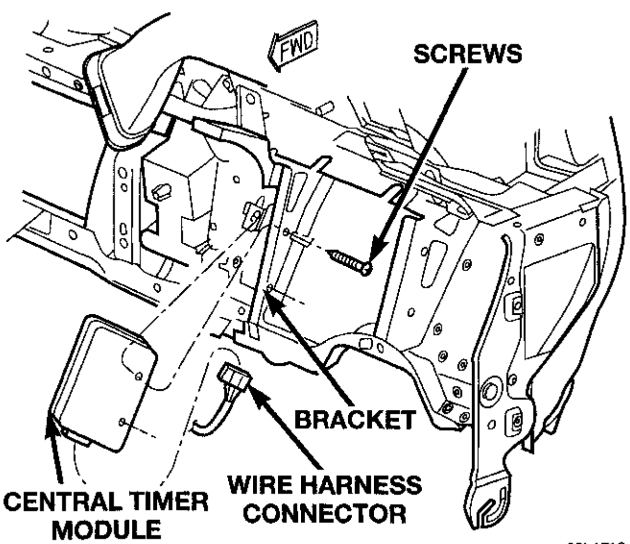

Fig. 14 Central Timer Module (Base) Remove/Install

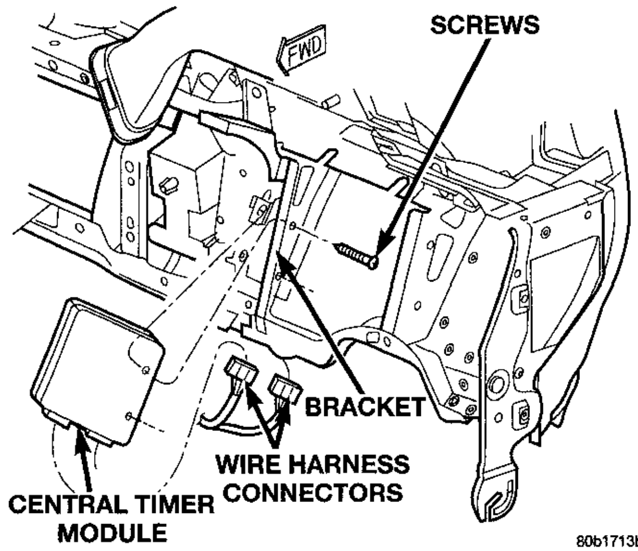

Fig. 15 Central Timer Module (High-Line) Remove/Install

(4) Pull the CTM into the instrument panel steering column opening far enough access and unplug the wire harness connector(s).

(5) Remove the CTM from the instrument panel.

(6) Reverse the removal procedures to install. Tighten the mounting screws to 1.6 N·m (15 in. lbs.).

NOTE: If a new high-line Central Timer Module is installed, the programmable features must be enabled and/or disabled to the customer's preferred settings. Use a DRB scan tool and the proper Diagnostic Procedures manual to perform these operations.

ASH RECEIVER

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(1) Disconnect and isolate the battery negative cable.

(2) Open the ash receiver. From the open position, close the ash receiver slightly and pull it straight out from the pivot pins in the lower instrument panel.

(3) Remove the three screws that secure the flame shield to the lower instrument panel (Fig. 16).

(4) Pull the flame shield away from the lower instrument panel far enough to disengage the two

REMOVAL AND INSTALLATION (Continued)

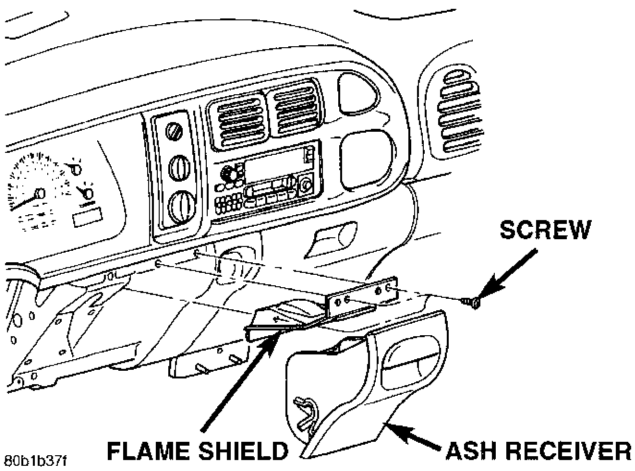

Fig. 16 Ash Receiver Remove/Install

retaining tabs on the top, then lower the shield far enough to access the ash receiver lamp and hood.

(5) Disengage the ash receiver lamp and hood retainer clip from the mounting hole in the flame shield.

(6) Remove the flame shield from the lower instrument panel.

(7) Reverse the removal procedures to install. Tighten the mounting screws to 2.2 N·m (20 in. lbs.).

CUP HOLDER OR STORAGE BIN

Vehicles equipped with an automatic transmission have a lighted fold-down cup holder installed on the instrument panel just inboard of the glove box. Vehicles equipped with a manual transmission have a lighted storage bin installed on the instrument panel in place of the fold-down cup holder.

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CUP HOLDER

(1) Disconnect and isolate the battery negative cable.

(2) Remove the cluster bezel from the instrument panel. See Cluster Bezel in the Removal and Installation section of this group for the procedures.

(3) Unlatch and fold the cup holder down from the instrument panel to its open position.

(4) Remove the six screws that secure the cup holder to the instrument panel (Fig. 17).

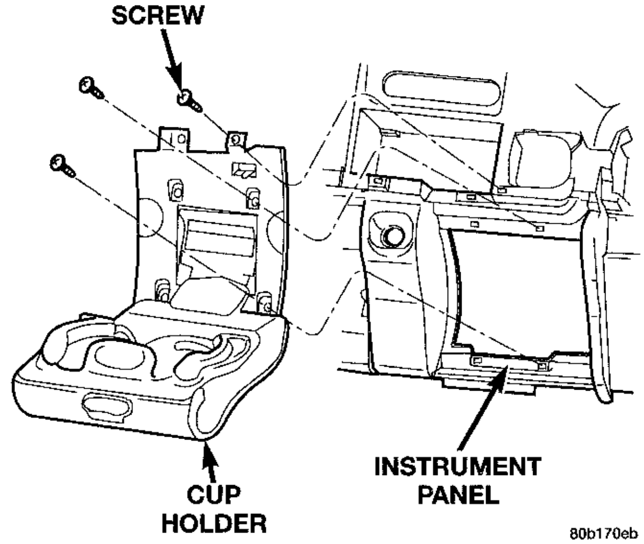

Fig. 17 Cup Holder Remove/Install - Automatic Transmission Only

(5) Pull the cup holder away from the instrument panel far enough to access and disengage the the lamp and hood retainer clip from the back of the unit.

(6) Remove the cup holder unit from the instrument panel.

(7) Reverse the removal procedures to install. Tighten the mounting screws to 2.2 N·m (20 in. lbs.).

STORAGE BIN

(1) Disconnect and isolate the battery negative cable.

(2) Remove the cluster bezel from the instrument panel. See Cluster Bezel in the Removal and Installation section of this group for the procedures.

(3) Remove the two screws that secure the top of the storage bin to the instrument panel (Fig. 18).

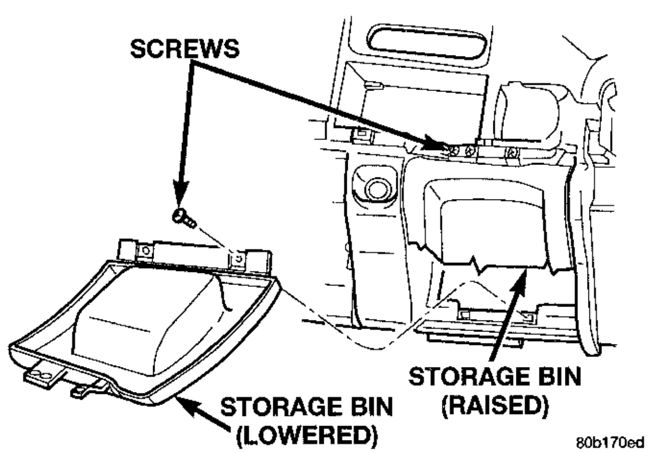

Fig. 18 Storage Bin Remove/Install - Manual Transmission Only

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REMOVAL AND INSTALLATION (Continued)

(4) Lower the top of the storage bin far enough to access and disengage the lamp and hood retainer clip from the back of the unit.

(5) Lower the top of the storage bin far enough to access and remove the two screws that secure the bottom of the storage bin to the instrument panel.

(6) Remove the storage bin unit from the instrument panel.

(7) Reverse the removal procedures to install. Tighten the mounting screws to 2.2 N·m (20 in. lbs.).

GLOVE BOX

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(1) Disconnect and isolate the battery negative cable.

(2) Open the glove box.

(3) While securing the glove box door with one hand, push the center of the glove box bin towards the front of the vehicle (Fig. 19). Flex the glove box bin far enough so that the glove box stops on each side of the bin will clear the sides of the instrument panel glove box opening.

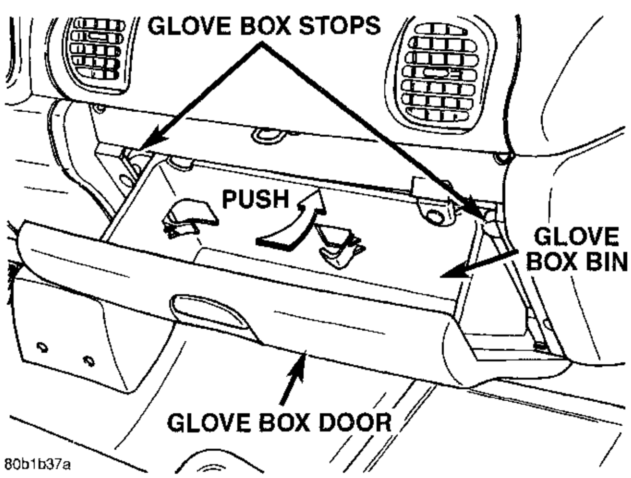

Fig. 19 Glove Box Remove/Install

(4) Roll the glove box downward until the stop bumpers are beyond the sides of the instrument panel glove box opening, then release the bin.

(5) Lift the bottom of the glove box upward to disengage the three glove box hinge hooks from the three hinge pins on the instrument panel.

(6) Reverse the removal procedures to install.

GLOVE BOX COMPONENTS

The only serviced component of the glove box is the glove box bin. If any other component of the glove box is faulty or damaged, the entire glove box assembly must be replaced.

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GLOVE BOX BIN

(1) Disconnect and isolate the battery negative cable.

(2) Remove the glove box from the instrument panel. See Glove Box in the Removal and Installation section of this group for the procedures.

(3) Remove the two screws that secure each outboard flange of the glove box bin to the glove box door (Fig. 20).

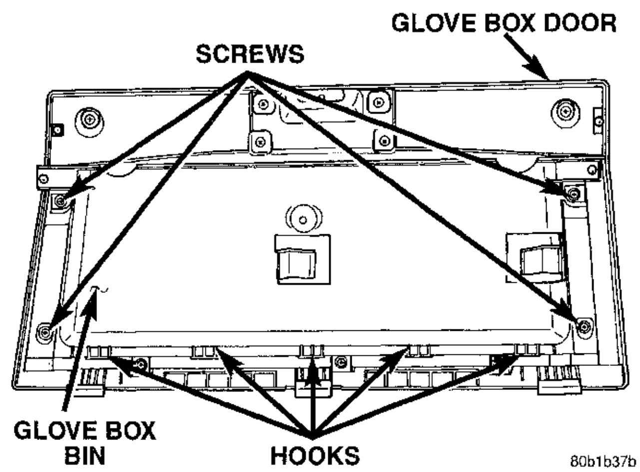

Fig. 20 Glove Box Bin Remove/Install

(4) Pull the top of the bin away from the top of the glove box door.

(5) Disengage the five hook formations on the bottom of the glove box bin from the slots near the bottom of the inner glove box door.

(6) Reverse the removal procedures to install. Tighten the mounting screws to 2.2 N·m (20 in. lbs.).

REMOVAL AND INSTALLATION (Continued)

GLOVE BOX LAMP AND SWITCH

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(1) Disconnect and isolate the battery negative cable.

(2) Remove the glove box from the instrument panel. See Glove Box in the Removal and Installation section of this group for the procedures.

(3) Reach through and above the instrument panel glove box opening to unplug the two wire harness connectors from the glove box lamp and switch (Fig. 21).

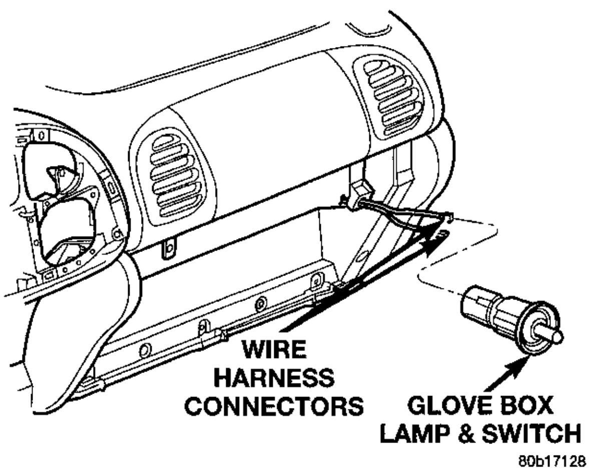

Fig. 21 Glove Box Lamp and Switch Remove/Install

(4) Reach through and above the instrument panel glove box opening to depress the retaining tabs on the top and bottom of the glove box lamp and switch housing.

(5) While holding the retaining tabs depressed, push the glove box lamp and switch unit out through the hole in the mounting bracket on the instrument panel glove box opening upper reinforcement.

(6) Reverse the removal procedures to install.

GLOVE BOX OPENING UPPER TRIM STRIP

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(1) Disconnect and isolate the battery negative cable.

(2) Open the glove box.

(3) Remove the three screws that secure the trim strip to the glove box opening upper reinforcement (Fig. 22).

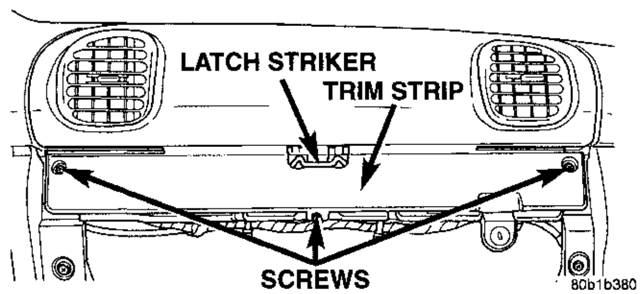

Fig. 22 Glove Box Opening Upper Trim Strip Remove/Install

(4) Remove the trim strip from the instrument panel.

(5) Reverse the removal procedures to install. Tighten the mounting screws to 2.2 N·m (20 in. lbs.).

GLOVE BOX LATCH STRIKER

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(1) Disconnect and isolate the battery negative cable.

(2) Remove the trim strip from the upper glove box opening. See Glove Box Opening Upper Trim Strip in the Removal and Installation section of this group for the procedures.

(3) Remove the two screws that secure the latch striker to the glove box opening upper reinforcement (Fig. 23).

(4) Reverse the removal procedures to install. Tighten the mounting screws to 2.2 N·m (20 in. lbs.).

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REMOVAL AND INSTALLATION (Continued)

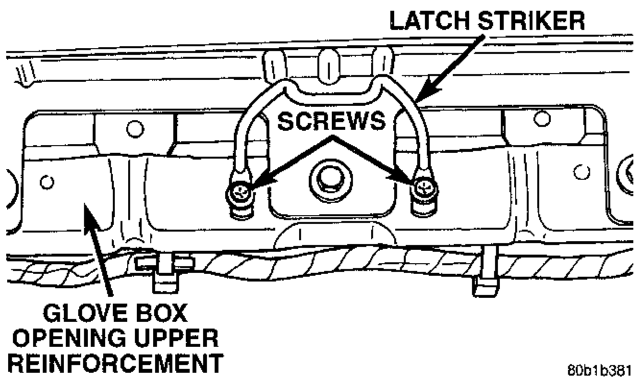

Fig. 23 Glove Box Latch Striker Remove/Install

INSTRUMENT PANEL ASSEMBLY

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(1) Place the front wheels in the straight-ahead position.

(2) Disconnect and isolate the battery negative cable.

(3) Remove the Airbag Control Module (ACM) and bracket from the floor panel transmission tunnel. Refer to Airbag Control Module in the Removal and Installation section of Group 8M - Passive Restraint Systems for the procedures.

(4) Remove the trim panels from the left and right cowl side inner panels. Refer to Group 23 - Body for the procedures.

(5) Remove the steering column opening cover and knee blocker from the instrument panel. See Steering Column Opening Cover and Knee Blocker in the Removal and Installation section of this group for the procedures.

(6) Remove the steering column from the vehicle. Refer to Group 19 - Steering for the procedures.

(7) From under the driver side of the instrument panel:

(a) Disconnect the park brake release handle linkage rod from the park brake mechanism on the left cowl side inner panel. See Park Brake Release Handle in the Removal and Installation section of this group for the procedures.

(b) Unplug the wire harness connector from the park brake switch on the park brake mechanism.

(c) Unplug the three junction block wire harness connectors that are closest to the dash panel. See Junction Block in the Removal and Installation section of this group for more information.

(d) Remove the screw in the center of the instrument panel to bulkhead wire harness connector and unplug the connector.

(e) Unplug the instrument panel to door wire harness connector located directly below the bulkhead wire harness connector.

(f) If the vehicle is equipped with the Infinity sound system option, unplug the Infinity wire harness connector located on the outboard side of the bulkhead wire harness connector.

(g) Unplug the wire harness connector from the stop lamp switch.

(h) Unplug the heater and air conditioner vacuum harness connector located near the inboard end of the heater-A/C housing.

(i) Remove the two screws that secure the inside hood latch release handle to the instrument panel lower reinforcement and lower the release handle to the floor.

(8) From the under the passenger side of the instrument panel, disconnect the radio antenna coaxial cable connector. Refer to Antenna in the Removal and Installation section of Group 8F - Audio Systems for the procedures.

(9) Loosen the right and left instrument panel cowl side roll-down bracket screws about 13 mm (0.50 inch) (Fig. 24).

(10) Remove the five screws that secure the top of the instrument panel to the top of the dash panel, removing the center screw last.

(11) Roll down the instrument panel and install a temporary hook in the center hole on top of the instrument panel. Secure the other end of the hook to the center hole in the top of the dash panel. The hook should support the instrument panel in its rolled down position about 46 cm (18 inches) from the dash panel.

(12) With the instrument panel supported in the roll-down position, reach over the passenger side end of the instrument panel to:

(a) Unplug the two wire harness connectors located on the heater-A/C housing.

(b) Disconnect the temperature control cable flag retainer from the top of the heater-A/C housing and pull the cable core adjuster clip off of the blend-air door lever. Refer to Temperature Control Cable in the Removal and Installation section of Group 24 - Heating and Air Conditioning for the procedures.

(13) With the aid of an assistant, remove the temporary hook and lift the instrument panel assembly off of the roll-down bracket screws and remove it from the vehicle.

REMOVAL AND INSTALLATION (Continued)

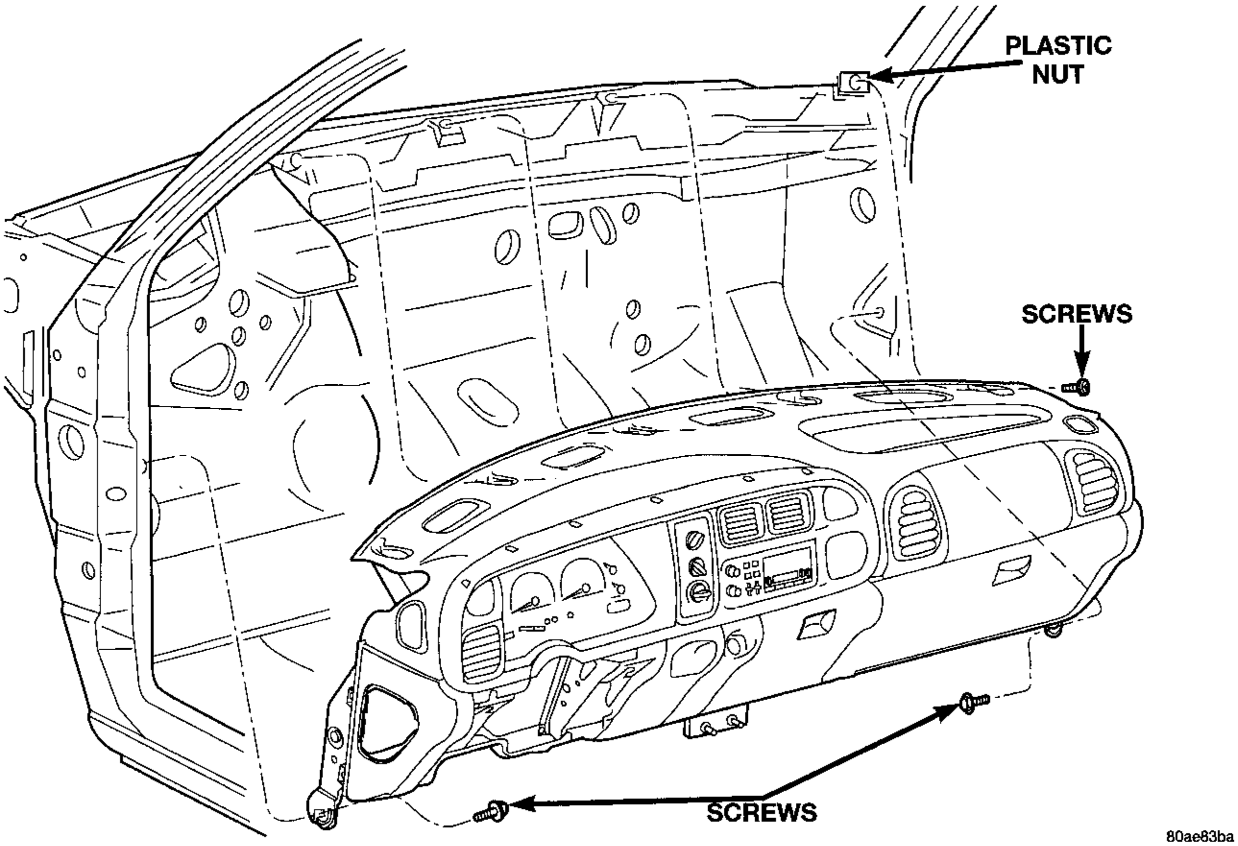

Fig. 24 Instrument Panel Assembly Remove/Install

(14) Reverse the removal procedures to install. Tighten the mounting hardware as follows:

• Instrument panel top to dash panel screws - 3 N·m (28 in. lbs.)

• Instrument panel roll-down screws - 12 N·m (105 in. lbs.).

JUNCTION BLOCK

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(1) Disconnect and isolate the battery negative cable.

(2) Roll down, but do not remove the instrument panel. See Instrument Panel Assembly in the Removal and Installation section of this group for the procedures.

(3) Reach through the outboard side of the instrument panel steering column opening to access and unplug all of the wire harness connectors from the junction block cavities (Fig. 25).

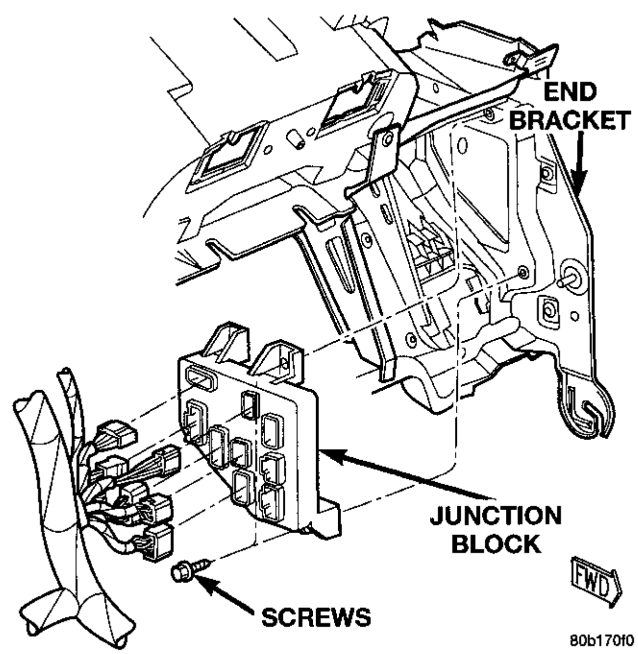

Fig. 25 Junction Block Remove/Install

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REMOVAL AND INSTALLATION (Continued)

(4) Remove the three screws that secure the junction block to the left instrument panel end bracket.

(5) Remove the junction block from the left instrument panel end bracket.

(6) Reverse the removal procedures to install. Tighten the mounting screws to 4 N·m (35 in. lbs.).

INSTRUMENT PANEL TOP COVER

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(1) Disconnect and isolate the battery negative cable.

(2) Remove the instrument panel from the vehicle and place it on a work bench. See Instrument Panel Assembly in the Removal and Installation section of this group for the procedures.

(3) Remove the cluster bezel from the instrument panel. See Cluster Bezel in the Removal and Installation section of this group for the procedures.

(4) Remove the passenger side airbag module from the instrument panel. Refer to Airbag Module in the Removal and Installation section of Group 8M - Passive Restraint Systems for the procedures.

(5) Remove the screws that secure the perimeter of the instrument panel top cover to the instrument panel base, the defroster duct and the demister ducts.

(6) Lift the top cover off of the instrument panel.

(7) Reverse the removal procedures to install. Tighten the mounting screws to 2.2 N·m (20 in. lbs.).

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AUDIO SYSTEMS

CONTENTS

GENERAL INFORMATION

INTRODUCTION

An audio system is standard factory-installed equipment on this model, unless the vehicle is ordered with an available radio delete option. Refer to 8W-47 Audio System in Group 8W - Wiring Diagrams for complete circuit descriptions and diagrams.

AUDIO SYSTEM

Several combinations of radio receivers and speaker systems are offered on this model. The standard equipment audio system includes an AM/FM/cassette (RAS sales code) receiver, and speakers in four locations.

Following are general descriptions of the major components in the standard and optional factory-installed audio systems. Refer to the owner's manual in the vehicle glove box for more information on the features, use and operation of each of the available audio systems.

DESCRIPTION AND OPERATION

RADIO

Available factory-installed radio receivers for this model include an AM/FM/cassette (RAS sales code), an AM/FM/cassette/5-band graphic equalizer with CD changer control feature (RBN sales code), an AM/FM/CD/3-band graphic equalizer (RBR sales code), or an AM/FM/CD/cassette/3-band graphic equalizer (RAZ sales code). All factory-installed receivers are stereo Electronically Tuned Radios (ETR) and include an electronic digital clock function.

The radio can only be serviced by an authorized radio repair station. Refer to the latest Warranty Policies and Procedures manual for a current listing of authorized radio repair stations.

For more information on radio features, setting procedures, and control functions refer to the owner's manual in the vehicle glove box.

IGNITION-OFF DRAW FUSE

All vehicles are equipped with an Ignition-Off Draw (IOD) fuse that is removed when the vehicle is shipped from the factory. This fuse feeds various accessories that require battery current when the ignition switch is in the Off position, including the clock. The fuse is removed to prevent battery discharge during vehicle storage.

When removing or installing the IOD fuse, it is important that the ignition switch be in the Off position. Failure to place the ignition switch in the Off position can cause the radio display to become scrambled when the IOD fuse is removed and replaced. Removing and replacing the IOD fuse again, with the ignition switch in the Off position, will correct the scrambled display condition.

The IOD fuse should be checked if the radio or clock displays are inoperative. The IOD fuse is located in the junction block. Refer to the label on the back of the junction block fuse access panel for IOD fuse identification and location.

DESCRIPTION AND OPERATION (Continued)

SPEAKER

The standard equipment speaker system includes speakers in four locations. One full-range 15.2 by 22.9 centimeter (6.0 by 9.0 inch) speaker is located in each front door. There is also one full-range 13.3 centimeter (5.25 inch) diameter speaker located in each rear cab side panel for the standard cab and the club cab models, or in each rear door of the quad cab models.

The optional premium speaker system features Infinity model speakers in six locations. Each of the standard front door speakers are replaced with Infinity model speakers that include an integral 30 watt dual amplifier, which is used to drive both the front door speaker and an Infinity tweeter mounted in the A-pillar garnish moulding. Each of the standard rear speakers is replaced by an Infinity model speaker, which is driven by the amplifier in the radio. The total available power of the premium speaker system is about 150 watts.

FILTER, CHOKE, AND SPEAKER RELAY

Models equipped with the Infinity premium speaker package use this filter, choke, and speaker relay unit to control battery feed to the two speaker-mounted amplifiers. The filter, choke, and speaker relay unit should be checked if there is no sound output noted from both of the front door speakers and the A-pillar tweeters.

The filter, choke, and speaker relay unit is mounted to the lower instrument panel center brace, inboard of the Central Timer Module (CTM) and directly above the 16-way data link connector. The filter, choke, and speaker relay unit can be accessed for service without instrument panel disassembly or removal.

The filter, choke, and speaker relay unit cannot be repaired and, if faulty or damaged, the unit must be replaced.

ANTENNA

All models use a fixed-length stainless steel rod-type antenna mast, installed at the right front fender of the vehicle. A plastic sleeve is installed over the length of the mast to reduce wind noise.

The antenna mast is connected to the center wire of the coaxial antenna cable, and is not grounded to any part of the vehicle. To eliminate static, the antenna base must have a good ground. The coaxial antenna cable shield (the outer wire mesh of the cable) is grounded to the antenna base and the radio chassis.

The antenna coaxial cable has an additional disconnect, located near the passenger side end of the instrument panel at the cowl side inner panel. This additional disconnect allows the instrument panel assembly to be removed and installed without removing the radio.

The factory-installed Electronically Tuned Radios (ETRs) automatically compensate for radio antenna trim. Therefore, no antenna trimmer adjustment is required or possible when replacing the receiver or the antenna.

RADIO NOISE SUPPRESSION

Radio Frequency Interference (RFI) and Electro-Magnetic Interference (EMI) noise suppression is accomplished primarily through circuitry internal to the radio receivers. These internal suppression devices are only serviced as part of the radio receiver.

External suppression devices that are serviced, and should be checked in the case of RFI or EMI noise complaints, include the following:

- Radio antenna base ground
- Radio chassis ground wire, strap, or bracket
- Engine-to-body ground strap (if the vehicle is so equipped)
- Cab-to-bed ground strap (if the vehicle is so equipped)
- Heater core ground strap (if the vehicle is so equipped)
- Resistor-type spark plugs
- Radio suppression-type secondary ignition wiring.

In addition, if the source of RFI or EMI noise is identified as a component on the vehicle (i.e., generator, blower motor, etc.), the ground path for that component should be checked. If excessive resistance is found in that circuit, repair that circuit as required before considering any component replacement.

If the source of the noise is identified as two-way mobile radio or telephone equipment, check the equipment installation for the following:

- Power connections should be made directly to the battery, and fused as closely to the battery as possible.
- The antenna should be mounted on the roof or toward the rear of the vehicle. Remember that magnetic antenna mounts on the roof panel can adversely affect the operation of an overhead console compass, if the vehicle is so equipped.
- The antenna cable should be fully shielded coaxial cable, should be as short as is practical, and should be routed away from the factory-installed vehicle wire harnesses whenever possible.
- The antenna and cable must be carefully matched to ensure a low Standing Wave Ratio (SWR).

Fleet vehicles are available with an extra-cost RFI-suppressed Powertrain Control Module (PCM). This unit reduces interference generated by the PCM on

AUTHENTIC RESTORATION PRODUCT

DESCRIPTION AND OPERATION (Continued)

some radio frequencies used in two-way radio communications. However, this unit will not resolve complaints of RFI in the commercial AM or FM radio frequency ranges.

DIAGNOSIS AND TESTING

AUDIO SYSTEM

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RADIO

For circuit descriptions and diagrams, refer to 8W-47 - Audio System in Group 8W - Wiring Diagrams.

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CAUTION: The speaker output of the radio is a "floating ground" system. Do not allow any speaker lead to short to ground, as damage to the radio may result.

(1) Check the fuse(s) in the junction block and the Power Distribution Center (PDC). If OK, go to Step 2. If not OK, repair the shorted circuit or component as required and replace the faulty fuse(s).

(2) Check for battery voltage at the fuse in the PDC. If OK, go to Step 3. If not OK, repair the open circuit to the battery as required.

(3) Turn the ignition switch to the On position. Check for battery voltage at the fuse in the junction block. If OK, go to Step 4. If not OK, repair the open circuit to the ignition switch as required.

(4) Turn the ignition switch to the Off position. Disconnect and isolate the battery negative cable. Remove the radio, but do not unplug the radio wire harness connectors. Check for continuity between the radio chassis and a good ground. There should be continuity. If OK, go to Step 5. If not OK, repair the open radio chassis ground circuit as required.

(5) Connect the battery negative cable. Turn the ignition switch to the On position. Check for battery voltage at the fused ignition switch output (accessory/run) circuit cavity of the left (gray) radio wire harness connector. If OK, go to Step 6. If not OK, repair the open circuit as required.

(6) Turn the ignition switch to the Off position. Check for battery voltage at the fused B(+) circuit cavity of the left (gray) radio wire harness connector. If OK, replace the faulty radio. If not OK, repair the open circuit to the Ignition-Off Draw (IOD) fuse as required.

SPEAKER

For circuit descriptions and diagrams, refer to 8W-47 - Audio System in Group 8W - Wiring Diagrams.

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

CAUTION: The speaker output of the radio is a "floating ground" system. Do not allow any speaker lead to short to ground, as damage to the radio may result.

(1) Turn the ignition switch to the On position. Turn the radio on. Adjust the balance and fader controls to check the performance of each individual speaker. Note the speaker locations that are not performing correctly. If only an Infinity tweeter is inoperative, go to Step 8. If any other speaker is inoperative, go to Step 2.

NOTE: If the vehicle is equipped with the Infinity premium speaker package and all of the Infinity-amplfied speakers are inoperative or lack response, see Filter, Choke, and Speaker Relay in the Diagnosis and Testing section of this group.

(2) Turn the radio off. Turn the ignition switch to the Off position. Disconnect and isolate the battery negative cable. Remove the radio from the instrument panel. Check both the speaker feed (+) circuit and return (–) circuit cavities for the inoperative speaker location(s) of the radio wire harness connectors for continuity to ground. In each case, there

DIAGNOSIS AND TESTING (Continued)

Audio System Diagnosis

CONDITION	POSSIBLE CAUSE	CORRECTION
NO AUDIO.	1. Fuse faulty. 2. Radio connector faulty. 3. Wiring faulty. 4. Ground faulty. 5. Radio faulty. 6. Speakers faulty.	1. Check radio fuses in junction block. Replace fuses, if required. 2. Check for loose or corroded radio connector. Repair, if required. 3. Check for battery voltage at radio connector. Repair wiring, if required. 4. Check for continuity between radio chassis and a known good ground. There should be continuity. Repair ground, if required. 5. See Radio in the Diagnosis and Testing section of this group. 6. See Speaker in the Diagnosis and Testing section of this group.
NO DISPLAY.	1. Fuse faulty. 2. Radio connector faulty. 3. Wiring faulty. 4. Ground faulty. 5. Radio faulty.	1. Check radio fuses in junction block. Replace fuses, if required. 2. Check for loose or corroded radio connector. Repair, if required. 3. Check for battery voltage at radio connector. Repair wiring, if required. 4. Check for continuity between radio chassis and a known good ground. There should be continuity. Repair ground, if required. 5. See Radio in the Diagnosis and Testing section of this group.
CLOCK WILL NOT KEEP SET TIME.	1. Fuse faulty. 2. Radio connector faulty. 3. Wiring faulty. 4. Ground faulty. 5. Radio faulty.	1. Check ignition-off draw fuse. Replace fuse, if required. 2. Check for loose or corroded radio connector. Repair, if required. 3. Check for battery voltage at radio connector. Repair wiring, if required. 4. Check for continuity between radio chassis and a known good ground. There should be continuity. Repair ground, if required. 5. See Radio in the Diagnosis and Testing section of this group.
POOR RADIO RECEPTION.	1. Antenna faulty. 2. Ground faulty. 3. Radio faulty.	1. See Antenna in the Diagnosis and Testing section of this group. 2. Check for continuity between radio chassis and a known good ground. There should be continuity. Repair ground, if required. 3. See Radio in the Diagnosis and Testing section of this group.
NO/POOR TAPE OPERATION.	1. Faulty tape. 2. Foreign objects behind tape door. 3. Dirty cassette tape head. 4. Faulty tape deck.	1. Insert known good tape and test operation. 2. Remove foreign objects and test operation. 3. Clean head with Mopar Cassette Head Cleaner. 4. Exchange or replace radio, if required.
NO COMPACT DISC OPERATION	1. Faulty CD. 2. Foreign material on CD. 3. Condensation on CD or optics. 4. Faulty CD player.	1. Insert known good CD and test operation. 2. Clean CD and test operation. 3. Allow temperature of vehicle interior to stabilize and test operation. 4. Exchange or replace radio, if required.

AUTHENTIC RESTORATION PRODUCT

DIAGNOSIS AND TESTING (Continued)

should be no continuity. If OK, go to Step 3. If not OK, repair the shorted speaker circuit(s) as required.

(3) If the inoperative speaker is an Infinity-amplified speaker (front door-mounted), go to Step 5. If the vehicle is equipped with the standard speaker system or the inoperative speaker is an Infinity rear-mounted speaker, check the resistance between the speaker feed (+) circuit and return (–) circuit cavities of the radio wire harness connectors for the inoperative speaker location(s). The meter should read between 3 and 8 ohms (speaker resistance). If OK, go to Step 4. If not OK, go to Step 5.

(4) Install a known good radio. Connect the battery negative cable. Turn the ignition switch to the On position. Turn on the radio and test the speaker operation. If OK, replace the faulty radio. If not OK, turn the radio off, turn the ignition switch to the Off position, disconnect and isolate the battery negative cable, remove the test radio, and go to Step 5.

(5) Unplug the speaker wire harness connector at the inoperative speaker. Check for continuity between the speaker feed (+) circuit cavities of the radio wire harness connector and the speaker wire harness connector. Repeat the check between the speaker return (–) circuit cavities of the radio wire harness connector and the speaker wire harness connector. In each case, there should be continuity. If OK with an Infinity-amplified speaker (front door-mounted), go to Step 6. If OK with the standard speakers or for an Infinity rear-mounted speaker, replace the faulty speaker. If not OK, repair the open circuit(s) as required.

(6) For each inoperative speaker location, check for continuity between the amplified speaker (–) circuit cavity in the body half of the speaker wire harness connector and a good ground. There should be continuity. If OK, go to Step 7. If not OK, repair the open circuit as required.

(7) Install the radio. Connect the battery negative cable. Turn the ignition switch to the On position. Turn the radio on. Check for battery voltage at the amplified speaker (+) circuit cavity of the speaker wire harness connector. If OK, replace the faulty speaker. If not OK, repair the open circuit to the filter, choke, and speaker relay as required.

(8) Turn the radio off. Turn the ignition switch to the Off position. Disconnect and isolate the battery negative cable. Unplug the wire harness connector at the front door speaker located on the same side of the vehicle as the inoperative tweeter. Check both the tweeter amplified feed (+) circuit and amplified return (–) circuit cavities in the body half of the front door speaker wire harness connector for continuity to ground. In each case, there should be no continuity. If OK, go to Step 9. If not OK, repair the shorted tweeter circuit(s) as required.

(9) Unplug the wire harness connector at the A-pillar garnish moulding for the inoperative tweeter. Check for continuity between the tweeter amplified feed (+) circuit cavities in the body halves of the front door speaker wire harness connector and the tweeter wire harness connector. Repeat the check between the tweeter amplified return (–) circuit cavities in the body halves of the front door speaker wire harness connector and the tweeter wire harness connector. In each case, there should be continuity. If OK, go to Step 10. If not OK, repair the open circuit(s) as required.

(10) Check the resistance between the tweeter amplified feed (+) circuit and amplified return (–) circuit cavities in the body half of the front door speaker wire harness connector. The meter should read between 3 and 8 ohms (speaker resistance). If OK, replace the faulty front door Infinity speaker and amplifier unit. If not OK, replace the faulty tweeter.

FILTER, CHOKE, AND SPEAKER RELAY

The filter, choke, and speaker relay is used to switch power to the individual speaker amplifiers used with the Infinity premium speaker package. The choke and relay are serviced only as a unit. If the front door speakers lack bass or low frequency response, while no sound is noted at the Infinity-amplified tweeters in the A-pillar garnish mouldings, the choke and relay should be considered suspect. However, before replacement make the following checks of the choke and relay circuits. For circuit descriptions and diagrams, refer to 8W-47 - Audio System in Group 8W - Wiring Diagrams.

(1) Check the fuse in the junction block. If OK, go to Step 2. If not OK, replace the faulty fuse.

(2) Check for battery voltage at the fuse in the junction block. If OK, go to Step 3. If not OK, repair the open circuit as required.

(3) Unplug the choke and relay wire harness connector. Check for battery voltage at the fused B(+) circuit cavity of the choke and relay wire harness connector. If OK, go to Step 4. If not OK, repair the open circuit as required.

(4) Probe the ground circuit cavity of the choke and relay wire harness connector. Check for continuity to a good ground. There should be continuity. If OK, go to Step 5. If not OK, repair the open circuit to ground as required.

(5) Turn the ignition switch to the On position and turn the radio on. Check for battery voltage at the radio 12-volt output circuit cavity of the choke and relay wire harness connector. If OK, go to Step 6. If not OK, repair the open circuit as required.

(6) Turn the radio and ignition switches to the Off position. Plug in the choke and relay wire harness

DIAGNOSIS AND TESTING (Continued)

connector. Check for battery voltage at the amplified speaker (+) circuit cavity of the choke and relay wire harness connector. There should be zero volts. Turn the ignition and radio switches to the On position. There should now be battery voltage. If OK, repair the circuits from the choke and relay wire harness connector to the speaker amplifiers as required. If not OK, replace the faulty choke and relay.

ANTENNA

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

The following four tests are used to diagnose the antenna with an ohmmeter:

- **Test 1** - Mast to ground test
- **Test 2** - Tip-of-mast to tip-of-conductor test
- **Test 3** - Body ground to battery ground test
- **Test 4** - Body ground to coaxial shield test.

The ohmmeter test lead connections for each test are shown in Antenna Tests (Fig. 1).

NOTE: This model has a two-piece antenna coaxial cable. Tests 2 and 4 must be conducted in two steps to isolate a coaxial cable problem; from the coaxial cable connection under the right end of the instrument panel near the right cowl side inner panel to the antenna base, and then from the coaxial cable connection to the radio chassis connection.

TEST 1

Test 1 determines if the antenna mast is insulated from the base. Proceed as follows:

(1) Unplug the antenna coaxial cable connector from the radio chassis and isolate.

(2) Connect one ohmmeter test lead to the tip of the antenna mast. Connect the other test lead to the antenna base. Check for continuity.

(3) There should be no continuity. If continuity is found, replace the faulty or damaged antenna base and cable assembly.

TEST 2

Test 2 checks the antenna for an open circuit as follows:

(1) Unplug the antenna coaxial cable connector from the radio chassis.

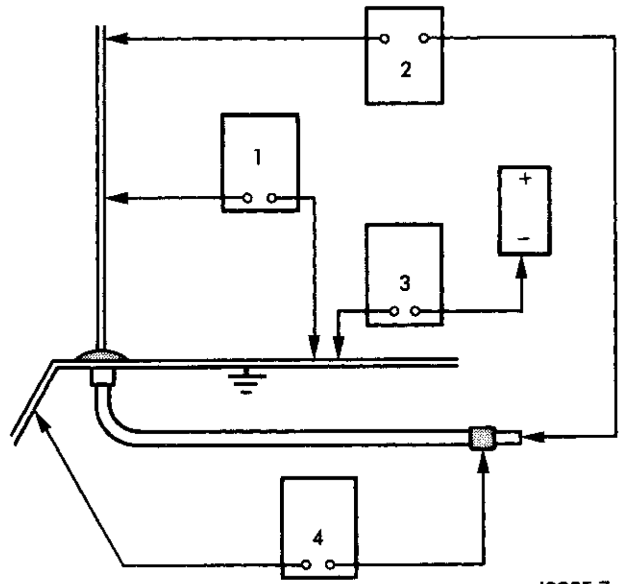

Fig. 1 Antenna Tests

(2) Connect one ohmmeter test lead to the tip of the antenna mast. Connect the other test lead to the center pin of the antenna coaxial cable connector.

(3) Continuity should exist (the ohmmeter should only register a fraction of an ohm). High or infinite resistance indicates damage to the base and cable assembly. Replace the faulty base and cable, if required.

TEST 3

Test 3 checks the condition of the vehicle body ground connection. This test should be performed with the battery positive cable removed from the battery. Disconnect both battery cables, the negative cable first. Reconnect the battery negative cable and perform the test as follows:

(1) Connect one ohmmeter test lead to the vehicle fender. Connect the other test lead to the battery negative post.

(2) The resistance should be less than one ohm.

(3) If the resistance is more than one ohm, check the braided ground strap connected to the engine and the vehicle body for being loose, corroded, or damaged. Repair the ground strap connection, if required.

TEST 4

Test 4 checks the condition of the ground between the antenna base and the vehicle body as follows:

(1) Connect one ohmmeter test lead to the vehicle fender. Connect the other test lead to the outer crimp on the antenna coaxial cable connector.

(2) The resistance should be less then one ohm.

(3) If the resistance is more then one ohm, clean and/or tighten the antenna base to fender mounting hardware.

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DIAGNOSIS AND TESTING (Continued)

RADIO FREQUENCY INTERFERENCE

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Inspect the ground connections at the following:
- Blower motor
- Electric fuel pump
- Generator
- Ignition module
- Wiper motor
- Antenna coaxial ground
- Radio ground
- Body-to-engine braided ground strap (if the vehicle is so equipped).

Clean, tighten, or repair the connections as required.

Also inspect the following secondary ignition system components, as described in Group 8D - Ignition Systems:
- Spark plug wire routing and condition
- Distributor cap and rotor
- Ignition coil
- Spark plugs.

Reroute the spark plug wires or replace the faulty components as required.

REMOVAL AND INSTALLATION

RADIO

WARNING: ON VEHICLES EQUIPPED WITH AIR-BAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRE-CAUTIONS COULD RESULT IN ACCIDENTAL AIR-BAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(1) Disconnect and isolate the battery negative cable.

(2) Remove the cluster bezel from the instrument panel. Refer to Cluster Bezel in the Removal and Installation section of Group 8E - Instrument Panel Systems for the procedures.

(3) Remove the two screws that secure the radio to the instrument panel (Fig. 2).

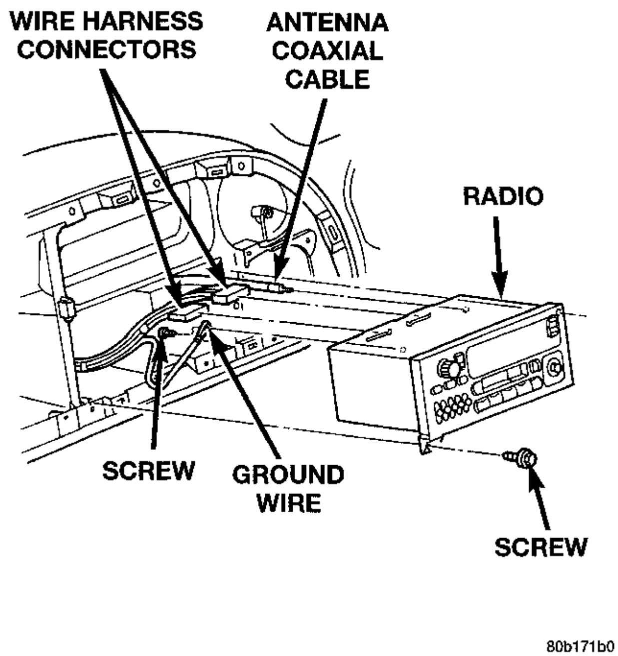

Fig. 2 Radio Remove/Install

(4) Pull the radio out from the instrument panel far enough to access the wire harness connectors and the antenna coaxial cable connector (Fig. 3).

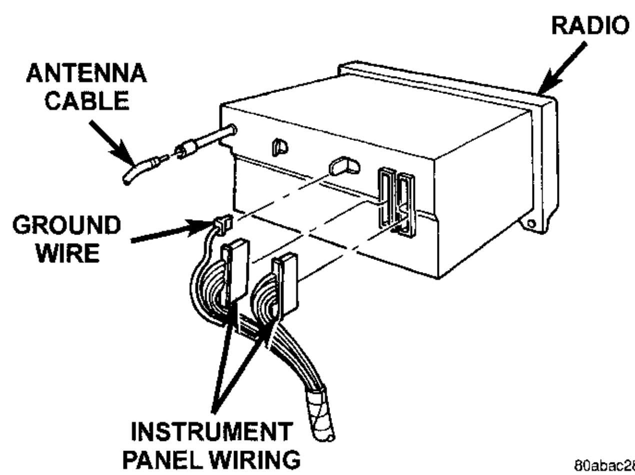

Fig. 3 Radio Connections - Typical

(5) Unplug the wire harness connectors and the antenna coaxial cable connector from the rear of the radio.

(6) If so equipped, remove the screw that secures the ground wire to the back of the radio chassis.

(7) Remove the radio from the instrument panel.

(8) Reverse the removal procedures to install. Tighten the radio ground wire screw to 7 N·m (65 in. lbs.). Tighten the radio mounting screws to 5 N·m (45 in. lbs.).

REMOVAL AND INSTALLATION (Continued)

FILTER, CHOKE, AND SPEAKER RELAY

(1) Disconnect and isolate the battery negative cable.

(2) From the driver side of the vehicle, reach under the instrument panel near the 16-way data link connector and inboard of the ash receiver to unplug the filter, choke, and speaker relay wire harness connector from the instrument panel wire harness (Fig. 4).

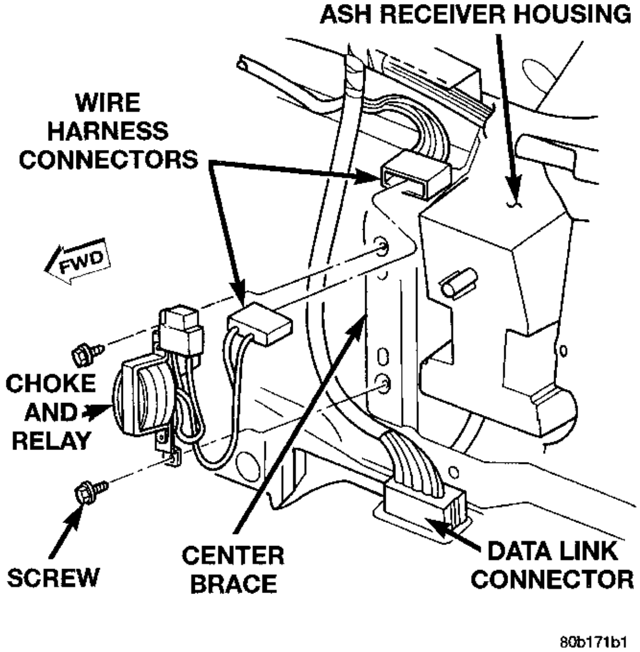

Fig. 4 Filter, Choke, and Speaker Relay Remove/Install

(3) Remove the two screws that secure the filter, choke, and speaker relay mounting bracket to the instrument panel center brace.

(4) Remove the filter, choke, and speaker relay unit from under the instrument panel.

(5) Reverse the removal procedures to install. Tighten the mounting screws to 2.7 N·m (24 in. lbs.).

SPEAKER

A-PILLAR TWEETER

The A-pillar-mounted tweeters are used only with the optional Infinity premium speaker package.

(1) Disconnect and isolate the battery negative cable.

(2) If the vehicle is so equipped, remove the grab handle from the A-pillar. Refer to Group 23 - Body for the procedures.

(3) Disengage the garnish moulding retainers from the A-pillar. Refer to Group 23 - Body for the procedures.

(4) Pull the garnish moulding away from the A-pillar far enough to access and unplug the tweeter wire harness connector (Fig. 5).

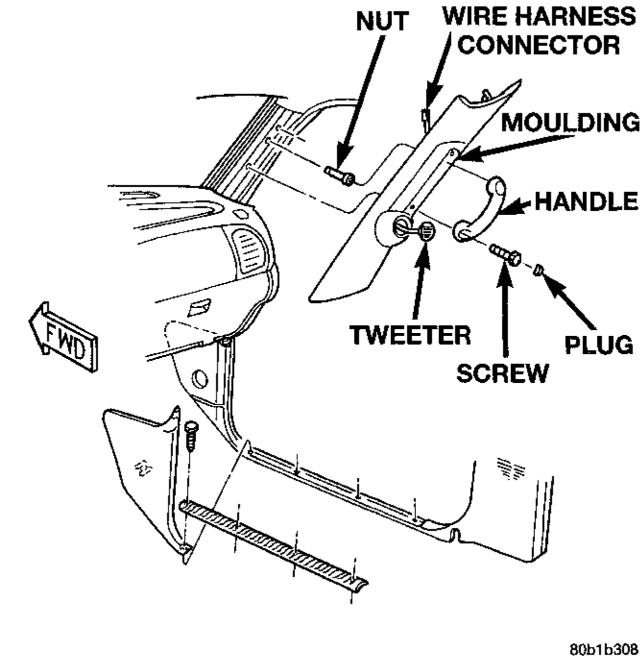

Fig. 5 A-Pillar Tweeter Remove/Install

(5) Remove the garnish moulding from the A-pillar.

(6) Disengage the tweeter wire harness retainers from the heat stakes on the back of the A-pillar garnish moulding.

(7) Unsnap the tweeter from the A-pillar garnish moulding mounting hole by pushing out on the tweeter from the inside of the moulding.

(8) Reverse the removal procedures to install. Use a suitable tape or adhesive to secure the tweeter wire harness to the inside of the garnish moulding.

FRONT DOOR

(1) Disconnect and isolate the battery negative cable.

(2) Remove the inside trim panel from the front door. Refer to Group 23 - Body for the procedures.

(3) Remove the screws that secure the speaker near the front of the front door inner panel (Fig. 6).

(4) Pull the speaker away from the inner door panel far enough to access and unplug the speaker wire harness connector.

(5) Remove the speaker from the door.

(6) Reverse the removal procedures to install. Tighten the speaker mounting screws to 4 N·m (35 in. lbs.).

REAR CAB SIDE PANEL

(1) Disconnect and isolate the battery negative cable.

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REMOVAL AND INSTALLATION (Continued)

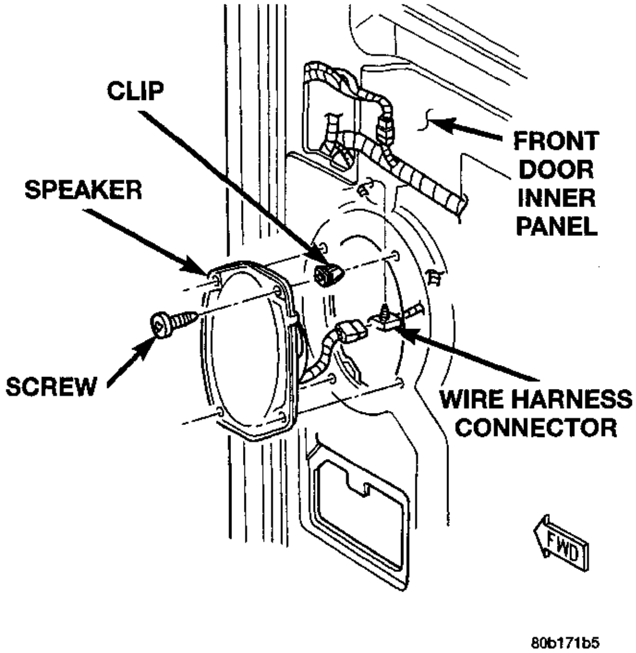


Fig. 6 Front Door Speaker Remove/Install

(2) Remove the quarter inner trim panel from the rear cab side. Refer to Group 23 - Body for the procedures.

(3) Remove the screws that secure the speaker to the rear cab side inner panel (Fig. 7) or (Fig. 8).

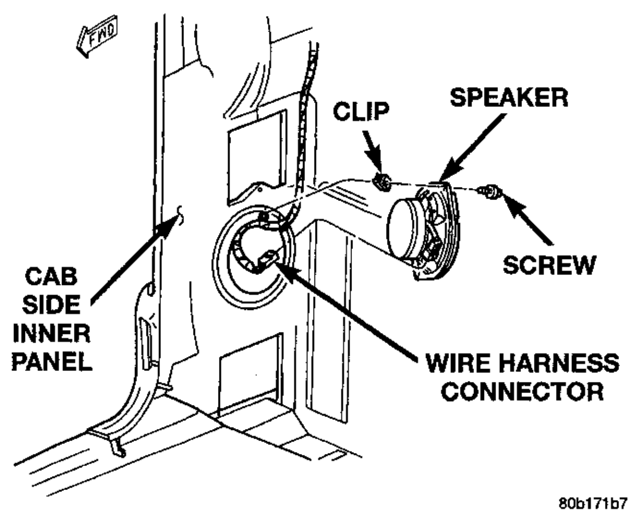


Fig. 7 Rear Speaker Remove/Install - Standard Cab

(4) Pull the speaker away from the rear cab side inner panel far enough to access and unplug the wire harness connector from the speaker.

(5) Remove the speaker from the rear cab side inner panel.

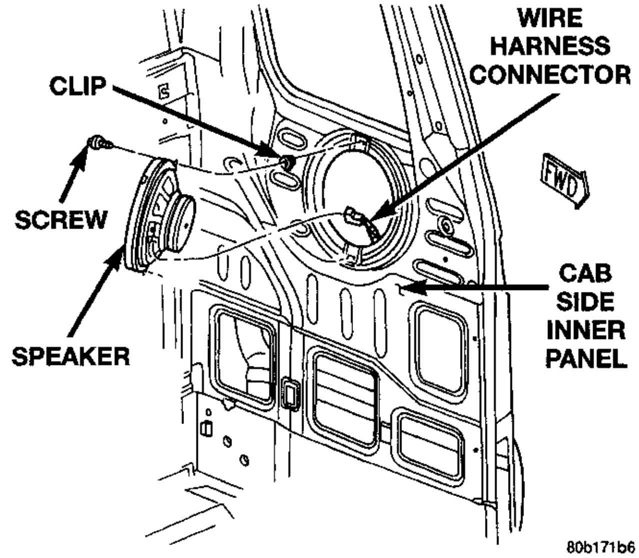


Fig. 8 Rear Speaker Remove/Install - Club Cab

(6) Reverse the removal procedures to install. Tighten the speaker mounting screws to 4 N·m (35 in. lbs.).

REAR DOOR

(1) Disconnect and isolate the battery negative cable.

(2) Remove the inside trim panel from the rear door. Refer to Group 23 - Body for the procedures.

(3) Remove the screws that secure the speaker near the rear of the rear door inner panel (Fig. 9).

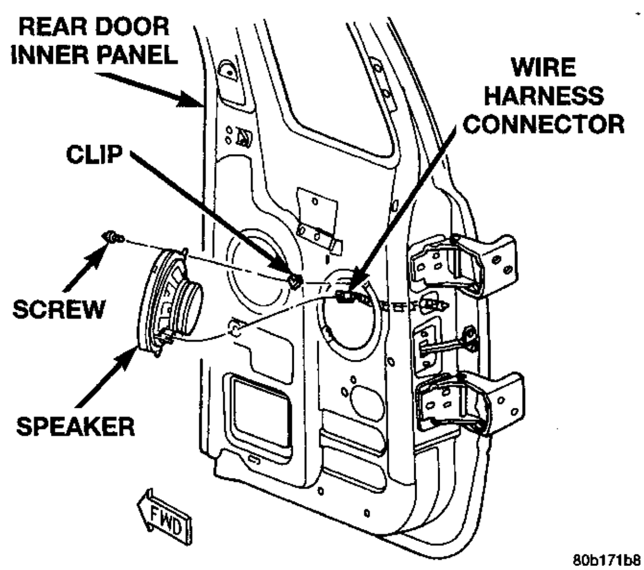


Fig. 9 Rear Door Speaker Remove/Install - Quad Cab

(4) Pull the speaker away from the inner door panel far enough to access and unplug the wire harness connector from the speaker.

REMOVAL AND INSTALLATION (Continued)

(5) Remove the speaker from the door.

(6) Reverse the removal procedures to install. Tighten the speaker mounting screws to 4 N·m (35 in. lbs.).

ANTENNA

WARNING: ON VEHICLES EQUIPPED WITH AIR-BAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRE-CAUTIONS COULD RESULT IN ACCIDENTAL AIR-BAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(1) Disconnect and isolate the battery negative cable.

(2) Reach under the passenger side of the instrument panel near the right cowl side inner panel to disengage the coaxial cable connector from the retainer clip located on the bottom of the heater-A/C housing (Fig. 10).

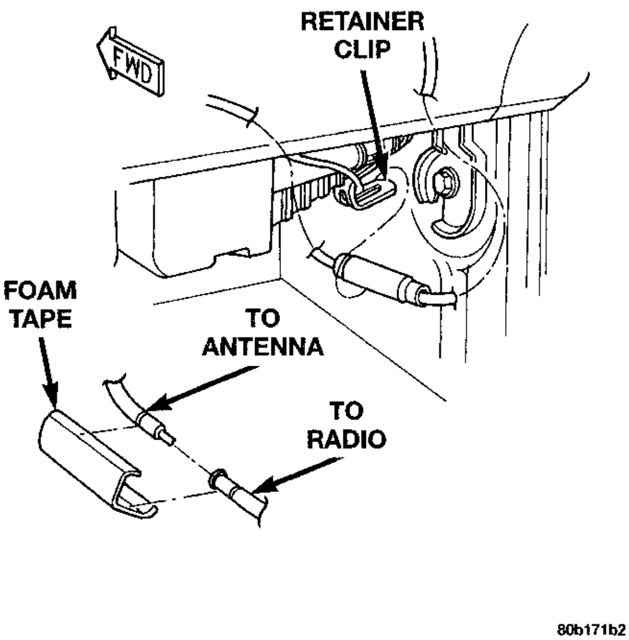


Fig. 10 Antenna Coaxial Cable Connector

(3) Remove the foam tape to access the coaxial cable connector. Unplug the connector by pulling it apart while twisting the metal connector halves. Do not pull on the cable.

(4) Securely tie a suitable length of cord or twine to the connector on the end of the coaxial cable half that is being removed from the vehicle. This cord will be used to pull or "fish" the cable back into position during reinstallation. To remove the radio half of the antenna coaxial cable, go to Step 5. To remove the antenna half of the antenna coaxial cable, go to Step 9.

(5) Remove the glove box from the instrument panel. Refer to Glove Box in the Removal and Installation section of Group 8E - Instrument Panel Systems for the procedures.

(6) Reach through the glove box opening to disengage the radio half of the coaxial cable from the retainer clips on the back of the instrument panel (Fig. 11).

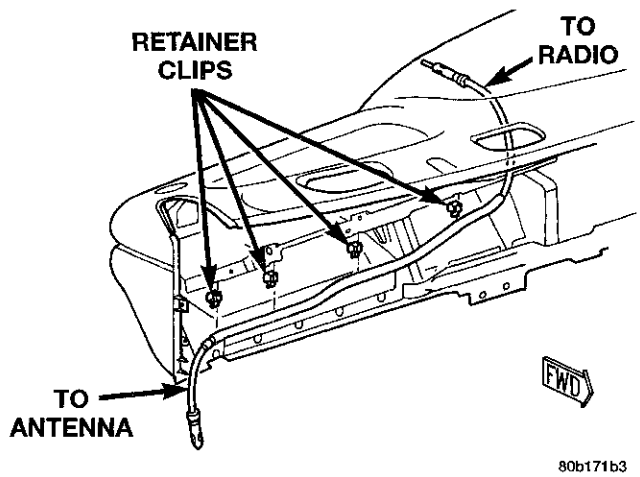


Fig. 11 Antenna Cable Routing

(7) Remove the radio from the instrument panel. See Radio in the Removal and Installation section of this group for the procedures.

(8) Remove the radio half of the antenna coaxial cable from the instrument panel.

(9) Reach above the Powertrain Control Module (PCM) on the right side of the dash panel in the engine compartment to disengage the antenna coaxial cable grommet from the hole in the dash panel (Fig. 12).

(10) Pull the antenna coaxial cable out of the passenger compartment and into the engine compartment through the hole in the dash panel.

(11) Raise the sleeve on the antenna mast far enough to access and unscrew the antenna mast from the antenna body (Fig. 13).

(12) Remove the antenna cap nut using an antenna nut wrench (Special Tool C-4816) (Fig. 14).

(13) Remove the antenna adapter from the top of the fender.

(14) Lower the antenna body and cable assembly through the top of the fender.

(15) Pull the antenna body and cable out through the opening between the right cowl side outer panel and the top of the fender, while feeding the antenna coaxial cable out of the engine compartment through the hole in the right cowl side reinforcement.

REMOVAL AND INSTALLATION (Continued)

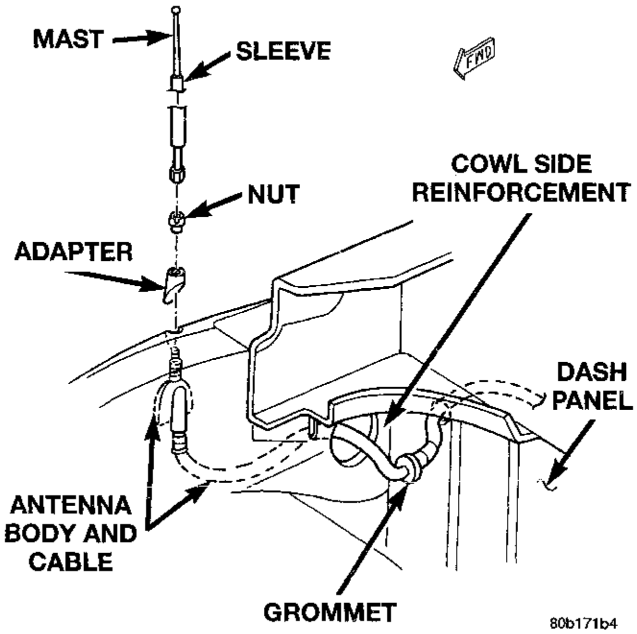


Fig. 12 Antenna Mounting

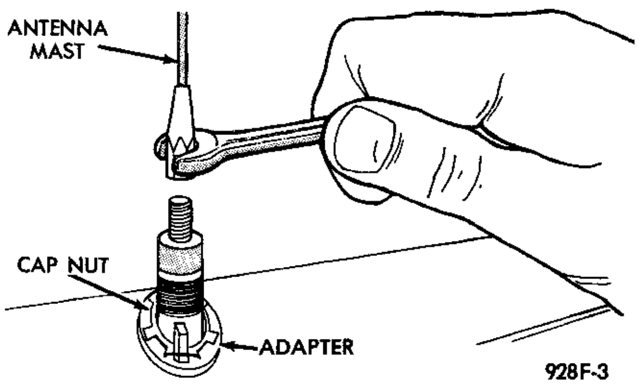


Fig. 13 Antenna Mast Remove/Install - Typical

(16) Remove the antenna body and cable from the vehicle.

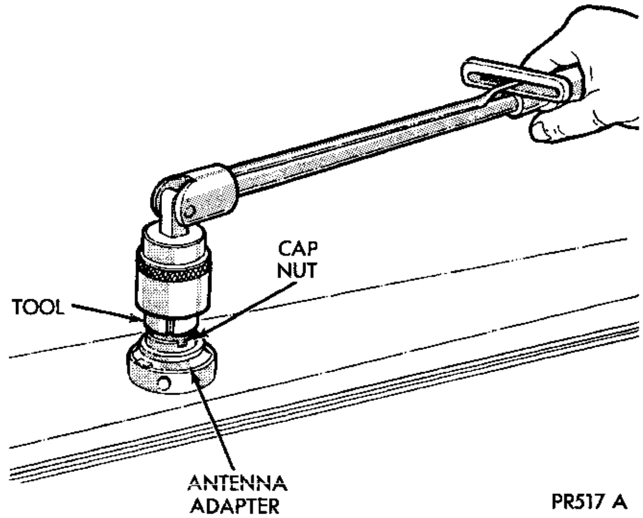
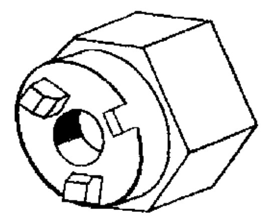


Fig. 14 Antenna Cap Nut Remove/Install - Typical

(17) Reverse the removal procedures to install. Tighten the antenna cap nut to 8 N·m (70 in. lbs.). Tighten the antenna mast to 3.3 N·m (30 in. lbs.).

SPECIAL TOOLS

ANTENNA



Antenna Nut Wrench C-4816

AUTHENTIC RESTORATION PRODUCT

HORN SYSTEMS

CONTENTS

GENERAL INFORMATION

INTRODUCTION

An electric horn system is standard factory-installed equipment on this model. Refer to 8W-41 - Horns/Cigar Lighter in Group 8W - Wiring Diagrams for complete circuit descriptions and diagrams.

HORN SYSTEM

Two horn systems are offered on this model. The standard equipment horn system features a single low-note electromagnetic horn unit, while the optional dual horn system features one low-note unit and one high-note unit.

Each horn system is activated by a switch concealed beneath the driver side airbag module trim cover in the center of the steering wheel. The horn system is connected to a non-switched battery feed so that the system remains functional, regardless of the ignition switch position.

Following are general descriptions of the major components in the horn system. Refer to the owner's manual in the vehicle glove box for more information on the features, use and operation of the horn system.

DESCRIPTION AND OPERATION

HORN RELAY

The horn relay is a International Standards Organization (ISO) micro-relay. The terminal designations and functions are the same as a conventional ISO relay. However, the micro-relay terminal orientation (or footprint) is different, current capacity is lower, and the relay case dimensions are smaller than those of the conventional ISO relay.

The horn relay is a electromechanical device that switches battery current to the horn when the horn switch grounds the relay coil. See Horn Relay in the Diagnosis and Testing section of this group for more information.

The horn relay is located in the Power Distribution Center (PDC), in the engine compartment. Refer to the PDC label for relay identification and location.

If a problem is encountered with a continuously sounding horn, it can usually be quickly resolved by removing the horn relay from the PDC until further diagnosis is completed.

The horn relay cannot be repaired and, if faulty or damaged, it must be replaced.

HORN SWITCH

A center-blow, resistive membrane-type horn switch is installed on the back side of the driver side airbag module trim cover in the center of the steering wheel. When the center area of the airbag trim cover is depressed, the horn switch completes a circuit to ground for the coil side of the horn relay. The steering wheel and steering column must be properly grounded for the horn switch to function.

The horn switch is only serviced as a part of the airbag module trim cover. If the horn switch should fail, or if the airbag is deployed, the airbag module trim cover and horn switch must be replaced as a unit.

HORN

The standard single, low-note, electromagnetic diaphragm-type horn is secured with a bracket to the right front fender wheelhouse extension in the engine compartment. The high-note horn for the optional dual-note horn system is connected in parallel with and secured with a bracket just forward of the low-note horn. Each horn is grounded through its wire harness connector and a wiring circuit to a ground

AUTHENTIC RESTORATION

DESCRIPTION AND OPERATION (Continued)

splice joint connector, and receives battery feed through the closed contacts of the horn relay.

The horns cannot be repaired or adjusted and, if faulty or damaged, they must be individually replaced.

CENTRAL TIMER MODULE

Two versions of the Central Timer Module (CTM) are available on this vehicle, a base version and a high-line version. The base version of the CTM is used on base models of the vehicle. It is also sometimes referred to as the Integrated Electronic Module (IEM). The base version of the CTM combines the functions of a chime/buzzer module, an intermittent wipe module, and an ignition lamp time delay relay in a single unit.

The high-line version of the CTM is used on high-line vehicles. The high-line CTM provides all of the functions of the base version CTM, but also is used to control and integrate many of the additional electronic functions and features included on the high-line models. The high-line version of the CTM contains a central processing unit and interfaces with other modules in the vehicle on the Chrysler Collision Detection (CCD) data bus network.

The CCD data bus network allows the sharing of sensor information. This helps to reduce wire harness complexity, reduce internal controller hardware, and reduce component sensor current loads. At the same time, this system provides increased reliability, enhanced diagnostics, and allows the addition of many new feature capabilities.

The horn relay is one of the outputs that the high-line CTM can control. The high-line CTM is programmed to energize or de-energize the horn relay in response to certain inputs from the Vehicle Theft Security System (VTSS) and the Remote Keyless Entry (RKE) system. Refer to Group 8P - Power Lock Systems for more information on the RKE system. Refer to Group 8Q - Vehicle Theft/Security Systems for more information on the VTSS.

Both versions of the CTM are mounted under the driver side end of the instrument panel, inboard of the instrument panel steering column opening. Refer to Central Timer Module in the Removal and Installation section of Group 8E - Instrument Panel Systems for the service procedures.

Refer to Central Timer Module in the Diagnosis and Testing section of Group 8U - Chime/Buzzer Warning Systems for diagnosis of the base version of the CTM. For diagnosis of the high-line version of the CTM or the CCD data bus, the use of a DRB scan tool and the proper Diagnostic Procedures manual are recommended. The CTM cannot be repaired and, if faulty or damaged, it must be replaced.

DIAGNOSIS AND TESTING

HORN RELAY

For circuit descriptions and diagrams, refer to 8W-41 - Horns/Cigar Lighter in Group 8W - Wiring Diagrams.

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

RELAY TEST

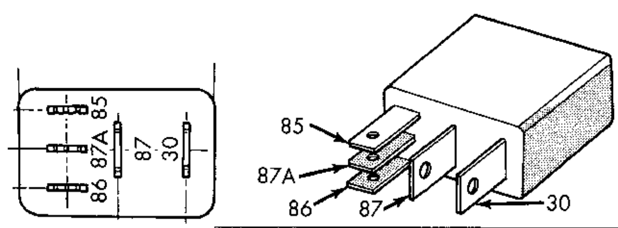
The horn relay (Fig. 1) is located in the Power Distribution Center (PDC) in the engine compartment. Refer to the PDC label for horn relay identification and location.

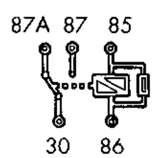
Remove the horn relay from the PDC as described in this group to perform the following tests:

(1) A relay in the de-energized position should have continuity between terminals 87A and 30, and no continuity between terminals 87 and 30. If OK, go to Step 2. If not OK, replace the faulty relay.

(2) Resistance between terminals 85 and 86 (electromagnet) should be 75 ± 5 ohms. If OK, go to Step 3. If not OK, replace the faulty relay.

(3) Connect a battery to terminals 85 and 86. There should now be continuity between terminals 30 and 87, and no continuity between terminals 87A and 30. If OK, see Relay Circuit Test in the Diagnosis and Testing section of this group. If not OK, replace the faulty relay.





TERMINAL LEGEND	
NUMBER	IDENTIFICATION
30	COMMON FEED
85	COIL GROUND
86	COIL BATTERY
87	NORMALLY OPEN
87A	NORMALLY CLOSED

9514-16

Fig. 1 Horn Relay

AUTHENTIC RESTORATION PRODUCT

DIAGNOSIS AND TESTING (Continued)

RELAY CIRCUIT TEST

(1) The relay common feed terminal cavity (30) is connected to battery voltage and should be hot at all times. If OK, go to Step 2. If not OK, repair the open circuit to the PDC fuse as required.

(2) The relay normally closed terminal (87A) is connected to terminal 30 in the de-energized position, but is not used for this application. Go to Step 3.

(3) The relay normally open terminal (87) is connected to the common feed terminal (30) in the energized position. This terminal supplies battery voltage to the horn(s). There should be continuity between the cavity for relay terminal 87 and the horn relay output circuit cavity of each horn wire harness connector at all times. If OK, go to Step 4. If not OK, repair the open circuit to the horn(s) as required.

(4) The coil battery terminal (86) is connected to the electromagnet in the relay. It is connected to battery voltage and should be hot at all times. Check for battery voltage at the cavity for relay terminal 86. If OK, go to Step 5. If not OK, repair the open circuit to the fuse in the PDC as required.

(5) The coil ground terminal (85) is connected to the electromagnet in the relay. It is grounded through the horn switch when the horn switch is depressed. It can also be grounded by the high-line Central Timer Module (CTM) in response to inputs from the Vehicle Theft Security System (VTSS) or the Remote Keyless Entry (RKE) system. Check for continuity to ground at the cavity for relay terminal 85. There should be continuity with the horn switch depressed, and no continuity with the horn switch released. If not OK, see Horn Switch in the Diagnosis and Testing section of this group.

HORN SWITCH

For circuit descriptions and diagrams, refer to 8W-41 - Horns/Cigar Lighter in Group 8W - Wiring Diagrams.

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(1) Disconnect and isolate the battery negative cable. Remove the steering column opening cover and knee blocker from the instrument panel.

(2) Check for continuity between the metal steering column jacket and a good ground. There should be continuity. If OK, go to Step 3. If not OK, refer to Steering Column in Group 19 - Steering for the proper installation of the steering column mounting hardware.

(3) Remove the driver side airbag module from the steering wheel. Refer to Airbag Module in the Removal and Installation section of Group 8M - Passive Restraint Systems for the procedures. Unplug the horn switch wire harness connectors from the airbag module.

(4) Unplug the horn relay from the Power Distribution Center (PDC). Check for continuity between the steering column half of the horn switch feed wire harness connector and a good ground. There should be no continuity. If OK, go to Step 5. If not OK, repair the short circuit as required.

(5) Check for continuity between the steering column half of the horn switch feed wire harness connector and the horn relay control circuit cavity for the horn relay in the PDC. There should be continuity. If OK, go to Step 6. If not OK, repair the open circuit as required.

(6) Check for continuity between the horn switch feed wire and the horn switch ground wire on the airbag module. There should be no continuity. If OK, go to Step 7. If not OK, replace the faulty horn switch.

(7) Depress the center of the airbag module trim cover and check for continuity between the horn switch feed wire and the horn switch ground wire on the airbag module. There should now be continuity. If not OK, replace the faulty horn switch.

HORN

For circuit descriptions and diagrams, refer to 8W-41 - Horns/Cigar Lighter in Group 8W - Wiring Diagrams.

(1) Measure the resistance between the horn mounting bracket and a good ground. There should be no measurable resistance. If OK, go to Step 2. If not OK, repair the horn ground connection as required.

(2) Unplug the horn wire harness connector. Depress the horn switch. There should be battery voltage at the horn relay output circuit cavity of horn wire harness connector. If OK, replace the faulty horn(s). If not OK, repair the open circuit to the horn relay as required.

REMOVAL AND INSTALLATION

HORN RELAY

(1) Disconnect and isolate the battery negative cable.

(2) Remove the cover from the Power Distribution Center (PDC) (Fig. 2).

(3) Refer to the label on the PDC for horn relay identification and location.

REMOVAL AND INSTALLATION (Continued)

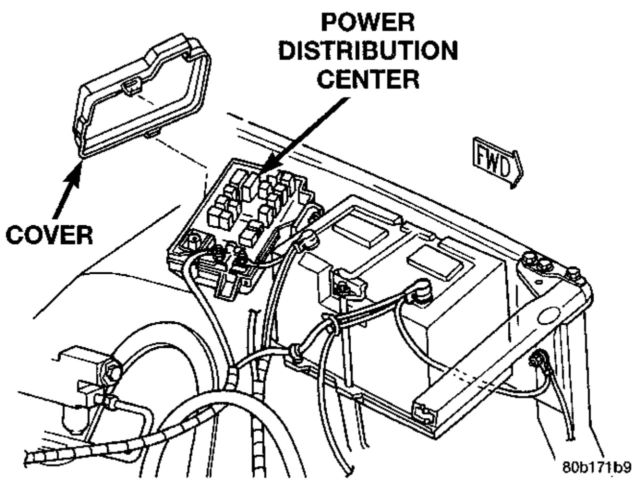


Fig. 2 Power Distribution Center

(4) Unplug the horn relay from the PDC.

(5) Install the horn relay by aligning the relay terminals with the cavities in the PDC and pushing the relay firmly into place.

(6) Install the PDC cover.

(7) Connect the battery negative cable.

(8) Test the relay operation.

HORN SWITCH

WARNING: ON VEHICLES EQUIPPED WITH A DRIVER SIDE AIRBAG, THE HORN SWITCH IS INTEGRAL TO THE AIRBAG MODULE TRIM COVER. SERVICE OF THIS COMPONENT SHOULD BE PERFORMED ONLY BY CHRYSLER-TRAINED AND AUTHORIZED DEALER SERVICE TECHNICIANS. FAILURE TO TAKE THE PROPER PRECAUTIONS OR TO FOLLOW THE PROPER PROCEDURES COULD RESULT IN ACCIDENTAL, INCOMPLETE, OR IMPROPER AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY. REFER TO DRIVER SIDE AIRBAG TRIM COVER AND HORN SWITCH IN THE REMOVAL AND INSTALLATION SECTION OF GROUP 8M - PASSIVE RESTRAINT SYSTEMS FOR THE SERVICE PROCEDURES.

HORN

(1) Disconnect and isolate the battery negative cable.

(2) Unplug the wire harness connector from the horn (Fig. 3).

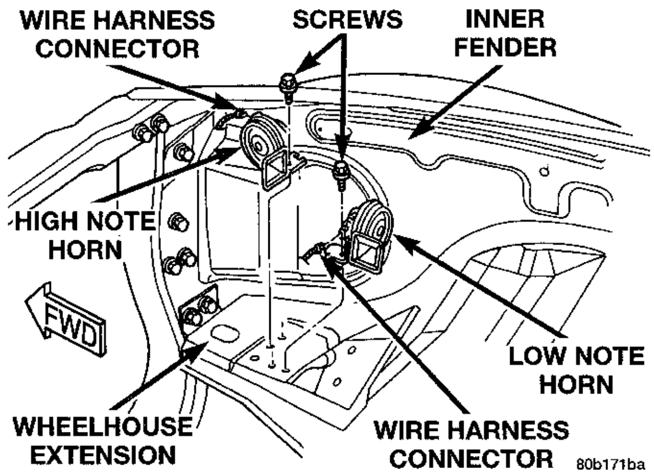


Fig. 3 Horns Remove/Install

(3) Remove the screw that secures the horn mounting bracket to the wheelhouse front extension.

(4) Remove the horn and mounting bracket from the wheelhouse front extension.

(5) Reverse the removal procedures to install. Tighten the mounting screw to 11 N·m (95 in. lbs.).

AUTHENTIC RESTORATION PRODUCT

SPEED CONTROL SYSTEM

CONTENTS

GENERAL INFORMATION

INTRODUCTION

The vehicle speed control system is electronically controlled and vacuum operated. The system is designed to operate between approximately 35 and 85 mph (56 and 137 km/h). Following are general descriptions of the major components in the speed control system. For diagnosis of the entire speed control system, refer to the appropriate Powertrain Diagnostic Procedures service manual and the DRB scan tool. Refer to Group 8W, Wiring Diagrams for complete circuit descriptions and wiring diagrams.

DESCRIPTION AND OPERATION

SPEED CONTROL SERVO

The servo unit consists of a solenoid valve body, a vacuum servo and the mounting bracket. The Powertrain Control Module (PCM) controls the solenoid valve body. The solenoid valve body controls the application and release of vacuum to the diaphragm of the vacuum servo. A cable connects the servo with the throttle linkage. The servo unit cannot be repaired and is serviced only as a complete assembly.

SPEED CONTROL SOLENOID CIRCUITS

When all of the speed control parameters are met, and the SET button is pressed, the PCM actuates the vent solenoid and "duty-cycles" the vacuum solenoid to open the throttle and bring the vehicle up to target speed. When the vehicle is at target speed, it will actuate the vent solenoid with the vacuum solenoid de-activated to maintain the vehicle at target speed. When the vehicle is above target speed, the PCM will "duty-cycle" the vent solenoid with the vacuum solenoid still de-activated to close the throttle to return to target speed.

SPEED CONTROL SWITCHES

Two separate speed control switch modules are mounted on the steering wheel to the left and right side of the driver's airbag module. Within the two switch modules, five **momentary** contact switches, supporting seven different speed control functions are used. The outputs from these switches are filtered into one input. The Powertrain Control Module (PCM) determines which output has been applied through **resistive multiplexing.** The input circuit voltage is measured by the PCM to determine which switch function has been selected.

A speed control indicator lamp, located on the instrument panel cluster is energized by the PCM via the CCD Bus. This occurs when speed control system power has been turned ON, and the engine is running.

The two switch modules are labeled: ON/OFF, SET, RESUME/ACCEL, CANCEL and COAST. Refer to the owner's manual for more information on speed

Mopar AUTHENTIC RESTORATION

DESCRIPTION AND OPERATION (Continued)

control switch functions and setting procedures. The individual switches cannot be repaired. If one individual switch fails, the switch module must be replaced.

STOP LAMP SWITCH

Vehicles equipped with the speed control option use a dual function stop lamp switch. The switch is mounted on the brake pedal mounting bracket under the instrument panel. The PCM monitors the state of the dual function stop lamp switch. Refer to Group 5, Brakes for more information on stop lamp switch service and adjustment procedures.

SERVO CABLE

The speed control servo cable is connected between the speed control vacuum servo diaphragm and the throttle body control linkage. This cable causes the throttle control linkage to open or close the throttle valve in response to movement of the vacuum servo diaphragm.

POWERTRAIN CONTROL MODULE

The speed control electronic control circuitry is integrated into the Powertrain Control Module (PCM). The PCM is located in the engine compartment. The PCM speed control functions are monitored by the On-Board Diagnostics (OBD). All OBD-sensed systems are monitored by the PCM. Each monitored circuit is assigned a Diagnostic Trouble Code (DTC). The PCM will store a DTC in electronic memory for certain failures it detects. See On-Board Diagnostic Test For Speed Control System in this group for more information. The PCM cannot be repaired and must be replaced if faulty.

VACUUM RESERVOIR

Gasoline Powered Engines: A vacuum reservoir is used to supply the vacuum needed to maintain proper speed control operation when engine vacuum drops, such as in climbing a grade while driving. A one-way check valve is used in the vacuum line between the reservoir and the vacuum source. This check valve is used to trap engine vacuum in the reservoir. On certain vehicle applications, this reservoir is shared with the heating/air-conditioning system. The vacuum reservoir cannot be repaired and must be replaced if faulty.

Diesel Powered Engines: A vacuum reservoir is not used if equipped with a diesel powered engine. Instead, an engine driven pump is used to supply vacuum for speed control operation. Refer to Vacuum Pump in Group 9, Engines for information.

VEHICLE SPEED INPUT

The Vehicle Speed Sensor (VSS) is no longer used for any Dodge truck in the 1998 model year.

Vehicle speed and distance covered are measured by the Rear Wheel Speed Sensor. The sensor is mounted to the rear axle. A signal is sent from this sensor to the Controller Antilock Brake (CAB) computer. A signal is then sent from the CAB to the Powertrain Control Module (PCM) to determine vehicle speed and distance covered. The PCM will then determine strategies for speed control system operation.

DIAGNOSIS AND TESTING

ROAD TEST

Perform a vehicle road test to verify reports of speed control system malfunction. The road test should include attention to the speedometer. Speedometer operation should be smooth and without flutter at all speeds.

Flutter in the speedometer indicates a problem which might cause surging in the speed control system. The cause of any speedometer problems should be corrected before proceeding. Refer to Group 8E, Instrument Panel and Gauges for speedometer diagnosis.

If a road test verifies a system problem and the speedometer operates properly, check for:

- A Diagnostic Trouble Code (DTC). If a DTC exists, conduct tests per the Powertrain Diagnostic Procedures service manual.
- A misadjusted brake (stop) lamp switch. This could also cause an intermittent problem.
- Loose, damaged or corroded electrical connections at the servo. Corrosion should be removed from electrical terminals and a light coating of Mopar MultiPurpose Grease, or equivalent, applied.
- Leaking vacuum reservoir.
- Loose or leaking vacuum hoses or connections.
- Defective one-way vacuum check valve.
- Secure attachment of both ends of the speed control servo cable.
- Smooth operation of throttle linkage and throttle body air valve.
- Failed speed control servo. Do the servo vacuum test.

CAUTION: When test probing for voltage or continuity at electrical connectors, care must be taken not to damage connector, terminals or seals. If these components are damaged, intermittent or complete system failure may occur.

AUTHENTIC RESTORATION PRODUCT

DIAGNOSIS AND TESTING (Continued)

ON-BOARD DIAGNOSTIC TEST FOR SPEED CONTROL SYSTEM

The Powertrain Control Module (PCM) monitors critical input and output circuits of the speed control system, making sure they are operational. A Diagnostic Trouble Code (DTC) is assigned to each input and output circuit monitored by the On-Board Diagnostic (OBD) system. Some circuits are checked continuously and some are checked only under certain conditions.

For DTC information, refer to Diagnostic Trouble Codes in Group 25, Emission Control System. This will include a complete list of DTC's including DTC's for the speed control system.

SPEED CONTROL SWITCHES

For complete speed control system diagnosis, refer to the appropriate Powertrain Diagnostic Procedures manual. To test each of the speed control switches only, refer to the following:

WARNING: BEFORE ATTEMPTING TO DIAGNOSE, REMOVE OR INSTALL ANY AIRBAG SYSTEM OR RELATED STEERING WHEEL AND STEERING COLUMN COMPONENTS, YOU MUST FIRST DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE. WAIT 2 MINUTES FOR SYSTEM CAPACITOR TO DISCHARGE BEFORE FURTHER SYSTEM SERVICE. FAILURE TO DO SO COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(1) Disconnect negative battery cable. Wait 2 minutes for airbag system capacitor to discharge.

(2) Remove the two speed control switch modules from steering wheel. Refer to the removal/installation section for procedures.

(3) Check continuity of each individual speed control switch module as shown in chart (Fig. 1). If OK, reinstall switch. If not OK, replace switch module assembly.

STOP LAMP SWITCH

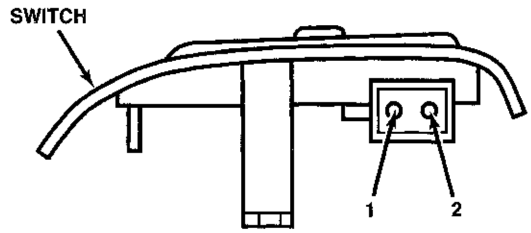
For continuity checks and switch adjustment, refer to Group 5, Brakes.

VACUUM SUPPLY TEST

Gasoline Powered Engines:

On gasoline powered engines: actual engine vacuum, a vacuum reservoir, a one-way check valve and vacuum lines are used to supply vacuum to the speed control servo.

(1) Disconnect vacuum hose at speed control servo and install a vacuum gauge into the disconnected hose.



SWITCH POSITION	RESISTANCE BETWEEN PINS 1 AND 2
ON	909 ohms +/- 9 ohms
SET	6650 ohms +/- 66 ohms
RESUME/ACCEL	15,400 ohms +/- 154 ohms
CANCEL	0 ohms (CLOSED CIRCUIT)
COAST	2940 ohms +/- 29 ohms

80a53490

Fig. 1 Speed Control Switch Continuity (Typical Switch Shown)

(2) Start engine and observe gauge at idle. Vacuum gauge should read at least ten inches of mercury.

(3) If vacuum is less than ten inches of mercury, determine source of leak. Check vacuum line to engine for leaks. Also check actual engine intake manifold vacuum. If manifold vacuum does not meet this requirement, check for poor engine performance and repair as necessary.

(4) If vacuum line to engine is not leaking, check for leak at vacuum reservoir. To locate and gain access to reservoir, refer to Vacuum Reservoir Removal/Installation in this group. Disconnect vacuum line at reservoir and connect a hand-operated vacuum pump to reservoir fitting. Apply vacuum. Reservoir vacuum should not bleed off. If vacuum is being lost, replace reservoir.

(5) Verify operation of one-way check valve and check it for leaks.

(a) Locate one-way check valve. The valve is located in vacuum line between vacuum reservoir and engine vacuum source. Disconnect vacuum hoses (lines) at each end of valve.

(b) Connect a hand-operated vacuum pump to reservoir end of check valve. Apply vacuum. Vacuum should not bleed off. If vacuum is being lost, replace one-way check valve.

(c) Connect a hand-operated vacuum pump to vacuum source end of check valve. Apply vacuum. Vacuum should flow through valve. If vacuum is not flowing, replace one-way check valve. Seal the fitting at opposite end of valve with a finger and

DIAGNOSIS AND TESTING (Continued)

apply vacuum. If vacuum will not hold, diaphragm within check valve has ruptured. Replace valve.

Diesel Powered Engines:

On diesel powered engines: an engine driven vacuum pump, a one-way check valve and vacuum lines are used to supply vacuum to the speed control servo. A vacuum reservoir is not used with diesel engines.

(1) Disconnect vacuum hose at speed control servo and install a vacuum gauge into the disconnected hose.

(2) Start engine and observe gauge at idle. For vacuum testing and vacuum specifications, refer to Vacuum Pump Output—Diesel Engine in Group 9, Engines.

(3) If vacuum pump output is OK, determine other source of leak. Check all vacuum lines to: speed control servo, engine vacuum pump and heating/air conditioning system for leaks.

(4) Verify operation of one-way check valve and check it for leaks.

(a) Locate one-way check valve. The valve is located in vacuum line between speed control servo and engine vacuum pump. Disconnect vacuum hoses (lines) at each end of valve.

(b) Connect a hand-operated vacuum pump to reservoir end of check valve. Apply vacuum. Vacuum should not bleed off. If vacuum is being lost, replace one-way check valve.

(c) Connect a hand-operated vacuum pump to vacuum source end of check valve. Apply vacuum. Vacuum should flow through valve. If vacuum is not flowing, replace one-way check valve. Seal the fitting at opposite end of valve with a finger and apply vacuum. If vacuum will not hold, diaphragm within check valve has ruptured. Replace valve.

SPEED CONTROL SERVO

For complete speed control system diagnosis, refer to the appropriate Powertrain Diagnostic Procedures manual. To test the speed control servo only, refer to the following:

The engine must be started and running for the following voltage tests.

(1) Start engine.

(2) Disconnect 4–way electrical connector at servo. Servo is attached to battery tray (Fig. 2).

(3) Turn speed control switch to ON position.

(4) Check for battery voltage at pin–3 of wiring harness 4–way connector (Fig. 3). This is the 12 volt feed from the stoplamp switch. When the brake pedal is depressed, voltage should not be present at pin–3. If voltage is not present with brake pedal **not** depressed, check for continuity between servo and stop lamp switch. Also check stop lamp switch adjustment. Refer to Group 5, Brakes for procedures.

(5) Connect a small gauge jumper wire between the disconnected servo harness 4–way connector pin–3, and pin–3 on the servo. Check for battery voltage at pins–1, 2 and 4 of the servo. If battery voltage is not at these pins, replace the servo.

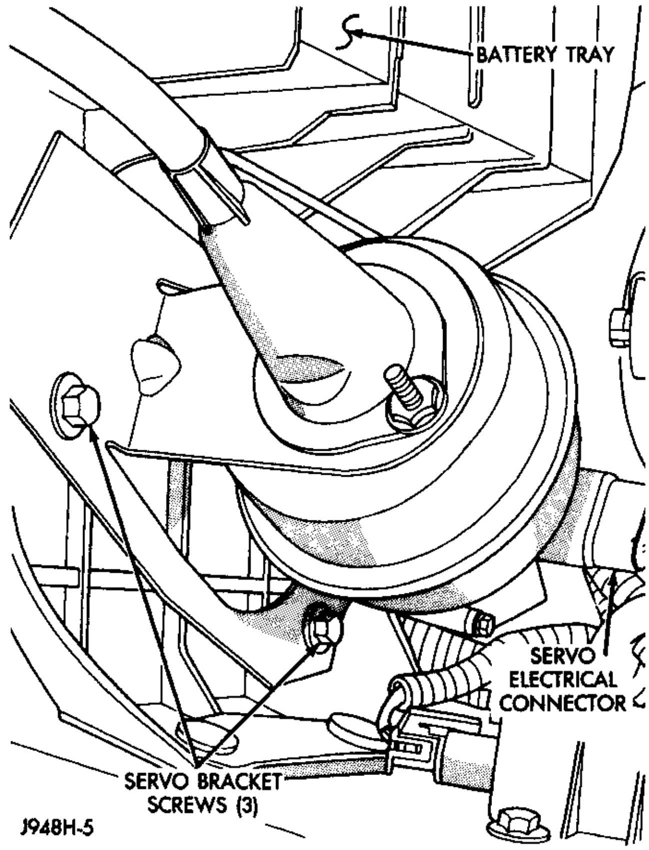


Fig. 2 Speed Control Servo Location

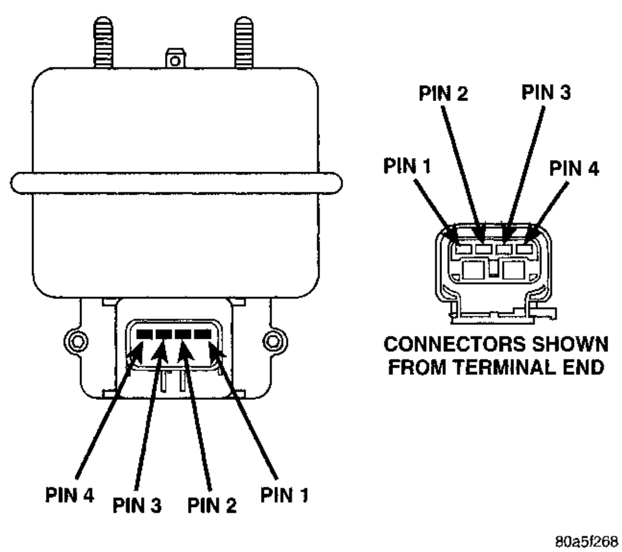


Fig. 3 Servo 4–Way Harness Connector

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DIAGNOSIS AND TESTING (Continued)

(6) Turn ignition switch to OFF position. Check for continuity between disconnected servo harness 4–way connector pin–4 and a good ground. There should be continuity. If not OK, repair open circuit to ground as required.

OVERSHOOT/UNDERSHOOT FOLLOWING SPEED CONTROL SET

If the operator repeatedly presses and releases the set button with their foot off of the accelerator (a "lift foot set" to begin speed control operation), the vehicle may accelerate and exceed the desired set speed by up to 5 MPH (8 km/h) and then decelerate to less than the desired set speed before finally achieving the desired set speed.

The Speed Control has an adaptive strategy that compensates for vehicle-to-vehicle variations in speed control cable lengths. When the speed control is set with the vehicle operators foot off of the accelerator pedal, the speed control thinks there is excessive speed control cable slack and adapts. If the lift foot sets are continually used, the speed control overshoot/undershoot condition will develop.

To "unlearn" the overshoot/undershoot condition, the vehicle operator has to press and release the set button while maintaining the desired set speed with the accelerator pedal (not decelerating or accelerating), and then turn the cruise control switch to the OFF position (or press the CANCEL button if equipped) after waiting 10 seconds. This procedure must be performed approximately 10–15 times to completely unlearn the overshoot/undershoot condition.

REMOVAL AND INSTALLATION

SPEED CONTROL SERVO

V-6/V-8 GAS POWERED ENGINES—REMOVAL

(1) Disconnect negative battery cable at battery.
(2) Disconnect electrical connector at servo (Fig. 4).
(3) Disconnect vacuum hose at servo.
(4) Disconnect servo cable at throttle body. Refer to Servo Cable Removal/Installation in this group.
(5) Remove three bolts retaining servo/servo mounting bracket to side of battery tray (Fig. 5).
(6) Position servo assembly to gain access to 2 servo mounting nuts (Fig. 5) or (Fig. 6).
(7) Remove 2 mounting nuts holding servo cable sleeve to bracket (Fig. 6).
(8) Pull speed control cable sleeve and servo away from servo mounting bracket to expose cable retaining clip (Fig. 6) and remove clip. Note: The servo mounting bracket displayed in (Fig. 6) is a typical bracket and may/may not be applicable to this model vehicle.

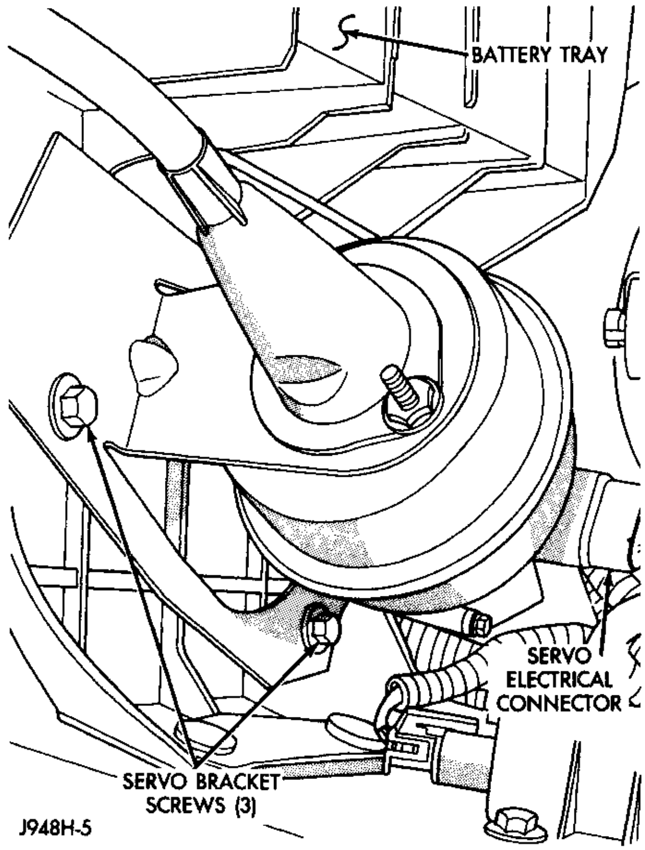

Fig. 4 Servo Location—Removal/Installation

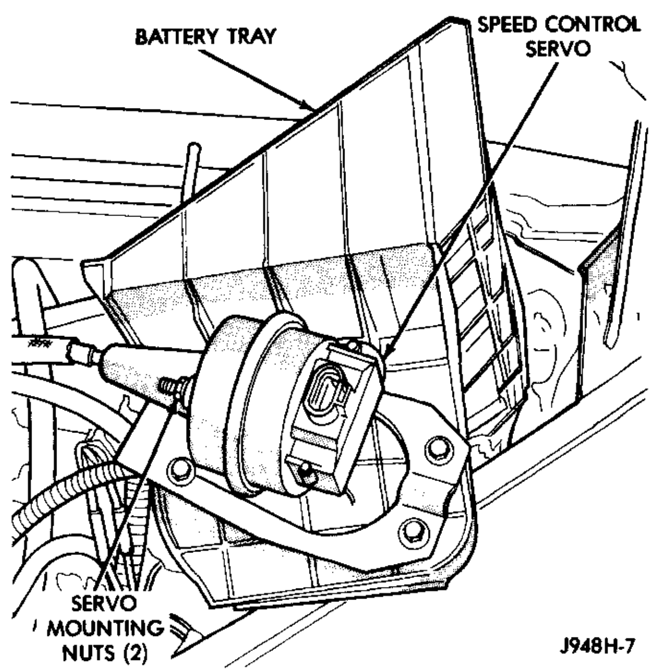

Fig. 5 Servo Mounting at Battery Tray

(9) Remove servo from mounting bracket.

REMOVAL AND INSTALLATION (Continued)

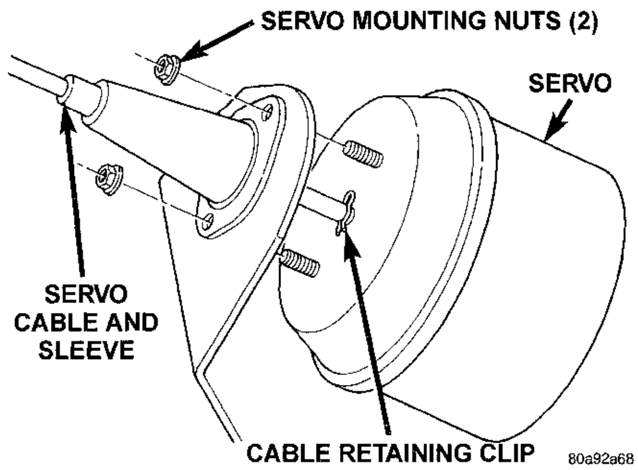

Fig. 6 Servo Cable Clip Remove/Install—Typical

INSTALLATION

(1) Position servo to mounting bracket.

(2) Align hole in cable connector with hole in servo pin. Install cable-to-servo retaining clip.

(3) Insert servo studs through holes in servo mounting bracket.

(4) Insert servo studs through holes in servo cable sleeve.

(5) Install servo mounting nuts and tighten to 8.5 N·m (75 in. lbs.) torque.

(6) Connect vacuum line to servo.

(7) Connect electrical connector to servo terminals.

(8) Install three bolts retaining servo/servo mounting bracket to battery tray.

(9) Connect servo cable to throttle body. Refer to Servo Cable Removal/Installation in this group.

(10) Connect negative battery cable to battery.

(11) Before starting engine, operate accelerator pedal to check for any binding.

8.0L V-10 AND 5.9L DIESEL ENGINE—REMOVAL

(1) Disconnect negative battery cable at battery. Diesel Engines: Disconnect both battery cables, negative cables first.

(2) Remove 2 bolts and battery holddown (Fig. 7).

(3) If equipped, pull up on battery heat shield to remove it (Fig. 8).

(4) Remove battery from vehicle.

(5) From under left front wheel opening, remove 2 forward battery tray nuts (Fig. 9).

(6) Remove 2 nuts and 2 bolts holding battery tray to vehicle (Fig. 10).

(7) Disconnect servo cable at throttle body. Refer to Servo Cable Removal/Installation in this group.

(8) Position battery tray up far enough for access to speed control servo electrical connector and vacuum line.

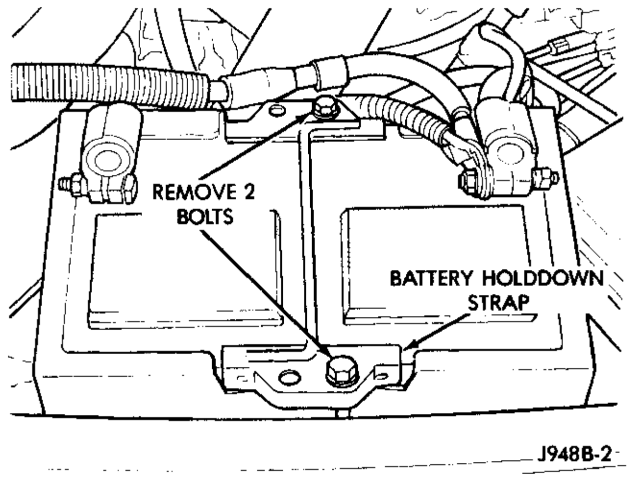

Fig. 7 Battery Holddown

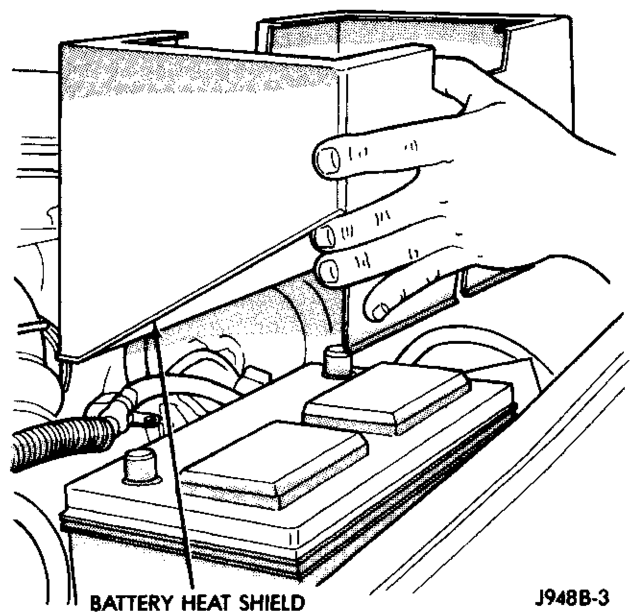

Fig. 8 Battery Heat Shield

(9) Disconnect electrical connector and vacuum line at servo.

(10) Position battery tray with attached servo assembly to gain access to 2 servo mounting nuts (Fig. 5) or (Fig. 6).

(11) Remove 2 mounting nuts holding servo cable sleeve to bracket (Fig. 6).

(12) Pull speed control cable sleeve and servo away from servo mounting bracket to expose cable retaining clip (Fig. 6) and remove clip. Note: The servo mounting bracket displayed in (Fig. 6) is a typical bracket and may/may not be applicable to this model vehicle.

(13) Remove servo from mounting bracket.

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REMOVAL AND INSTALLATION (Continued)

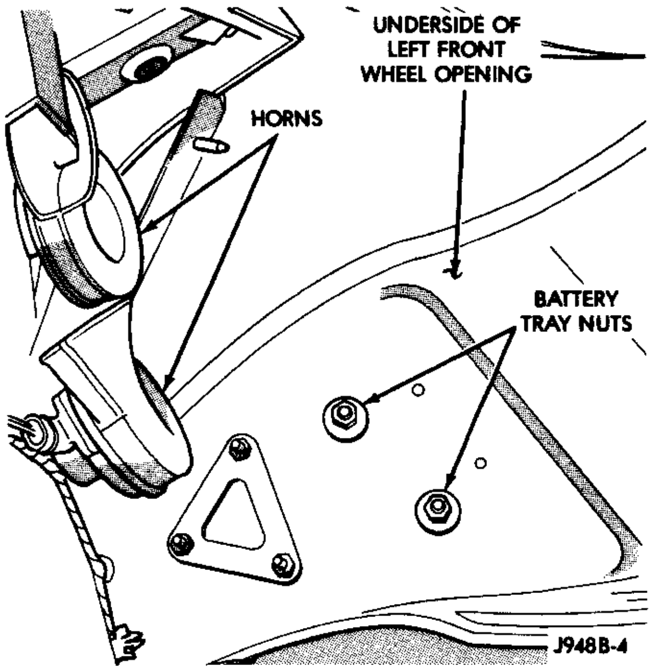


Fig. 9 Forward Battery Tray Nuts

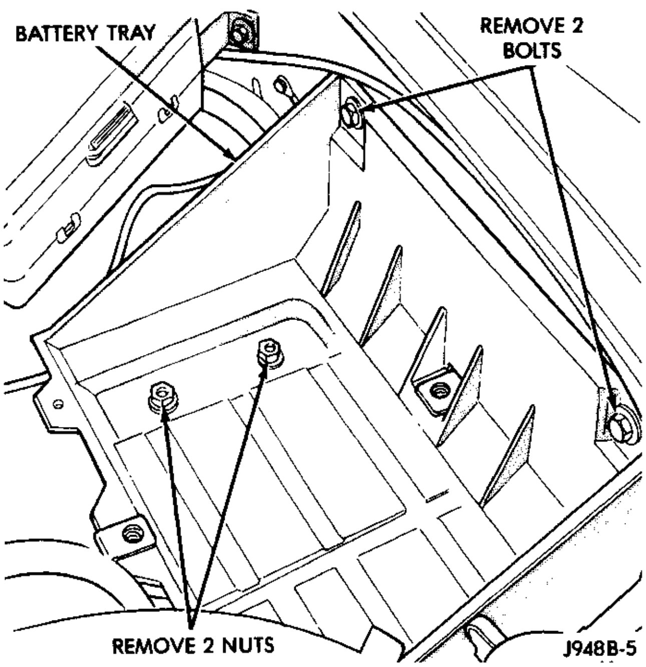


Fig. 10 Battery Tray Mounting

INSTALLATION

(1) Position servo to mounting bracket.

(2) Align hole in cable connector with hole in servo pin. Install cable-to-servo retaining clip.

(3) Insert servo studs through holes in servo mounting bracket.

(4) Insert servo studs through holes in servo cable sleeve.

(5) Install servo mounting nuts and tighten to 8.5 N·m (75 in. lbs.) torque.

(6) Connect vacuum line to servo.

(7) Connect electrical connector to servo terminals.

(8) Connect servo cable to throttle body. Refer to Servo Cable Removal/Installation in this group.

(9) Install battery tray. Tighten all battery tray mounting hardware to 16 N·m (140 in. lbs.) torque.

(10) Position battery into battery tray.

(11) If equipped, install battery heat shield.

(12) Install battery holddown clamp. Tighten bolt to 4 N·m (35 in. lbs.) torque.

(13) Connect negative battery cable(s) to battery(s).

(14) Before starting engine, operate accelerator pedal to check for any binding.

SPEED CONTROL SWITCHES

REMOVAL

WARNING: BEFORE BEGINNING ANY AIRBAG SYSTEM COMPONENT REMOVAL OR INSTALLATION, REMOVE AND ISOLATE THE NEGATIVE (-) CABLE FROM THE BATTERY. THIS IS THE ONLY SURE WAY TO DISABLE THE AIRBAG SYSTEM. THEN WAIT TWO MINUTES FOR SYSTEM CAPACITOR TO DISCHARGE BEFORE FURTHER SYSTEM SERVICE. FAILURE TO DO THIS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE INJURY.

(1) Disconnect and isolate negative battery cable.

(2) Remove airbag module. Refer to Group 8M, Passive Restraint Systems for procedures.

(3) Remove switch-to-steering wheel mounting screws (Fig. 11).

(4) Remove switch.

(5) Remove electrical connector at switch.

INSTALLATION

(1) Install electrical connector to switch.

(2) Install switch and mounting screws.

(3) Tighten screws to 1.5 N·m (14 in. lbs.) torque.

(4) Install airbag module. Refer to Group 8M, Passive Restraint Systems for procedures.

(5) Connect negative battery cable.

STOP LAMP SWITCH

Refer to Stop Lamp Switch in Group 5, Brakes for removal/installation and adjustment procedures.

REMOVAL AND INSTALLATION (Continued)

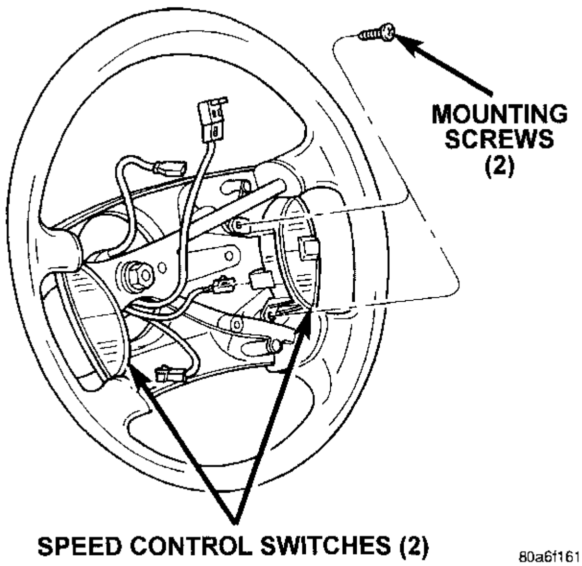


Fig. 11 Speed Control Switches

SERVO CABLE

REMOVAL

(1) Disconnect negative battery cable at battery. Diesel Engine: Remove both negative battery cables at both batteries.

(2) Remove air cleaner (all except V-10 and diesel engine).

(3) Using finger pressure only, remove speed control cable connector at bellcrank by pushing connector off the bellcrank pin (Fig. 12), (Fig. 13) or (Fig. 14). DO NOT try to pull connector off perpendicular to the bellcrank pin. Connector will be broken.

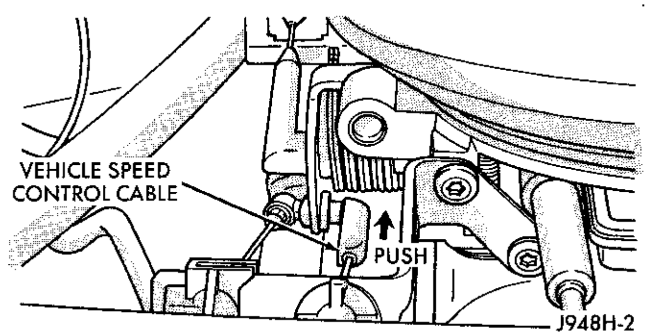


Fig. 12 Servo Cable at Throttle Body—V-6/V-8 Engine

(4) Squeeze 2 tabs on sides of speed control cable at throttle body mounting bracket (locking plate) and push out of bracket.

(5) Remove servo cable from servo. Refer to Speed Control Servo Removal/Installation in this group.

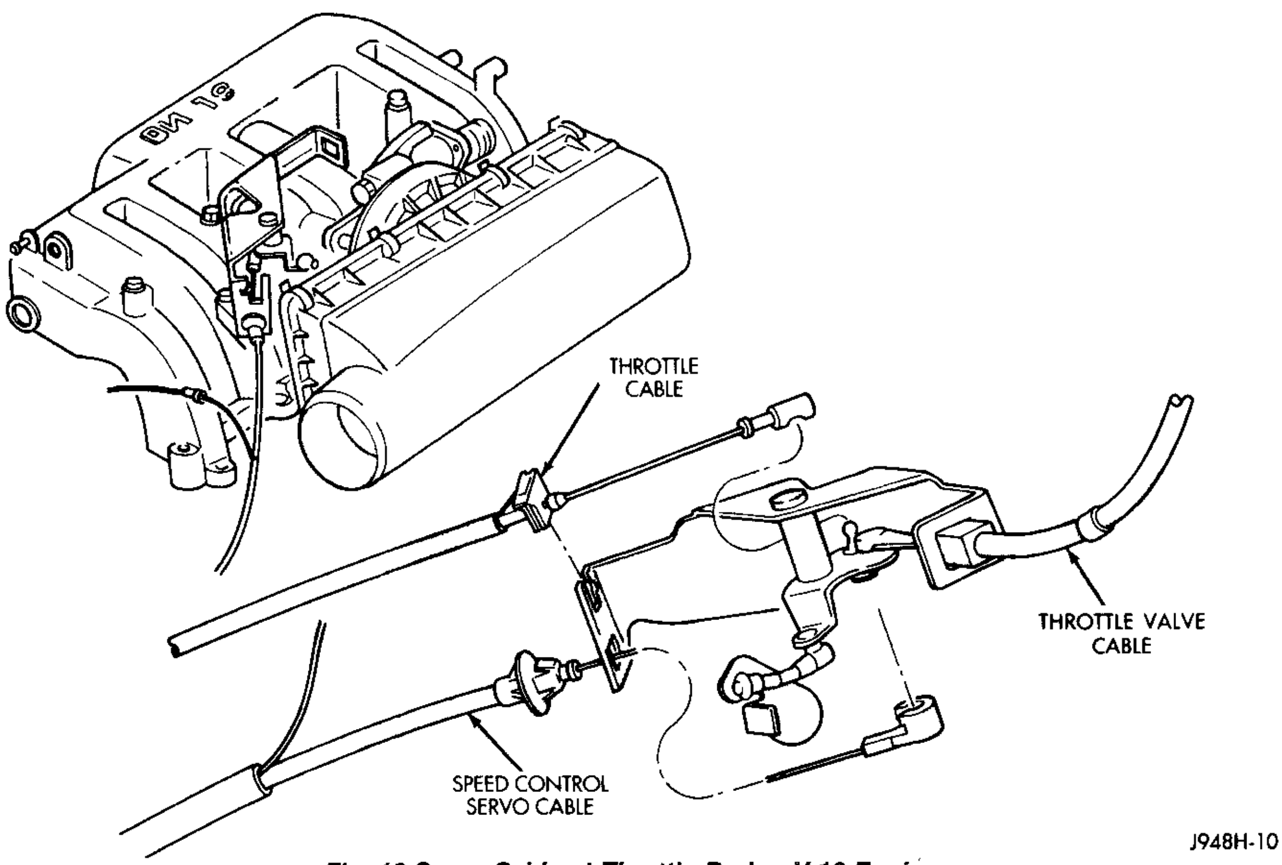


Fig. 13 Servo Cable at Throttle Body—V-10 Engine

REMOVAL AND INSTALLATION (Continued)

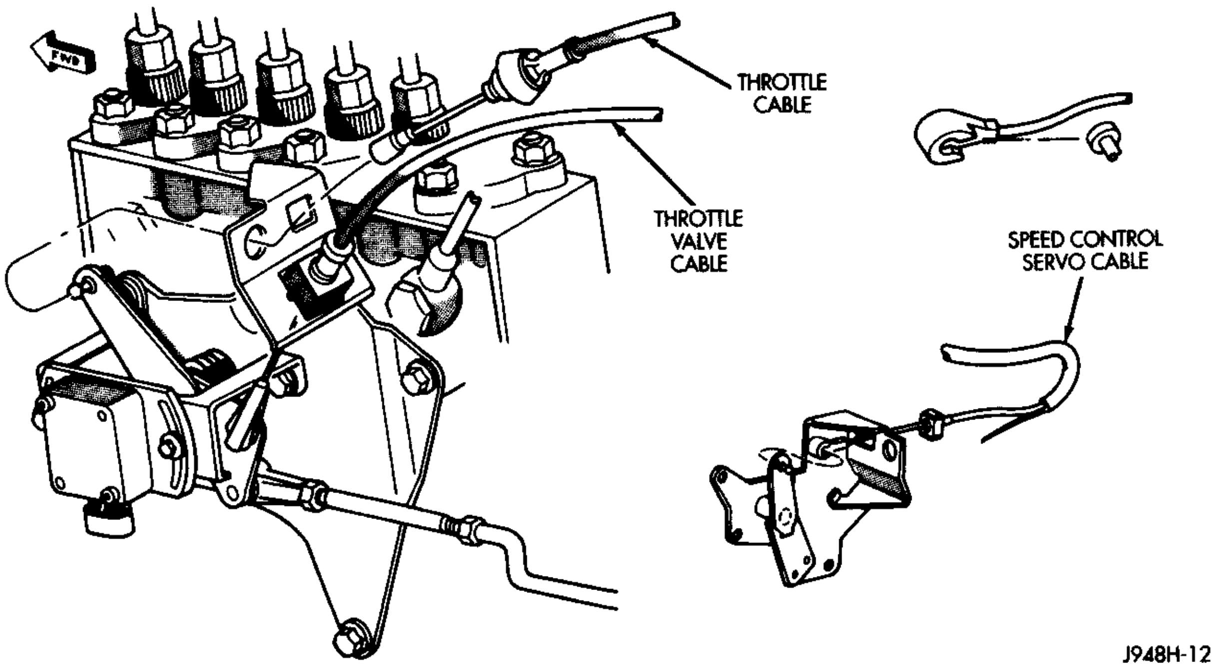


Fig. 14 Servo Cable—Diesel Engine

INSTALLATION

(1) Install end of cable to speed control servo. Refer to Speed Control Servo Removal/Installation.

(2) Install cable into throttle body mounting bracket (injection pump bracket on diesel engine). Cable snaps into bracket.

(3) Install speed control cable connector at throttle body bellcrank pin (injection pump bellcrank pin on diesel engine). Connector snaps onto pin.

(4) Connect negative battery cable(s) to battery(s).

(5) Before starting engine, operate accelerator pedal to check for any binding.

VACUUM RESERVOIR

The vacuum reservoir is located under the plastic cowel plenum cover at lower base of windshield. The vacuum reservoir is not used if equipped with a diesel engine.

REMOVAL

(1) Disconnect and isolate battery negative cable.

(2) Remove both windshield wiper arm/blade assemblies. Refer to Group 8K, Wiper and Washer Systems.

(3) Remove rubber weather-strip at front edge of cowel grill (Fig. 15).

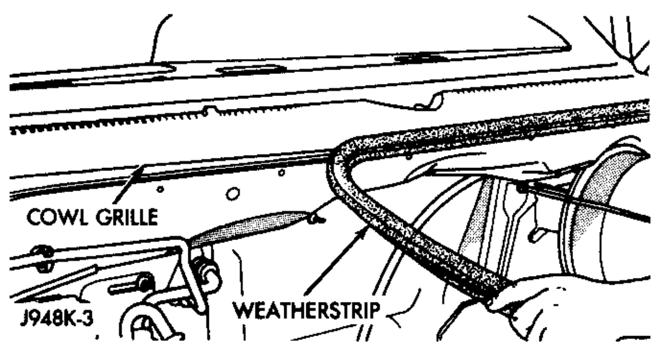


Fig. 15 Cowel Grille Panel Weather-strip

REMOVAL AND INSTALLATION (Continued)

(4) Release cowel grill plastic anchor screws (Fig. 16).

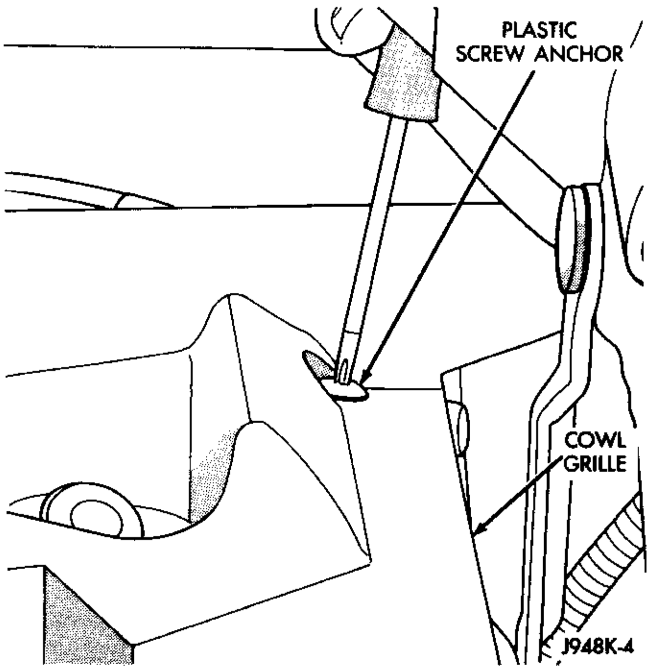


Fig. 16 Plastic Anchor Screws Remove/Install

(5) Lift cowel plenum cover/grille panel from vehicle far enough to access vacuum reservoir.

(6) Disconnect vacuum supply line from vacuum reservoir (Fig. 17).

(7) Remove 2 vacuum reservoir mounting screws.

(8) Remove vacuum reservoir from vehicle.

INSTALLATION

(1) Install vacuum reservoir and two mounting screws. Tighten screws to 2.2 N·m (20 in. lbs.) torque.

(2) Connect vacuum supply hose to vacuum reservoir.

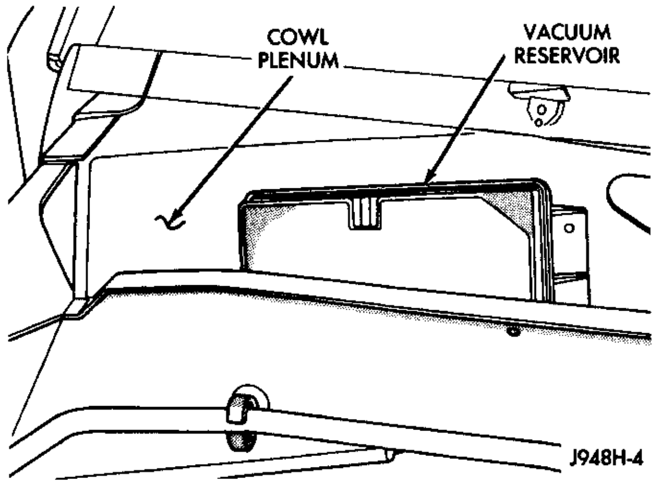


Fig. 17 Vacuum Reservoir Remove/Install

(3) Position cowel plenum cover/grille panel to vehicle.

(4) Install and tighten cowel cover fasteners to vehicle body.

(5) Install rubber weather-strip at front edge of cowel grill.

(6) Install windshield wiper arms. Refer to Group 8K, Wiper and Washer Systems.

(7) Connect negative battery to cable.

SPECIFICATIONS

TORQUE CHART

Description	Torque
Servo Mounting Bracket Nuts	8.5 N·m (75 in. lbs.)
Switch Module Mounting Screws	1.5 N·m (15 in. lbs.)
Vacuum Reservoir Mounting Screws	2.2 N·m (20 in. lbs.)

Mopar AUTHENTIC RESTORATION PRODUCT

TURN SIGNAL AND HAZARD WARNING SYSTEMS

CONTENTS

GENERAL INFORMATION

INTRODUCTION

Turn signal and hazard warning systems are standard factory-installed equipment on this model. Refer to 8W-52 - Turn Signals in Group 8W - Wiring Diagrams for complete circuit descriptions and diagrams.

TURN SIGNAL SYSTEM

With the ignition switch in the On or Accessory position, and the multi-function switch control lever moved up (right turn) or down (left turn), the turn signal system is activated. The switch has a detent position in each direction that provides turn signals with automatic cancellation, and an intermediate momentary position in each direction that provides turn signals only until the multi-function switch lever is released.

When the turn signal switch is in a detent position, it is turned off by one of two cancelling cam lobes molded into the hub of the clockspring mechanism. When turning the steering wheel causes one of the cam lobes to contact a cancel actuator in the multi-function switch, the turn signal switch automatically returns to the off position. When the turn signal system is activated, the selected (right or left) turn signal indicator lamp, front park/turn signal lamp, and rear tail/stop/turn signal lamp bulbs will flash.

Following are general descriptions of the major components in the turn signal system. Refer to the owner's manual in the vehicle glove box for more information on the features, use and operation of the turn signal system.

HAZARD WARNING SYSTEM

The hazard warning system is activated by a switch button in the multi-function switch. The button is located on the top of the steering column between the steering wheel and the instrument panel. The hazard warning switch button is identified with a double triangle.

The hazard warning system is connected to a non-switched battery feed so that the system remains functional, regardless of the ignition switch position. Push the switch button in to activate the hazard warning system, and push in on the button again to turn the system off. When the hazard warning system is activated, the right and left turn signal indicators, front park/turn signal lamps, and rear tail/stop/turn signal lamps will flash.

Following are general descriptions of the major components in the hazard warning system. Refer to the owner's manual in the vehicle glove box for more information on the features, use and operation of the hazard warning system.

DESCRIPTION AND OPERATION

COMBINATION FLASHER

The combination flasher is a smart relay that functions as both the turn signal system and hazard warning system flasher. The combination flasher contains active electronic Integrated Circuitry (IC) elements. This flasher is designed to handle the current flow requirements of the factory-installed lighting. If supplemental lighting is added to the turn signal lamp circuits, such as when towing a trailer with lights, the combination flasher will automatically try to compensate to keep the flash rate the same.

DESCRIPTION AND OPERATION (Continued)

While the combination flasher has a International Standards Organization (ISO)-type relay terminal configuration or footprint, the internal circuitry is much different. The combination flasher does not use standard ISO-relay inputs or provide ISO-relay type outputs or functions. The combination flasher should never be substituted for an ISO-relay or replaced with an ISO-relay, or else component and vehicle damage may occur.

The combination flasher has five blade-type terminals intended for the following inputs and outputs: Battery B+, Ignition B+, Ground, Turn Signal circuit, and Hazard Warning circuit. Constant battery voltage and ground are supplied to the flasher so that it can perform the hazard warning function, and ignition switched battery voltage is supplied for the turn signal function. Refer to 8W-52 - Turn Signals in Group 8W - Wiring Diagrams for complete circuit descriptions, diagrams and terminal function identification.

The IC within the combination flasher (Fig. 1) contains the logic that controls the flasher operation and the flash rate. Pin 6 of the IC receives a sense voltage from the hazard warning portion of the multi-function switch. When the hazard switch is turned on, the "hazard on sense" voltage will become low due to the circuit being grounded through the turn signal bulbs. This low voltage sense signals the IC to energize the flash control Positive-Negative-Positive (PNP) transistor at a pre-calibrated flash rate or frequency. Each time the PNP transistor energizes the hazard warning circuit, the pin 6 "hazard on sense" voltage will become high and the IC signals the PNP transistor to de-energize the circuit. This cycling will continue until the hazard warning switch is turned off.

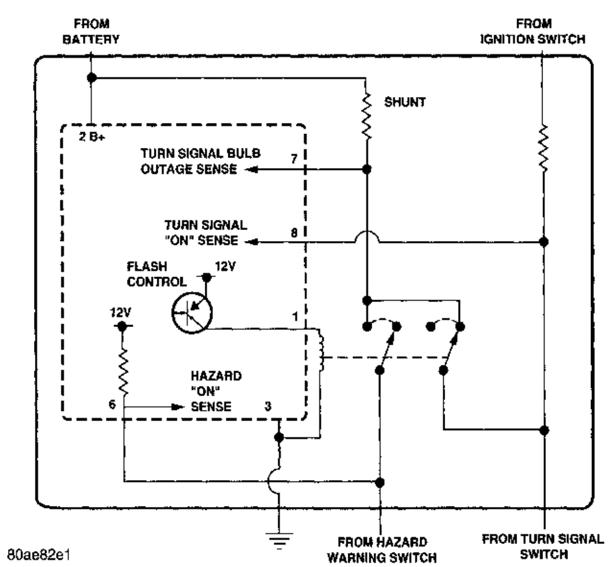


Fig. 1 Combination Flasher - Typical

Likewise, pin 8 of the IC receives a sense voltage from the turn signal portion of the multi-function switch. When the left or right turn signal is turned on, the "turn signal on sense" voltage will become low due to the circuit being grounded through the turn signal bulbs. This low voltage sense signals the IC to energize the flash control PNP transistor at a pre-calibrated flash rate or frequency. Each time the PNP transistor energizes the turn signal circuit, the pin 8 "turn signal on sense" voltage will become high and the IC signals the PNP transistor to de-energize the circuit. This cycling will continue until the right or left turn signal is turned off.

A special design feature of the combination flasher allows it to "sense" that a turn signal circuit or bulb is not operating, and provide the driver an indication of the condition by flashing the remaining bulbs in the affected circuit at a higher rate (120 flashes-per-minute or higher). Conventional flashers either continue flashing at their typical rate (heavy-duty type), or discontinue flashing the affected circuit entirely (standard-duty type). During turn signal operation, the combination flasher IC compares normal battery voltage input on pin 2 with the shunt resistor voltage input on pin 7. If the IC "senses" that the voltage difference between pin 2 and pin 7 is different than the pre-calibrated value of the IC, it will increase the rate at which it signals the PNP transistor to energize the pin 1 output. Thus, the inoperative half (left or right side) of the turn signal circuit will flash faster.

Because of the active electronic elements within the combination flasher, it cannot be tested with conventional automotive electrical test equipment. If the combination flasher is believed to be faulty, test the turn signal and hazard warning system circuits as described in this group. Then replace the combination flasher with a known good unit to confirm system operation.

The combination flasher cannot be repaired and, if faulty or damaged, it must be replaced.

TURN SIGNAL SWITCH AND HAZARD WARNING SWITCH

The turn signal and hazard warning switches are contained in the multi-function switch assembly (Fig. 2). The multi-function switch assembly is secured to the left side of the steering column. A switch stalk that extends from the left side of the steering column is moved up or down to activate the right or left turn signals, respectively. A latching push-button that extends upward from the multi-function switch and through the top of the upper steering column shroud is used to control the hazard warning system.

The multi-function switch contains circuitry for the following functions:

DESCRIPTION AND OPERATION (Continued)

- Turn signals
- Hazard warning
- Headlamp beam selection
- Headlamp optical horn
- Windshield wipers
- Windshield washers.

The information contained in this group addresses only the switch functions for the turn signal and hazard warning systems. For information relative to the other switch functions, refer to the proper group. However, the multi-function switch cannot be repaired. If any function of the multi-function switch is faulty, or if the switch is damaged, the entire switch assembly must be replaced.

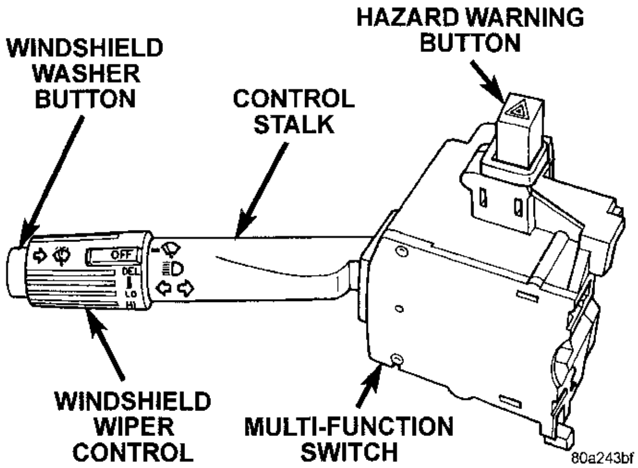


Fig. 2 Multi-Function Switch

TURN SIGNAL INDICATOR LAMP

The turn signal indicator lamps are located in the instrument cluster. They flash with the exterior turn signal lamps to give the driver a visual indication that a turn signal or the hazard warning system is operating. Refer to Turn Signal Indicator Lamp in Group 8E - Instrument Panel Systems for diagnosis or service of these lamps.

TURN SIGNAL LAMP

The exterior lamps in the turn signal and hazard warning circuits include the front park/turn signal, and the rear tail/stop/turn signal. Refer to Exterior Lamps in Group 8L - Lamps for diagnosis and service of the turn signal lamps.

DIAGNOSIS AND TESTING

INTRODUCTION

When diagnosing the turn signal or hazard warning circuits, remember that high generator output can burn out bulbs rapidly and repeatedly. If this is a problem on the vehicle being diagnosed, refer to Group 8C - Charging System for further diagnosis of a possible generator overcharging condition.

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

TURN SIGNAL AND HAZARD WARNING SYSTEMS

For circuit descriptions and diagrams, refer to 8W-52 - Turn Signals in Group 8W - Wiring Diagrams.

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

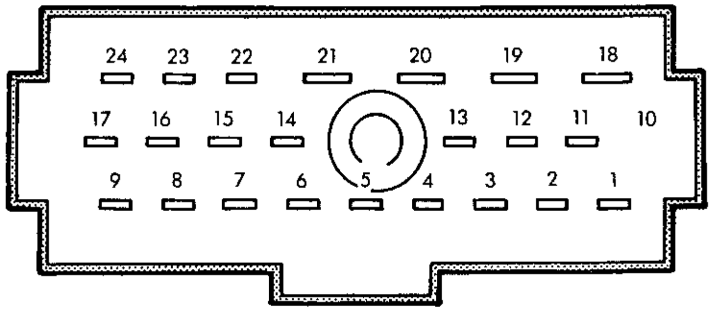
(1) Turn the ignition switch to the On position. Actuate the turn signal lever or the hazard warning button. Observe the turn signal indicator lamp(s) in the instrument cluster. If the flash rate is very high, check for a turn signal bulb that is not lit or is very dimly lit. Repair the circuits to that lamp or replace the faulty bulb, as required. Test the operation of the turn signal and hazard warning systems again. If the turn signal indicator(s) fail to light, go to Step 2.

(2) Turn the ignition switch to the Off position. Check the turn signal fuse in the junction block and/or the hazard warning fuse in the Power Distribution Center (PDC). If OK, go to Step 3. If not OK, repair the shorted circuit or component as required and replace the faulty fuse(s).

(3) Turn the ignition switch to the On position to check for battery voltage at the turn signal fuse in the junction block; or, leave the ignition switch in the Off position to check for battery voltage at the hazard warning fuse in the PDC. If OK, go to Step 4. If not OK, repair the open circuit as required.

(4) Turn the ignition switch to the Off position. Disconnect and isolate the battery negative cable. Unplug the combination flasher from the junction block and replace it with a known good unit. Connect the battery negative cable. Test the operation of the turn signal and hazard warning systems. If OK, dis-

DIAGNOSIS AND TESTING (Continued)



VIEW FROM TERMINAL CASE

SWITCH POSITIONS		
TURN SIGNAL	HAZARD WARNING	CONTINUITY BETWEEN
NEUTRAL	OFF	12 AND 14 AND 15
LEFT	OFF	15 AND 16 AND 17
LEFT	OFF	12 AND 14
LEFT	OFF	22 AND 23 WITH OPTIONAL CORNER LAMPS
RIGHT	OFF	11 AND 12 AND 17
RIGHT	OFF	14 AND 15
RIGHT	OFF	23 AND 24 WITH OPTIONAL CORNER LAMPS
NEUTRAL	ON	11 AND 12 AND 13 AND 15 AND 16

908J-4

Fig. 3 Multi-Function Switch Continuity

card the faulty combination flasher. If not OK, remove the test flasher and go to Step 5.

(5) Turn the ignition switch to the On position. Check for battery voltage at the fused ignition switch output circuit cavity for the combination flasher in the junction block. If OK, go to Step 6. If not OK, repair the open circuit to the turn signal fuse as required.

(6) Turn the ignition switch to the Off position. Check for battery voltage at the fused B(+) circuit cavity for the combination flasher in the junction block. If OK, go to Step 7. If not OK, repair the open circuit to the hazard warning fuse as required.

(7) Disconnect and isolate the battery negative cable. Check for continuity between the ground circuit cavity for the combination flasher in the junction block and a good ground. There should be continuity. If OK, go to Step 8. If not OK, repair the circuit to ground as required.

(8) Unplug the multi-function switch wire harness connector as described in this group. Check for continuity between the combination flasher hazard signal circuit cavities in the junction block and in the multi-function switch wire harness connector. There should be continuity. If OK, go to Step 9. If not OK, repair the open circuit as required.

(9) Check for continuity between the combination flasher turn signal circuit cavities in the junction block and in the multi-function switch wire harness connector. There should be continuity. If OK, test the multi-function switch as described in this group. If not OK, repair the open circuit as required.

MULTI-FUNCTION SWITCH

Perform the diagnosis of the hazard warning and/or turn signal systems as described in this group before testing the multi-function switch. For circuit descriptions and diagrams, refer to 8W-52 - Turn Signals in Group 8W - Wiring Diagrams.

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(1) Disconnect and isolate the battery negative cable. Unplug the multi-function switch wire harness connector.

(2) Using an ohmmeter, perform the switch continuity checks at the switch terminals as shown in the Multi-Function Switch Continuity chart (Fig. 3).

DIAGNOSIS AND TESTING (Continued)

(3) If the switch fails any of the continuity checks, replace the faulty switch. If the switch is OK, repair the lighting circuits as required.

REMOVAL AND INSTALLATION

COMBINATION FLASHER

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(1) Disconnect and isolate the battery negative cable.
(2) Remove the fuse access panel by unsnapping it from the left end of the instrument panel (Fig. 4).

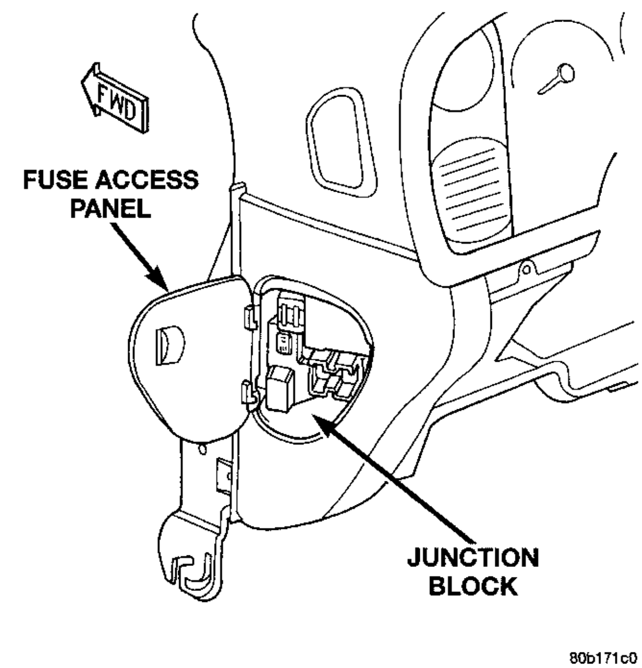


Fig. 4 Junction Block

(3) Unplug the combination flasher from the junction block.
(4) Install the combination flasher by aligning the flasher terminals with the cavities in the junction block and pushing the flasher firmly into place.
(5) Connect the battery negative cable.
(6) Test the flasher operation.
(7) Reinstall the fuse access panel.

MULTI-FUNCTION SWITCH

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(1) Disconnect and isolate the battery negative cable.
(2) If the vehicle is so equipped, remove the tilt steering column lever.
(3) Remove both the upper and lower shrouds from the steering column (Fig. 5).

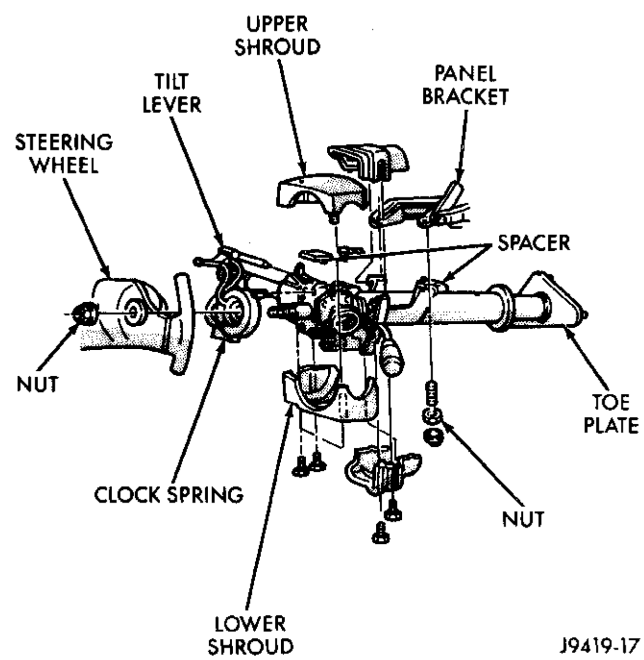


Fig. 5 Steering Column Shrouds Remove/Install - Typical

(4) Remove the lower fixed column shroud.
(5) Move the upper fixed column shroud far enough to access the rear of the multi-function switch (Fig. 6).
(6) Remove the tamper proof mounting screws (a Snap On tamper proof torx bit TTXR20B2 or equivalent is required) that secure the multi-function switch to the steering column.
(7) Gently pull the switch away from the steering column far enough to access and remove the multi-function switch wire harness connector screw.

REMOVAL AND INSTALLATION (Continued)

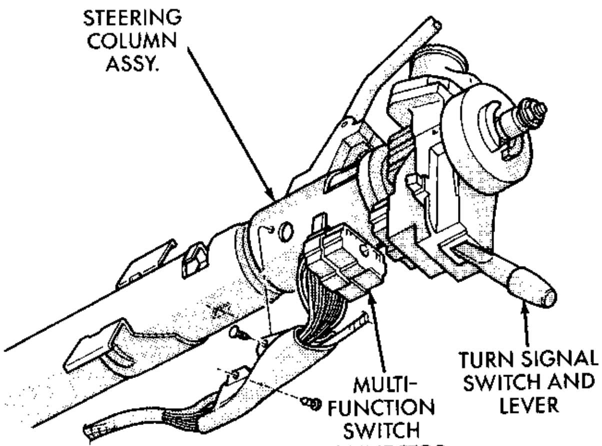


Fig. 6 Multi-Function Switch Connector - Typical

(8) Unplug the wire harness connector from the multi-function switch.

(9) Reverse the removal procedures to install. Tighten the fasteners as follows:

- Multi-function switch wire harness connector screw - 2 N·m (17 in. lbs.)
- Multi-function switch mounting screws - 2 N·m (17 in. lbs.).

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WIPER AND WASHER SYSTEMS

CONTENTS

GENERAL INFORMATION

INTRODUCTION

Windshield wiper and washer systems are standard factory-installed equipment on this model. Refer to 8W-53 - Wipers in Group 8W - Wiring Diagrams for complete circuit descriptions and diagrams.

WINDSHIELD WIPER SYSTEM

An intermittent windshield wiper system is standard equipment on this model. The intermittent wiper system lets the driver select from either of two wiper speeds, low or high, or the intermittent wipe delay mode. A knob on the end of the multi-function switch stalk is rotated to select the desired wiper speed, or the intermittent wipe delay mode and interval.

On models equipped with a base version of the CTM, the intermittent wipe mode delay times are driver adjustable from about one-half second to about eighteen seconds. On models equipped with a high-line version of the CTM, the intermittent wipe mode delay times are speed sensitive. Above about sixteen kilometers-per-hour (ten miles-per-hour) the delay is driver adjustable from about one-half second to about eighteen seconds. Below about sixteen kilometers-per-hour (ten miles-per-hour) the high-line CTM doubles the delay time, or provides delays of about one second to about thirty-six seconds. The intermittent wipe mode is provided by delay logic and relay control circuitry contained within the Central Timer Module (CTM), and an intermittent wipe relay.

The windshield wipers will operate only when the ignition switch is in the Accessory or On positions. A fuse located in the junction block protects the circuitry of the windshield wiper system.

Following are general descriptions of the major components in the windshield wiper system. Refer to the owner's manual in the vehicle glove box for more information on the features, use and operation of the windshield wiper system.

WINDSHIELD WASHER SYSTEM

An electrically operated windshield washer system is standard equipment. A knob on the end of the multi-function switch stalk is depressed toward the steering column to activate the washer system. A washer reservoir in the engine compartment holds the washer fluid, which is pressurized by a pump when the windshield washer switch is actuated. The windshield washer pump feeds the pressurized washer fluid through the washer system plumbing to the windshield washer nozzles.

An optional equipment low washer fluid warning lamp in the instrument cluster will warn the driver when the washer fluid level needs to be checked. Refer to Low Washer Fluid Warning Lamp in Group 8E - Instrument Panel Systems for more information on this feature.

The washers will operate only when the ignition switch is in the Accessory or On positions. A fuse

GENERAL INFORMATION (Continued)

located in the junction block protects the circuitry of the washer system.

Following are general descriptions of the major components in the windshield washer system. Refer to the owner's manual in the vehicle glove box for more information on the features, use and operation of the windshield washer system.

DESCRIPTION AND OPERATION

WIPER ARM AND BLADE

All Ram truck models have two 50.8-centimeter (20-inch) windshield wiper blades with non-replaceable rubber elements (squeegees). These wiper blades include an anti-lift feature. The wiper blades and squeegees must be oriented correctly when installed on the wiper arms for the anti-lift feature to be effective. See Wiper Blade in the Removal and Installation section of this group for more information.

Caution should be exercised to protect the rubber squeegees from any petroleum-based cleaners or contaminants, which will rapidly deteriorate the rubber. If the squeegees are damaged, worn, or contaminated, the entire wiper blade assembly must be replaced.

Wiper squeegees exposed to the elements for a long time tend to lose their wiping effectiveness. Periodic cleaning of the squeegees is suggested to remove deposits of salt and road film. The wiper blades, arms, and windshield should be cleaned with a sponge or cloth and windshield washer fluid, a mild detergent, or a non-abrasive cleaner. If the squeegees continue to streak or smear, the wiper blades should be replaced.

The blades are mounted to spring-loaded wiper arms. The spring tension of the wiper arms controls the pressure applied to the blades on the glass. The windshield wiper arms are secured by an integral latch to the two wiper pivots on the cowl plenum cover/grille panel at the base of the windshield.

The wiper arms and blades cannot be adjusted or repaired. If faulty or damaged, they must be replaced.

WIPER LINKAGE AND PIVOT

The wiper linkage and pivot module is secured with four screws through four rubber grommet-type insulators to the cowl plenum panel beneath the cowl plenum cover/grille panel. The wiper motor is secured with screws to the center of the linkage and pivot module bracket, and the wiper pivots are secured to the ends of the module bracket.

The two wiper pivot crank arms and the wiper motor crank arm each have ball studs on their ends. The motor crank arm ball stud is the longer of the three. Two drive links connect the motor crank arm to the pivot crank arms.

The passenger side drive link has a plastic socket-type bushing on each end. The driver side drive link has a plastic socket-type bushing on one end, and a plastic sleeve-type bushing on the other end. The socket-type bushing on one end of each drive link is snap-fit over the ball stud on the crank arm of its respective pivot. The driver side drive link sleeve-type bushing end is then fit over the motor crank arm ball stud, and the second socket-type bushing of the passenger side drive link is snap-fit over the exposed end of the motor crank arm ball stud.

The wiper linkage, pivots, bushings, mounting bracket, and motor are only serviced as a complete unit. If any part of this assembly is faulty or damaged, the entire wiper module must be replaced.

WIPER MOTOR

The two-speed permanent magnet wiper motor has an integral transmission and park switch. The motor also contains an internal automatic resetting circuit breaker to protect the motor from overloads.

The motor is secured to the wiper linkage and pivot module bracket with three screws. The wiper motor output shaft passes through a hole in the module bracket, where a nut secures the wiper motor crank arm to the motor output shaft.

Wiper speed is controlled by current flow to the proper set of brushes. The wiper motor completes its wipe cycle when the windshield wiper switch on the end of the multi-function switch stalk is turned to the Off position, and parks the blades in the lowest portion of the wipe pattern.

The windshield wiper linkage, pivots, bushings, mounting bracket, and motor are only serviced as a complete unit. If any part of this unit is faulty or damaged, the entire wiper module must be replaced.

WIPER SWITCH AND WASHER SWITCH

The windshield wiper and washer switches are contained in the multi-function switch assembly (Fig. 1). The multi-function switch assembly is secured to the left side of the steering column. A knob on the end of the multi-function switch stalk is rotated to select the desired wiper speed or intermittent wipe delay, or depressed toward the steering column to activate the washer system.

The multi-function switch contains circuitry for the following functions:

- Turn signals
- Hazard warning
- Headlamp beam selection
- Headlamp optical horn
- Windshield wipers
- Windshield washers.

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DESCRIPTION AND OPERATION (Continued)

The information contained in this group addresses only the switch functions for the windshield wiper and washer systems. For information relative to the other switch functions, refer to the proper group. However, the multi-function switch cannot be repaired. If any function of the multi-function switch is faulty, or if the switch is damaged, the entire switch assembly must be replaced.

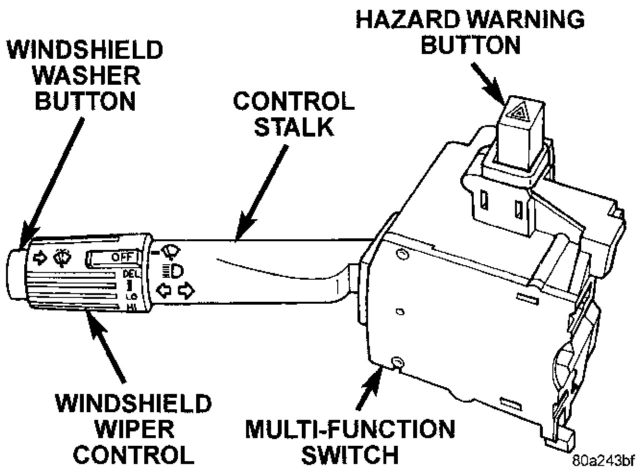

Fig. 1 Multi-Function Switch

CENTRAL TIMER MODULE

Two versions of the Central Timer Module (CTM) are available on this vehicle, a base version and a high-line version. The base version of the CTM is used on base models of the vehicle. It is also sometimes referred to as the Integrated Electronic Module (IEM). The base version of the CTM combines the functions of a chime/buzzer module, an intermittent wipe module, and an ignition lamp time delay relay in a single unit.

The high-line version of the CTM is used on high-line vehicles. The high-line CTM provides all of the functions of the base version CTM, but also is used to control and integrate many of the additional electronic functions and features included on the high-line models. The high-line version of the CTM contains a central processing unit and interfaces with other modules in the vehicle on the Chrysler Collision Detection (CCD) data bus network.

The CCD data bus network allows the sharing of sensor information. This helps to reduce wire harness complexity, reduce internal controller hardware, and reduce component sensor current loads. At the same time, this system provides increased reliability, enhanced diagnostics, and allows the addition of many new feature capabilities.

Both the base and the high-line versions of the CTM support the intermittent wipe and wipe-after-wash features, but only the high-line CTM supports the speed sensitive intermittent wipe. The intermittent wipe relay is one of the outputs that both the base and the high-line versions of the CTM can control. Each CTM is programmed to energize or de-energize the intermittent wipe relay in response to certain inputs from the windshield wiper and washer switches and from the windshield wiper motor park switch.

For the speed sensitive intermittent wipe feature, the high-line CTM also uses vehicle speed messages, which are received on the CCD data bus from the Powertrain Control Module (PCM). Refer to Group 14 - Fuel Systems for more information on the PCM and the PCM inputs.

Both versions of the CTM are mounted under the driver side end of the instrument panel, inboard of the instrument panel steering column opening. Refer to Central Timer Module in the Removal and Installation section of Group 8E - Instrument Panel Systems for the service procedures.

See Wiper System in the Diagnosis and Testing section of this group for diagnosis of the base version of the CTM. For diagnosis of the high-line version of the CTM or the CCD data bus, a DRB scan tool and the proper Diagnostic Procedures manual are recommended. The CTM cannot be repaired and, if faulty or damaged, it must be replaced.

INTERMITTENT WIPE RELAY

The intermittent wipe relay is a International Standards Organization (ISO) micro-relay. The terminal designations and functions are the same as a conventional ISO relay. However, the micro-relay terminal orientation (or footprint) is different, current capacity is lower, and the relay case dimensions are smaller than those of the conventional ISO relay.

The intermittent wipe relay is a electromechanical device that switches battery current to the windshield wiper motor or wiper motor park switch when the relay coil is grounded by the Central Timer Module (CTM) in response to inputs from the windshield wiper (multi-function) switch. See Intermittent Wipe Relay in the Diagnosis and Testing section of this group for more information.

The intermittent wipe relay is located in the Power Distribution Center (PDC), in the engine compartment. Refer to the PDC label for relay identification and location.

The intermittent wipe relay cannot be repaired and, if faulty or damaged, it must be replaced.

WASHER RESERVOIR

The washer fluid reservoir is secured to the left side of the radiator fan shroud in the engine compartment. The washer pump and motor unit has a barbed nipple, which is installed through a rubber grommet seal inserted in a hole near the bottom of

DESCRIPTION AND OPERATION (Continued)

the reservoir. The washer pump is retained by an interference fit between the barbed nipple and the grommet seal, which is a light press fit.

A snap-fit filler cap with a rubber seal and an integral bail strap is fit to the reservoir filler neck. On models so equipped, the reservoir also has a hole provided for a washer fluid level sensor. Refer to Low Washer Fluid Warning Lamp in the Diagnosis and Testing section of Group 8E - Instrument Panel Systems for diagnosis of the sensor.

The washer reservoir, grommet seals and filler cap are each available for service.

WASHER PUMP

The washer pump and motor are mounted near the bottom of the washer reservoir. A barbed nipple on the pump housing passes through a rubber grommet seal installed in a hole near the bottom of the reservoir. The washer pump is retained by an interference fit between the barbed pump nipple and the grommet seal, which is a light press fit.

A permanently lubricated and sealed motor is coupled to a rotor-type pump. Washer fluid is gravity-fed from the reservoir to the pump. When the motor is energized, the pump pressurizes the washer fluid and forces it through the plumbing to the nozzles.

The washer pump and motor unit cannot be repaired. If faulty, the entire washer pump and motor unit must be replaced.

WASHER FLUID LEVEL SENSOR

The washer fluid level sensor is mounted on the inboard side of the reservoir above the washer pump. A barbed nipple on the sensor is press-fit into a rubber grommet seal installed in a hole in the side of the reservoir.

When the fluid level in the reservoir falls below the pivoting float on the sensor, the float changes position and closes the internal switch contacts of the sensor. Refer to Low Washer Fluid Warning Lamp in the Diagnosis and Testing section of Group 8E - Instrument Panel Systems for diagnosis of the low washer fluid warning lamp and circuit, including the sensor.

The washer fluid level sensor cannot be repaired. If faulty or damaged, the sensor unit must be replaced.

WASHER NOZZLE AND PLUMBING

Pressurized washer fluid is fed through a single hose, attached to a barbed nipple on the washer pump. The hose is routed along the left inner fender shield to an in-line fitting near the dash panel.

A second hose is routed from the in-line fitting through a grommet inserted in a hole in the cowl plenum panel to a wye fitting located in the cowl plenum area, beneath the cowl plenum cover/grille panel. Hoses from the wye fitting in the cowl plenum are routed through clips molded to the underside of the cowl plenum cover/grille panel to the two washer nozzles. The washer nozzles are snap-fit into openings in the cowl plenum cover/grille panel.

The two fluidic washer nozzles are not adjustable. The nozzles and hose fittings cannot be repaired and, if faulty or damaged, they must be replaced.

DIAGNOSIS AND TESTING

WIPER SYSTEM

If the problem being diagnosed involves only the pulse wipe or wipe-after-wash modes, see Washer System in the Diagnosis and Testing section of this group. For circuit descriptions and diagrams, refer to 8W-53 - Wipers in Group 8W - Wiring Diagrams.

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(1) Check the fuse in the junction block. If OK, go to Step 2. If not OK, repair the shorted circuit or component as required and replace the faulty fuse.

(2) Turn the ignition switch to the On position. Check for battery voltage at the fuse in the junction block. If OK, go to Step 3. If not OK, repair the open circuit to the ignition switch as required.

(3) Turn the ignition switch to the Off position. Disconnect and isolate the battery negative cable. Unplug the multi-function switch wire harness connector. Connect the battery negative cable. Turn the ignition switch to the On position. Check for battery voltage at the fused ignition switch output (run/accessory) circuit cavity of the multi-function switch wire harness connector. If OK, go to Step 4. If not OK, repair the open circuit to the fuse in the junction block as required.

(4) If the problem being diagnosed involves only the intermittent wipe feature, go to Step 5. If the problem being diagnosed involves all wiper modes, or only the Low and/or High speed modes, go to Step 7.

(5) Turn the ignition switch to the Off position. Disconnect and isolate the battery negative cable. Move the Central Timer Module (CTM) from its mounting position far enough so that the CTM wire harness connectors can be accessed. See Central Timer Module in the Removal and Installation section of Group 8E - Instrument Panel Systems for the

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DIAGNOSIS AND TESTING (Continued)

procedures. Unplug the 14-way CTM wire harness connector. Check for continuity between the wiper switch mode sense circuit cavities of the multi-function switch wire harness connector and the CTM 14-way wire harness connector. There should be continuity. If OK, go to Step 6. If not OK, repair the open circuit as required.

(6) Check for continuity between the windshield wiper switch signal circuit cavities of the multi-function switch wire harness connector and the CTM 14-way wire harness connector. There should be continuity. If OK, see Intermittent Wipe Relay in the Diagnosis and Testing section of this group. If not OK, repair the open circuit as required.

(7) Check for continuity between the two wiper switch low speed output circuit cavities of the multi-function switch wire harness connector. There should be continuity. If OK, go to Step 8. If not OK, repair the open circuit as required.

(8) Test the wiper switch. See Wiper Switch and Washer Switch in the Diagnosis and Testing section of this group for the procedures. If the switch tests OK, plug in the multi-function switch wire harness connector and go to Step 9. If not OK, replace the faulty switch and test the wiper system operation. If still not OK, go to Step 9.

(9) Turn the ignition switch to the Off position. Disconnect and isolate the battery negative cable. Move the wiper module far enough to access the wiper motor wire harness connector. Measure the resistance between the ground circuit cavity of the wiper motor wire harness connector and a good ground. The meter should read zero ohms. If OK, go to Step 10. If not OK, repair the circuit to ground as required.

(10) Connect the battery negative cable. Turn the ignition switch to the On position. Place the multi-function switch in the positions indicated in the tests below, and check for battery voltage at the wiper motor wire harness connector.

(a) Check for battery voltage at the fused ignition switch output (run/accessory) circuit cavity of the wiper motor wire harness connector with the wiper switch in any position. If OK, go to Step 2. If not OK, repair the open circuit as required.

(b) Check for battery voltage at the wiper switch low speed output circuit cavity of the wiper motor wire harness connector with the wiper switch in the Low position. If OK, go to Step 3. If not OK, repair the open circuit as required.

(c) Check for battery voltage at the wiper switch high speed output circuit cavity of the wiper motor wire harness connector with the wiper switch in the High position. If OK, go to Step 4. If not OK, repair the open circuit as required.

(d) Check for battery voltage at the wiper park switch sense circuit cavity of the wiper motor wire harness connector with the wiper switch in the Low or High position, then move the switch to the Off position. The meter should switch between battery voltage and zero volts while the wipers are cycling. The meter should read battery voltage when the switch is moved to the Off position until the wipers park, and then read a steady zero volts. If not OK, replace the faulty wiper motor.

WASHER SYSTEM

The diagnosis found here addresses an inoperative washer pump or wipe-after-wash feature. If the washer pump operates, but no washer fluid is emitted from the washer nozzles, be certain to check the fluid level in the reservoir. Check for ice or other foreign material in the reservoir, and for pinched, disconnected, broken, or incorrectly routed washer system plumbing. For circuit descriptions and diagrams, refer to 8W-53 - Wipers in Group 8W - Wiring Diagrams.

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(1) Turn the ignition switch to the On position. Turn the wiper switch to the Low or High speed position. Check whether the wipers operate. If OK, go to Step 2. If not OK, see Wiper System in the Diagnosis and Testing section of this group.

(2) Turn the wiper switch to the Off position. Depress the washer switch. The washer pump should operate and the wipers should operate for as long as the washer switch is depressed. The wipers should continue to operate for about three sweep cycles after the switch is released before they park. If the wipers are OK, but the washers are not, go to Step 3. If the washers are OK, but the wipers are not, go to Step 5.

(3) Turn the ignition switch to the Off position. Disconnect and isolate the battery negative cable. Unplug the washer pump wire harness connector. Measure the resistance between the ground circuit cavity of the washer pump wire harness connector and a good ground. The meter should read zero ohms. If OK, go to Step 4. If not OK, repair the circuit to ground as required.

(4) Connect the battery negative cable. Turn the ignition switch to the On position. With the washer switch depressed, measure the voltage at the washer

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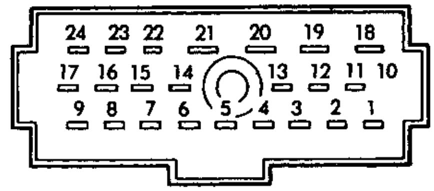
DIAGNOSIS AND TESTING (Continued)

switch output circuit cavity of the washer pump wire harness connector. The meter should read battery voltage. If OK, replace the faulty pump. If not OK, repair the open circuit as required.

(5) Turn the ignition switch to the Off position. Disconnect and isolate the battery negative cable. Move the Central Timer Module (CTM) from its mounting position far enough so that the CTM wire harness connectors can be accessed. See Central Timer Module in the Removal and Installation section of Group 8E - Instrument Panel Systems for the procedures. Unplug the 14-way wire harness connector from the CTM. Connect the battery negative cable. Turn the ignition switch to the On position. With the washer switch depressed, check for battery voltage at the washer switch sense circuit cavity of the 14-way CTM wire harness connector. If OK, see Intermittent Wipe Relay in the Diagnosis and Testing section of this group. If not OK, repair the open circuit as required.



MULTIFUNCTION SWITCH PINS

SWITCH POSITION	CONTINUITY BETWEEN
OFF	PIN 6 AND PIN 7
DELAY	PIN 8 AND PIN 9 PIN 2 AND PIN 4 PIN 1 AND PIN 2 PIN 1 AND PIN 4
LOW	PIN 4 AND PIN 6
HIGH	PIN 4 AND PIN 5
WASH	PIN 3 AND PIN 4

*RESISTANCE AT MAXIMUM DELAY POSITION SHOULD BE BETWEEN 270,000 OHMS AND 330,000 OHMS.

*RESISTANCE AT MINIMUM DELAY POSITION SHOULD BE ZERO WITH OHMMETER SET ON HIGH OHM SCALE.

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Fig. 2 Multi-Function Switch Continuity

WIPER SWITCH AND WASHER SWITCH

See Wiper System and/or Washer System in the Diagnosis and Testing section of this group before testing the multi-function switch. For circuit descriptions and diagrams, refer to 8W-53 - Wipers in Group 8W - Wiring Diagrams.

WARNING: ON VEHICLES EQUIPPED WITH AN AIRBAG, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(1) Disconnect and isolate the battery negative cable.

(2) Unplug the multi-function switch wire harness connector from the multi-function switch.

(3) Using an ohmmeter, perform the switch continuity checks at the switch terminals as shown in the Multi-Function Switch Continuity chart (Fig. 2).

(4) If the switch fails any of the continuity checks, replace the faulty switch. If the switch is OK, repair the wiper system and/or washer system wire harness circuits as required.

INTERMITTENT WIPE RELAY

For circuit descriptions and diagrams, refer to 8W-53 - Wipers in Group 8W - Wiring Diagrams.

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

RELAY TEST

The intermittent wipe relay (Fig. 3) is located in the Power Distribution Center (PDC) in the engine compartment. Refer to the PDC label for intermittent wipe relay identification and location.

Remove the intermittent wipe relay from the PDC as described in the Removal and Installation section of this group to perform the following tests:

(1) A relay in the de-energized position should have continuity between terminals 87A and 30, and no continuity between terminals 87 and 30. If OK, go to Step 2. If not OK, replace the faulty relay.

(2) Resistance between terminals 85 and 86 (electromagnet) should be 75 ± 5 ohms. If OK, go to Step 3. If not OK, replace the faulty relay.

(3) Connect a battery to terminals 85 and 86. There should now be continuity between terminals 30 and 87, and no continuity between terminals 87A and 30. If OK, see Relay Circuit Test in the Diagnosis and Testing section of this group. If not OK, replace the faulty relay.

RELAY CIRCUIT TEST

(1) The relay common feed terminal cavity (30) is connected to the wiper (multi-function) switch. There should be continuity between the cavity for relay terminal 30 and the two fused ignition switch output

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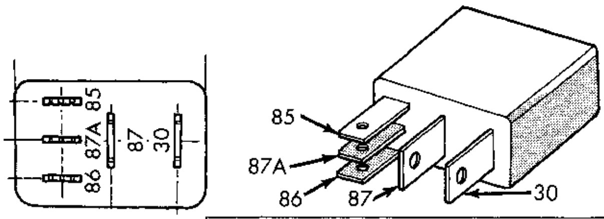
DIAGNOSIS AND TESTING (Continued)



TERMINAL LEGEND	
NUMBER	IDENTIFICATION
30	COMMON FEED
85	COIL GROUND
86	COIL BATTERY
87	NORMALLY OPEN
87A	NORMALLY CLOSED

Fig. 3 Intermittent Wipe Relay

circuit cavities of the multi-function switch wire harness connector at all times. If OK, go to Step 2. If not OK, repair the open circuit(s) to the multi-function switch as required.

(2) The relay normally closed terminal (87A) is connected to terminal 30 in the de-energized position. There should be continuity between the cavity for relay terminal 87A and the wiper park switch sense circuit cavities of the wiper motor wire harness connector and the 14-way Central Timer Module (CTM) wire harness connector at all times. If OK, go to Step 3. If not OK, repair the open circuit(s) to the wiper motor and CTM as required.

(3) The relay normally open terminal (87) is connected to the common feed terminal (30) in the energized position. There should be battery voltage at the cavity for relay terminal 87 with the ignition switch in the On or Accessory positions. If OK, go to Step 4. If not OK, repair the open circuit to the ignition switch as required.

(4) The coil battery terminal (86) is connected to the electromagnet in the relay. There should be battery voltage at the cavity for relay terminal 86 with the ignition switch in the On or Accessory positions. If OK, go to Step 5. If not OK, repair the open circuit to the ignition switch as required.

(5) The coil ground terminal (85) is connected to the electromagnet in the relay. It is grounded by the CTM to energize the relay and cycle the wiper motor. Check for continuity between the cavity for relay terminal 85 and the intermittent wiper relay control circuit cavity of the 14-way CTM wire harness connector. There should be continuity. If OK, replace the faulty base version CTM; or, use a DRB scan tool and the proper Diagnostic Procedures manual for diagnosis of the high-line version CTM. If not OK, repair the open circuit to the CTM as required.

REMOVAL AND INSTALLATION

WIPER BLADE

NOTE: The notched retainer end of the wiper element should always be oriented towards the end of the wiper blade that is nearest to the wiper pivot.

(1) Turn the windshield wiper switch to the On position. By turning the ignition switch to the On and Off positions, cycle the wiper blades to a convenient working location on the windshield.

(2) Lift the wiper arm to raise the wiper blade and element off of the windshield glass.

(3) To remove the wiper blade from the wiper arm, push the release tab under the arm tip and slide the blade away from the tip towards the pivot end of the arm (Fig. 4).

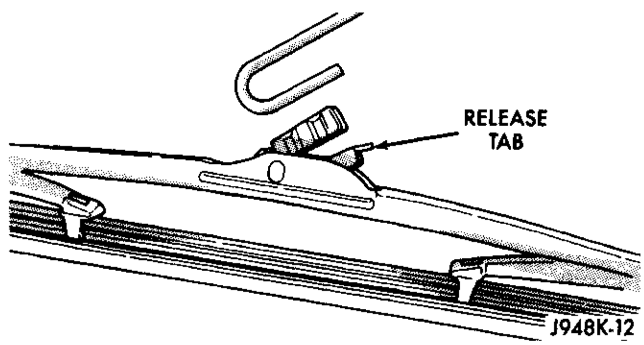


Fig. 4 Wiper Blade Remove/Install - Typical

(4) To install the wiper blade on the wiper arm, slide the blade retainer into the U-shaped formation on the tip of the wiper arm until the release tab snaps into its locked position. Be certain that the notched retainer for the wiper element is oriented towards the end of the wiper blade that is nearest to the wiper pivot.

WIPER ARM

CAUTION: The use of a screwdriver or other prying tool to remove a wiper arm may distort it. This distortion could allow the arm to come off of the pivot shaft, regardless of how carefully it is installed.

(1) Open the hood of the vehicle.

(2) Lift the wiper arm to permit the latch to be pulled out to its holding position, then release the arm (Fig. 5). The arm will remain off the windshield with the latch in this position.

(3) Remove the wiper arm from the pivot using a rocking motion.

(4) Install the wiper arm and blade with the wiper motor in the Park position. See the Wiper Arm Installation illustration (Fig. 6).

REMOVAL AND INSTALLATION (Continued)

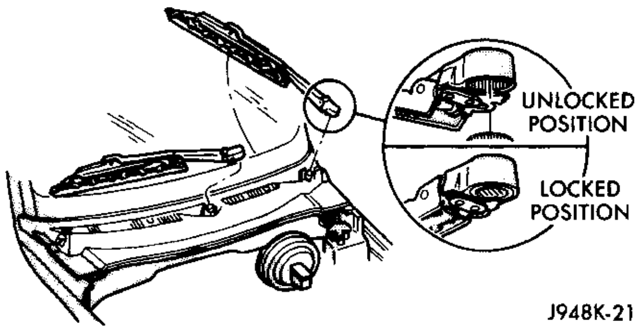


Fig. 5 Wiper Arm Remove/Install

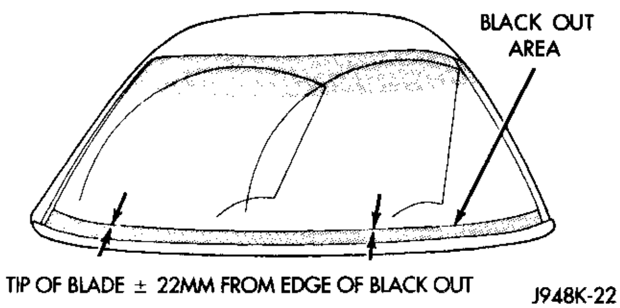


Fig. 6 Wiper Arm Installation

(5) Mount the arms on the pivot shafts so that the tip of the wiper blade is on the upper edge of the lower windshield blackout area ± 22 mm (± 0.86 in.).

(6) Lift the wiper arm away from the windshield slightly to relieve the spring tension on the latch. Push the latch into the locked position and slowly release the arm until the wiper blade rests on the windshield.

(7) Operate the wipers with the windshield glass wet, then turn the wiper switch to the Off position. Check for the correct wiper arm positioning and readjust if required.

WIPER LINKAGE AND PIVOT

The wiper linkage and pivots can only be removed from or installed in the vehicle as a unit with the wiper motor. See Wiper Motor in the Removal and Installation section of this group for the procedures.

WIPER MOTOR

(1) Disconnect and isolate the battery negative cable.

(2) Remove the wiper arms from the wiper pivots. See Wiper Arm in the Removal and Installation section of this group for the procedures.

(3) Remove the weatherstrip along the front edge of the cowl plenum cover/grille panel and the cowl plenum panel (Fig. 7).

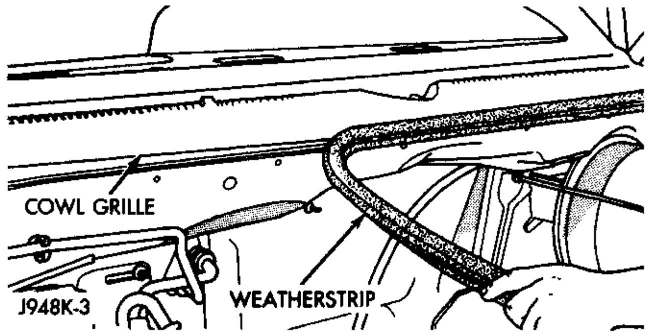


Fig. 7 Cowl Plenum Cover/Grille Panel Weatherstrip

(4) Remove the plastic screws that secure the cowl plenum cover/grille panel to the studs on the cowl top panel near the base of the windshield (Fig. 8).

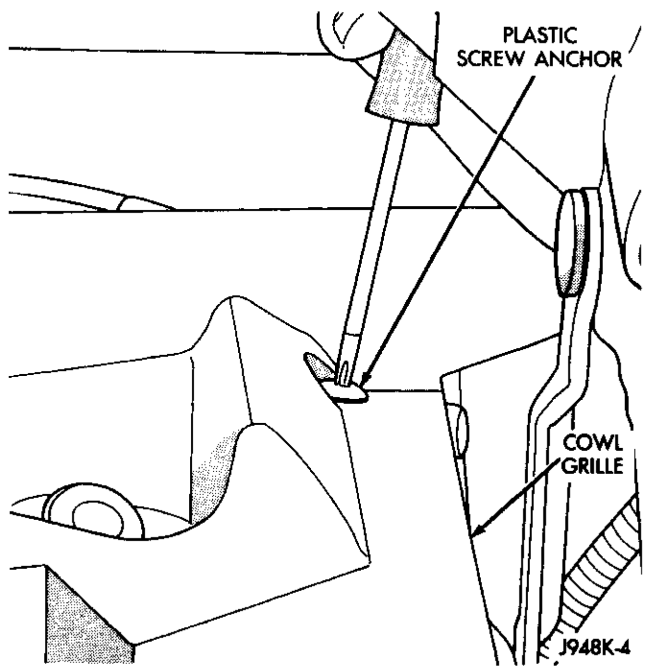


Fig. 8 Cowl Plenum Plastic Screws Remove/Install

(5) Lift the cowl plenum cover/grille panel from the cowl top far enough to access the windshield washer nozzle plumbing near the left end of the cowl plenum.

(6) Disconnect the windshield washer supply hose at the wye fitting (Fig. 9).

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REMOVAL AND INSTALLATION (Continued)

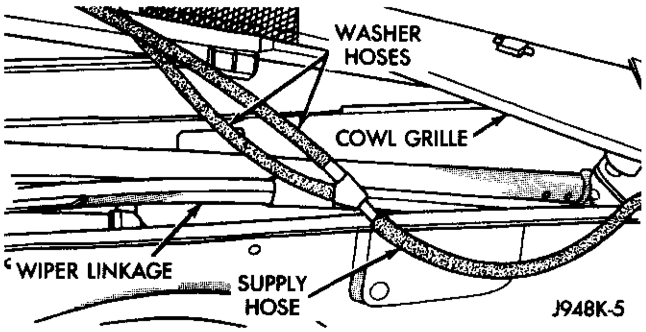

Fig. 9 Washer Supply Hose Remove/Install

(7) Remove the cowl plenum cover/grille panel from the vehicle and set it aside.

(8) Remove the four screws that secure the wiper module to the cowl plenum panel (Fig. 10).

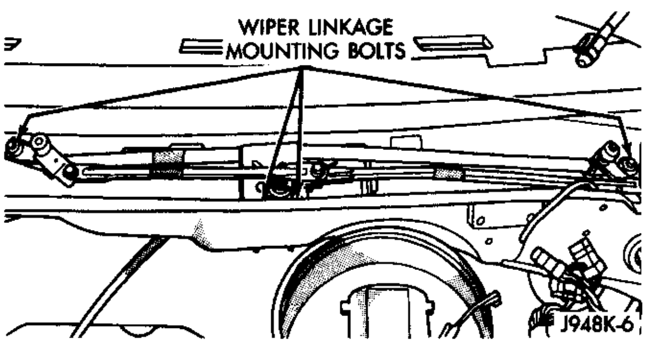

Fig. 10 Wiper Module Remove/Install

(9) Move the wiper module as required to access the wiper motor wire harness connector.

(10) Unplug the wiper motor wire harness connectors from the wiper motor (Fig. 11).

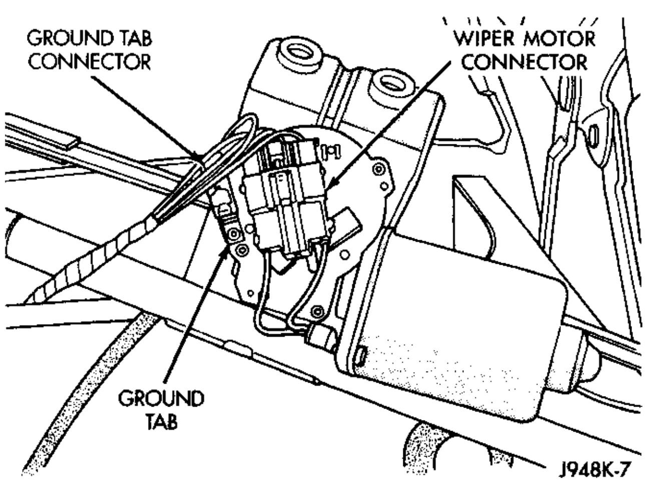

Fig. 11 Wiper Motor Wire Harness Connectors

(11) Remove the wiper module from the cowl plenum.

(12) Reverse the removal procedures to install. Be certain that the washer nozzle hoses are correctly routed and installed in the retainers on the underside of the cowl plenum cover/grille panel. Tighten the mounting screws to 8 N·m (72 in. lbs.).

INTERMITTENT WIPE RELAY

(1) Disconnect and isolate the battery negative cable.

(2) Remove the cover from the Power Distribution Center (PDC) (Fig. 12).

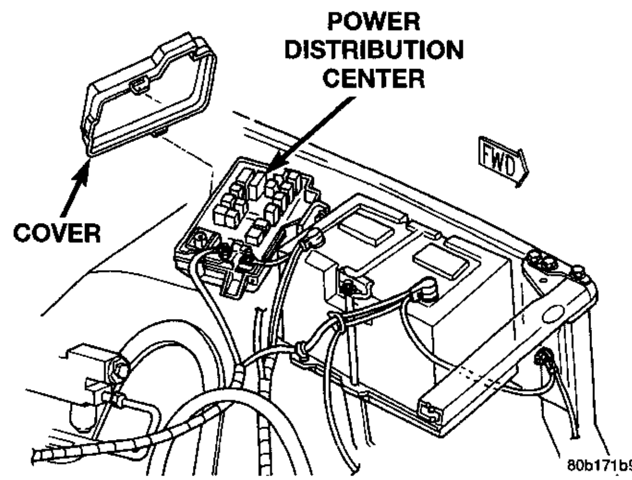

Fig. 12 Power Distribution Center

(3) Refer to the label on the PDC cover for intermittent wipe relay identification and location.

(4) Unplug the intermittent wipe relay from the PDC.

(5) Install the intermittent wipe relay by aligning the relay terminals with the cavities in the PDC and pushing the relay firmly into place.

(6) Install the PDC cover.

(7) Connect the battery negative cable.

(8) Test the relay operation.

MULTI-FUNCTION SWITCH

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(1) Disconnect and isolate the battery negative cable.

(2) If the vehicle is so equipped, remove the tilt steering column lever.

(3) Remove both the upper and lower shrouds from the steering column (Fig. 13).

(4) Remove the lower fixed column shroud.

REMOVAL AND INSTALLATION (Continued)

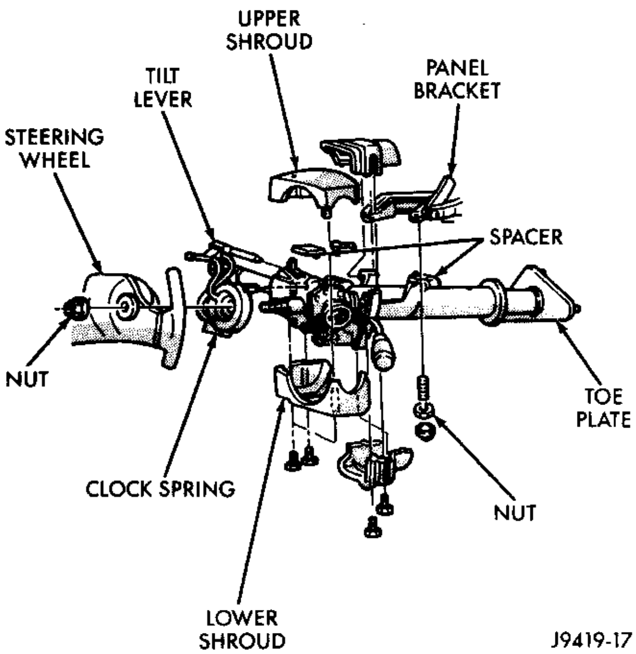

Fig. 13 Steering Column Shrouds Remove/Install - Typical

(5) Move the upper fixed column shroud far enough to access the rear of the multi-function switch (Fig. 14).

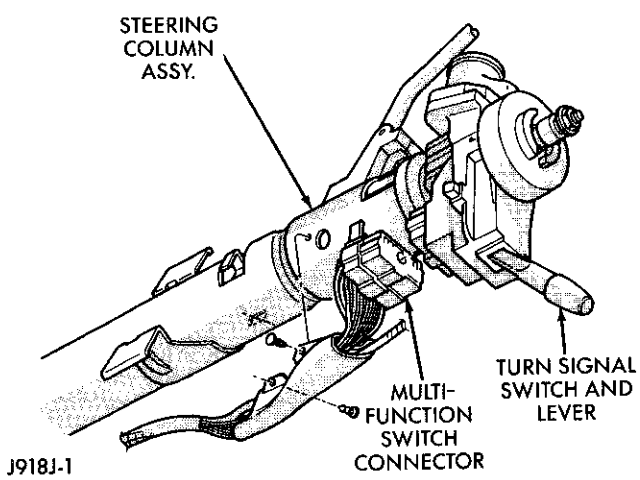

Fig. 14 Multi-Function Switch Connector - Typical

(6) Remove the tamper proof mounting screws (a Snap On tamper proof torx bit TTXR20B2 or equivalent is required) that secure the multi-function switch to the steering column.

(7) Gently pull the switch away from the steering column far enough to access and remove the multi-function switch wire harness connector screw.

(8) Unplug the wire harness connector from the multi-function switch.

(9) Reverse the removal procedures to install. Tighten the fasteners as follows:

- Multi-function switch wire harness connector screw - 2 N·m (17 in. lbs.)
- Multi-function switch mounting screws - 2 N·m (17 in. lbs.).

WASHER SYSTEM

WASHER RESERVOIR

(1) Disconnect and isolate the battery negative cable.

(2) Drain the engine cooling system and remove the upper hose from the radiator. Refer to Group 7 - Cooling System for the procedures.

(3) Unplug the wire harness connectors from the washer pump and, if the vehicle is so equipped, the washer fluid level sensor.

(4) Remove the washer supply hose from the washer pump and drain the washer fluid from the reservoir into a clean container for reuse.

(5) While pulling the reservoir away from the fan shroud, lift the reservoir upwards far enough to disengage the reservoir mounting tabs from the upper and lower mounting slots in the fan shroud (Fig. 15).

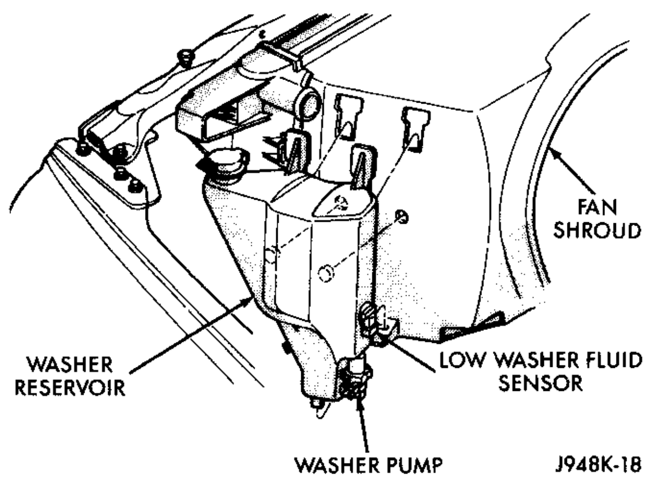

Fig. 15 Washer Reservoir Remove/Install

(6) Remove the reservoir from the engine compartment.

(7) Reverse the removal procedures to install.

WASHER PUMP

(1) Disconnect and isolate the battery negative cable.

(2) Unplug the wire harness connector from the washer pump.

(3) Remove the washer supply hose from the washer pump and drain the washer fluid from the reservoir into a clean container for reuse.

(4) Using a trim stick or another suitable wide flat-bladed tool, gently pry the barbed inlet nipple of the washer pump out of the rubber grommet seal in

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REMOVAL AND INSTALLATION (Continued)

the reservoir. Care must be taken not to damage the reservoir.

(5) Remove the rubber grommet seal from the reservoir and discard.

(6) Reverse the removal procedures to install. Always use a new rubber grommet seal on the reservoir.

WASHER FLUID LEVEL SENSOR

(1) Disconnect and isolate the battery negative cable.

(2) Unplug the wire harness connector from the washer pump.

(3) Remove the washer supply hose from the washer pump and drain the washer fluid from the reservoir into a clean container for reuse.

NOTE: The pivoting float of the washer fluid sensor must be in a horizontal position within the reservoir in order to be removed. With the reservoir empty and held in an upright position, the pivoting float will orient itself to the horizontal position when the sensor connector is pointed straight downwards.

(4) Using a trim stick or another suitable wide flat-bladed tool, gently pry the washer fluid level sensor out of the rubber grommet seal. Care must be taken not to damage the reservoir.

(5) Remove the rubber grommet seal from the reservoir and discard.

(6) Reverse the removal procedures to install. Always use a new rubber grommet seal on the reservoir.

WASHER NOZZLE

(1) Remove the cowl plenum cover/grille panel from the cowl top. See Wiper Motor in the Removal and Installation section of this group for the procedures.

(2) From the underside of the cowl plenum cover/grille panel, disconnect the washer hose from the nozzle fitting.

(3) From the underside of the cowl plenum cover/grille panel, compress the retaining tabs of the washer nozzle and push the nozzle out through the top of the panel.

(4) Reverse the removal procedures to install.

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LAMPS

CONTENTS

LAMP DIAGNOSIS

INDEX

GENERAL INFORMATION

GENERAL INFORMATION

Each vehicle is equipped with various lamp assemblies. A good ground is necessary for proper lighting operation. Grounding is provided by the lamp socket when it comes in contact with the metal body, or through a separate ground wire.

When changing lamp bulbs check the socket for corrosion. If corrosion is present, clean it with a wire brush and coat the inside of the socket lightly with Mopar Multi-Purpose Grease or equivalent.

SAFETY PRECAUTIONS

WARNING: EYE PROTECTION SHOULD BE USED WHEN SERVICING GLASS COMPONENTS. PERSONAL INJURY CAN RESULT.

CAUTION: Do not touch the glass of halogen bulbs with fingers or other possibly oily surface, reduced bulb life will result.

Do not use bulbs with higher candle power than indicated in the Bulb Application table at the end of this group. Damage to lamp and/or Daytime Running Lamp Module can result.

Do not use fuses, circuit breakers or relays having greater amperage value than indicated on the fuse panel or in the Owners Manual.

When it is necessary to remove components to service another, it should not be necessary to apply excessive force or bend a component to remove it. Before damaging a trim component, verify hidden fasteners or captured edges are not holding the component in place.

DAYTIME RUNNING LAMPS

The daytime running lamps are controlled by the Daytime Running Lamp Module (DRLM). The DRLM is located in the engine compartment on the left fender wheelhouse. The DRLM allows the high beam headlamps to illuminate at a reduced intensity when the engine is running with the headlamp switch OFF. The Daytime running lamps will go out when the headlamp switch is turned to the headlamps on position. The passing light feature will flash bright high beams while the daytime running lamps are activated.

DIAGNOSIS AND TESTING

DIAGNOSTIC PROCEDURES

When a vehicle experiences problems with the headlamp system, verify the condition of the battery connections, charging system, headlamp bulbs, wire connectors, relay, high beam dimmer switch and headlamp switch. Refer to Group 8W, Wiring Diagrams for component locations and circuit information.

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DIAGNOSIS AND TESTING (Continued)

HEADLAMP DIAGNOSIS

Always begin any diagnosis by testing all of the fuses and circuit breakers in the system. Refer to Group 8W, Wiring Diagrams.

Conventional and halogen headlamps are interchangeable. It is recommended that they not be intermixed on a given vehicle.

CONDITION	POSSIBLE CAUSES	CORRECTION
HEADLAMPS ARE DIM WITH ENGINE IDLING OR IGNITION TURNED OFF	1. Loose or corroded battery cables. 2. Loose or worn generator drive belt. 3. Charging system output too low. 4. Battery has insufficient charge. 5. Battery is sulfated or shorted. 6. Poor lighting circuit Z1-ground. 7. Both headlamp bulbs defective.	1. Clean and secure battery cable clamps and posts. 2. Adjust or replace generator drive belt. 3. Test and repair charging system, refer to Group 8A, 4. Test battery state-of -charge , refer to Group 8A. 5. Load test battery, refer to Group 8A. 6. Test for voltage drop across Z1-ground locations, refer to Group 8W. 7. Replace both headlamp bulbs.
HEADLAMP BULBS BURN OUT FREQUENTLY	1. Charging system output too high. 2. Loose or corroded terminals or splices in circuit.	1. Test and repair charging system, refer to Group 8A. 2. Inspect and repair all connectors and splices, refer to Group 8W.
HEADLAMPS ARE DIM WITH ENGINE RUNNING ABOVE IDLE*	1. Charging system output too low. 2. Poor lighting circuit Z1-ground. 3. High resistance in headlamp circuit. 4. Both headlamp bulbs defective.	1. Test and repair charging system, refer to Group 8A. 2. Test for voltage drop across Z1-ground locations, refer to Group 8W. 3. Test amperage draw of headlamp circuit. 4. Replace both headlamp bulbs.
HEADLAMPS FLASH RANDOMLY	1. Poor lighting circuit Z1-ground. 2. High resistance in headlamp circuit. 3. Faulty headlamps switch circuit breaker. 4. Loose or corroded terminals or splices in circuit.	1. Test for voltage drop across Z1-ground locations, refer to Group 8W. 2. Test amperage draw of headlamp circuit. Should not exceed 30 amps. 3. Replace headlamp switch. 4. Inspect and repair all connectors and splices, refer to Group 8W.
HEADLAMPS DO NOT ILLUMINATE	1. No voltage to headlamps. 2. No Z1-ground at headlamps. 3. Faulty headlamp switch. 4. Faulty headlamp dimmer (multi-function) switch. 5. Broken connector terminal or wire splice in headlamp circuit.	1. Repair open headlamp circuit, refer to Group 8W. 2. Repair circuit ground, refer to Group 8W. 3. Replace headlamp switch. 4. Replace multi-function switch. 5. Repair connector terminal or wire splice.
1. Headlamps stay on with key out (DRLM equipped vehicles).	1. Failed DRLM	1. Replace DRLM.
*Canada vehicles must have lamps ON.		

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DIAGNOSIS AND TESTING (Continued)

FOG LAMP

FOG LAMP DIAGNOSIS

CONDITION	POSSIBLE CAUSES	CORRECTION
FOG LAMPS ARE DIM WITH ENGINE IDLING OR IGNITION TURNED OFF.	1. Loose or corroded battery cables. 2. Loose or worn generator drive belt. 3. Charging system output too low. 4. Battery has insufficient charge. 5. Battery is sulfated or shorted. 6. Poor lighting circuit Z1-ground.	1. Clean and secure battery cable clamps and posts. 2. Adjust or replace generator drive belt. 3. Test and repair charging system. Refer to Group 8A, 4. Test battery state-of -charge. Refer to Group 8A. 5. Load test battery. Refer to Group 8A. 6. Test for voltage drop across Z1-ground locations. Refer to Group 8W.
FOG LAMP BULBS BURN OUT FREQUENTLY	1. Charging system output too high. 2. Loose or corroded terminals or splices in circuit.	1. Test and repair charging system. Refer to Group 8A. 2. Inspect and repair all connectors and splices. Refer to Group 8W.
FOG LAMPS ARE DIM WITH ENGINE RUNNING ABOVE IDLE	1. Charging system output too low. 2. Poor lighting circuit Z1-ground. 3. High resistance in fog lamp circuit.	1. Test and repair charging system. Refer to Group 8A. 2. Test for voltage drop across Z1-ground locations. Refer to Group 8W. 3. Test amperage draw of fog lamp circuit.
FOG LAMPS FLASH RANDOMLY	1. Poor lighting circuit Z1-ground. 2. High resistance in fog lamp circuit. 3. Faulty fog lamp switch. 4. Loose or corroded terminals or splices in circuit.	1. Test for voltage drop across Z1-ground locations. Refer to Group 8W. 2. Test amperage draw of fog lamp circuit. 3. Replace fog lamp switch. 4. Inspect and repair all connectors and splices. Refer to Group 8W.
FOG LAMPS DO NOT ILLUMINATE	1. Blown fuse for fog lamp. 2. No Z1-ground at fog lamps. 3. Faulty fog lamp switch. 4. Broken connector terminal or wire splice in fog lamp circuit. 5. Defective or burned out bulb.	1. Replace fuse. Refer to Group 8W. 2. Repair circuit ground. Refer to Group 8W. 3. Replace fog lamp switch. 4. Repair connector terminal or wire splice. 5. Replace bulb.

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HEADLAMP ALIGNMENT

INDEX

GENERAL INFORMATION

HEADLAMP ALIGNMENT

Headlamps can be aligned using the screen method provided in this section. Alignment Tool C-4466-A or equivalent can also be used. Refer to instructions provided with the tool for proper procedures. **The preferred headlamp alignment setting is 0 for the left/right adjustment and 1″ down for the up/down adjustment.**

SERVICE PROCEDURES

HEADLAMP ALIGNMENT PREPARATION

(1) Verify headlamp dimmer switch and high beam indicator operation.

(2) Verify headlamps are set for low beam operation.

(3) Correct defective components that could hinder proper headlamp alignment.

(4) Verify proper tire inflation.

(5) Clean headlamp lenses.

(6) Verify that luggage area is not heavily loaded.

(7) Fuel tank should be FULL. Add 2.94 kg (6.5 lbs.) of weight over the fuel tank for each estimated gallon of missing fuel.

ALIGNMENT SCREEN PREPARATION

(1) Position vehicle on a level surface perpendicular to a flat wall 7.62 meters (25 ft) away from front of headlamp lens (Fig. 1).

(2) If necessary, tape a line on the floor 7.62 meters (25 ft) away from and parallel to the wall.

(3) Up 1.27 meters (5 feet) from the floor, tape a line on the wall at the centerline of the vehicle. Sight along the centerline of the vehicle (from rear of vehicle forward) to verify accuracy of the line placement.

(4) Rock vehicle side-to-side three times to allow suspension to stabilize.

(5) Jounce front suspension three times by pushing downward on front bumper and releasing.

(6) Measure the distance from the center of headlamp lens to the floor. Transfer measurement to the alignment screen (with tape). Use this line for up/down adjustment reference.

(7) Measure distance from the centerline of the vehicle to the center of each headlamp being aligned. Transfer measurements to screen (with tape) to each side of vehicle centerline. Use these lines for left/right adjustment reference.

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SERVICE PROCEDURES (Continued)

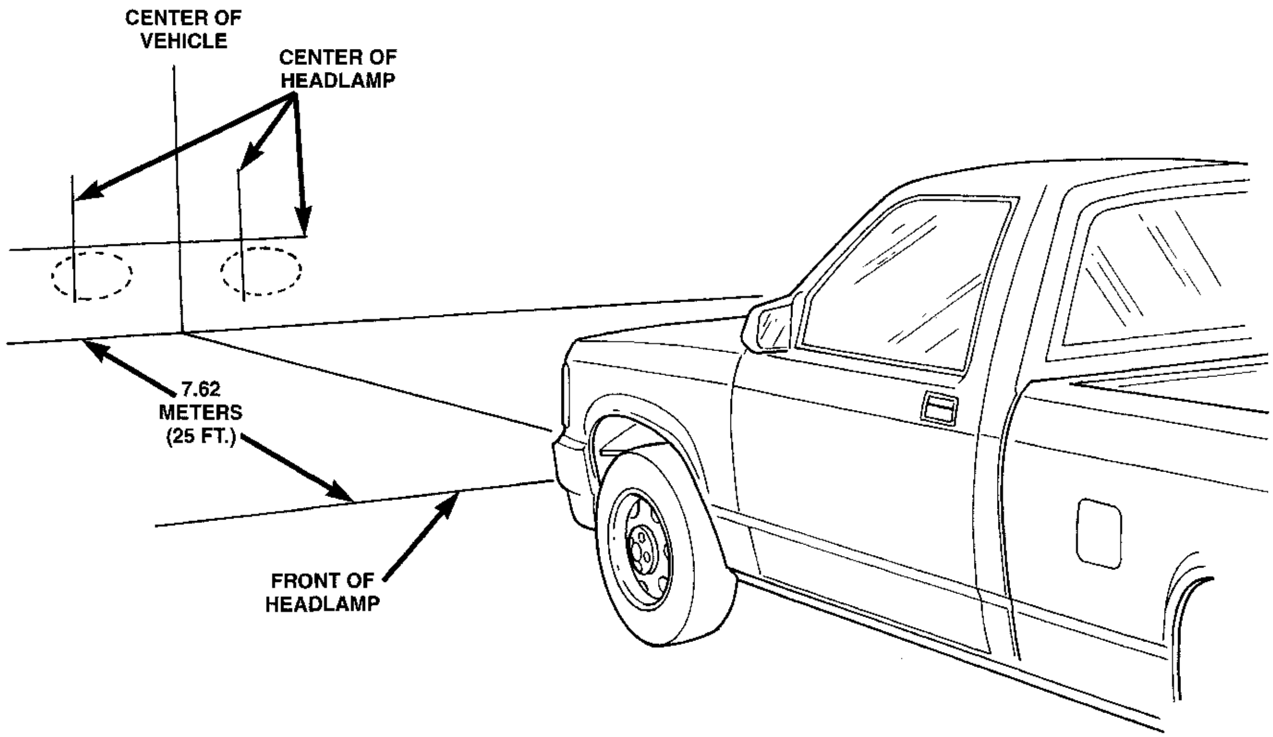


Fig. 1 Headlamp Alignment Screen—Typical

HEADLAMP ADJUSTMENT

A properly aimed low beam headlamp will project top edge of high intensity pattern on screen from 50 mm (2 in.) above to 50 mm (2 in.) below headlamp centerline. The side-to-side outboard edge of high intensity pattern should be from 50 mm (2 in.) left to 50 mm (2 in.) right of headlamp centerline (Fig. 1). **The preferred headlamp alignment is 1″ down for the up/down adjustment and 0 for the left/right adjustment.** The high beam pattern should be correct when the low beams are aligned properly.

To adjust headlamp aim, rotate alignment screws (Fig. 2) to achieve the specified high intensity pattern.

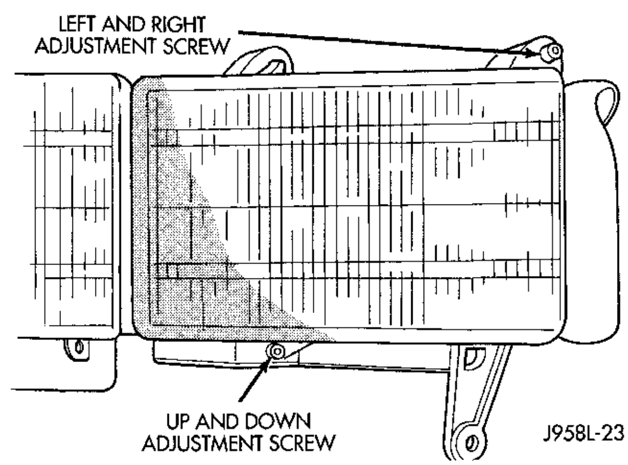


Fig. 2 Aero Headlamp Alignment

SERVICE PROCEDURES (Continued)

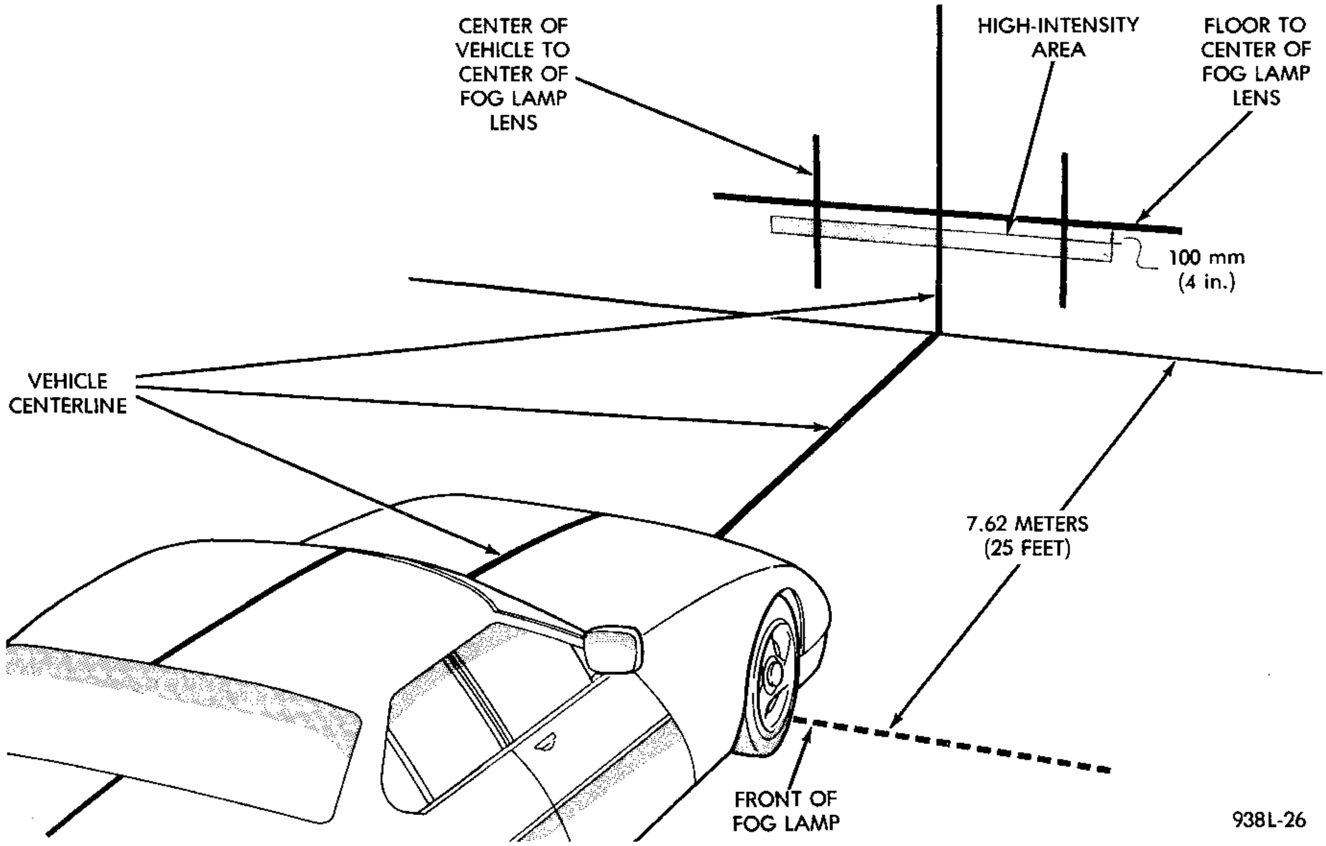


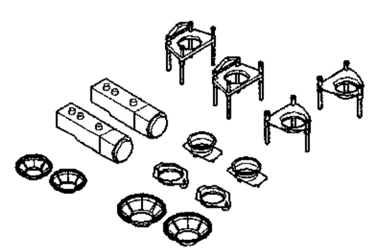
Fig. 3 Fog Lamp Alignment —Typical

FOG LAMP ALIGNMENT

Prepare an alignment screen. Refer to Alignment Screen Preparation paragraph in this section. A properly aligned fog lamp will project a pattern on the alignment screen 100 mm (4 in.) below the fog lamp centerline and straight ahead (Fig. 3).

SPECIAL TOOLS

SPECIAL TOOLS—HEADLAMP ALIGNMENT



Headlamp Aiming Kit C-4466–A

LAMP BULB SERVICE

INDEX

REMOVAL AND INSTALLATION

HEADLAMP

On driver side and on vehicles with dual batteries, the headlamp assembly must be removed to service the headlamp bulb.

REMOVAL

(1) Release hood latch and open hood.
(2) To remove headlamp assembly on drivers side or passenger side when equipped with dual batteries, refer to Headlamp Removal paragraph of Exterior Lamps section.
(3) Disengage wire connector from headlamp bulb.
(4) Remove retaining ring holding bulb to headlamp (Fig. 1).
(5) Pull bulb from headlamp.

INSTALLATION

CAUTION: Do not touch the bulb glass with fingers or other oily surfaces. Reduced bulb life will result.

(1) Position bulb in headlamp.
(2) Install retaining ring holding bulb to headlamp (Fig. 1).
(3) Connect wire connector to headlamp bulb.

FOG LAMP

REMOVAL

(1) Disengage fog lamp harness connector.
(2) Rotate bulb assembly counterclockwise and pull from lamp to separate (Fig. 2).

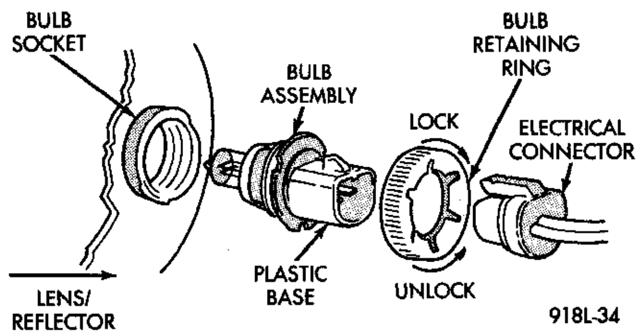


Fig. 1 Headlamp Bulb Removal

INSTALLATION

CAUTION: Do not touch the bulb glass with fingers or other oily surfaces. Reduced bulb life will result.

(1) Position bulb assembly in lamp and rotate clockwise.
(2) Connect fog lamp harness connector.

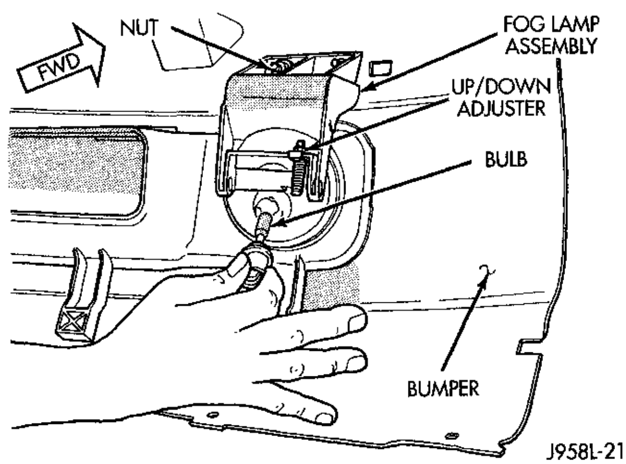


Fig. 2 Fog Lamp

REMOVAL AND INSTALLATION (Continued)

PARK AND TURN SIGNAL LAMP

REMOVAL

(1) Remove park and turn signal lamp.

(2) Rotate bulb socket 1/4 turn counterclockwise and pull turn signal lamp socket from back of lamp.

(3) Pull park and turn signal lamp bulb from socket.

INSTALLATION

(1) Install park and turn signal lamp bulb in socket.

(2) Install park and turn signal lamp socket into back of lamp.

(3) Install park/turn signal lamp.

ROOF CLEARANCE LAMP BULB

For bulb replacement refer roof clearance lamp removal/installation procedure.

CENTER HIGH MOUNTED STOP LAMP (CHMSL) BULB

REMOVAL

(1) Remove the CHMSL from the roof panel.

(2) Rotate sockets 1/4 turn clockwise and remove from lamp. (The center bulbs light the stoplamp and the outside bulbs light the cargo lamp.)

(3) Pull bulb from socket.

INSTALLATION

(1) Push bulb into socket.

(2) Position socket in lamp an rotate socket 1/4 turn counterclockwise.

(3) Install the CHMSL.

CARGO LAMP BULB

The cargo lamp bulb is incorporated in the CHMSL assembly, refer to the CHMSL bulb removal and installation procedure for bulb replacement.

SIDE IDENTIFICATION (ID) LAMP BULBS

The bulbs in the side ID lamps can not be replaced. If a bulb should fail, the entire lamp would require replacement. Refer to the Side Identification Lamp Removal/Installation procedure in this group.

TAIL, STOP, TURN SIGNAL AND BACK-UP LAMP BULB—PICKUP

REMOVAL

(1) Remove screws from tail lamp (Fig. 3).

(2) Grasp lamp, firmly pull lamp rearward to disengage retaining studs.

(3) Remove socket from tail lamp.

(4) Separate tail lamp from cargo box.

(5) Pull bulb from socket.

INSTALLATION

(1) Install bulb in socket.

(2) Install socket in tail lamp.

(3) Position tail lamp in cargo box, engage retaining studs and install screws (Fig. 3).

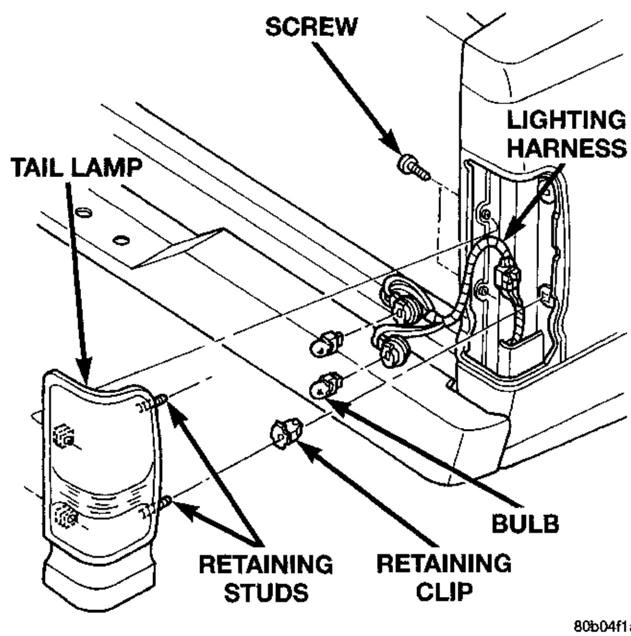


Fig. 3 Tail, Stop, Turn Signal and Back-up Lamp Bulb

AUTHENTIC RESTORATION PRODUCT

REMOVAL AND INSTALLATION (Continued)

TAIL, STOP, TURN SIGNAL AND BACK-UP LAMP BULB—CAB CHASSIS

REMOVAL

(1) Remove screws holding tail lamp lens to lamp body.

(2) Separate lens from lamp.

(3) Grasp bulb, push in slightly and rotate 1/2 turn counter-clockwise.

INSTALLATION

(1) Install bulb in socket.

(2) Install lamp lens.

REAR IDENTIFICATION (ID) LAMP BULBS

The bulbs in the rear ID lamps can not be replaced. If a bulb should fail, the entire lamp would require replacement.

LICENSE PLATE LAMP BULB

REMOVAL

(1) Remove license plate lamp lens.

(2) Pull bulb from license plate lamp.

INSTALLATION

(1) Install bulb in license plate lamp.

(2) Install license plate lamp lens.

UNDERHOOD LAMP BULB

REMOVAL

(1) Disconnect the wire harness connector from the underhood lamp.

(2) Rotate the bulb counterclock-wise. Remove it from the lamp socket.

INSTALLATION

(1) Insert the replacement bulb in the lamp base socket. Rotate it clockwise.

(2) Connect the wire harness connector to the lamp.

DOME LAMP BULB

REMOVAL

(1) Remove dome lamp lens.

(2) Pull bulb from lamp.

INSTALLATION

(1) Install bulb in lamp.

(2) Position lens on lamp and snap into place.

OVERHEAD CONSOLE READING LAMP BULB

REMOVAL

(1) Insert a flat blade screwdriver in slot at front of lens (Fig. 4).

(2) Rotate the screwdriver until lens snaps out of the housing.

(3) Remove lens from housing.

(4) Remove bulb from terminals.

INSTALLATION

(1) Insert bulb into reading lamp terminals.

(2) Replace lens by holding lens level and pushing rearward into housing.

(3) Push lens up to snap into housing.

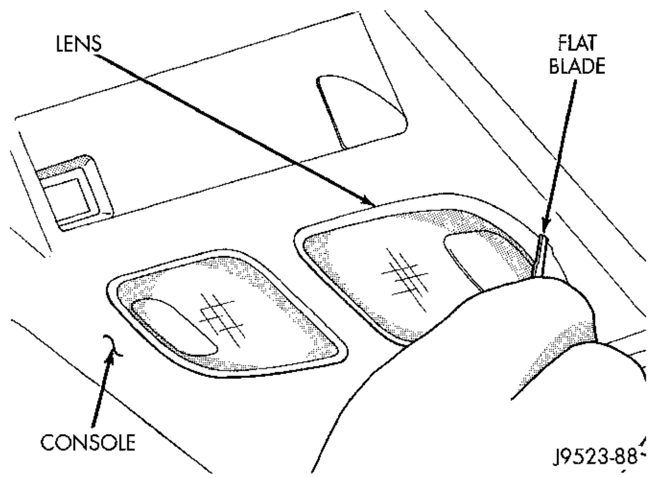


Fig. 4 Overhead Console Reading Lamp Bulb Removal

LAMP SERVICE

INDEX

REMOVAL AND INSTALLATION

HEADLAMP

REMOVAL

(1) Release hood latch and open hood.
(2) Remove park and turn signal lamp.
(3) Remove screws holding top of headlamp module to radiator closure panel (Fig. 1).
(4) From behind front bumper, remove screws holding bottom of headlamp module to radiator closure panel.
(5) Separate headlamp module from radiator closure panel.
(6) Disengage wire connector from headlamp bulb.
(7) Separate headlamp module from vehicle.

INSTALLATION

(1) If removed, install headlamp bulb.
(2) Connect headlamp bulb wire connector.
(3) Position headlamp in radiator closure panel.
(4) From behind front bumper, install the screws holding bottom of headlamp module to radiator closure panel.
(5) Install the screws holding top of headlamp module to radiator closure panel (Fig. 1).
(6) Install park and turn signal lamp.
(7) Close hood.

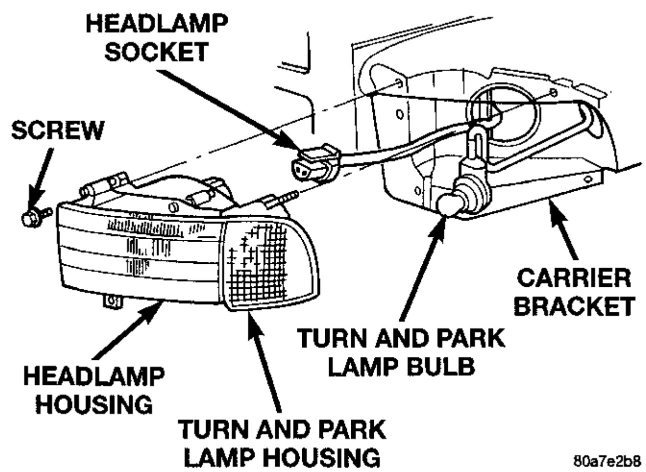


Fig. 1 Headlamp Removal/Installation

FOG LAMP

The fog lamps are serviced from the rearward side of the front bumper.

REMOVAL

(1) Disengage fog lamp harness connector.
(2) Remove fog lamp to bumper attaching nuts (Fig. 2).
(3) Separate fog lamp from bumper.

INSTALLATION

(1) Position fog lamp in bumper.
(2) Install fog lamp to bumper attaching nuts.
(3) Connect fog lamp harness connector.
(4) Check for proper operation and beam alignment.

AUTHENTIC RESTORATION PRODUCT

REMOVAL AND INSTALLATION (Continued)

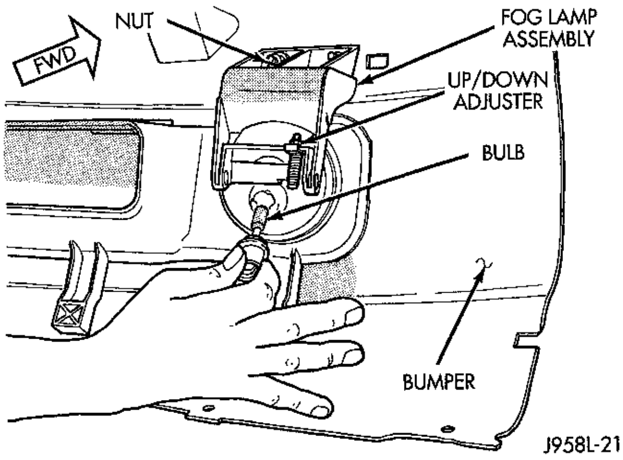


Fig. 2 Fog Lamp

PARK, TURN SIGNAL AND SIDE MARKER LAMP

REMOVAL

(1) Remove screw attaching the park lamp to headlamp module.
(2) Grasp lamp and pull forward to disengage clip attaching park/turn lamp to headlamp module.
(3) Separate park lamp headlamp module.
(4) Rotate park/turn signal socket 1/4 turn counter-clockwise and remove from back of lamp.
(5) Remove side marker socket from back of lamp.
(6) Separate park/turn signal lamp from vehicle.

INSTALLATION

(1) Install side marker socket from back of lamp.
(2) Install park/turn signal socket in back of lamp.
(3) Install park/turn signal lamp in vehicle.
(4) Install screw attaching the park lamp to headlamp module.

ROOF CLEARANCE LAMP

REMOVAL

(1) Remove screws holding clearance lamp lens to roof panel (Fig. 3).
(2) Rotate socket 1/4 turn counterclockwise and separate socket from lamp.

INSTALLATION

(1) Install socket in lamp and rotate socket 1/4 turn clockwise.
(2) Position clearance lamp on roof.
(3) Install screws holding clearance lamp lens to roof panel. Tighten to 1 N·m (13 in. lbs.).

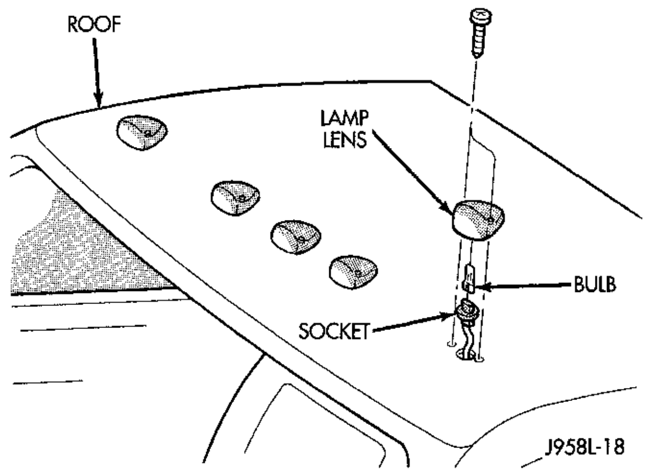


Fig. 3 Roof Clearance Lamps

CENTER HIGH MOUNTED STOP LAMP (CHMSL)

REMOVAL

(1) Remove screws holding CHMSL to roof panel (Fig. 4).
(2) Separate CHMSL from roof.
(3) Disengage wire connector from body wire harness.
(4) Separate CHMSL from vehicle.

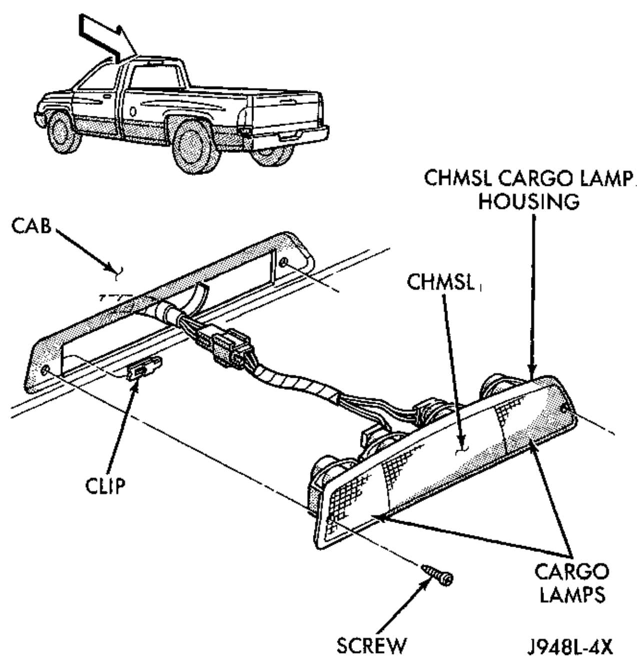


Fig. 4 Center High Mounted Stop Lamp

INSTALLATION

(1) Position lamp at cab roof and connect wire connector.
(2) Install screws holding CHMSL to roof panel. Tighten securely.

REMOVAL AND INSTALLATION (Continued)

CARGO LAMP

The cargo lamp is incorporated into the CHMSL, if equipped. Refer to Center High Mounted Stop Lamp paragraph for service procedures.

SIDE IDENTIFICATION (ID) LAMPS

REMOVAL

(1) Using a flat blade screw driver, carefully pry lamp to disengage clips attaching ID lamp to retainer (Fig. 5).
(2) Separate ID lamp from retainer.
(3) Disengage lamp bulb socket from lamp.
(4) Remove screws attaching lamp retainer to rear fender.
(5) Separate retainer from rear fender.

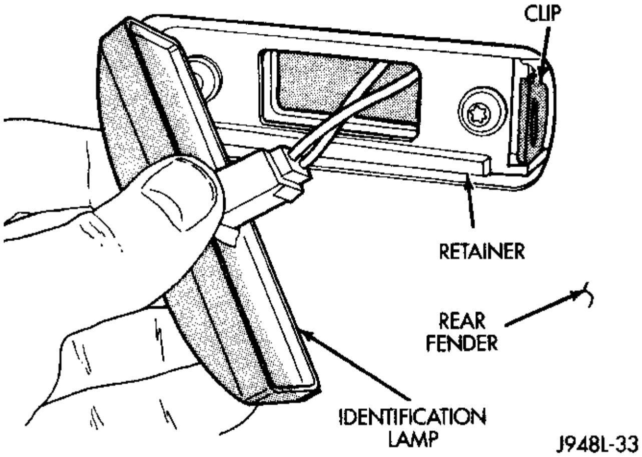


Fig. 5 Side Identification Lamps

INSTALLATION

(1) Position retainer on rear fender.
(2) Install screws attaching lamp retainer to rear fender.
(3) Engage lamp bulb socket to lamp.
(4) Position an press ID lamp in retainer.

TAIL, STOP, TURN SIGNAL AND BACK-UP LAMPS—PICKUP

REMOVAL

(1) Release tailgate latch and open tailgate.
(2) Remove screws holding tail lamp to cargo box (Fig. 6).
(3) Grasp lamp, firmly pull lamp rearward to disengage retaining studs.
(4) Remove socket from tail lamp.
(5) Separate tail lamp from cargo box.
(6) Separate tail lamp from vehicle.

INSTALLATION

(1) Install socket in tail lamp.

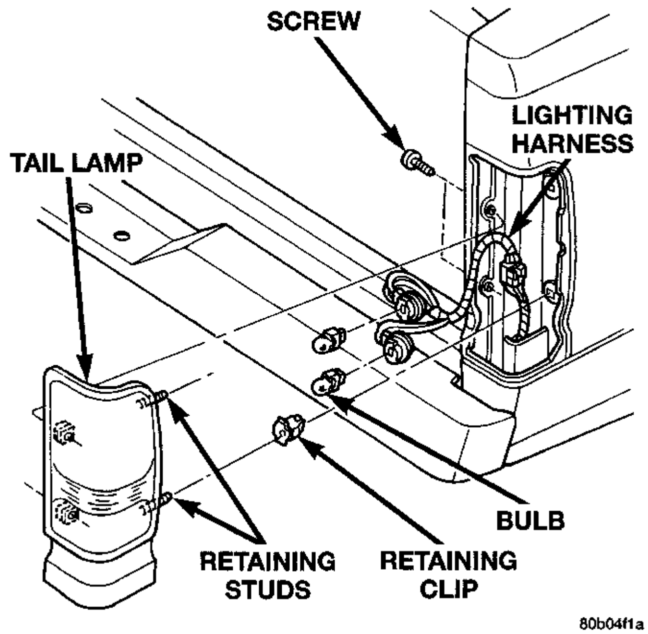


Fig. 6 Tail Lamp Assembly

(2) Position tail lamp in cargo box, engage retaining studs and install screws.
(3) Close tailgate.

TAIL, STOP, TURN SIGNAL AND BACK-UP LAMPS—CHASSIS CAB

REMOVAL

(1) Remove nuts holding tail lamp to mounting bracket (Fig. 7).
(2) Disengage tail lamp wire connector from body wire harness.
(3) Separate tail lamp from vehicle.

INSTALLATION

Reverse the removal procedure.

REAR IDENTIFICATION (ID) LAMPS

REMOVAL

Individual lamps may be replaced by removing the lamp from the light bar.
(1) Remove screws holding rear ID lamps to tailgate (Fig. 8).
(2) Separate ID lamps from tailgate.
(3) Disengage ID lamp wire connector from body wire harness.
(4) Separate ID lamp from vehicle.

INSTALLATION

Reverse the removal procedure.

AUTHENTIC RESTORATION PRODUCT

REMOVAL AND INSTALLATION (Continued)

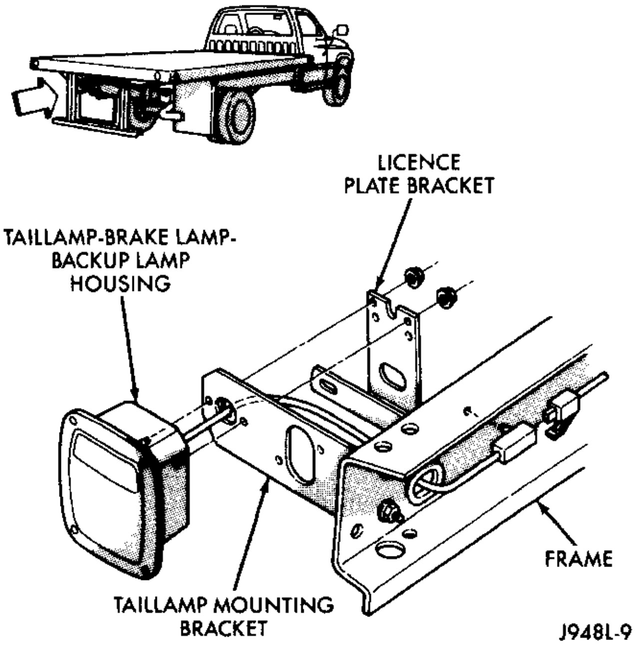


Fig. 7 Tail, Stop, Turn Signal and Back-up Lamps—Cab Chassis

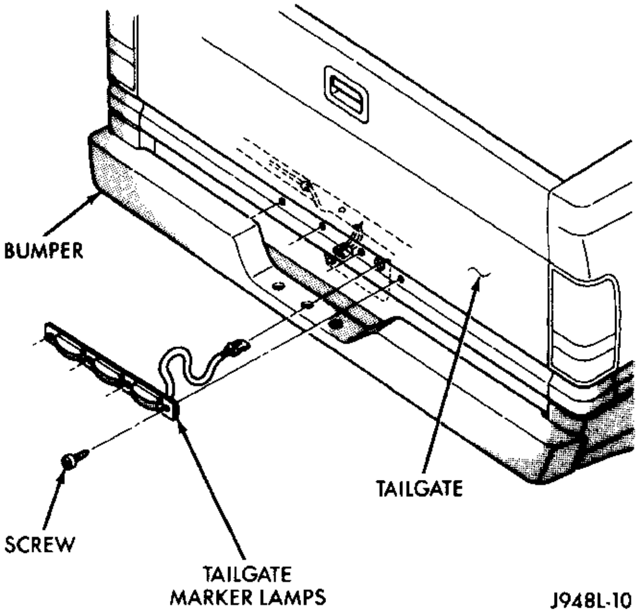


Fig. 8 Rear Identification Lamps

LICENSE PLATE LAMP

REMOVAL

(1) Remove screws holding license plate panel to cargo box.

(2) Disengage license plate lamp wire connector from body wire harness (Fig. 9).

(3) Separate license plate lamp from vehicle.

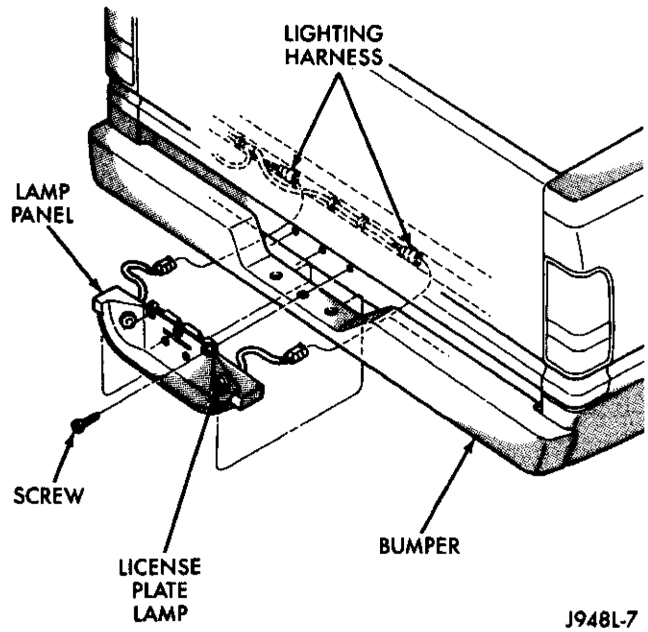


Fig. 9 License Plate Lamp Panel

INSTALLATION

Reverse the removal procedure.

DOME LAMP

REMOVAL

(1) Using a suitable flat blade screw driver, pry dome lamp lens from dome lamp.

(2) Remove screws holding dome lamp to roof reinforcement (Fig. 10).

(3) Separate dome lamp from roof.

(4) Disengage dome lamp wire connector from body wire harness.

(5) Separate dome lamp from vehicle.

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REMOVAL AND INSTALLATION (Continued)

INSTALLATION

(1) Position dome lamp at headliner.

(2) Connect dome lamp wire connector to body wire harness.

(3) Install screws holding dome lamp to roof reinforcement (Fig. 10).

(4) Place dome lamp lens on dome lamp and snap into place.

OVERHEAD CONSOLE READING LAMP

To service overhead console refer to Group 8C, Overhead Console.

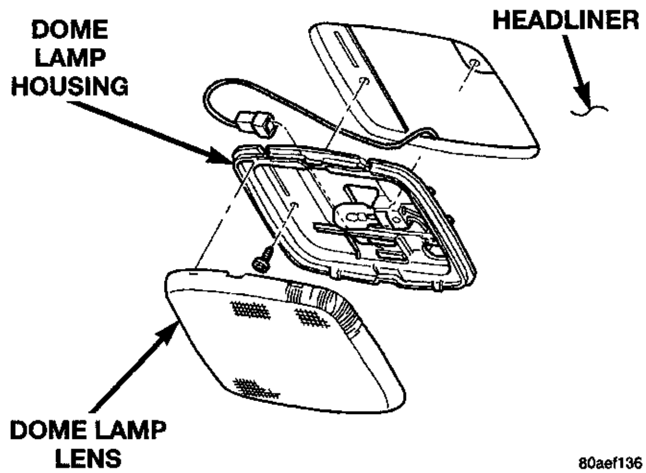

Fig. 10 Dome Lamp

AUTHENTIC RESTORATION PRODUCT

LAMP SYSTEMS

INDEX

REMOVAL AND INSTALLATION

DAYTIME RUNNING LAMP MODULE (DRLM)

REMOVAL

(1) Release hood latch an open hood.
(2) Disengage wire connector from DRLM (Fig. 1).
(3) Remove screws attaching DRLM to left front inner fender panel.
(4) Separate DRLM from fender.

INSTALLATION

(1) Position DRLM on fender.
(2) Install screws attaching DRLM to left front inner fender panel.
(3) Engage wire connector to DRLM (Fig. 1).
(4) Close hood.

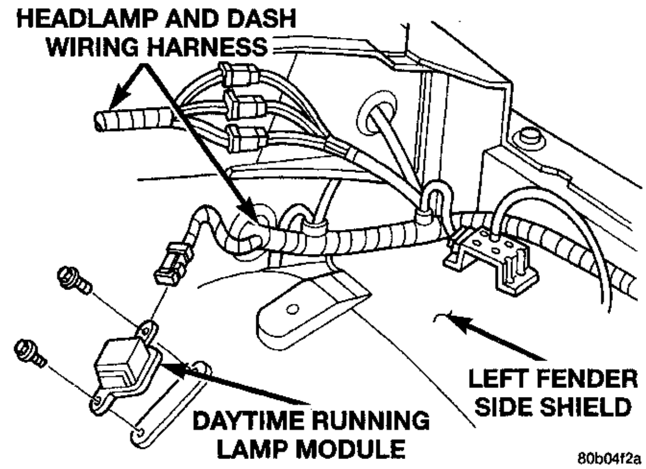

Fig. 1 Daytime Running Lamp Module (DRLM)

Mopar AUTHENTIC RESTORATION PRODUCT

BULB APPLICATION

INDEX

GENERAL INFORMATION

GENERAL INFORMATION

The following Bulb Application Tables lists the lamp title on the left side of the column and trade number or part number on the right.

CAUTION: Do not use bulbs that have a higher candle power than the bulb listed in the Bulb Application Table. Damage to lamp can result. Do not touch halogen bulbs with fingers or other oily surfaces. Bulb life will be reduced.

SPECIFICATIONS

EXTERIOR LAMPS

LAMP	BULB
Back-up	3157
Cargo	921
Center High Mounted Stop	921
Clearance	168
Headlamp	9004LL
License Plate	1155
License Plate—Step Bumper	168
Park/Turn Signal	3157NA
Snow Plow Control	161
Tail/Stop/Turn Signal	3157
Tail/Stop/Cab—Chassis	1157
Underhood	105

INTERIOR LAMPS

DIMMER CONTROLLED LAMPS

Service procedures for most of the lamps in the instrument panel, Instrument cluster and switches are located in Group 8E, Instrument Panel and Gauges. Some components have lamps that can only be serviced by a Authorized Service Center (ASC) after the component is removed from the vehicle. Contact local dealer for location of nearest ASC. When illumination goes out in the Electronic Instrument Cluster (EIC) the complete button module must be replaced. The Mechanical Instrument Cluster (MIC) uses PC194 bulbs for illumination.

LAMP	BULB
A/C Heater Control	158
Ash Receiver	161
Cigar Lighter	161
Headlamp Switch	158
Heater Control	158
Instrument Cluster	PC194
Radio	ASC

INDICATOR LAMPS

Service procedures for most of the lamps in the instrument panel, instrument cluster and switches are located in Group 8E, Instrument Panel and Gauges.

LAMP	BULB
Airbag High Line	PC194
Airbag low Line	PC74
Anti-lock Brake	PC74
Battery Voltage	PC194
Brake Warning	PC194
Check Engine	PC74
Engine Oil Pressure	PC74
Four Wheel Drive	PC194
High Beam	PC194
Low Fuel	PC194
Low Washer Fluid	PC74
Maintenance Required	PC74
Message Center	PC194
Seat Belt	PC74
Turn Signal	PC194
Upshift	PC74

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SPECIFICATIONS (Continued)

NON-DIMMING LAMPS

Some components have lamps that can only be serviced by a Authorized Service Center (ASC) after the component is removed from the vehicle. Contact local dealer for location of nearest ASC.

LAMP	BULB
Dome	1004
Glove Compartment	1891

PASSIVE RESTRAINT SYSTEMS

CONTENTS

AIRBAG SYSTEMS

INDEX

GENERAL INFORMATION

INTRODUCTION

A dual front airbag system is standard factory-installed equipment on this model. Refer to 8W-43 - Airbag System in Group 8W - Wiring Diagrams for complete circuit descriptions and diagrams.

AIRBAG SYSTEM

The driver side airbag system includes an inflatable airbag module in the center of the steering wheel. The passenger side airbag system includes a second inflatable airbag module in the instrument panel above the glove box. These supplemental restraint systems are designed to reduce serious injuries to the driver and front seat passenger during a frontal impact of the vehicle.

The primary passenger restraints in this vehicle are the standard equipment factory-installed seat belts, which require active use by the vehicle occupants. The airbag is a supplemental passive restraint system that was designed and is intended to enhance the protection for the front seat occupants of the vehicle **only** when used in conjunction with the seat belts. Refer to the owner's manual in the vehicle glove box for more information on the features, use and operation of all of the factory-installed passenger restraints, including the airbag system.

Following are general descriptions of the major components in the airbag system. To test the airbag system, refer to the proper Diagnostic Procedures manual. If an airbag module assembly is faulty or damaged and non-deployed, refer to the parts return list in the current Chrysler Corporation Warranty Policies and Procedures manual for the proper handling and disposal procedures.

GENERAL INFORMATION (Continued)

WARNING:

- THE AIRBAG SYSTEM IS A SENSITIVE, COMPLEX ELECTROMECHANICAL UNIT. BEFORE ATTEMPTING TO DIAGNOSE OR SERVICE ANY AIRBAG SYSTEM OR RELATED STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENTS YOU MUST FIRST DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE. THEN WAIT TWO MINUTES FOR THE SYSTEM CAPACITOR TO DISCHARGE BEFORE FURTHER SYSTEM SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE AIRBAG SYSTEM. FAILURE TO DO THIS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.
- THE AIRBAG MODULE INFLATOR ASSEMBLIES CONTAIN ARGON GAS PRESSURIZED TO OVER 2500 PSI. DO NOT ATTEMPT TO DISMANTLE AN AIRBAG MODULE OR TAMPER WITH ITS INFLATOR. DO NOT PUNCTURE, INCINERATE, OR BRING INTO CONTACT WITH ELECTRICITY. DO NOT STORE AT TEMPERATURES EXCEEDING 93° C (200° F).
- REPLACE AIRBAG SYSTEM COMPONENTS ONLY WITH PARTS SPECIFIED IN THE CHRYSLER MOPAR PARTS CATALOG. SUBSTITUTE PARTS MAY APPEAR INTERCHANGEABLE, BUT INTERNAL DIFFERENCES MAY RESULT IN INFERIOR OCCUPANT PROTECTION.
- THE FASTENERS, SCREWS, AND BOLTS ORIGINALLY USED FOR THE AIRBAG SYSTEM COMPONENTS HAVE SPECIAL COATINGS AND ARE SPECIFICALLY DESIGNED FOR THE AIRBAG SYSTEM. THEY MUST NEVER BE REPLACED WITH ANY SUBSTITUTES. ANY TIME A NEW FASTENER IS NEEDED, REPLACE IT WITH THE CORRECT FASTENERS PROVIDED IN THE SERVICE PACKAGE OR SPECIFIED IN THE CHRYSLER MOPAR PARTS CATALOG.
- WHEN A STEERING COLUMN HAS AN AIRBAG MODULE ATTACHED, NEVER PLACE THE COLUMN ON THE FLOOR OR ANY OTHER SURFACE WITH THE STEERING WHEEL OR AIRBAG MODULE FACE DOWN.

DESCRIPTION AND OPERATION

AIRBAG MODULE

DRIVER SIDE

The airbag module protective trim cover is the most visible part of the driver side airbag system. The module is mounted directly to the steering wheel. Located under the airbag module trim cover are the horn switch, the airbag cushion, and the airbag cushion supporting components. The airbag module includes a housing to which the cushion and inflator are attached and sealed. The airbag module cannot be repaired, and must be replaced if deployed or in any way damaged.

The inflator assembly is mounted to the back of the airbag module. The inflator includes a small canister of highly compressed argon gas. The inflator seals the hole in the airbag cushion so it can discharge the compressed gas it contains directly into the cushion when supplied with the proper electrical signal. The protective trim cover is fitted to the front of the airbag module and forms a decorative cover in the center of the steering wheel. Upon airbag deployment, this cover will split at a predetermined breakout line.

PASSENGER SIDE

The airbag door in the instrument panel top cover above the glove box is the most visible part of the passenger side airbag system. Located under the airbag door are the airbag cushion and its supporting components. The airbag module includes a housing to which the cushion and inflator are attached and sealed. The airbag module cannot be repaired, and must be replaced if deployed or in any way damaged.

The inflator assembly is mounted to the back of the airbag module. The inflator includes a small canister of highly compressed argon gas. The inflator seals the hole in the airbag cushion so it can discharge the compressed gas it contains directly into the cushion when supplied with the proper electrical signal. The airbag door has a living hinge at the top, which is secured to the instrument panel top cover. The door also has predetermined breakout lines concealed beneath its decorative cover. Upon airbag deployment, the airbag door will split at the breakout lines and the door will pivot out of the way.

The airbag module is secured at the bottom to the steel structural base of the instrument panel above the glove box opening. The airbag door is serviced as a unit with the passenger side airbag module, and includes the two passenger side heating and air conditioning panel outlet housings and barrels. Following an airbag deployment, the airbag module assembly must be replaced.

STORAGE

An airbag module must be stored in its original, special container until used for service. Also, it must be stored in a clean, dry environment; away from sources of extreme heat, sparks, and high electrical energy. Always place or store an airbag module on a surface with its trim cover or airbag side facing up, to minimize movement in case of an accidental deployment.

DESCRIPTION AND OPERATION (Continued)

AIRBAG CONTROL MODULE

The Airbag Control Module (ACM) is secured to a bracket on the floor panel transmission tunnel below the instrument panel inside the vehicle. The ACM mounting bracket also serves as the instrument panel center support. The ACM contains a microprocessor, the impact sensor, and an energy storage capacitor. The microprocessor contains the airbag system logic. The ACM system logic includes On-Board Diagnostics (OBD) capability, and communicates with the instrument cluster circuitry on the Chrysler Collision Detection (CCD) data bus to control the airbag indicator lamp.

The microprocessor in the ACM monitors the impact sensor signal and the airbag system electrical circuits to determine the system readiness. If the ACM detects a monitored system fault, it sends messages to the instrument cluster on the CCD data bus to turn on the airbag indicator lamp. A pre-programmed decision algorithm in the ACM microprocessor determines when the deceleration rate signaled by the impact sensor indicates an impact that is severe enough to require airbag system protection. When the programmed conditions are met, the ACM sends an electrical signal to deploy the airbag system components.

Only one impact sensor is used in this airbag system. The impact sensor is an accelerometer that senses the rate of vehicle deceleration, which provides verification of the direction and severity of an impact. The impact sensor is calibrated for the specific vehicle, and is only serviced as a unit with the ACM.

The ACM also contains an energy-storage capacitor. This capacitor stores enough electrical energy to deploy the airbags for up to one second following a battery disconnect or failure during an impact. The purpose of the capacitor is to provide airbag system protection in a severe secondary impact, if the initial impact has damaged or disconnected the battery, but was not severe enough to deploy the airbags.

Club cab and quad cab models of this vehicle are equipped with a structural seat belt control system. The structural seat belt control system includes a Seatbelt Control Timer Module (SCTM). The SCTM has a hard wired input to the ACM. If the ACM detects a fault input from the SCTM, or if the ACM does not detect an input from the SCTM, it sends messages to the instrument cluster on the CCD data bus to turn on the seat belt reminder lamp. See Structural Seat Belt Control System in this group for more information.

The ACM cannot be repaired or adjusted and, if damaged or faulty, it must be replaced.

CLOCKSPRING

The clockspring is mounted on the steering column behind the steering wheel. This assembly consists of a plastic housing which contains a flat, ribbon-like, electrically conductive tape that winds and unwinds with the steering wheel rotation.

The clockspring is used to maintain a continuous electrical circuit between the instrument panel wire harness and the driver side airbag module, the horn switch, and the vehicle speed control switches on vehicles that are so equipped.

The clockspring must be properly centered when it is installed on the steering column following any service removal, or it will be damaged. See Clockspring Centering in the Adjustments section of this group for the procedures.

The clockspring cannot be repaired. If the clockspring is faulty, damaged, or if the airbag has been deployed, the clockspring must be replaced.

PASSENGER AIRBAG DISARM SWITCH

A Passenger Airbag Disarm Switch (PADS) located on the instrument panel allows the passenger side airbag module to be disarmed when certain child restraint devices are being used in the right front seating position. The PADS is equipped with a key cylinder so that the switch position can only be changed using an ignition key. When the ignition switch is in the On position and the passenger side airbag is disarmed, a Light-Emitting Diode (LED) illuminates an “Off” indicator lamp on the face plate of the switch.

To actuate the PADS switch, insert the ignition key in the switch key cylinder. The PADS key cylinder is then rotated with the ignition key to its clockwise stop (the key cylinder slot will be aligned with the Off indicator lamp) to disarm the passenger side airbag. When the PADS key cylinder is rotated with the ignition key to its counterclockwise stop (the key cylinder slot will be in a vertical position), the Off indicator lamp will be extinguished and the passenger side airbag module will once again be armed.

WARNING: THE KEY MUST ALWAYS BE REMOVED FROM THE PASSENGER AIRBAG DISARM SWITCH KEY CYLINDER AFTER THE SWITCH HAS BEEN USED. NEVER LEAVE A KEY IN THE PADS KEY CYLINDER.

The PADS cannot be adjusted or repaired and, if faulty or damaged, the PADS unit must be replaced.

DIAGNOSIS AND TESTING

AIRBAG SYSTEM

A DRB scan tool is required for diagnosis of the airbag system. Refer to the proper Diagnostic Procedures manual for more information.

(1) Connect the DRB scan tool to the 16-way data link wire harness connector. The connector is located on the driver side lower edge of the instrument panel, inboard of the steering column (Fig. 1) .

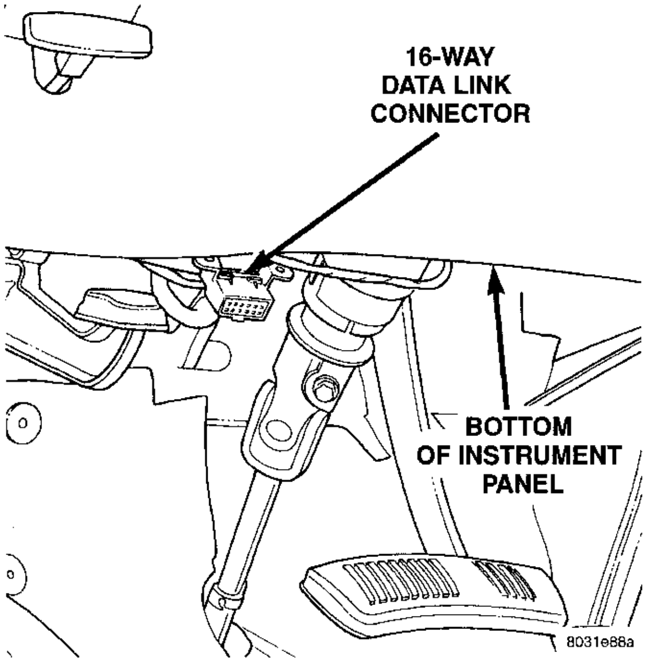

Fig. 1 16-Way Data Link Connector - Typical

(2) Turn the ignition switch to the On position. Exit the vehicle with the DRB. Use the latest version of the proper DRB cartridge.

(3) Using the DRB, read and record the active Diagnostic Trouble Code (DTC) data.

(4) Read and record any stored DTC data.

(5) Refer to the proper Diagnostic Procedures manual if any DTC is found in Step 3 or Step 4.

(6) Erase the stored DTC data. If any problems remain, the stored DTC data will not erase.

(7) With the ignition switch still in the On position, make sure nobody is in the vehicle.

(8) From outside of the vehicle (away from the airbag modules in case of an accidental deployment) turn the ignition switch to the Off position for about ten seconds, and then back to the On position. Observe the airbag indicator lamp in the instrument cluster. It should light for six to eight seconds, and then go out. This indicates that the airbag system is functioning normally.

NOTE: If the airbag indicator lamp fails to light, or lights and stays on, there is an airbag system malfunction. Refer to the proper Diagnostic Procedures manual to diagnose the problem.

NOTE: All extended cab models (club cab or quad cab) are equipped with a structural seat, which uses an electronic structural seat belt control system to control the latching and unlatching of the integral seat belt retractors. The structural seat belt control system MUST be tested to ensure proper operation following the service of any airbag system component. See Seat Belt Control System Test Mode in the Seat Belt Control Systems section of this group for the test procedure.

SERVICE PROCEDURES

AIRBAG SYSTEM

NON-DEPLOYED

At no time should any source of electricity be permitted near the inflator on the back of an airbag module. When carrying a non-deployed airbag module, the trim cover or airbag side of the module should be pointed away from the body to minimize injury in the event of an accidental deployment. If the module is placed on a bench or any other surface, the trim cover or airbag side of the module should be face up to minimize movement in the event of an accidental deployment.

In addition, the airbag system should be disarmed whenever any steering wheel, steering column, or instrument panel components require diagnosis or service. Failure to observe this warning could result in accidental airbag deployment and possible personal injury. Refer to Group 8E - Instrument Panel Systems for additional service procedures on the instrument panel. Refer to Group 19 - Steering for additional service procedures on the steering wheel and steering column.

DEPLOYED

Any vehicle which is to be returned to use after an airbag deployment, must have both airbag modules, the clockspring, and the steering column assembly replaced. These components will be damaged or weakened as a result of an airbag deployment, which may or may not be obvious during a visual inspection, and are not intended for reuse.

Other vehicle components should be closely inspected, but are to be replaced only as required by the extent of the visible damage incurred.

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SERVICE PROCEDURES (Continued)

CLEANUP PROCEDURE

Following an airbag system deployment, the vehicle interior may contain a powdery residue. This residue consists of harmless particulate by-products of the small pyrotechnic charge used to initiate the airbag deployment. However, this residue may cause irritation to the skin, eyes, nose, or throat, be sure to wear safety glasses, rubber gloves, and a long-sleeved shirt during cleanup (Fig. 2) .

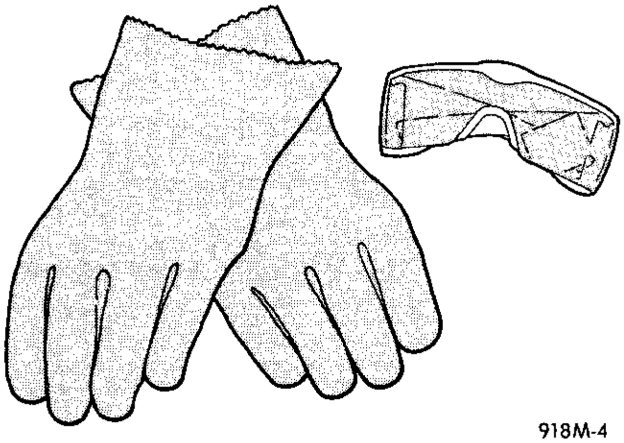

Fig. 2 Wear Safety Glasses and Rubber Gloves

WARNING: IF YOU EXPERIENCE SKIN IRRITATION DURING CLEANUP, RUN COOL WATER OVER THE AFFECTED AREA. ALSO, IF YOU EXPERIENCE IRRITATION OF THE NOSE OR THROAT, EXIT THE VEHICLE FOR FRESH AIR UNTIL THE IRRITATION CEASES. IF IRRITATION CONTINUES, SEE A PHYSICIAN.

Begin the cleanup by removing the airbag modules from the vehicle as described in this group.

Use a vacuum cleaner to remove any residual powder from the vehicle interior. Clean from outside the vehicle and work your way inside, so that you avoid kneeling or sitting on a non-cleaned area.

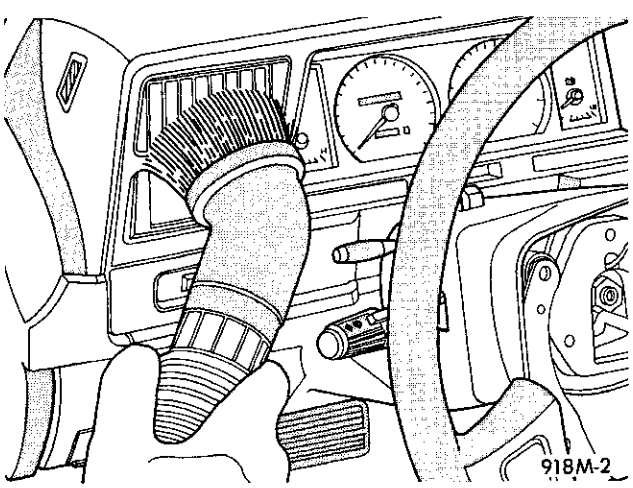

Fig. 3 Vacuum Heater and A/C Outlets

Be sure to vacuum the heater and air conditioning outlets as well (Fig. 3). Run the heater and air conditioning blower on the lowest speed setting and vacuum any powder expelled from the outlets. You may need to vacuum the interior of the vehicle a second time to recover all of the powder .

Place the deployed airbag modules in your vehicular scrap pile.

REMOVAL AND INSTALLATION

AIRBAG MODULE

WARNING:

• THE AIRBAG SYSTEM IS A SENSITIVE, COMPLEX ELECTROMECHANICAL UNIT. BEFORE ATTEMPTING TO DIAGNOSE OR SERVICE ANY AIRBAG SYSTEM OR RELATED STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENTS YOU MUST FIRST DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE. THEN WAIT TWO MINUTES FOR THE SYSTEM CAPACITOR TO DISCHARGE BEFORE FURTHER SYSTEM SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE AIRBAG SYSTEM. FAILURE TO DO THIS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

• WHEN REMOVING A DEPLOYED AIRBAG MODULE, RUBBER GLOVES, EYE PROTECTION, AND A LONG-SLEEVED SHIRT SHOULD BE WORN. THERE MAY BE DEPOSITS ON THE AIRBAG MODULE AND OTHER INTERIOR SURFACES. IN LARGE DOSES, THESE DEPOSITS MAY CAUSE IRRITATION TO THE SKIN AND EYES.

DRIVER SIDE

(1) Disconnect and isolate the battery negative cable. If the airbag has not been deployed, wait two minutes for the system capacitor to discharge before further service.

(2) From the underside of the steering wheel, remove the two screws that secure the driver side airbag module to the steering wheel.

(3) Pull the airbag module away from the steering wheel far enough to access the wire harness connectors on the back of the airbag module.

(4) Unplug the airbag module and horn switch wire harness connectors from the back of the airbag module.

(5) Remove the driver side airbag module from the steering wheel.

REMOVAL AND INSTALLATION (Continued)

(6) If the airbag has been deployed, the clockspring and steering column must be replaced. See Clockspring in the Removal and Installation section of this group for the clockspring service procedures. Refer to Group 19 - Steering for the steering column service procedures.

(7) When installing the airbag module, connect the clockspring wire harness connector to the module by pressing straight in on the connector. Be certain that the connector is fully engaged by listening for a faint click. When the click is heard, the connector is latched.

(8) Connect the horn switch wire harness connector.

(9) Position the airbag module in the steering wheel. Be certain that the airbag and horn wiring is not pinched between the airbag module and the steering wheel armature.

(10) Install the airbag module mounting screws. Tighten the mounting screws to 10.2 N·m (90 in. lbs.).

(11) Do not connect the battery negative cable at this time. See Airbag System in the Diagnosis and Testing section of this group for the proper procedures.

PASSENGER SIDE

WARNING: THE PANEL OUTLET BARRELS INSTALLED IN THE PASSENGER SIDE AIRBAG DOOR PANEL OUTLET HOUSINGS MUST NEVER BE REINSTALLED FOLLOWING REMOVAL FOR ANY REASON. THEY MUST BE REPLACED WITH NEW BARRELS. REFER TO DUCTS AND OUTLETS IN THE REMOVAL AND INSTALLATION SECTION OF GROUP 24 - HEATING AND AIR CONDITIONING FOR THE SERVICE PROCEDURES. FAILURE TO OBSERVE THIS WARNING COULD RESULT IN OCCUPANT INJURIES UPON AIRBAG DEPLOYMENT.

(1) Disconnect and isolate the battery negative cable. If the airbag has not been deployed, wait two minutes for the system capacitor to discharge before further service.

(2) Remove the glove box from the instrument panel. Refer to Glove Box in the Removal and Installation section of Group 8E - Instrument Panel Systems for the procedures.

(3) Remove the glove box opening upper trim strip from the instrument panel. Refer to Glove Box Opening Upper Trim Strip in the Removal and Installation section of Group 8E - Instrument Panel Systems for the procedures.

(4) Remove the four screws that secure the two plastic support brackets of the passenger side airbag door panel outlet housing to the glove box opening upper reinforcement.

(5) Reach through and above the glove box opening to access and unplug the passenger side airbag module wire harness connector (Fig. 4) .

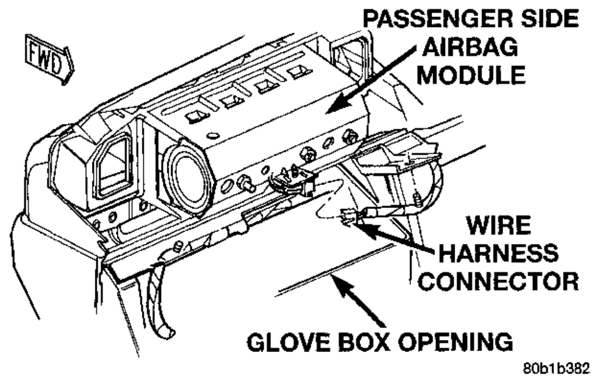

Fig. 4 Passenger Side Airbag Module Wire Harness Connector

(6) Remove the two screws that secure the passenger side airbag module front bracket to the instrument panel (Fig. 5) .

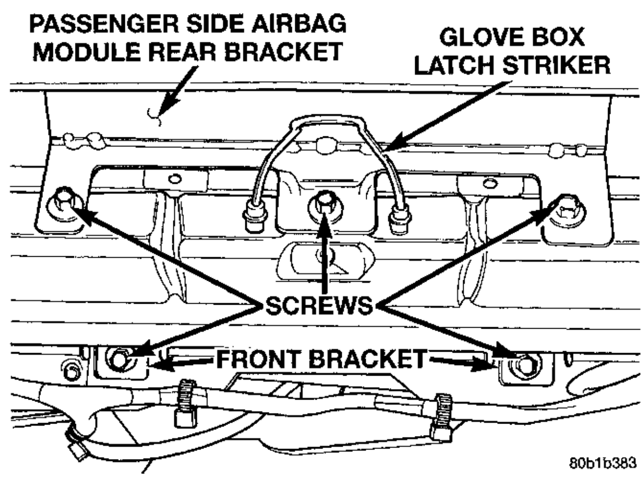

Fig. 5 Passenger Side Airbag Module Remove/Install

(7) Remove the three screws that secure the passenger side airbag module rear bracket to the glove box opening upper reinforcement.

(8) Using a trim stick or another suitable wide flat-bladed tool and starting at the lower left edge, gently pry the passenger side airbag door away from the instrument panel top cover to release the five snap retainers (Fig. 6) .

(9) Remove the passenger side airbag module and door from the instrument panel as a unit.

(10) Inspect the five slots in the instrument panel top cover airbag door opening and remove any airbag door snap retainers that did not remain on the airbag door tabs during removal.

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REMOVAL AND INSTALLATION (Continued)

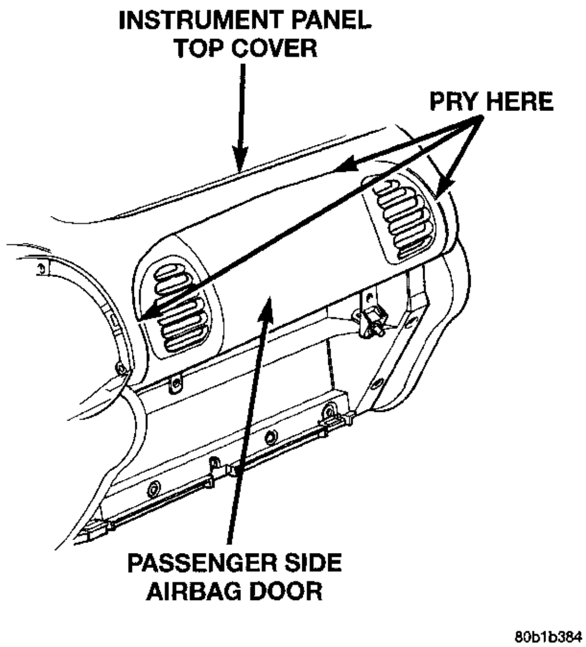

Fig. 6 Passenger Side Airbag Door Remove/Install

(11) Reverse the removal procedures to install. When reinstalling the airbag door to the instrument panel top cover, be certain that the snap retainers on the airbag door tabs are fully engaged in the five instrument panel top cover slots. Tighten the four passenger side airbag door panel outlet housing plastic support bracket mounting screws to 2.2 N·m (20 in. lbs.). Tighten the passenger side airbag module front and rear bracket mounting screws to 9 N·m (80 in. lbs.).

(12) Before reinstalling the glove box, be certain that the airbag module wire harness connector latches are fully engaged.

(13) Do not connect the battery negative cable at this time. See Airbag System in the Diagnosis and Testing section of this group for the proper procedures.

DRIVER SIDE AIRBAG TRIM COVER AND HORN SWITCH

WARNING:

• THE AIRBAG SYSTEM IS A SENSITIVE, COMPLEX ELECTROMECHANICAL UNIT. BEFORE ATTEMPTING TO DIAGNOSE OR SERVICE ANY AIRBAG SYSTEM OR RELATED STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENTS YOU MUST FIRST DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE. THEN WAIT TWO MINUTES FOR THE SYSTEM CAPACITOR TO DISCHARGE BEFORE FURTHER SYSTEM SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE AIRBAG SYSTEM. FAILURE TO DO THIS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

• THE HORN SWITCH IS INTEGRAL TO THE AIRBAG MODULE TRIM COVER. SERVICE OF THIS COMPONENT SHOULD BE PERFORMED ONLY BY CHRYSLER-TRAINED AND AUTHORIZED DEALER SERVICE TECHNICIANS. FAILURE TO TAKE THE PROPER PRECAUTIONS OR TO FOLLOW THE PROPER PROCEDURES COULD RESULT IN ACCIDENTAL, INCOMPLETE, OR IMPROPER AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(1) Disconnect and isolate the battery negative cable. If the airbag has not been deployed, wait two minutes for the system capacitor to discharge before further service.

(2) Remove the driver side airbag module from the steering wheel. See Airbag Module in the Removal and Installation section of this group for the procedures.

(3) Disengage the horn switch feed wire retainer from the hole in the trim cover retainer on the back of the airbag housing.

(4) Remove the three nuts that secure the trim cover retainer to the studs on the airbag housing.

(5) Remove the horn switch ground wire eyelet from the lower left airbag housing stud.

(6) Remove the trim cover retainer from the airbag housing studs.

(7) Disengage the six trim cover locking blocks from the lip around the outside edge of the airbag housing and remove the housing from the cover.

WARNING: USE EXTREME CARE TO PREVENT ANY FOREIGN MATERIAL FROM ENTERING THE DRIVER SIDE AIRBAG MODULE, OR BECOMING ENTRAPPED BETWEEN THE DRIVER SIDE AIRBAG MODULE TRIM COVER AND THE DRIVER SIDE AIRBAG MODULE. FAILURE TO OBSERVE THIS WARNING COULD RESULT IN OCCUPANT INJURIES UPON AIRBAG DEPLOYMENT.

(8) When reinstalling the trim cover and horn switch, be certain that the locking blocks are fully engaged on the lip of the airbag housing (Fig. 7) .

(9) When reinstalling the trim cover retainer, be certain that the tabs on the retainer are engaged in each of the retainer slots of the trim cover.

(10) Install the horn switch ground wire eyelet over the lower left airbag housing stud.

(11) Install and tighten the trim cover retainer nuts to 10 N·m (90 in. lbs.).

(12) Reverse the remaining removal procedures to complete the installation, but do not connect the battery negative cable at this time. See Airbag System

REMOVAL AND INSTALLATION (Continued)

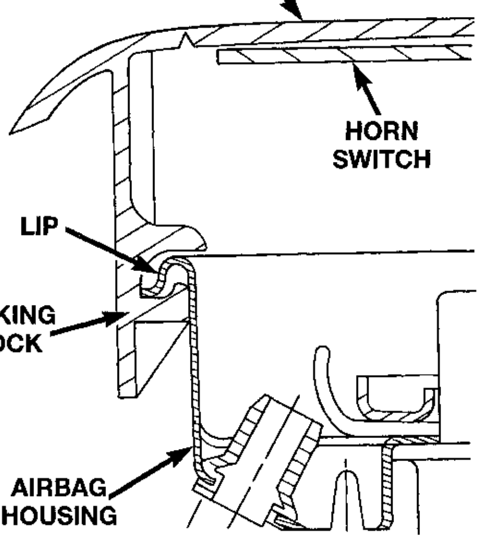

Fig. 7 Airbag Trim Cover Locking Blocks Installed

in the Diagnosis and Testing section of this group for the proper procedures.

PASSENGER AIRBAG DISARM SWITCH

WARNING: THE AIRBAG SYSTEM IS A SENSITIVE, COMPLEX ELECTROMECHANICAL UNIT. BEFORE ATTEMPTING TO DIAGNOSE OR SERVICE ANY AIRBAG SYSTEM OR RELATED STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENTS YOU MUST FIRST DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE. THEN WAIT TWO MINUTES FOR THE SYSTEM CAPACITOR TO DISCHARGE BEFORE FURTHER SYSTEM SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE AIRBAG SYSTEM. FAILURE TO DO THIS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(1) Disconnect and isolate the battery negative cable. If the airbag has not been deployed, wait two minutes for the system capacitor to discharge before further service.

(2) Remove the cluster bezel from the instrument panel. Refer to Cluster Bezel in the Removal and Installation section of Group 8E - Instrument Panel Systems for the procedures.

(3) Remove the glove box from the instrument panel. Refer to Glove Box in the Removal and Installation section of Group 8E - Instrument Panel Systems for the procedures.

(4) Remove the three screws that secure the switch mounting plate to the instrument panel (Fig. 8) .

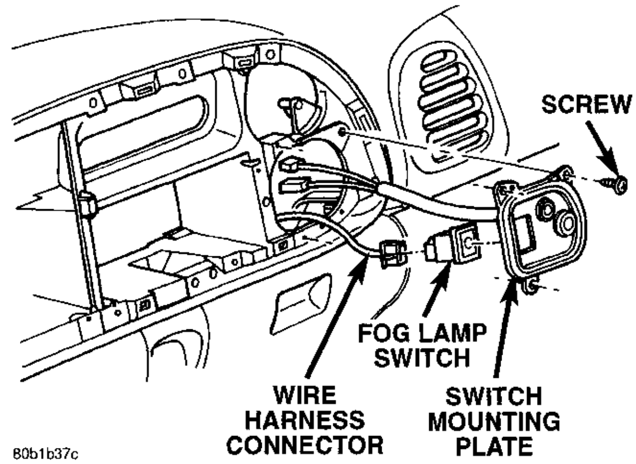

Fig. 8 Switch Mounting Plate Remove/Install

(5) If the vehicle is equipped with fog lamps, pull the switch mounting plate away from the instrument panel far enough to access and unplug the wire harness connector from the back of the fog lamp switch.

(6) Reach through the glove box opening to access and unplug the two passenger airbag disarm switch wire harness connectors, located on a bracket on the inboard glove box opening reinforcement (Fig. 9) .

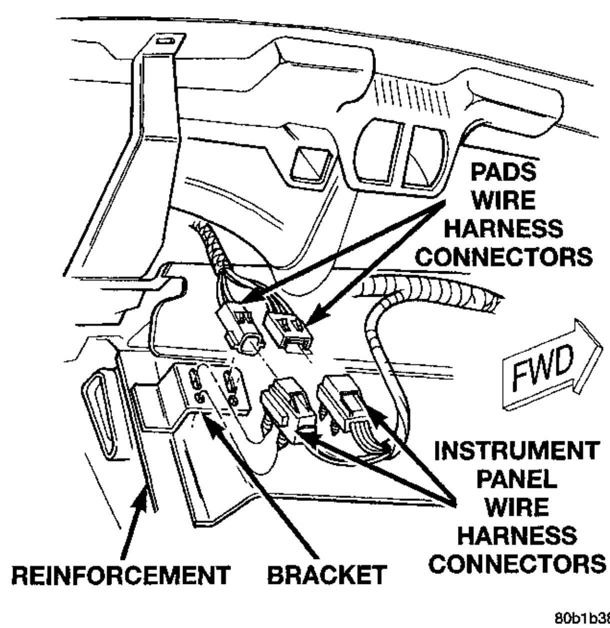

Fig. 9 Passenger Airbag Disarm Switch Connectors

(7) Remove the switch mounting plate and passenger airbag disarm switch from the instrument panel as a unit.

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REMOVAL AND INSTALLATION (Continued)

(8) Remove the three screws that secure the passenger airbag disarm switch to the switch mounting plate (Fig. 10) .

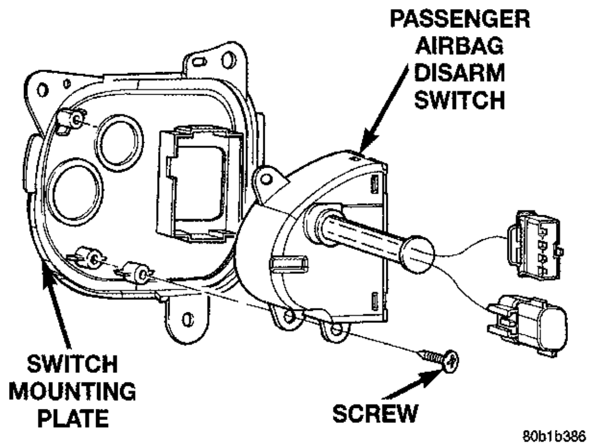

Fig. 10 Passenger Airbag Disarm Switch Remove/ Install

(9) Remove the passenger airbag disarm switch from the switch mounting plate.

(10) Reverse the removal procedures to install. Tighten the mounting screws to 2.2 N·m (20 in. lbs.).

(11) Do not connect the battery negative cable at this time. See Airbag System in the Diagnosis and Testing section of this group for the proper procedures.

AIRBAG CONTROL MODULE

WARNING:

• THE AIRBAG CONTROL MODULE CONTAINS THE IMPACT SENSOR, WHICH ENABLES THE SYSTEM TO DEPLOY THE AIRBAG. BEFORE ATTEMPTING TO DIAGNOSE OR SERVICE ANY AIRBAG SYSTEM OR RELATED STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENTS YOU MUST FIRST DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE. THEN WAIT TWO MINUTES FOR THE SYSTEM CAPACITOR TO DISCHARGE BEFORE FURTHER SYSTEM SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE AIRBAG SYSTEM. FAILURE TO DO THIS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

• NEVER STRIKE OR KICK THE AIRBAG CONTROL MODULE, AS IT CAN DAMAGE THE IMPACT SENSOR OR AFFECT ITS CALIBRATION. IF AN AIRBAG CONTROL MODULE IS ACCIDENTALLY DROPPED DURING SERVICE, THE MODULE MUST BE SCRAPPED AND REPLACED WITH A NEW UNIT.

(1) Disconnect and isolate the battery negative cable. If the airbag has not been deployed, wait two minutes for the system capacitor to discharge before further service.

(2) If the vehicle is equipped with a manual transmission, remove the center console from the floor panel transmission tunnel. Refer to Group 23 - Body for the procedures.

(3) If the vehicle is equipped with an automatic transmission, remove the two screws that secure the trim cover to the airbag control module mounting bracket, then pull the top of the trim cover rearward to release the two snap clips from the instrument panel support bracket (Fig. 11) .

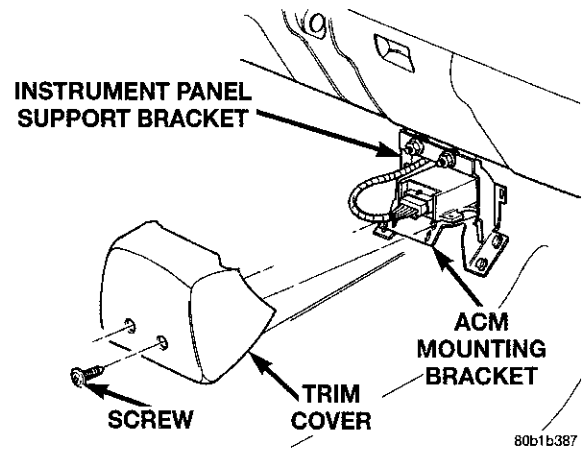

Fig. 11 Airbag Control Module Trim Cover Remove/ Install

(4) Loosen but do not remove the two screws on the sides that secure the instrument panel support bracket to the airbag control module mounting bracket (Fig. 12) .

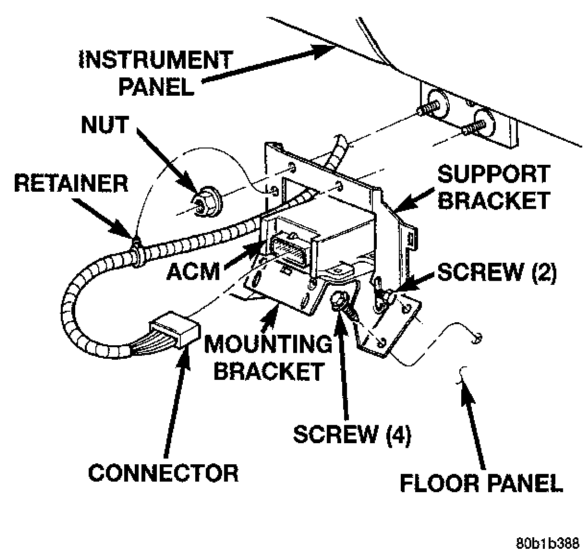

Fig. 12 Airbag Control Module Remove/Install

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REMOVAL AND INSTALLATION (Continued)

(5) Remove the two nuts that secure the support bracket to the stubs on the lower instrument panel.

(6) Disengage the wire harness retainer from the hole in the support bracket.

(7) Pull the top of the support bracket away from the instrument panel studs and fold it down over the airbag control module until it is laying on the floor panel.

(8) Unplug the wire harness connector from the airbag control module.

NOTE: Always remove and replace the airbag control module and its mounting bracket as a unit. Replacement modules include a replacement mounting bracket. Do not transfer the module to another mounting bracket.

(9) Remove the four screws that secure the mounting bracket to the floor panel transmission tunnel.

(10) Remove the airbag control module, the mounting bracket and the support bracket as a unit from the floor panel.

(11) When installing the airbag control module, position the unit with the arrow on the module housing pointing forward.

(12) Attach the ACM to the floor panel transmission tunnel with the four mounting screws.

(13) Reverse the removal procedures to install. Before installing the trim cover or the floor console, be certain that the airbag control module wire harness connector latches are fully engaged and that the connector lock is pushed in. Tighten the mounting hardware as follows:

- Mounting bracket screws - 14 N·m (125 in. lbs.)
- Support bracket nuts - 14 N·m (125 in. lbs.)
- Trim cover screws - 2.2 N·m (20 in. lbs.).

(14) Do not connect the battery negative cable at this time. See Airbag System in the Diagnosis and Testing section of this group for the proper procedures.

CLOCKSPRING

WARNING: THE AIRBAG SYSTEM IS A SENSITIVE, COMPLEX ELECTROMECHANICAL UNIT. BEFORE ATTEMPTING TO DIAGNOSE OR SERVICE ANY AIRBAG SYSTEM OR RELATED STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENTS YOU MUST FIRST DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE. THEN WAIT TWO MINUTES FOR THE SYSTEM CAPACITOR TO DISCHARGE BEFORE FURTHER SYSTEM SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE AIRBAG SYSTEM. FAILURE TO DO THIS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(1) Turn the steering wheel until the front wheels are in the straight-ahead position before starting the procedure.

(2) Disconnect and isolate the battery negative cable. If the airbag has not been deployed, wait two minutes for the system capacitor to discharge before further service.

(3) Remove the driver side airbag module from the steering wheel. See Airbag Module in the Removal and Installation section of this group for the procedures.

(4) If the vehicle is equipped with the optional vehicle speed control, unplug the wire harness connectors from the speed control switches in the steering wheel.

(5) Remove the nut that secures the steering wheel to the steering column upper shaft.

(6) Remove the steering wheel with a steering wheel puller (Special Tool C-3428-B).

(7) Remove the steering column opening cover and knee blocker from the instrument panel. Refer to Steering Column Opening Cover and Knee Blocker in the Removal and Installation section of Group 8E - Instrument Panel Systems for the procedures.

(8) If the vehicle is so equipped, remove the tilt steering column lever.

(9) Remove both the upper and lower shrouds from the steering column (Fig. 13) .

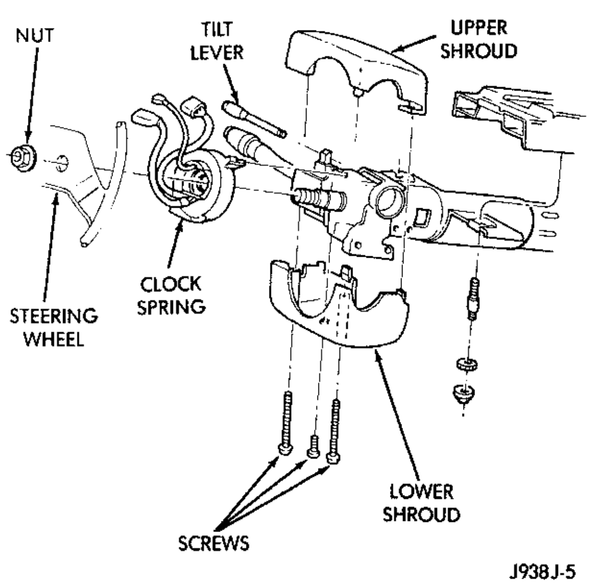

Fig. 13 Steering Column Shrouds Remove/Install - Typical

(10) Remove the lower fixed column shroud from the steering column.

(11) Unplug the wire harness connectors from the clockspring.

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REMOVAL AND INSTALLATION (Continued)

(12) Unplug the wire harness connector between the clockspring and the instrument panel wire harness, located on the instrument panel lower reinforcement underneath the steering column.

(13) To remove the clockspring, carefully lift the locating fingers of the clockspring assembly from the steering column as necessary. The clockspring cannot be repaired. It must be replaced if faulty or damaged, or if the airbag has been deployed.

CAUTION: Before installing the clockspring, be certain that the front wheels are still in the straight-ahead position.

(14) When installing the clockspring, snap the clockspring onto the steering column. If the clockspring is not positioned properly in relation to the steering wheel, see Clockspring Centering in the Adjustments section of this group before installing the steering wheel.

(15) Plug the clockspring wire harness connector into the instrument panel wire harness. Be certain that the wire harness locator clips are properly seated on the outside of the wiring trough and that the connector latches are fully engaged.

(16) Reinstall the steering column shrouds. Be certain that the clockspring wire harness is inside the shrouds.

(17) Reinstall the steering column opening cover and knee blocker to the instrument panel. Refer to Steering Column Opening Cover and Knee Blocker in the Removal and Installation section of Group 8E - Instrument Panel Systems for the procedures.

(18) The front wheels should still be in the straight-ahead position. Install the steering wheel being certain to index the flats on the hub of the steering wheel with the formations on the inside of the clockspring. Pull the wire harnesses from the clockspring through the upper and lower holes between the steering wheel back trim cover and the steering wheel armature. Tighten the steering wheel nut to 61 N·m (45 ft. lbs.). Be certain not to pinch the wiring between the steering wheel and the nut.

(19) If the vehicle is so equipped, plug in the wire harness connectors to the vehicle speed control switches. Be certain that the speed control switch wire harnesses are routed between the steering wheel back trim cover and the steering wheel armature.

(20) Install the driver side airbag module onto the steering wheel. See Airbag Module in the Removal and Installation section of this group for the procedures.

ADJUSTMENTS

CLOCKSPRING CENTERING

The clockspring is designed to wind and unwind when the steering wheel is rotated, but is only designed to rotate the same number of turns (about five complete rotations) as the steering wheel can be turned from stop to stop. If the rotating tape within the clockspring is not indexed properly to the steering wheel and the front wheels, the clockspring may become wound too tight and fail during use. The clockspring must be centered if it is not known to be properly indexed, or if the front wheels were moved from the straight-ahead position with the clockspring removed during any service procedure.

WARNING: THE AIRBAG SYSTEM IS A SENSITIVE, COMPLEX ELECTROMECHANICAL UNIT. BEFORE ATTEMPTING TO DIAGNOSE OR SERVICE ANY AIRBAG SYSTEM OR RELATED STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENTS YOU MUST FIRST DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE. THEN WAIT TWO MINUTES FOR THE SYSTEM CAPACITOR TO DISCHARGE BEFORE FURTHER SYSTEM SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE AIRBAG SYSTEM. FAILURE TO DO THIS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(1) Turn the steering wheel until the front wheels are in the straight-ahead position before starting the centering procedure.

(2) Disconnect and isolate the battery negative cable. If the airbag has not been deployed, wait two minutes for the system capacitor to discharge before further service.

(3) Remove the driver side airbag module from the steering wheel. See Airbag Module in the Removal and Installation section of this group for the procedures.

(4) If the vehicle is equipped with the optional vehicle speed control, unplug the wire harness connectors from the speed control switches in the steering wheel.

(5) Remove the nut that secures the steering wheel to the steering column upper shaft.

(6) Remove the steering wheel with a steering wheel puller (Special Tool C-3428-B).

(7) Depress the two plastic clockspring auto-locking tabs (Fig. 14) .

(8) Keeping the locking mechanism disengaged, rotate the clockspring rotor clockwise to the end of its travel. **Do not apply excessive torque.**

(9) From the end of the clockwise travel, rotate the rotor about two and one-half turns counterclockwise.

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ADJUSTMENTS (Continued)

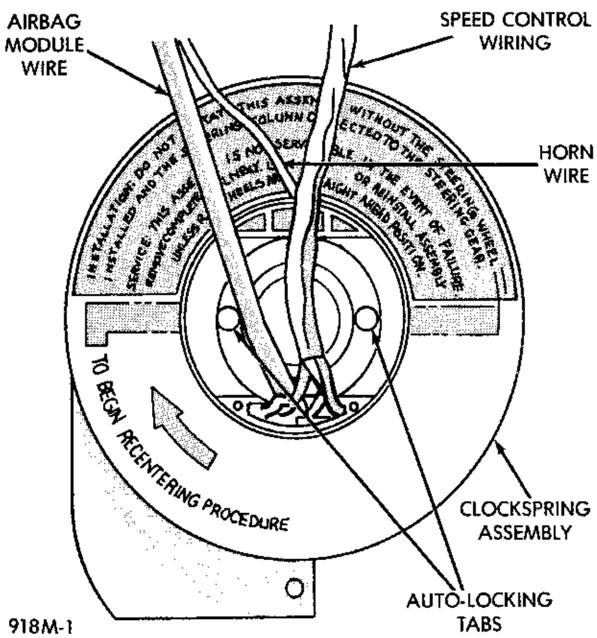


Fig. 14 Clockspring Auto-Locking Tabs

The clockspring horn wire harness should end up at the top, and the airbag wire harness and optional speed control switch wire harnesses at the bottom.

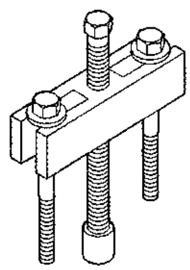
(10) The front wheels should still be in the straight-ahead position. Install the steering wheel being certain to index the flats on the hub of the steering wheel with the formations on the inside of the clockspring. Pull the wire harnesses from the clockspring through the upper and lower holes between the steering wheel back trim cover and the steering wheel armature. Tighten the steering wheel nut to 61 N·m (45 ft. lbs.). Be certain not to pinch the wiring between the steering wheel and the nut.

(11) If the vehicle is so equipped, plug in the wire harness connectors to the vehicle speed control switches. Be certain that the speed control switch wire harnesses are routed between the steering wheel back trim cover and the steering wheel armature.

(12) Install the driver side airbag module onto the steering wheel. See Airbag Module in the Removal and Installation section of this group for the procedures.

SPECIAL TOOLS

STEERING WHEEL



Puller C-3428-B

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SEAT BELT CONTROL SYSTEMS

INDEX

GENERAL INFORMATION

INTRODUCTION

A structural seat belt control system is standard factory-installed equipment on all extended cab (club cab and quad cab) versions of this model. Refer to 8W-67 - Restraint System in Group 8W - Wiring Diagrams for complete circuit descriptions and diagrams.

STRUCTURAL SEAT BELT CONTROL SYSTEM

A structural seat with driver and passenger side integrated seat belt retractors and height adjusters is standard equipment on all extended cab (club cab and quad cab) models. In this system the seat belts are anchored to the seat back frame instead of the vehicle body, providing easier access to the rear seating area of the vehicle.

However, because the structural seat system has the seat belt and retractor mounted on a movable reclining seat back frame, a typical inertia-type mechanism cannot be used to latch the seat belt retractor. Therefore, an electronic structural seat belt control system is used to actuate the seat belt retractor latches. The structural seat belt control system consists of a Seatbelt Control Timer Module (SCTM) and two electric seat belt retractor latch solenoids, one for each front outboard seating position.

The structural seat belt control system also has a test mode feature. This feature allows the seat belt control system to be tested for proper operation while the vehicle is stationary by overriding the normal SCTM control functions. The seat belt control system **must** be tested for proper operation following the service of any seat belt control system or airbag system component. See Seat Belt Control System Test Mode on the Diagnosis and Testing section of this group for more information.

Following are general descriptions of the major components in the structural seat belt control system. Refer to the owner's manual in the vehicle glove box for more information on the features, use and operation of all of the factory-installed passenger restraints, including the structural seat belt system.

DESCRIPTION AND OPERATION

SEATBELT CONTROL TIMER MODULE

The Seatbelt Control Timer Module (SCTM) is secured to a bracket underneath the front edge of the front seat center cushion. The SCTM mounting bracket also serves as the support for the slide-out rear seat cup holder unit. The SCTM controls the supply of battery current to both of the front seat belt retractor latch solenoids. The SCTM contains an electromechanical Gravity (G)-sensor and an electronic timer circuit. The SCTM monitors the ignition switch state and both door jamb switches through hard wired inputs. In response to those inputs, the SCTM controls hard wired outputs to both seat belt retractor latch solenoids. The SCTM also sends diagnostic outputs to the Airbag Control Module (ACM) over a hard wired fault circuit.

The SCTM provides battery current to energize the seat belt retractor latch solenoids whenever the ignition switch is in the On or Accessory positions, unless the G-sensor input indicates a vehicle condition that requires the seat belt retractor to be latched. When the seat belt retractor latch solenoids are energized the retractor spools are unlatched, and the seat belt webbing can be extracted from the retractor. When the solenoids are de-energized the retractor spools latch, preventing the seat belt webbing from being extracted further from the retractor. This logic ensures that the seat belts will latch and/or remain latched if battery power is lost during a vehicle collision.

The electromechanical G-sensor within the SCTM monitors the rate of vehicle acceleration and deceleration in any horizontal direction. The G-sensor also

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DESCRIPTION AND OPERATION (Continued)

responds to the horizontal attitude of the vehicle. If the G-sensor monitors a gravity force of greater than about 0.7G in any horizontal direction, or that the vehicle is tilted in any direction at an angle of greater than about 45 degrees, the SCTM will sense the input from the G-sensor and de-energize the seat belt retractor latch solenoids, which will cause the retractors to latch.

The SCTM electronic timer circuit provides the vehicle occupants with the ability to extract the seat belt webbing from the retractor spool for a time period of about 30 minutes after the ignition switch is turned to the Off position. The electronic timer circuit also monitors the state of the door jamb switches, and unlatches the seat belt retractors after either door jamb switch cycles from open to closed or from closed to open. Each time the SCTM receives an input indicating a change in the state of a monitored switch has occurred, the 30 minute timer starts again. The timer also is used to de-energize the retractor latch solenoids after about 30 minutes, and prevent the battery from being drained while the vehicle is not being driven.

The hard wired SCTM output to the ACM is used to indicate whether a fault condition is present in the structural seat belt control system. The ACM monitors the input from the SCTM and sends the proper messages to the instrument cluster on the Chrysler Collision Detection (CCD) data bus to turn the seat belt reminder lamp on or off. If the ACM receives a fault input or does not detect any input from the SCTM, it sets a fault code and sends messages to the instrument cluster to turn the lamp on. See Seat Belt Reminder Lamp in the Description and Operation section of Group 8E - Instrument Panel Systems for more information.

See Airbag Systems in this group for more information about the ACM. For diagnosis of the CCD data bus, the ACM or the ACM input from the SCTM, the use of a DRB scan tool and the proper Diagnostic Procedures manual are recommended. The SCTM cannot be repaired. If faulty or damaged, it must be replaced.

SEAT BELT RETRACTOR LATCH SOLENOID

A seat belt retractor latch solenoid is integral to each of the two outboard front seat belt retractors. The solenoid is grounded at all times through its wire harness connector and circuit. The solenoid receives battery current, which is switched by the Seatbelt Control Timer Module (SCTM), through a fuse in the junction block.

When the seat belt retractor latch solenoids are energized the retractor spools are unlatched, and the seat belt webbing can be withdrawn from the retractor. When the solenoids are de-energized the retractor spools latch, preventing the seat belt webbing from being withdrawn any further from the retractor.

The seat belt retractor latch solenoids cannot be repaired. If the solenoid is faulty or damaged, the entire seat belt retractor unit must be replaced. Refer to Group 23 - Body for the seat belt retractor service procedures.

DOOR JAMB SWITCH

The door jamb switches are mounted to the door hinge pillars. The switches close a path to ground for the Seatbelt Control Timer Module (SCTM) when a door is opened, and open the ground path when a door is closed.

The door jamb switches cannot be repaired and, if faulty or damaged, they must be replaced. Refer to Door Jamb Switch in the Removal and Installation section of Group 8Q - Vehicle Theft Security Systems for the service procedures.

DIAGNOSIS AND TESTING

SEAT BELT CONTROL SYSTEM TEST MODE

The structural seat belt control system has a test mode feature. This feature allows the seat belt control system to be tested for proper operation while the vehicle is stationary by overriding the normal Seatbelt Control Timer Module (SCTM) control functions. The seat belt control system and the airbag system **must** be tested for proper operation following the service of any seat belt control system or airbag system component. See Airbag Systems in this group for more information on testing of the airbag system.

This test mode will confirm the following:

- Both door jamb switches and their input circuits to the SCTM are functional.
- The fused B(+), fused ignition switch output (run/acc), and ground circuits to the SCTM are functional.
- The SCTM fault circuit to the Airbag Control Module (ACM), the ACM, the Chrysler Collision Detection (CCD) data bus, and the seat belt reminder lamp in the instrument cluster are functional.
- Both seat belt retractor latch solenoids and their circuits are functional and can be activated by the SCTM.

To initiate the seat belt control system test mode, proceed as follows:

(1) If the seat belt control system test mode has not been performed previously within the past 72 hours, reset the SCTM by removing the Ignition-Off Draw (IOD) fuse from the junction block, then reinstalling it.

(2) Sit in the driver side front seat of the vehicle and close all doors.

(3) Push in the cigar lighter.

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DIAGNOSIS AND TESTING (Continued)

(4) Within five seconds the ignition switch must be cycled On, Off, On, Off, On, Off, and then finally back to On. Leave the ignition switch in the On position for the remainder of this procedure. This action enters the seat belt control system into its test mode for a maximum of five minutes. After five minutes, the seat belt control system will automatically return to its normal operating mode.

(5) The seat belt reminder lamp should light shortly after entering the test mode to confirm that the seat belt control system is in the test mode, and that the seat belt control system fault circuit is functional. If the lamp fails to light, use a DRB scan tool and the proper Diagnostic Procedures manual to diagnose the SCTM fault circuit to the ACM, the ACM, and the CCD data bus.

(6) Open the driver side front door. Check that both the passenger and driver side outboard front seat belt retractors are unlatched by slowly pulling the seat belt webbing out of the retractor. If only one retractor is unlatched, the latched retractor and circuit must be diagnosed. See Seat Belt Retractor Latch Solenoid in the Diagnosis and Testing section of this group. If both retractors are latched, see Seatbelt Control Timer Module in the Diagnosis and Testing section of this group.

(7) Close the driver side front door. Check that both the passenger and driver side outboard front seat belt retractors are latched by slowly pulling the seat belt webbing out of the retractor. If only one retractor is latched, the unlatched retractor and circuit must be diagnosed. See Seat Belt Retractor Latch Solenoid in the Diagnosis and Testing section of this group. If both retractors are unlatched, see Seatbelt Control Timer Module in the Diagnosis and Testing section of this group.

(8) Repeat Step 6 and Step 7, but open and close the passenger side front door instead of the driver side.

(9) Turn the ignition switch to the Off position. This will cause the seat belt control system to exit its test mode and return to normal operation.

(10) Turn the ignition switch back to the On position. The seat belt reminder and airbag indicator lamps should turn off shortly after their normal display functions (about six and seven seconds, respectively). If either lamp remains lighted, use a DRB scan tool and the proper Diagnostic Procedures manual to diagnose the SCTM fault circuit to the ACM, the airbag system, the ACM, and the CCD data bus.

(11) If the seat belt control system test mode has timed out prior to completion of the tests (about five minutes after the test was initiated), go back to Step 2.

The SCTM is programmed to consider certain parameters as an indication of a faulty Gravity (G)-sensor. In some peculiar vehicle use situations these parameters may be exceeded, causing the seat belt reminder lamp to illuminate indicating an SCTM fault, and then extinguish for no apparent reason. The following parameters should be considered if an intermittent seat belt reminder lamp illumination complaint is being diagnosed, and the test mode reveals no problems with the structural seat belt control system operation.

- If the SCTM monitors ten ignition cycles without an input from the G-sensor indicating that the vehicle has accelerated or decelerated sufficiently to require the seat belts to be latched. An ignition cycle is defined as: The ignition switch turned to the On position for at least thirty minutes, followed by the ignition switch being turned to the Off position. The SCTM considers this a G-sensor fault because it would normally be expected that the seat belts would require latching at some point within ten ignition cycles of driving. The SCTM will discontinue the fault signal and reset the ignition cycle counter to zero as soon as it sees a "normal" G-sensor input.
- If the SCTM monitors that the G-sensor input has required the seat belts to remain latched for more than about four seconds. This condition could occur if the vehicle is parked on a steep grade with the ignition switch in the On position, and is considered a G-sensor fault by the SCTM because the duration of the G-sensor input requiring the seat belts to be latched should not normally exceed four seconds. The SCTM will discontinue the fault signal as soon as it sees a "normal" G-sensor input.

SEATBELT CONTROL TIMER MODULE

For circuit descriptions and diagrams, refer to 8W-67 - Restraint System in Group 8W - Wiring Diagrams.

(1) Check the fused B(+) fuse in the junction block. If OK, go to Step 2. If not OK, repair the shorted circuit or component as required and replace the faulty fuse.

(2) Check for battery voltage at the fused B(+) fuse in the junction block. If OK, go to Step 3. If not OK, repair the open circuit as required.

(3) Check the fused ignition switch output (run/acc) fuse in the junction block. If OK, go to Step 4. If not OK, repair the shorted circuit or component as required and replace the faulty fuse.

(4) Turn the ignition switch to the On position. Check for battery voltage at the fused ignition switch output (run/acc) fuse in the junction block. If OK, go to Step 5. If not OK, repair the open circuit to the ignition switch as required.

(5) Turn the ignition switch to the Off position. Disconnect and isolate the battery negative cable. Unplug the Seatbelt Control Timer Module (SCTM)

DIAGNOSIS AND TESTING (Continued)

wire harness connector. Connect the battery negative cable. Check for battery voltage at the fused B(+) circuit cavity of the SCTM wire harness connector. If OK, go to Step 6. If not OK, repair the open circuit to the junction block as required.

(6) Turn the ignition switch to the On position. Check for battery voltage at the fused ignition switch output (run/acc) circuit cavity of the SCTM wire harness connector. If OK, go to Step 7. If not OK, repair the open circuit to the junction block as required.

(7) Turn the ignition switch to the Off position. Disconnect and isolate the battery negative cable. Check for continuity between the two ground circuit cavities of the SCTM wire harness connector and a good ground. There should be continuity. If OK, go to Step 8. If not OK, repair the open circuit to ground as required.

(8) Check for continuity between the right door ajar switch sense circuit cavity of the SCTM wire harness connector and a good ground. There should be no continuity with the right front door closed, and continuity with the right front door open. Repeat this test for the left door ajar switch sense circuit. If both circuits check OK, and the problem is with only one inoperative latch solenoid, see Seat Belt Retractor Latch Solenoid in the Diagnosis and Testing section of this group. If both circuits check OK, and the problem is with both latch solenoids being inoperative, replace the faulty SCTM. If either or both door ajar switch sense circuits is not OK, see Door Jamb Switch in the Diagnosis and Testing section of this group.

SEAT BELT RETRACTOR LATCH SOLENOID

For circuit descriptions and diagrams, refer to 8W-67 - Restraint System in Group 8W - Wiring Diagrams.

(1) Disconnect and isolate the battery negative cable. Unplug the wire harness connector from the Seatbelt Control Timer Module (SCTM).

(2) Check the resistance between the inoperative (driver or passenger) latch signal circuit cavity of the SCTM wire harness connector and a good ground. The correct resistance should be from 50 to 60 ohms. If OK, see Seatbelt Control Timer Module in the Diagnosis and Testing section of this group. If not OK, go to Step 3.

(3) Unplug the wire harness connector at the inoperative (driver or passenger) seat belt retractor latch solenoid. Check the resistance between the two terminals of the latch solenoid. The correct resistance should be from 50 to 60 ohms. If OK, go to Step 4. If not OK, replace the faulty seat belt retractor unit.

(4) Check the resistance between the ground circuit cavity of the latch solenoid wire harness connector and a good ground. There should be no measurable resistance. If OK, repair the inoperative (driver or passenger) latch signal circuit between the solenoid wire harness connector and the SCTM wire harness connector as required. If not OK, repair the circuit to ground as required.

DOOR JAMB SWITCH

For circuit descriptions and diagrams, refer to 8W-67 - Restraint System in Group 8W - Wiring Diagrams.

(1) Disconnect and isolate the battery negative cable. Unplug the inoperative (driver or passenger) door jamb switch from its wire harness connector. Check for continuity between the ground circuit cavity of the door jamb switch wire harness connector and a good ground. There should be continuity. If OK, go to Step 2. If not OK, repair the circuit to ground as required.

(2) Check for continuity between the door jamb switch ground circuit terminal and each of the other two terminals of the door jamb switch. There should be continuity with the switch plunger released, and no continuity with the switch plunger depressed. If OK, go to Step 3. If not OK, replace the faulty switch.

(3) Unplug the Seatbelt Control Timer Module (SCTM) wire harness connector. Check for continuity between the inoperative (driver or passenger) door ajar switch sense circuit cavity of the SCTM wire harness connector and a good ground. There should be no continuity. If OK, go to Step 4. If not OK, repair the short circuit as required.

(4) Check for continuity between the inoperative (driver or passenger) door ajar switch sense circuit cavities of the SCTM wire harness connector and the door jamb switch wire harness connector. There should be continuity. If not OK, repair the open circuit as required.

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REMOVAL AND INSTALLATION

SEATBELT TIMER CONTROL MODULE

(1) Disconnect and isolate the battery negative cable.

(2) Remove the fasteners that secure the front seat adjusters to the floor panel. Refer to Group 23 - Body for the procedures.

(3) Tilt the seat back and reach under the forward edge of the front seat center cushion to remove the two screws that secure the seatbelt timer control module to the mounting bracket (Fig. 1) .

(4) Lower the seatbelt control timer module from the mounting bracket far enough to access and unplug the wire harness connector.

(5) Remove the seatbelt control timer module from under the front seat.

(6) Reverse the removal procedures to install. Tighten the mounting screws to 2.2 N·m (20 in. lbs.).

(7) Do not connect the battery negative cable at this time. See Seatbelt Control System Test Mode in the Diagnosis and Testing section of this group for the proper procedures.

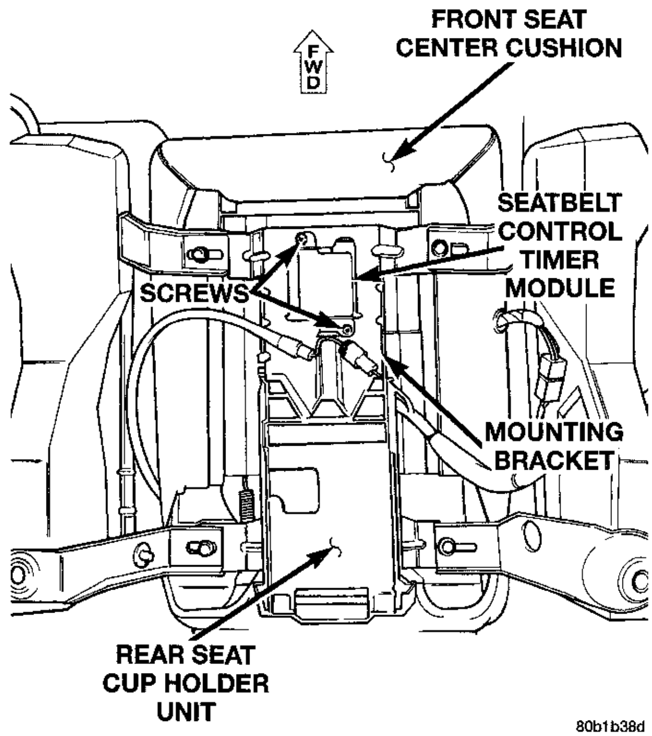

Fig. 1 Seatbelt Timer Control Module Remove/Install

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ELECTRICALLY HEATED SYSTEMS

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GENERAL INFORMATION

INTRODUCTION

Electrically heated outside rear view mirrors are an additional factory-installed option on models that are equipped with the factory-installed power mirror option. Refer to 8W-62 - Power Mirrors in Group 8W - Wiring Diagrams for complete circuit descriptions and diagrams.

HEATED MIRROR SYSTEM

The heated mirror system will only operate when the ignition switch is in the On position. When the heated mirror switch is in the On position, an electric heater grid located behind the glass of each of the outside rear view mirrors is energized. When energized, each of these grids produce heat to help clear the outside rear view mirrors of ice, snow, or fog.

The heated mirror system is controlled by a momentary switch that is integral to the heater and air conditioner control assembly, which is located between the instrument cluster and the radio near the center of the instrument cluster bezel on the instrument panel. An amber indicator lamp next to the switch button will light to indicate when the heated mirror system is turned on. The heater and air conditioner control assembly also contains the heated mirror system timer and logic circuitry, and an integral heated mirror relay.

The heated mirror system will be automatically turned off after a programmed time interval of about ten minutes. After the initial time interval has expired, if the heated mirror switch is depressed again during the same ignition cycle, the heated mirror system will automatically turn off after about five minutes.

The heated mirror system will automatically shut off if the ignition switch is turned to the Off position, or it can be turned off manually by depressing the heated mirror switch again. Following are general descriptions of the major components in the heated mirror system. Refer to the owner's manual in the vehicle glove box for more information on the features, use and operation of the heated mirror system.

DESCRIPTION AND OPERATION

OUTSIDE MIRROR HEATING GRID

Vehicles equipped with the optional heated mirror system have an electric heating grid located behind the mirror glass of each outside rear view mirror. The heated mirrors are controlled by the heated mirror switch. Electrical current is directed to the heating grid inside the mirror only when the heated mirror switch is in the On position.

If the outside mirror heating grids are both inoperative, see Heated Mirror System in the Diagnosis and Testing section of this group. If only one of the outside mirror heating grids is inoperative, see Outside Mirror Heating Grid in the Diagnosis and Testing section of this group.

The heating grid behind each outside mirror glass cannot be repaired and, if faulty or damaged, the entire power mirror unit must be replaced. Refer to Power Mirror in the Removal and Installation section of Group 8T - Power Mirror Systems for the service procedures.

HEATED MIRROR CONTROL

The heated mirror switch, heated mirror indicator lamp, heated mirror electronic timer/control/logic circuitry and heated mirror relay are all integral to the heater and air conditioner control assembly, which is located between the instrument cluster and the radio near the center of the instrument cluster bezel on the instrument panel. The momentary-type switch provides a hard-wired battery signal to the electronic circuitry each time it is depressed. An amber heated mirror indicator lamp next to the heated mirror

DESCRIPTION AND OPERATION (Continued)

switch lights to indicate when the heated mirror system is turned On.

The heated mirror electronic timer/control/logic circuitry responds to the switch input by energizing or de-energizing the heated mirror relay. Energizing the heated mirror relay provides electrical current to the outside rear view mirror heating grids.

The heated mirror switch, heated mirror indicator lamp, heated mirror electronic timer/control/logic circuitry and heated mirror relay cannot be repaired. If damaged or faulty, the entire heater and air conditioner control assembly must be replaced. Refer to Heater-A/C Control in the Removal and Installation section of Group 24 - Heating and Air Conditioning for the service procedures.

DIAGNOSIS AND TESTING

HEATED MIRROR SYSTEM

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

For circuit descriptions and diagrams, refer to 8W-62 Power Mirrors in Group 8W - Wiring Diagrams. The operation of the heated mirror system can be confirmed in one of the following manners:

1. Turn the ignition switch to the On position. While monitoring the instrument panel voltmeter, set the heated mirror switch in the On position. When the heated mirror switch is turned On, a distinct voltmeter needle deflection should be noted.
2. Turn the ignition switch to the On position. Set the heated mirror switch in the On position. The heated mirror operation can be checked by feeling the outside rear view mirror glass. A distinct difference in temperature between the unheated and heated mirror glass can be detected within three to four minutes of operation.

The above checks will confirm system operation. Illumination of the heated mirror indicator lamp means that there is electrical current available at the heated mirror relay, but does not confirm that the electrical current is reaching the outside mirror glass heating grids.

If the heated mirror system does not operate, the problem should be isolated in the following manner:

(1) Confirm that the ignition switch is in the On position.

(2) Check the fuses in the Power Distribution Center (PDC) and in the junction block. The fuses must be tight in their receptacles and all electrical connections must be secure.

When the above steps have been completed and the outside rear view mirror heating grid is still inoperative, one or more of the following is faulty:

- Heated mirror control
- Outside mirror heating grid
- Heated mirror wire harness circuits or connectors.

If setting the heated mirror switch to the On position produces a severe voltmeter deflection, check for a short circuit between the heated mirror control output and the outside rear view mirror heating grids.

HEATED MIRROR CONTROL

For circuit descriptions and diagrams, refer to 8W-62 Power Mirrors in Group 8W - Wiring Diagrams.

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(1) Check the fuse in the junction block. If OK, go to Step 2. If not OK, repair the shorted circuit or component as required and replace the faulty fuse.

(2) Turn the ignition switch to the On position. Check for battery voltage at the fuse in the junction block. If OK, go to Step 3. If not OK, repair the open circuit to the ignition switch as required.

(3) Disconnect and isolate the battery negative cable. Remove the heater and air conditioner control from the instrument panel. Refer to Heater-A/C Control in the Removal and Installation section of Group 24 - Heating and Air Conditioning for the procedures. Unplug the 3-way heated mirror switch wire harness connector from the control. Check for continuity between the ground circuit cavity of the heated mirror switch wire harness connector and a good ground. There should be continuity. If OK, go to Step 4. If not OK, repair the open circuit to ground as required.

(4) Connect the battery negative cable. Turn the ignition switch to the On position. Check for battery voltage at the fused ignition switch output (run) circuit cavity of the heated mirror switch wire harness connector. If OK, go to Step 5. If not OK, repair the open circuit to the fuse in the junction block as required.

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DIAGNOSIS AND TESTING (Continued)

(5) Turn the ignition switch to the Off position. Disconnect and isolate the battery negative cable. Reconnect the 3-way heated mirror switch wire harness connector to the heater and air conditioner control. Connect the battery negative cable. Turn the ignition switch to the On position. Depress and release the heated mirror switch. The amber heated mirror indicator lamp next to the switch button should light. If OK, go to Step 6. If not OK, replace the faulty heater and air conditioner control assembly.

(6) Back probe the heated mirror switch output circuit cavity of the heated mirror switch wire harness connector and check for battery voltage. If OK, see Outside Mirror Heating Grid in the Diagnosis and Testing section of this group. If not OK, replace the faulty heater and air conditioner control assembly.

OUTSIDE MIRROR HEATING GRID

For circuit descriptions and diagrams, refer to 8W-62 - Power Mirrors in Group 8W - Wiring Diagrams.

(1) Disconnect and isolate the battery negative cable. Remove the front door trim panel on the side of the vehicle with the inoperative outside mirror heating grid. Refer to Group 23 - Body for the procedures. Unplug the wire harness connector at the mirror. Check for continuity between the ground circuit cavity in the body half of the power mirror wire harness connector and a good ground. If OK, go to Step 2. If not OK, repair the open circuit to ground as required.

(2) Connect the battery negative cable. Turn the ignition switch to the On position. Turn on the heated mirror system. Check for battery voltage at the heated mirror switch output circuit cavity in the body half of the power mirror wire harness connector. If OK, go to Step 3. If not OK, repair the open circuit to the heated mirror switch as required.

(3) Check for continuity between the ground circuit and the heated mirror switch output circuit cavities in the mirror half of the power mirror wire harness connector. There should be continuity. If not OK, replace the faulty power mirror. If OK, check the resistance through the electric heating grid. The correct resistance through the outside mirror heating grid should be from 10 to 16 ohms when measured at an ambient temperature of 21° C (70° F). If not OK, replace the faulty power mirror.

REMOVAL AND INSTALLATION

HEATED MIRROR SYSTEM

Service procedures for the components used in the heated mirror system can be found in the Removal and Installation section of the proper group, as follows:

- Heated mirror control - refer to Heater-A/C Control in the Removal and Installation section of Group 24 - Heating and Air Conditioning Systems
- Outside mirror heating grid - refer to Power Mirror in the Removal and Installation section of Group 8T - Power Mirror Systems.

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POWER LOCK SYSTEMS

CONTENTS

GENERAL INFORMATION

INTRODUCTION

Power door locks are optional factory-installed equipment on this model. Power windows are included on vehicles equipped with the power door lock option. The Remote Keyless Entry (RKE) system is also an available option on models equipped with power door locks. Refer to 8W-61 - Power Door Locks in Group 8W - Wiring Diagrams for complete circuit descriptions and diagrams.

POWER LOCK SYSTEM

The power lock system allows both doors to be locked or unlocked electrically by operating the switch on either door trim panel. The power lock system operates on non-switched battery current supplied through a fuse in the junction block so that the system remains functional, regardless of the ignition switch position.

Two different power lock systems are offered. Both power lock systems include the power lock switches on each door trim panel, and the power lock motors inside each door. On models without the optional Remote Keyless Entry (RKE) system, the power lock switches are hard-wired directly to the power lock motors, and a base version of the Central Timer Module (CTM) is used.

On models with the optional RKE system, a high-line version of the CTM is used. The high-line CTM incorporates the RKE receiver and logic, power lock control circuitry, and power lock and unlock relays. The power lock switches are hard-wired to the CTM, and the CTM controls the hard-wired output to the power lock motors.

Following are general descriptions of the major components in the power lock system. Refer to the owner's manual in the vehicle glove box for more information on the features, use and operation of the power lock system.

REMOTE KEYLESS ENTRY SYSTEM

The Remote Keyless Entry (RKE) system is a radio frequency system that allows the use of a remote battery-powered radio transmitter to control the power lock system. On vehicles with the RKE option, the power locks can be operated by depressing the Lock or Unlock buttons of the RKE transmitter. If the vehicle is so equipped, the RKE transmitter also arms and disarms the factory-installed vehicle theft alarm. Refer to Group 8Q - Vehicle Theft/Security Systems for more information on the optional vehicle theft alarm.

The RKE system includes an illuminated entry feature, which turns on the courtesy lamps for a timed interval (about thirty seconds), when the power door locks are unlocked using the RKE transmitter. The

GENERAL INFORMATION (Continued)

RKE system for this vehicle also features a programmable horn chirp and a panic feature. The programmable horn chirp feature allows the enabling or disabling of the horn chirp request that the RKE receiver issues as an audible indication that a valid Lock signal has been received from the RKE transmitter. The panic feature allows the vehicle operator to cause the horn to pulse, the headlights to flash and the courtesy lamps to light for about three minutes by depressing the Panic button on the RKE transmitter.

The RKE system can retain the vehicle access codes of up to four RKE transmitters. The transmitter codes are retained in RKE system memory, even if the battery is disconnected. If a transmitter is faulty or is lost, new transmitter vehicle access codes can be programmed into the system using a DRB scan tool as described in the proper Diagnostic Procedures manual.

The RKE system consists of the key fob remote radio transmitter and a radio receiver with program logic, which is integral to the high-line version of the Central Timer Module (CTM).

Following are general descriptions of the major components in the RKE system. Refer to the owner's manual in the vehicle glove box for more information on the features, use and operation of the RKE system.

DESCRIPTION AND OPERATION

CENTRAL TIMER MODULE

Two versions of the Central Timer Module (CTM) are available on this vehicle, a base version and a high-line version. The base version of the CTM is used on base models of the vehicle. It is also sometimes referred to as the Integrated Electronic Module (IEM). The base version of the CTM combines the functions of a chime/buzzer module, an intermittent wipe module, and an ignition lamp time delay relay in a single unit.

The high-line version of the CTM is used on high-line vehicles. The high-line CTM provides all of the functions of the base version CTM, but also is used to control and integrate many of the additional electronic functions and features included on the high-line models. The high-line version of the CTM contains a central processing unit and interfaces with other modules in the vehicle on the Chrysler Collision Detection (CCD) data bus network.

The CCD data bus network allows the sharing of sensor information. This helps to reduce wire harness complexity, reduce internal controller hardware, and reduce component sensor current loads. At the same time, this system provides increased reliability, enhanced diagnostics, and allows the addition of many new feature capabilities.

The high-line CTM controls features and functions of the power lock, illuminated entry, and Remote Keyless Entry (RKE) systems. The high-line CTM receives hard-wired inputs from the power lock switches, CCD message inputs from the Powertrain Control Module (PCM) and Airbag Control Module (ACM), and coded radio frequency inputs from the RKE transmitters. In response to those and many other inputs, the internal programming of the CTM sends the proper outputs to control the power lock motors, the headlamp (or security) and horn relays, and the courtesy lamps.

Some of the features and functions of the power lock, illuminated entry and RKE systems made possible because of the communication of the CTM on the CCD data bus network include:

- A door-lock inhibit feature which prevents the power lock system from being energized with a power door lock switch if the key is in the ignition and/or the headlamps are on. However, the locks can still be operated manually, with a key, or energized with the RKE transmitter.
- A Panic Mode feature which can provide additional personal security and protection. When the Panic button on the RKE transmitter is depressed the vehicle horn will pulse, the headlights will flash, and the interior lights will illuminate on the vehicle for about three minutes, or until the Panic button is depressed a second time. A vehicle speed of about 24 kilometers-per-hour (15 miles-per-hour) will also cancel the panic mode.
- An enhanced accident response feature will unlock both doors, then prevent the power door locks from locking the doors for a predetermined time interval, after receiving a CCD message from the ACM indicating a frontal impact of the vehicle requiring airbag deployment. This feature will also turn on the courtesy lamps ten seconds after receiving the ACM deployment message, if the CCD vehicle speed message from the PCM indicates that the vehicle is not moving. Of course, these responses are dependent upon functional battery power and wiring circuitry following the impact.
- Rolling door locks is a programmable feature of the power lock system. This feature will automatically lock all of the doors after the vehicle reaches a speed of about 24 kilometers-per-hour (15 miles-per-hour) or greater. This feature will also lock the doors if a door is opened, then closed again, at any speed above 24 kilometers-per-hour (15 miles-per-hour).
- A programmable feature of the RKE system is the enabling or disabling of the horn chirp following activation of the RKE Lock function. This feature can be enabled or disabled and, if enabled, the horn chirp

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DESCRIPTION AND OPERATION (Continued)

duration (twenty or forty milliseconds) can be selected.

Both versions of the CTM are mounted under the driver side end of the instrument panel, inboard of the instrument panel steering column opening. Refer to Central Timer Module in the Removal and Installation section of Group 8E - Instrument Panel Systems for the service procedures.

The programmable features of the CTM can be enabled or disabled using the DRB scan tool as described in the proper Diagnostic Procedures manual. Refer to Central Timer Module in the Diagnosis and Testing section of Group 8U for diagnosis of the base version of the CTM. For diagnosis of the high-line version of the CTM or of the CCD data bus, a DRB scan tool and the proper Diagnostic Procedures manual are recommended. The CTM cannot be repaired and, if faulty or damaged, it must be replaced.

POWER LOCK SWITCH

The power locks can be controlled by a two-way switch integral to the power window and lock switch and bezel unit on the trim panel of each front door. A Light-Emitting Diode (LED) in the paddle of each switch is illuminated whenever the ignition switch is in the On position.

On models with a base version of the Central Timer Module (CTM), the power lock switches are hard-wired to the power lock motors. On models with a high-line version of the CTM, the power lock switch controls the battery feeds to the lock and unlock sense inputs of the high-line CTM. The CTM then relays the correct battery and ground feeds to the power lock motors.

The power window and lock switch and bezel unit cannot be repaired and, if faulty or damaged, the entire switch and bezel unit must be replaced.

POWER LOCK MOTOR

In the power lock and Remote Keyless Entry (RKE) systems, the door latch lock mechanisms can be actuated by a reversible electric motor. The power lock motor is integral to the door latch mounted within each door.

On models with a base version of the Central Timer Module (CTM), the power lock motor direction is controlled by the battery and ground feeds from the power lock switches. On models with the high-line version of the CTM, the power lock motor direction is controlled by the battery and ground feeds from the power lock and unlock relays, which are integral to the high-line CTM.

The power lock motor cannot be repaired and, if faulty or damaged, the entire door latch unit must be replaced.

REMOTE KEYLESS ENTRY TRANSMITTER

The Remote Keyless Entry (RKE) system transmitter is equipped with three buttons, labeled Lock, Unlock, and Panic. It is also equipped with a key ring and is designed to serve as a key fob. The operating range of the transmitter radio signal is up to 7 meters (23 feet) from the RKE receiver.

Each transmitter has a different vehicle access code, which must be programmed into the memory of the RKE receiver in the vehicle in order to operate the RKE system. See Remote Keyless Entry Transmitter Programming in the Service Procedures section this group for more information.

The transmitter operates on two Duracell DL2016 (or equivalent) batteries. Typical battery life is from one to two years. The RKE transmitter cannot be repaired and, if faulty or damaged, it must be replaced.

REMOTE KEYLESS ENTRY RECEIVER

The Remote Keyless Entry (RKE) receiver is a radio frequency unit that is integral to the high-line version of the Central Timer Module (CTM). The CTM also contains the program logic and control circuitry for the RKE system. The CTM is mounted under the driver side end of the instrument panel, inboard of the instrument panel steering column opening.

The RKE receiver has a memory function to retain the vehicle access codes of at least one, but no more than four RKE transmitters. The receiver is designed to retain the transmitter codes in memory, even if the battery is disconnected.

The RKE receiver is energized by one of three radio frequency inputs from the RKE transmitter; Unlock, Lock, or Panic. The programming of the CTM responds to these RKE inputs, as well as many other inputs, by sending the proper control outputs to the power lock motors, the courtesy lamp circuit, the horn relay, and the headlamp (or security) relay.

For diagnosis or programming of the RKE receiver within the high-line CTM, a DRB scan tool and the proper Diagnostic Procedures manual are recommended. The RKE receiver is only serviced as a unit with the high-line CTM and, if faulty or damaged, the CTM unit must be replaced.

HEADLAMP RELAY

The headlamp (or security) relay is a International Standards Organization (ISO) micro-relay. The terminal designations and functions are the same as a conventional ISO relay. However, the micro-relay terminal orientation (or footprint) is different, current capacity is lower, and the relay case dimensions are smaller than those of the conventional ISO relay.

DESCRIPTION AND OPERATION (Continued)

The headlamp relay is a electromechanical device that switches battery current to the headlamps when the high-line Central Timer Module (CTM) grounds the relay coil. See Headlamp Relay in the Diagnosis and Testing section of this group for more information.

The headlamp (or security) relay is located in the Power Distribution Center (PDC), in the engine compartment. Refer to the PDC label for relay identification and location.

The headlamp relay cannot be repaired and, if faulty or damaged, it must be replaced.

HORN RELAY

The horn relay is a International Standards Organization (ISO) micro-relay. The terminal designations and functions are the same as a conventional ISO relay. However, the micro-relay terminal orientation (or footprint) is different, current capacity is lower, and the relay case dimensions are smaller than those of the conventional ISO relay.

The horn relay is a electromechanical device that switches battery current to the horn when the horn switch or the high-line Central Timer Module (CTM) grounds the relay coil. See Horn Relay in the Diagnosis and Testing section of this group for more information.

The horn relay is located in the Power Distribution Center (PDC), in the engine compartment. Refer to the PDC label for relay identification and location.

If a problem is encountered with a continuously sounding horn, it can usually be quickly resolved by removing the horn relay from the PDC until further diagnosis is completed.

The horn relay cannot be repaired and, if faulty or damaged, it must be replaced.

DIAGNOSIS AND TESTING

POWER LOCK SYSTEM

As a preliminary diagnosis for the power lock system used on vehicles with a base version of the Central Timer Module (CTM), note the system operation while you actuate both the Lock and Unlock functions with the power lock switches. Then, proceed as follows:

- If the entire power lock system fails to function with both of the power lock switches, check the fuses in the junction block.
- If the entire power lock system fails to function with only one of the power lock switches, see Power Lock Switch in the Diagnosis and Testing section of this group.
- If one power lock motor fails to operate with both of the power lock switches, see Power Lock Motor in the Diagnosis and Testing section of this group.

POWER LOCK SYSTEM AND REMOTE KEYLESS ENTRY SYSTEM

As a preliminary diagnosis for vehicles with the power lock and Remote Keyless Entry (RKE) systems (high-line version of the Central Timer Module), note the system operation while you actuate both the Lock and Unlock functions with the power lock switches and the RKE transmitter. Then, proceed as follows:

- If the entire power lock system fails to function with either the power lock switches or the RKE transmitter, check the fuses in the junction block.
- If the power lock system functions with both power lock switches, but not with the RKE transmitter, see Remote Keyless Entry Transmitter in the Diagnosis and Testing section of this group.
- If the entire power lock system functions with the RKE transmitter, but not with one or both of the power lock switches, see Power Lock Switch in the Diagnosis and Testing section of this group.
- If one power lock motor fails to operate with both of the power lock switches and/or the RKE transmitter, see Power Lock Motor in the Diagnosis and Testing section of this group.

If the problem being diagnosed involves only the RKE horn chirp or panic mode features, see Horn Relay and/or Headlamp Relay in the Diagnosis and Testing section of this group. If both of these relays check OK, further diagnosis should be performed using a DRB scan tool as described in the proper Diagnostic Procedures manual.

POWER LOCK SWITCH

The Light-Emitting Diode (LED) illumination lamps for all of the power window and lock switch and bezel unit switch paddles receive battery current through the power window circuit breaker in the junction block. If all of the LEDs are inoperative in either or both power window and lock switch and bezel units, refer to Group 8S - Power Window Systems for diagnosis. If only one LED in a power window and lock switch and bezel unit is inoperative, replace the faulty switch and bezel unit. For circuit descriptions and diagrams, refer to 8W-61 - Power Door Locks in Group 8W - Wiring Diagrams.

(1) Check the fuse in the junction block. If OK, go to Step 2. If not OK, repair the shorted circuit or component as required and replace the faulty fuse.

(2) Check for battery voltage at the fuse in the junction block. If OK, go to Step 3. If not OK, repair the open circuit to the Power Distribution Center (PDC) as required.

(3) Disconnect and isolate the battery negative cable. Remove the power window and lock switch and

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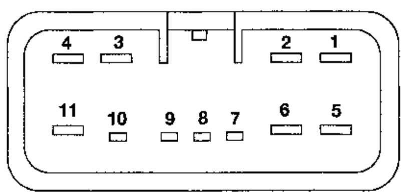
DIAGNOSIS AND TESTING (Continued)

bezel unit from the door trim panel. Unplug the wire harness connector from the switch and bezel unit.

(4) Connect the battery negative cable. Check for battery voltage at the fused B(+) circuit cavity of the body half of the power window and lock switch and bezel unit wire harness connector. If OK, go to Step 5. If not OK, repair the open circuit to the junction block as required.

(5) Test the power lock switch continuity. See the Power Lock Switch Continuity charts to determine if the continuity is correct in the Neutral, Lock and Unlock switch positions (Fig. 1) or (Fig. 2). If OK, repair the door lock switch output (lock and/or unlock) circuit(s) from the body half of the power window and lock switch and bezel unit wire harness connector to the power lock motors or the high-line version of the Central Timer Module (CTM) as required. If not OK, replace the faulty switch.



VIEW OF SWITCH SIDE CONNECTOR

DRIVER SIDE LOCK SWITCH	
SWITCH POSITION	CONTINUITY BETWEEN
NEUTRAL	7 & 9, 8 & 9
LOCK	7 & 9, 8 & 10
UNLOCK	7 & 10, 8 & 9
LAMP	3 & 5

80b099e7

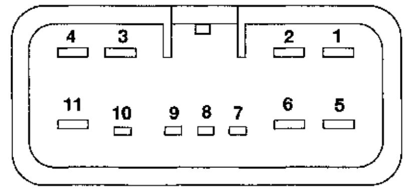
Fig. 1 Power Lock Switch Continuity - Driver Side

CENTRAL TIMER MODULE

NOTE: The following tests may not prove conclusive in the diagnosis of the high-line version of the Central Timer Module (CTM). The most reliable, efficient, and accurate means to diagnose the high-line CTM requires the use of a DRB scan tool and the proper Diagnostic Procedures manual.

For circuit descriptions and diagrams, refer to 8W-61 - Power Door Locks in Group 8W - Wiring Diagrams.

(1) Check the fuses in the junction block. If OK, go to Step 2. If not OK, repair the shorted circuit or component as required and replace the faulty fuse.



VIEW OF SWITCH SIDE CONNECTOR

PASSENGER SIDE LOCK SWITCH	
SWITCH POSITION	CONTINUITY BETWEEN
NEUTRAL	6 & 7, 9 & 10
LOCK	5 & 7, 9 & 10
UNLOCK	5 & 9, 6 & 7
LAMP	8 & 11

80b099e8

Fig. 2 Power Lock Switch Continuity - Passenger Side

(2) Check for battery voltage at the fuse in the junction block. If OK, go to Step 3. If not OK, repair the open circuit to the Power Distribution Center (PDC) as required.

(3) Disconnect and isolate the battery negative cable. Remove the Central Timer Module (CTM) from its mounting bracket to access the CTM wire harness connectors. Refer to Central Timer Module in the Removal and Installation section of Group 8E - Instrument Panel Systems for the procedures.

(4) Unplug the wire harness connectors from the CTM. Check the wire harness connectors and the receptacles in the CTM for loose, corroded, or damaged terminals and pins. If OK, go to Step 5. If not OK, repair as required.

(5) Probe the ground circuit cavity of the 14-way CTM wire harness connector and check for continuity to a good ground. Repeat the check between the ground circuit cavity of the 18-way CTM wire harness connector and a good ground. In each case, there should be continuity. If OK, go to Step 6. If not OK, repair the open circuit(s) to ground as required.

(6) Connect the battery negative cable. Check for battery voltage at the fused B(+) circuit cavity of the 14-way CTM wire harness connector. If OK, go to Step 7. If not OK, repair the open circuit to the junction block as required.

(7) Probe the door lock switch output (lock) circuit cavity of the 18-way CTM wire harness connector and check for battery voltage as you actuate each power lock switch to the Lock position. If OK, go to Step 8. If not OK, repair the open circuit from either

DIAGNOSIS AND TESTING (Continued)

or both power lock switch(es) to the CTM as required.

(8) Probe the door lock switch output (unlock) circuit cavity of the 18-way CTM wire harness connector and check for battery voltage as you actuate each power lock switch to the Unlock position. If OK, go to Step 9. If not OK, repair the open circuit from either or both power lock switch(es) to the CTM as required.

(9) Disconnect and isolate the battery negative cable. Reinstall the wire harness connectors to the CTM. Connect the battery negative cable. Back-probe the door lock driver circuit cavity of the 18-way CTM wire harness connector and check for battery voltage as either power lock switch is moved to the Lock position. Repeat the test pressing the Lock button of the Remote Keyless Entry (RKE) transmitter. If OK, go to Step 10. If not OK using the power lock switch, but OK with the RKE transmitter, see Power Lock Switch in the Diagnosis and Testing section of this group. If not OK using the RKE transmitter, but OK with the power lock switch, see Remote Keyless Entry Transmitter in the Diagnosis and Testing section of this group. If not OK, with the power lock switch or the RKE transmitter, replace the faulty CTM.

(10) Back-probe the door unlock driver circuit cavity of the 18-way CTM wire harness connector and check for battery voltage as the power lock switch is moved to the Unlock position. Repeat the test pressing the Unlock button of the RKE transmitter. If OK, see Power Lock Motor in the Diagnosis and Testing section of this group. If not OK using the power lock switch, but OK with the RKE transmitter, see Power Lock Switch in the Diagnosis and Testing section of this group. If not OK using the RKE transmitter, but OK with the power lock switch, see Remote Keyless Entry Transmitter in the Diagnosis and Testing section of this group. If not OK, with the power lock switch or the RKE transmitter, replace the faulty CTM.

POWER LOCK MOTOR

On models with a base version of the Central Timer Module (CTM), confirm proper power lock switch operation before you proceed with this diagnosis. On models with a high-line version of the CTM, confirm proper power lock switch, power lock switch output circuit, and CTM operation before you proceed with this diagnosis. See Power Lock Switch and Central Timer Module in the Diagnosis and Testing section of this group. On models with a high-line version of the CTM, remember that the CTM circuitry controls the output to each of the power lock motors. For circuit descriptions and diagrams, refer to 8W-61 - Power Door Locks in Group 8W - Wiring Diagrams.

(1) Check each power lock motor for correct operation while moving the power lock switch to both the Lock and Unlock positions. If both of the power lock motors are inoperative, go to Step 2. If one power lock motor is inoperative, go to Step 3.

(2) If both of the power lock motors are inoperative, the problem may be caused by one shorted motor. Unplugging a shorted power lock motor from the power lock circuit will allow the good power lock motor to operate. Unplug each power lock motor wire harness connector, one at a time, and recheck both the lock and unlock functions by operating the power lock switch. If both of the power lock motors are still inoperative after the above test, check for a short or open circuit between the power lock motors and the power lock switch or high-line CTM. If unplugging one power lock motor causes the other motor to become functional, go to Step 3 to test the unplugged motor.

(3) Once it is determined which power lock motor is inoperative, that motor can be tested as follows. Unplug the wire harness connector at the inoperative power lock motor. Apply 12 volts to the motor terminals to check its operation in one direction. Reverse the polarity to check the operation in the other direction. If OK, repair the short or open circuits between the power lock motor and the power lock switch or high-line CTM as required. If not OK, replace the faulty power lock motor.

REMOTE KEYLESS ENTRY TRANSMITTER

(1) Replace the Remote Keyless Entry (RKE) transmitter batteries. See Remote Keyless Entry Transmitter Battery Replacement in the Service Procedures section of this group. Test each of the transmitter functions. If OK, discard the faulty batteries. If not OK, go to Step 2.

(2) Program the suspect RKE transmitter and another known good transmitter into the RKE module. Use a DRB scan tool, as described in the proper Diagnostic Procedures manual. See Remote Keyless Entry Transmitter Programming in the Service Procedures section of this group.

(3) Test the RKE system operation with both transmitters. If both transmitters fail to operate the power lock system, use a DRB scan tool and the proper Diagnostic Procedures manual for further diagnosis of the RKE system. If the known good transmitter operates the power locks and the suspect transmitter does not, replace the faulty transmitter.

NOTE: Be certain to perform the Remote Keyless Entry Transmitter Programming procedure again following this test. This procedure will erase the access code of the test transmitter from the RKE receiver.

DIAGNOSIS AND TESTING (Continued)

RELAYS

The headlamp (or security) relay and the horn relay are located in the Power Distribution Center (PDC) in the engine compartment. Each of these relays can be tested as described in the following procedure, however the circuits they are used in do vary. To test the relay circuits, refer to the circuit descriptions and diagrams in 8W-39 - Vehicle Theft Security System in Group 8W - Wiring Diagrams.

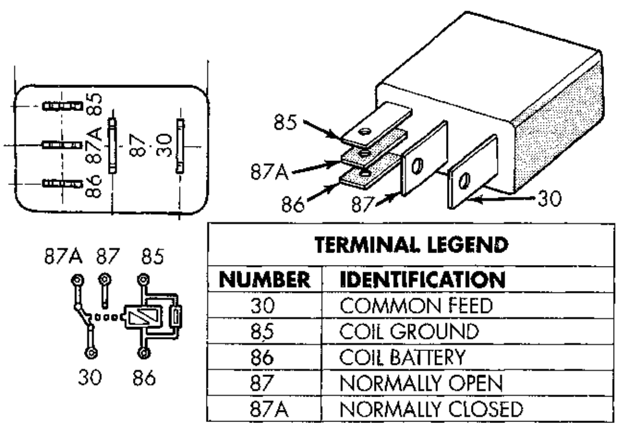
WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

Remove the relay (Fig. 3) from the PDC as described in this group to perform the following tests:

(1) A relay in the de-energized position should have continuity between terminals 87A and 30, and no continuity between terminals 87 and 30. If OK, go to Step 2. If not OK, replace the faulty relay.

(2) Resistance between terminals 85 and 86 (electromagnet) should be 75 ± 5 ohms. If OK, go to Step 3. If not OK, replace the faulty relay.

(3) Connect a battery to terminals 85 and 86. There should now be continuity between terminals 30 and 87, and no continuity between terminals 87A and 30. If OK, test the relay circuits. If not OK, replace the faulty relay.



NUMBER	IDENTIFICATION
30	COMMON FEED
85	COIL GROUND
86	COIL BATTERY
87	NORMALLY OPEN
87A	NORMALLY CLOSED

9514-16

Fig. 3 Relay Terminals

SERVICE PROCEDURES

REMOTE KEYLESS ENTRY TRANSMITTER BATTERY REPLACEMENT

The Remote Keyless Entry (RKE) transmitter case snaps open and shut for battery access. To replace the RKE transmitter batteries:

(1) Using a trim stick or another suitable wide flat-bladed tool, gently pry at the center seam of the transmitter case halves near the key ring until the two halves unsnap.

(2) Lift the back half of the transmitter case off of the transmitter.

(3) Remove the two batteries from the transmitter.

(4) Replace the two batteries with new Duracell DL2016, or their equivalent. Be certain that the batteries are installed with their polarity correctly oriented.

(5) Align the two transmitter case halves with each other, and squeeze them firmly together until they snap back into place.

REMOTE KEYLESS ENTRY TRANSMITTER PROGRAMMING

To program the Remote Keyless Entry (RKE) transmitter access codes into the RKE receiver in the Central Timer Module (CTM) requires the use of a DRB scan tool. Refer to the proper Diagnostic Procedures manual for more information.

REMOVAL AND INSTALLATION

POWER LOCK SWITCH

(1) Disconnect and isolate the battery negative cable.

(2) Using a wide flat-bladed tool such as a trim stick, gently pry the upper edge of the switch bezel to release the retainer that secures the switch bezel to the door trim panel opening (Fig. 4).

(3) Pull the switch and bezel unit away from the door trim panel opening far enough to access and unplug the wire harness connector.

(4) Remove the power window and lock switch and bezel unit from the door trim panel.

(5) Reverse the removal procedures to install. When installing the switch and bezel unit to the door trim panel opening, insert the rear of the bezel into the opening, then push down on the front of the bezel until the retaining tab snaps into place.

REMOVAL AND INSTALLATION (Continued)

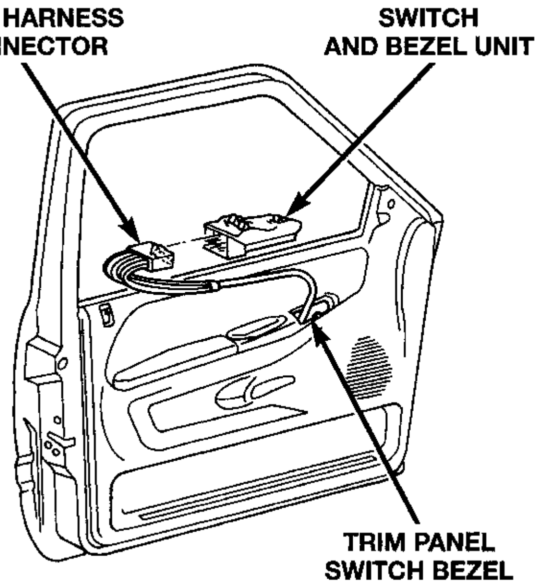


Fig. 4 Power Window and Lock Switch and Bezel Unit Remove/Install

POWER LOCK MOTOR

The power lock motor is integral to the door latch unit. If the power lock motor is faulty or damaged, the entire door latch unit must be replaced. Refer to Group 23 - Body for the door latch service procedures.

HEADLAMP RELAY

(1) Disconnect and isolate the battery negative cable.

(2) Remove the cover from the Power Distribution Center (PDC) (Fig. 5).

(3) Refer to the label on the PDC for headlamp (or security) relay identification and location.

(4) Unplug the headlamp relay from the PDC.

(5) Install the headlamp relay by aligning the relay terminals with the cavities in the PDC and pushing the relay firmly into place.

(6) Install the PDC cover.

(7) Connect the battery negative cable.

(8) Test the relay operation.

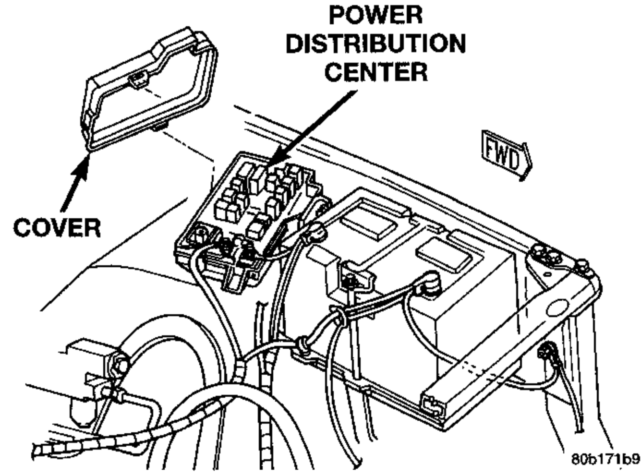


Fig. 5 Power Distribution Center

HORN RELAY

(1) Disconnect and isolate the battery negative cable.

(2) Remove the cover from the Power Distribution Center (PDC) (Fig. 6).

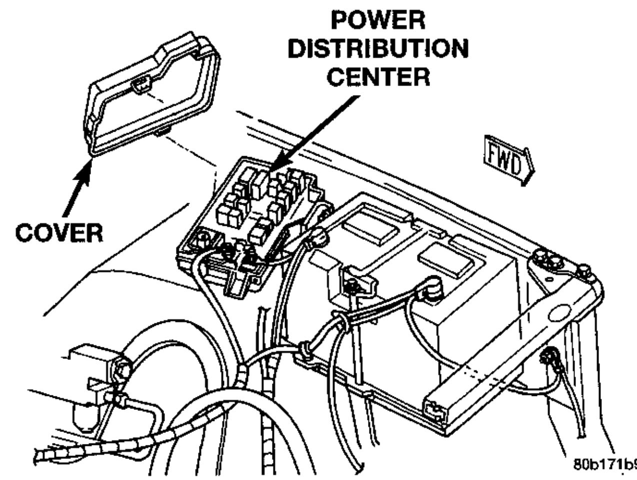


Fig. 6 Power Distribution Center

(3) Refer to the label on the PDC for horn relay identification and location.

(4) Unplug the horn relay from the PDC.

(5) Install the horn relay by aligning the relay terminals with the cavities in the PDC and pushing the relay firmly into place.

(6) Install the PDC cover.

(7) Connect the battery negative cable.

(8) Test the relay operation.

AUTHENTIC RESTORATION PRODUCT

VEHICLE THEFT/SECURITY SYSTEMS

CONTENTS

GENERAL INFORMATION

INTRODUCTION

The Vehicle Theft Security System (VTSS) is an available factory-installed option on this model. Refer to 8W-39 - Vehicle Theft Security System in Group 8W - Wiring Diagrams for complete circuit descriptions and diagrams.

VEHICLE THEFT SECURITY SYSTEM

The Vehicle Theft Security System (VTSS) is designed to provide perimeter protection against unauthorized use or tampering by monitoring the vehicle doors and the ignition system. If unauthorized use or tampering is detected, the system responds by sounding the horn, flashing the headlamps, and providing an engine no-run feature.

Following are general descriptions of the features and major components of the VTSS. Refer to the owner's manual in the vehicle glove box for more information on the features, use and operation of the vehicle theft security system.

ENABLING

If the vehicle is so equipped, the Vehicle Theft Security System (VTSS) feature is enabled in the high-line Central Timer Module (CTM) before the vehicle is shipped from the factory. However, if the high-line CTM requires replacement, the VTSS feature must be enabled in the new CTM using a DRB scan tool. Refer to the Vehicle Theft Security System menu item on the DRB scan tool for the procedures.

The VTSS engine no-run feature is disabled when it is shipped from the factory. This is done by programming within the Powertrain Control Module (PCM). The logic in the PCM prevents the VTSS engine no-run feature from arming until the engine start counter within the PCM sees twenty engine starts. The VTSS no-run feature must be enabled when the vehicle is received from the assembly plant.

Once the VTSS engine no-run feature has been enabled, it cannot be disabled unless the PCM is replaced with a new unit. The same VTSS engine no-run feature enable logic will apply anytime the PCM is replaced with a new unit.

ARMING

Passive arming of the Vehicle Theft Security System (VTSS) occurs when the vehicle is exited with the key removed from the ignition switch, the headlamps are turned off, and the doors are locked while they are open using the power lock switch. The power lock switch will not function if the key is in the ignition switch or the headlamps are turned on with the driver side front door open. The VTSS will not arm if the doors are locked using the key in the lock cylinder or using the mechanical lock button.

Active arming of the VTSS occurs when the Remote Keyless Entry (RKE) transmitter is used to lock the vehicle. For active arming to occur, the doors must be closed and the ignition switch must be in the Off position when the RKE transmitter Lock button is depressed. However, once the VTSS arming process has been completed, the ignition switch can be turned to the Accessory position without triggering the alarm.

Once the VTSS begins passive or active arming, the security lamp in the instrument cluster will flash

GENERAL INFORMATION (Continued)

rapidly for about fifteen seconds. This indicates that the VTSS arming is in progress. Turning a key in the ignition switch, opening a door, or unlocking a door by any means during the fifteen second arming process will cause the security lamp to stop flashing and the arming process to abort. Once the fifteen second arming function is successfully completed, the security lamp will stop flashing to indicate that the VTSS is armed.

DISARMING

Passive disarming of the Vehicle Theft Security System (VTSS) occurs when the vehicle is unlocked using the key to unlock either door. Active disarming of the VTSS occurs when the vehicle is unlocked by depressing the Unlock button of the Remote Keyless Entry (RKE) transmitter.

Once the alarm has been activated (horn sounding, headlamps flashing, and the engine no-run feature), either disarming method will also deactivate the alarm.

POWER-UP MODE

When the armed Vehicle Theft Security System (VTSS) senses that the battery has been disconnected and reconnected, it enters its power-up mode. In the power-up mode the alarm system remains armed following a battery failure or disconnect. If the VTSS was armed prior to a battery disconnect or failure, the system will have to be actively or passively disarmed after the battery is reconnected.

The power-up mode will also apply if the battery goes dead while the system is armed, and battery jump-starting is attempted. The engine no-run feature will prevent the engine from starting until the alarm system has been actively or passively disarmed.

TAMPER ALERT

The Vehicle Theft Security System (VTSS) tamper alert will sound the horn three times upon disarming, if the alarm was triggered and has since timed-out (about fifteen minutes). This feature alerts the vehicle operator that the VTSS was activated while the vehicle was unattended.

DESCRIPTION AND OPERATION

CENTRAL TIMER MODULE

Two versions of the Central Timer Module (CTM) are available on this vehicle, a base version and a high-line version. The base version of the CTM is used on base models of the vehicle. It is also sometimes referred to as the Integrated Electronic Module (IEM). The base version of the CTM combines the functions of a chime/buzzer module, an intermittent wipe module, and an ignition lamp time delay relay in a single unit.

The high-line version of the CTM is used on high-line vehicles. The high-line CTM provides all of the functions of the base version CTM, but also is used to control and integrate many of the additional electronic functions and features included on the high-line models. The high-line version of the CTM contains a central processing unit and interfaces with other modules in the vehicle on the Chrysler Collision Detection (CCD) data bus network.

The CCD data bus network allows the sharing of sensor information. This helps to reduce wire harness complexity, reduce internal controller hardware, and reduce component sensor current loads. At the same time, this system provides increased reliability, enhanced diagnostics, and allows the addition of many new feature capabilities.

One of the features that the high-line CTM supports and controls is the Vehicle Theft Security System (VTSS). In the VTSS, the CTM receives hard-wired inputs from the door jamb, door lock cylinder, and ignition switches. The programming in the CTM allows it to process the information from these inputs and send control outputs to energize or de-energize the headlamp (or security) relay, horn relay, and the security lamp. The CTM also sends CCD data bus messages to the Powertrain Control Module (PCM) to control the engine no-run feature of the VTSS

The high-line CTM also contains the receiver and control logic for the power lock and Remote Keyless Entry (RKE) systems, which are integrated into the arming, disarming, and triggering functions of the VTSS.

Both versions of the CTM are mounted under the driver side end of the instrument panel, inboard of the instrument panel steering column opening. Refer to Central Timer Module in the Removal and Installation section of Group 8E - Instrument Panel Systems for the service procedures.

For diagnosis of the high-line version of the CTM or of the CCD data bus, a DRB scan tool and the proper Diagnostic Procedures manual are recommended. The CTM cannot be repaired and, if faulty or damaged, it must be replaced.

DOOR JAMB SWITCH

The door jamb switches are mounted to the door hinge pillars. The switches close a path to ground for the Central Timer Module (CTM) when a door is opened, and open the ground path when a door is closed.

The door jamb switches cannot be repaired and, if faulty or damaged, they must be replaced.

DESCRIPTION AND OPERATION (Continued)

DOOR LOCK CYLINDER SWITCH

The door lock cylinder switches are mounted to the back of the key lock cylinder inside each door. They are normally-open momentary switches that close to ground only when the lock cylinder is rotated to the unlock position.

The door lock cylinder switches cannot be repaired and, if faulty or damaged, they must be replaced.

HEADLAMP RELAY

The headlamp (or security) relay is a International Standards Organization (ISO) micro-relay. The terminal designations and functions are the same as a conventional ISO relay. However, the micro-relay terminal orientation (or footprint) is different, current capacity is lower, and the relay case dimensions are smaller than those of the conventional ISO relay.

The headlamp relay is a electromechanical device that switches battery current to the headlamps when the high-line Central Timer Module (CTM) grounds the relay coil. See Headlamp Relay in the Diagnosis and Testing section of this group for more information.

The headlamp (or security) relay is located in the Power Distribution Center (PDC), in the engine compartment. Refer to the PDC label for relay identification and location.

The headlamp relay cannot be repaired and, if faulty or damaged, it must be replaced.

HORN RELAY

The horn relay is a International Standards Organization (ISO) micro-relay. The terminal designations and functions are the same as a conventional ISO relay. However, the micro-relay terminal orientation (or footprint) is different, current capacity is lower, and the relay case dimensions are smaller than those of the conventional ISO relay.

The horn relay is a electromechanical device that switches battery current to the horn when the horn switch or the high-line Central Timer Module (CTM) grounds the relay coil. See Horn Relay in the Diagnosis and Testing section of this group for more information.

The horn relay is located in the Power Distribution Center (PDC), in the engine compartment. Refer to the PDC label for relay identification and location.

If a problem is encountered with a continuously sounding horn, it can usually be quickly resolved by removing the horn relay from the PDC until further diagnosis is completed.

The horn relay cannot be repaired and, if faulty or damaged, it must be replaced.

SECURITY LAMP

The security lamp is an amber lamp located within the instrument cluster on the instrument panel. The security lamp receives fused battery feed at all times and is grounded by the high-line Central Timer Module (CTM) to give a visible indication of the Vehicle Theft Security System (VTSS) arming status.

The security lamp incandescent bulb and bulb holder can be serviced. Refer to Cluster Bulbs in the Removal and Installation section of Group 8E - Instrument Panel Systems for the service procedures.

DIAGNOSIS AND TESTING

VEHICLE THEFT SECURITY SYSTEM

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

The Vehicle Theft Security System (VTSS) and the Chrysler Collision Detection (CCD) data bus network should be diagnosed using a DRB scan tool and the proper Diagnostic Procedures manual. The DRB will provide confirmation that the data bus is functional, that the high-line Central Timer Module (CTM) is receiving and sending the proper messages on the data bus, that the CTM is receiving the proper hard-wired inputs and sending the proper hard-wired outputs, and that the Powertrain Control Module (PCM) is receiving the data bus messages from the CTM. Refer to the Vehicle Theft Security System menu item on the DRB scan tool for the procedures. Refer to 8W-39 - Vehicle Theft Security System in Group 8W - Wiring Diagrams for complete circuit descriptions and diagrams.

RELAYS

The headlamp (or security) relay and the horn relay are located in the Power Distribution Center (PDC) in the engine compartment. Each of these relays can be tested as described in the following procedure, however the circuits they are used in do vary. To test the relay circuits, refer to the circuit descriptions and diagrams in 8W-39 - Vehicle Theft Security System in Group 8W - Wiring Diagrams.

DIAGNOSIS AND TESTING (Continued)

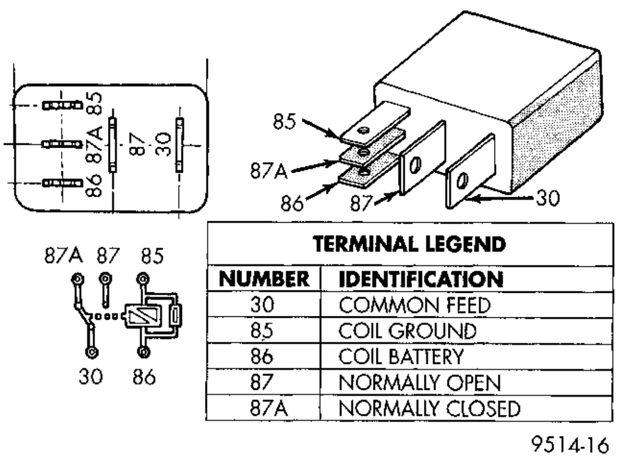
WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

Remove the relay (Fig. 1) from the PDC as described in this group to perform the following tests:

(1) A relay in the de-energized position should have continuity between terminals 87A and 30, and no continuity between terminals 87 and 30. If OK, go to Step 2. If not OK, replace the faulty relay.

(2) Resistance between terminals 85 and 86 (electromagnet) should be 75 ± 5 ohms. If OK, go to Step 3. If not OK, replace the faulty relay.

(3) Connect a battery to terminals 85 and 86. There should now be continuity between terminals 30 and 87, and no continuity between terminals 87A and 30. If OK, test the relay circuits. If not OK, replace the faulty relay.



TERMINAL LEGEND	
NUMBER	IDENTIFICATION
30	COMMON FEED
85	COIL GROUND
86	COIL BATTERY
87	NORMALLY OPEN
87A	NORMALLY CLOSED

Fig. 1 Relay Terminals

REMOVAL AND INSTALLATION

DOOR JAMB SWITCH

(1) Disconnect and isolate the battery negative cable.

(2) Grasp the body of the door jamb switch with a pair of pliers and move the switch gently back-and-forth while pulling it out of the door hinge pillar mounting hole.

(3) Pull the door jamb switch out from the pillar far enough to access the wire harness connector (Fig. 2).

(4) Unplug the door jamb switch from the wire harness connector.

(5) Reverse the removal procedures to install.

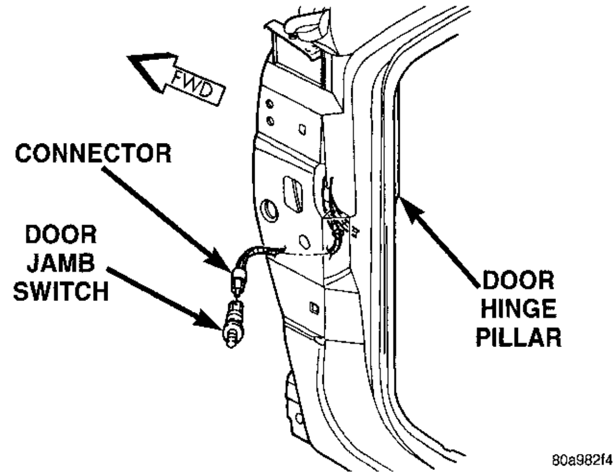


Fig. 2 Door Jamb Switch Remove/Install

DOOR LOCK CYLINDER SWITCH

(1) Disconnect and isolate the battery negative cable.

(2) Remove the door outside latch handle mounting hardware and linkage from the inside of the door. Refer to Group 23 - Body for the procedures.

(3) From the outside of the door, pull the door outside latch handle out far enough to access the door lock cylinder switch (Fig. 3).

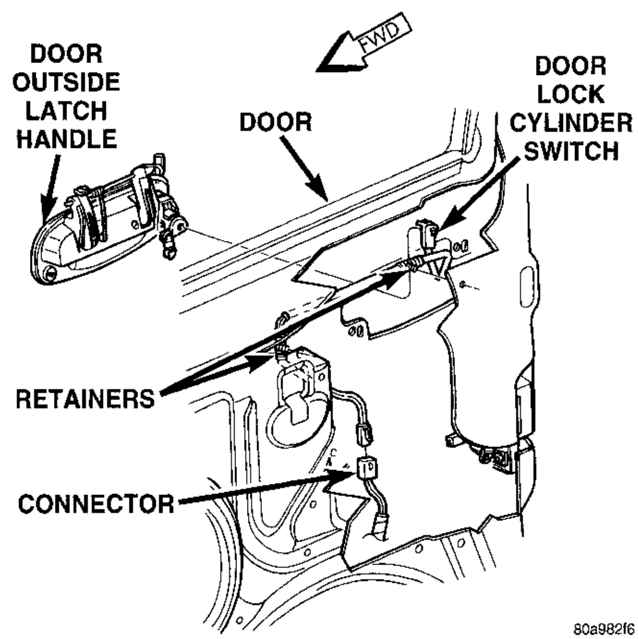


Fig. 3 Door Lock Cylinder Switch Remove/Install - Typical

(4) Disengage the door lock cylinder switch from the back of the lock cylinder.

(5) Unplug the door lock cylinder switch wire harness connector.

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REMOVAL AND INSTALLATION (Continued)

(6) Disengage the retainers that secure the door lock cylinder switch wire harness to the inner door panel.

(7) Remove the door lock cylinder switch from the door.

(8) Reverse the removal procedures to install.

HEADLAMP RELAY

(1) Disconnect and isolate the battery negative cable.

(2) Remove the cover from the Power Distribution Center (PDC) (Fig. 4).

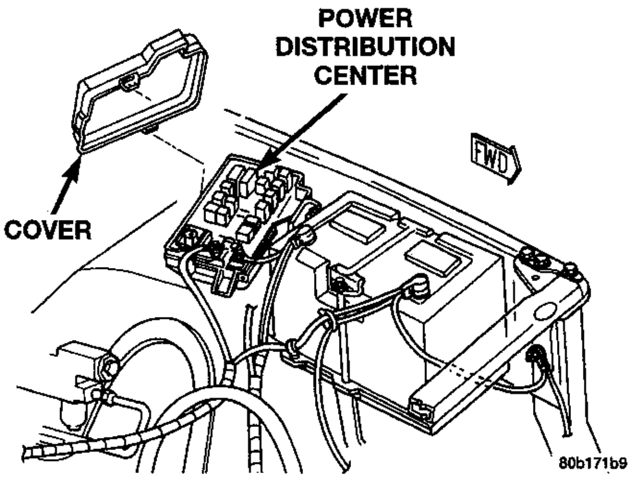

Fig. 4 Power Distribution Center

(3) Refer to the label on the PDC for headlamp (or security) relay identification and location.

(4) Unplug the headlamp relay from the PDC.

(5) Install the headlamp relay by aligning the relay terminals with the cavities in the PDC and pushing the relay firmly into place.

(6) Install the PDC cover.

(7) Connect the battery negative cable.

(8) Test the relay operation.

HORN RELAY

(1) Disconnect and isolate the battery negative cable.

(2) Remove the cover from the Power Distribution Center (PDC) (Fig. 5).

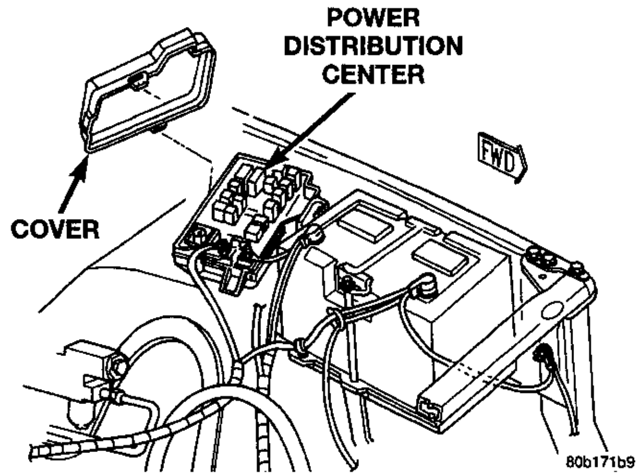

Fig. 5 Power Distribution Center

(3) Refer to the label on the PDC for horn relay identification and location.

(4) Unplug the horn relay from the PDC.

(5) Install the horn relay by aligning the relay terminals with the cavities in the PDC and pushing the relay firmly into place.

(6) Install the PDC cover.

(7) Connect the battery negative cable.

(8) Test the relay operation.

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POWER SEAT SYSTEMS

CONTENTS

GENERAL INFORMATION

INTRODUCTION

A six-way driver side power seat is an available factory-installed option for this model, when it is also equipped with the split bench seat option. Extended cab (club cab and quad cab) versions equipped with the power seat option also have a driver side power lumbar support feature. Refer to 8W-63 - Power Seat in Group 8W - Wiring Diagrams for complete circuit descriptions and diagrams.

POWER SEAT SYSTEM

The power seat system option allows the driver to electrically adjust his seating position for optimum control and comfort using the power seat switches located on the outboard seat cushion side shield. The power seat system allows the seating position to be adjusted forward, rearward, front up, front down, rear up, or rear down. The power seat system receives battery current through a fuse in the Power Distribution Center and a circuit breaker in the junction block, regardless of the ignition switch position.

Extended cab (club cab and quad cab) models equipped with the power seat option also feature a power operated lumbar support in the driver side seat back. The power lumbar support allows the driver to inflate or deflate a bladder located in the lower seat back to achieve optimum comfort and support in the lower lumbar region of the spinal column. The power lumbar support shares the battery feed circuit of the power seat system.

The power seat system includes the power seat adjuster and motors unit, the power lumbar support bladder and electric pump (extended cab only), the power seat switch, and the circuit breaker. Following are general descriptions of the major components in the power seat system. Refer to the owner's manual in the vehicle glove box for more information on the features, use and operation of the power seat system.

DESCRIPTION AND OPERATION

POWER SEAT SWITCH

The power seat in standard cab models can be adjusted in six different ways using the power seat switch. The power seat switch for extended cab models (club cab and quad cab) has an additional switch knob for adjusting the power lumbar support. The switch is located on the lower outboard side of the driver side seat cushion on the seat cushion side shield on all models. Refer to the owner's manual in the vehicle glove box for more information on the power seat switch functions and the seat adjusting procedures.

The individual switches in the power seat switch module cannot be repaired. If one switch is damaged or faulty, the entire power seat switch module must be replaced.

POWER SEAT ADJUSTER AND MOTORS

There are three reversible motors that operate the power seat adjuster. The motors are connected to worm-drive gearboxes that move the seat adjuster through a combination of screw-type drive units.

The front and rear of a seat are operated by different motors. They can be raised or lowered independently of each other. When the center seat switch is pushed in the Up or Down direction, both the front and rear motors operate in unison. On standard cab models the entire seat is moved up or down, on extended cab models (club cab and quad cab) the seat cushion moves independently of the seat back in the up or down directions. The forward-rearward motor is operated by pushing the center seat switch in the Forward or Rearward direction, which moves the entire seat in the selected direction on all models.

When a power seat switch is actuated, a battery feed and a ground path are applied through the switch contacts to the motor(s). The motor(s) and drive unit(s) operate to move the seat in the selected direction until the switch is released, or until the travel limit of the power seat adjuster is reached. When the switch is moved in the opposite direction, the battery feed and ground path to the motor(s) are reversed through the switch contacts. This causes the motor to run in the opposite direction.

Each motor contains a self-resetting circuit breaker to protect it from overload. Consecutive or frequent resetting of the circuit breakers must not be allowed to continue, or the motors may be damaged. Make the necessary repairs.

The power seat adjuster and motors cannot be repaired, and are serviced only as a complete unit. If any component in this unit is faulty or damaged, the entire power seat adjuster and motors assembly must be replaced.

POWER LUMBAR ADJUSTER AND MOTOR

There is a reversible motor that operates the power lumbar adjuster. The motor is connected to a pump that inflates or deflates the rubber lumbar adjuster bladder unit.

When the power lumbar switch is actuated, a battery feed and a ground path are applied through the switch contacts to the motor. The motor operates to move the pump in the selected direction until the switch is released, or until the inflation limit of the lumbar bladder is reached. When the switch is moved in the opposite direction, the battery feed and ground path to the motor are reversed through the switch contacts. This causes the motor to run in the opposite direction, and the pump deflates the bladder.

The motor contains a self-resetting circuit breaker to protect it from overload. Consecutive or frequent resetting of the circuit breaker must not be allowed to continue, or the motor may be damaged. Make the necessary repairs.

The power lumbar adjuster and motor cannot be repaired, and are serviced only as a complete unit. If any component in this unit is damaged or is faulty, the entire power lumbar adjuster and motor unit must be replaced.

CIRCUIT BREAKER

An automatic resetting circuit breaker in the junction block is used to protect the power seat system circuit. The circuit breaker can protect the system from a short circuit, or from an overload condition caused by an obstructed or stuck seat adjuster.

The circuit breaker cannot be repaired and, if faulty or damaged, it must be replaced.

DIAGNOSIS AND TESTING

POWER SEAT SYSTEM

Before any testing of the power seat system is attempted, the battery should be fully-charged and all wire harness connections and pins cleaned and tightened to ensure proper continuity and grounds. For circuit descriptions and diagrams, refer to 8W-63 - Power Seat in Group 8W - Wiring Diagrams.

With the dome lamp on, apply the power seat switch in the direction of the failure. If the dome lamp dims, the seat may be jamming. Check under and behind the seat for binding or obstructions. If the dome lamp does not dim, proceed with testing of the individual components and circuits.

CIRCUIT BREAKER

For circuit descriptions and diagrams, refer to 8W-63 - Power Seat in Group 8W - Wiring Diagrams.

(1) Locate the correct circuit breaker in the junction block. Pull out the circuit breaker slightly, but be certain that the circuit breaker terminals still contact the terminals in the junction block cavities.

(2) Connect the negative lead of a 12-volt DC voltmeter to a good ground.

(3) With the voltmeter positive lead, check both terminals of the circuit breaker for battery voltage.

If only one terminal has battery voltage, the circuit breaker is faulty and must be replaced. If neither terminal has battery voltage, repair the open circuit from the Power Distribution Center (PDC) as required.

POWER SEAT ADJUSTER AND MOTORS

For circuit descriptions and diagrams, refer to 8W-63 - Power Seat in Group 8W - Wiring Diagrams.

Operate the power seat switch to move all three seat motors in each direction. The seat should move in each of the selected directions. If the power seat adjuster fails to operate in only one direction, move the adjuster a short distance in the opposite direction and test again to be certain that the adjuster is not at its travel limit. If the power seat adjuster still fails to operate in only one direction, see Power Seat Switch in the Diagnosis and Testing section of this group. If the power seat adjuster fails to operate in more than one direction, proceed as follows:

DIAGNOSIS AND TESTING (Continued)

(1) Test the circuit breaker in the junction block as described in this group. If OK, go to Step 2. If not OK, replace the faulty circuit breaker.

(2) Remove the power seat switch from the seat. Check for battery voltage at the fused B(+) circuit cavity of the power seat switch wire harness connector. If OK, go to Step 3. If not OK, repair the open circuit to the junction block as required.

(3) Check for continuity between the ground circuit cavity of the power seat switch wire harness connector and a good ground. There should be continuity. If OK, go to Step 4. If not OK, repair the open circuit to ground as required.

(4) Test the power seat switch as described in this group. If the switch tests OK, check the wire harness for the inoperative power seat motor(s) between the power seat switch and the motor for shorts or opens. If the circuits check OK, replace the faulty power seat adjuster and motors assembly. If the circuits are not OK, repair the wire harness as required.

POWER LUMBAR ADJUSTER AND MOTOR

For circuit descriptions and diagrams, refer to 8W-63 - Power Seat in Group 8W - Wiring Diagrams.

Operate the power seat switch to inflate and deflate the power lumbar support. The lumbar support should inflate and deflate as selected. If the power lumbar support fails to operate in only one direction, move the support a short distance in the opposite direction and test again to be certain that the support is not already fully inflated or deflated. If the power lumbar support still fails to operate in only one direction, see Power Seat Switch in the Diagnosis and Testing section of this group. If the power lumbar support fails to operate in more than one direction, proceed as follows:

(1) Test the circuit breaker in the junction block as described in this group. If OK, go to Step 2. If not OK, replace the faulty circuit breaker.

(2) Remove the power seat switch from the seat. Check for battery voltage at the fused B(+) circuit cavity of the power seat switch wire harness connector. If OK, go to Step 3. If not OK, repair the open circuit to the junction block as required.

(3) Check for continuity between the ground circuit cavity of the power seat switch wire harness connector and a good ground. There should be continuity. If OK, go to Step 4. If not OK, repair the open circuit to ground as required.

(4) Test the power seat switch as described in this group. If the switch tests OK, check the wire harness between the power seat switch and the power lumbar support motor for shorts or opens. If the circuits check OK, replace the faulty power lumbar support adjuster and motor assembly. If the circuits are not OK, repair the wire harness as required.

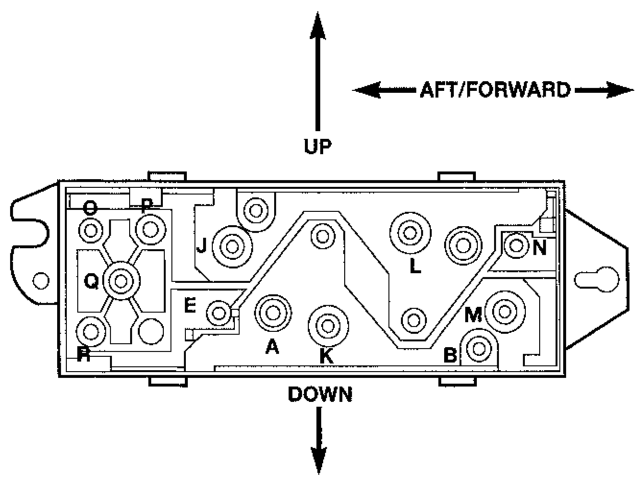
POWER SEAT SWITCH

For circuit descriptions and diagrams, refer to 8W-63 - Power Seat in Group 8W - Wiring Diagrams.

(1) Disconnect and isolate the battery negative cable.

(2) Remove the power seat switch from the power seat.

(3) Use an ohmmeter to test the continuity of the power seat switches in each position. See the Power Seat Switch Continuity chart (Fig. 1). If OK, see Power Seat Adjuster and Motors or Power Lumbar Adjuster and Motor in the Diagnosis and Testing section of this group. If not OK, replace the faulty power seat switch module.



TERMINALS SHOWN AS VIEWED FROM REAR OF SWITCH

POWER SEAT SWITCH	
SWITCH POSITION	CONTINUITY BETWEEN
OFF	B-N, B-J, B-M, B-E, B-L, B-K
VERTICAL UP	A-E, A-M, B-N, B-J
VERTICAL DOWN	A-J, A-N, B-M, B-E
HORIZONTAL FORWARD	A-L, B-K
HORIZONTAL AFT	A-K, B-L
FRONT TILT UP	A-M, B-N
FRONT TILT DOWN	A-N, B-M
REAR TILT UP	A-E, B-J
REAR TILT DOWN	A-J, B-E
LUMBAR OFF	O-P, P-R
LUMBAR UP (INFLATE)	O-P, Q-R
LUMBAR DOWN (DEFLATE)	O-R, P-Q

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Fig. 1 Power Seat Switch Continuity

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REMOVAL AND INSTALLATION

POWER SEAT SWITCH

STANDARD CAB

(1) Disconnect and isolate the battery negative cable.

(2) Remove the two screws that secure the power seat switch and bezel unit to the seat cushion frame (Fig. 2).

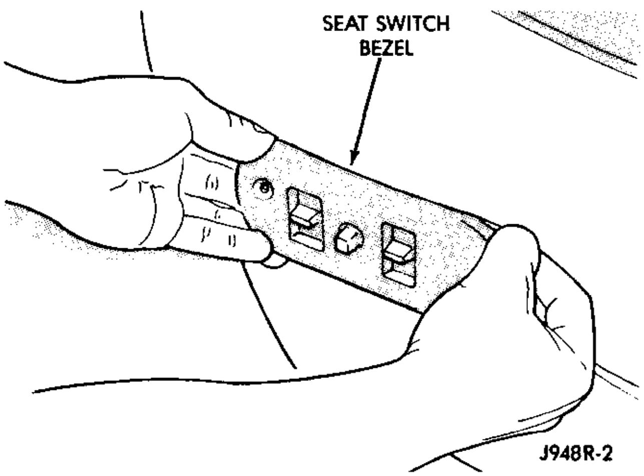

Fig. 2 Seat Switch and Bezel Remove/Install

(3) Pull the switch and bezel unit out from the seat far enough to access the switch wire harness connector. Gently pry the locking tabs of the switch away from the wire harness connector and carefully unplug the connector from the power seat switch module (Fig. 3).

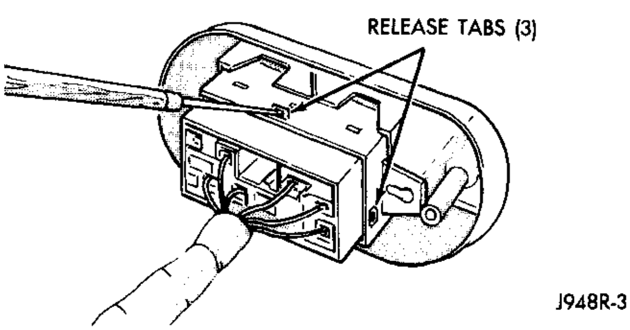

Fig. 3 Power Seat Switch Connector Remove

(4) Remove the two screws that secure the power seat switch module to the bezel and remove the bezel.

(5) Reverse the removal procedures to install. Tighten the switch mounting screws to 2.2 N·m (20 in. lbs.).

EXTENDED CAB

(1) Disconnect and isolate the battery negative cable.

(2) Remove the screw that secures the recliner lever to the recliner mechanism release shaft on the outboard side of the driver side front seat.

(3) Pull the recliner lever off of the recliner mechanism release shaft.

(4) Remove the three screws that secure the driver side seat cushion side shield to the outboard seat cushion frame.

(5) Pull the driver side seat cushion side shield away from the seat cushion frame far enough to access the power seat switch module wire harness connector.

(6) Gently pry the locking tabs of the switch away from the wire harness connector and carefully unplug the connector from the power seat switch module.

(7) Remove the seat cushion side shield and power seat switch module from the seat as a unit.

(8) Remove the two screws that secure the power seat switch to the inside of the seat cushion side shield (Fig. 4).

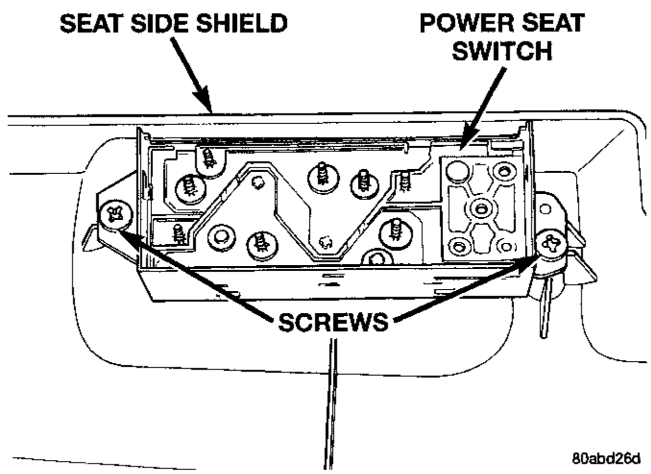

Fig. 4 Power Seat Switch Remove/Install - Typical

(9) Remove the power seat switch from the seat cushion side shield.

(10) Reverse the removal procedures to install. Tighten the switch mounting screws to 2.2 N·m (20 in. lbs.).

POWER SEAT ADJUSTER AND MOTORS

(1) Disconnect and isolate the battery negative cable.

(2) Remove the driver side seat, adjuster and motors assembly from the vehicle as a unit. Refer to Group 23 - Body for the procedures.

(3) Unplug the power seat wire harness connectors at each of the three power seat motors.

(4) Release the power seat wire harness retainers from the seat adjuster and motors assembly.

REMOVAL AND INSTALLATION (Continued)

(5) Remove the fasteners that secure the center seat cushion section to the brackets on the power seat adjuster.

(6) Remove the screws that secure the power seat adjuster and motors assembly to the seat cushion frame.

(7) Remove the power seat adjuster and motors assembly from the seat cushion frame.

(8) Reverse the removal procedures to install.

POWER LUMBAR ADJUSTER AND MOTOR

(1) Disconnect and isolate the battery negative cable.

(2) Remove the trim from the driver side seat back. Refer to Group 23 - Body for the procedures.

(3) Unplug the wire harness connector at the power lumbar inflator motor.

(4) Unhook the power lumbar adjuster and motor assembly clips from the steel support rod welded to the seat back frame (Fig. 5).

(5) Remove the power lumbar adjuster and motor assembly from the seat back frame.

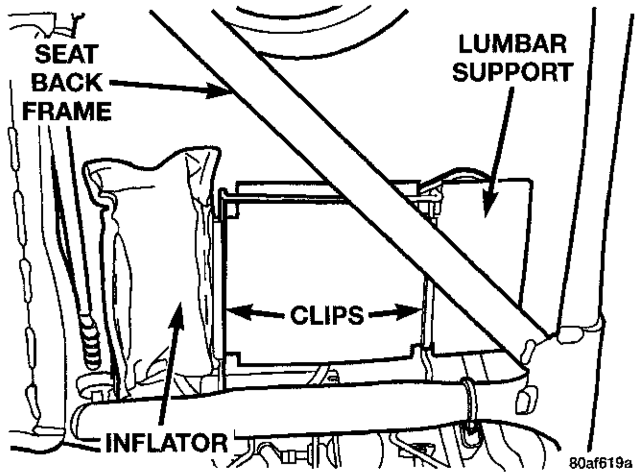

Fig. 5 Power Lumbar Adjuster and Motor Remove/ Install

(6) Reverse the removal procedures to install.

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POWER WINDOW SYSTEMS

CONTENTS

GENERAL INFORMATION

INTRODUCTION

Power windows are available as factory-installed optional equipment on this model. The power lock system is included on vehicles equipped with the power window option. Refer to 8W-60 - Power Windows in Group 8W - Wiring Diagrams for complete circuit descriptions and diagrams.

POWER WINDOW SYSTEM

The power window system allows each of the front door windows to be raised and lowered electrically by actuating a switch on the trim panel of each respective door. Additionally, the master switch on the driver side door trim panel allows the driver to raise or lower the passenger side front door window. The power window system receives battery feed through a circuit breaker in the junction block, only when the ignition switch is in the On position.

The power window system includes the power window switches on each front door trim panel, the circuit breaker in the junction block, and the power window motors inside each front door. This group covers diagnosis and service of only the electrical components in the power window system. For service of mechanical components, such as the regulator, lift plate, window tracks, or glass refer to Group 23 - Body.

Following are general descriptions of the major components in the power window system. Refer to the owner's manual in the vehicle glove box for more information on the features, use and operation of the power window system.

DESCRIPTION AND OPERATION

POWER WINDOW SWITCH

The power windows are controlled by two-way switches integral to the power window and lock switch and bezel unit on the trim panel of each front door. A second power window switch in the driver side switch and bezel unit allows the driver to control the passenger side window. A Light-Emitting Diode (LED) in the paddle of each switch is illuminated whenever the ignition switch is in the On position.

The power window switches control the battery and ground feeds to the power window motors. The passenger side power window switch receives a ground feed through the driver side power window switch for operating the passenger side power window motor.

The power window and lock switch and bezel unit cannot be repaired and, if faulty or damaged, the entire switch and bezel unit must be replaced.

POWER WINDOW MOTOR

A permanent magnet reversible motor moves the window regulator through an integral gearbox mechanism. A positive and negative battery connection to the two motor terminals will cause the motor to rotate in one direction. Reversing the current through these same two connections will cause the motor to rotate in the opposite direction.

In addition, each power window motor is equipped with an integral self-resetting circuit breaker to protect the motor from overloads. The power window motor and gearbox assembly cannot be repaired and, if faulty or damaged, the entire power window regulator assembly must be replaced.

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DESCRIPTION AND OPERATION (Continued)

CIRCUIT BREAKER

An automatic resetting circuit breaker in the junction block is used to protect the power window system circuit. The circuit breaker can protect the system from a short circuit, or from an overload condition caused by an obstructed or stuck window glass or regulator.

The circuit breaker cannot be repaired and, if faulty, it must be replaced.

DIAGNOSIS AND TESTING

POWER WINDOW SYSTEM

For circuit descriptions and diagrams, refer to 8W-60 - Power Windows in Group 8W - Wiring Diagrams.

ALL WINDOWS INOPERATIVE

(1) Check the circuit breaker in the junction block, as described in this group. If OK, go to Step 2. If not OK, replace the faulty circuit breaker.

(2) Disconnect and isolate the battery negative cable. Remove the power window and lock switch and bezel unit from the driver side front door trim panel. Unplug the wire harness connector from the switch and bezel unit.

(3) Check for continuity between the ground circuit cavity of the switch and bezel unit wire harness connector and a good ground. If OK, see Power Window Switch in the Diagnosis and Testing section of this group. If not OK, repair the circuit to ground as required.

ONE WINDOW INOPERATIVE

The window glass must be free to slide up and down for the power window motor to function properly. If the glass is not free to move up and down, the motor will overload and trip the integral circuit breaker. To determine if the glass is free, disconnect the regulator plate from the glass. Then slide the window up and down by hand.

There is an alternate method to check if the glass is free. Position the glass between the up and down stops. Then, shake the glass in the door. Check that the glass can be moved slightly from side to side, front to rear, and up and down. Then check that the glass is not bound tight in the tracks. If the glass is free, proceed with the diagnosis that follows. If the glass is not free, refer to Group 23 - Body for the door window glass and hardware service and adjustment procedures.

(1) Disconnect and isolate the battery negative cable. Remove the power window and lock switch and bezel unit from the door trim panel on the side of the vehicle with the inoperative window. Unplug the wire harness connector from the switch and bezel unit.

(2) Connect the battery negative cable. Turn the ignition switch to the On position. Check for battery voltage at the fused ignition switch output (run) circuit cavity in the body half of the switch and bezel unit wire harness connector. If OK, and the inoperative power window is on the driver side, go to Step 4. If OK, and the inoperative power window is on the passenger side, go to Step 3. If not OK, repair the open circuit to the junction block as required.

(3) Disconnect and isolate the battery negative cable. Check for continuity between each of the two master window switch right up/down control circuit cavities in the body half of the passenger side switch and bezel unit wire harness connector and a good ground. In each case, there should be continuity. If OK, go to Step 4. If not OK, repair the open circuit to the driver side switch and bezel unit as required.

(4) Test the power window switch continuity. See Power Window Switch in the Diagnosis and Testing section of this group. If OK, go to Step 5. If not OK, replace the faulty power window and lock switch and bezel unit.

(5) Refer to the circuit diagrams in 8W-60 - Power Windows in Group 8W - Wiring Diagrams. Check the continuity in each circuit between the inoperative power window and lock switch and bezel unit wire harness connector cavities and the corresponding power window motor wire harness connector cavities. If OK, see Power Window Motor in the Diagnosis and Testing section of this group. If not OK, repair the open circuit(s) as required.

NOTE: The passenger side power window switch receives the ground feed for operating the passenger side power window motor through the driver side power window switch and wire harness connector.

CIRCUIT BREAKER

For circuit descriptions and diagrams, refer to 8W-60 - Power Windows in Group 8W - Wiring Diagrams.

(1) Locate the circuit breaker in the junction block. Pull out the circuit breaker slightly, but be certain that the circuit breaker terminals still contact the terminals in the junction block cavities.

(2) Connect the negative lead of a 12-volt DC voltmeter to a good ground.

(3) With the voltmeter positive lead, check both terminals of the circuit breaker for battery voltage.

If only one terminal has battery voltage, the circuit breaker is faulty and must be replaced. If neither terminal has battery voltage, repair the open circuit from the Power Distribution Center (PDC) as required. If the circuit breaker checks OK, but no

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DIAGNOSIS AND TESTING (Continued)

power windows operate, see Power Window System in the Diagnosis and Testing section of this group.

POWER WINDOW SWITCH

The Light-Emitting Diode (LED) illumination lamps for all of the power window and lock switch and bezel unit switch paddles receive battery current through the power window circuit breaker in the junction block. If all of the LEDs are inoperative in either or both power window and lock switch and bezel units and the power windows are inoperative, perform the diagnosis for Power Window System in this group. If the power windows operate, but any or all of the LEDs are inoperative, the power window and lock switch and bezel unit with the inoperative LED(s) is faulty and must be replaced. For circuit descriptions and diagrams, refer to 8W-60 - Power Windows in Group 8W - Wiring Diagrams.

(1) Check the circuit breaker in the junction block. If OK, go to Step 2. If not OK, replace the faulty circuit breaker.

(2) Turn the ignition switch to the On position. Check for battery voltage at the circuit breaker in the junction block. If OK, turn the ignition switch to the Off position and go to Step 3. If not OK, repair the circuit to the ignition switch as required.

(3) Disconnect and isolate the battery negative cable. Remove the power window and lock switch and bezel unit from the door trim panel. Unplug the wire harness connector from the switch and bezel unit.

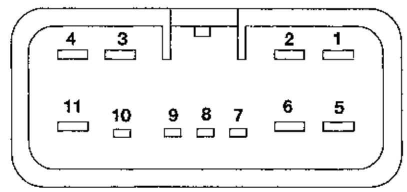
(4) Test the power window switch continuity. See the Power Window Switch Continuity charts to determine if the continuity is correct in the Neutral, Up and Down switch positions (Fig. 1) or (Fig. 2). If OK, see Power Window Motor in the Diagnosis and Testing section of this group. If not OK, replace the faulty switch.

POWER WINDOW MOTOR

For circuit descriptions and diagrams, refer to 8W-60 - Power Windows in Group 8W - Wiring Diagrams. Before you proceed with this diagnosis, confirm proper switch operation. See Power Window Switch in the Diagnosis and Testing section of this group.

(1) Disconnect and isolate the battery negative cable. Remove the trim panel from the door with the inoperative power window.

(2) Unplug the power window motor wire harness connector. Apply 12 volts across the motor terminals to check its operation in one direction. Reverse the connections across the motor terminals to check the operation in the other direction. Remember, if the window is in the full up or full down position, the motor will not operate in that direction by design. If OK, repair the circuits from the power window motor



VIEW OF SWITCH SIDE CONNECTOR

DRIVER SIDE WINDOW SWITCH	
SWITCH POSITION	CONTINUITY BETWEEN
NEUTRAL	1 & 3, 2 & 3, 3 & 4, 3 & 6
LEFT UP	3 & 4, 5 & 6
RIGHT UP	1 & 5, 2 & 3
LEFT DOWN	3 & 6, 4 & 5
RIGHT DOWN	1 & 3, 2 & 5
LAMP	3 & 5

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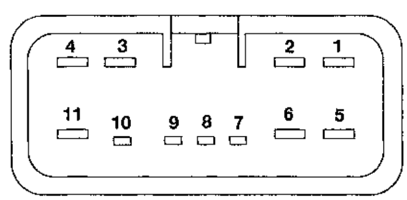
Fig. 1 Power Window Switch Continuity - Driver Side



VIEW OF SWITCH SIDE CONNECTOR

PASSENGER SIDE WINDOW SWITCH	
SWITCH POSITION	CONTINUITY BETWEEN
NEUTRAL	1 & 4, 2 & 3
UP	2 & 3, 4 & 11
DOWN	1 & 4, 3 & 11
LAMP	8 & 11

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Fig. 2 Power Window Switch Continuity - Passenger Side

DIAGNOSIS AND TESTING (Continued)

to the power window switch as required. If not OK, replace the faulty motor.

(3) If the motor operates in both directions, check the operation of the window glass and lift mechanism through its complete up and down travel. There should be no binding or sticking of the window glass or lift mechanism through the entire travel range. If not OK, refer to Group 23 - Body to check the window glass, tracks, and regulator for sticking, binding, or improper adjustment.

REMOVAL AND INSTALLATION

POWER WINDOW SWITCH

(1) Disconnect and isolate the battery negative cable.

(2) Using a wide flat-bladed tool such as a trim stick, gently pry the upper edge of the switch bezel to release the retainer that secures the switch bezel to the door trim panel opening (Fig. 3).

(3) Pull the switch and bezel unit away from the door trim panel opening far enough to access and unplug the wire harness connector.

(4) Remove the power window and lock switch and bezel unit from the door trim panel.

(5) Reverse the removal procedures to install. When installing the switch and bezel unit to the door trim panel opening, insert the rear of the bezel into the opening, then push down on the front of the bezel until the retaining tab snaps into place.

POWER WINDOW MOTOR

The power window motor and mechanism is integral to the power window regulator unit. If the power window motor or mechanism is faulty or damaged, the entire power window regulator unit must be replaced. Refer to Group 23 - Body for the window regulator service procedures.

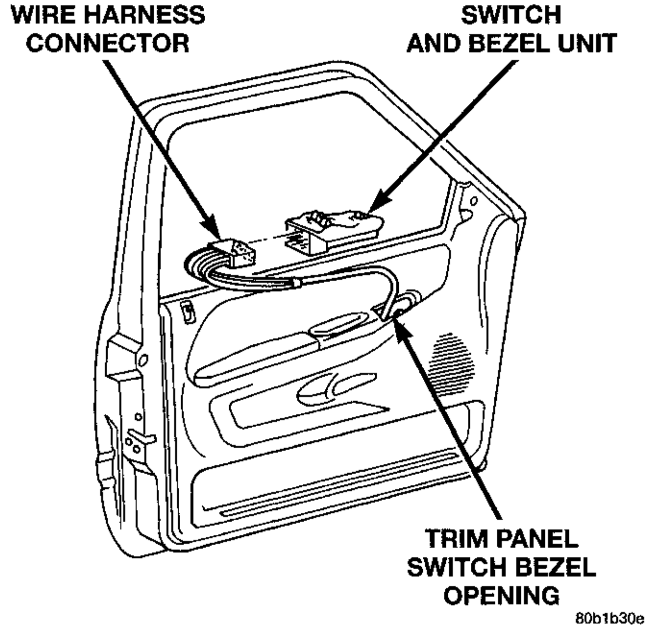

Fig. 3 Power Window and Lock Switch and Bezel Unit Remove/Install

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POWER MIRROR SYSTEMS

CONTENTS

EXTERIOR MIRRORS

INDEX

GENERAL INFORMATION

INTRODUCTION

Power operated or power operated and heated outside rear view mirrors are available factory-installed options on this model. Refer to 8W-62 - Power Mirrors in Group 8W - Wiring Diagrams for complete circuit descriptions and diagrams.

POWER MIRROR SYSTEM

The power operated or power operated and heated outside rear view mirrors allow the driver to adjust both outside mirrors electrically from the driver side front seat position by operating a switch on the driver side front door trim panel. The power mirrors receive a non-switched battery feed through a fuse in the junction block so that the system will remain operational, regardless of the ignition switch position.

The heated mirror option includes an electric heating grid behind the mirror glass in each outside mirror, which can clear the mirror glass of ice, snow, or fog. The heating grid receives fused battery current through the heated mirror relay in the heater and air conditioner control only when the ignition switch is in the On position, and the heated mirror system is turned on. Refer to Heated Mirror System in Group 8N - Electrically Heated Systems for more information.

Following are general descriptions of the major components in the power mirror system. Refer to the owner's manual in the vehicle glove box for more information on the features, use and operation of the power mirror system.

DESCRIPTION AND OPERATION

POWER MIRROR

Each power mirror head contains two electric motors, two drive mechanisms, and the mirror glass. One motor and drive controls mirror up-and-down movement, and the other controls right-and-left movement.

The power mirrors in vehicles equipped with the available heated mirror system option also include an electric heating grid located behind the mirror glass. This heating grid is energized by the heated mirror relay in the heater and air conditioner control only when the ignition switch is in the On position, and the heated mirror system is turned on. Refer to Heated Mirror System in Group 8N - Electrically Heated Systems for more information.

The power mirror assembly cannot be repaired. If any component of the power mirror unit is faulty or damaged, the entire assembly must be replaced.

POWER MIRROR SWITCH

Both the right and left power outside mirrors are controlled by a single multi-function switch unit located on and mounted to the upper flag area of the

DESCRIPTION AND OPERATION (Continued)

driver side door trim panel. The switch knob is rotated clockwise (right mirror control), or counter-clockwise (left mirror control) to select the mirror to be adjusted. The switch knob is then moved in a joystick fashion to control movement of the selected mirror up, down, right, or left.

The power mirror switch cannot be repaired and, if faulty or damaged, it must be replaced. The power switch knob is available for service replacement.

DIAGNOSIS AND TESTING

POWER MIRROR SYSTEM

For circuit descriptions and diagrams, refer to 8W-62 - Power Mirrors in Group 8W - Wiring Diagrams.

(1) Check the fuses in the Power Distribution Center (PDC) and the junction block. If OK, go to Step 2. If not OK, repair the shorted circuit or component as required and replace the faulty fuse(s).

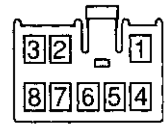
(2) Check for battery voltage at the fuse in the junction block. If OK, go to Step 3. If not OK, repair the open circuit to the PDC as required.

(3) Disconnect and isolate the battery negative cable. Remove the driver side door trim panel and unplug the wire harness connector from the power mirror switch. Connect the battery negative cable. Check for battery voltage at the fused B(+) circuit cavity in the door wire harness half of the power mirror switch wire harness connector. If OK, go to Step 4. If not OK, repair the open circuit to the junction block as required.

(4) Disconnect and isolate the battery negative cable. Check for continuity between the ground circuit cavity in the door wire harness half of the power mirror switch wire harness connector and a good ground. There should be continuity. If OK, go to Step 5. If not OK, repair the circuit to ground as required.

(5) Check the power mirror switch continuity as shown in (Fig. 1). If OK, go to Step 6. If not OK, replace the faulty switch.

(6) Unplug the wire harness connector at the inoperative power mirror. Use two jumper wires, one connected to a 12-volt battery feed, and the other connected to a good body ground. See the Power Mirror Test chart for the correct jumper wire connections to the power mirror half of the power mirror wire harness connector (Fig. 2). If the power mirror(s) do not respond as indicated in the chart, replace the faulty power mirror assembly. If the power mirror(s) do respond as indicated in the chart, repair the circuits between the power mirror and the power mirror switch for a short or open as required.



MIRROR SELECTOR KNOB IN "L" POSITION	
MOVE LEVER	CONTINUITY BETWEEN
UP	Pins 3 and 8, 1 and 7, 4 and 7
RIGHT	Pins 3 and 7, 2 and 8, 5 and 8
DOWN	Pins 3 and 7, 1 and 8, 4 and 8
LEFT	Pins 3 and 8, 2 and 7, 5 and 7
MIRROR SELECTOR KNOB IN "R" POSITION	
MOVE LEVER	**CONTINUITY BETWEEN**
UP	Pins 6 and 8, 1 and 7, 4 and 7
RIGHT	Pins 6 and 7, 2 and 8, 5 and 8
DOWN	Pins 6 and 7, 1 and 8, 4 and 8
LEFT	Pins 6 and 8, 2 and 7, 5 and 7

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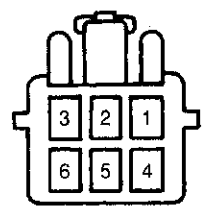
Fig. 1 Power Mirror Switch Continuity



		Left or Right Mirror
12 Volts	**Ground**	**MIRROR MOVEMENT**
Pin 3	Pin 1	UP
Pin 1	Pin 3	DOWN
Pin 2	Pin 1	LEFT
Pin 1	Pin 2	RIGHT

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Fig. 2 Power Mirror Test

REMOVAL AND INSTALLATION

POWER MIRROR SWITCH

(1) Disconnect and isolate the battery negative cable.

(2) Pull the control knob rearward to remove it from the power mirror switch stem (Fig. 3).

(3) Remove the nut that secures the power mirror switch to the driver side front door trim panel.

(4) Remove the trim panel from the inside of the driver side front door. Refer to Group 23 - Body for the procedures.

REMOVAL AND INSTALLATION (Continued)

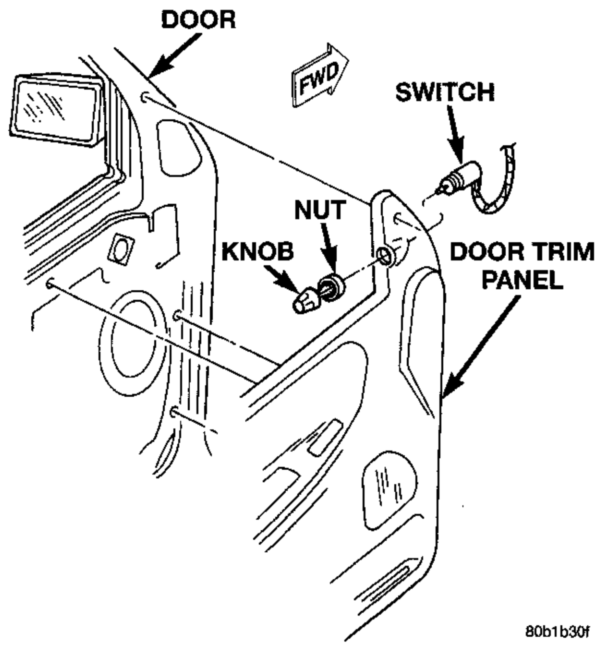

Fig. 3 Power Mirror Switch Remove/Install

(5) Pull the trim panel away from the inner door far enough to access the power mirror switch wire harness connector.

(6) Unplug the power mirror switch wire harness connector.

(7) Remove the power mirror switch from the back of the door trim panel.

(8) Reverse the removal procedures to install.

POWER MIRROR

(1) Disconnect and isolate the battery negative cable.

(2) Remove the trim panel from the inside of the front door. Refer to Group 23 - Body for the procedures.

(3) Remove the mirror flag seal from the inner door panel (Fig. 4).

(4) Unplug the wire harness connector from the power mirror (Fig. 5).

(5) Remove the three nuts that secure the power mirror to the inner door panel.

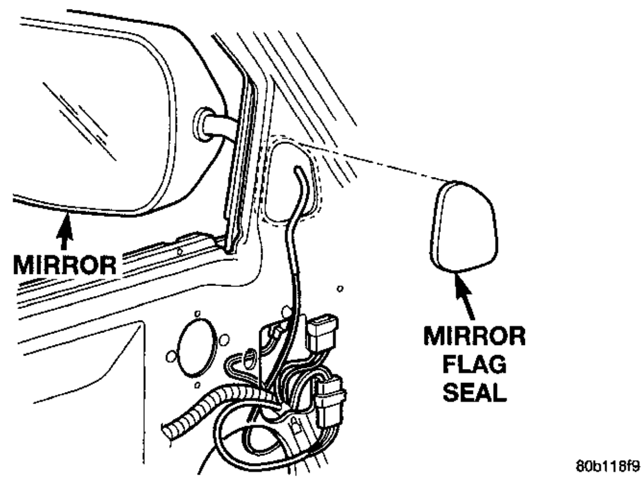

Fig. 4 Mirror Flag Seal Remove/Install

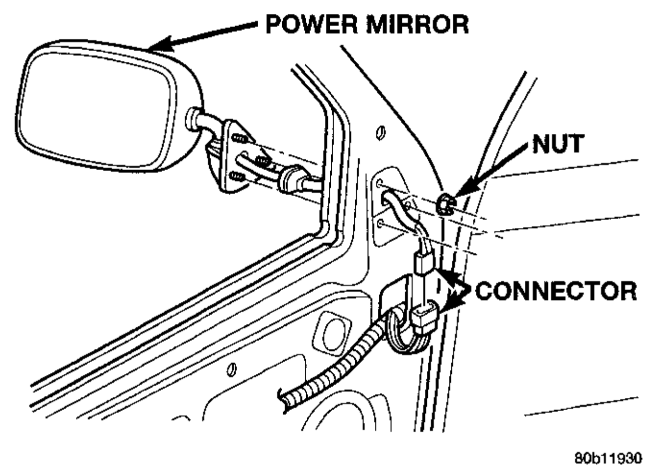

Fig. 5 Power Mirror Remove/Install

(6) Unseat the power mirror wire harness grommet by pushing it out through the hole in the door flag from the inside.

(7) Pull the mirror from the outside of the door while feeding the wire harness, grommet, and connector out through the hole from the inside of the door.

(8) Reverse the removal procedures to install. Tighten the mounting nuts to 7.5 N·m (65 in. lbs.).

INTERIOR MIRRORS

INDEX

GENERAL INFORMATION

INTRODUCTION

An automatic dimming inside day/night rear view mirror is an available factory-installed option on this model. Refer to 8W-44 - Interior Lighting in Group 8W - Wiring Diagrams for complete circuit descriptions and diagrams.

AUTOMATIC DAY/NIGHT MIRROR SYSTEM

The automatic day/night mirror system is able to automatically change the reflectance of the inside rear view mirror in order to reduce the glare of headlamps approaching the vehicle from the rear. The automatic day/night rear view mirror receives battery current through a fuse in the junction block only when the ignition switch is in the On position.

A switch located on the bottom of the automatic day/night mirror housing allows the vehicle operator to select whether the automatic dimming feature is operational. When the automatic day/night mirror is turned on, the mirror switch is lighted by an integral Light-Emitting Diode (LED). The mirror will automatically disable its self-dimming feature whenever the vehicle is being driven in reverse.

Following is a general description of the automatic day/night mirror. Refer to the owner's manual in the vehicle glove box for more information on the features, use and operation of the automatic day/night mirror system.

DESCRIPTION AND OPERATION

AUTOMATIC DAY/NIGHT MIRROR

The automatic day/night mirror uses a thin layer of electrochromic material between two pieces of conductive glass to make up the face of the mirror. When the mirror switch is in the On position, two photocell sensors are used by the mirror circuitry to monitor external light levels and adjust the reflectance of the mirror.

The ambient photocell sensor is located on the forward-facing (windshield side) of the rear view mirror housing, and detects the ambient light levels outside of the vehicle. The headlamp photocell sensor is located inside the rear view mirror housing behind the mirror glass and faces rearward, to detect the level of the light being received at the rear window side of the mirror. When the circuitry of the automatic day/night mirror detects that the difference between the two light levels is too great (the light level received at the rear of the mirror is much higher than that at the front of the mirror), it begins to darken the mirror.

The automatic day/night mirror circuitry also monitors the transmission using an input from the backup lamp circuit. The mirror circuitry is programmed to automatically disable its self-dimming feature whenever it senses that the transmission backup lamp circuit is energized.

The automatic day/night mirror is a completely self-contained unit and cannot be repaired. If faulty or damaged, the entire mirror assembly must be replaced.

DIAGNOSIS AND TESTING

AUTOMATIC DAY/NIGHT MIRROR

For circuit descriptions and diagrams, refer to 8W-44 - Interior Lighting in Group 8W - Wiring Diagrams.

(1) Check the fuse in the junction block. If OK, go to Step 2. If not OK, repair the shorted circuit or component as required replace the faulty fuse.

(2) Turn the ignition switch to the On position. Check for battery voltage at the fuse in the junction block. If OK, go to Step 3. If not OK, repair the open circuit to the ignition switch as required.

(3) Turn the ignition switch to the Off position. Disconnect and isolate the battery negative cable. Unplug the wire harness connector from the automatic day/night mirror (Fig. 1). Connect the battery negative cable. Turn the ignition switch to the On

DIAGNOSIS AND TESTING (Continued)

position. Check for battery voltage at the fused ignition switch output (run/start) circuit cavity of the automatic day/night mirror wire harness connector. If OK, go to Step 4. If not OK, repair the open circuit to the junction block as required.

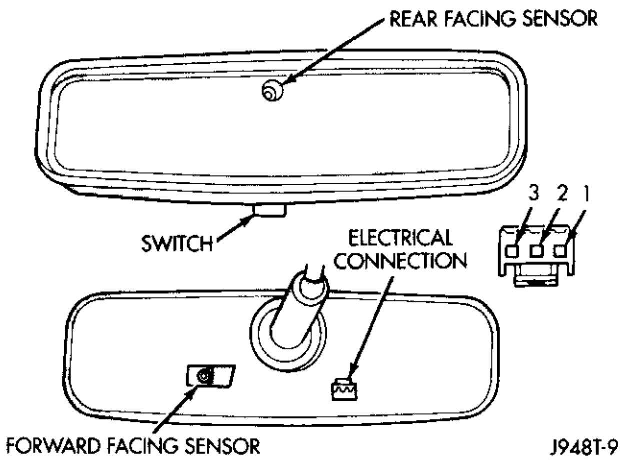

Fig. 1 Automatic Day/Night Mirror

(4) Turn the ignition switch to the Off position. Disconnect and isolate the battery negative cable. Check for continuity between the ground circuit cavity of the automatic day/night mirror wire harness connector and a good ground. There should be continuity. If OK, go to Step 5. If not OK, repair the circuit to ground as required.

(5) Connect the battery negative cable. Turn the ignition switch to the On position. Set the parking brake. Place the transmission gear selector lever in the Reverse position. Check for battery voltage at the backup lamp switch output circuit cavity of the automatic day/night mirror wire harness connector. If OK, go to Step 6. If not OK, repair the open circuit as required.

(6) Turn the ignition switch to the Off position. Disconnect the battery negative cable. Plug in the automatic day/night mirror wire harness connector. Connect the battery negative cable. Turn the ignition switch to the On position. Place the transmission gear selector lever in the Neutral position. Place the mirror switch in the On (LED in the mirror switch is lighted) position. Cover the forward facing ambient photocell sensor to keep out any ambient light.

NOTE: The ambient photocell sensor must be covered completely, so that no light reaches the sensor. Use a finger pressed tightly against the sensor, or cover the sensor completely with electrical tape.

(7) Shine a light into the rearward facing headlamp photocell sensor. The mirror glass should darken. If OK, go to Step 8. If not OK, replace the faulty automatic day/night mirror unit.

(8) With the mirror glass darkened, place the transmission gear selector lever in the Reverse position. The mirror should return to its normal reflectance. If not OK, replace the faulty automatic day/night mirror unit.

REMOVAL AND INSTALLATION

AUTOMATIC DAY/NIGHT MIRROR

(1) Disconnect and isolate the battery negative cable.

(2) Unplug the wire harness connector from the automatic day/night mirror (Fig. 2).

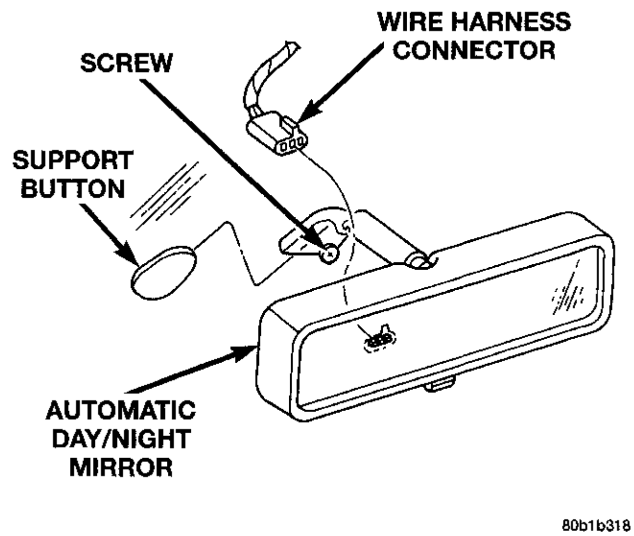

Fig. 2 Automatic Day/Night Mirror Remove/Install

(3) Remove the set screw that secures the automatic day/night mirror to the windshield support button.

(4) Push the automatic day/night mirror upwards far enough for the mounting bracket to clear the support button and remove the mirror from the windshield.

(5) Reverse the removal procedures to install. Tighten the mounting screw to 1 N·m (9 in. lbs.).

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CHIME/BUZZER WARNING SYSTEMS

CONTENTS

GENERAL INFORMATION

INTRODUCTION

A chime warning system is standard factory-installed equipment on this model. Refer to 8W-44 - Interior Lighting or 8W-45 - Central Timer Module in Group 8W - Wiring Diagrams for complete circuit descriptions and diagrams.

INTRODUCTION

The chime warning system provides an audible warning to the driver under the following conditions:

- ABS lamp illumination
- Airbag indicator lamp illumination
- Check engine lamp illumination
- Check gauges lamp illumination
- Driver side seat belt is not fastened with the ignition switch in the On position
- Head or park lamps are turned on with the ignition switch Off and the driver side front door open
- Key is in the ignition switch with the ignition switch Off and the driver side front door open
- Low fuel warning lamp illumination - less than about one-eighth tank of fuel remaining
- Low washer fluid warning lamp illumination
- Transmission oil temperature warning lamp illumination.

Following are general descriptions of the major components in the chime warning system. Refer to the owner's manual in the vehicle glove box for more information on the features, use and operation of the chime warning system.

DESCRIPTION AND OPERATION

CENTRAL TIMER MODULE

Two versions of the Central Timer Module (CTM) are available on this vehicle, a base version and a high-line version. The base version of the CTM is used on base models of the vehicle. It is also sometimes referred to as the Integrated Electronic Module (IEM). The base version of the CTM combines the functions of a chime/buzzer module, an intermittent wipe module, and an ignition lamp time delay relay in a single unit.

The high-line version of the CTM is used on high-line vehicles. The high-line CTM provides all of the functions of the base version CTM, but also is used to control and integrate many of the additional electronic functions and features included on the high-line models. The high-line version of the CTM contains a central processing unit and interfaces with other modules in the vehicle on the Chrysler Collision Detection (CCD) data bus network.

The CCD data bus network allows the sharing of sensor information. This helps to reduce wire harness complexity, reduce internal controller hardware, and reduce component sensor current loads. At the same time, this system provides increased reliability, enhanced diagnostics, and allows the addition of many new feature capabilities.

One of the functions and features that both versions of the CTM support is the chime warning system. The CTM contains a chime tone generator to perform the functions of the chime warning module.

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DESCRIPTION AND OPERATION (Continued)

The CTM uses hard-wired switch inputs, internal programming, and a hard-wired chime request input from the instrument cluster circuitry to detect when a chime tone is required.

Both versions of the CTM are mounted under the driver side end of the instrument panel, inboard of the instrument panel steering column opening. Refer to Central Timer Module in the Removal and Installation section of Group 8E - Instrument Panel Systems for the service procedures.

This group covers the diagnosis and service of only the hard-wired inputs used by the CTM to determine that a chime tone should be generated. See Central Timer Module in the Diagnosis and Testing section of this group for diagnosis of the base version of the CTM. For diagnosis of the high-line version of the CTM or of the CCD data bus, a DRB scan tool and the proper Diagnostic Procedures manual are recommended. The CTM cannot be repaired and, if faulty or damaged, it must be replaced.

INSTRUMENT CLUSTER

The instrument cluster is an electromechanical unit that contains integrated circuitry and internal programming to perform a variety of functions. The instrument cluster circuitry monitors hard-wired switch inputs, as well as message inputs received from other vehicle electronic modules on the Chrysler Collision Detection (CCD) data bus network.

The instrument cluster uses these many inputs along with its internal programming to provide hard-wired chime tone requests to the Central Timer Module (CTM), which performs the functions of the chime warning module on this model. The instrument cluster circuitry also has a self-diagnostic capability. Refer to Instrument Cluster in the Diagnosis and Testing section of Group 8E - Instrument Panel Systems for more information on this feature.

The only instrument cluster diagnosis found in this group consists of confirming the viability of the hard-wired chime request circuit between the instrument cluster circuitry and the CTM, and diagnosis of the hard-wired seat belt switch input to the instrument cluster. For diagnosis of the CCD data bus and the data bus message inputs, a DRB scan tool and the proper Diagnostic Procedures manual are recommended.

Refer to Instrument Cluster in the Removal and Installation section of Group 8E - Instrument Panel Systems for the instrument cluster service procedures. Refer to the Diagnosis and Testing section of Group 8E - Instrument Panel systems for more information on the remaining hard-wired instrument cluster inputs. The instrument cluster chime warning circuitry cannot be repaired and, if faulty or damaged, the instrument cluster assembly must be replaced.

DRIVER DOOR JAMB SWITCH

The driver door jamb switch is mounted to the driver side door hinge pillar. The switch closes a path to ground for the Central Timer Module (CTM) when the driver door is opened, and opens the ground path when the driver door is closed.

The driver door jamb switch cannot be repaired and, if faulty or damaged, it must be replaced. Refer to Door Jamb Switch in the Removal and Installation section of Group 8Q - Vehicle Theft/Security Systems for the service procedures.

KEY-IN IGNITION SWITCH

The key-in ignition switch is integral to the ignition switch, which is mounted on the right side of the steering column. It closes a path to ground for the Central Timer Module (CTM) when the ignition key is inserted in the ignition lock cylinder and the driver door jamb switch is closed (driver door is open). The key-in ignition switch opens the ground path when the key is removed from the ignition lock cylinder. The ground path is also opened when the driver door jamb switch is open (driver door is closed).

The key-in ignition switch cannot be repaired and, if faulty or damaged, the entire ignition switch must be replaced. Refer to Group 8D - Ignition Systems for the service procedures.

HEADLAMP SWITCH

The headlamp switch is located in the instrument panel, outboard of the steering column. It closes a path to ground for the Central Timer Module (CTM) when the park or head lamps are on and the driver door jamb switch is closed (driver door is open). The headlamp switch opens the ground path when the headlamp switch is turned off. The ground path is also opened when the driver door jamb switch is open (driver door is closed).

The headlamp switch cannot be repaired and, if faulty or damaged, it must be replaced. Refer to Headlamp Switch in the Removal and Installation section of Group 8E - Instrument Panel Systems for the service procedures.

DRIVER SEAT BELT SWITCH

The driver seat belt switch is integral to the driver seat belt retractor assembly. The driver seat belt switch is normally closed, providing a battery voltage signal to the instrument cluster when the ignition switch is in the On or Start positions.

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DESCRIPTION AND OPERATION (Continued)

The seat belt switch monitors the amount of seat belt webbing wound onto the seat belt retractor spool. When the seat belt tip-half webbing is pulled out of the retractor far enough to engage the seat belt buckle-half, the switch opens the seat belt switch sense circuit.

The driver seat belt switch cannot be repaired and, if faulty or damaged, the entire driver seat belt and retractor unit must be replaced. Refer to Group 23 - Body for the service procedures.

DIAGNOSIS AND TESTING

CENTRAL TIMER MODULE

Before testing the Central Timer Module (CTM) for an inoperative chime function, be sure to test the hard-wired switch and instrument cluster chime request circuits as described in this group. For circuit descriptions and diagrams, refer to 8W-45 - Central Timer Module in Group 8W - Wiring Diagrams.

NOTE: The following tests may not prove conclusive in the diagnosis of the high-line version of the Central Timer Module (CTM). The most reliable, efficient, and accurate means to diagnose the high-line CTM requires the use of a DRB scan tool and the proper Diagnostic Procedures manual.

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(1) Check the fuses in the junction block. If OK, go to Step 2. If not OK, repair the shorted circuit or component as required and replace the faulty fuse.

(2) Check for battery voltage at the fuse in the junction block. If OK, go to Step 3. If not OK, repair the open circuit to the Power Distribution Center (PDC) as required.

(3) Disconnect and isolate the battery negative cable. Remove the CTM from its mounting bracket to access the CTM wire harness connectors. Refer to Central Timer Module in the Removal and Installation section of Group 8E - Instrument Panel Systems for the procedures.

(4) Unplug the wire harness connectors from the CTM. Check the wire harness connectors and the receptacles in the module for loose, corroded, or damaged terminals and pins. If OK, go to Step 5. If not OK, repair as required.

(5) Probe the ground circuit cavity of the 14-way CTM wire harness connector and check for continuity to a good ground. On the high-line version of the CTM, repeat the check between the ground circuit cavity of the 18-way CTM wire harness connector and a good ground. In each case, there should be continuity. If OK, go to Step 6. If not OK, repair the open circuit(s) to ground as required.

(6) Connect the battery negative cable. Check for battery voltage at the fused B(+) circuit cavity of the 14-way CTM wire harness connector. If OK, go to Step 7. If not OK, repair the open circuit to the junction block as required.

(7) Turn the ignition switch to the On position. Check for battery voltage at the fused ignition switch output (run/start) circuit cavity of the 14-way CTM wire harness connector. On the high-line version of the CTM, repeat the check at the fused ignition switch output (run/accessory) circuit cavity of the 18-way CTM wire harness connector. If OK, replace the faulty CTM. If not OK, repair the open circuit from the CTM to the junction block as required.

DRIVER DOOR JAMB SWITCH

For circuit descriptions and diagrams, refer to 8W-45 - Central Timer Module in Group 8W - Wiring Diagrams.

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(1) Rotate the headlamp switch knob counterclockwise to ensure that the dome lamps are not switched off. Open the driver door and note whether the interior lamps light. They should light. If OK, see Key-In Ignition Switch and/or Headlamp Switch in the Diagnosis and Testing section of this group. If not OK, go to Step 2.

(2) Disconnect and isolate the battery negative cable. Unplug the driver door jamb switch from its wire harness connector. Check for continuity between the ground circuit cavity of the driver door jamb switch wire harness connector and a good ground. There should be continuity. If OK, go to Step 3. If not OK, repair the circuit to ground as required.

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DIAGNOSIS AND TESTING (Continued)

(3) Check for continuity between the door jamb switch ground circuit terminal and each of the other two terminals of the driver door jamb switch. There should be continuity with the switch plunger released, and no continuity with the switch plunger depressed. If OK, go to Step 4. If not OK, replace the faulty switch.

(4) Remove the Central Timer Module (CTM) from its mounting bracket to access the CTM wire harness connectors. Refer to Central Timer Module in the Removal and Installation section of Group 8E - Instrument Panel Systems for the procedures. Unplug the 14-way CTM wire harness connector. Check for continuity between the driver door switch sense circuit cavity of the 14-way CTM wire harness connector and a good ground. There should be no continuity. If OK, go to Step 5. If not OK, repair the short circuit as required.

(5) Check for continuity between the driver door switch sense circuit cavities of the 14-way CTM wire harness connector and the driver door jamb switch wire harness connector. There should be continuity. If OK, see Key-In Ignition Switch and/or Headlamp Switch in the Diagnosis and Testing section of this group. If not OK, repair the open circuit as required.

KEY-IN IGNITION SWITCH

For circuit descriptions and diagrams, refer to 8W-40 - Instrument Cluster or 8W-44 - Interior Lighting in Group 8W - Wiring Diagrams.

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(1) Disconnect and isolate the battery negative cable. Remove the steering column shrouds. Refer to Group 8D - Ignition Systems for the procedures. Unplug the key-in ignition switch wire harness connector from the ignition switch.

(2) Check for continuity between the key-in ignition switch sense and ground terminals of the key-in ignition switch. There should be continuity with the key in the ignition lock cylinder, and no continuity with the key removed from the ignition lock cylinder. If OK, go to Step 3. If not OK, replace the faulty ignition switch assembly.

(3) Open the driver door. Check for continuity between the ground circuit cavity of the key-in ignition switch wire harness connector and a good ground. There should be continuity. If OK, go to Step 4. If not OK, repair the open circuit to the driver door jamb switch as required.

(4) Remove the Central Timer Module (CTM) from its mounting bracket to access the CTM wire harness connectors. Refer to Central Timer Module in the Removal and Installation section of Group 8E - Instrument Panel Systems for the procedures. Unplug the 14-way CTM wire harness connector. Close the driver door. Check for continuity between the key-in ignition switch sense circuit cavity of the CTM wire harness connector and a good ground. There should be no continuity. If OK, go to Step 5. If not OK, repair the short circuit as required.

(5) Check for continuity between the key-in ignition switch sense circuit cavities of the key-in ignition switch wire harness connector and the 14-way CTM wire harness connector. There should be continuity. If OK, test the CTM as described in this group. If not OK, repair the open circuit as required.

HEADLAMP SWITCH

For circuit descriptions and diagrams, refer to 8W-45 - Central Timer Module in Group 8W - Wiring Diagrams.

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(1) Disconnect and isolate the battery negative cable. Remove the headlamp switch from the instrument panel. Refer to Headlamp Switch in the Removal and Installation section of Group 8E - Instrument Panel Systems for the procedures. Unplug the headlamp switch wire harness connectors. Check for continuity between the left door jamb switch sense circuit cavity of the headlamp switch wire harness connector and a good ground. There should be continuity with the driver door open, and no continuity with the driver door closed. If OK, go to Step 2. If not OK, repair the circuit to the driver door jamb switch as required.

(2) Remove the Central Timer Module (CTM) from its mounting bracket to access the CTM wire harness connectors. Refer to Central Timer Module in the Removal and Installation section of Group 8E - Instrument Panel Systems for the procedures. Unplug the 14-way CTM wire harness connector. Remove the key from the ignition lock cylinder. Check for continuity between the key-in ignition switch sense circuit cavity of the 14-way CTM wire

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DIAGNOSIS AND TESTING (Continued)

harness connector and a good ground. There should be no continuity. If OK, go to Step 3. If not OK, repair the short circuit as required.

(3) Check for continuity between the key-in ignition switch sense circuit cavities of the 14-way CTM wire harness connector and the headlamp switch wire harness connector. There should be continuity. If OK, go to Step 4. If not OK, repair the open circuit as required.

(4) Check for continuity between the left front door jamb switch sense circuit terminal and the key-in ignition switch sense circuit terminal of the headlamp switch. There should be no continuity with the switch in the Off position, and continuity with the switch in the park or head lamps On position. If OK, see Central Timer Module in the Diagnosis and Testing section of this group. If not OK, replace the faulty headlamp switch.

DRIVER SEAT BELT SWITCH

For circuit descriptions and diagrams, refer to 8W-40 - Instrument Cluster or 8W-44 - Interior Lighting in Group 8W - Wiring Diagrams.

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(1) Check the fuse in the junction block. If OK, go to Step 2. If not OK, repair the shorted circuit or component as required and replace the faulty fuse.

(2) Turn the ignition switch to the On position. Check for battery voltage at the fuse in the junction block. If OK, go to Step 3. If not OK, repair the open circuit to the ignition switch as required.

(3) Turn the ignition switch to the Off position. Disconnect and isolate the battery negative cable. Unplug the wire harness connector from the driver seat belt retractor. Check for continuity between the fused ignition switch output circuit cavity in the body half of the driver seat belt switch wire harness connector and the fuse in the junction block. There should be continuity. If OK, go to Step 4. If not OK, repair the open circuit as required.

(4) Check for continuity between the two cavities in the seat belt half of the driver seat belt switch wire harness connector. There should be no continuity with the seat belt webbing retracted, and continuity with the seat belt webbing pulled out of the retractor far enough to engage the seat belt buckle. If OK, go to Step 5. If not OK, replace the faulty driver side seat belt and retractor assembly.

(5) Remove the instrument cluster from the instrument panel. Check for continuity between the seat belt switch sense circuit cavities of the instrument cluster wire harness connector (connector B) and the body half of the driver seat belt switch wire harness connector. There should be continuity. If OK, see Instrument Cluster in the Diagnosis and Testing section of this group for diagnosis of the chime request circuit. If not OK, repair the open circuit as required.

INSTRUMENT CLUSTER

Before performing this test, see Driver Seat Belt Switch in the Diagnosis and Testing section of this group, and Instrument Cluster in the Diagnosis and Testing section of Group 8E - Instrument Panel Systems. For circuit descriptions and diagrams, refer to 8W-40 - Instrument Cluster or 8W-45 - Central Timer Module in Group 8W - Wiring Diagrams.

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(1) Disconnect and isolate the battery negative cable. Remove the instrument cluster from the instrument panel. Refer to Instrument Cluster in the Removal and Installation section of Group 8E - Instrument Panel Systems for the procedures.

(2) Remove the Central Timer Module (CTM) from its mounting bracket to access the CTM wire harness connectors. Refer to Central Timer Module in the Removal and Installation section of Group 8E - Instrument Panel Systems for the procedures. Unplug the 14-way CTM wire harness connector.

(3) Check for continuity between the chime request circuit cavity of the 14-way CTM wire harness connector and a good ground. There should be no continuity. If OK, go to Step 4. If not OK, repair the short circuit as required.

(4) Check for continuity between the chime request circuit cavities of the 14-way CTM wire harness connector and the instrument cluster wire harness connector (connector B). There should be continuity. If OK, test the CTM as described in this group. If not OK, repair the open circuit as required.

REMOVAL AND INSTALLATION

CHIME WARNING SYSTEM SWITCHES

Service procedures for the various hard-wired switches used in the chime warning system can be found in the Removal and Installation section of the proper group, as follows:

- Driver door jamb switch - refer to Group 8Q - Vehicle Theft/Security Systems
- Driver seat belt switch - refer to Group 23 - Body
- Headlamp switch - refer to Group 8E - Instrument Panel Systems
- Key-in ignition switch - refer to Group 8D - Ignition Systems.

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OVERHEAD CONSOLE SYSTEMS

CONTENTS

GENERAL INFORMATION

INTRODUCTION

An overhead console featuring an electronic compass and an outside ambient temperature thermometer is an available factory-installed option on this model. Refer to 8W-49 - Overhead Console in Group 8W - Wiring Diagrams for complete circuit descriptions and diagrams.

OVERHEAD CONSOLE

The overhead console for this model includes an electronic compass and an outside ambient temperature thermometer. The overhead console also houses two reading and courtesy lamps.

Following are general descriptions of the major components used in the overhead console. Refer to the owner's manual in the vehicle glove box for more information on the use and operation of the various overhead console features.

DESCRIPTION AND OPERATION

COMPASS

The compass will display the direction in which the vehicle is pointed using the eight major compass headings (Examples: north is N, northeast is NE). It does not display the headings in actual degrees.

The self-calibrating compass unit requires no adjusting in normal use. The only calibration that may prove necessary is to drive the vehicle in three complete circles, on level ground, in not less than 48 seconds. This will reorient the compass unit to its vehicle.

The compass unit also will compensate for magnetism the body of the vehicle may acquire during normal use. However, avoid placing anything magnetic directly on the roof of the vehicle. Magnetic mounts for an antenna, a repair order hat, or a funeral procession flag can exceed the compensating ability of the compass unit if placed on the roof panel.

Magnetic bit drivers used on the fasteners that hold the overhead console assembly to the roof header can also affect compass operation. If the vehicle roof should become magnetized, the demagnetizing and calibration procedures found in this group may be required to restore proper compass operation.

The compass and thermometer display module cannot be repaired, and are only available for service as a unit. If faulty or damaged, the complete module must be replaced.

THERMOMETER

The thermometer displays the outside ambient temperature. The temperature display can be changed from Fahrenheit to Celsius using the U.S./Metric button, located just to the right of the display. The displayed temperature is not an instant reading of conditions, but an average temperature. It may take the thermometer display several minutes to respond to a major temperature change, such as driving out of a heated garage into winter temperatures.

When the ignition switch is turned to the Off position, the last displayed temperature reading stays in the thermometer unit memory. When the ignition

DESCRIPTION AND OPERATION (Continued)

switch is turned to the On position again, the thermometer will display the memory temperature for one minute; then update the display to the current average temperature reading within five minutes.

The thermometer function is supported by an ambient temperature sensor. The sensor is mounted outside the passenger compartment near the front and center of the vehicle, and is hard-wired to the module. The ambient temperature sensor is available as a separate service item.

The thermometer and compass display module cannot be repaired, and is only available for service as a unit. If faulty or damaged, the complete module must be replaced.

READING AND COURTESY LAMP

All reading and courtesy lamps located in the overhead console are activated by the door jamb switches. When the doors are closed, the lamps can be individually activated by depressing the corresponding lens.

When a door is open, depressing the lamp lens switches will not turn the lamps off. Refer to Group 8L - Lamps, for diagnosis of the reading and courtesy lamps.

The reading and courtesy lamp lenses and bulbs are available for service replacement. The reading and courtesy lamp housing, switches, bulb holders and wiring are only available as part of the overhead console wire harness. If any of these components are faulty or damaged, the entire overhead console wire harness assembly must be replaced.

DIAGNOSIS AND TESTING

COMPASS AND THERMOMETER DISPLAY MODULE

If the problem with the compass and thermometer display module is an inaccurate or scrambled display, see Self-Diagnostic Test in the Diagnosis and Testing section of this group. If the problem is a no-display condition, use the following procedures. For circuit descriptions and diagrams, refer to 8W-49 - Overhead Console in Group 8W - Wiring Diagrams.

(1) Check the fuses in the junction block. If OK, go to Step 2. If not OK, repair the shorted circuit or component as required and replace the faulty fuse(s).

(2) Check for battery voltage at the fused B(+) fuse in the junction block. If OK, go to Step 3. If not OK, repair the open circuit to the Power Distribution Center (PDC) as required.

(3) Turn the ignition switch to the On position. Check for battery voltage at the fused ignition switch output (run/start) fuse in the junction block. If OK, go to Step 4. If not OK, repair the open circuit to the ignition switch as required.

(4) Turn the ignition switch to the Off position. Disconnect and isolate the battery negative cable. Remove the overhead console from the headliner. Check for continuity between the ground circuit cavities of the overhead console wire harness connector and a good ground. There should be continuity. If OK, go to Step 5. If not OK, repair the open circuit to ground as required.

(5) Connect the battery negative cable. Check for battery voltage at each of the two fused B(+) circuit cavities of the overhead console wire harness connector. If OK, go to Step 6. If not OK, repair the open circuit(s) to the junction block as required.

(6) Turn the ignition switch to the On position. Check for battery voltage at the fused ignition switch output (run/start) circuit cavity of the overhead console wire harness connector. If OK, go to Step 7. If not OK, repair the open circuit to the junction block as required.

(7) Check for battery voltage at the park lamp switch output circuit cavity of the overhead console wire harness connector. There should be zero volts with the headlamp switch in the Off position, and battery voltage with the park or head lamps turned on. If OK, go to Step 8. If not OK, repair the open circuit to the headlamp switch as required.

(8) Check for voltage at the fused panel lamps dimmer switch signal circuit cavity of the overhead console wire harness connector. There should be zero volts with the headlamp switch in the Off position. When the park or head lamps are turned on, the voltage should vary as the dimmer switch is rotated. If OK, see Self-Diagnostic Test in the Diagnosis and Testing section of this group for further diagnosis of the module. If not OK, repair the open circuit to the junction block as required.

SELF-DIAGNOSTIC TEST

A self-diagnostic test is used to determine that the compass, thermometer and all of the display module segments are operating properly electrically. Initiate the self-diagnostic test as follows:

(1) With the ignition switch in the Off position, simultaneously press and hold the Comp/Temp button and the U.S./Metric button.

(2) Turn the ignition switch to the On position.

(3) Continue to hold both buttons until the module display performs a walking segment test. In this test, all of the compass points are displayed, along with various number combinations. These combinations verify that all of the display segments are functional. If any segment should fail to light during the test, the compass and thermometer display module is faulty and must be replaced. To repeat the test, momentarily depress and release the Comp/Temp button one time.

(4) Momentarily depress and release the U.S./Metric button one time. All of the display segments will light simultaneously for about two seconds. If any

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DIAGNOSIS AND TESTING (Continued)

Compass and Thermometer Display Module Diagnosis		
CONDITION	**POSSIBLE CAUSE**	**CORRECTION**
DISPLAY COMPLETELY DARK	1. Display has been switched off. 2. Faulty fuse. 3. Faulty wire harness or connectors. 4. Faulty compass and thermometer display module.	1. Depress the Comp/Temp button to switch the module to the compass or thermometer display option. 2. Check the fuses in the junction block and replace, if required. 3. Refer to Group 8W - Wiring Diagrams. Test and repair the wiring or connections, if required. 4. Replace the faulty compass and thermometer display module, if required.
DISPLAY SEGMENTS MISSING	1. Faulty compass and thermometer display module.	1. See Self-Diagnostic Test in the Diagnosis and Testing section of this group. Replace the faulty compass and thermometer display module, if required.
ERRATIC COMPASS OPERATION	1. Magnet or strong magnetic field near the module. 2. Variance setting incorrect. 3. Calibration incorrect. 4. Faulty compass and thermometer display module.	1. Remove magnet and/or demagnetize the vehicle. See Compass Demagnetizing in the Service Procedures section of this group. 2. See Compass Variation Adjustment in the Service Procedures section of this group. 3. See Compass Calibration in the Service Procedures section of this group. 4. See Self-Diagnostic Test in the Diagnosis and Testing section of this group. Replace the faulty compass and thermometer display module, if required.
ERRATIC THERMOMETER OPERATION	1. Faulty ambient temperature sensor wire harness or connectors. 2. Faulty ambient temperature sensor. 3. Faulty compass and thermometer display module.	1. See Thermometer in the Diagnosis and Testing section of this group. Repair the ambient temperature sensor wiring or connections, if required. 2. See Thermometer in the Diagnosis and Testing section of this group. Replace the faulty ambient temperature sensor, if required. 3. See Self-Diagnostic Test in the Diagnosis and Testing section of this group. Replace the faulty compass and thermometer display module, if required.

segment should fail to light during the test, the compass and thermometer display module is faulty and must be replaced. To repeat the test, momentarily depress and release the Comp/Temp button one time.

(5) Momentarily depress and release the U.S./Metric button one time, or turn the ignition switch to the Off position to exit the self-diagnostic test mode and

DIAGNOSIS AND TESTING (Continued)

return the compass and thermometer display module to normal operation.

NOTE: If the compass functions, but accuracy is suspect, it may be necessary to perform a variation adjustment. This procedure allows the compass unit to accommodate variations in the earth's magnetic field strength, based on geographic location. See Compass Variation Adjustment in the Service Procedures section of this group.

NOTE: If the compass reading has blanked out, and only "CAL" appears in the display, demagnetizing may be necessary to remove excessive residual magnetic fields from the vehicle. See Compass Demagnetizing in the Service Procedures section of this group.

THERMOMETER

The thermometer function is supported by a ambient temperature sensor, a wiring circuit, and a portion of the overhead console compass and thermometer display module display. The sensor is mounted outside the passenger compartment near the front and center of the vehicle.

If any portion of the ambient temperature sensor circuit fails, the thermometer display will self-diagnose the circuit. An "SC" (short circuit) will appear in the display in place of the temperature, when the sensor is exposed to temperatures above 55° C (131° F), or if the sensor circuit is shorted. An "OC" (open circuit) will appear in the display in place of the temperature, when the sensor is exposed too temperatures below -40° C (-40° F), or if the sensor circuit is open.

The ambient temperature sensor circuit can also be diagnosed using the following Sensor Test, and Sensor Circuit Test. If the temperature sensor and circuit are confirmed to be OK, but the temperature display is inoperative or incorrect, see Compass and Thermometer Display Module in the Diagnosis and Testing section of this group. For circuit descriptions and diagrams, refer to 8W-49 - Overhead Console in Group 8W - Wiring Diagrams.

SENSOR TEST

(1) Turn the ignition switch to the Off position. Disconnect and isolate the battery negative cable. Unplug the temperature sensor wire harness connector.

(2) Measure the resistance of the temperature sensor. At -40° C (-40° F), the sensor resistance is 336 kilohms. At 55° C (140° F), the sensor resistance is 2.488 kilohms. The sensor resistance should read between these two values. If OK, see Sensor Circuit Test in the Diagnosis and Testing section of this group. If not OK, replace the faulty sensor.

SENSOR CIRCUIT TEST

(1) Turn the ignition switch to the Off position. Disconnect and isolate the battery negative cable. Unplug the ambient temperature sensor wire harness connector and the overhead console wire harness connector.

(2) Connect a jumper wire between the two terminals in the body half of the sensor wire harness connector.

(3) Check for continuity between the sensor return circuit and the ambient temperature sensor signal circuit cavities of the overhead console wire harness connector. There should be continuity. If OK, go to Step 4. If not OK, repair the open circuit as required.

(4) Remove the jumper wire from the ambient temperature sensor wire harness connector. Check for continuity between the sensor return circuit cavity of the overhead console wire harness connector and a good ground. There should be no continuity. If OK, go to Step 5. If not OK, repair the short circuit as required.

(5) Check for continuity between the ambient temperature sensor signal circuit cavity of the overhead console wire harness connector and a good ground. There should be no continuity. If OK, see Compass and Thermometer Display Module in the Diagnosis and Testing section of this group. If not OK, repair the short circuit as required.

SERVICE PROCEDURES

COMPASS VARIATION ADJUSTMENT

Variance is the difference between magnetic north and geographic north. In some geographic locations, the difference between magnetic and geographic north is great enough to cause the compass to give false readings. If this problem occurs, the compass variance must be set.

To set the compass variance:

(1) Using the Variance Settings map, find your geographic location and note the zone number (Fig. 1).

(2) Turn the ignition switch to the On position.

(3) Depress both the U.S./Metric, and the Comp/Temp buttons. Hold the buttons down until "VAR" appears in the display. This takes about five seconds.

(4) Release both of the buttons. "VAR" will remain in the display.

(5) Press and release the U.S./Metric button. The number "1" will appear just to the right of "VAR" in the display. This number represents the variance zone number. Press and release the U.S./Metric button to step through the zone numbers, until the zone

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SERVICE PROCEDURES (Continued)

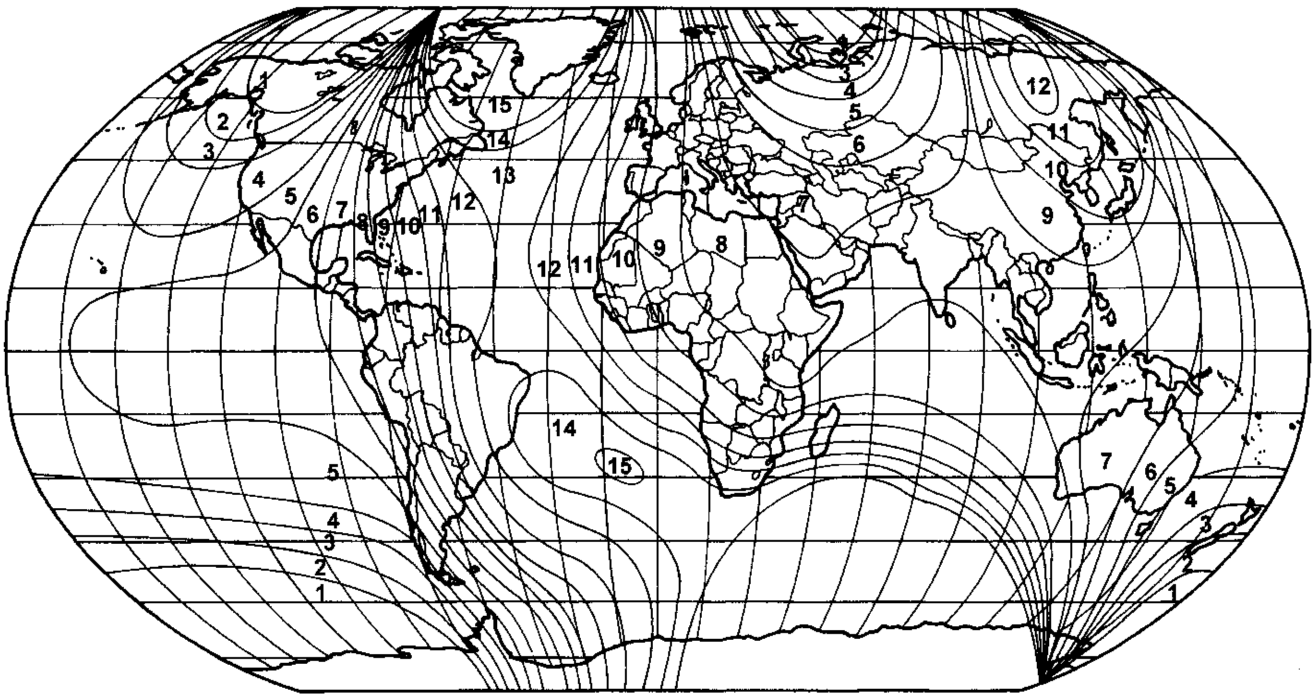

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Fig. 1 Variance Settings

number for your geographic location appears in the display.

(6) Press the Comp/Temp button to enter this zone number into the compass unit memory.

(7) Confirm that the correct directions are now indicated by the compass.

COMPASS CALIBRATION

CAUTION: Do not place any external magnets, such as magnetic roof mount antennas, in the vicinity of the compass. Do not use magnetic tools when servicing the overhead console.

The electronic compass unit features a self-calibrating design, which simplifies the calibration procedure. This feature automatically updates the compass calibration while the vehicle is being driven. This allows the compass unit to compensate for small changes in the residual magnetism that the vehicle may acquire during normal use. Do not attempt to calibrate the compass near large metal objects such as other vehicles, large buildings, or bridges.

NOTE: Whenever the compass is calibrated manually, the variation number must also be reset. See Compass Variation Adjustment in the Service Procedures section of this group.

Calibrate the compass manually as follows:

(1) Start the engine.

(2) Depress both the U.S./Metric and Comp/Temp buttons. Hold the buttons down until "CAL" appears in the display. This takes about ten seconds, and appears about five seconds after "VAR" is displayed.

(3) Release both of the buttons.

(4) Drive the vehicle on a level surface, away from large metal objects, through three or more complete circles in not less than 48 seconds. The "CAL" message will disappear from the display to indicate that the compass is now calibrated.

NOTE: If the "CAL" message remains in the display, either there is excessive magnetism near the compass, or the unit is faulty. Repeat the demagnetizing and calibration procedures at least one more time.

NOTE: If the wrong direction is still indicated in the compass display, the area selected for calibration may be too close to a strong magnetic field. Repeat the calibration procedure in another location.

COMPASS DEMAGNETIZING

A degaussing tool (Special Tool 6029) is used to demagnetize, or degauss, the roof panel. Equivalent units must be rated as continuous duty for 110/115 volts and 60 Hz. They must also have a field strength of over 350 gauss at 7 millimeters (0.25 inch) beyond the tip of the probe.

SERVICE PROCEDURES (Continued)

To demagnetize the roof panel, proceed as follows:

(1) Be certain the ignition switch is in the Off position, before you begin the demagnetizing procedure.

(2) Place a piece of paper approximately 22 by 28 centimeters (8.5 by 11 inches), oriented on the vehicle lengthwise from front to rear, on the center line of the roof at the windshield header (Fig. 2). The purpose of the paper is to protect the roof panel from scratches, and to define the area to be demagnetized.

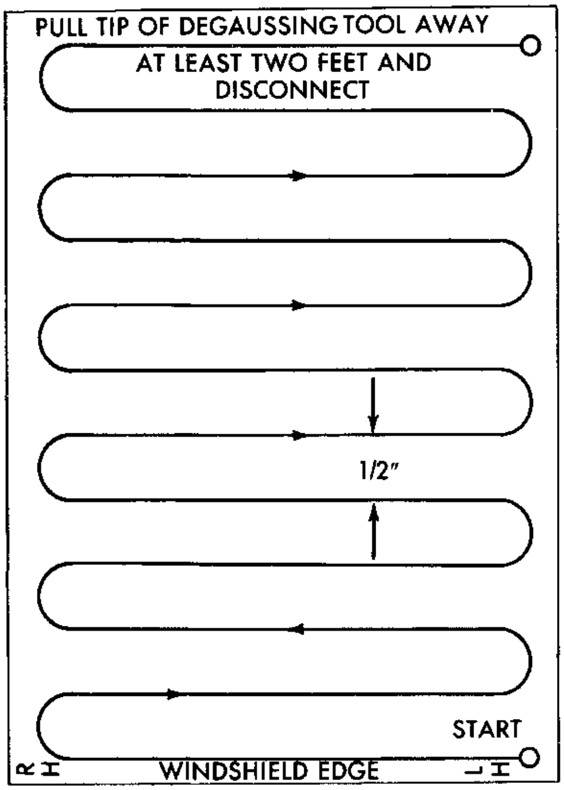

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Fig. 2 Roof Demagnetizing Pattern

(3) Plug in the degaussing tool, while keeping the tool at least 61 centimeters (2 feet) away from the compass unit.

(4) Slowly approach the center line of the roof panel at the windshield header, with the degaussing tool plugged in.

(5) Contact the roof panel with the plastic coated tip of the degaussing tool. Be sure that the template is in place to avoid scratching the roof panel. Using a slow, back-and-forth sweeping motion, and allowing 13 millimeters (0.50 inch) between passes, move the tool at least 11 centimeters (4 inches) to each side of the roof center line, and 28 centimeters (11 inches) back from the windshield header.

(6) With the degaussing tool still energized, slowly back it away from the roof panel. When the tip of the tool is at least 61 centimeters (2 feet) from the roof panel, unplug the tool.

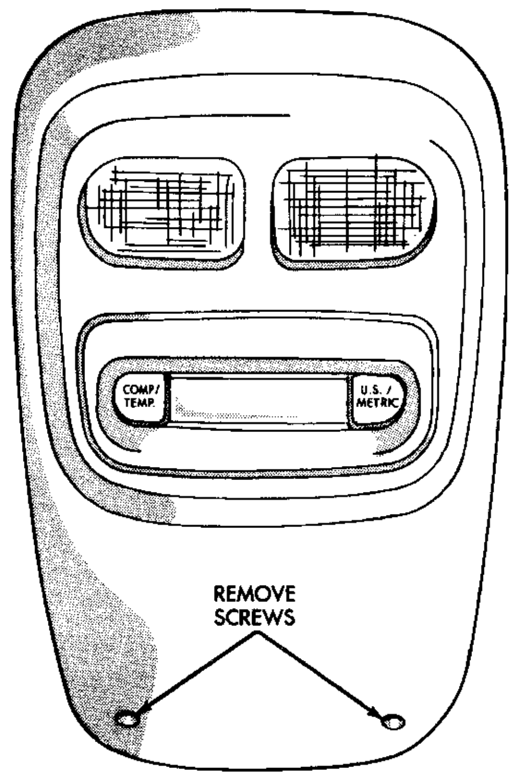
(7) Calibrate the compass and adjust the compass variance as described in the Service Procedures section of this group.

REMOVAL AND INSTALLATION

OVERHEAD CONSOLE

(1) Disconnect and isolate the battery negative cable.

(2) Remove the two screws that secure the front of the overhead console to the windshield header (Fig. 3).



J948C-5

Fig. 3 Overhead Console Mounting Screws

(3) Pull the front of the console down slightly, then slide the console rearward to disengage the two mounting clips that secure the rear of the overhead console to the inner roof panel reinforcement (Fig. 4).

(4) Lower the overhead console from the headliner far enough to access and unplug the wire harness connector from the compass and thermometer display module.

(5) Reverse the removal procedures to install. Tighten the mounting screws to 2.2 N·m (20 in. lbs.).

REMOVAL AND INSTALLATION (Continued)

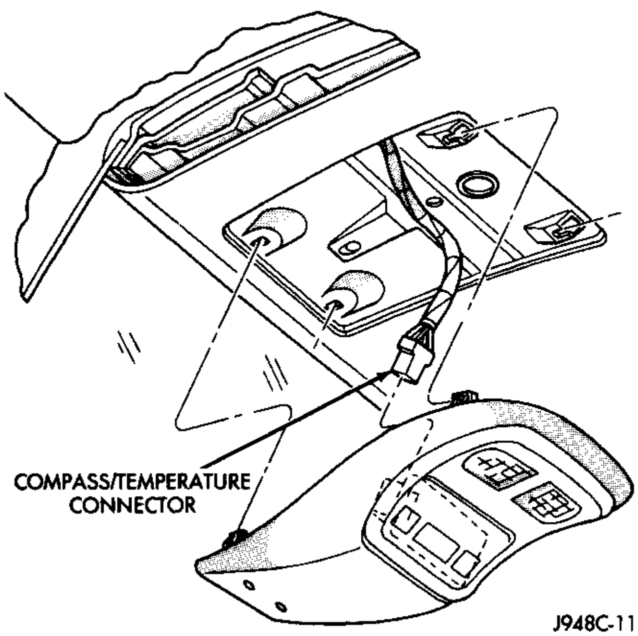


Fig. 4 Overhead Console Remove/Install

COMPASS AND THERMOMETER DISPLAY MODULE

(1) Disconnect and isolate the battery negative cable.

(2) Remove the overhead console from the headliner. See Overhead Console in the Removal and Installation section of group for the procedures.

(3) Remove the three screws that secure the compass and thermometer display module to the overhead console housing (Fig. 5).

(4) Unplug the lighting wire harness connector from the compass and thermometer display module (Fig. 6).

(5) Remove the compass and thermometer display module from the overhead console housing.

(6) Reverse the removal procedures to install. Tighten the mounting screws to 2.2 N·m (20 in. lbs.).

READING AND COURTESY LAMP BULB

(1) Disconnect and isolate the battery negative cable.

(2) Insert a long, narrow, flat-bladed tool in the notch on the curved edge of the reading and courtesy lamp lens.

(3) Gently pry the lens downward from the overhead console housing and pivot the lens down. It may be necessary to move the tool along the edge of the lens to free the lens from the console housing.

(4) Remove the bulb by pulling it straight down from the bulb holders.

(5) Install a new bulb by aligning its ends with the bulb holders, and pushing it firmly into place.

(6) Pivot the lens back up into position and press upward firmly until it snaps back into place.

(7) Connect the battery negative cable.

(8) Test the lamp by depressing the lens to check for proper lamp switching and lighting.

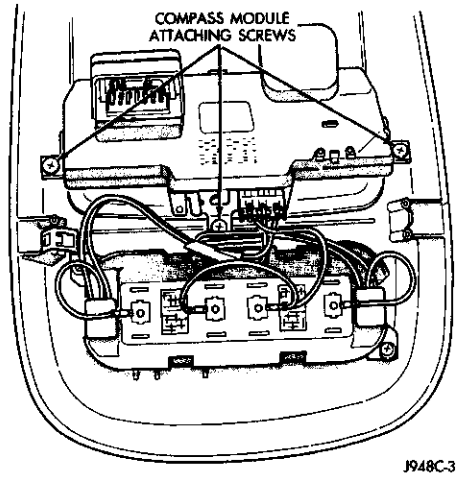


Fig. 5 Compass and Thermometer Display Module Remove/Install

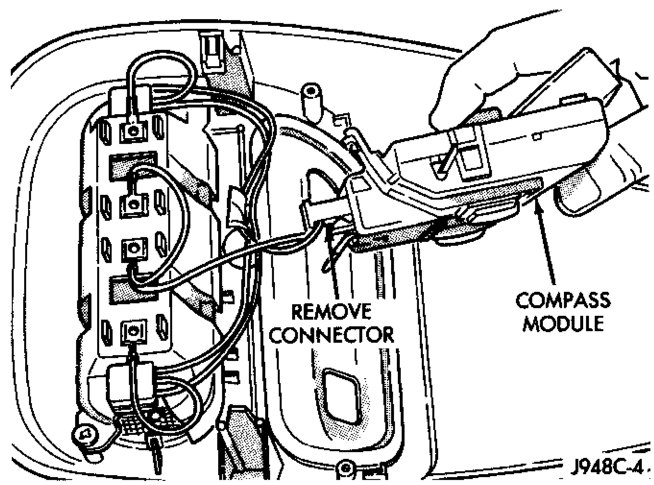


Fig. 6 Lighting Wire Harness Connector

REMOVAL AND INSTALLATION (Continued)

AMBIENT TEMPERATURE SENSOR

(1) Disconnect and isolate the battery negative cable.

(2) Locate the ambient temperature sensor, on the underside of the hood near the hood latch striker (Fig. 7).

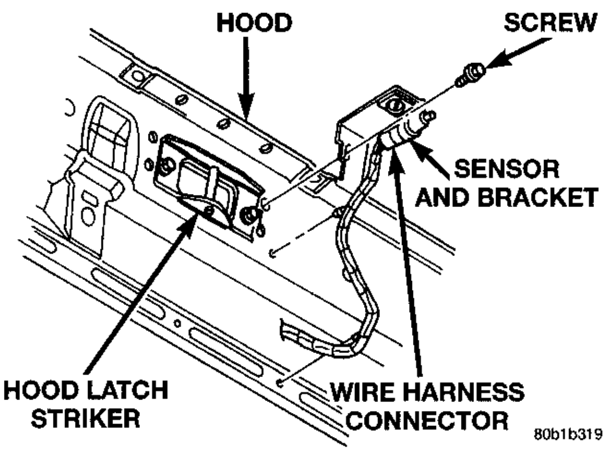


Fig. 7 Ambient Temperature Sensor Remove/Install

(3) Unplug the wire harness connector from the ambient temperature sensor.

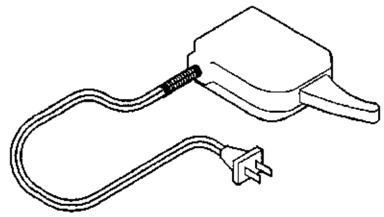
(4) Remove the screw that secures the ambient temperature sensor to the inner hood reinforcement.

(5) Remove the ambient temperature sensor from under the hood.

(6) Reverse the removal procedures to install. Tighten the ambient temperature sensor mounting screw to 5.6 N·m (50 in. lbs.).

SPECIAL TOOLS

COMPASS



Degaussing Tool 6029

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WIRING DIAGRAMS

CONTENTS

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8W-01 GENERAL INFORMATION

INDEX

DESCRIPTION AND OPERATION

INTRODUCTION

Chrysler wiring diagrams are designed to provide information regarding the vehicles wiring content. In order to effectively use Chrysler wiring diagrams to diagnose and repair a Chrysler vehicle, it is important to understand all of their features and characteristics.

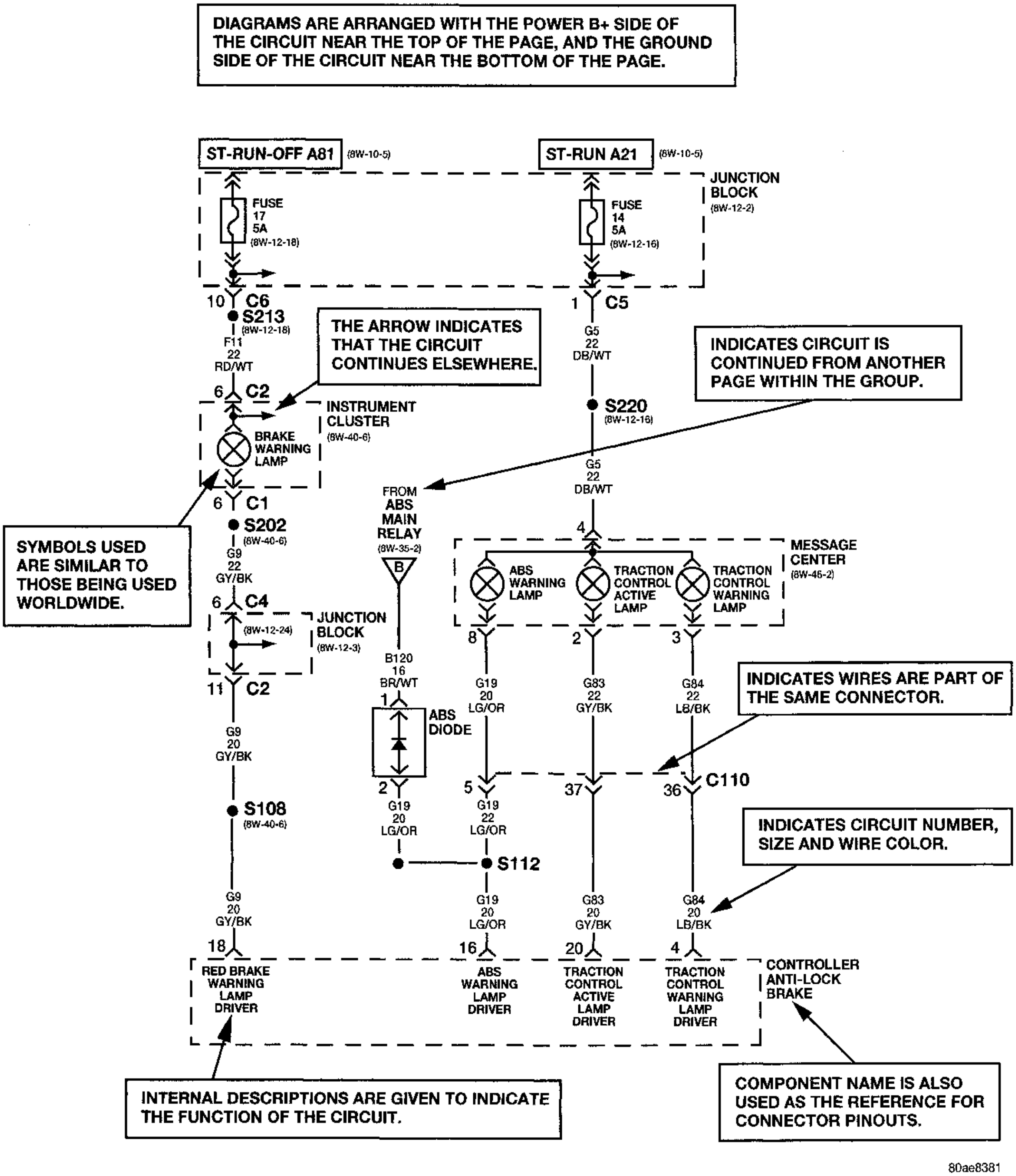
Diagrams are arranged such that the power (B+) side of the circuit is placed near the top of the page, and the ground (B-) side of the circuit is placed near the bottom of the page.

All switches, components, and modules are shown in the at rest position with the doors closed and the key removed from the ignition.

Components are shown two ways. A solid line around a component indicates that the component is complete. A dashed line around a component indicates that the component being shown is not complete. Incomplete components have a reference number to indicate the page where the component is shown complete.

It is important to realize that no attempt is made on the diagrams to represent components and wiring as they appear on the vehicle. For example, a short piece of wire is treated the same as a long one. In addition, switches and other components are shown as simply as possible, with regard to function only.

DESCRIPTION AND OPERATION (Continued)



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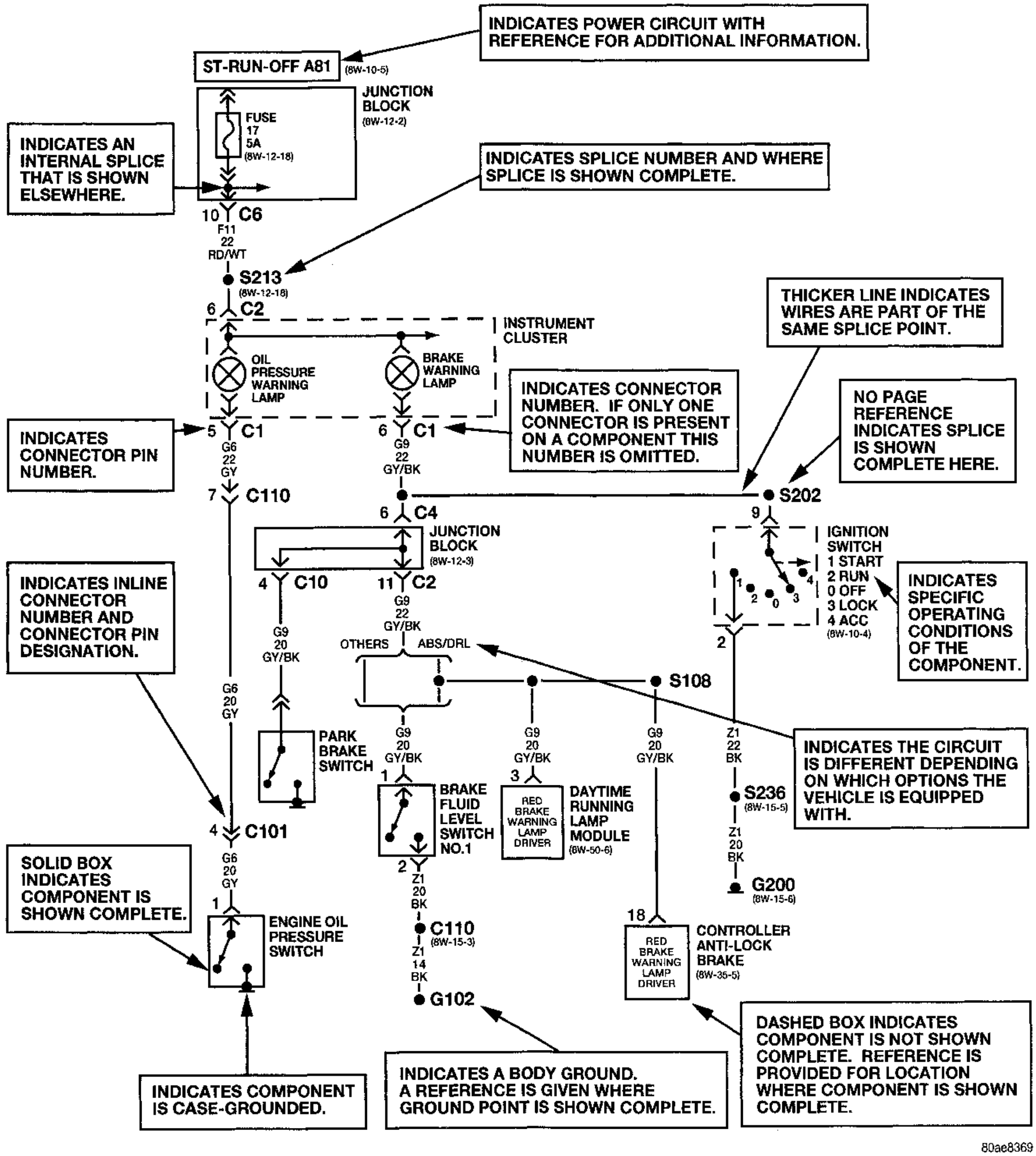
DESCRIPTION AND OPERATION (Continued)



DESCRIPTION AND OPERATION (Continued)

CIRCUIT INFORMATION

Each wire shown in the diagrams contains a code which identifies the main circuit, part of the main circuit, gage of wire, and color (Fig. 1).

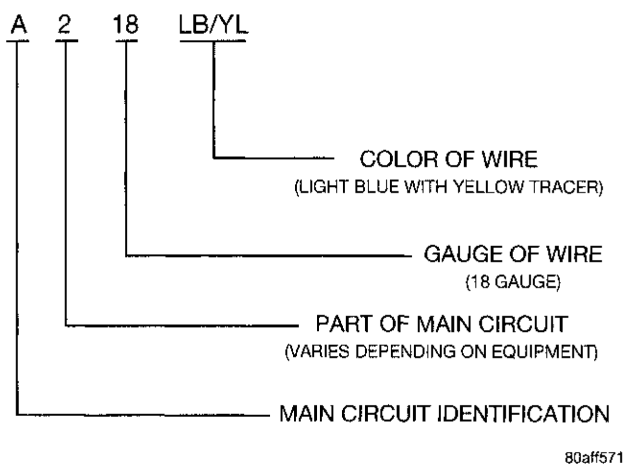


Fig. 1 Wire Code Identification

COLOR CODE	COLOR	STANDARD TRACER COLOR
BL	BLUE	WT
BK	BLACK	WT
BR	BROWN	WT
DB	DARK BLUE	WT
DG	DARK GREEN	WT
GY	GRAY	BK
LB	LIGHT BLUE	BK
LG	LIGHT GREEN	BK
OR	ORANGE	BK
PK	PINK	BK or WT
RD	RED	WT
TN	TAN	WT
VT	VIOLET	WT
WT	WHITE	BK
YL	YELLOW	BK
*	WITH TRACER	

CIRCUIT FUNCTIONS

All circuits in the diagrams use an alpha/numeric code to identify the wire and its function. To identify which circuit code applies to a system, refer to the Circuit Identification Code Chart. This chart shows the main circuits only and does not show the secondary codes that may apply to some models.

CIRCUIT	FUNCTION
A	BATTERY FEED
B	BRAKE CONTROLS
C	CLIMATE CONTROLS
D	DIAGNOSTIC CIRCUITS
E	DIMMING ILLUMINATION CIRCUITS
F	FUSED CIRCUITS
G	MONITORING CIRCUITS (GAUGES)
H	OPEN
I	NOT USED
J	OPEN
K	POWERTRAIN CONTROL MODULE
L	EXTERIOR LIGHTING
M	INTERIOR LIGHTING
N	NOT USED
O	NOT USED
P	POWER OPTION (BATTERY FEED)
Q	POWER OPTIONS (IGNITION FEED)
R	PASSIVE RESTRAINT
S	SUSPENSION/STEERING
T	TRANSMISSION/TRANSAXLE/ TRANSFER CASE
U	OPEN
V	SPEED CONTROL, WIPER/WASHER
W	OPEN
X	AUDIO SYSTEMS
Y	OPEN
Z	GROUNDS

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DESCRIPTION AND OPERATION (Continued)

SECTION IDENTIFICATION

The wiring diagrams are grouped into individual sections. If a component is most likely found in a particular group, it will be shown complete (all wires, connectors, and pins) within that group. For example, the Auto Shutdown Relay is most likely to be found in Group 30, so it is shown there complete. It can, however, be shown partially in another group if it contains some associated wiring.

SYMBOLS

International symbols are used throughout the wiring diagrams. These symbols are consistent with those being used around the world

GROUP	TOPIC
8W-01 thru 8W-09	General Information and Diagram Overview
8W-10 thru 8W-19	Main Sources of Power and Vehicle Grounding
8W-20 thru 8W-29	Starting and Charging
8W-30 thru 8W-39	Powertrain/Drivetrain Systems
8W-40 thru 8W-49	Body Electrical items and A/C
8W-50 thru 8W-59	Exterior Lighting, Wipers, and Trailer Tow
8W-60 thru 8W-69	Power Accessories
8W-70	Splice Information
8W-80	Connector Pin Outs
8W-90	Connector Locations (including grounds)
8W-95	Splice Locations

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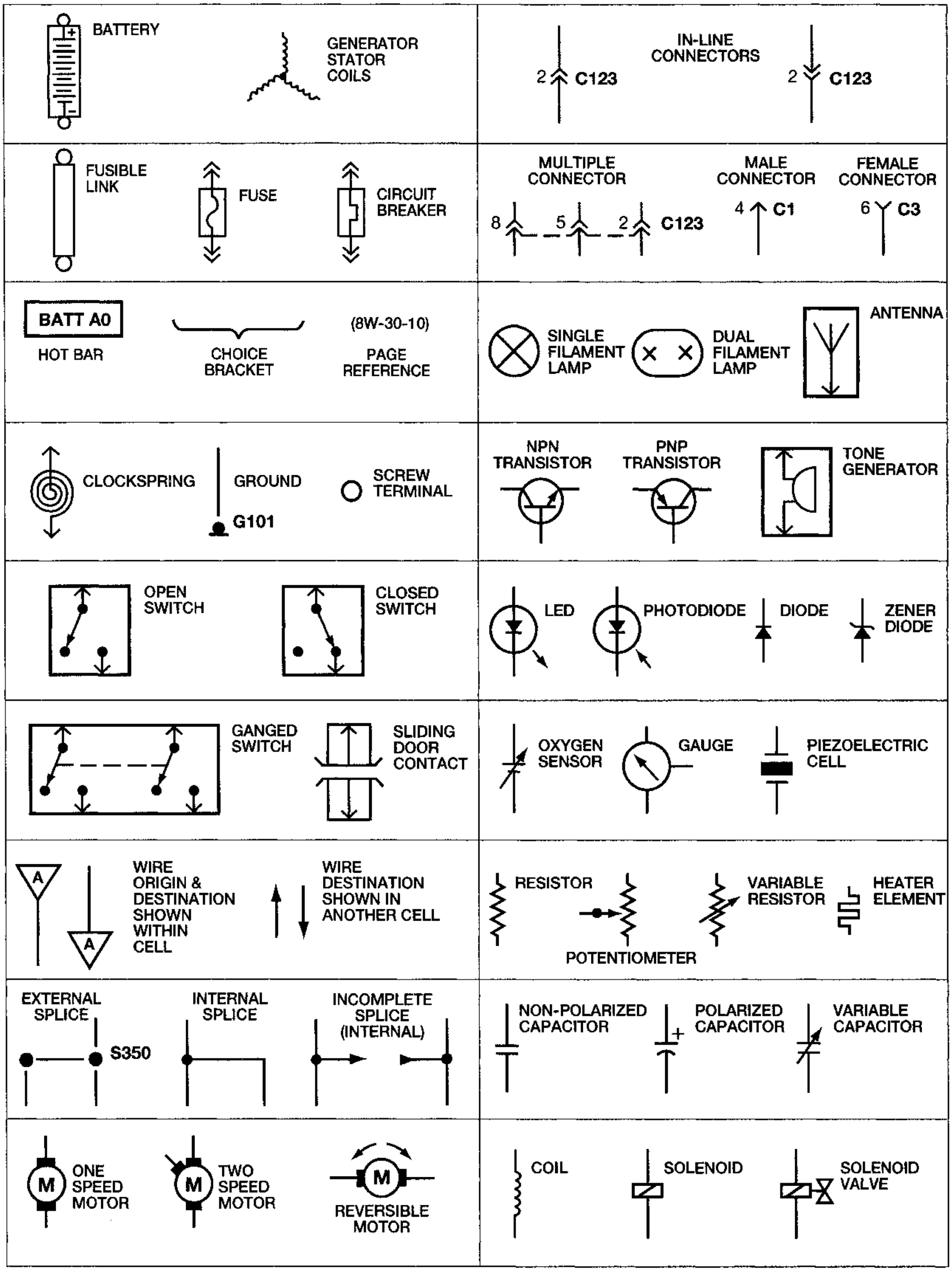
DESCRIPTION AND OPERATION (Continued)



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Wiring Diagram Symbols

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DESCRIPTION AND OPERATION (Continued)

CONNECTOR INFORMATION

CAUTION: Not all connectors are serviced. Some connectors are serviced only with a harness. A typical example might be the Supplemental Restraint System connectors. Always check parts availability before attempting a repair.

IDENTIFICATION

In-line connectors are identified by a number, as follows:

- In-line connectors located on the **engine compartment harness** are **C100** series numbers.
- Connectors located on the **instrument panel harness** are **C200** series numbers.
- Connectors located on the **body harness** are **C300** series numbers.
- **Jumper harness connectors** are **C400** series numbers.
- **Grounds and ground connectors** are identified with a **"G"** and follow the same series numbering as the in-line connector.

Component connectors are identified by the component name instead of a number (Fig. 2). Multiple connectors on a component use a C1, C2, etc. identifier (Fig. 3).

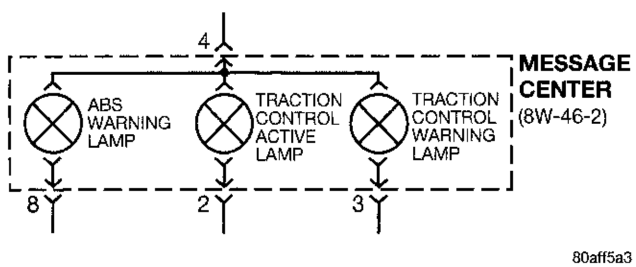


Fig. 2 Component Identification

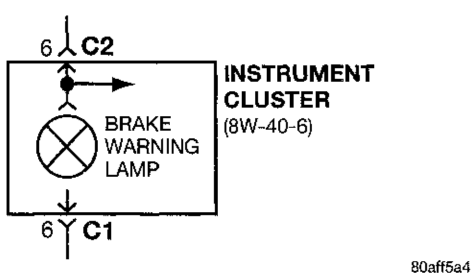


Fig. 3 Connector Identification

LOCATIONS

Section 8W-90 contains connector/ground location illustrations. The illustrations contain the connector name (or number)/ground number and component identification. Connector/ground location charts in Section 8W-90 reference the illustration number for components and connectors.

Section 8W-80 shows each connector and the circuits involved with that connector. The connectors are identified using the name/number on the Diagram pages.

SPLICE LOCATIONS

Splice Location charts in Section 8W-70 show the entire splice, and provide references to other sections the splice serves.

Section 8W-95 contains illustrations that show the general location of the splices in each harness. The illustrations show the splice by number, and provide a written location.

NOTES, CAUTIONS, and WARNINGS

Throughout this group additional important information is presented in three ways; Notes, Cautions, and Warnings.

NOTES are used to help describe how switches or components operate to complete a particular circuit. They are also used to indicate different conditions that may appear on the vehicle. For example, an up-to and after condition.

CAUTIONS are used to indicate information that could prevent making an error that may damage the vehicle.

WARNINGS provide information to prevent personal injury and vehicle damage. Below is a list of general warnings that should be followed any time a vehicle is being serviced.

WARNING: ALWAYS WEAR SAFETY GLASSES FOR EYE PROTECTION.

WARNING: USE SAFETY STANDS ANYTIME A PROCEDURE REQUIRES BEING UNDER A VEHICLE.

WARNING: BE SURE THAT THE IGNITION SWITCH ALWAYS IS IN THE OFF POSITION, UNLESS THE PROCEDURE REQUIRES IT TO BE ON.

WARNING: SET THE PARKING BRAKE WHEN WORKING ON ANY VEHICLE. AN AUTOMATIC TRANSMISSION SHOULD BE IN PARK. A MANUAL TRANSMISSION SHOULD BE IN NEUTRAL.

WARNING: OPERATE THE ENGINE ONLY IN A WELL-VENTILATED AREA.

WARNING: KEEP AWAY FROM MOVING PARTS WHEN THE ENGINE IS RUNNING, ESPECIALLY THE FAN AND BELTS.

DESCRIPTION AND OPERATION (Continued)

WARNING: TO PREVENT SERIOUS BURNS, AVOID CONTACT WITH HOT PARTS SUCH AS THE RADIATOR, EXHAUST MANIFOLD(S), TAIL PIPE, CATALYTIC CONVERTER, AND MUFFLER.

WARNING: DO NOT ALLOW FLAME OR SPARKS NEAR THE BATTERY. GASES ARE ALWAYS PRESENT IN AND AROUND THE BATTERY.

WARNING: ALWAYS REMOVE RINGS, WATCHES, LOOSE HANGING JEWELRY, AND LOOSE CLOTHING.

TAKE OUTS

The abbreviation T/O is used in the component location section to indicate a point in which the wiring harness branches out to a component.

ELECTROSTATIC DISCHARGE (ESD) SENSITIVE DEVICES

All ESD sensitive components are solid state and a symbol (Fig. 4) is used to indicate this. When handling any component with this symbol comply with the following procedures to reduce the possibility of electrostatic charge build up on the body and inadvertent discharge into the component. If it is not known whether the part is ESD sensitive, assume that it is.

(1) Always touch a known good ground before handling the part. This should be repeated while handling the part and more frequently after sliding across a seat, sitting down from a standing position, or walking a distance.

(2) Avoid touching electrical terminals of the part, unless instructed to do so by a written procedure.

(3) When using a voltmeter, be sure to connect the ground lead first.

(4) Do not remove the part from its protective packing until it is time to install the part.

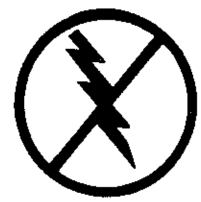
(5) Before removing the part from its package, ground the package to a known good ground on the vehicle.

DIAGNOSIS AND TESTING

TROUBLESHOOTING TOOLS

When diagnosing a problem in an electrical circuit there are several common tools necessary. These tools are listed and explained below.

• Jumper Wire - This is a test wire used to connect two points of a circuit. It can be used to bypass an open in a circuit.



948W-193

Fig. 4 Electrostatic Discharge Symbol

WARNING: NEVER USE A JUMPER WIRE ACROSS A LOAD, SUCH AS A MOTOR, CONNECTED BETWEEN A BATTERY FEED AND GROUND.

• Voltmeter - Used to check for voltage on a circuit. Always connect the black lead to a known good ground and the red lead to the positive side of the circuit.

CAUTION: Most of the electrical components used in today's vehicle are solid state. When checking voltages in these circuits use a meter with a 10-megohm or greater impedance rating.

• Ohmmeter - Used to check the resistance between two points of a circuit. Low or no resistance in a circuit means good continuity.

CAUTION: - Most of the electrical components used in today's vehicle are Solid State. When checking resistance in these circuits use a meter with a 10-megohm or greater impedance rating. In addition, make sure the power is disconnected from the circuit. Circuits that are powered up by the vehicle electrical system can cause damage to the equipment and provide false readings.

• Probing Tools - These tools are used for probing terminals in connectors (Fig. 5). Select the proper size tool from Special Tool Package 6807, and insert it into the terminal being tested. Use the other end of the tool to insert the meter probe.

INTERMITTENT AND POOR CONNECTIONS

Most intermittent electrical problems are caused by faulty electrical connections or wiring. It is also possible for a sticking component or relay to cause a problem. Before condemning a component or wiring assembly check the following items.

• Connectors are fully seated
• Spread terminals, or terminal push out
• Terminals in the wiring assembly are fully seated into the connector/component and locked in position

AUTHENTIC RESTORATION

DIAGNOSIS AND TESTING (Continued)

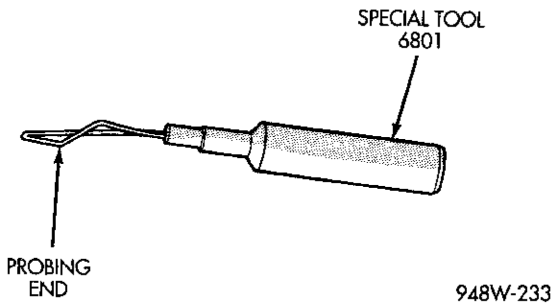


Fig. 5 Probing Tool

- Dirt or corrosion on the terminals. Any amount of corrosion or dirt could cause an intermittent problem
- Damaged connector/component casing exposing the item to dirt and moisture
- Wire insulation that has rubbed through causing a short to ground
- Some or all of the wiring strands broken inside of the insulation covering.
- Wiring broken inside of the insulation

TROUBLESHOOTING TESTS

Before beginning any tests on a vehicles electrical system use the Wiring Diagrams and study the circuit. Also refer to the Troubleshooting Wiring Problems in this section.

TESTING FOR VOLTAGE POTENTIAL

(1) Connect the ground lead of a voltmeter to a known good ground (Fig. 6).

(2) Connect the other lead of the voltmeter to the selected test point. The vehicle ignition may need to be turned ON to check voltage. Refer to the appropriate test procedure.

TESTING FOR CONTINUITY

(1) Remove the fuse for the circuit being checked or, disconnect the battery.

(2) Connect one lead of the ohmmeter to one side of the circuit being tested (Fig. 7).

(3) Connect the other lead to the other end of the circuit being tested. Low or no resistance means good continuity.

TESTING FOR A SHORT TO GROUND

(1) Remove the fuse and disconnect all items involved with the fuse.

(2) Connect a test light or a voltmeter across the terminals of the fuse.

(3) Starting at the fuse block, wiggle the wiring harness about six to eight inches apart and watch the voltmeter/test lamp.

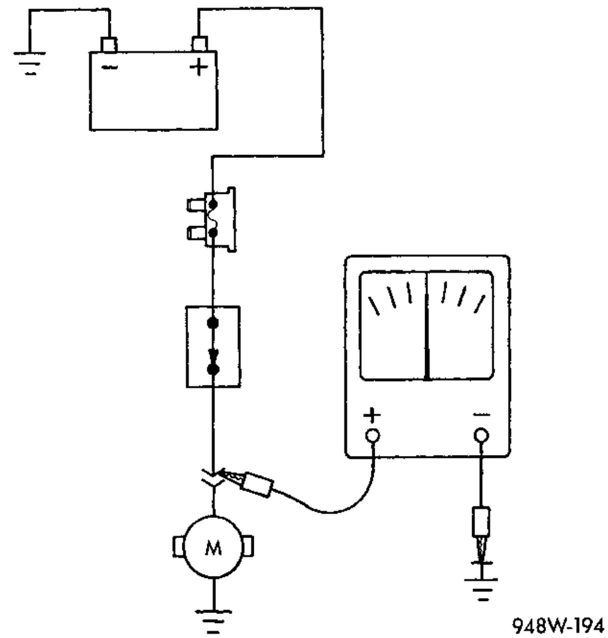


Fig. 6 Testing for Voltage Potential

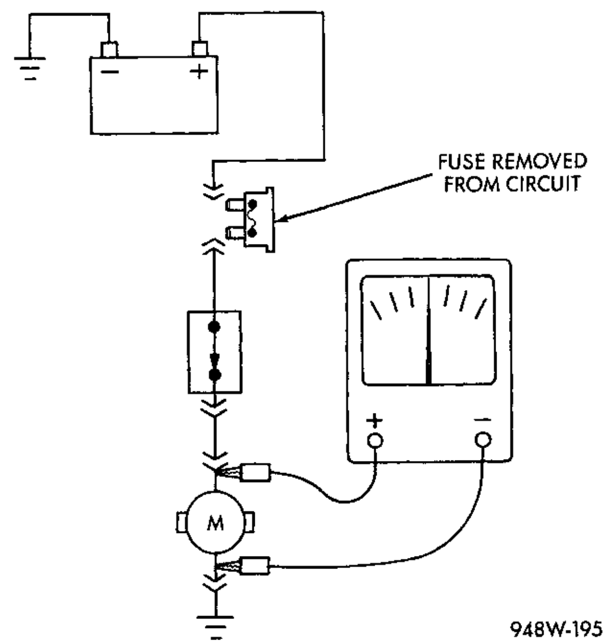


Fig. 7 Testing for Continuity

(4) If the voltmeter registers voltage or the test lamp glows, there is a short to ground in that general area of the wiring harness.

TESTING FOR A SHORT TO GROUND ON FUSES POWERING SEVERAL LOADS

(1) Refer to the wiring diagrams and disconnect or isolate all items on the suspected fused circuits.

(2) Replace the blown fuse.

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DIAGNOSIS AND TESTING (Continued)

(3) Supply power to the fuse by turning ON the ignition switch or re-connecting the battery.

(4) Start connecting the items in the fuse circuit one at a time. When the fuse blows the circuit with the short to ground has been isolated.

TESTING FOR A VOLTAGE DROP

(1) Connect the positive lead of the voltmeter to the side of the circuit closest to the battery (Fig. 8).

(2) Connect the other lead of the voltmeter to the other side of the switch or component.

(3) Operate the item.

(4) The voltmeter will show the difference in voltage between the two points.

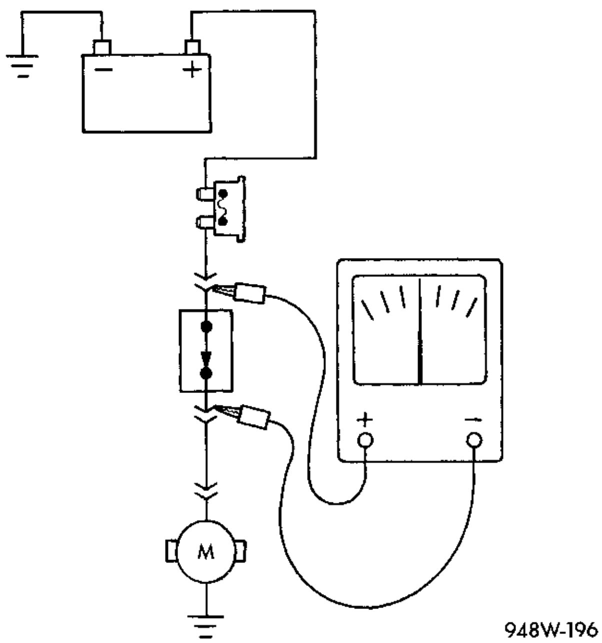


Fig. 8 Testing for Voltage Drop

TROUBLESHOOTING WIRING PROBLEMS

When troubleshooting wiring problems there are six steps which can aid in the procedure. The steps are listed and explained below. Always check for non-factory items added to the vehicle before doing any diagnosis. If the vehicle is equipped with these items, disconnect them to verify these add-on items are not the cause of the problem.

(1) Verify the problem.

(2) Verify any related symptoms. Do this by performing operational checks on components that are in the same circuit. Refer to the wiring diagrams.

(3) Analyze the symptoms. Use the wiring diagrams to determine what the circuit is doing, where the problem most likely is occurring and where the diagnosis will continue.

(4) Isolate the problem area.

(5) Repair the problem.

(6) Verify proper operation. For this step check for proper operation of all items on the repaired circuit. Refer to the wiring diagrams.

SERVICE PROCEDURES

WIRING REPAIR

When replacing or repairing a wire, it is important that the correct gage be used as shown in the wiring diagrams. The wires must also be held securely in place to prevent damage to the insulation.

(1) Disconnect battery negative cable

(2) Remove 1 inch of insulation from each end of the wire.

(3) Place a piece of heat shrink tubing over one side of the wire. Make sure the tubing will be long enough to cover and seal the entire repair area.

(4) Spread the strands of the wire apart on each part of the exposed wire (example 1). (Fig. 9)

(5) Push the two ends of wire together until the strands of wire are close to the insulation (example 2) (Fig. 9)

(6) Twist the wires together (example 3) (Fig. 9)

(7) Solder the connection together using rosin core type solder only. **Do not use acid core solder.**

(8) Center the heat shrink tubing over the joint, and heat using a heat gun. Heat the joint until the tubing is tightly sealed and sealant comes out of both ends of the tubing.

(9) Secure the wire to the existing ones to prevent chafing or damage to the insulation

(10) Connect battery and test all affected systems.

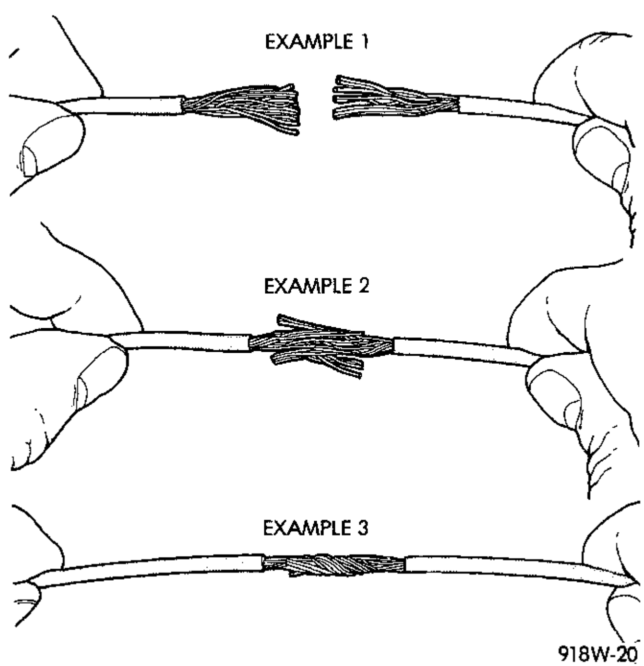


Fig. 9 Wire Repair

SERVICE PROCEDURES (Continued)

TERMINAL/CONNECTOR REPAIR-MOLEX CONNECTORS

(1) Disconnect battery.

(2) Disconnect the connector from its mating half/ component.

(3) Insert the terminal releasing special tool 6742 into the terminal end of the connector (Fig. 10).

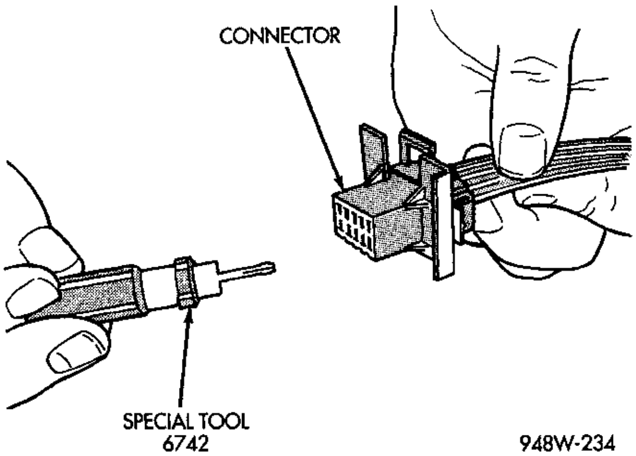


Fig. 10 Molex Connector Repair

(4) Using special tool 6742 release the locking fingers on the terminal (Fig. 11).

(5) Pull on the wire to remove it from the connector.

(6) Repair or replace the connector or terminal, as necessary.

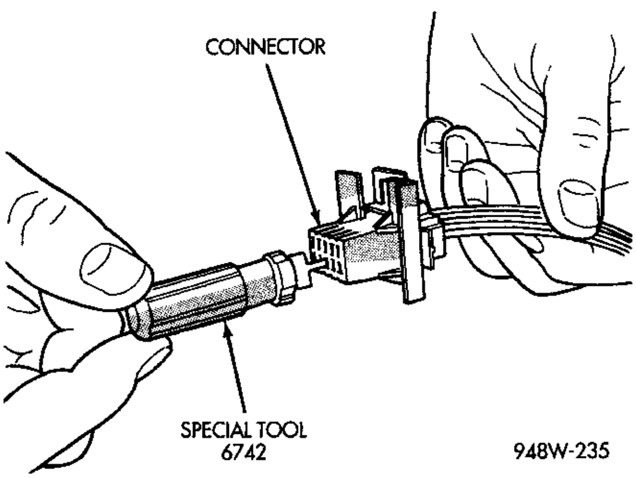


Fig. 11 Using Special Tool 6742

TERMINAL/CONNECTOR REPAIR—THOMAS AND BETTS CONNECTORS

(1) Disconnect battery.

(2) Disconnect the connector from its mating half/ component.

(3) Push in the two lock tabs on the side of the connector (Fig. 12).

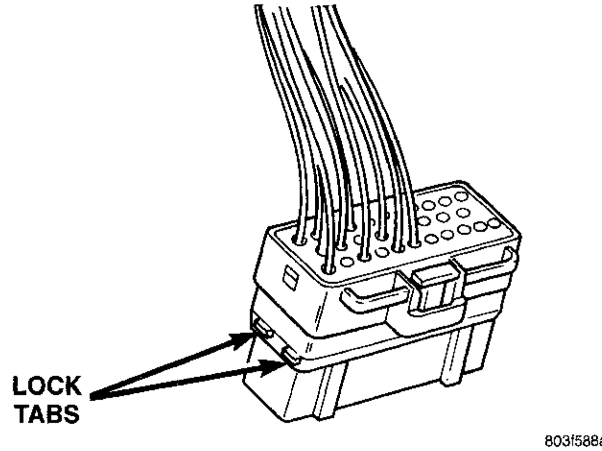


Fig. 12 Thomas and Betts Connector Lock Release Tabs

(4) Insert the probe end of special tool 6934 into the back of the connector cavity (Fig. 13).

(5) Grasp the wire and tool 6934 and slowly remove the wire and terminal from the connector.

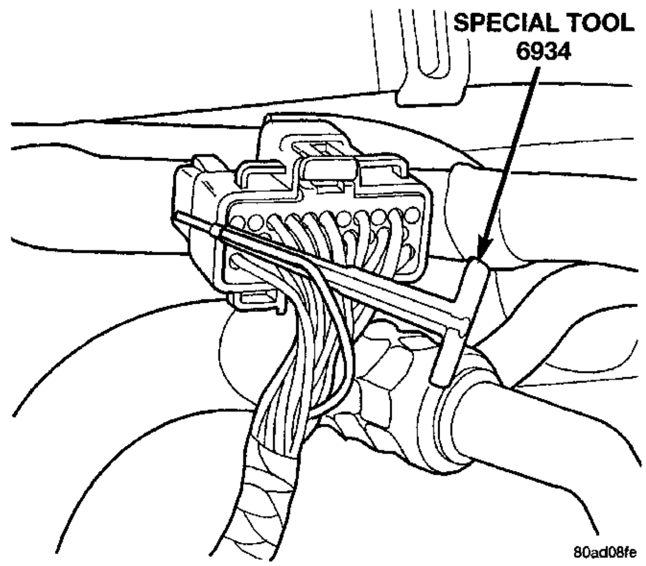


Fig. 13 Removing Wire Terminal

(6) Repair or replace the terminal.

(7) Install the wire and terminal in the connector. Fully seat the terminal in the connector.

(8) Push in the single lock tab on the side of the connector (Fig. 14).

CONNECTOR REPLACEMENT

(1) Disconnect battery.

(2) Disconnect the connector that is to be repaired from its mating half/component

(3) Remove the connector locking wedge, if required (Fig. 15)

SERVICE PROCEDURES (Continued)

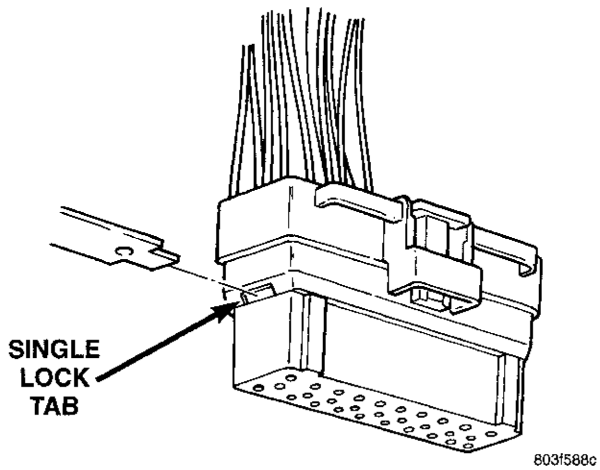


Fig. 14 Single Lock Tab

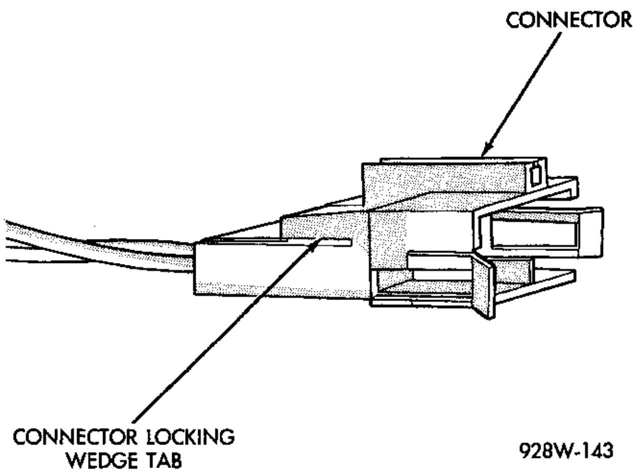


Fig. 15 Connector Locking Wedge

(4) Position the connector locking finger away from the terminal using the proper pick from special tool kit 6680. Pull on the wire to remove the terminal from the connector (Fig. 16) (Fig. 17).

(5) Reset the terminal locking tang, if it has one.

(6) Insert the removed wire in the same cavity on the repair connector.

(7) Repeat steps four through six for each wire in the connector, being sure that all wires are inserted into the proper cavities. For additional connector pin-out identification, refer to the wiring diagrams.

(8) Insert the connector locking wedge into the repaired connector, if required.

(9) Connect connector to its mating half/component.

(10) Connect battery and test all affected systems.

CONNECTOR AND TERMINAL REPLACEMENT

(1) Disconnect battery.

(2) Disconnect the connector (that is to be repaired) from its mating half/component.

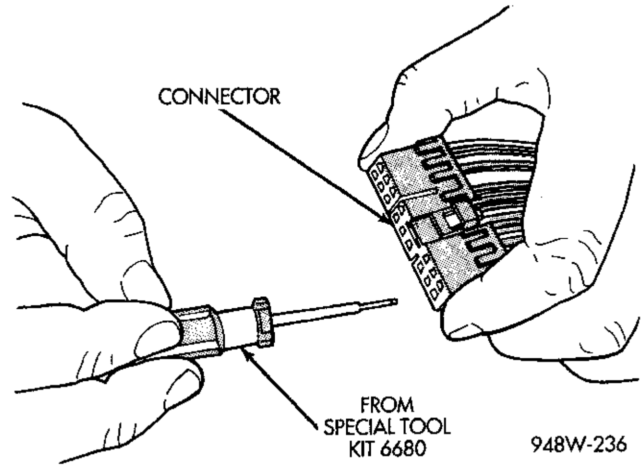


Fig. 16 Terminal Removal

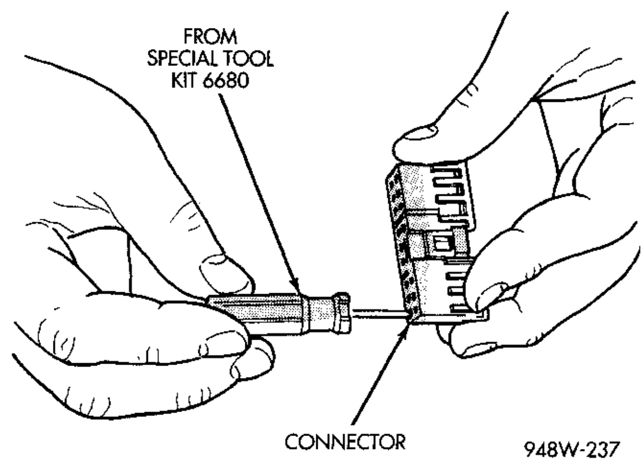


Fig. 17 Terminal Removal Using Special Tool

(3) Cut off the existing wire connector directly behind the insulator. Remove six inches of tape from the harness.

(4) Stagger cut all wires on the harness side at 1/2 inch intervals (Fig. 18).

(5) Remove 1 inch of insulation from each wire on the harness side.

(6) Stagger cut the matching wires on the repair connector assembly in the opposite order as was done on the harness side of the repair. Allow extra length for soldered connections. Check that the overall length is the same as the original (Fig. 18).

(7) Remove 1 inch of insulation from each wire.

(8) Place a piece of heat shrink tubing over one side of the wire. Be sure the tubing will be long enough to cover and seal the entire repair area.

(9) Spread the strands of the wire apart on each part of the exposed wires.

(10) Push the two ends of wire together until the strands of wire are close to the insulation.

(11) Twist the wires together.

Mopar AUTHENTIC RESTORATION PRODUCT

SERVICE PROCEDURES (Continued)

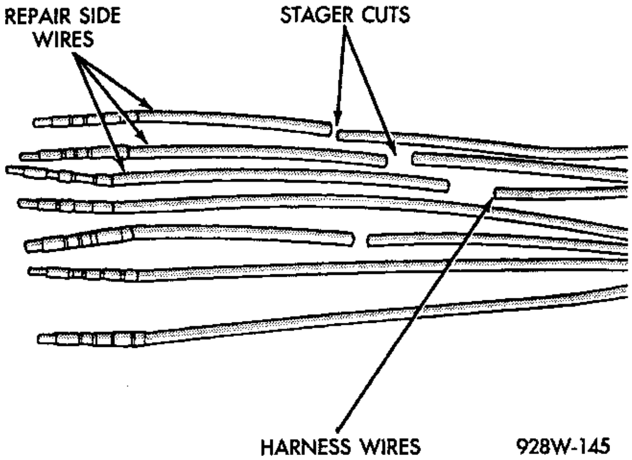


Fig. 18 Stagger Cutting Wires

(12) Solder the connection together using rosin core type solder only. **Do not use acid core solder.**

(13) Center the heat shrink tubing over the joint and heat using a heat gun. Heat the joint until the tubing is tightly sealed and sealant comes out of both ends of the tubing

(14) Repeat steps 8 through 13 for each wire.

(15) Re-tape the wire harness starting 1-1/2 inches behind the connector and 2 inches past the repair.

(16) Re-connect the repaired connector.

(17) Connect the battery, and test all affected systems.

TERMINAL REPLACEMENT

(1) Disconnect battery.

(2) Disconnect the connector being repaired from its mating half. Remove connector locking wedge, if required (Fig. 19).

(3) Remove connector locking wedge, if required (Fig. 19).

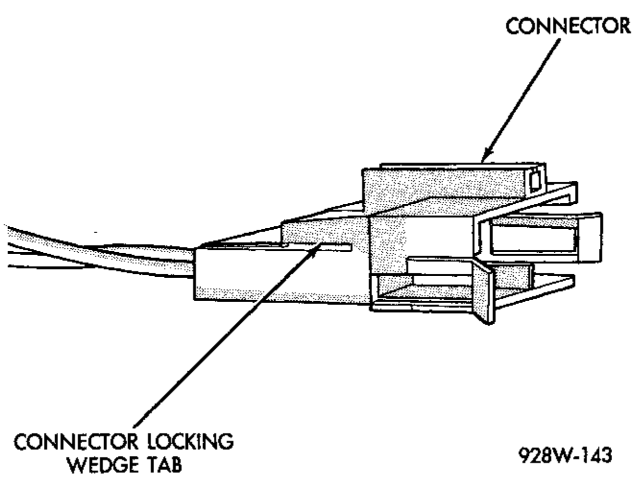


Fig. 19 Connector Locking Wedge Tab (Typical)

(4) Position the connector locking finger away from the terminal using the proper pick from special tool kit 6680. Pull on the wire to remove the terminal from the connector (Fig. 20) (Fig. 21).

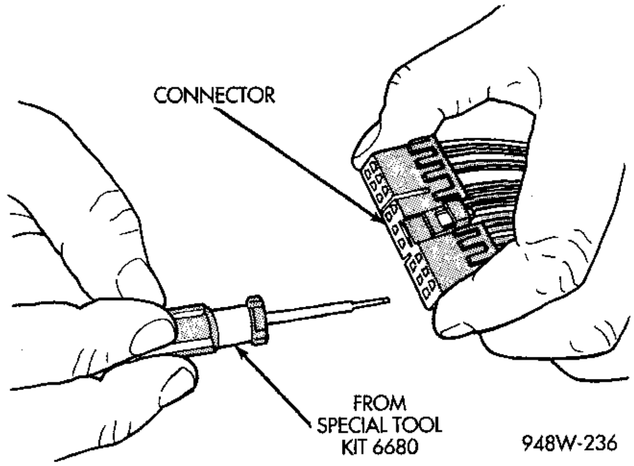


Fig. 20 Terminal Removal

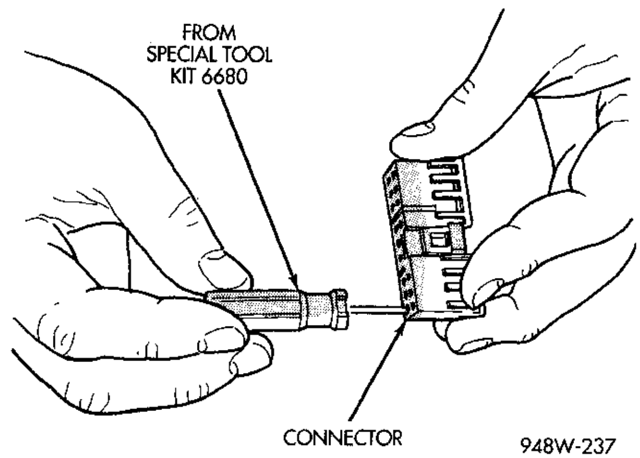


Fig. 21 Terminal Removal Using Special Tool

(5) Cut the wire 6 inches from the back of the connector.

(6) Remove 1 inch of insulation from the wire on the harness side.

(7) Select a wire from the terminal repair assembly that best matches the color wire being repaired.

(8) Cut the repair wire to the proper length and remove 1 inch of insulation.

(9) Place a piece of heat shrink tubing over one side of the wire. Make sure the tubing will be long enough to cover and seal the entire repair area.

(10) Spread the strands of the wire apart on each part of the exposed wires.

(11) Push the two ends of wire together until the strands of wire are close to the insulation.

(12) Twist the wires together.

(13) Solder the connection together using rosin core type solder only. **Do not use acid core solder.**

SERVICE PROCEDURES (Continued)

(14) Center the heat shrink tubing over the joint and heat using a heat gun. Heat the joint until the tubing is tightly sealed and sealant comes out of both ends of the tubing.

(15) Insert the repaired wire into the connector.

(16) Install the connector locking wedge, if required, and reconnect the connector to its mating half/component.

(17) Re-tape the wire harness starting 1-1/2 inches behind the connector and 2 inches past the repair.

(18) Connect battery, and test all affected systems.

DIODE REPLACEMENT

(1) Disconnect the battery.

(2) Locate the diode in the harness, and remove the protective covering.

(3) Remove the diode from the harness, pay attention to the current flow direction (Fig. 22).

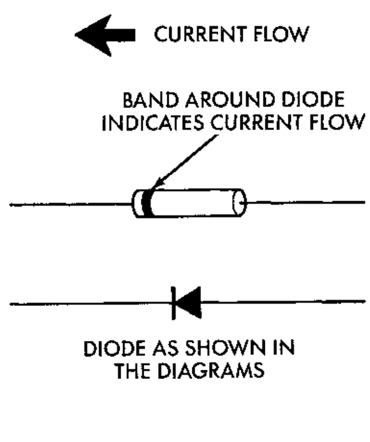


Fig. 22 Diode Identification

(4) Remove the insulation from the wires in the harness. Only remove enough insulation to solder in the new diode.

(5) Install the new diode in the harness, making sure current flow is correct. If necessary refer to the appropriate wiring diagram for current flow.

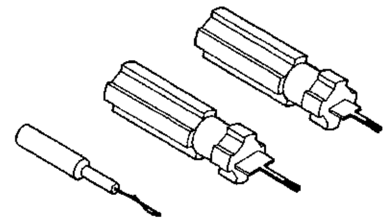
(6) Solder the connection together using rosin core type solder only. **Do not use acid core solder.**

(7) Tape the diode to the harness using electrical tape making, sure the diode is completely sealed from the elements.

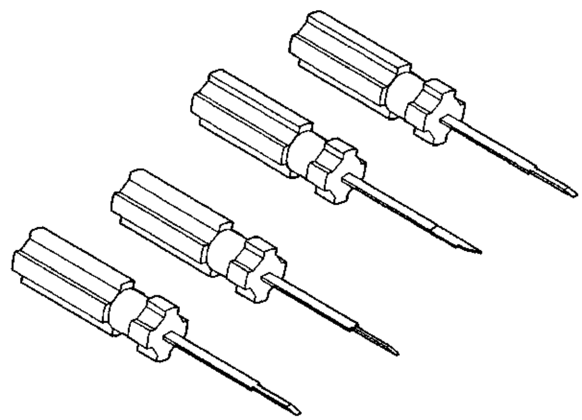
(8) Re-connect the battery, and test affected systems.

SPECIAL TOOLS

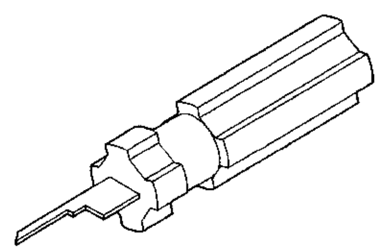
WIRING/TERMINAL



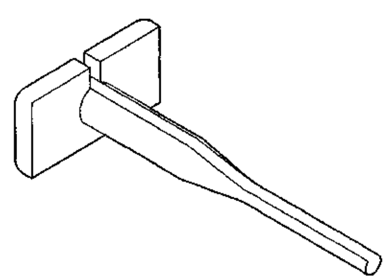
Probing Tool Package 6807



Terminal Pick 6680



Terminal Removing Tool 6932



Terminal Removing Tool 6934

AUTHENTIC RESTORATION

8W-02 COMPONENT INDEX

Mopar AUTHENTIC RESTORATION PRODUCT

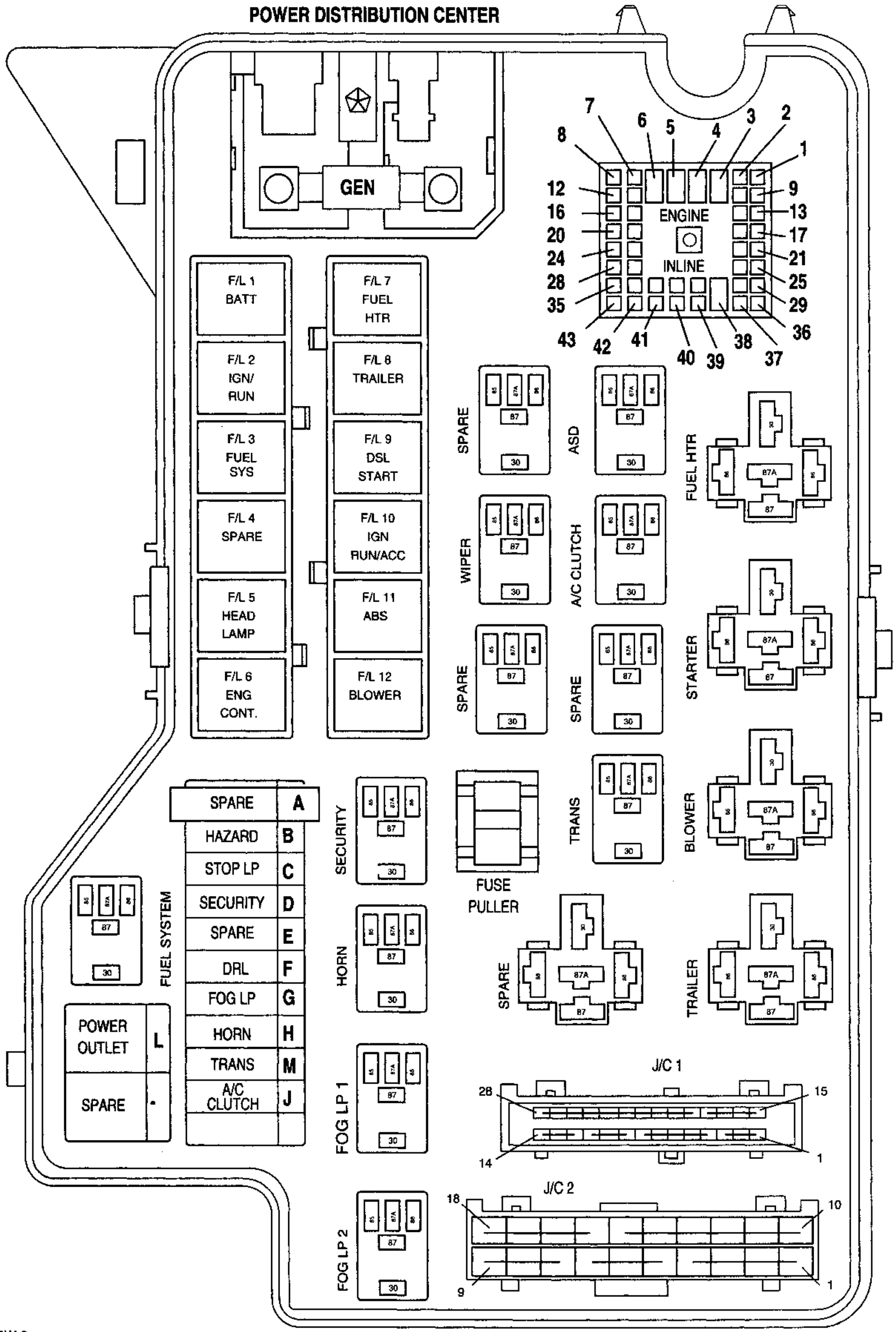
SPECIAL TOOLS (Continued)

Mopar AUTHENTIC RESTORATION PRODUCT

8W-10 POWER DISTRIBUTION

Mopar AUTHENTIC RESTORATION PRODUCT

POWER DISTRIBUTION CENTER



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BR001001

Mopar AUTHENTIC RESTORATION PRODUCT

FUSES

CAV	CIRCUIT	AMPS	FUNCTION
1	A7 10RD/BK	50	FUSED (B+)
2	A2 14PK/BK	30	FUSED (B+)
3	A14 16RD/WT	20	FUSED (B+)
4	-	-	-
5	A3 12RD/YL	40	HEADLAMP SWITCH
6	A16 14RD/LB	30	AUTO SHUT DOWN RELAY
7	A112 12RD/TN	40	FUEL HEATER RELAY
8	A6 12RD/OR	40	FUSED (B+)
9	A18 10RD/BK	50	FUEL SHUT DOWN RELAY
10	A1 10RD	50	IGNITION SWITCH
11	A10 10RD/DG	40	CONTROLLER ANTI-LOCK BRAKE
12	C111 12DG/YL	40	BLOWER RELAY

mopar AUTHENTIC RESTORATION PRODUCT

FUSES

CAV	CIRCUIT	AMPS	FUNCTION
A	-	-	-
B	L9 16BK/VT	20	COMBINATION FLASHER
C	F32 16PK/DB	20	STOP LAMP SWITCH
D	F39	15	HEADLAMP RELAY
E	-	-	-
F	L20 18LG/WT	10	DAYTIME RUNNING LAMP MODULE
G	L38 20BR/WT	10	FOG LAMP RELAY
H	F31	10	HORN RELAY
J	C26 22PK/DB	10	A/C COMPRESSOR CLUTCH RELAY
K1	A142 14DG/OR	10	FUSED B(+)
K2	A141 20DG/WT		OXYGEN SENSORS
L	A12 16RD/TN	20	POWER OUTLET
M	T17 22YL	10	TRANSMISSION RELAY
GEN	A11 6BK/GY	140	GENERATOR

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Mopar AUTHENTIC RESTORATION PRODUCT

A/C COMPRESSOR CLUTCH RELAY

CAV	CIRCUIT	FUNCTION
30	C26 22PK/DB	FUSED B(+)
85	C13 22DB/OR	A/C COMPRESSOR CLUTCH RELAY CONTROL
85	C13 20DB/OR *	A/C COMPRESSOR CLUTCH RELAY CONTROL
86	F12 20DB/WT	FUSED IGN. (ST-RUN)
87	C3 22DB/BK	A/C COMPRESSOR CLUTCH RELAY OUTPUT

AUTO SHUT DOWN RELAY

CAV	CIRCUIT	FUNCTION
30	A16 14RD/LB	FUSED B(+)
85	K51 22DB/YL	AUTO SHUT DOWN RELAY CONTROL
86	F18 20LG/BK	FUSED IGN. (ST-RUN)
87	A142 14DG/OR	AUTO SHUT DOWN RELAY SENSE

BLOWER MOTOR RELAY

CAV	CIRCUIT	FUNCTION
30	C111 12DG/YL	FUSED B(+)
85	Z1 22BK	GROUND
86	F15 22DB	FUSED IGN. (RUN)
87	C1 12DG	BLOWER MOTOR

ENGINE STARTER MOTOR RELAY

CAV	CIRCUIT	FUNCTION
30	A2 14PK/BK	FUSED B(+)
85	T41 22BK/WT	ENGINE STARTER MOTOR RELAY CONTROL
85	T41 20BK/WT *	ENGINE STARTER MOTOR RELAY CONTROL
86	T141 14YL/RD	ENGINE STARTER MOTOR DRIVER
87	T40 14BR	ENGINE STARTER MOTOR RELAY OUTPUT
87	T40 14BR	STARTER RELAY CONTACT TO SOLENOID

* DIESEL

mopar AUTHENTIC RESTORATION PRODUCT

FOG LAMP RELAY NO. 1

CAV	CIRCUIT	FUNCTION
30	L38 20BR/WT	PARK LAMP SWITCH OUTPUT
85	L35 22BR/YL	GROUND
86	L7 18BK/YL	HIGH BEAM INDICATOR LAMP DRIVER
87	L139 22VT	FOG LAMP RELAY OUTPUT

FOG LAMP RELAY NO. 2

CAV	CIRCUIT	FUNCTION
30	L139 22VT	FOG LAMP RELAY NO. 1 OUTPUT
85	Z1 22BK	GROUND
86	L3 16RD/OR	FOG LAMP RELAY NO. 2 CONTROL
86	G34 20RD/GY	
87A	L39 20LB	FOG LAMP RELAY NO. 1 OUTPUT

FUEL HEATER RELAY

CAV	CIRCUIT	FUNCTION
30	A112 12RD/TN	FUSED B(+)
85	Z1 22BK	GROUND
86	F12 20DB/WT	FUSED IGN. (ST-RUN)
87	A93 12RD/YL	FUEL HEATER RELAY OUT PUT

FUEL PUMP RELAY

CAV	CIRCUIT	FUNCTION
30	A14 16RD/WT	ASD RELAY CONTACT
85	K31 22BR/WT	FUEL PUMP RELAY OUTPUT
86	F18 20LG/BK	FUSED (B+)
87	A61 16DG/BK	ABS SYSTEM RELAY CONTACT

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HORN RELAY

CAV	CIRCUIT	FUNCTION
30	F31	FUSED B(+)
85	X3 22BK/RD	HORN RELAY CONTROL
86	F31	FUSED B(+)
87	X2 20DG/RD	HORN RELAY OUTPUT

SECURITY RELAY

CAV	CIRCUIT	FUNCTION
30	F39	FUSED B(+)
85	G50 22 RD/DB	HEADLAMP SIGNAL
86	F39	FUSED B(+)
87	L4 16VT/WT	SECURITY RELAY OUT PUT

TRAILER TOW RELAY

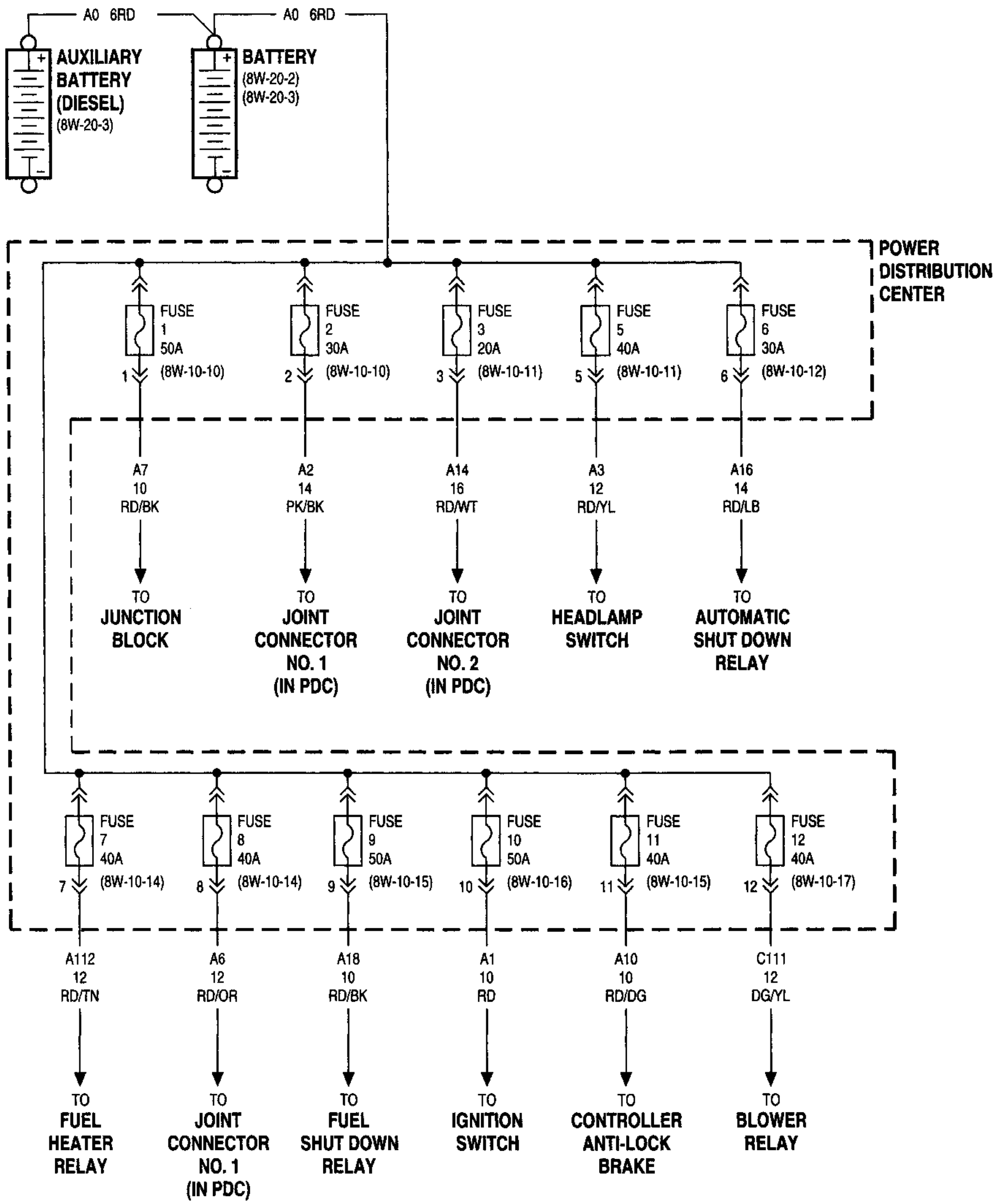
CAV	CIRCUIT	FUNCTION
30	A6 12RD/OR	FUSED B(+)
85	Z1 22BK	GROUND
86	L7 18BK/YL	PARK LAMP SWITCH OUTPUT
87	L76 12BK/OR	TRAILER PARK LAMPS

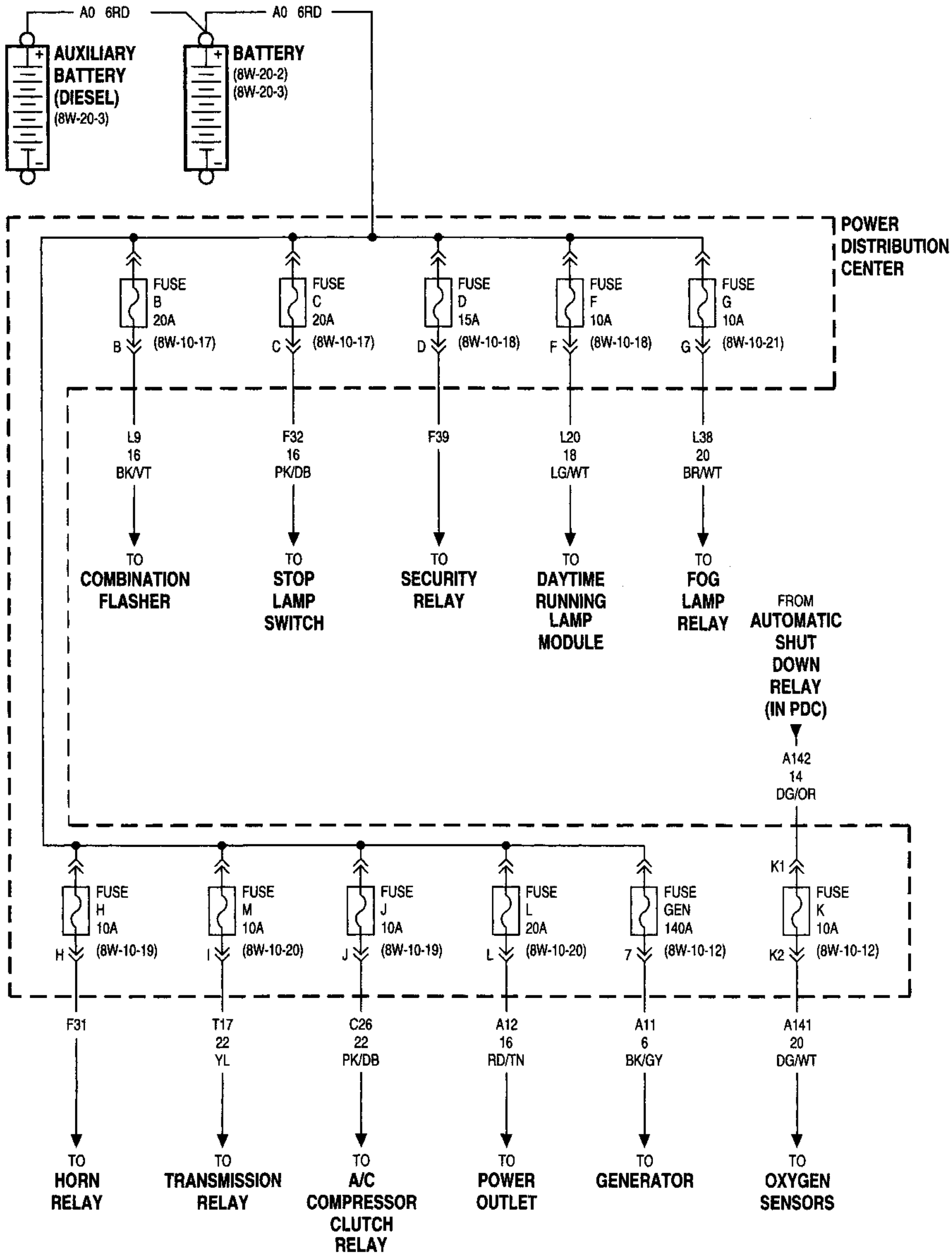
TRANSMISSION RELAY

CAV	CIRCUIT	FUNCTION
30	T17 22YL	FUSED B(+)
85	K30 22PK/WT	TRANSMISSION RELAY CONTROL
86	T125 18 WT/DB	MODULE CONTROL CIRCUIT
87	T16 22RD	TRANSMISSION CONTROL RELAY OUTPUT

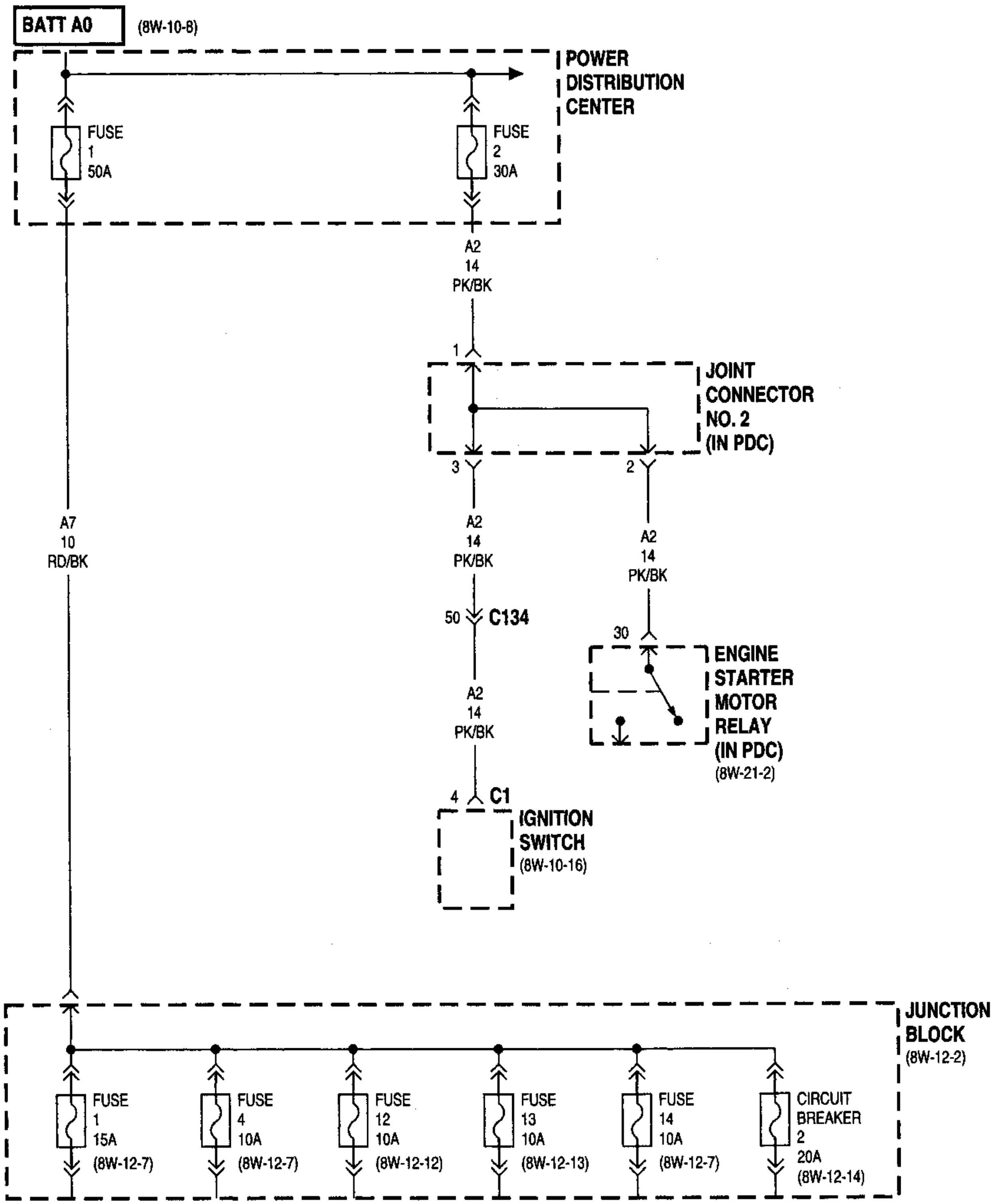
WIPER MOTOR RELAY

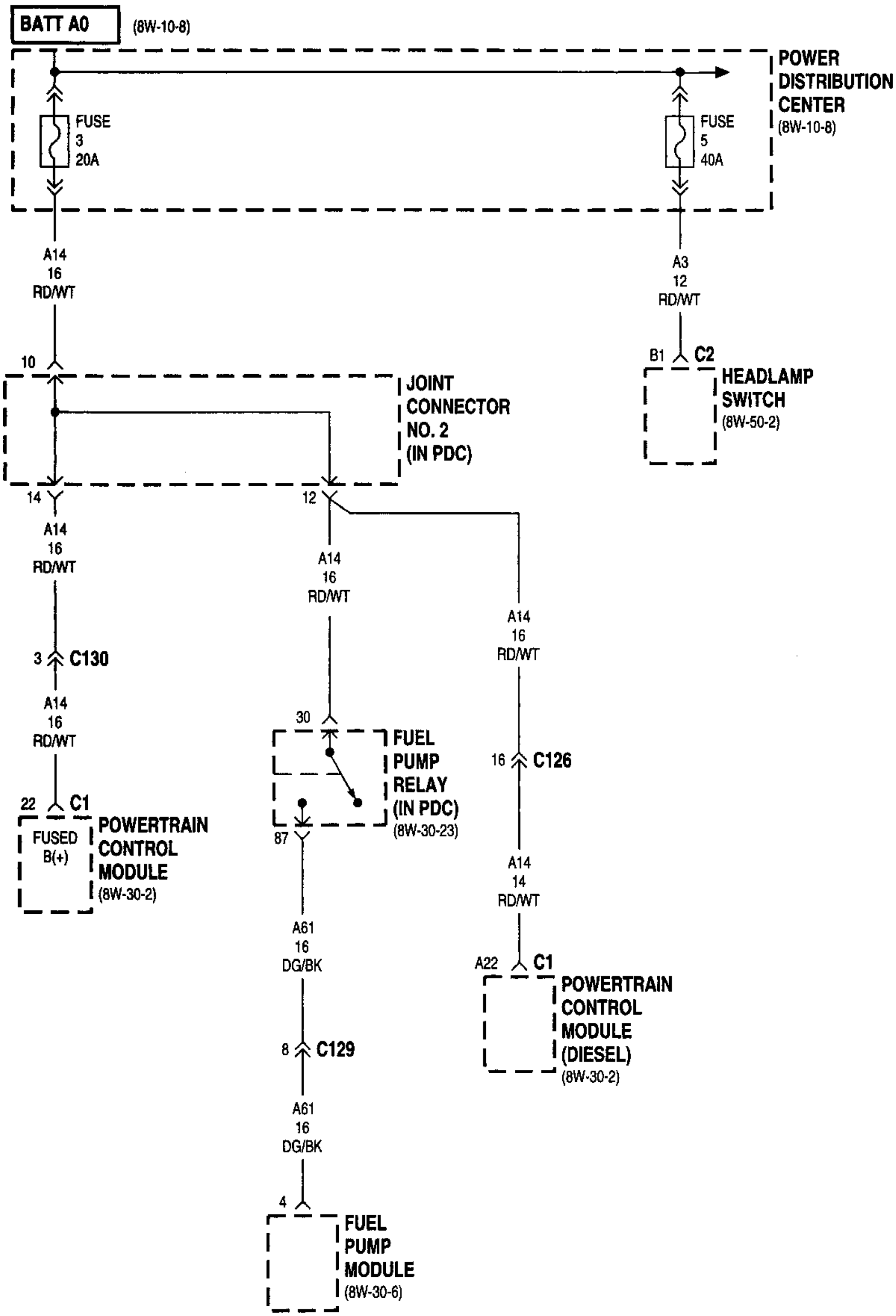
CAV	CIRCUIT	FUNCTION
30	V49 16RD/BK	WIPER RELAY OUT PUT
85	V18 22YL/DG	
86	V6 16DB	FUSED IGN. (RUN/ACC)
87	V6 16DB	FUSED IGN. (RUN/ACC)
87A	V5 16DG	

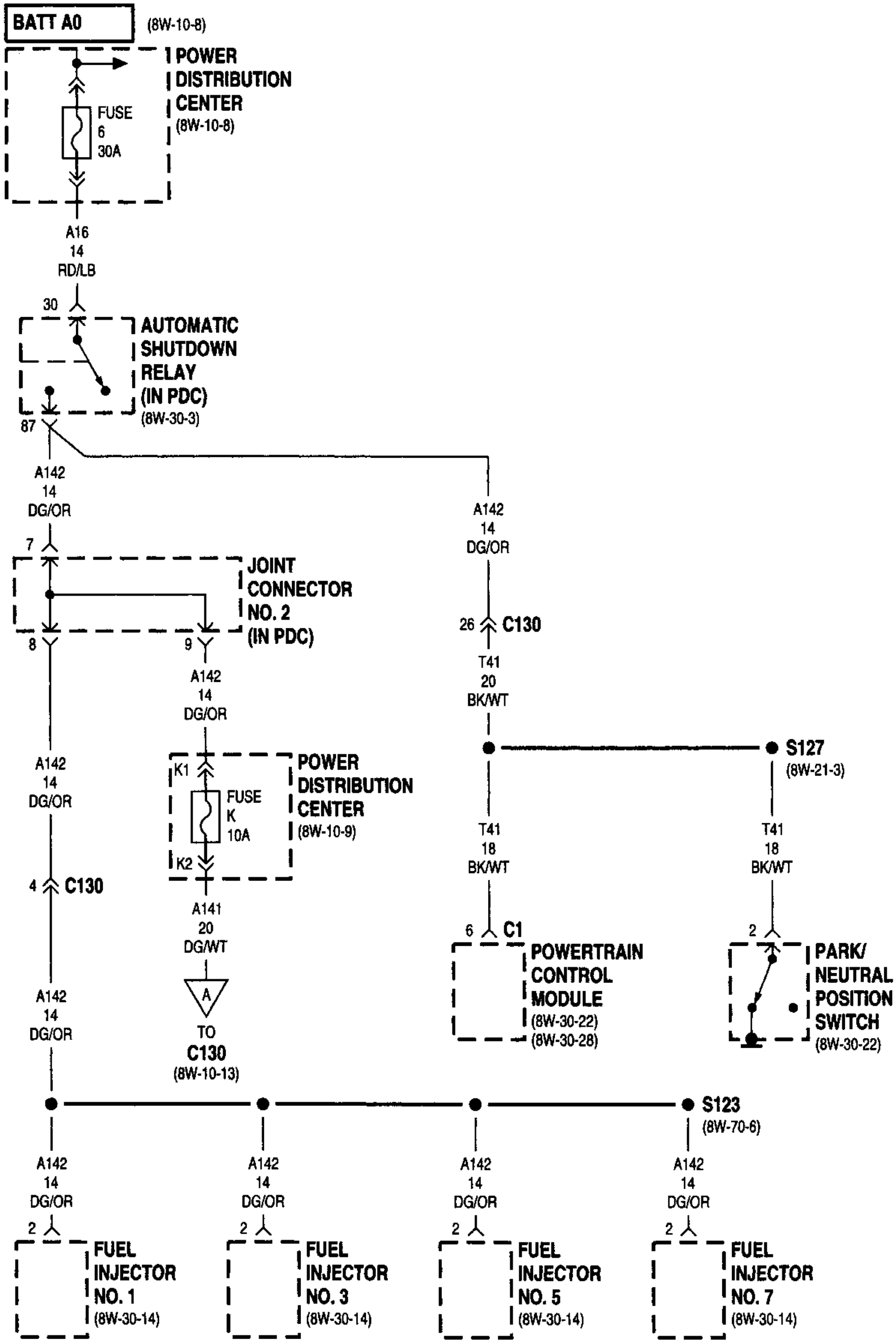

A0 6RD
A0 6RD
AUXILIARY BATTERY (DIESEL)
(8W-20-3)
BATTERY
(8W-20-2)
(8W-20-3)
POWER DISTRIBUTION CENTER
FUSE 1 50A
1 (8W-10-10)
FUSE 2 30A
2 (8W-10-10)
FUSE 3 20A
3 (8W-10-11)
FUSE 5 40A
5 (8W-10-11)
FUSE 6 30A
6 (8W-10-12)
A7 10 RD/BK
A2 14 PK/BK
A14 16 RD/WT
A3 12 RD/YL
A16 14 RD/LB
TO JUNCTION BLOCK
TO JOINT CONNECTOR NO. 1 (IN PDC)
TO JOINT CONNECTOR NO. 2 (IN PDC)
TO HEADLAMP SWITCH
TO AUTOMATIC SHUT DOWN RELAY
FUSE 7 40A
7 (8W-10-14)
FUSE 8 40A
8 (8W-10-14)
FUSE 9 50A
9 (8W-10-15)
FUSE 10 50A
10 (8W-10-16)
FUSE 11 40A
11 (8W-10-15)
FUSE 12 40A
12 (8W-10-17)
A112 12 RD/TN
A6 12 RD/OR
A18 10 RD/BK
A1 10 RD
A10 10 RD/DG
C111 12 DG/YL
TO FUEL HEATER RELAY
TO JOINT CONNECTOR NO. 1 (IN PDC)
TO FUEL SHUT DOWN RELAY
TO IGNITION SWITCH
TO CONTROLLER ANTI-LOCK BRAKE
TO BLOWER RELAY


A0 6RD
A0 6RD
AUXILIARY BATTERY (DIESEL) (8W-20-3)
BATTERY (8W-20-2) (8W-20-3)
POWER DISTRIBUTION CENTER
FUSE B 20A (8W-10-17)
FUSE C 20A (8W-10-17)
FUSE D 15A (8W-10-18)
FUSE F 10A (8W-10-18)
FUSE G 10A (8W-10-21)
L9 16 BK/VT
F32 16 PK/DB
F39
L20 18 LG/WT
L38 20 BR/WT
TO COMBINATION FLASHER
TO STOP LAMP SWITCH
TO SECURITY RELAY
TO DAYTIME RUNNING LAMP MODULE
TO FOG LAMP RELAY
FROM AUTOMATIC SHUT DOWN RELAY (IN PDC)
A142 14 DG/OR
K1
FUSE H 10A (8W-10-19)
FUSE M 10A (8W-10-20)
FUSE J 10A (8W-10-19)
FUSE L 20A (8W-10-20)
FUSE GEN 140A (8W-10-12)
FUSE K 10A (8W-10-12)
K2
F31
T17 22 YL
C26 22 PK/DB
A12 16 RD/TN
A11 6 BK/GY
A141 20 DG/WT
TO HORN RELAY
TO TRANSMISSION RELAY
TO A/C COMPRESSOR CLUTCH RELAY
TO POWER OUTLET
TO GENERATOR
TO OXYGEN SENSORS

AUTHENTIC RESTORATION PRODUCT Mopar




BATT A0
(8W-10-8)
FUSE
3
20A
FUSE
5
40A
POWER
DISTRIBUTION
CENTER
(8W-10-8)
A14
16
RD/WT
A3
12
RD/WT
B1
C2
HEADLAMP
SWITCH
(8W-50-2)
10
JOINT
CONNECTOR
NO. 2
(IN PDC)
14
12
A14
16
RD/WT
A14
16
RD/WT
A14
16
RD/WT
3
C130
A14
16
RD/WT
30
FUEL
PUMP
RELAY
(IN PDC)
(8W-30-23)
16
C126
22
C1
FUSED
B(+)
POWERTRAIN
CONTROL
MODULE
(8W-30-2)
87
A14
14
RD/WT
A61
16
DG/BK
A22
C1
POWERTRAIN
CONTROL
MODULE
(DIESEL)
(8W-30-2)
8
C129
A61
16
DG/BK
4
FUEL
PUMP
MODULE
(8W-30-6)



BATT A0
(8W-10-8)
POWER DISTRIBUTION CENTER
(8W-10-8)
FUSE 6 30A
A16 14 RD/LB
30
AUTOMATIC SHUTDOWN RELAY (IN PDC)
(8W-30-3)
87
A142 14 DG/OR
7
JOINT CONNECTOR NO. 2 (IN PDC)
8
9
A142 14 DG/OR
POWER DISTRIBUTION CENTER
(8W-10-9)
K1
FUSE K 10A
K2
A141 20 DG/WT
A
TO C130
(8W-10-13)
A142 14 DG/OR
4 C130
A142 14 DG/OR
A142 14 DG/OR
26 C130
T41 20 BK/WT
S127
(8W-21-3)
T41 18 BK/WT
T41 18 BK/WT
6 C1
POWERTRAIN CONTROL MODULE
(8W-30-22)
(8W-30-28)
2
PARK/ NEUTRAL POSITION SWITCH
(8W-30-22)
S123
(8W-70-6)
A142 14 DG/OR
2
FUEL INJECTOR NO. 1
(8W-30-14)
A142 14 DG/OR
2
FUEL INJECTOR NO. 3
(8W-30-14)
A142 14 DG/OR
2
FUEL INJECTOR NO. 5
(8W-30-14)
A142 14 DG/OR
2
FUEL INJECTOR NO. 7
(8W-30-14)

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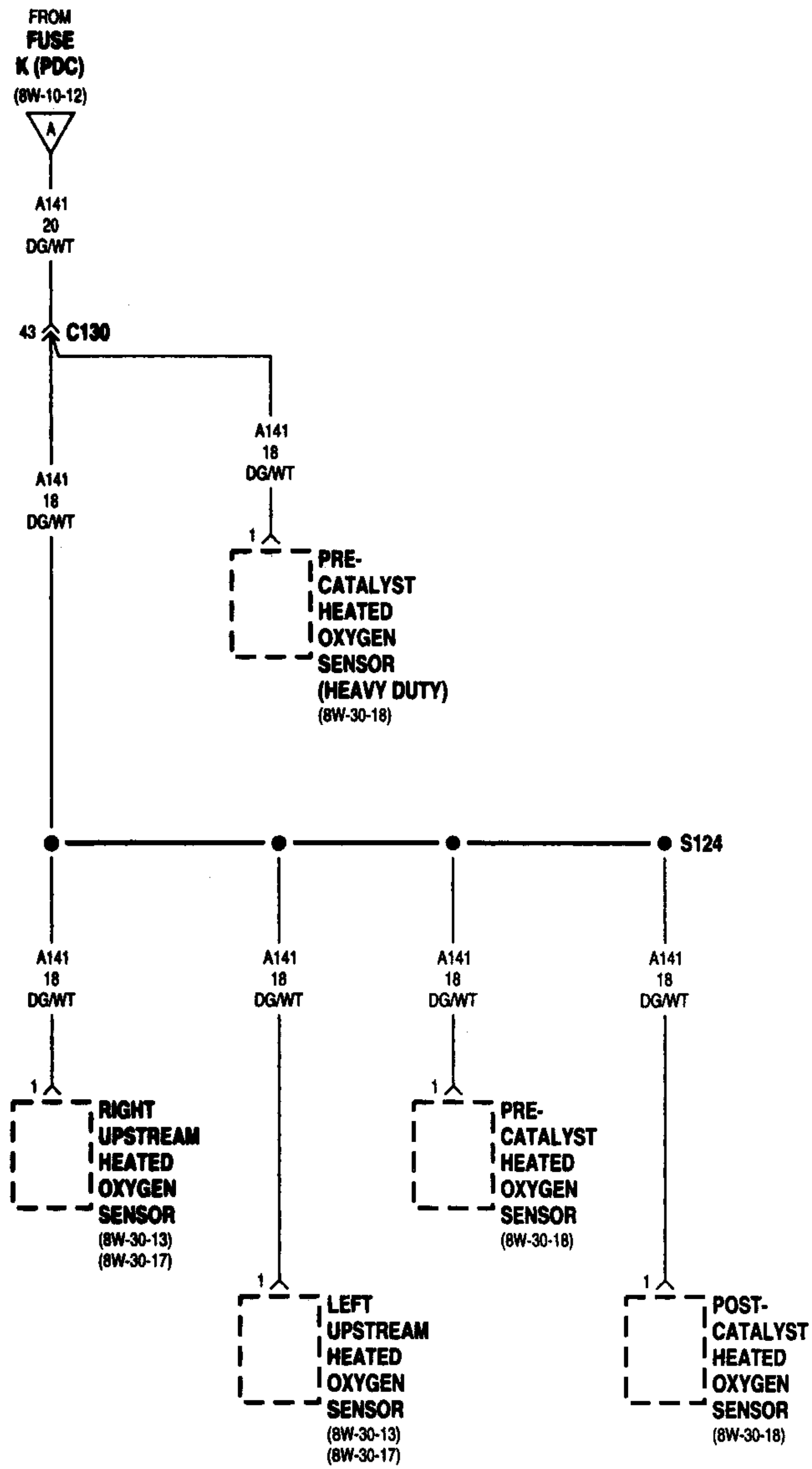

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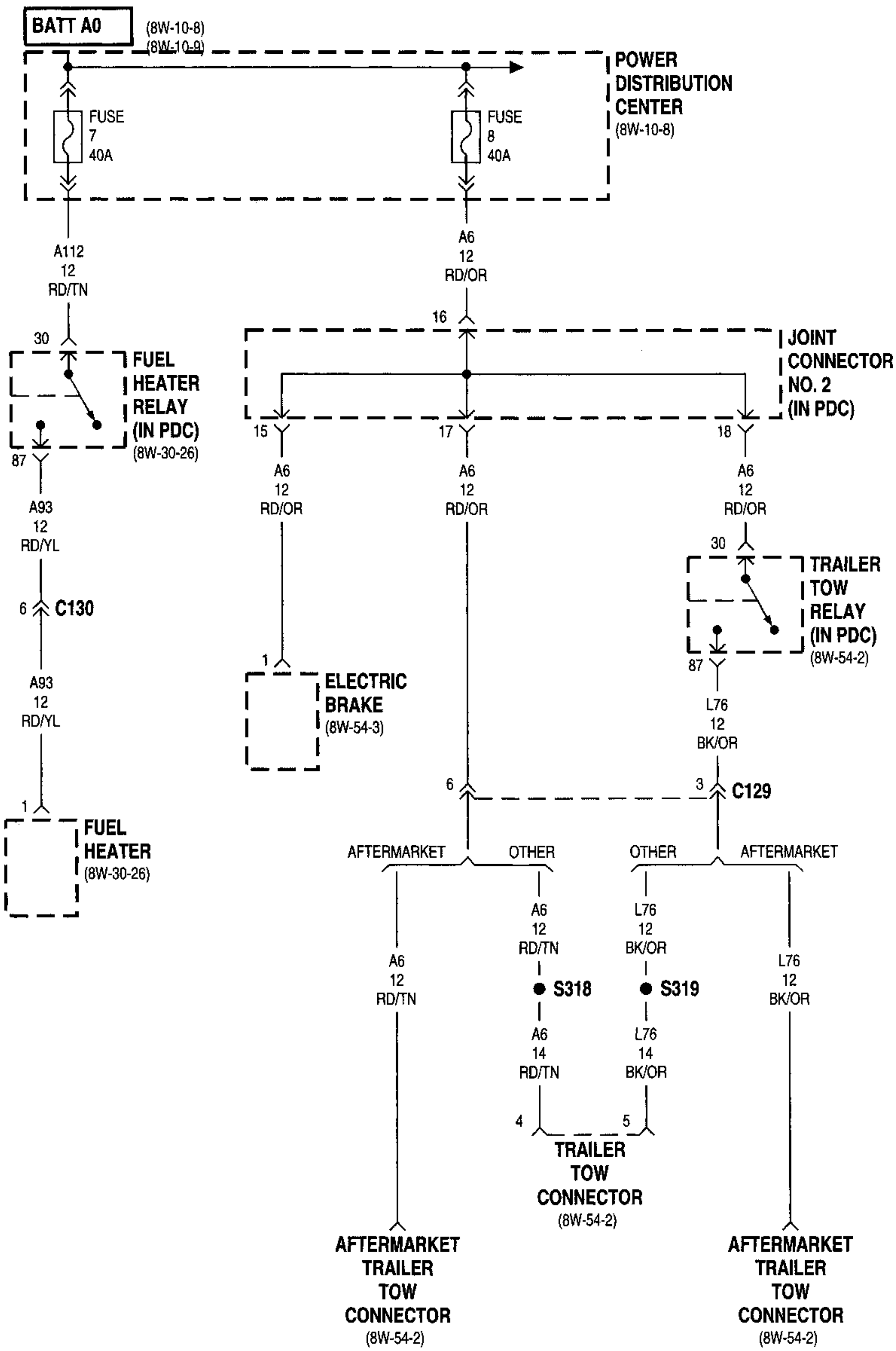

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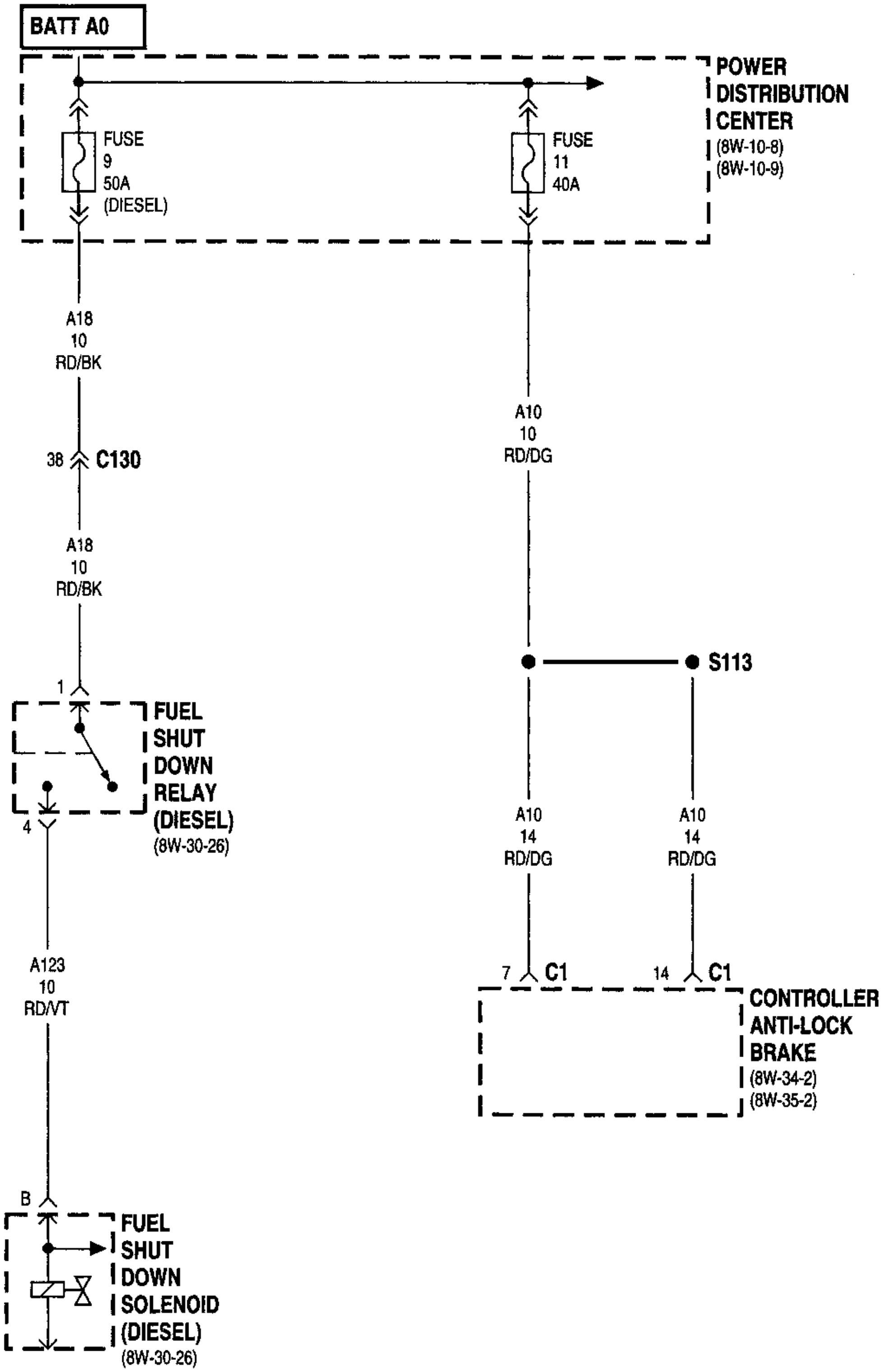
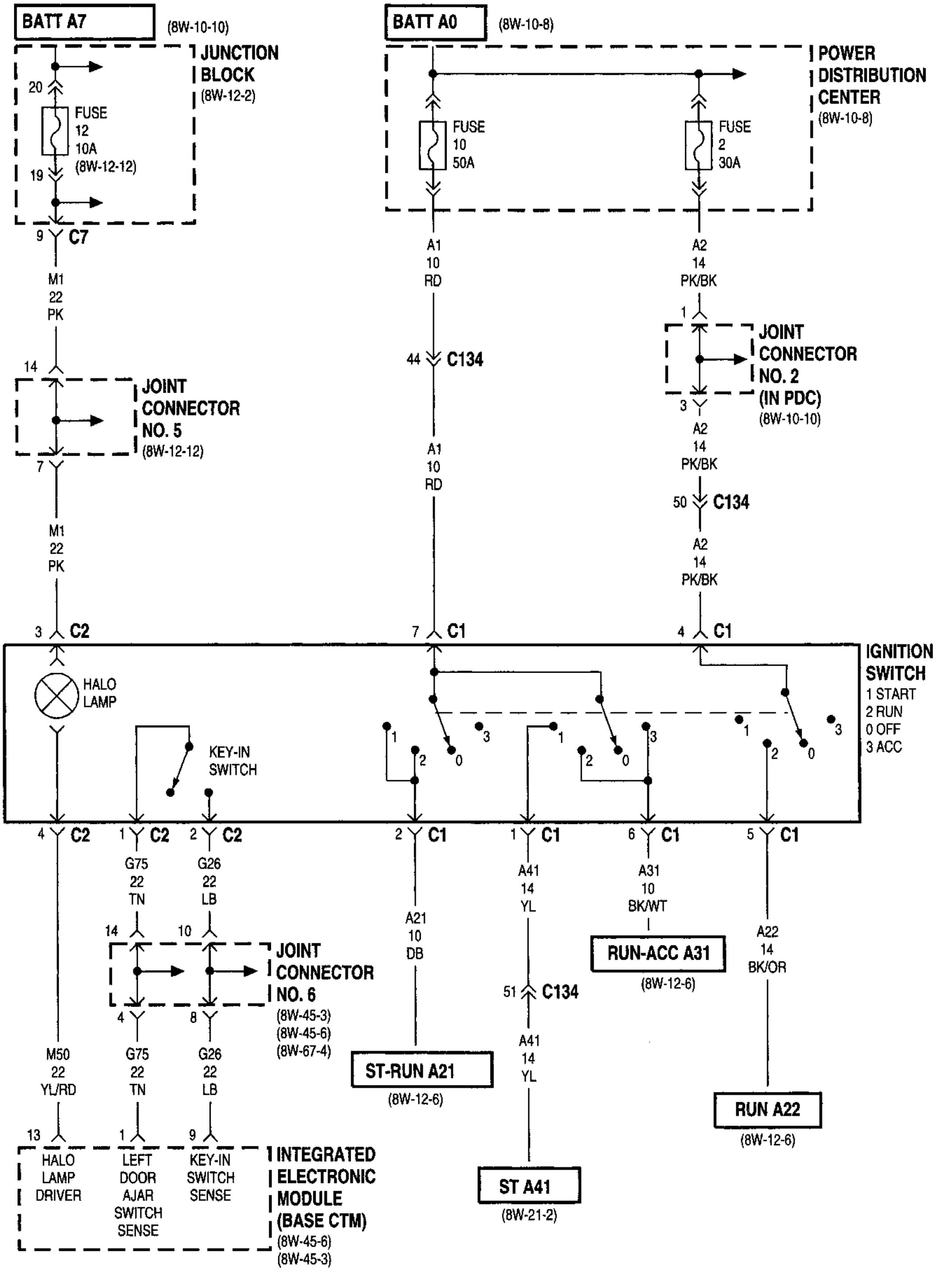
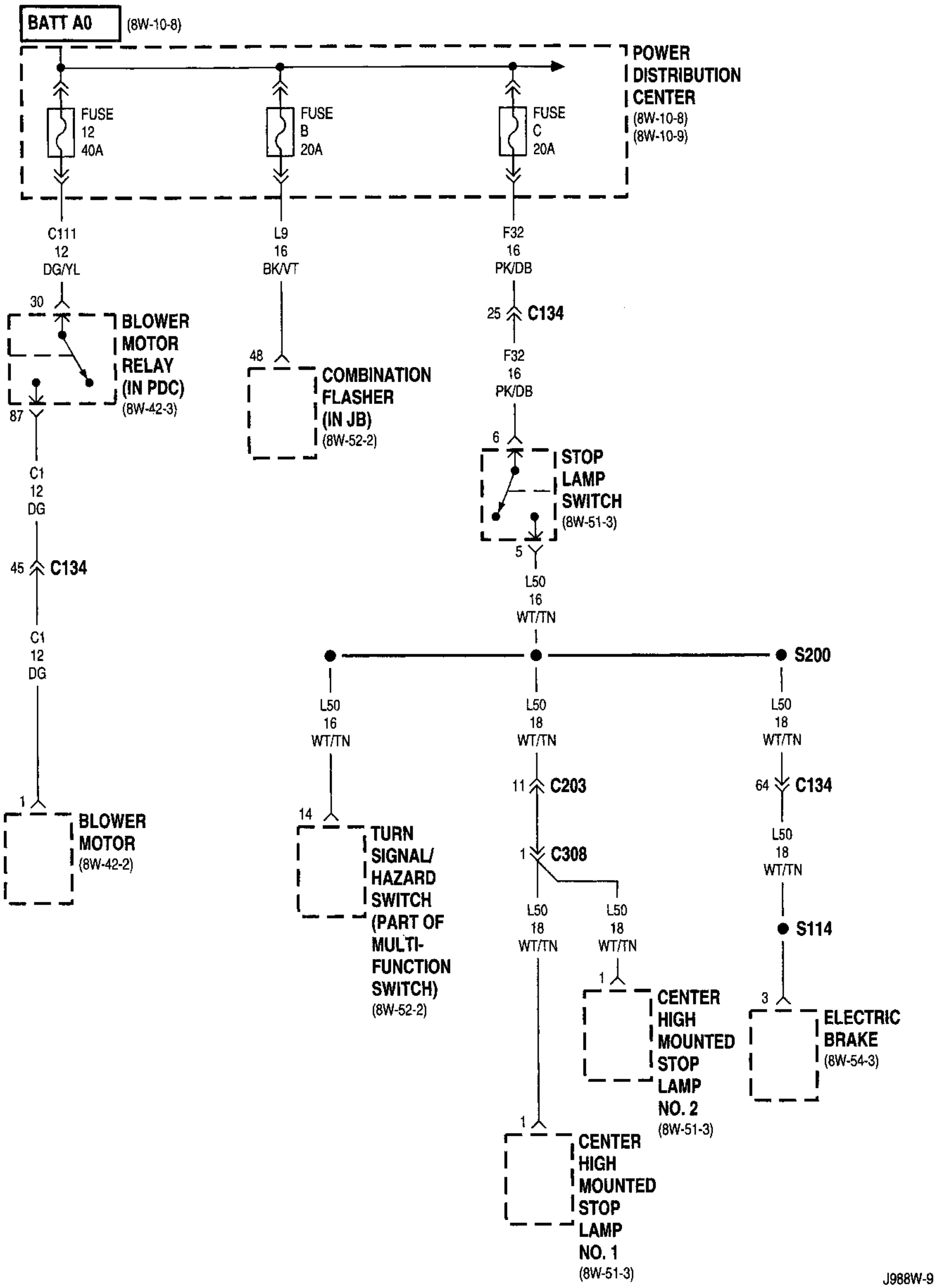



BATT A7
(8W-10-10)
JUNCTION BLOCK
(8W-12-2)
20
FUSE
12
10A
(8W-12-12)
19
9 C7
M1
22
PK
14
JOINT CONNECTOR NO. 5
(8W-12-12)
7
M1
22
PK
3 C2
HALO LAMP
KEY-IN SWITCH
4 C2
1 C2
2 C2
G75
22
TN
G26
22
LB
14
10
JOINT CONNECTOR NO. 6
(8W-45-3)
(8W-45-6)
(8W-67-4)
4
8
M50
22
YL/RD
G75
22
TN
G26
22
LB
13
1
9
HALO LAMP DRIVER
LEFT DOOR AJAR SWITCH SENSE
KEY-IN SWITCH SENSE
INTEGRATED ELECTRONIC MODULE (BASE CTM)
(8W-45-6)
(8W-45-3)
BATT A0
(8W-10-8)
POWER DISTRIBUTION CENTER
(8W-10-8)
FUSE
10
50A
FUSE
2
30A
A1
10
RD
44 C134
A1
10
RD
7 C1
A2
14
PK/BK
1
JOINT CONNECTOR NO. 2 (IN PDC)
(8W-10-10)
3
A2
14
PK/BK
50 C134
A2
14
PK/BK
4 C1
IGNITION SWITCH
1 START
2 RUN
0 OFF
3 ACC
2 C1
1 C1
6 C1
5 C1
A21
10
DB
ST-RUN A21
(8W-12-6)
A41
14
YL
51 C134
A41
14
YL
ST A41
(8W-21-2)
A31
10
BK/WT
RUN-ACC A31
(8W-12-6)
A22
14
BK/OR
RUN A22
(8W-12-6)

Mopar AUTHENTIC RESTORATION PRODUCT



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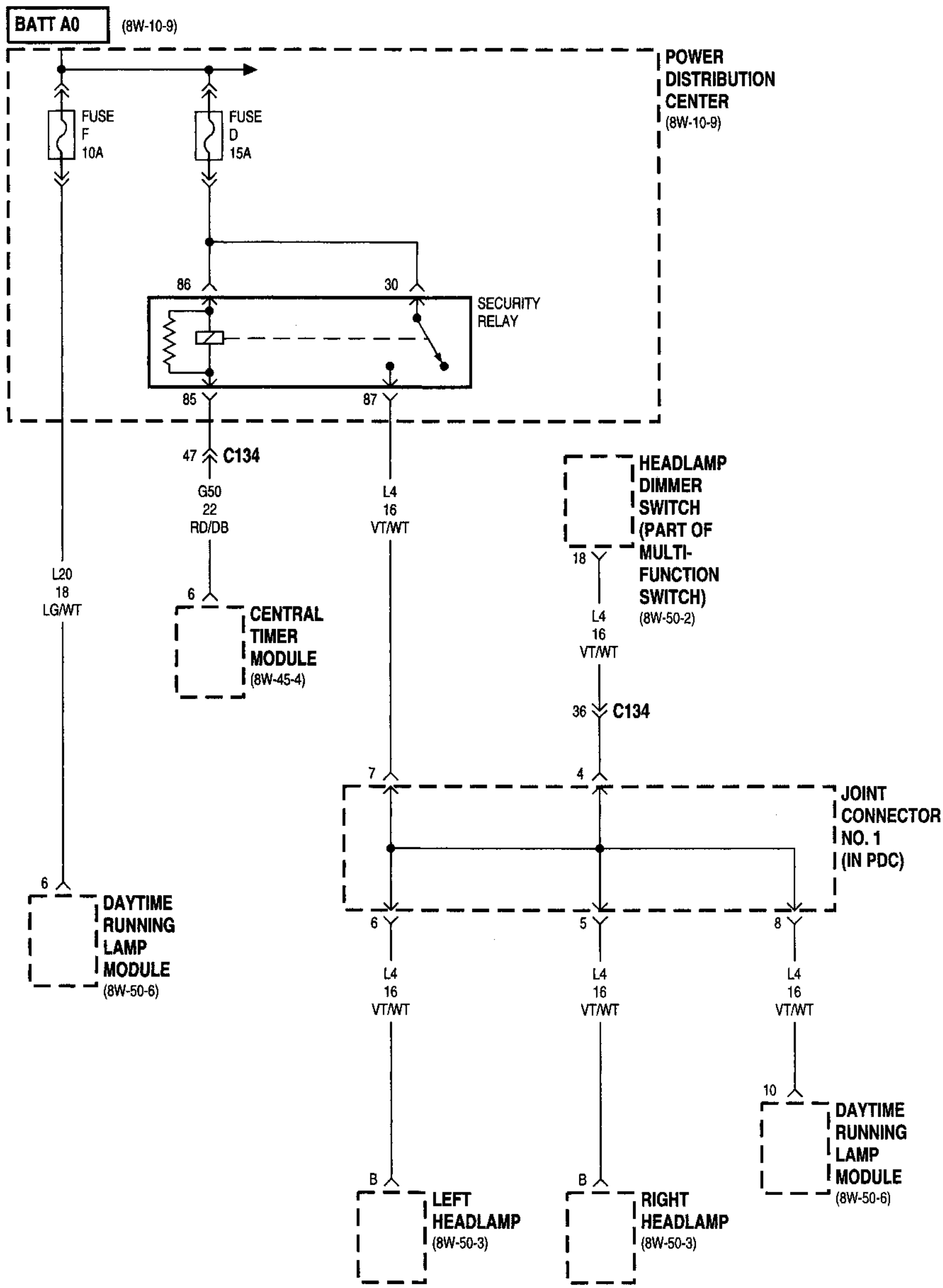

BATT A0
(8W-10-9)
POWER DISTRIBUTION CENTER
(8W-10-9)
FUSE F 10A
FUSE D 15A
86
30
SECURITY RELAY
85
87
47
C134
G50 22 RD/DB
L4 16 VT/WT
L20 18 LG/WT
6
CENTRAL TIMER MODULE
(8W-45-4)
HEADLAMP DIMMER SWITCH (PART OF MULTI-FUNCTION SWITCH)
(8W-50-2)
18
L4 16 VT/WT
36
C134
7
4
JOINT CONNECTOR NO. 1 (IN PDC)
6
DAYTIME RUNNING LAMP MODULE
(8W-50-6)
6
5
8
L4 16 VT/WT
L4 16 VT/WT
L4 16 VT/WT
10
DAYTIME RUNNING LAMP MODULE
(8W-50-6)
B
LEFT HEADLAMP
(8W-50-3)
B
RIGHT HEADLAMP
(8W-50-3)

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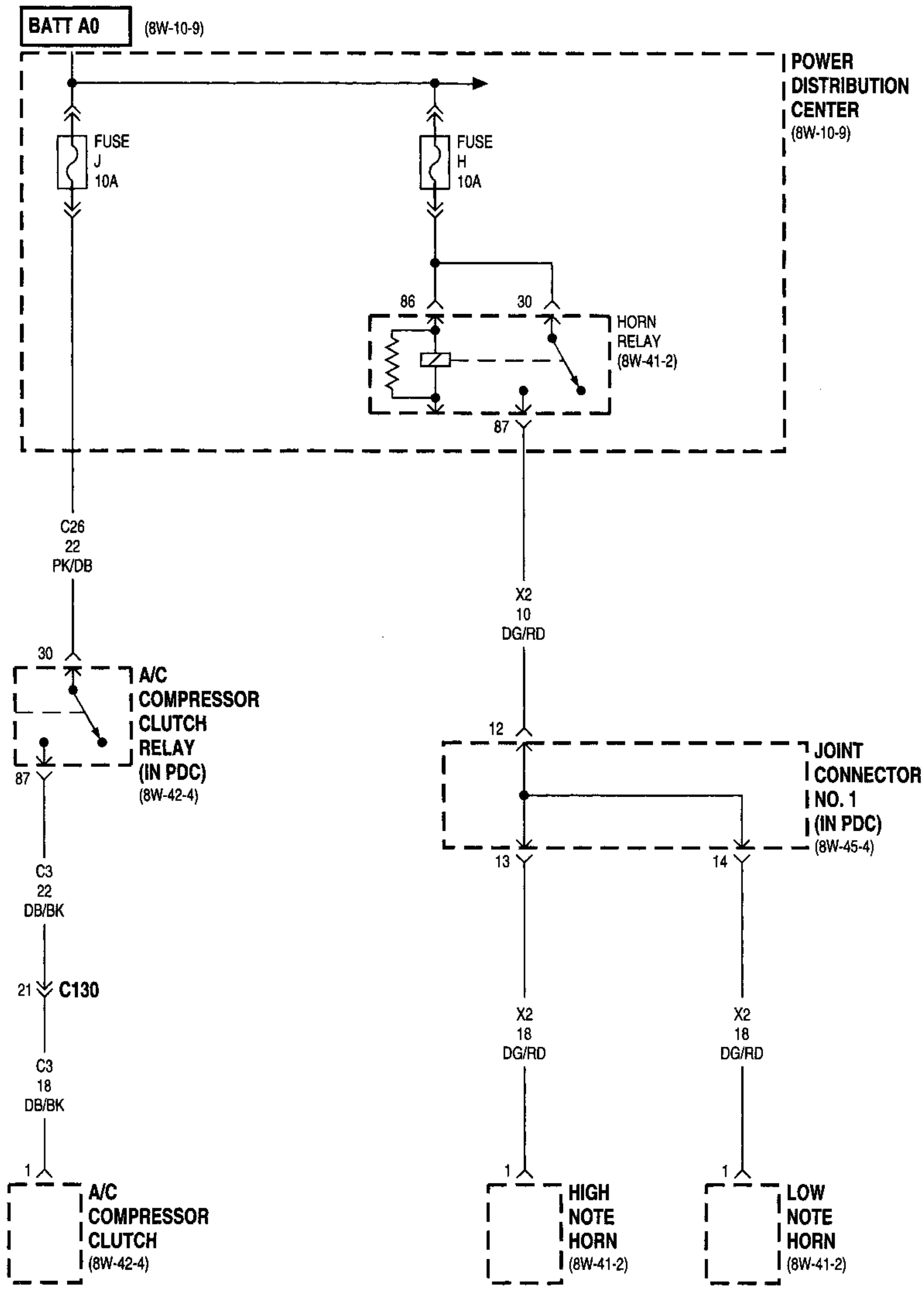
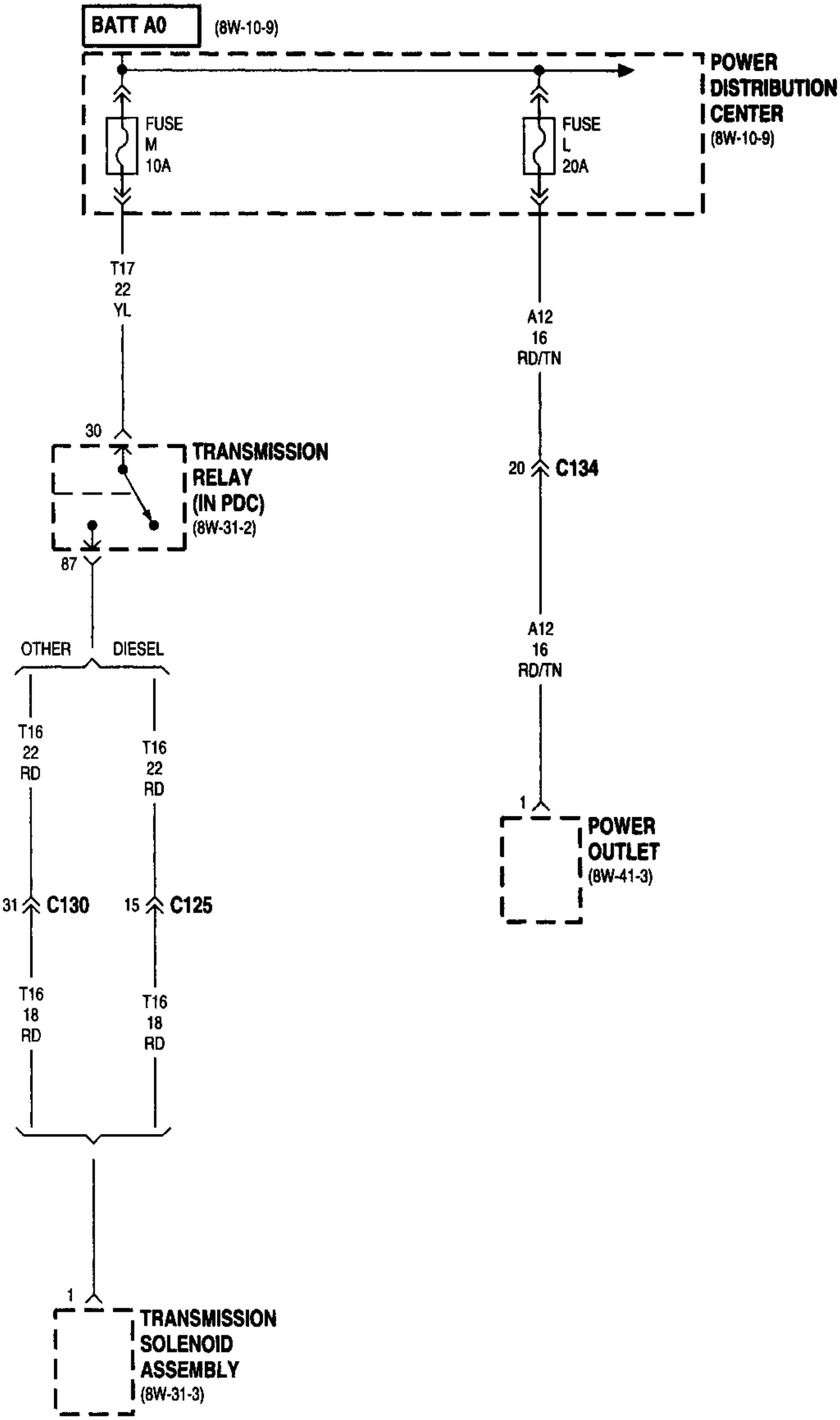
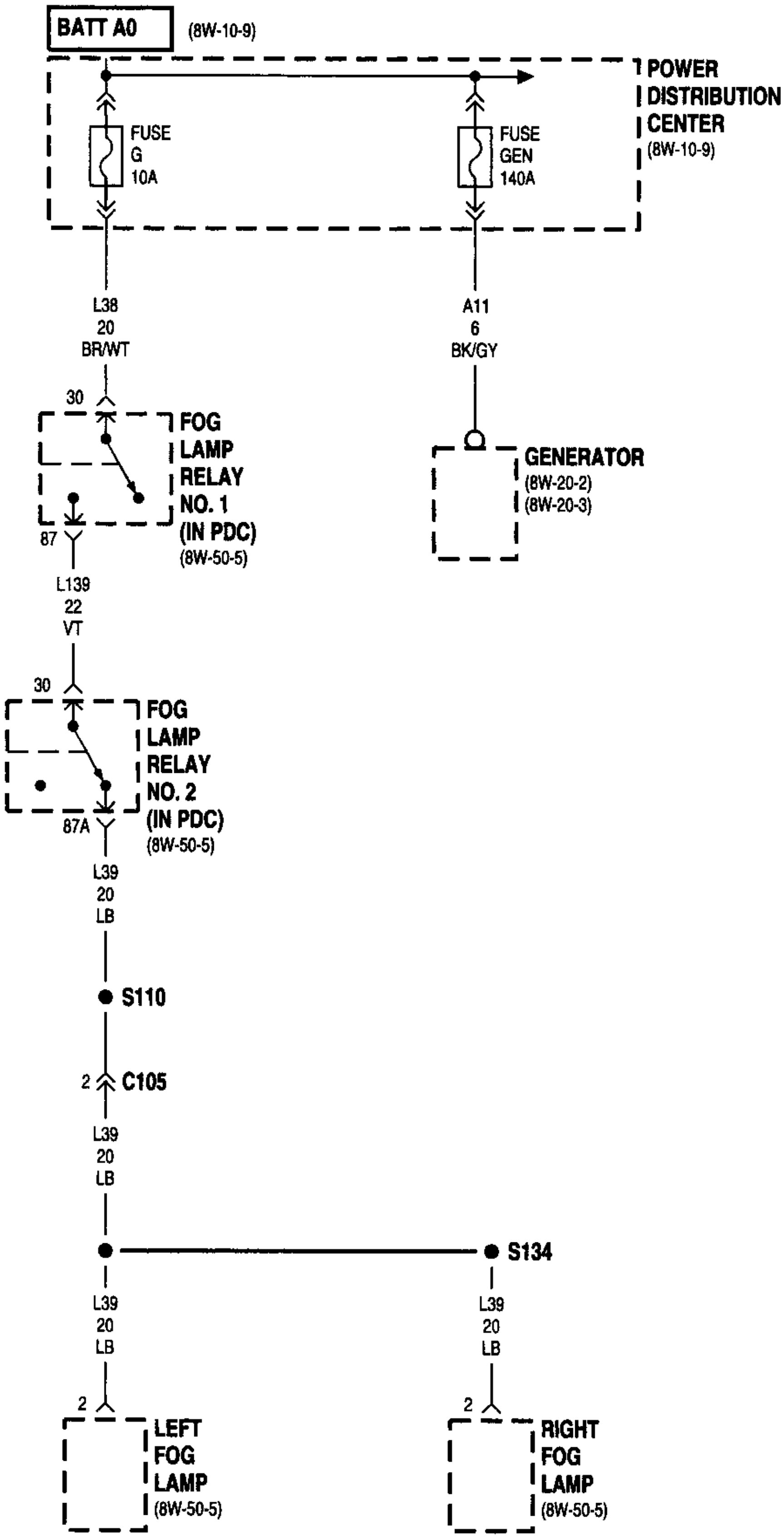

BATT A0
(8W-10-9)
POWER DISTRIBUTION CENTER
(8W-10-9)
FUSE J 10A
FUSE H 10A
86
30
HORN RELAY
(8W-41-2)
87
C26
22
PK/DB
X2
10
DG/RD
30
A/C COMPRESSOR CLUTCH RELAY (IN PDC)
(8W-42-4)
87
12
JOINT CONNECTOR NO. 1 (IN PDC)
(8W-45-4)
13
14
C3
22
DB/BK
21
C130
C3
18
DB/BK
X2
18
DG/RD
X2
18
DG/RD
1
A/C COMPRESSOR CLUTCH
(8W-42-4)
1
HIGH NOTE HORN
(8W-41-2)
1
LOW NOTE HORN
(8W-41-2)


BATT A0
(8W-10-9)
POWER DISTRIBUTION CENTER
(8W-10-9)
FUSE M 10A
FUSE L 20A
T17 22 YL
A12 16 RD/TN
30
TRANSMISSION RELAY (IN PDC)
(8W-31-2)
87
20 C134
A12 16 RD/TN
OTHER
DIESEL
T16 22 RD
T16 22 RD
1
POWER OUTLET
(8W-41-3)
31 C130
15 C125
T16 18 RD
T16 18 RD
1
TRANSMISSION SOLENOID ASSEMBLY
(8W-31-3)


BATT A0
(8W-10-9)
POWER DISTRIBUTION CENTER
(8W-10-9)
FUSE G 10A
FUSE GEN 140A
L38 20 BR/WT
A11 6 BK/GY
30
FOG LAMP RELAY NO. 1 (IN PDC)
(8W-50-5)
87
GENERATOR
(8W-20-2)
(8W-20-3)
L139 22 VT
30
FOG LAMP RELAY NO. 2 (IN PDC)
(8W-50-5)
87A
L39 20 LB
S110
2 C105
L39 20 LB
S134
L39 20 LB
L39 20 LB
2
2
LEFT FOG LAMP
(8W-50-5)
RIGHT FOG LAMP
(8W-50-5)

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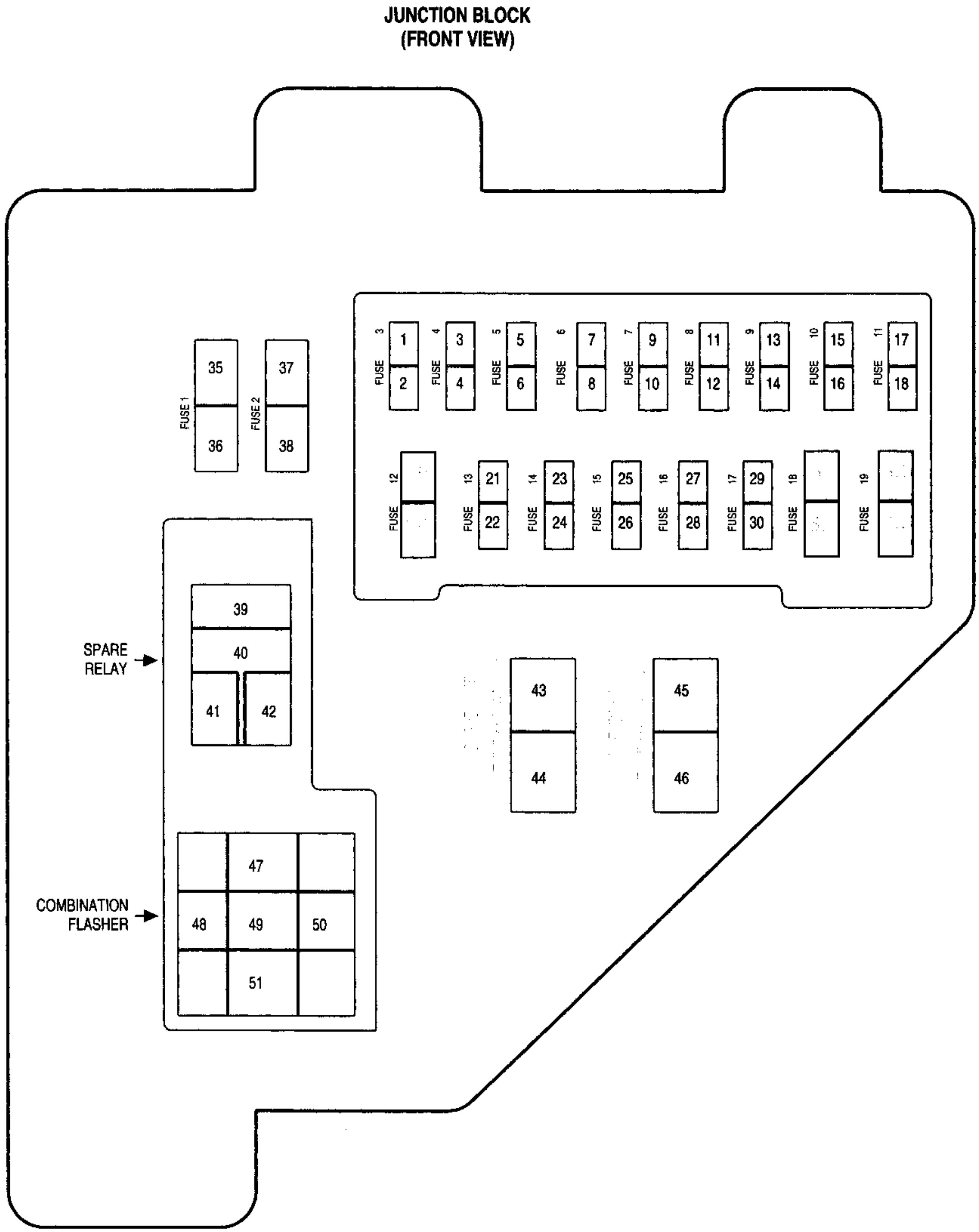
8W-12 JUNCTION BLOCK



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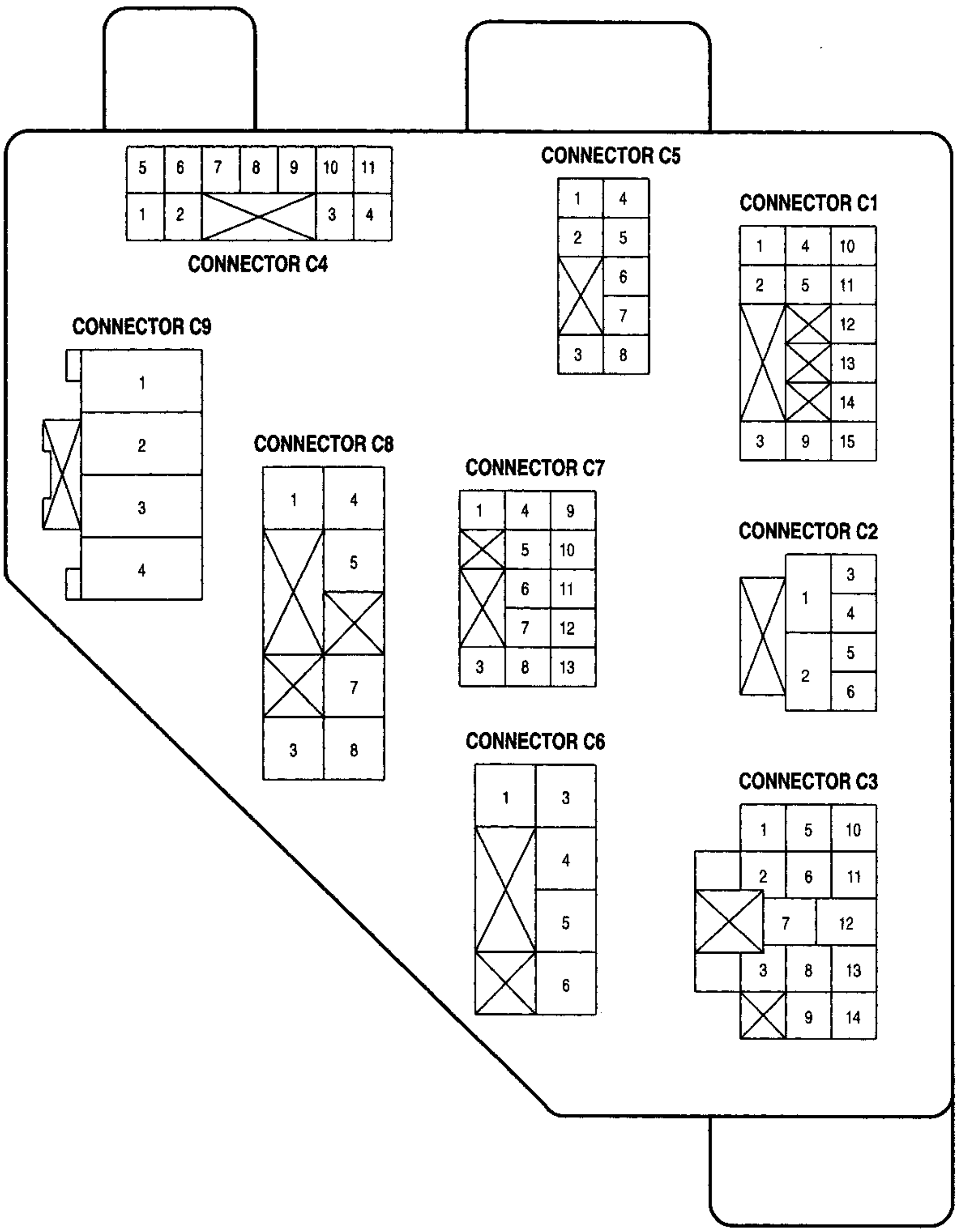
JUNCTION BLOCK
(REAR VIEW)



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FUSES

FUSE NO.	AMPS	FUSED CIRCUIT	FEED CIRCUIT
1	15A	F33	BATT A7
2	10A	F15	RUN A22
3	10A	A20	RUN A22
4	10A	X60	BATT A7
5	5A	E2	E1
6	25A	V6	RUN-ACC A31
7	10A	L10	RUN A22
8	10A	X12	RUN-ACC A31
9	10A	F18	ST-RUN A21
10	10A	COMBO. FLASHER	RUN-ACC A31
11	10A	F12	ST-RUN A21
12	10A	M1	BATT A7
13	10A	F35	BATT A7
14	10A	F73	BATT A7
15	20A	F30	RUN-ACC A31
16	10A	F13	RUN-ACC A31
17	10A	G5	ST-RUN A21
18	10A	F23	RUN A22
19	10A	F14	ST-RUN A21

CIRCUIT BREAKERS

C.B. NO.	AMPS	FUSED CIRCUIT	FEED CIRCUIT
C.B.1	20A	F21	RUN A22
C.B.2	20A	F37	BATT A7

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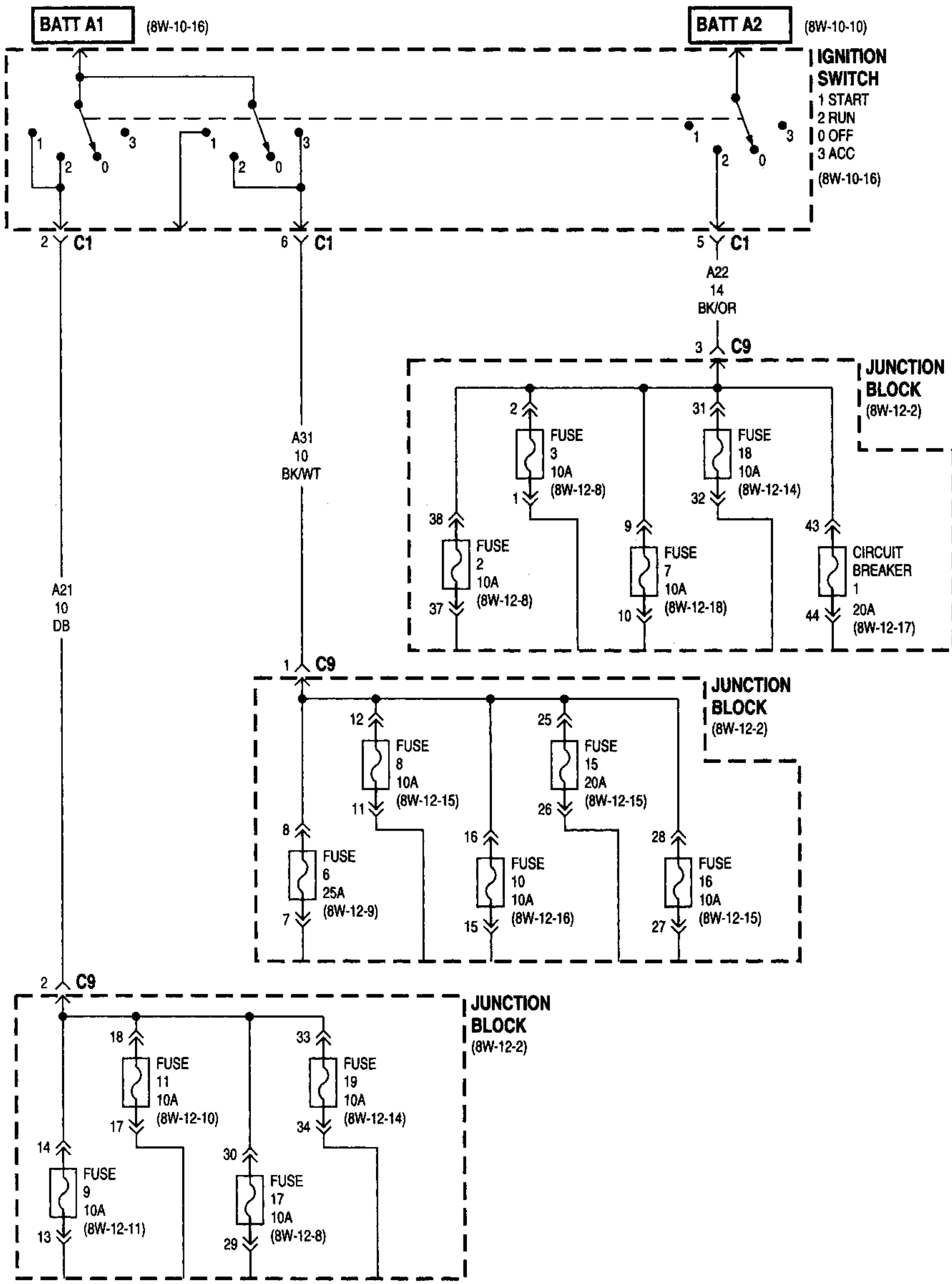
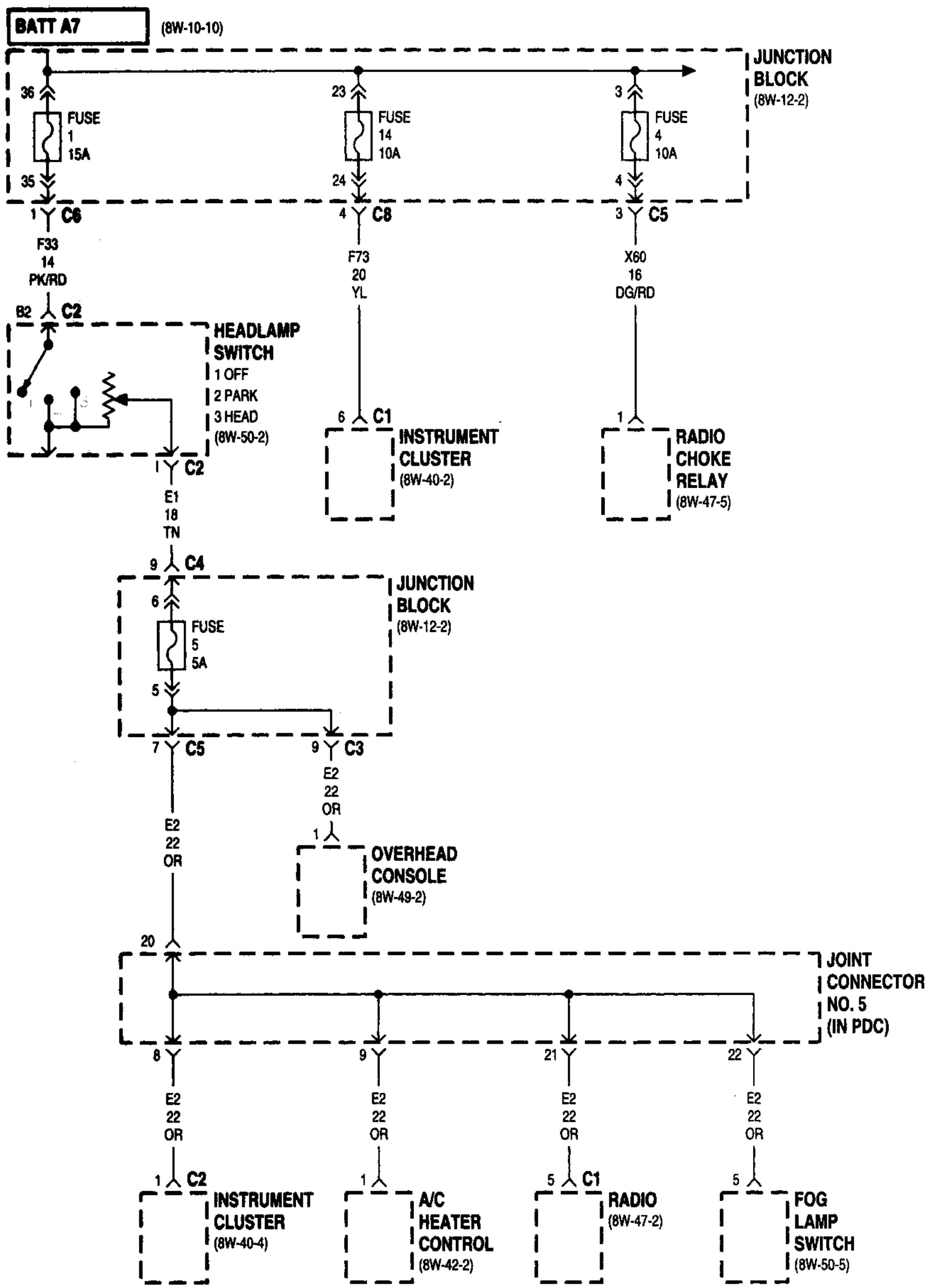
SPARE RELAY

CAV	CIRCUIT	FUNCTION
39	F33	FUSED B(+)
40	-	-
41	-	-
42	-	-

COMBINATION FLASHER

CAV	CIRCUIT	FUNCTION
47	L6	TURN SWITCH
48	L9	BATTERY
49	L19	HAZARD SWITCH
50	Z3	GROUND
	Z3	GROUND
51	L5	FUSED IGN. (RUN-ACC)


BATT A1
(8W-10-16)
BATT A2
(8W-10-10)
IGNITION SWITCH
1 START
2 RUN
0 OFF
3 ACC
(8W-10-16)
2 C1
6 C1
5 C1
A22
14
BK/OR
3 C9
JUNCTION BLOCK
(8W-12-2)
FUSE 3 10A (8W-12-8)
FUSE 18 10A (8W-12-14)
FUSE 2 10A (8W-12-8)
FUSE 7 10A (8W-12-18)
CIRCUIT BREAKER 1 20A (8W-12-17)
A31
10
BK/WT
A21
10
DB
1 C9
JUNCTION BLOCK
(8W-12-2)
FUSE 8 10A (8W-12-15)
FUSE 15 20A (8W-12-15)
FUSE 6 25A (8W-12-9)
FUSE 10 10A (8W-12-16)
FUSE 16 10A (8W-12-15)
2 C9
JUNCTION BLOCK
(8W-12-2)
FUSE 11 10A (8W-12-10)
FUSE 19 10A (8W-12-14)
FUSE 9 10A (8W-12-11)
FUSE 17 10A (8W-12-8)


BATT A7
(8W-10-10)
JUNCTION BLOCK
(8W-12-2)
36
FUSE 1 15A
35
23
FUSE 14 10A
24
3
FUSE 4 10A
4
1 C6
4 C8
3 C5
F33 14 PK/RD
F73 20 YL
X60 16 DG/RD
B2 C2
HEADLAMP SWITCH
1 OFF
2 PARK
3 HEAD
(8W-50-2)
6 C1
INSTRUMENT CLUSTER
(8W-40-2)
1
RADIO CHOKE RELAY
(8W-47-5)
1 C2
E1 18 TN
9 C4
JUNCTION BLOCK
(8W-12-2)
6
FUSE 5 5A
5
7 C5
9 C3
E2 22 OR
1
OVERHEAD CONSOLE
(8W-49-2)
E2 22 OR
20
JOINT CONNECTOR NO. 5 (IN PDC)
8
9
21
22
E2 22 OR
E2 22 OR
E2 22 OR
E2 22 OR
1 C2
INSTRUMENT CLUSTER
(8W-40-4)
1
A/C HEATER CONTROL
(8W-42-2)
5 C1
RADIO
(8W-47-2)
5
FOG LAMP SWITCH
(8W-50-5)

J988W-9

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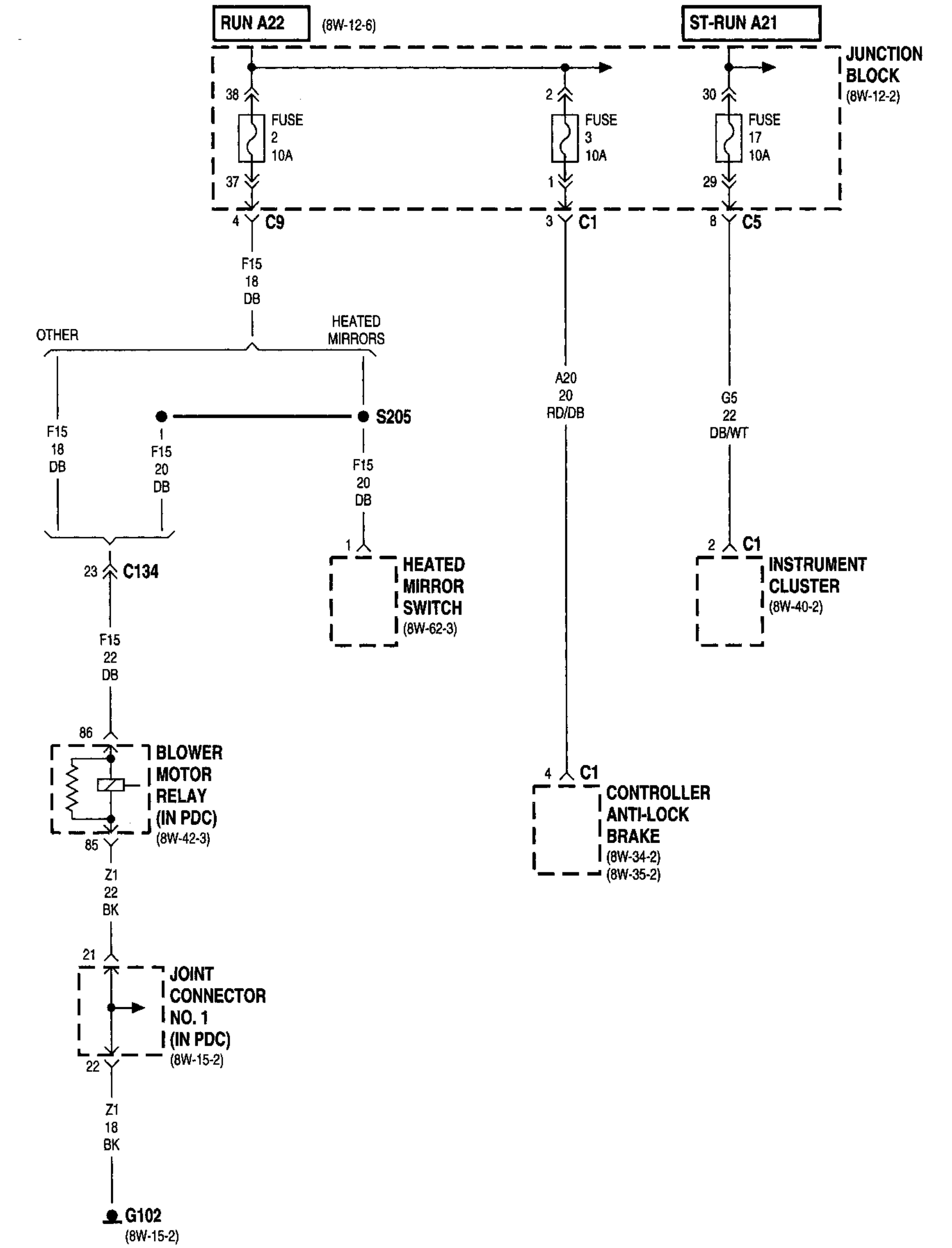
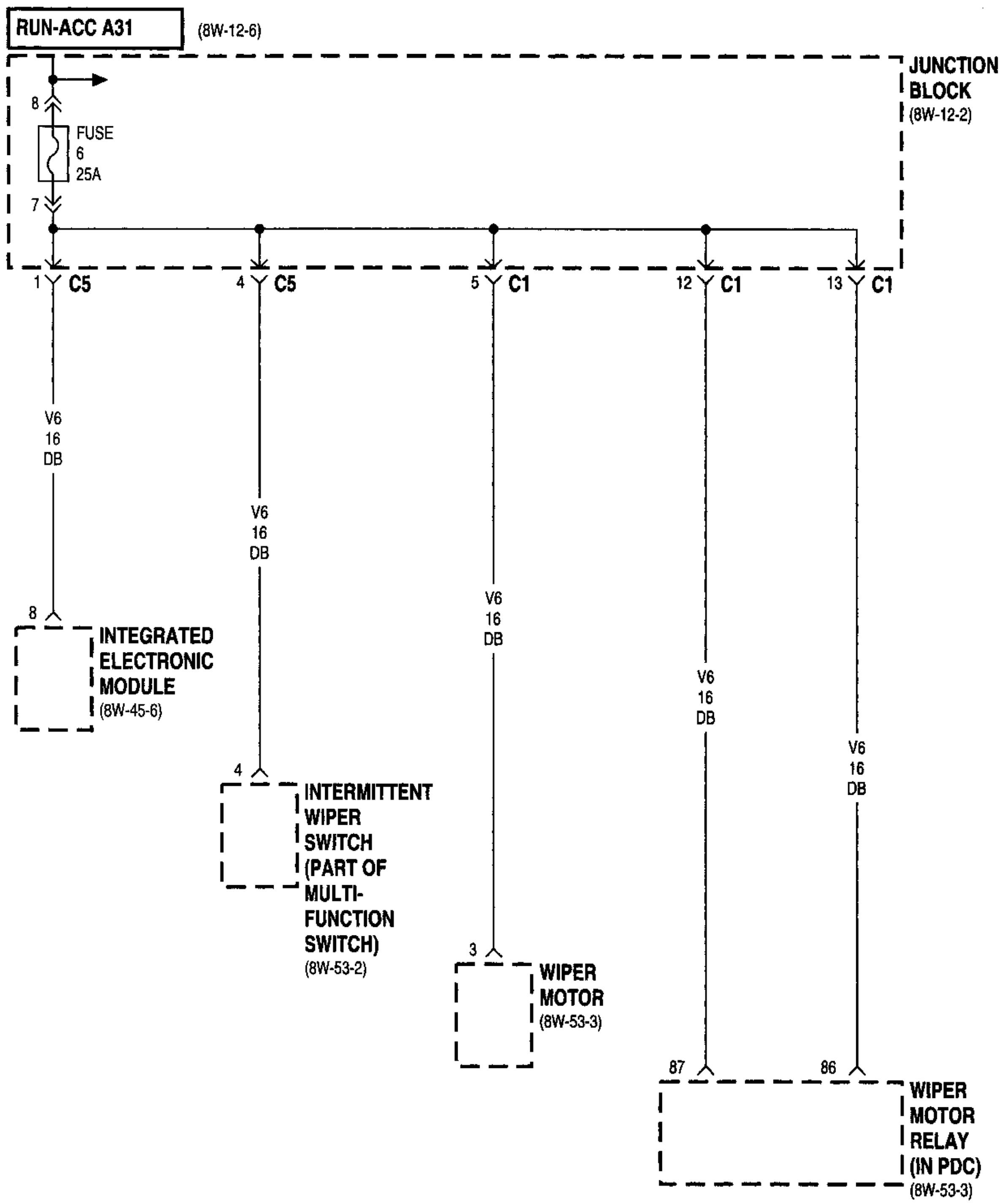
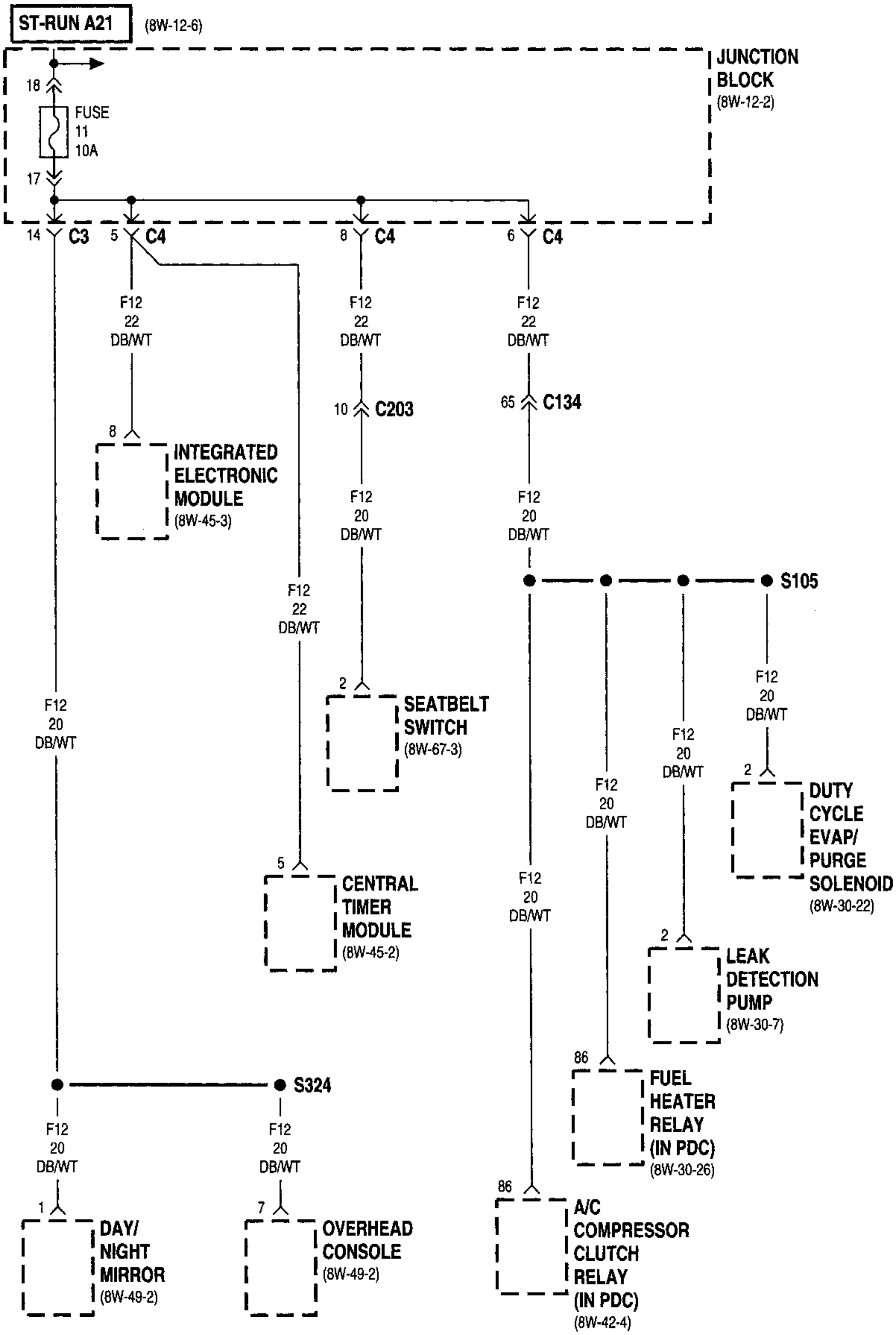
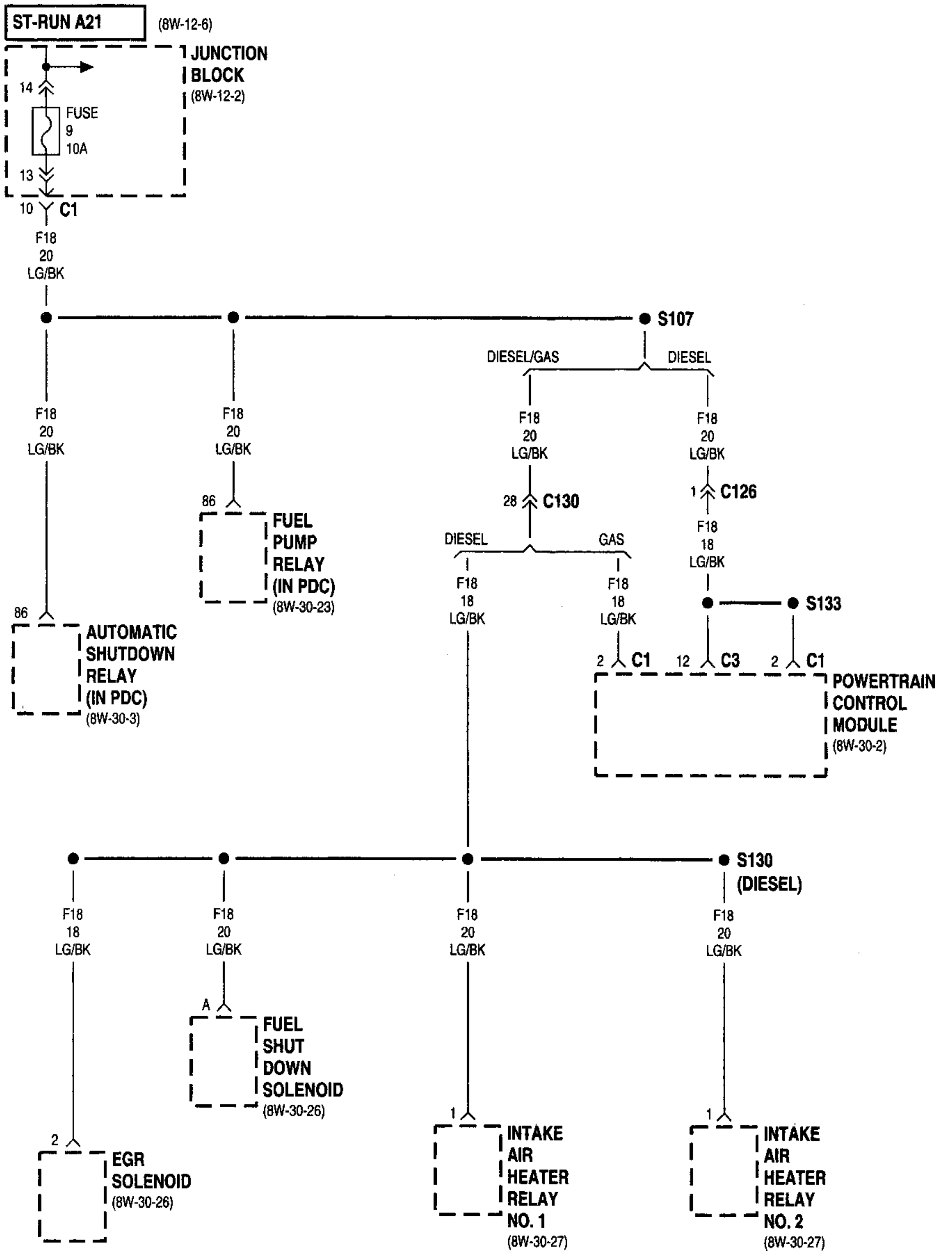


Mopar AUTHENTIC RESTORATION PRODUCT




ST-RUN A21
(8W-12-6)
JUNCTION BLOCK
(8W-12-2)
18
FUSE
11
10A
17
14 C3
5 C4
8 C4
6 C4
F12
22
DB/WT
8
INTEGRATED ELECTRONIC MODULE
(8W-45-3)
10 C203
65 C134
F12
20
DB/WT
S105
2
SEATBELT SWITCH
(8W-67-3)
5
CENTRAL TIMER MODULE
(8W-45-2)
DUTY CYCLE EVAP/ PURGE SOLENOID
(8W-30-22)
LEAK DETECTION PUMP
(8W-30-7)
86
FUEL HEATER RELAY (IN PDC)
(8W-30-26)
A/C COMPRESSOR CLUTCH RELAY (IN PDC)
(8W-42-4)
S324
1
DAY/ NIGHT MIRROR
(8W-49-2)
7
OVERHEAD CONSOLE
(8W-49-2)


ST-RUN A21
(8W-12-6)
JUNCTION BLOCK
(8W-12-2)
14
FUSE
9
10A
13
10
C1
F18
20
LG/BK
S107
DIESEL/GAS
DIESEL
F18
20
LG/BK
86
FUEL PUMP RELAY (IN PDC)
(8W-30-23)
28
C130
1
C126
F18
18
LG/BK
DIESEL
GAS
S133
2
C1
12
C3
2
C1
86
AUTOMATIC SHUTDOWN RELAY (IN PDC)
(8W-30-3)
POWERTRAIN CONTROL MODULE
(8W-30-2)
S130
(DIESEL)
A
FUEL SHUT DOWN SOLENOID
(8W-30-26)
2
EGR SOLENOID
(8W-30-26)
1
INTAKE AIR HEATER RELAY NO. 1
(8W-30-27)
1
INTAKE AIR HEATER RELAY NO. 2
(8W-30-27)

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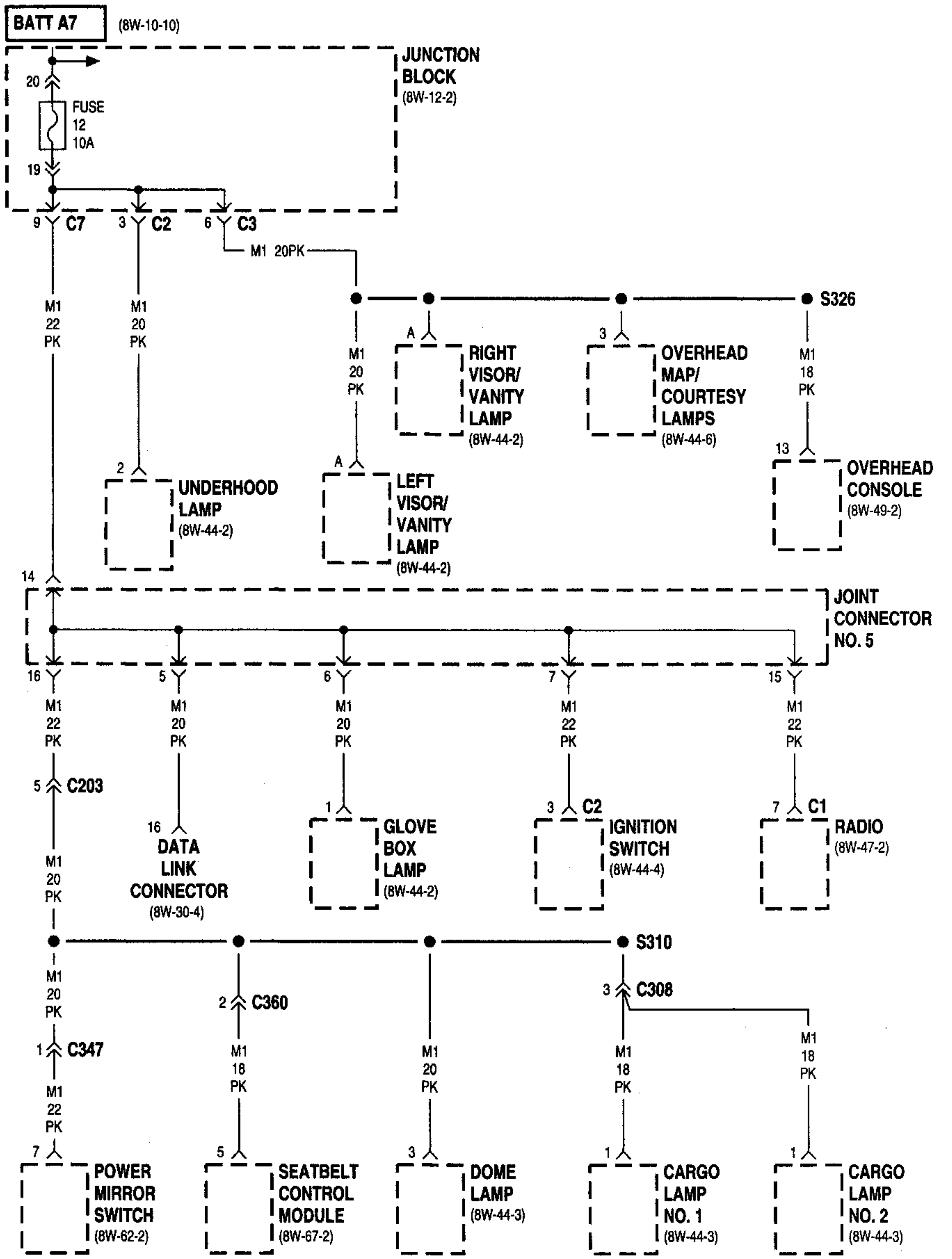
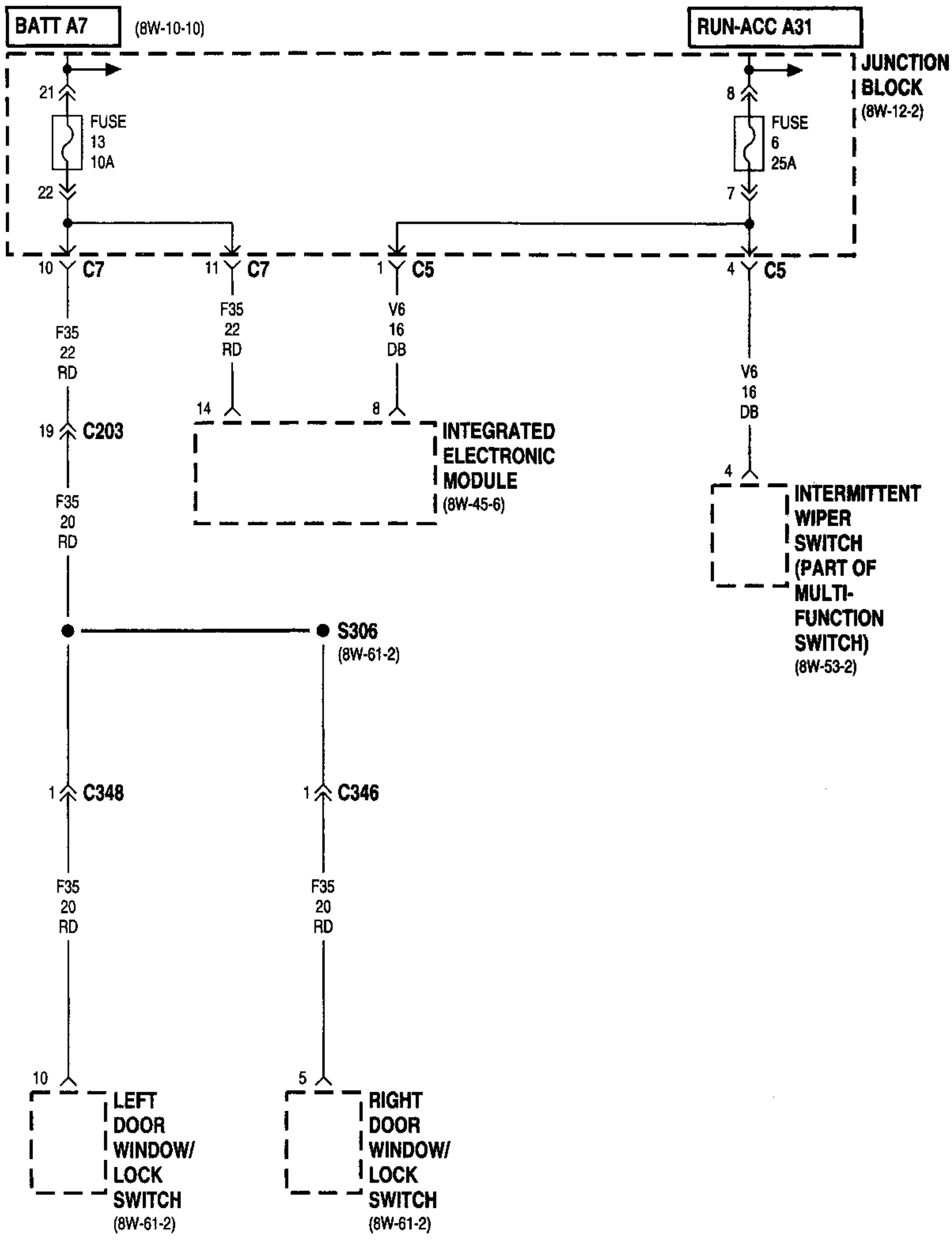
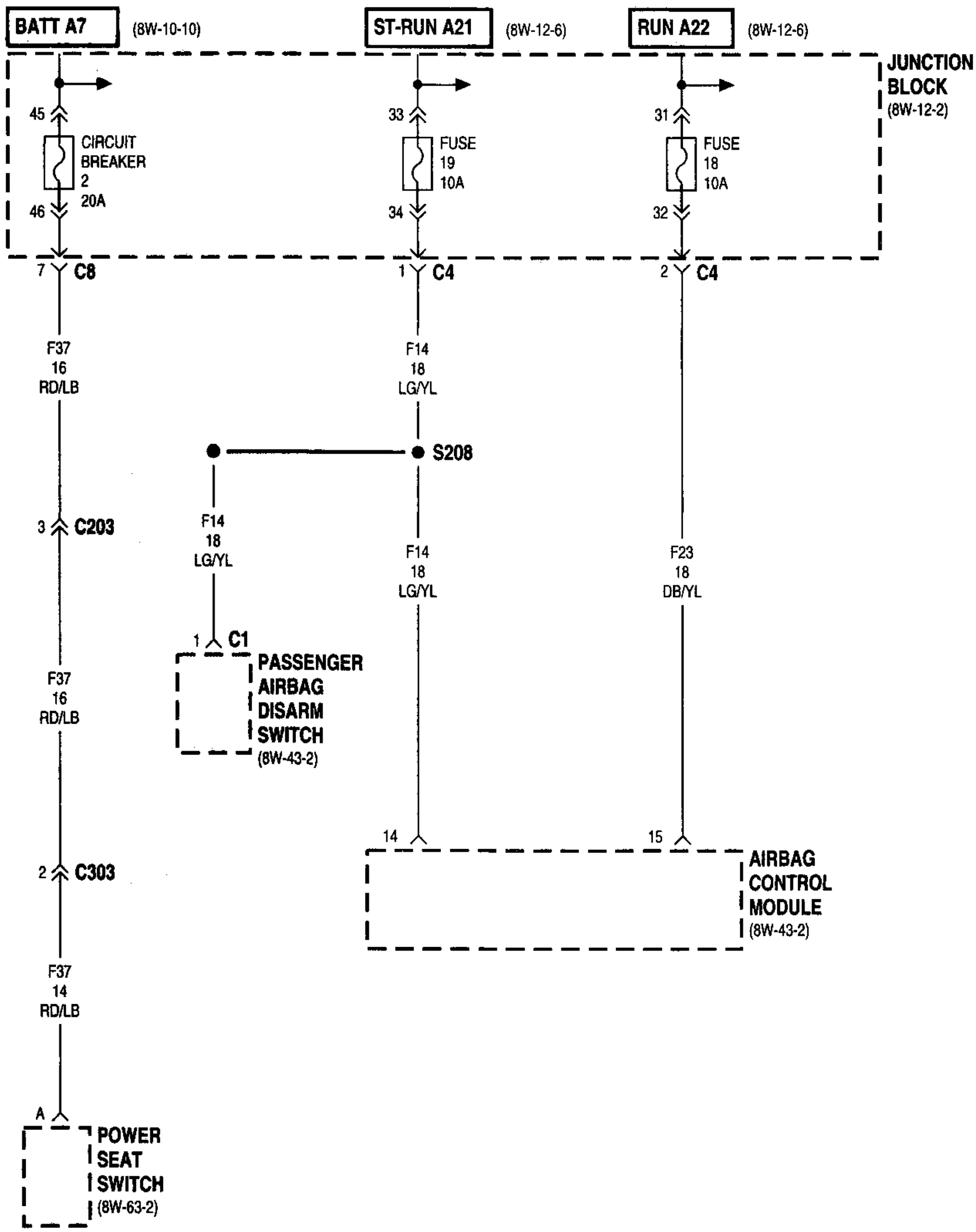
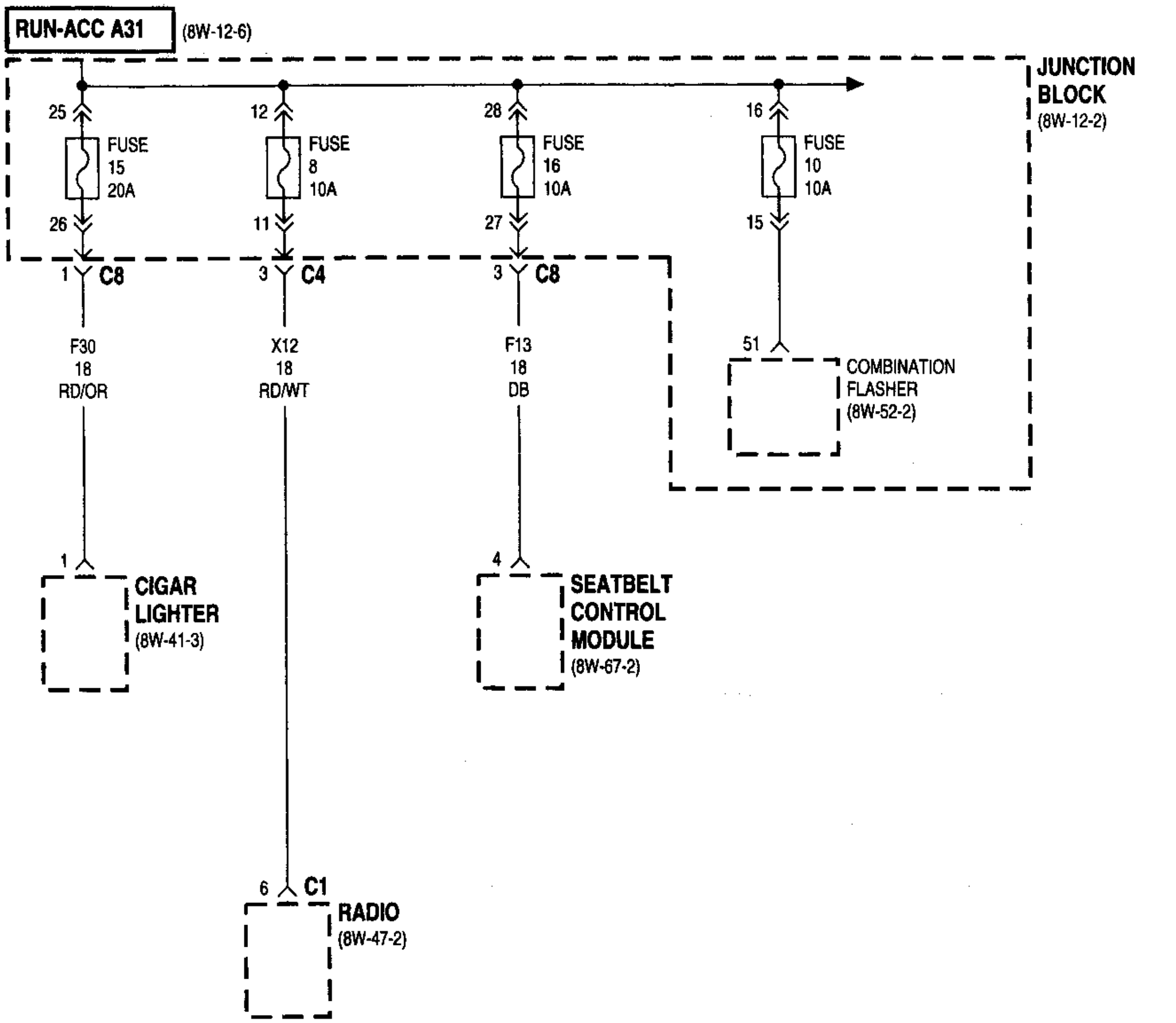
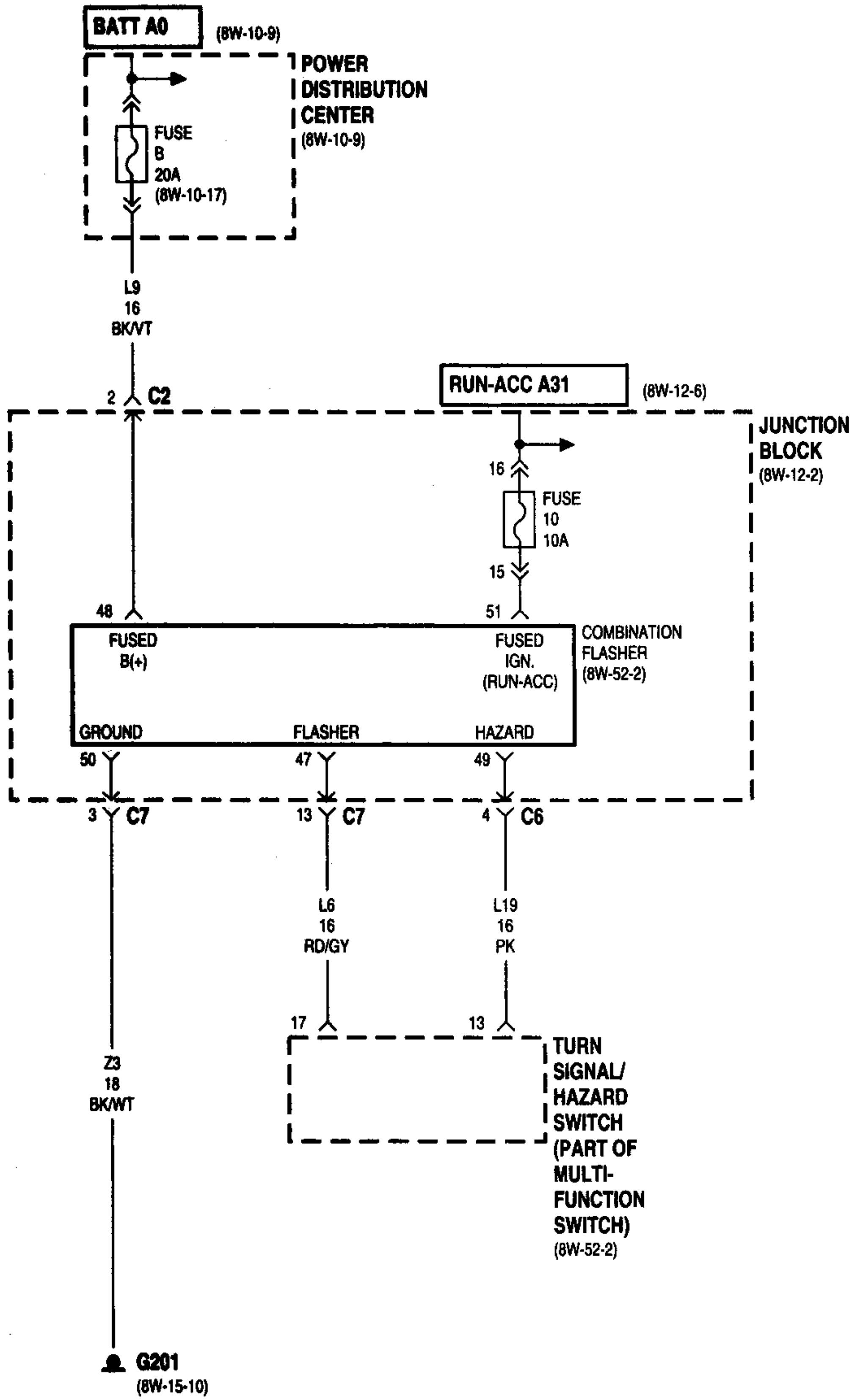



BATT A7
(8W-10-10)
RUN-ACC A31
JUNCTION BLOCK
(8W-12-2)
21
FUSE 13 10A
22
8
FUSE 6 25A
7
10 C7
11 C7
1 C5
4 C5
F35 22 RD
F35 22 RD
V6 16 DB
V6 16 DB
19 C203
14
8
INTEGRATED ELECTRONIC MODULE
(8W-45-6)
4
INTERMITTENT WIPER SWITCH (PART OF MULTI-FUNCTION SWITCH)
(8W-53-2)
F35 20 RD
S306
(8W-61-2)
1 C348
1 C346
F35 20 RD
F35 20 RD
10
5
LEFT DOOR WINDOW/ LOCK SWITCH
(8W-61-2)
RIGHT DOOR WINDOW/ LOCK SWITCH
(8W-61-2)

AUTHENTIC RESTORATION PRODUCT

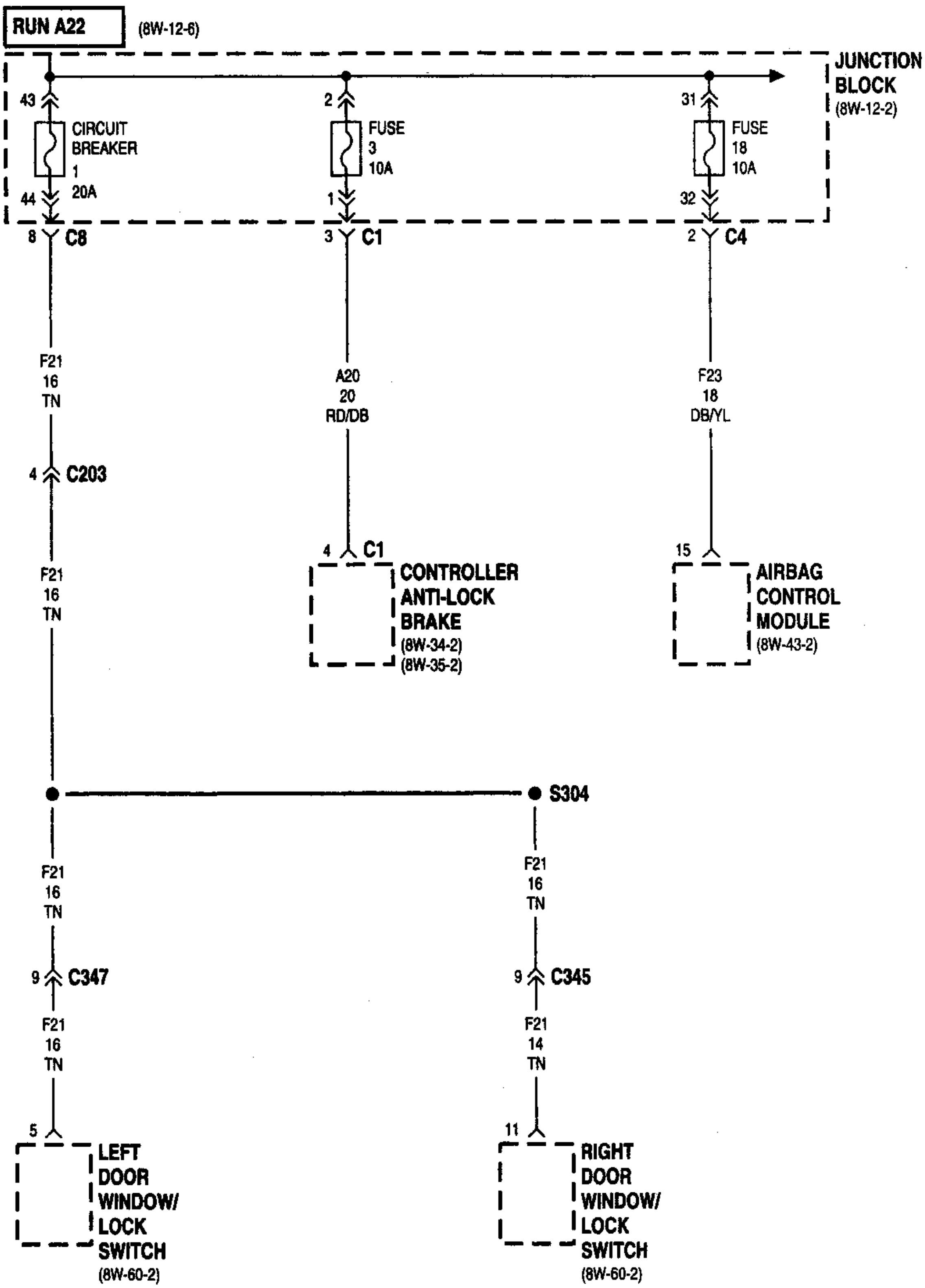


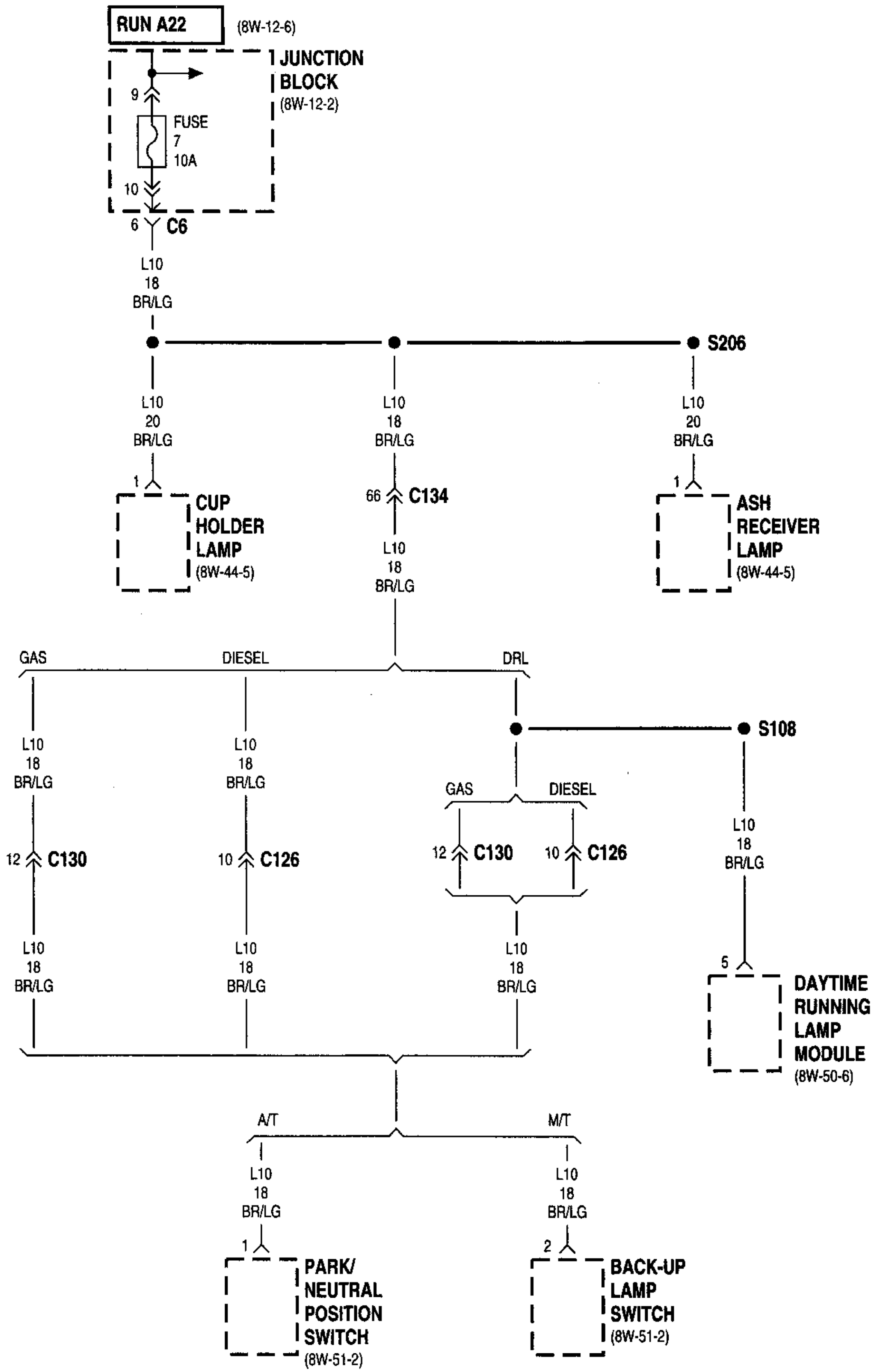

RUN-ACC A31
(8W-12-6)
JUNCTION BLOCK
(8W-12-2)
25
FUSE
15
20A
26
12
FUSE
8
10A
11
28
FUSE
16
10A
27
16
FUSE
10
10A
15
1 C8
3 C4
3 C8
F30
18
RD/OR
X12
18
RD/WT
F13
18
DB
51
COMBINATION FLASHER
(8W-52-2)
1
CIGAR LIGHTER
(8W-41-3)
4
SEATBELT CONTROL MODULE
(8W-67-2)
6 C1
RADIO
(8W-47-2)



BATT A0
(8W-10-9)
POWER DISTRIBUTION CENTER
(8W-10-9)
FUSE
B
20A
(8W-10-17)
L9
16
BK/VT
2
C2
RUN-ACC A31
(8W-12-6)
JUNCTION BLOCK
(8W-12-2)
16
FUSE
10
10A
15
48
51
FUSED
B(+)
FUSED
IGN.
(RUN-ACC)
COMBINATION FLASHER
(8W-52-2)
GROUND
FLASHER
HAZARD
50
47
49
3
C7
13
C7
4
C6
L6
16
RD/GY
L19
16
PK
17
13
TURN SIGNAL/ HAZARD SWITCH (PART OF MULTI-FUNCTION SWITCH)
(8W-52-2)
Z3
18
BK/WT
G201
(8W-15-10)

AUTHENTIC RESTORATION PRODUCT




RUN A22
(8W-12-6)
JUNCTION BLOCK
(8W-12-2)
9
FUSE
7
10A
10
6
C6
L10
18
BR/LG
S206
L10
20
BR/LG
L10
18
BR/LG
L10
20
BR/LG
1
CUP HOLDER LAMP
(8W-44-5)
66
C134
1
ASH RECEIVER LAMP
(8W-44-5)
L10
18
BR/LG
GAS
DIESEL
DRL
L10
18
BR/LG
L10
18
BR/LG
S108
GAS
DIESEL
L10
18
BR/LG
12
C130
10
C126
12
C130
10
C126
L10
18
BR/LG
L10
18
BR/LG
L10
18
BR/LG
5
DAYTIME RUNNING LAMP MODULE
(8W-50-6)
A/T
M/T
L10
18
BR/LG
L10
18
BR/LG
1
PARK/ NEUTRAL POSITION SWITCH
(8W-51-2)
2
BACK-UP LAMP SWITCH
(8W-51-2)

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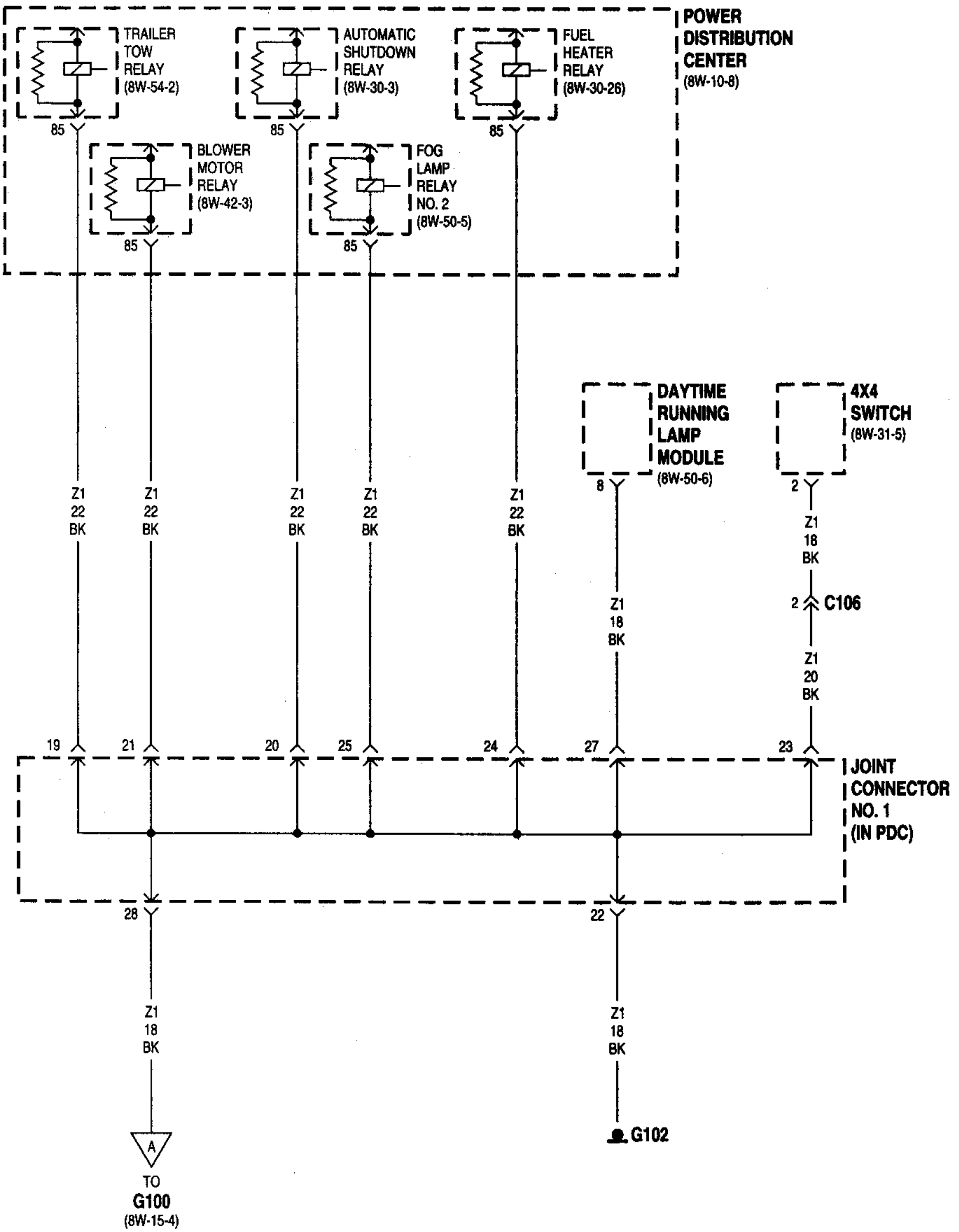
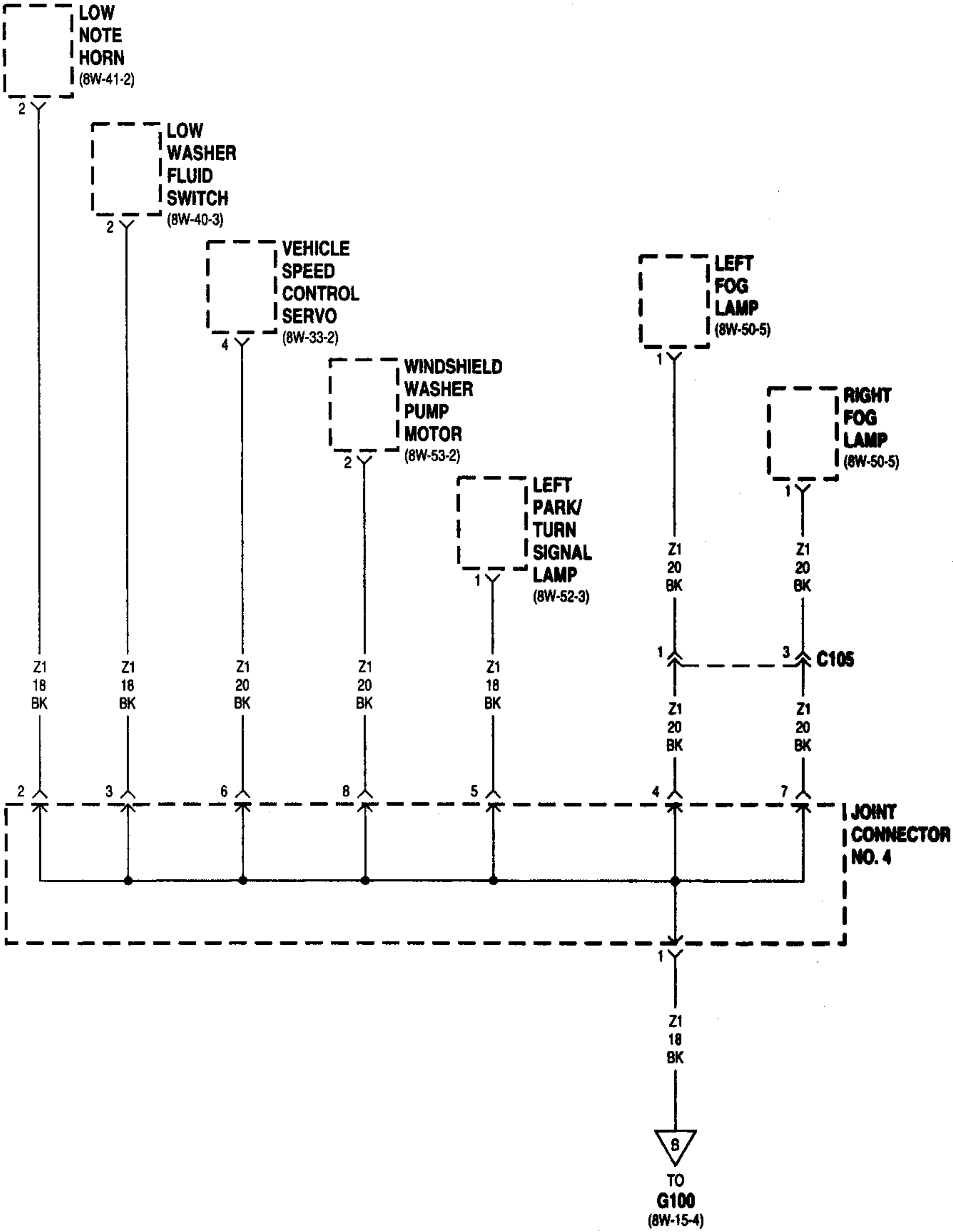
8W-15 GROUND DISTRIBUTION


TRAILER TOW RELAY (8W-54-2)
AUTOMATIC SHUTDOWN RELAY (8W-30-3)
FUEL HEATER RELAY (8W-30-26)
POWER DISTRIBUTION CENTER (8W-10-8)
BLOWER MOTOR RELAY (8W-42-3)
FOG LAMP RELAY NO. 2 (8W-50-5)
85
Z1 22 BK
DAYTIME RUNNING LAMP MODULE (8W-50-6)
4X4 SWITCH (8W-31-5)
Z1 18 BK
C106
Z1 20 BK
JOINT CONNECTOR NO. 1 (IN PDC)
19
21
20
25
24
27
23
28
22
A
TO G100 (8W-15-4)
G102


LOW NOTE HORN (8W-41-2)
LOW WASHER FLUID SWITCH (8W-40-3)
VEHICLE SPEED CONTROL SERVO (8W-33-2)
WINDSHIELD WASHER PUMP MOTOR (8W-53-2)
LEFT PARK/ TURN SIGNAL LAMP (8W-52-3)
LEFT FOG LAMP (8W-50-5)
RIGHT FOG LAMP (8W-50-5)
Z1 18 BK
Z1 20 BK
C105
JOINT CONNECTOR NO. 4
B
TO G100 (8W-15-4)

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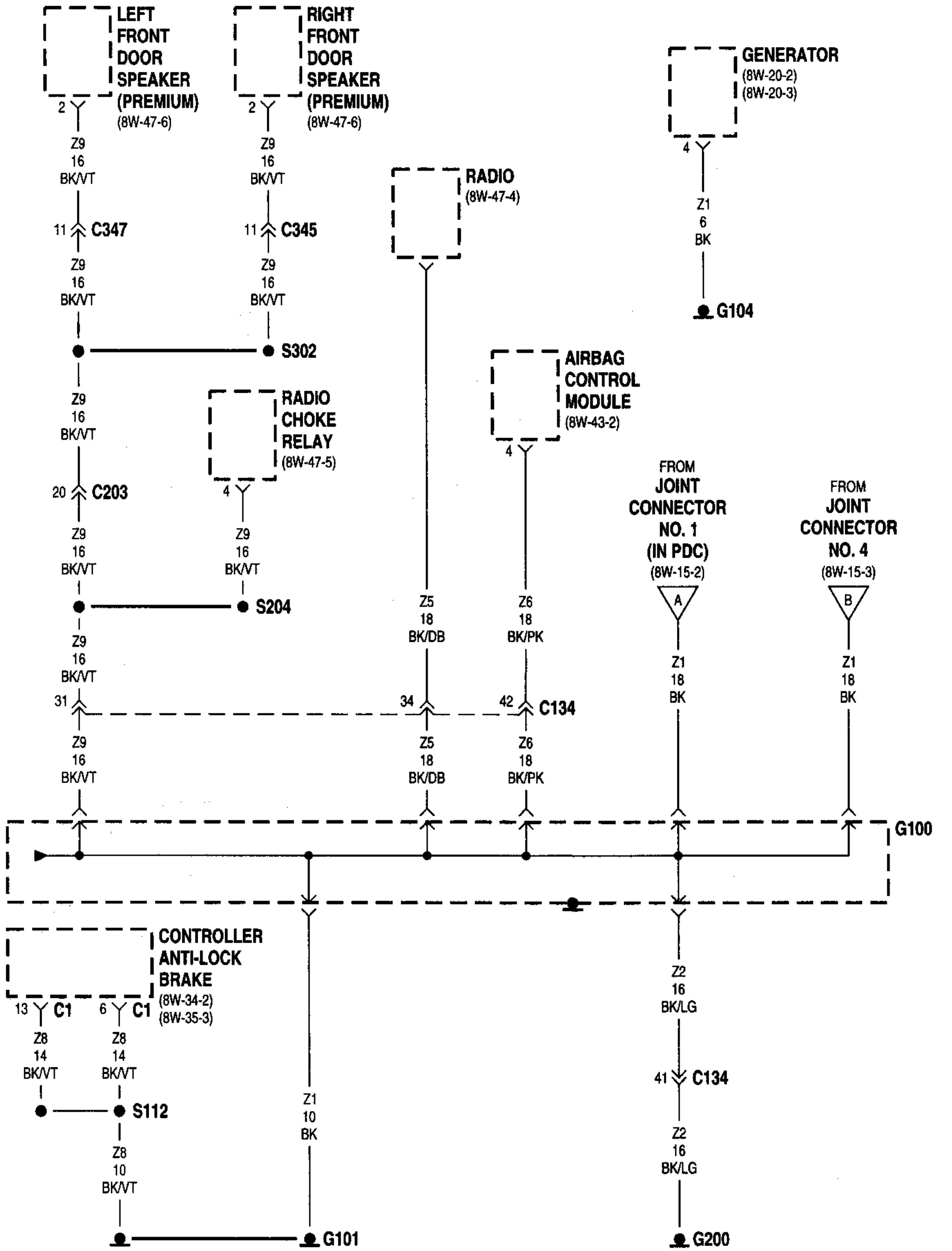
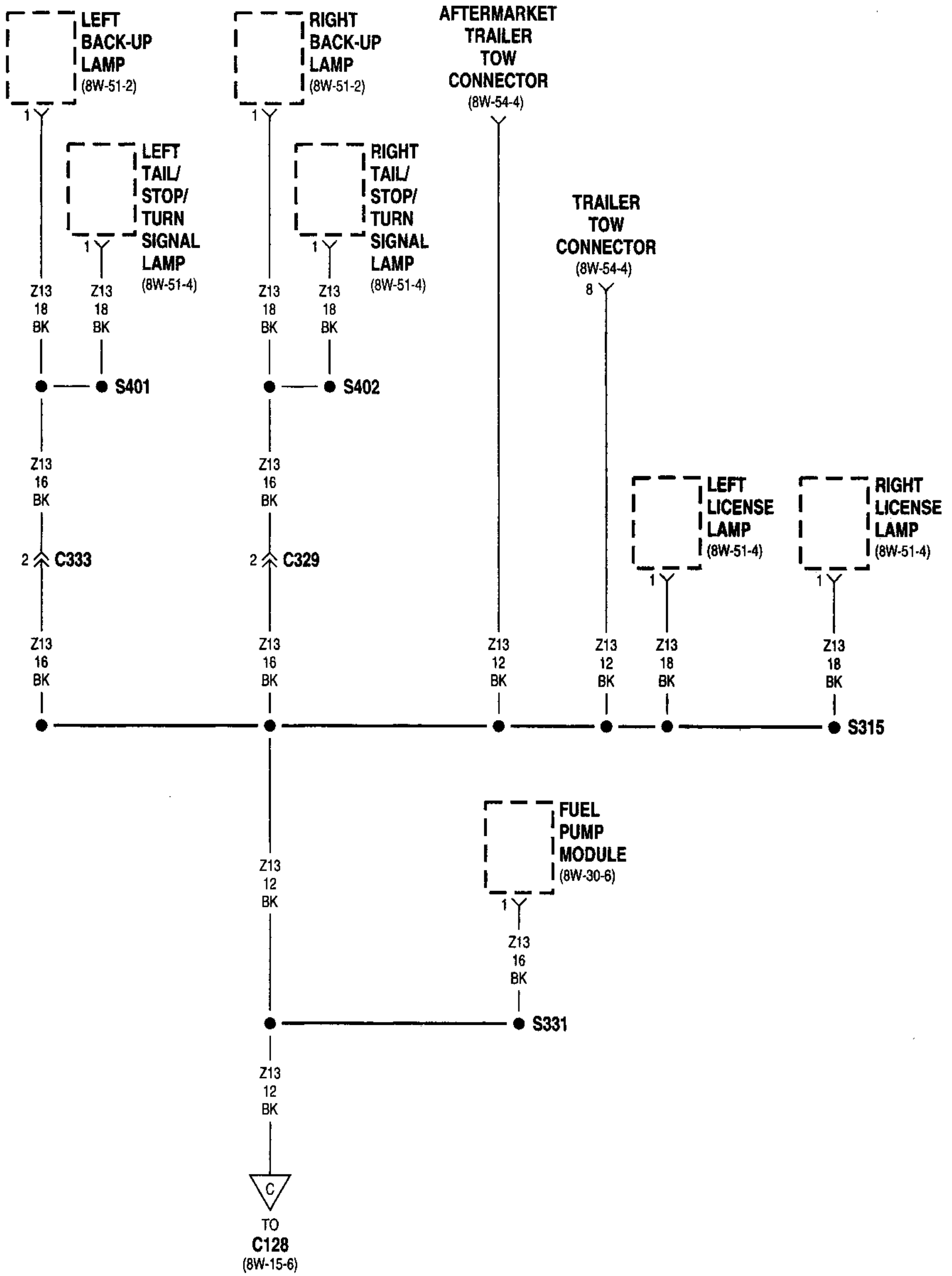
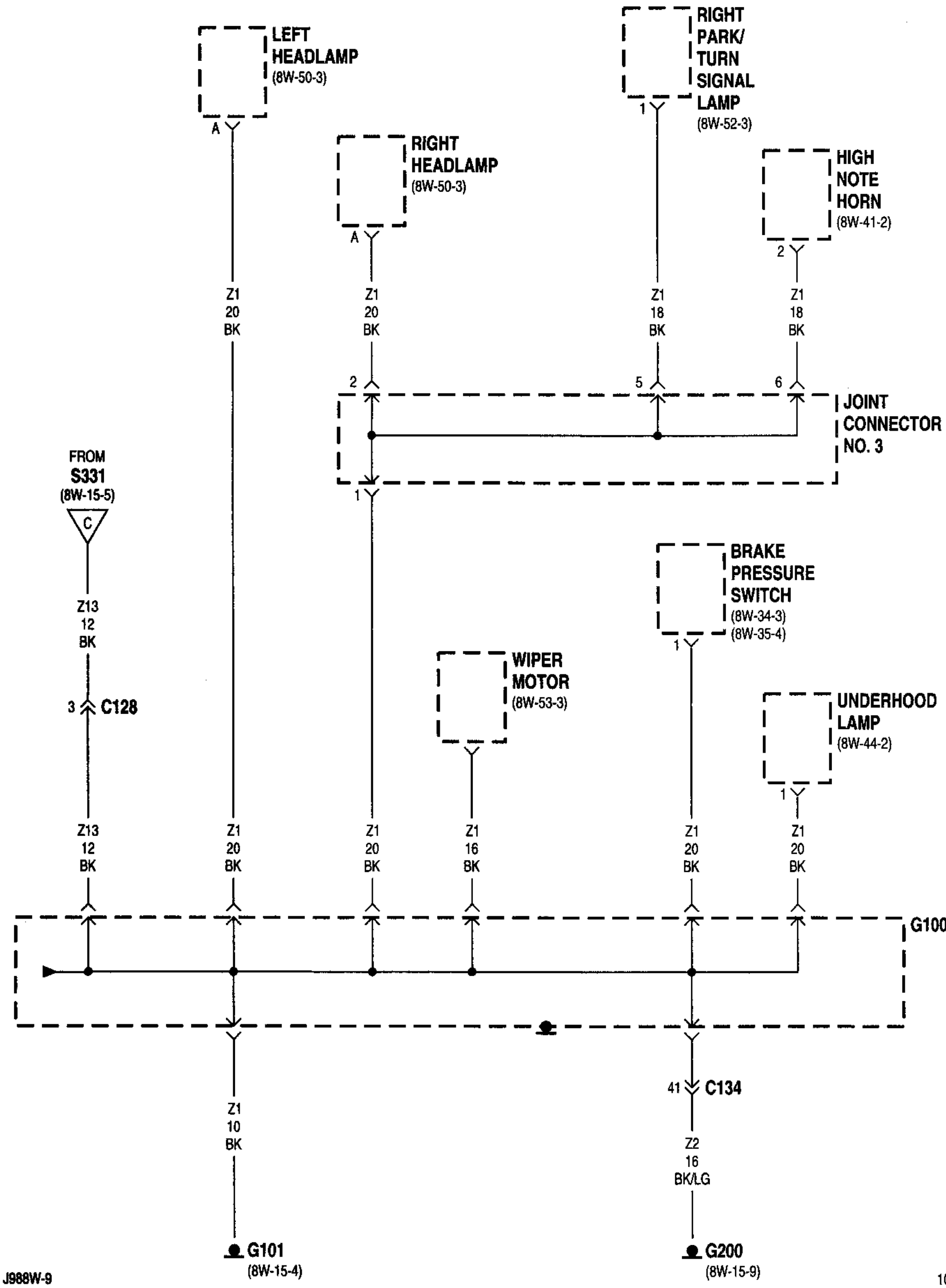
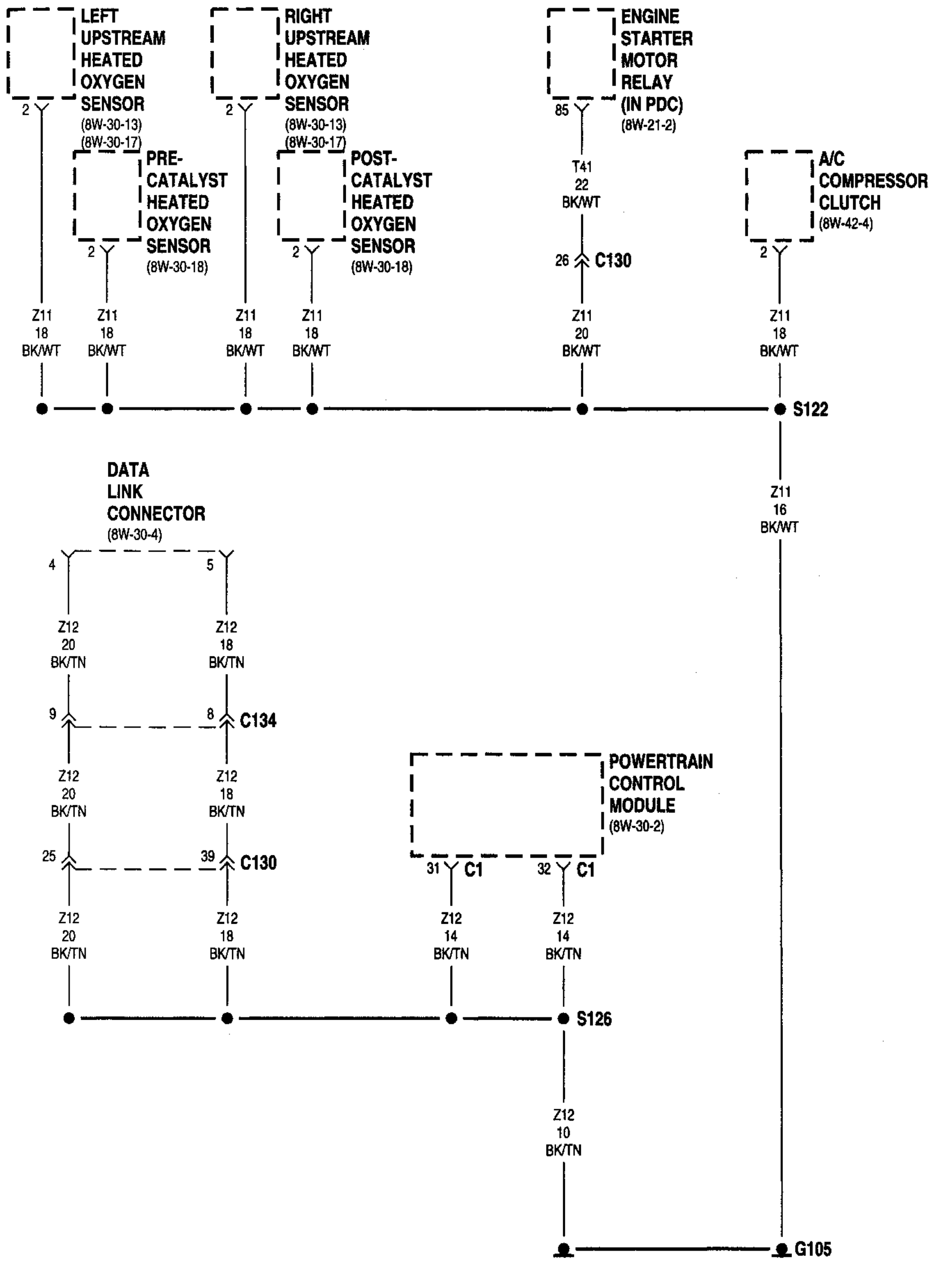
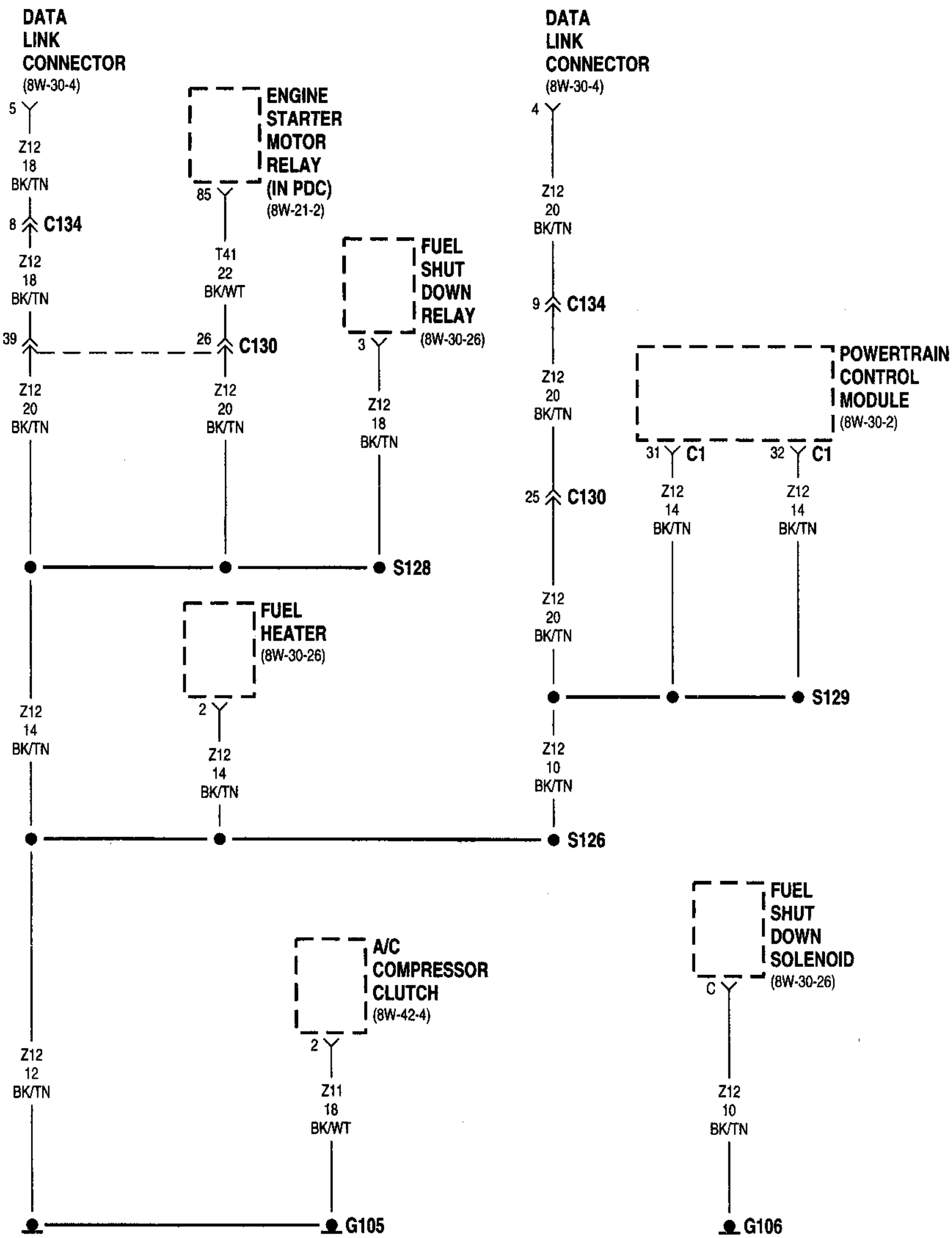

LEFT FRONT DOOR SPEAKER (PREMIUM)
(8W-47-6)
RIGHT FRONT DOOR SPEAKER (PREMIUM)
(8W-47-6)
GENERATOR
(8W-20-2)
(8W-20-3)
Z9 16 BK/VT
C347
C345
RADIO
(8W-47-4)
Z1 6 BK
G104
S302
AIRBAG CONTROL MODULE
(8W-43-2)
RADIO CHOKE RELAY
(8W-47-5)
C203
FROM JOINT CONNECTOR NO. 1 (IN PDC)
(8W-15-2)
FROM JOINT CONNECTOR NO. 4
(8W-15-3)
S204
Z5 18 BK/DB
Z6 18 BK/PK
Z1 18 BK
C134
G100
CONTROLLER ANTI-LOCK BRAKE
(8W-34-2)
(8W-35-3)
C1
Z8 14 BK/VT
Z2 16 BK/LG
S112
Z1 10 BK
Z8 10 BK/VT
G101
G200
(8W-15-9)

AUTHENTIC RESTORATION PRODUCT




LEFT HEADLAMP
(8W-50-3)
A
Z1
20
BK
RIGHT HEADLAMP
(8W-50-3)
A
Z1
20
BK
RIGHT PARK/ TURN SIGNAL LAMP
(8W-52-3)
1
Z1
18
BK
HIGH NOTE HORN
(8W-41-2)
2
Z1
18
BK
2
5
6
JOINT CONNECTOR NO. 3
1
FROM
S331
(8W-15-5)
C
Z13
12
BK
3
C128
Z13
12
BK
BRAKE PRESSURE SWITCH
(8W-34-3)
(8W-35-4)
1
WIPER MOTOR
(8W-53-3)
UNDERHOOD LAMP
(8W-44-2)
1
Z1
20
BK
Z1
20
BK
Z1
16
BK
Z1
20
BK
Z1
20
BK
G100
Z1
10
BK
41
C134
Z2
16
BK/LG
G101
(8W-15-4)
G200
(8W-15-9)


LEFT UPSTREAM HEATED OXYGEN SENSOR (8W-30-13) (8W-30-17)
RIGHT UPSTREAM HEATED OXYGEN SENSOR (8W-30-13) (8W-30-17)
ENGINE STARTER MOTOR RELAY (IN PDC) (8W-21-2)
PRE-CATALYST HEATED OXYGEN SENSOR (8W-30-18)
POST-CATALYST HEATED OXYGEN SENSOR (8W-30-18)
A/C COMPRESSOR CLUTCH (8W-42-4)
2
85
T41 22 BK/WT
26 C130
Z11 18 BK/WT
Z11 20 BK/WT
S122
Z11 16 BK/WT
DATA LINK CONNECTOR (8W-30-4)
4
5
Z12 20 BK/TN
Z12 18 BK/TN
9
8 C134
25
39 C130
POWERTRAIN CONTROL MODULE (8W-30-2)
31 C1
32 C1
Z12 14 BK/TN
S126
Z12 10 BK/TN
G105


DATA
LINK
CONNECTOR
(8W-30-4)
5
Z12
18
BK/TN
8
C134
Z12
18
BK/TN
39
Z12
20
BK/TN
ENGINE
STARTER
MOTOR
RELAY
(IN PDC)
(8W-21-2)
85
T41
22
BK/WT
26
C130
Z12
20
BK/TN
FUEL
SHUT
DOWN
RELAY
(8W-30-26)
3
Z12
18
BK/TN
S128
FUEL
HEATER
(8W-30-26)
2
Z12
14
BK/TN
Z12
14
BK/TN
S126
Z12
12
BK/TN
A/C
COMPRESSOR
CLUTCH
(8W-42-4)
2
Z11
18
BK/WT
G105
DATA
LINK
CONNECTOR
(8W-30-4)
4
Z12
20
BK/TN
9
C134
Z12
20
BK/TN
25
C130
Z12
20
BK/TN
POWERTRAIN
CONTROL
MODULE
(8W-30-2)
31
C1
32
C1
Z12
14
BK/TN
Z12
14
BK/TN
S129
Z12
10
BK/TN
FUEL
SHUT
DOWN
SOLENOID
(8W-30-26)
C
Z12
10
BK/TN
G106

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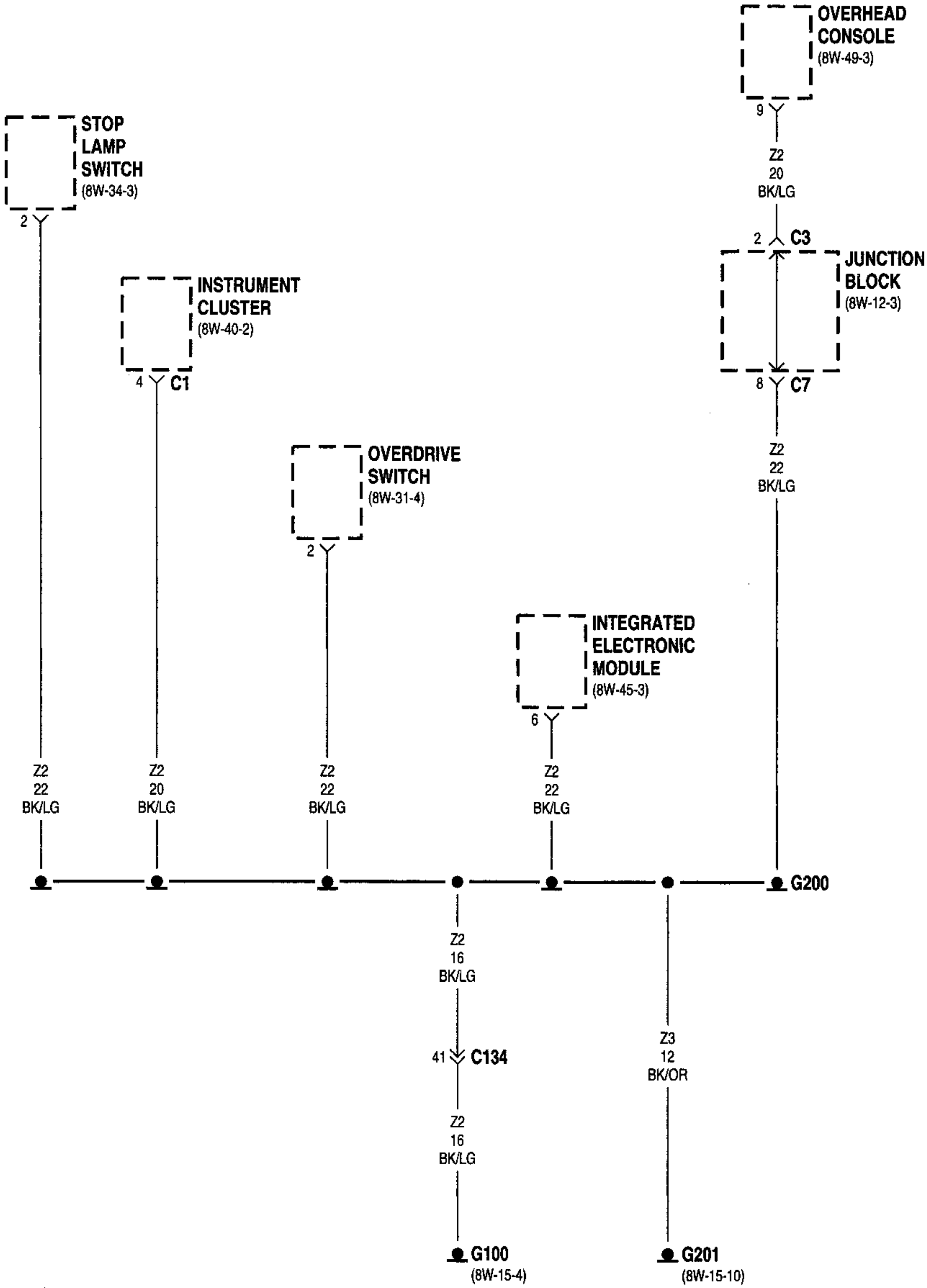
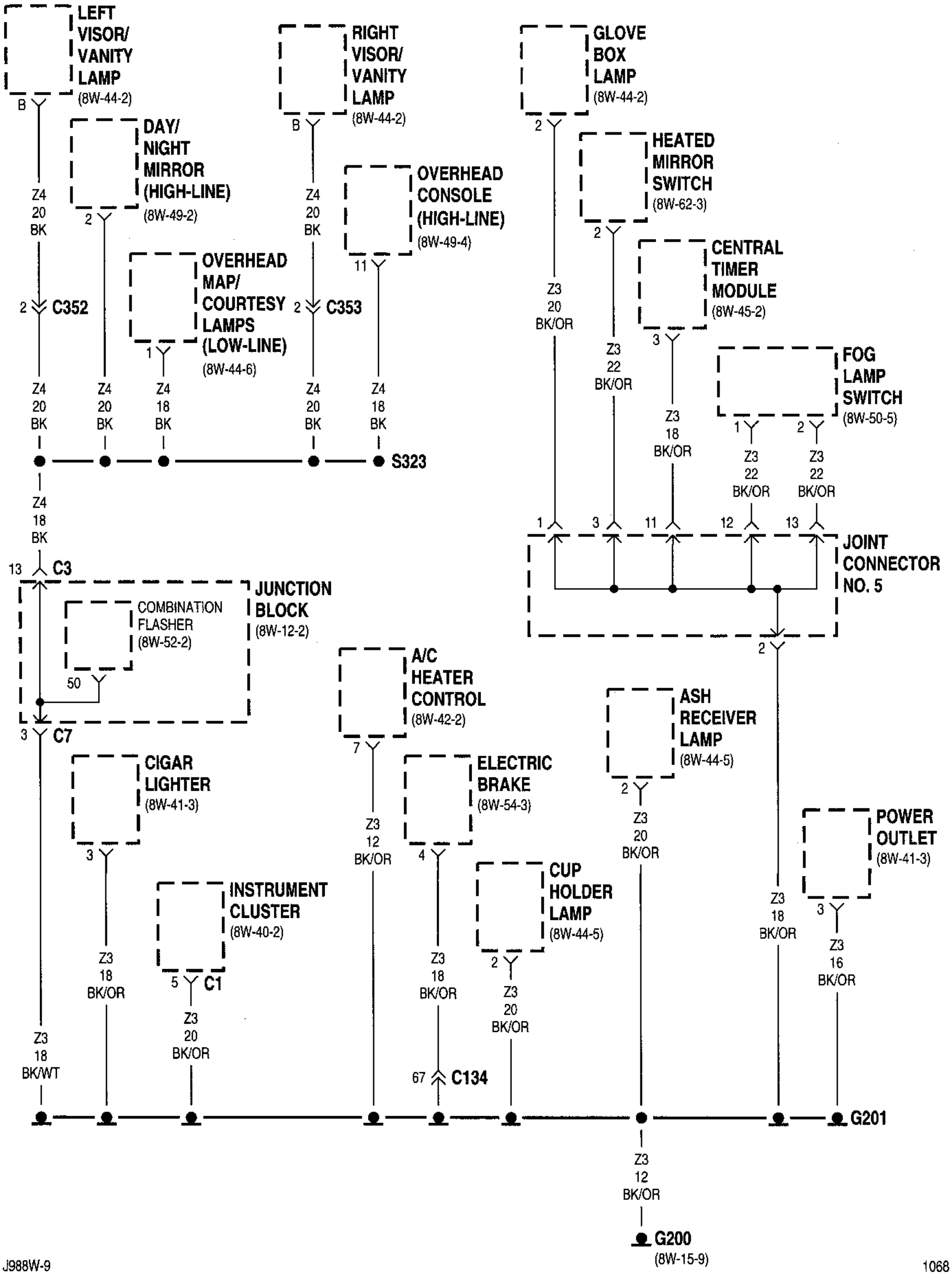
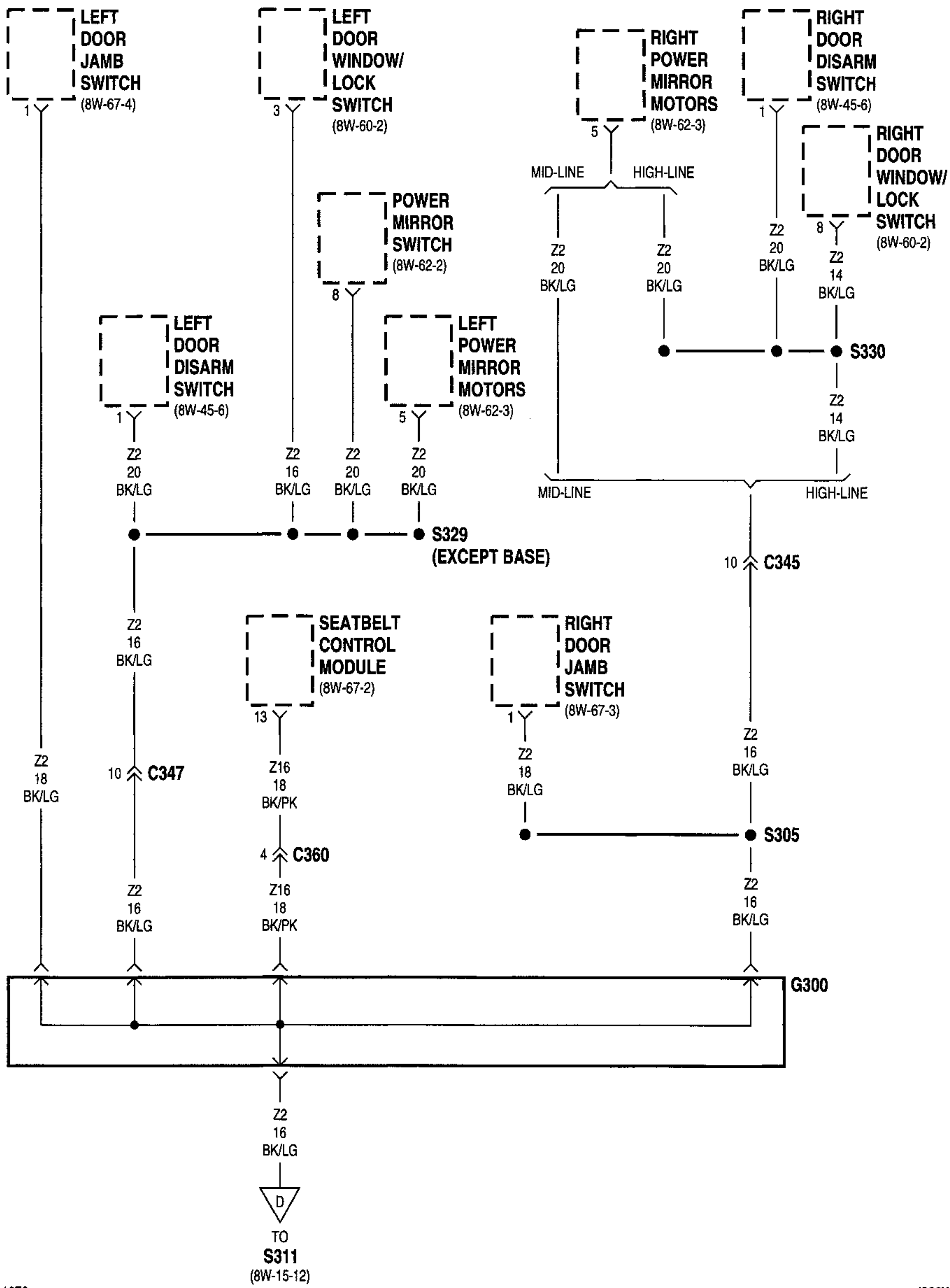


AUTHENTIC RESTORATION PRODUCT




LEFT DOOR JAMB SWITCH (8W-67-4)
1
LEFT DOOR WINDOW/ LOCK SWITCH (8W-60-2)
3
RIGHT POWER MIRROR MOTORS (8W-62-3)
5
MID-LINE
HIGH-LINE
RIGHT DOOR DISARM SWITCH (8W-45-6)
1
RIGHT DOOR WINDOW/ LOCK SWITCH (8W-60-2)
8
POWER MIRROR SWITCH (8W-62-2)
8
LEFT DOOR DISARM SWITCH (8W-45-6)
1
LEFT POWER MIRROR MOTORS (8W-62-3)
5
Z2 20 BK/LG
Z2 14 BK/LG
S330
Z2 16 BK/LG
S329 (EXCEPT BASE)
C345
10
SEATBELT CONTROL MODULE (8W-67-2)
13
RIGHT DOOR JAMB SWITCH (8W-67-3)
1
Z2 18 BK/LG
C347
10
Z16 18 BK/PK
C360
4
S305
G300
D
TO S311 (8W-15-12)

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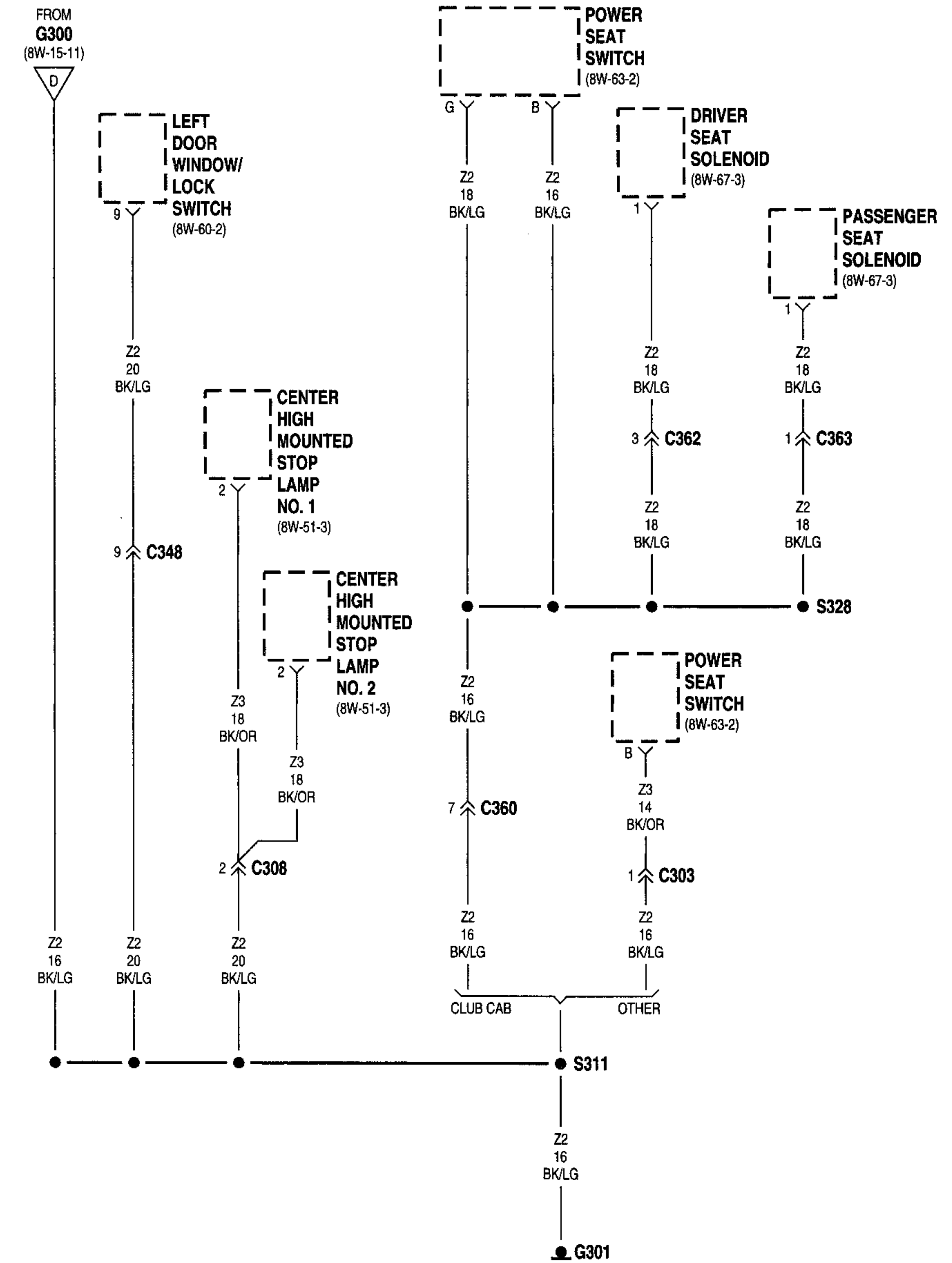
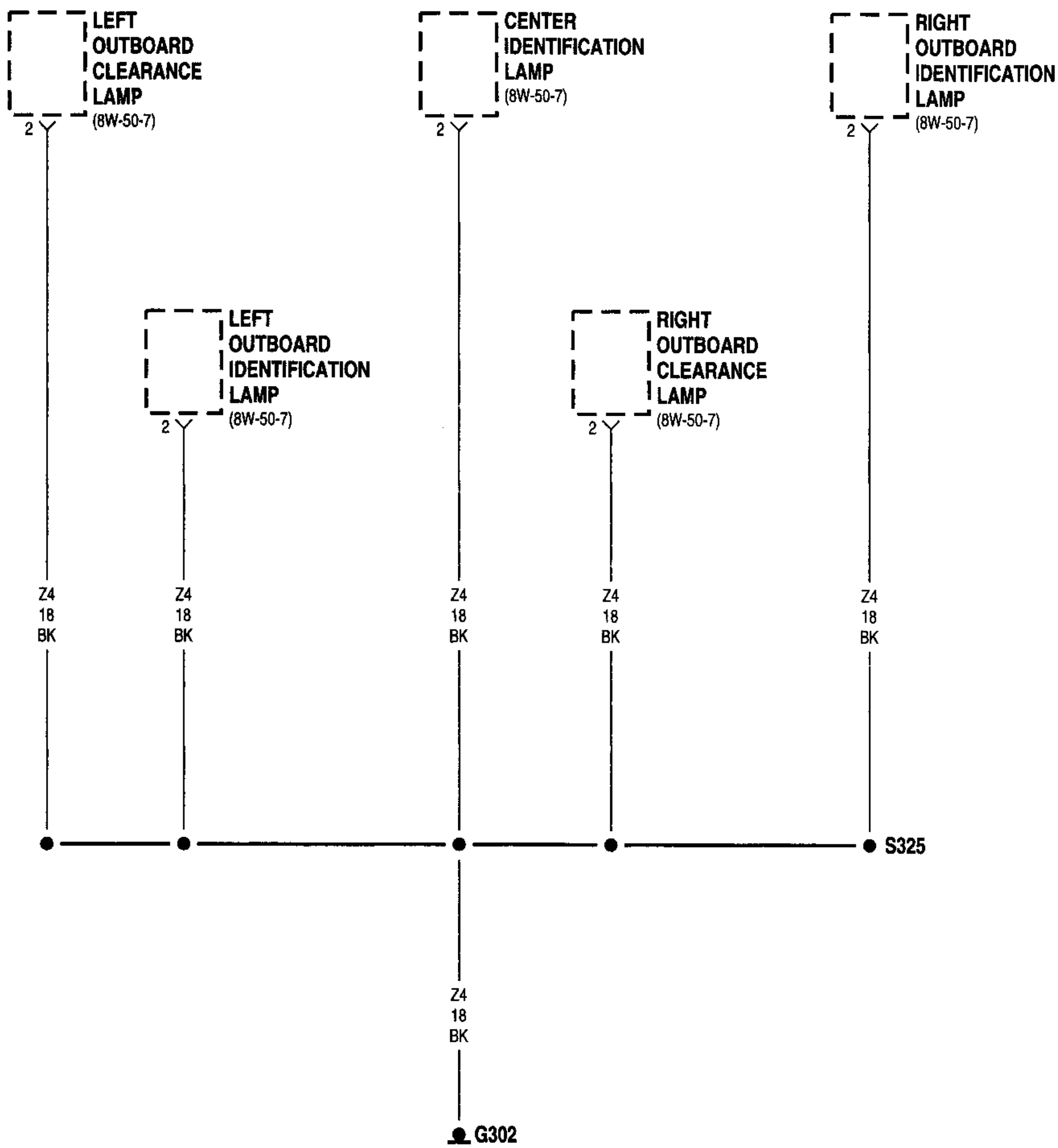


J988W-9 G301


LEFT OUTBOARD CLEARANCE LAMP
(8W-50-7)
2
CENTER IDENTIFICATION LAMP
(8W-50-7)
2
RIGHT OUTBOARD IDENTIFICATION LAMP
(8W-50-7)
2
LEFT OUTBOARD IDENTIFICATION LAMP
(8W-50-7)
2
RIGHT OUTBOARD CLEARANCE LAMP
(8W-50-7)
2
Z4
18
BK
Z4
18
BK
Z4
18
BK
Z4
18
BK
Z4
18
BK
S325
Z4
18
BK
G302

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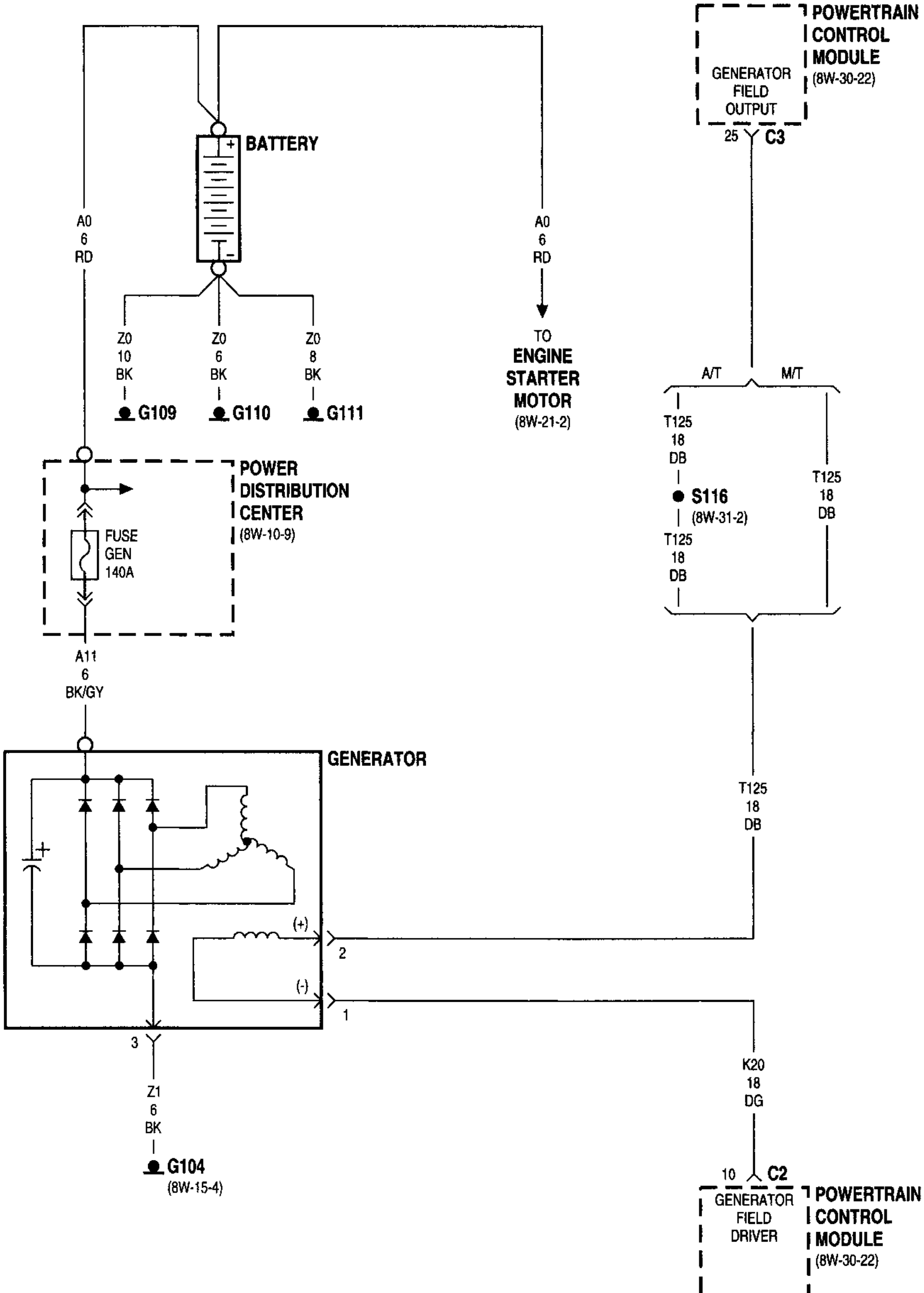
8W-20 CHARGING SYSTEM


POWERTRAIN CONTROL MODULE
(8W-30-22)
GENERATOR FIELD OUTPUT
25 C3
BATTERY
A0 6 RD
A0 6 RD
Z0 10 BK
Z0 6 BK
Z0 8 BK
G109
G110
G111
TO ENGINE STARTER MOTOR
(8W-21-2)
A/T
M/T
T125 18 DB
S116
(8W-31-2)
T125 18 DB
T125 18 DB
POWER DISTRIBUTION CENTER
(8W-10-9)
FUSE GEN 140A
A11 6 BK/GY
GENERATOR
T125 18 DB
(+)
2
(-)
1
3
Z1 6 BK
G104
(8W-15-4)
K20 18 DG
10 C2
GENERATOR FIELD DRIVER
POWERTRAIN CONTROL MODULE
(8W-30-22)

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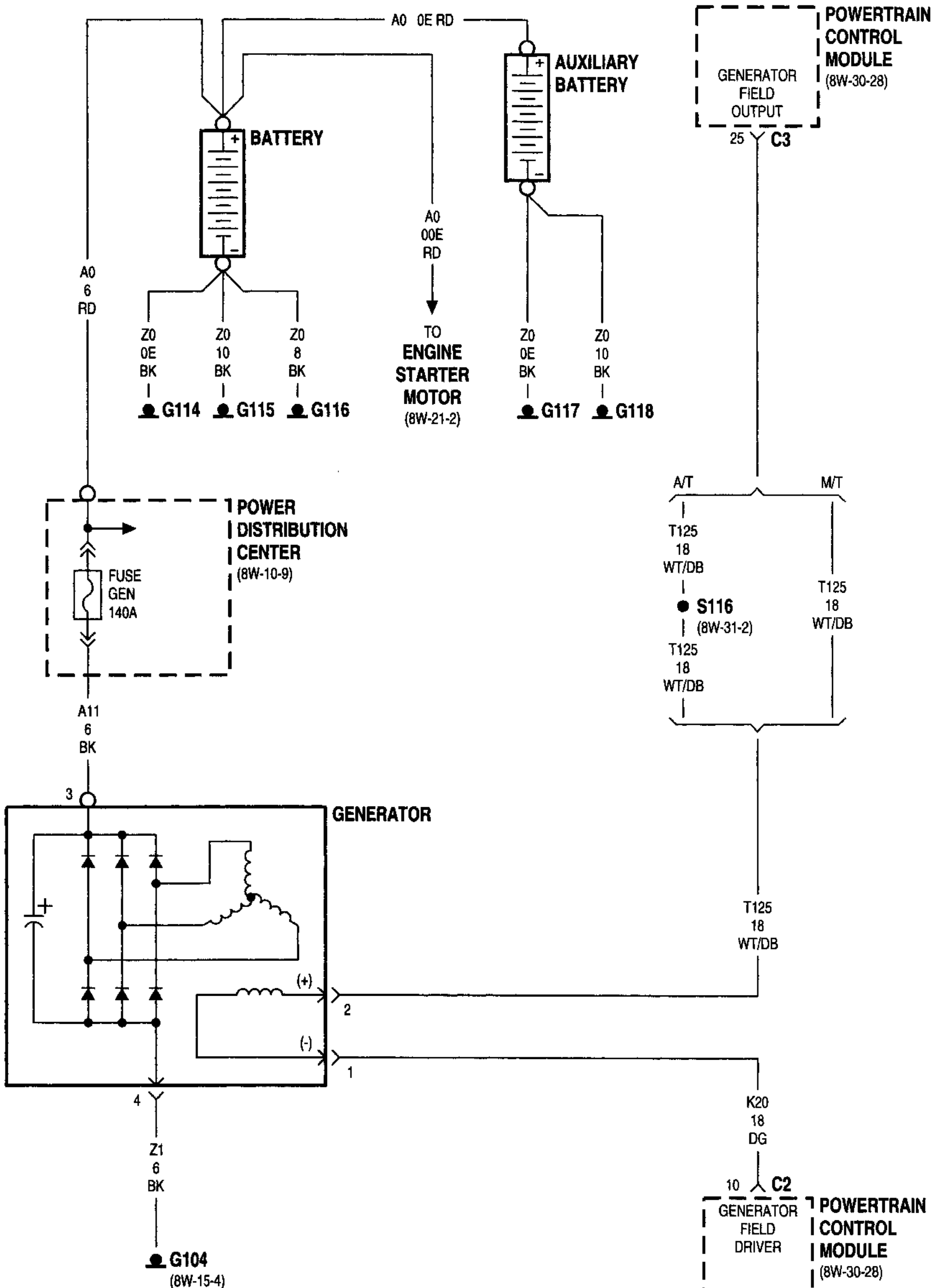
DIESEL



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8W-21 STARTING SYSTEM

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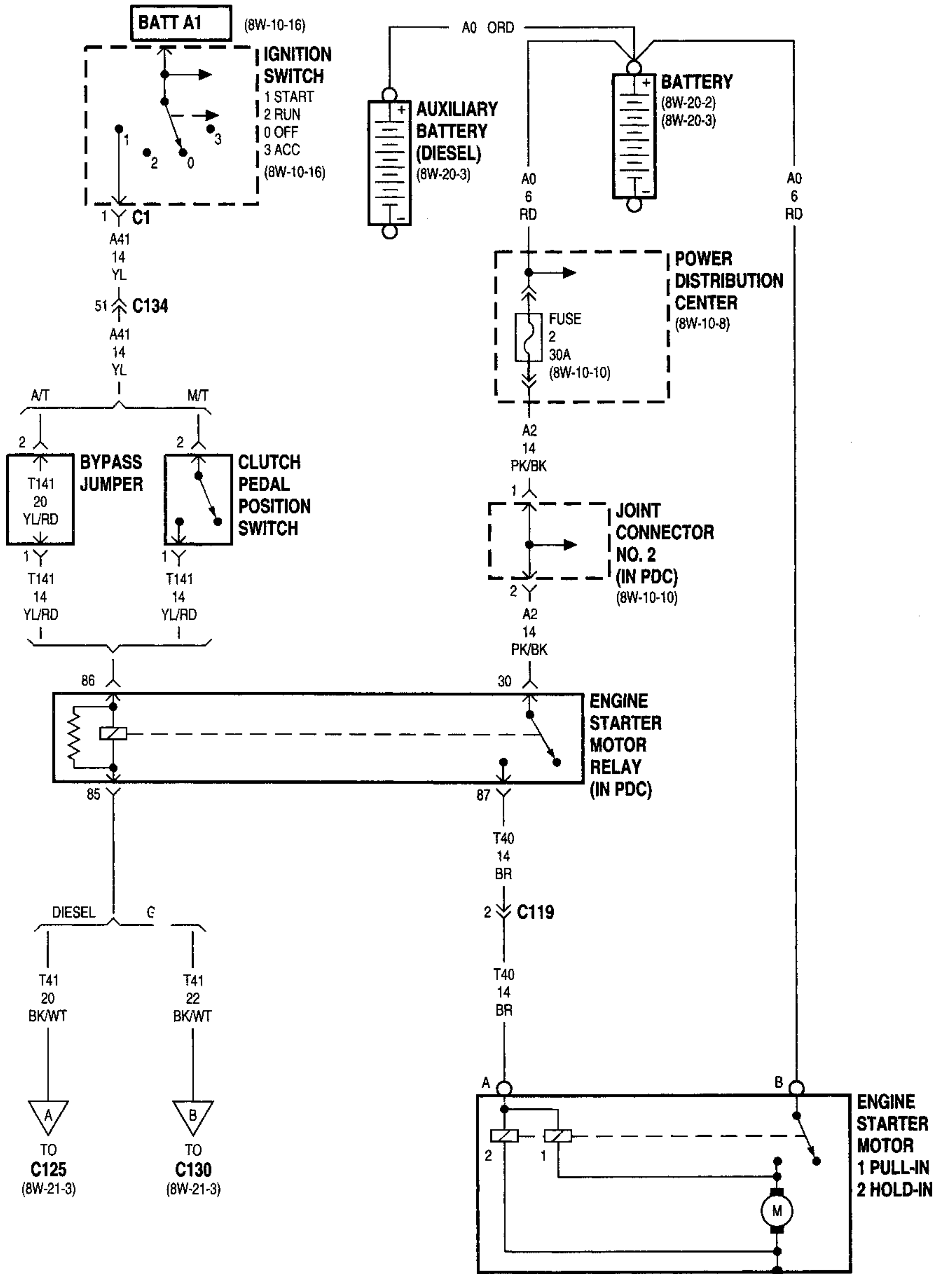

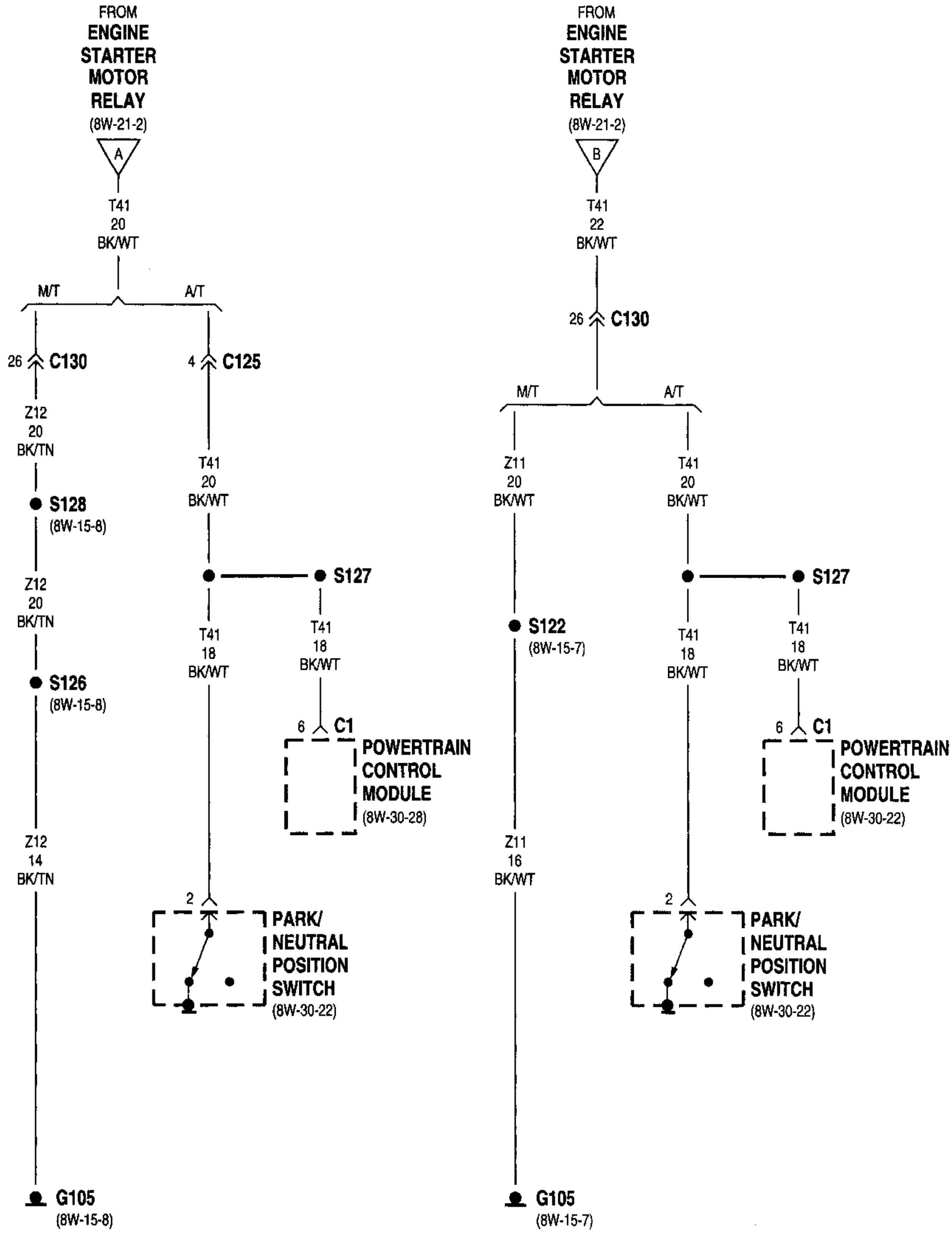
FROM
ENGINE
STARTER
MOTOR
RELAY
(8W-21-2)
A
T41
20
BK/WT
M/T
A/T
26
C130
4
C125
Z12
20
BK/TN
S128
(8W-15-8)
T41
20
BK/WT
S127
Z12
20
BK/TN
T41
18
BK/WT
T41
18
BK/WT
S126
(8W-15-8)
6
C1
POWERTRAIN
CONTROL
MODULE
(8W-30-28)
Z12
14
BK/TN
2
PARK/
NEUTRAL
POSITION
SWITCH
(8W-30-22)
G105
(8W-15-8)
FROM
ENGINE
STARTER
MOTOR
RELAY
(8W-21-2)
B
T41
22
BK/WT
26
C130
M/T
A/T
Z11
20
BK/WT
T41
20
BK/WT
S127
S122
(8W-15-7)
T41
18
BK/WT
T41
18
BK/WT
6
C1
POWERTRAIN
CONTROL
MODULE
(8W-30-22)
Z11
16
BK/WT
2
PARK/
NEUTRAL
POSITION
SWITCH
(8W-30-22)
G105
(8W-15-7)

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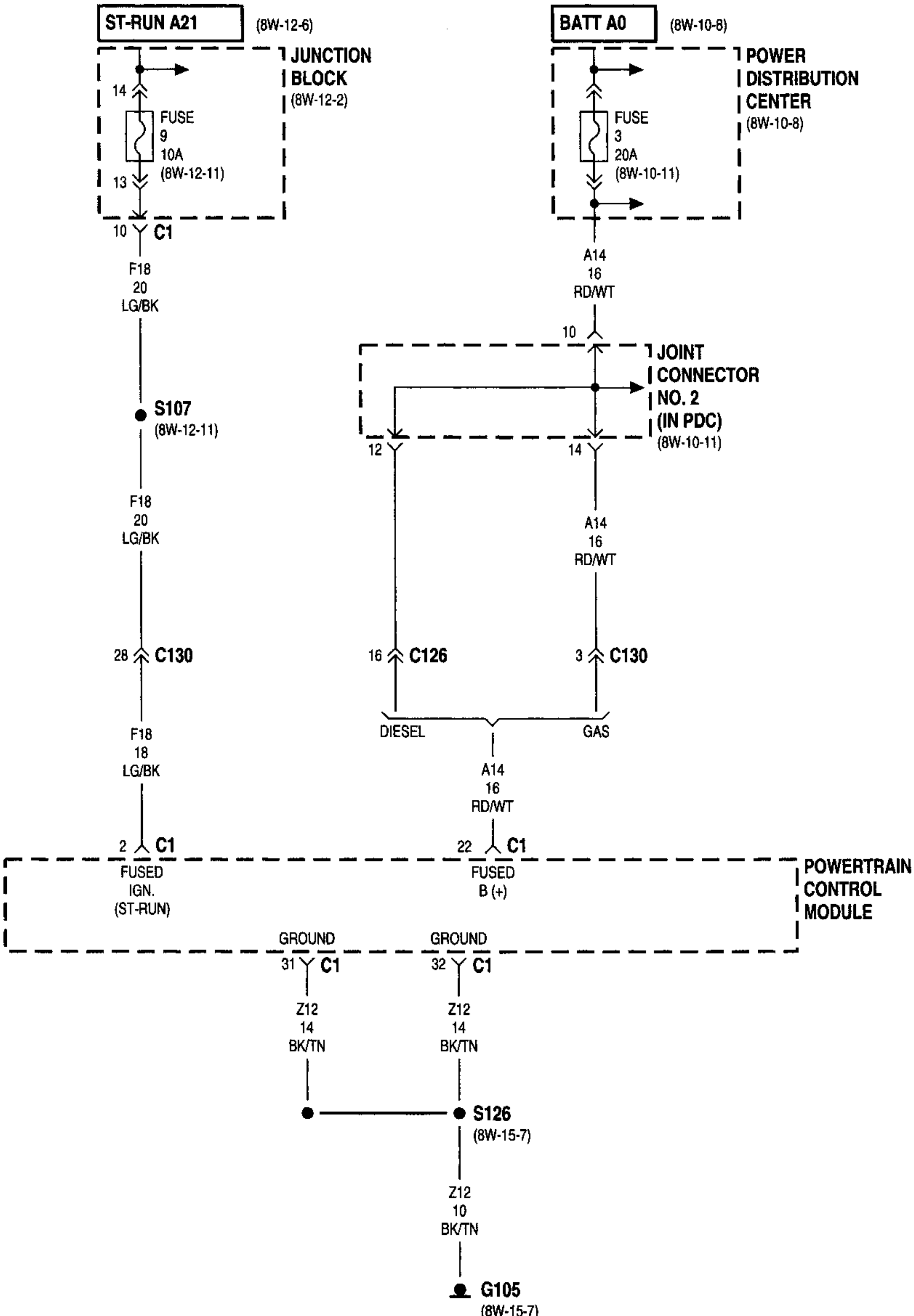
8W-30 FUEL/IGNITION SYSTEMS


ST-RUN A21
(8W-12-6)
JUNCTION BLOCK
(8W-12-2)
14
FUSE
9
10A
(8W-12-11)
13
10 C1
F18
20
LG/BK
S107
(8W-12-11)
F18
20
LG/BK
28 C130
F18
18
LG/BK
2 C1
BATT A0
(8W-10-8)
POWER DISTRIBUTION CENTER
(8W-10-8)
FUSE
3
20A
(8W-10-11)
A14
16
RD/WT
10
JOINT CONNECTOR NO. 2 (IN PDC)
(8W-10-11)
12
14
A14
16
RD/WT
16 C126
3 C130
DIESEL
GAS
A14
16
RD/WT
22 C1
FUSED IGN. (ST-RUN)
FUSED B (+)
POWERTRAIN CONTROL MODULE
GROUND
GROUND
31 C1
32 C1
Z12
14
BK/TN
Z12
14
BK/TN
S126
(8W-15-7)
Z12
10
BK/TN
G105
(8W-15-7)

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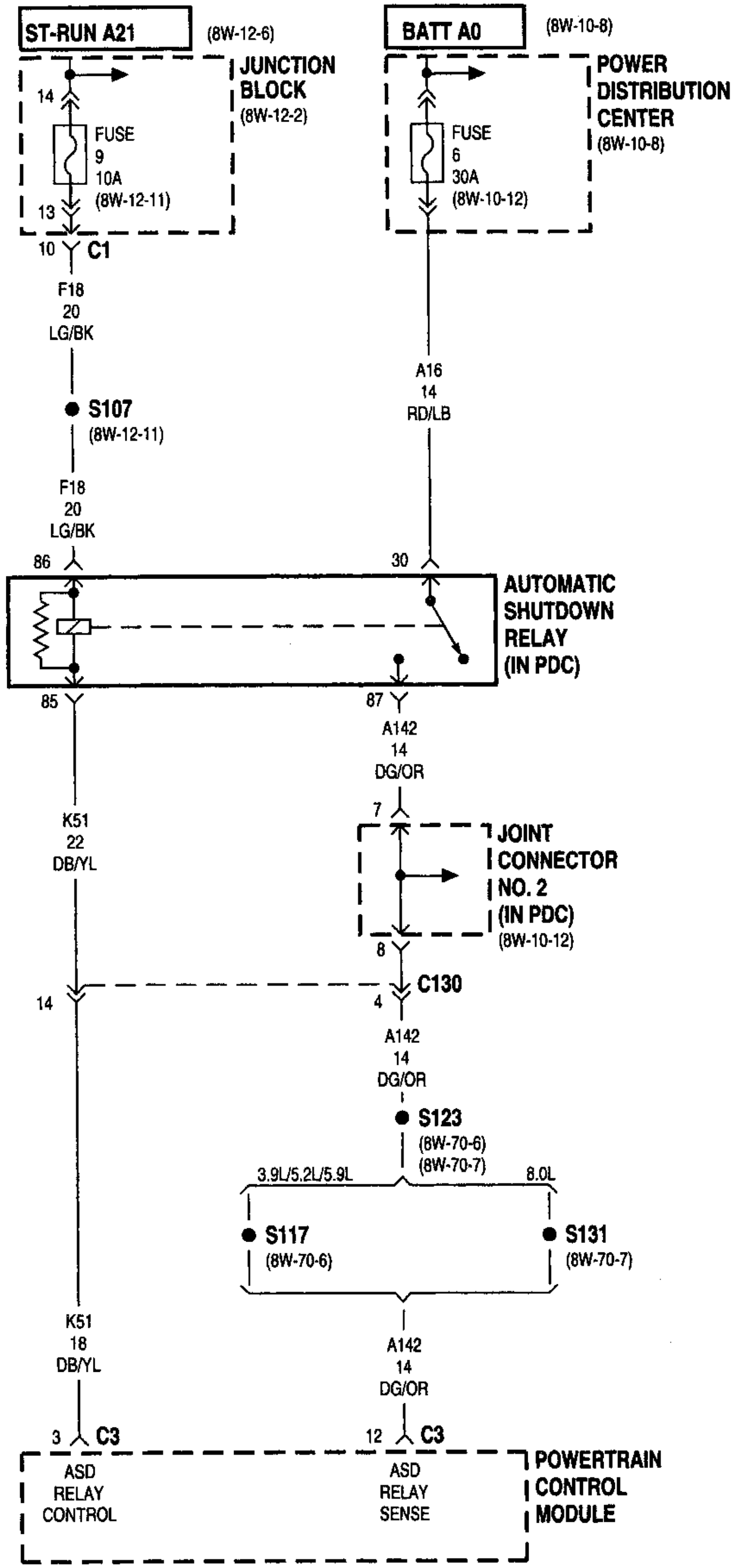

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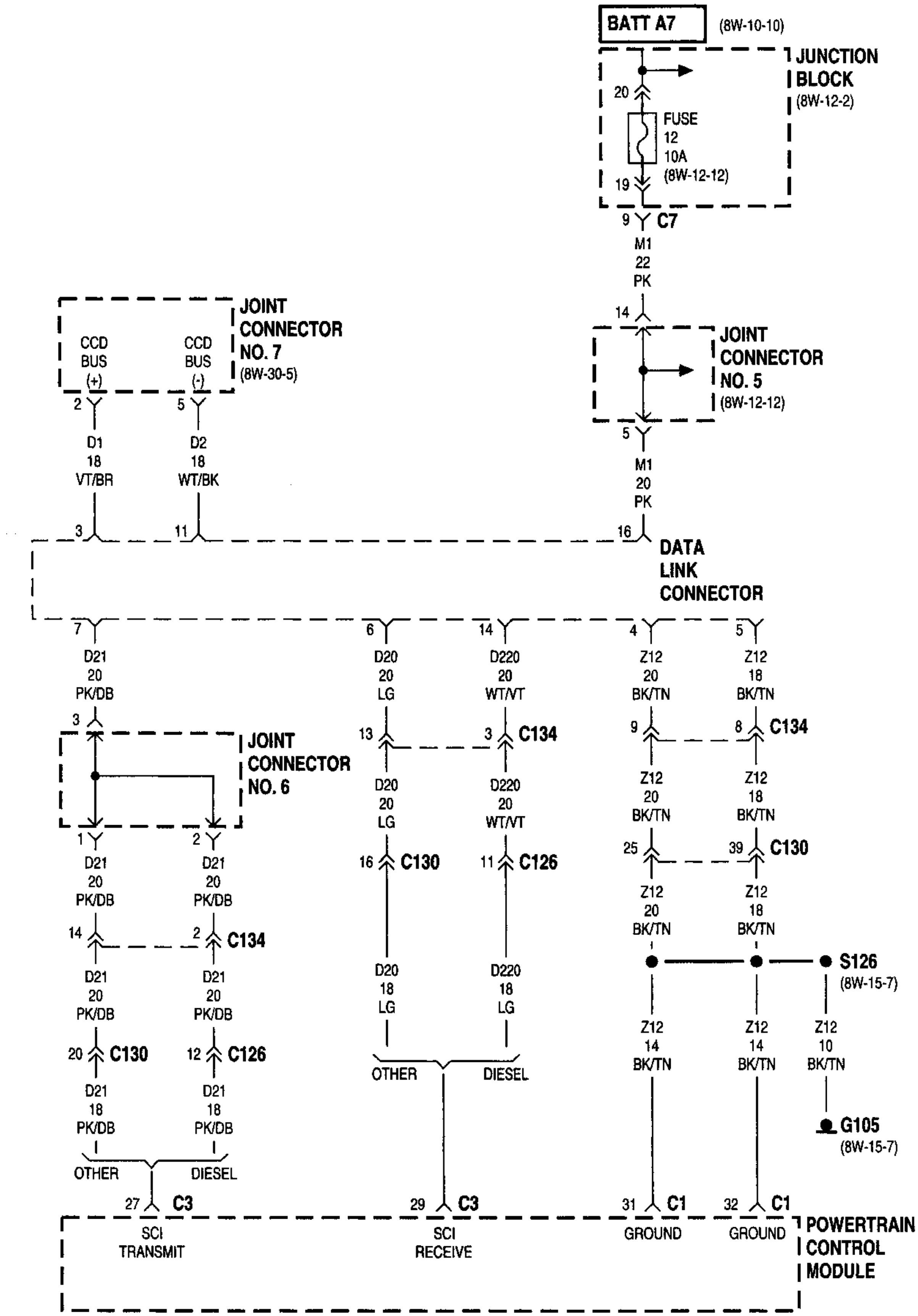

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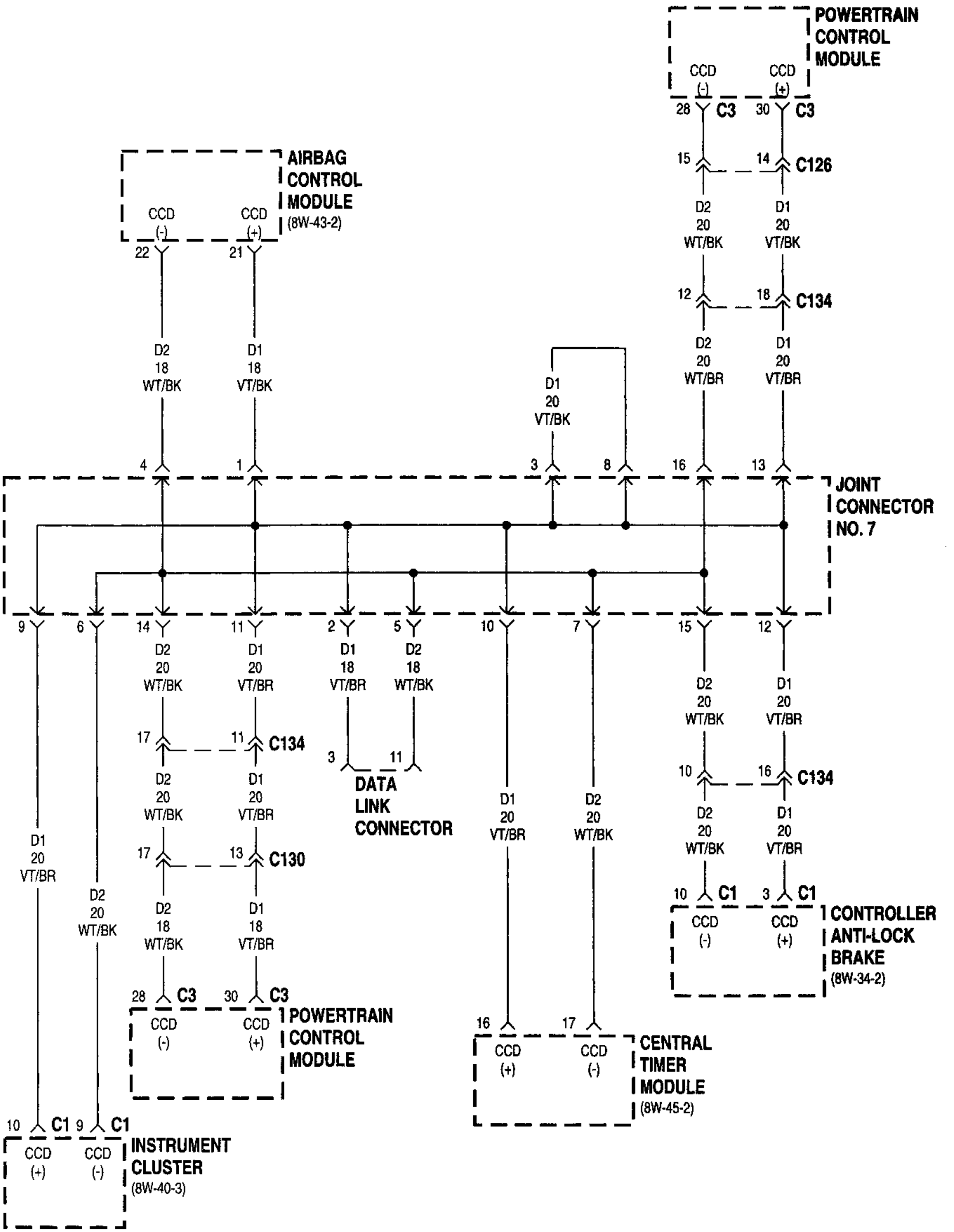
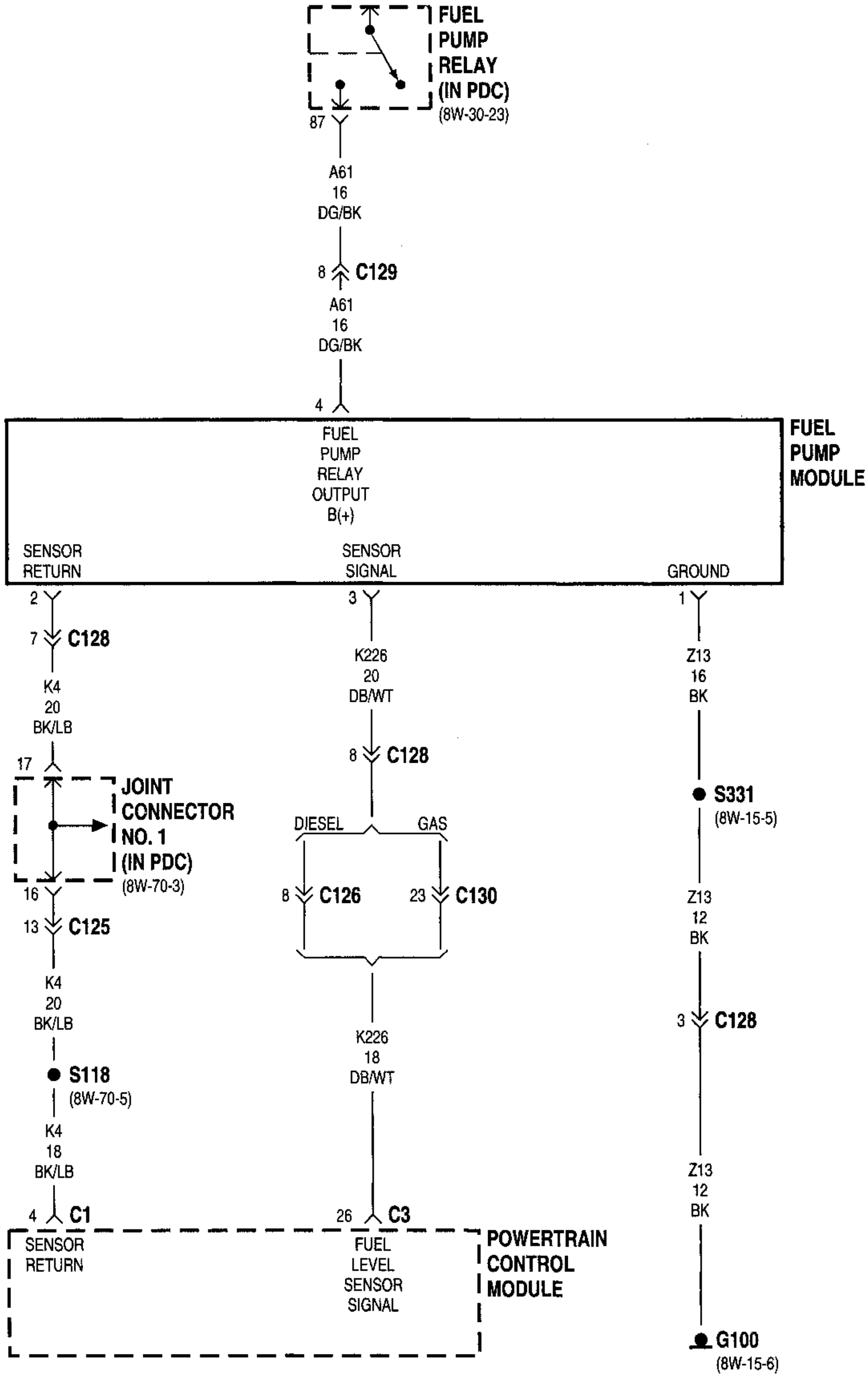


CCD

J988W-9


FUEL PUMP RELAY (IN PDC)
(8W-30-23)
87
A61
16
DG/BK
8
C129
A61
16
DG/BK
4
FUEL PUMP RELAY OUTPUT B(+)
FUEL PUMP MODULE
SENSOR RETURN
SENSOR SIGNAL
GROUND
2
3
1
7
C128
K4
20
BK/LB
K226
20
DB/WT
Z13
16
BK
8
C128
17
JOINT CONNECTOR NO. 1 (IN PDC)
(8W-70-3)
S331
(8W-15-5)
DIESEL
GAS
16
8
C126
23
C130
13
C125
Z13
12
BK
K4
20
BK/LB
3
C128
K226
18
DB/WT
S118
(8W-70-5)
K4
18
BK/LB
Z13
12
BK
4
C1
26
C3
POWERTRAIN CONTROL MODULE
SENSOR RETURN
FUEL LEVEL SENSOR SIGNAL
G100
(8W-15-6)

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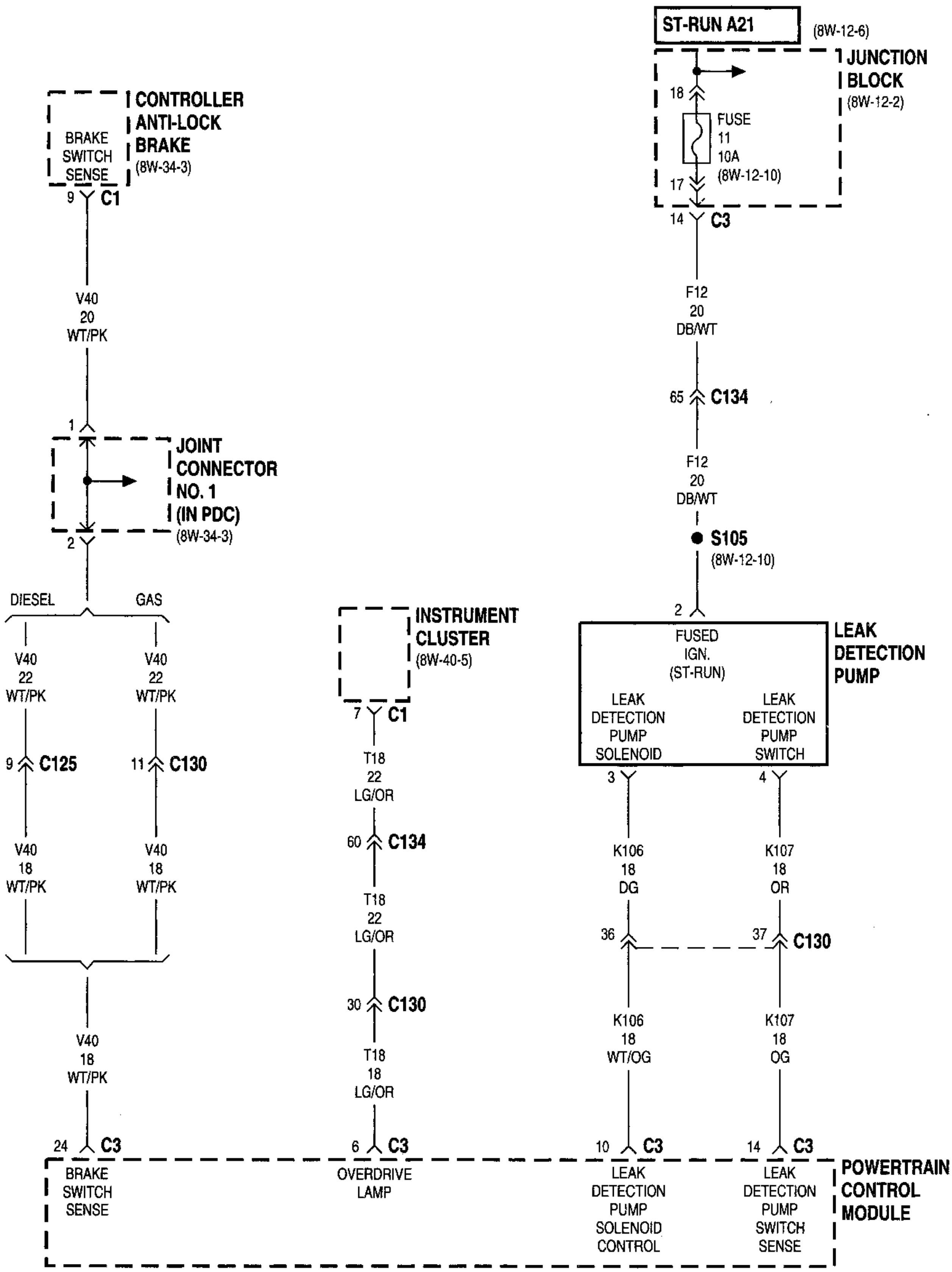

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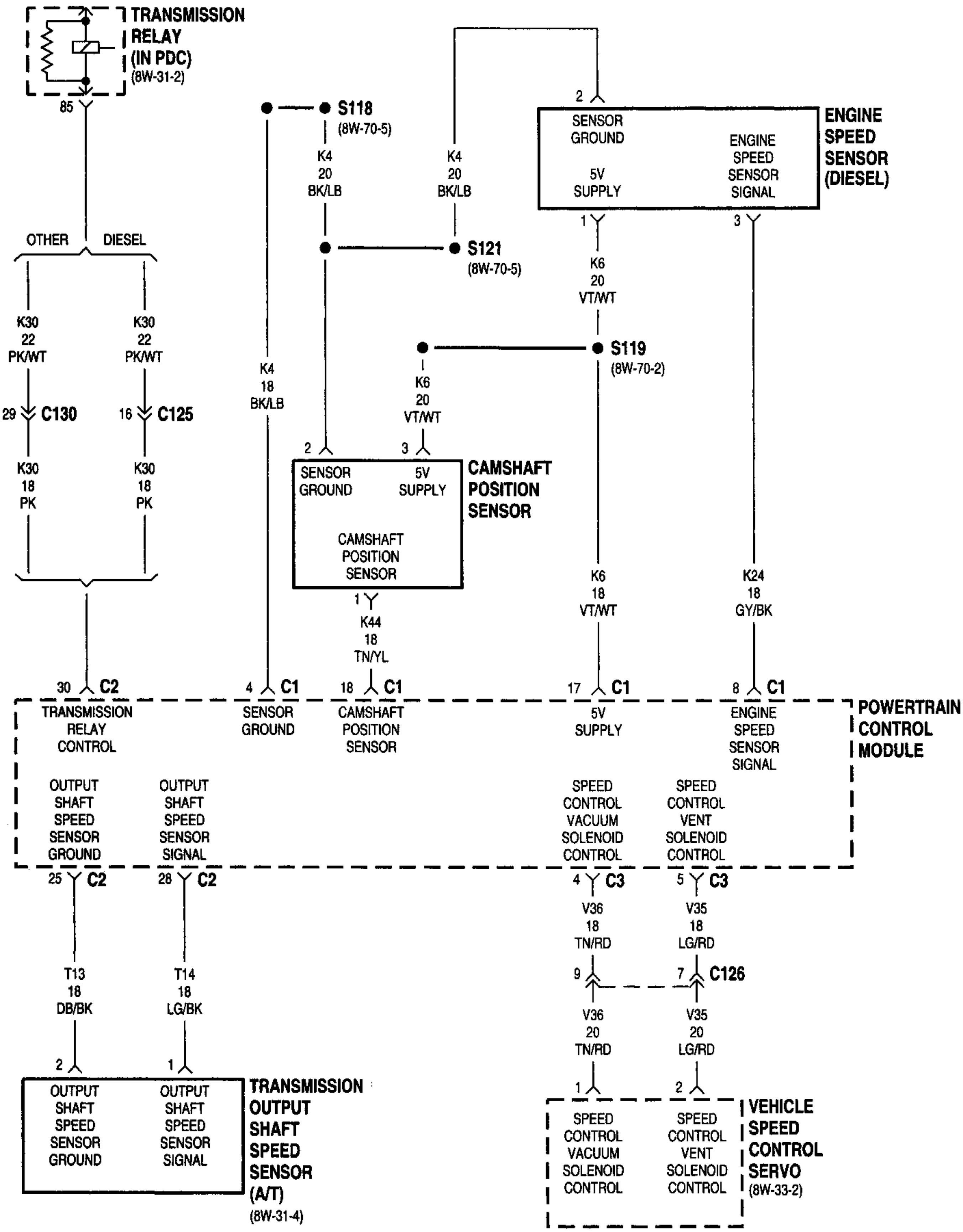
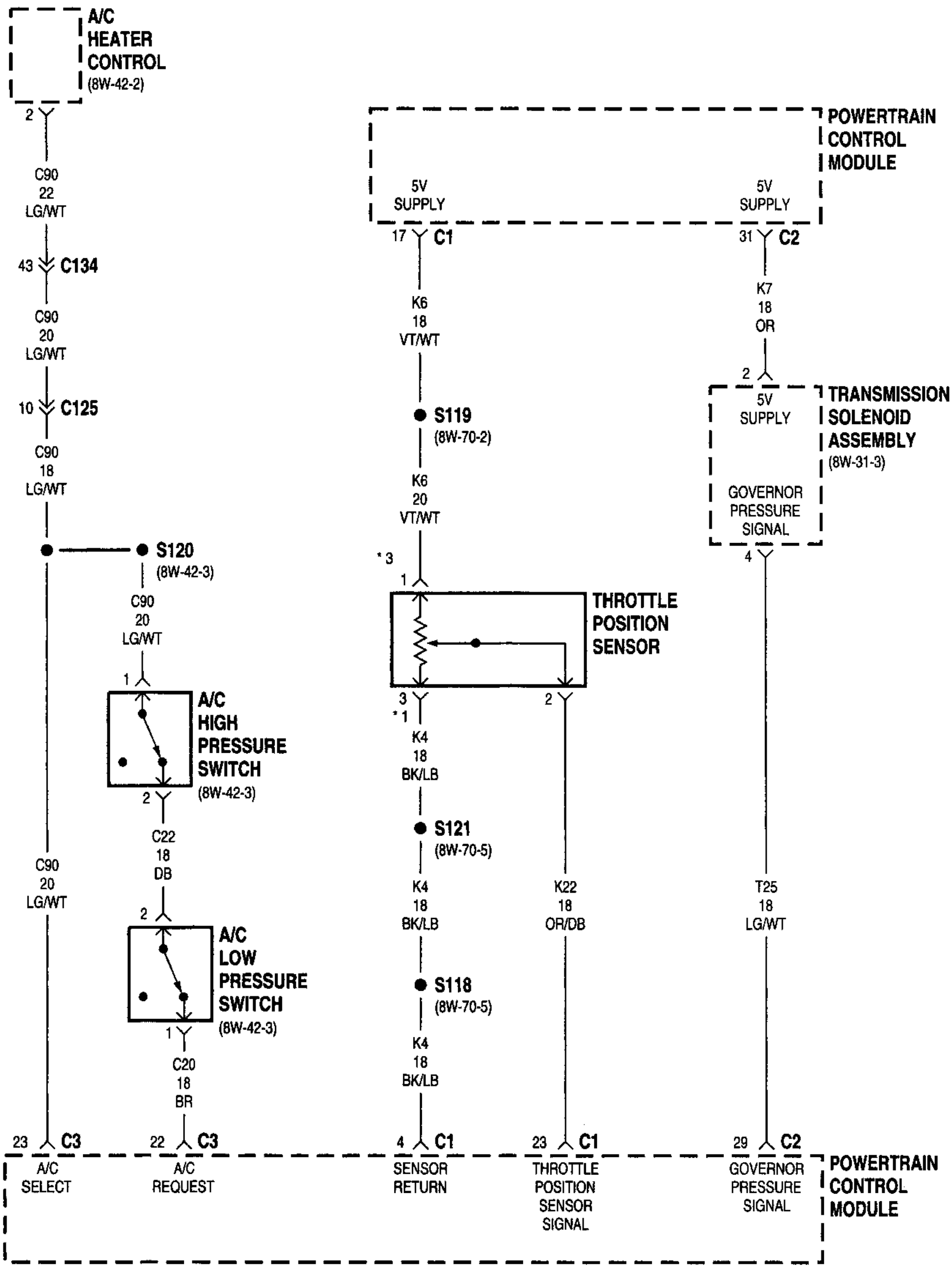
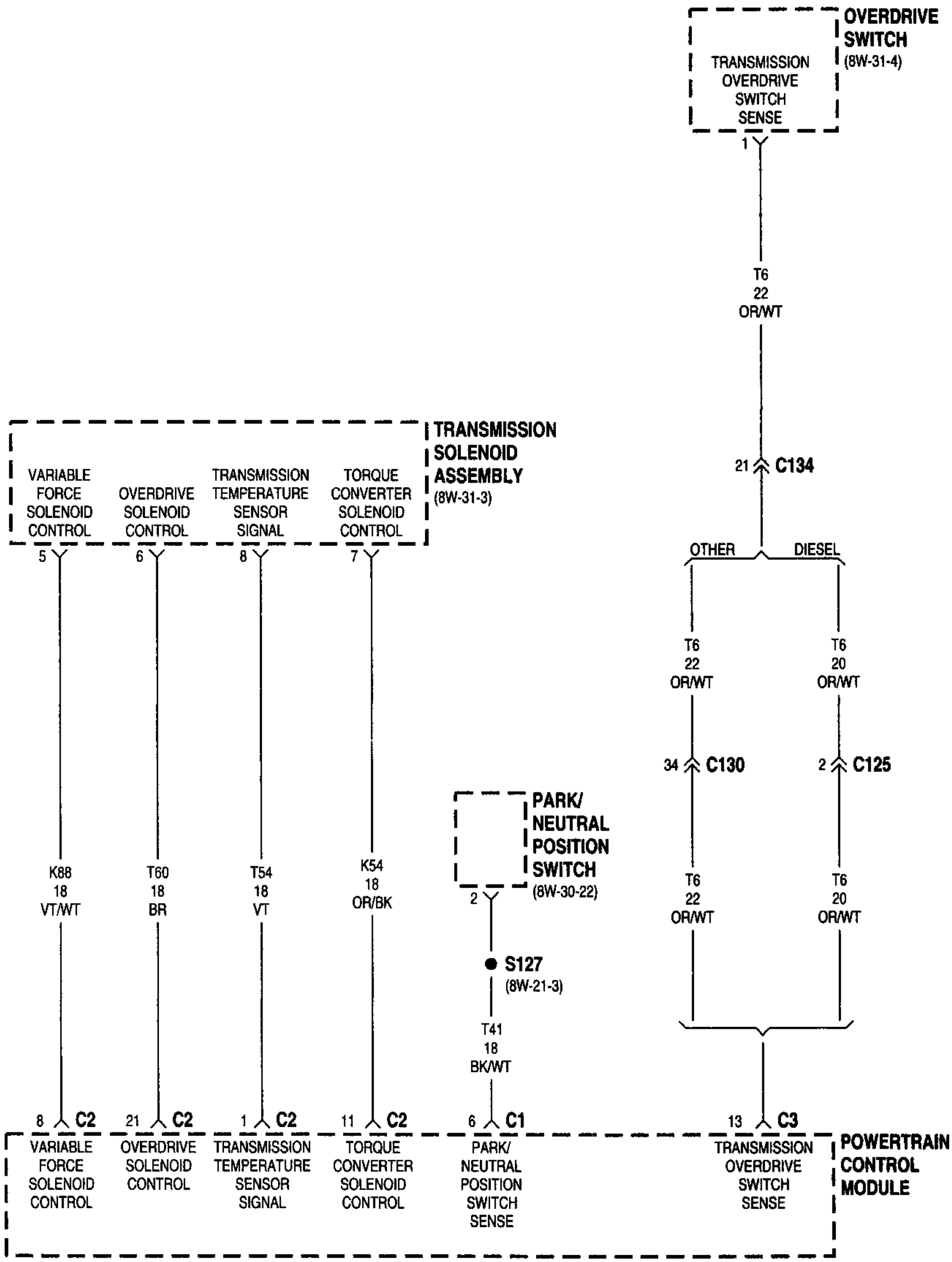


TRANSMISSION RELAY (IN PDC) (8W-31-2)
85
OTHER
DIESEL
K30 22 PK/WT
K30 22 PK/WT
29 C130
16 C125
K30 18 PK
K30 18 PK
S118 (8W-70-5)
K4 20 BK/LB
K4 20 BK/LB
S121 (8W-70-5)
K4 18 BK/LB
ENGINE SPEED SENSOR (DIESEL)
SENSOR GROUND
5V SUPPLY
ENGINE SPEED SENSOR SIGNAL
K6 20 VT/WT
S119 (8W-70-2)
K6 20 VT/WT
CAMSHAFT POSITION SENSOR
SENSOR GROUND
5V SUPPLY
CAMSHAFT POSITION SENSOR
K44 18 TN/YL
K6 18 VT/WT
K24 18 GY/BK
30 C2
4 C1
18 C1
17 C1
8 C1
POWERTRAIN CONTROL MODULE
TRANSMISSION RELAY CONTROL
SENSOR GROUND
CAMSHAFT POSITION SENSOR
5V SUPPLY
ENGINE SPEED SENSOR SIGNAL
OUTPUT SHAFT SPEED SENSOR GROUND
OUTPUT SHAFT SPEED SENSOR SIGNAL
SPEED CONTROL VACUUM SOLENOID CONTROL
SPEED CONTROL VENT SOLENOID CONTROL
25 C2
28 C2
4 C3
5 C3
T13 18 DB/BK
T14 18 LG/BK
V36 18 TN/RD
V35 18 LG/RD
9
7 C126
V36 20 TN/RD
V35 20 LG/RD
TRANSMISSION OUTPUT SHAFT SPEED SENSOR (A/T) (8W-31-4)
OUTPUT SHAFT SPEED SENSOR GROUND
OUTPUT SHAFT SPEED SENSOR SIGNAL
VEHICLE SPEED CONTROL SERVO (8W-33-2)
SPEED CONTROL VACUUM SOLENOID CONTROL
SPEED CONTROL VENT SOLENOID CONTROL

Mopar AUTHENTIC RESTORATION PRODUCT




OVERDRIVE SWITCH
(8W-31-4)
TRANSMISSION OVERDRIVE SWITCH SENSE
1
T6
22
OR/WT
21
C134
OTHER
DIESEL
T6
22
OR/WT
T6
20
OR/WT
34
C130
2
C125
T6
22
OR/WT
T6
20
OR/WT
TRANSMISSION SOLENOID ASSEMBLY
(8W-31-3)
VARIABLE FORCE SOLENOID CONTROL
OVERDRIVE SOLENOID CONTROL
TRANSMISSION TEMPERATURE SENSOR SIGNAL
TORQUE CONVERTER SOLENOID CONTROL
5
6
8
7
K88
18
VT/WT
T60
18
BR
T54
18
VT
K54
18
OR/BK
PARK/ NEUTRAL POSITION SWITCH
(8W-30-22)
2
S127
(8W-21-3)
T41
18
BK/WT
8
C2
21
C2
1
C2
11
C2
6
C1
13
C3
VARIABLE FORCE SOLENOID CONTROL
OVERDRIVE SOLENOID CONTROL
TRANSMISSION TEMPERATURE SENSOR SIGNAL
TORQUE CONVERTER SOLENOID CONTROL
PARK/ NEUTRAL POSITION SWITCH SENSE
TRANSMISSION OVERDRIVE SWITCH SENSE
POWERTRAIN CONTROL MODULE

J988W-9

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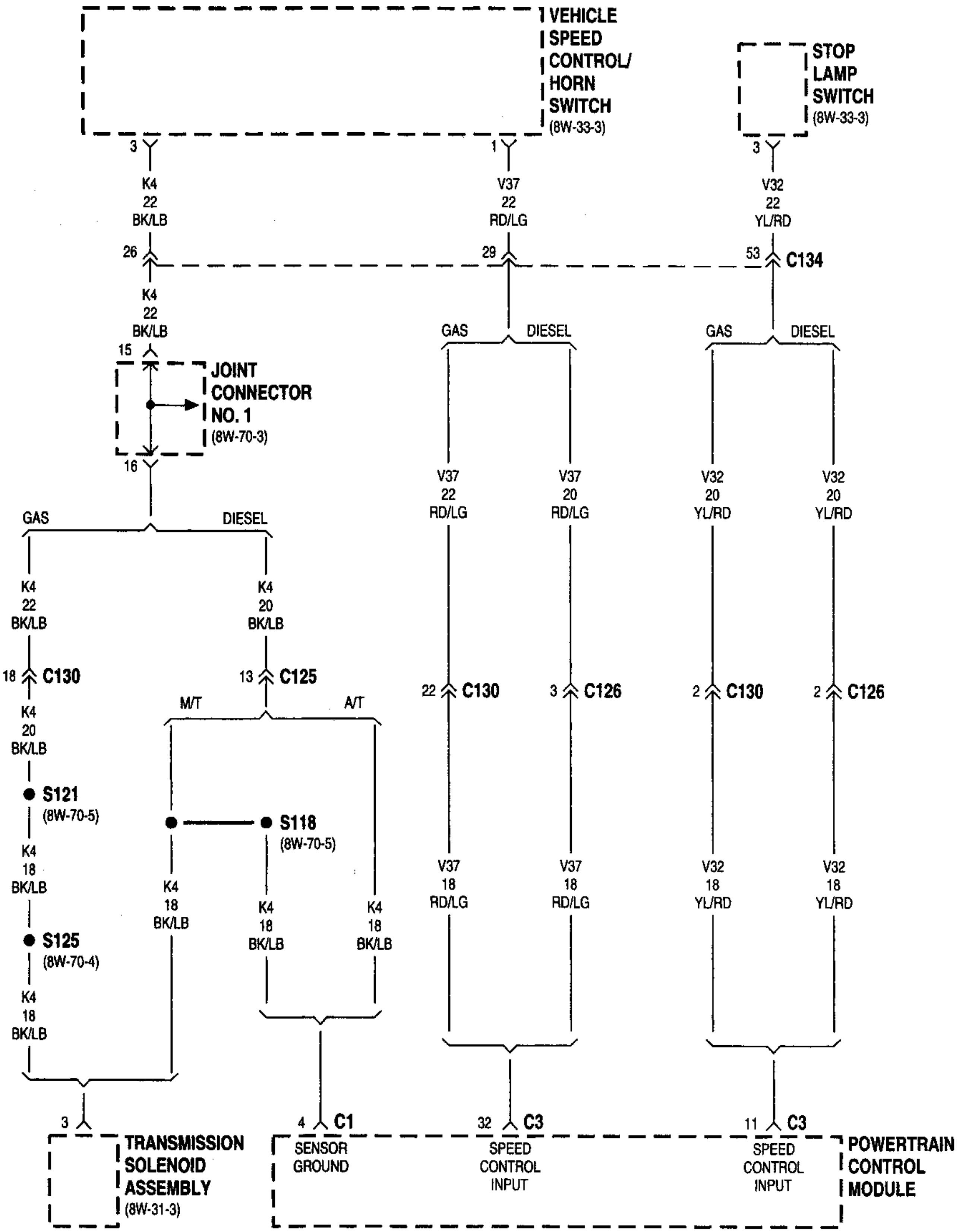
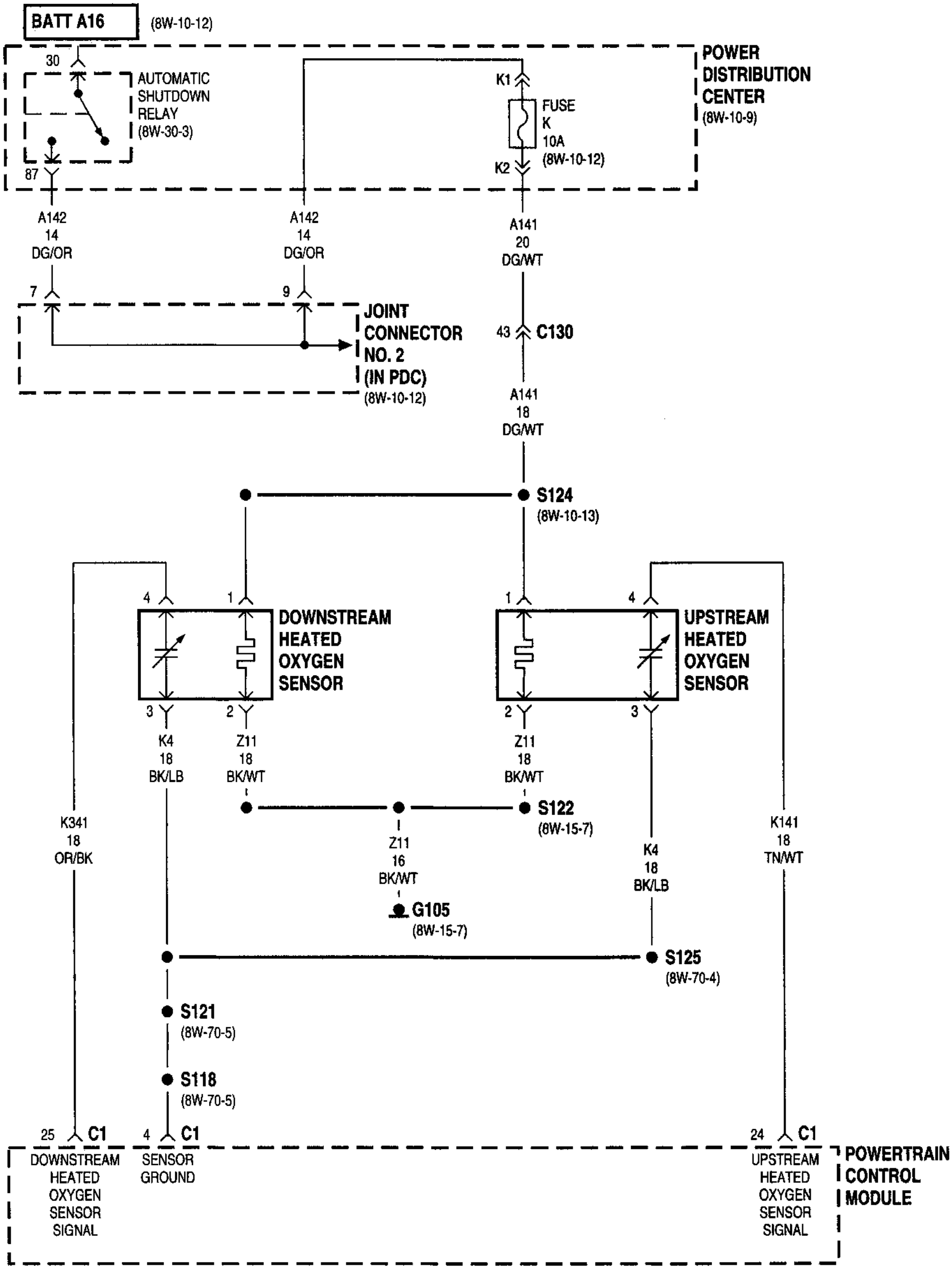
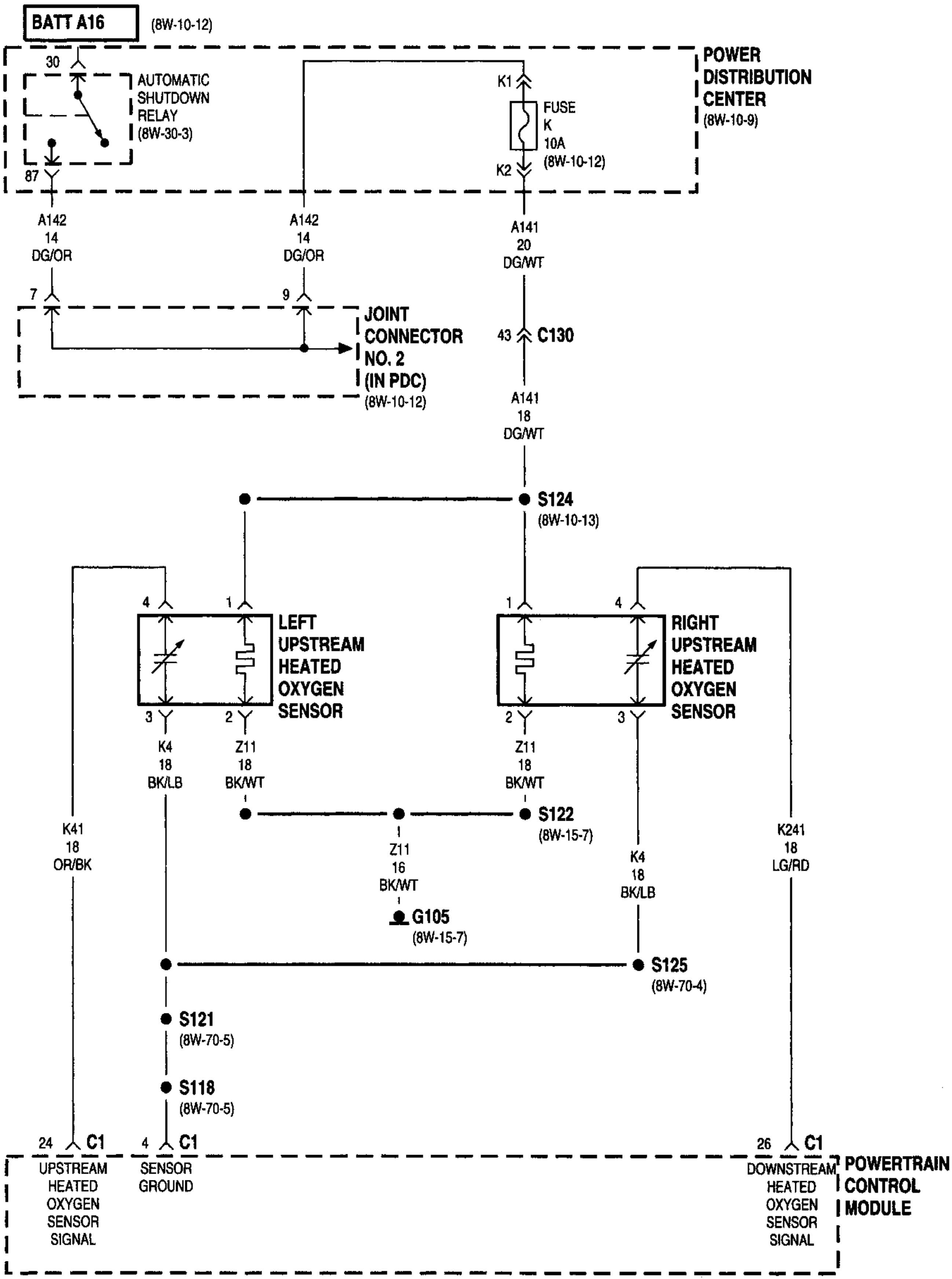


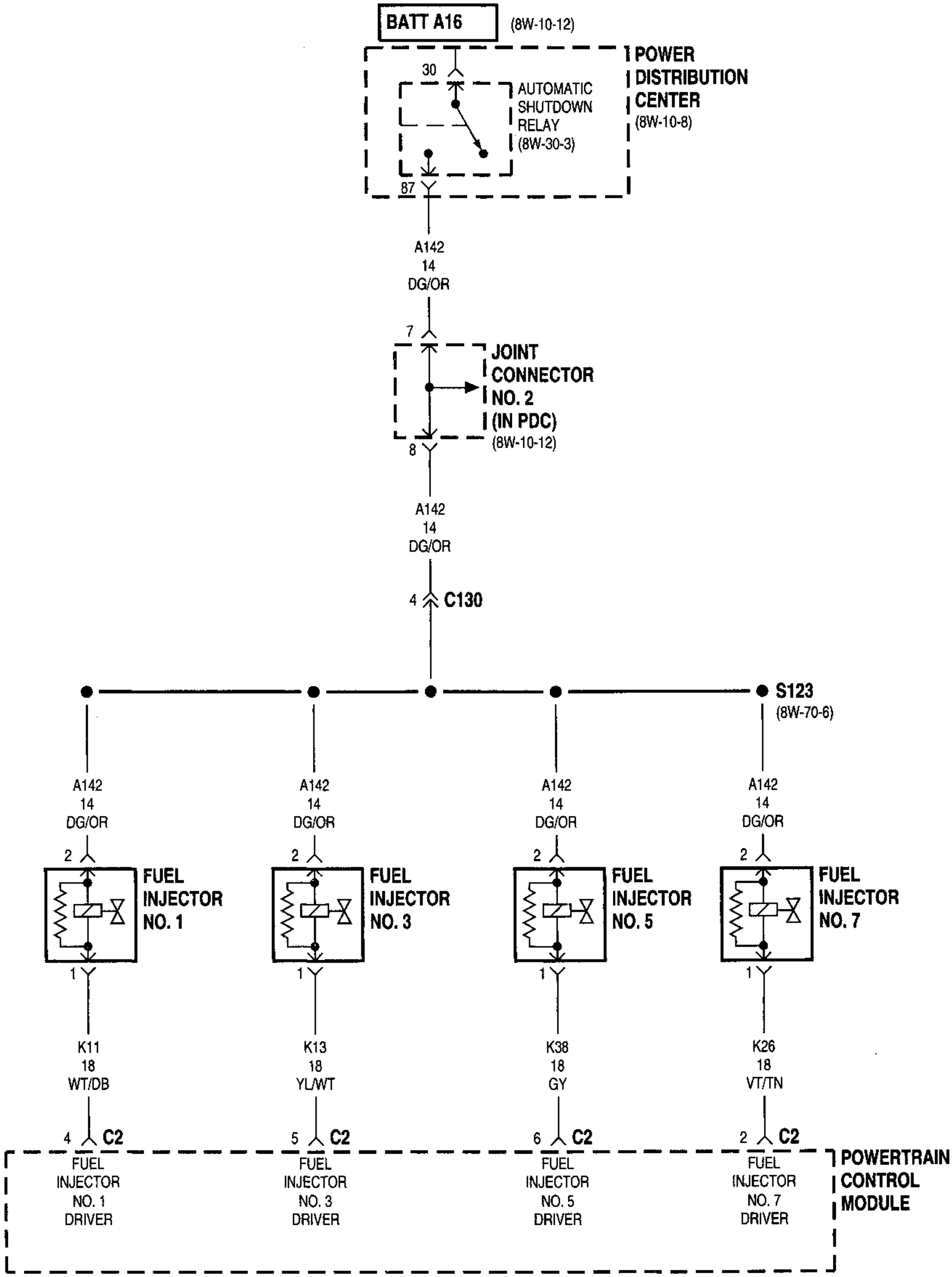
Mopar AUTHENTIC RESTORATION PRODUCT



Mopar AUTHENTIC RESTORATION PRODUCT



AUTHENTIC RESTORATION PRODUCT



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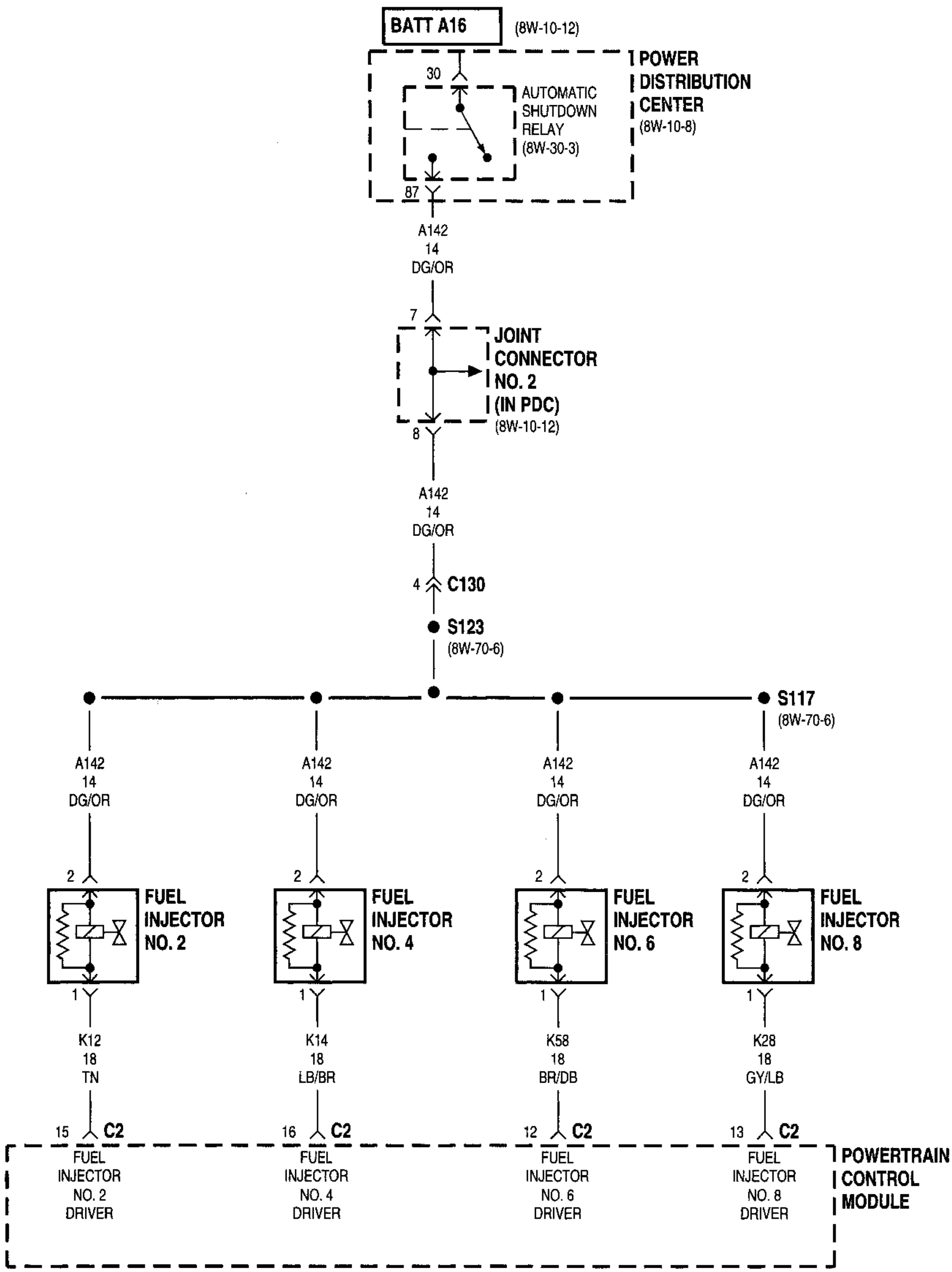
3.9L/5.2L/5.9L



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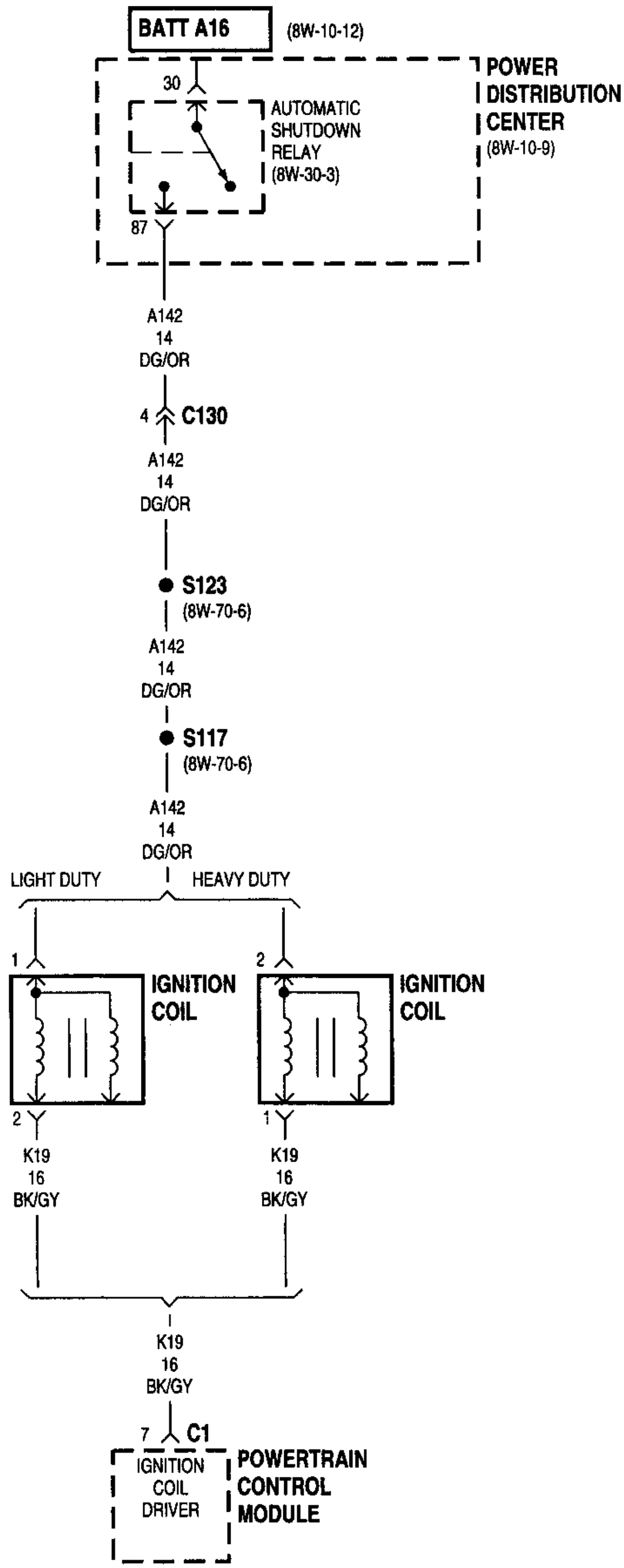
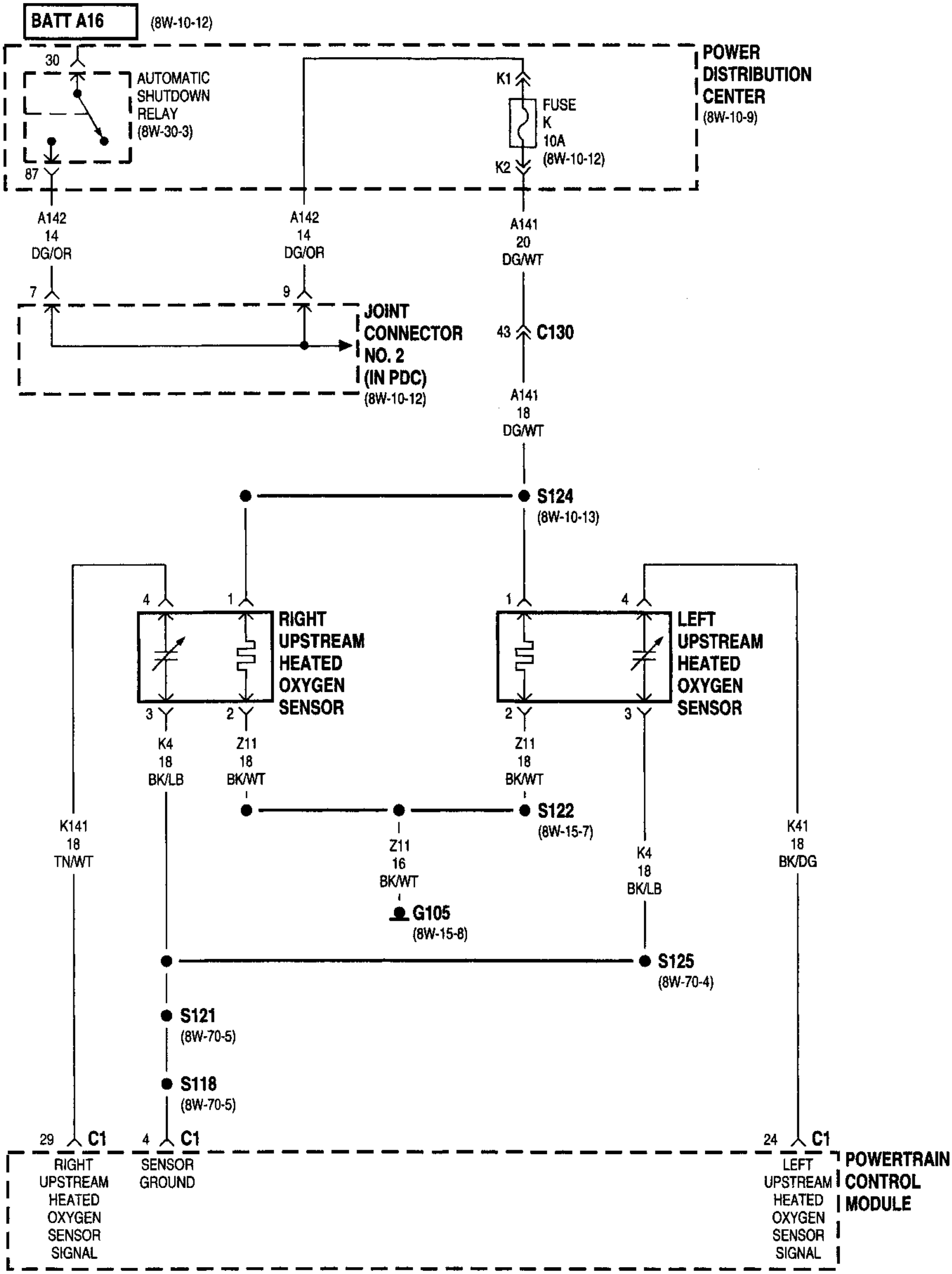
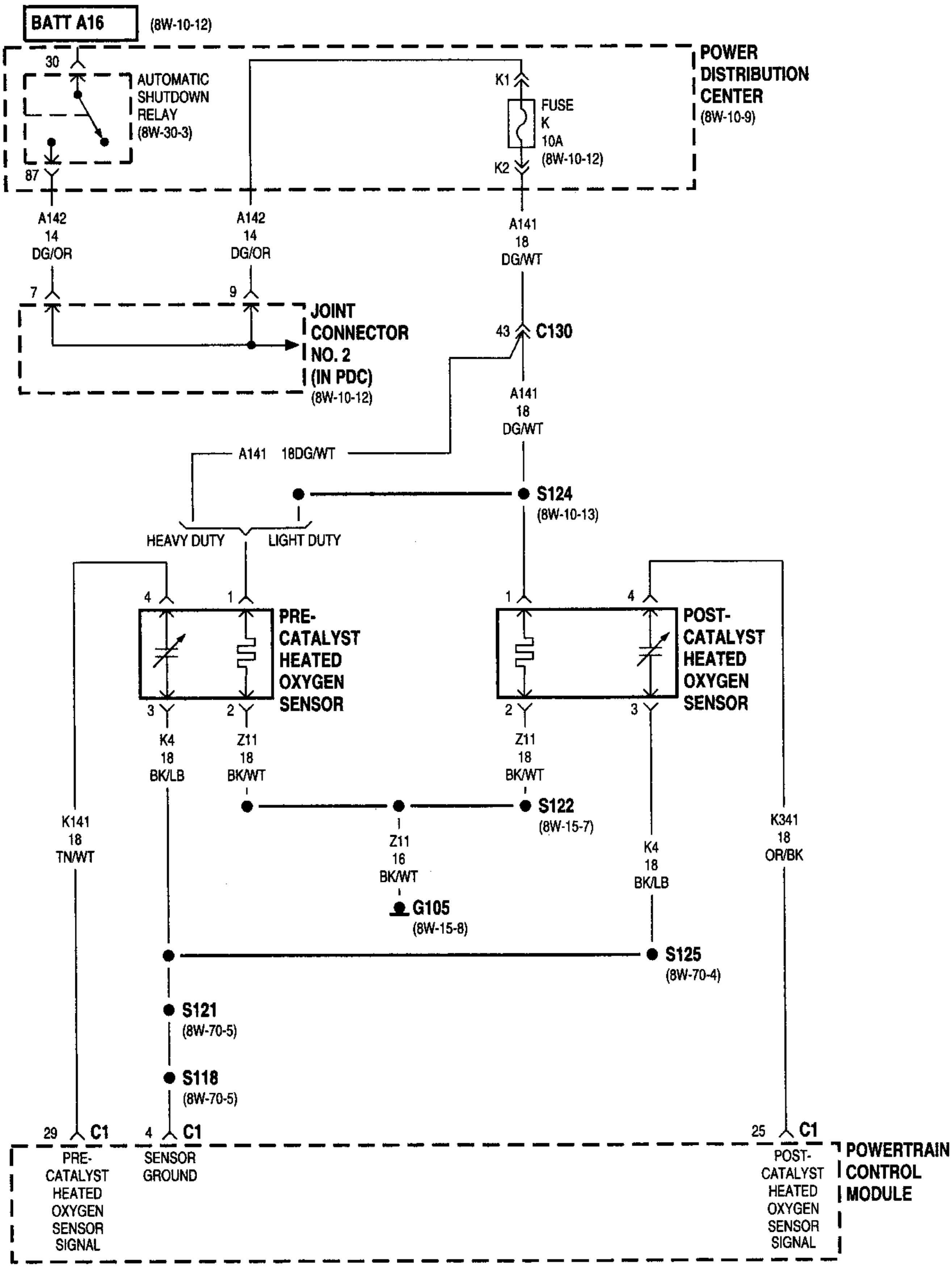
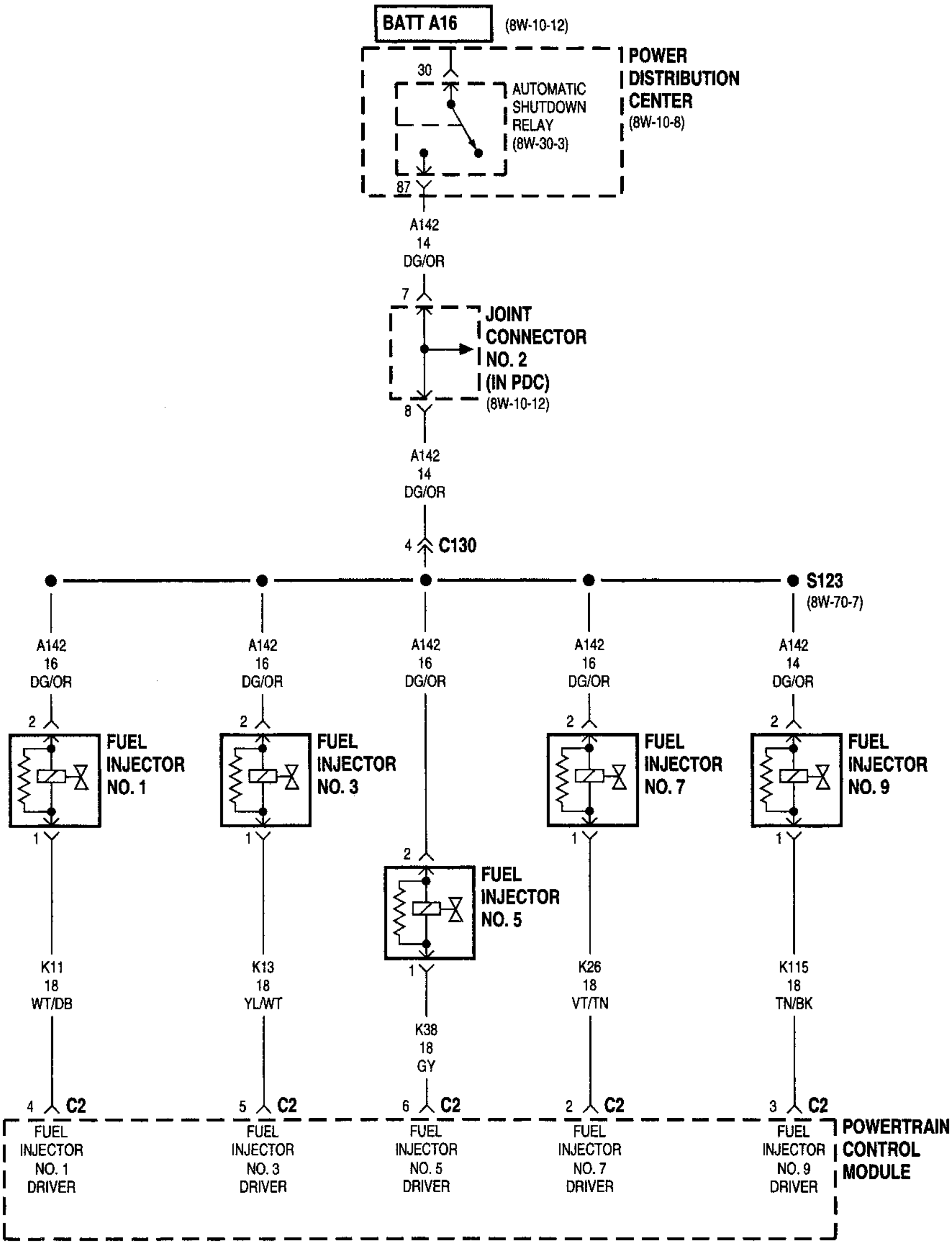

BATT A16
(8W-10-12)
POWER
DISTRIBUTION
CENTER
(8W-10-9)
30
AUTOMATIC
SHUTDOWN
RELAY
(8W-30-3)
87
A142
14
DG/OR
4
C130
A142
14
DG/OR
S123
(8W-70-6)
A142
14
DG/OR
S117
(8W-70-6)
A142
14
DG/OR
LIGHT DUTY
HEAVY DUTY
1
IGNITION
COIL
2
2
IGNITION
COIL
1
K19
16
BK/GY
K19
16
BK/GY
K19
16
BK/GY
7
C1
IGNITION
COIL
DRIVER
POWERTRAIN
CONTROL
MODULE

AUTHENTIC RESTORATION PRODUCT

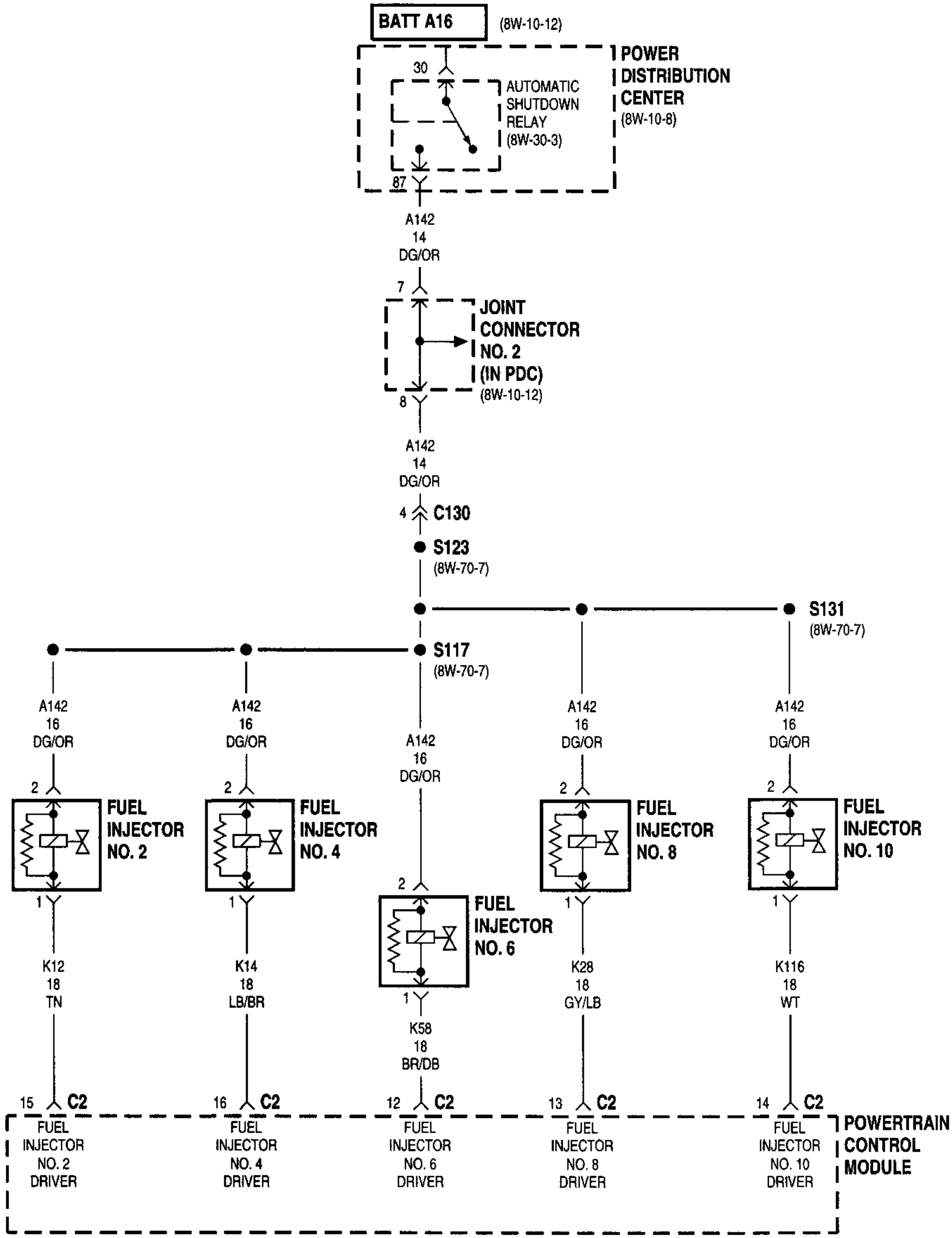
8.0L



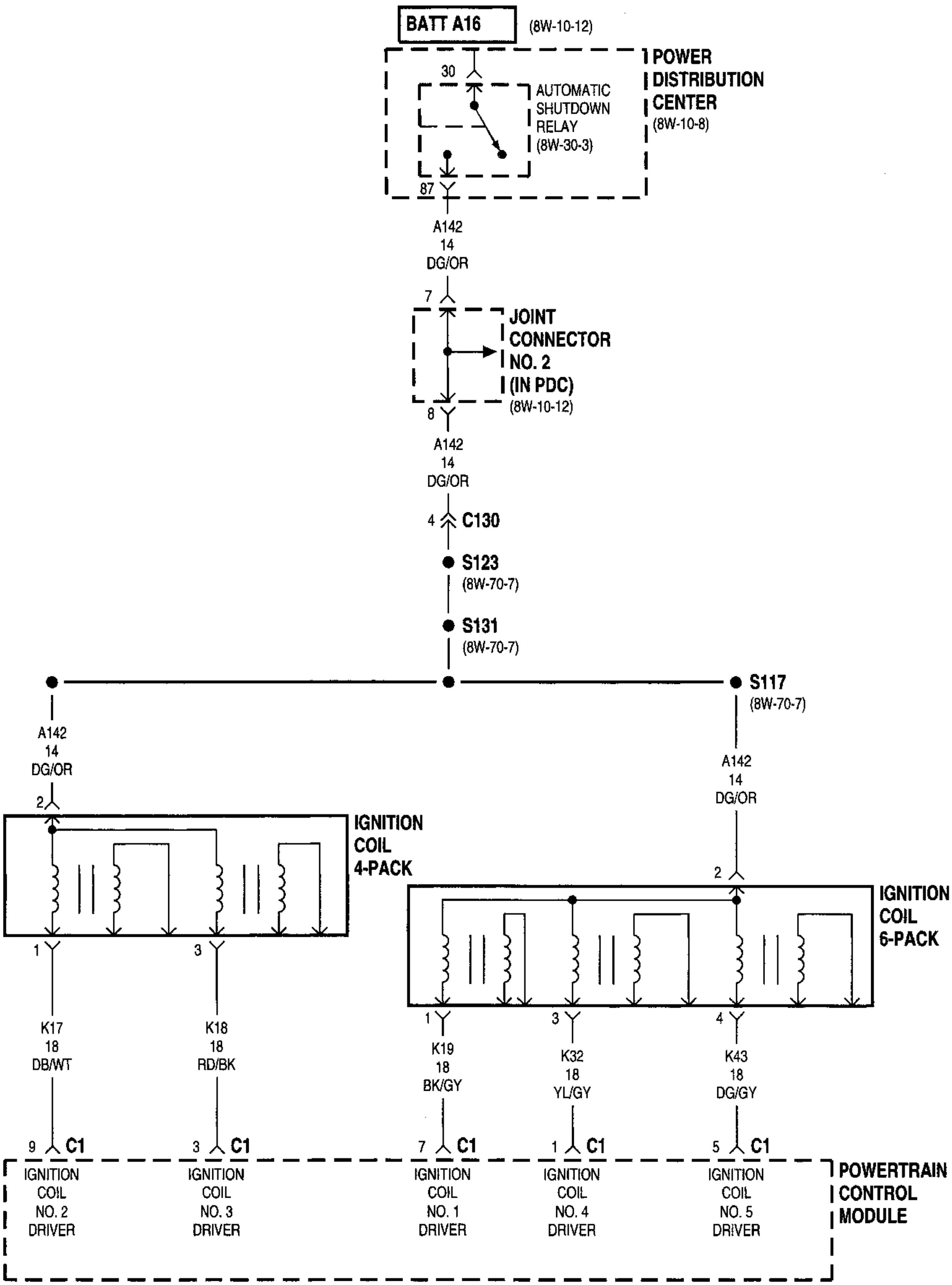

BATT A16
(8W-10-12)
30
AUTOMATIC SHUTDOWN RELAY
(8W-30-3)
87
K1
FUSE K 10A
(8W-10-12)
K2
POWER DISTRIBUTION CENTER
(8W-10-9)
A142 14 DG/OR
A142 14 DG/OR
A141 18 DG/WT
7
9
JOINT CONNECTOR NO. 2 (IN PDC)
(8W-10-12)
43
C130
A141 18 DG/WT
A141 18DG/WT
S124
(8W-10-13)
HEAVY DUTY
LIGHT DUTY
4
1
PRE-CATALYST HEATED OXYGEN SENSOR
1
4
POST-CATALYST HEATED OXYGEN SENSOR
3
2
2
3
K4 18 BK/LB
Z11 18 BK/WT
Z11 18 BK/WT
S122
(8W-15-7)
K141 18 TN/WT
Z11 16 BK/WT
G105
(8W-15-8)
K4 18 BK/LB
K341 18 OR/BK
S125
(8W-70-4)
S121
(8W-70-5)
S118
(8W-70-5)
29
C1
4
C1
25
C1
PRE-CATALYST HEATED OXYGEN SENSOR SIGNAL
SENSOR GROUND
POST-CATALYST HEATED OXYGEN SENSOR SIGNAL
POWERTRAIN CONTROL MODULE


BATT A16
(8W-10-12)
POWER
DISTRIBUTION
CENTER
(8W-10-8)
30
AUTOMATIC
SHUTDOWN
RELAY
(8W-30-3)
87
A142
14
DG/OR
7
JOINT
CONNECTOR
NO. 2
(IN PDC)
(8W-10-12)
8
A142
14
DG/OR
4
C130
S123
(8W-70-7)
A142
16
DG/OR
A142
16
DG/OR
A142
16
DG/OR
A142
16
DG/OR
A142
14
DG/OR
FUEL
INJECTOR
NO. 1
FUEL
INJECTOR
NO. 3
FUEL
INJECTOR
NO. 5
FUEL
INJECTOR
NO. 7
FUEL
INJECTOR
NO. 9
K11
18
WT/DB
K13
18
YL/WT
K38
18
GY
K26
18
VT/TN
K115
18
TN/BK
4 C2
5 C2
6 C2
2 C2
3 C2
FUEL
INJECTOR
NO. 1
DRIVER
FUEL
INJECTOR
NO. 3
DRIVER
FUEL
INJECTOR
NO. 5
DRIVER
FUEL
INJECTOR
NO. 7
DRIVER
FUEL
INJECTOR
NO. 9
DRIVER
POWERTRAIN
CONTROL
MODULE

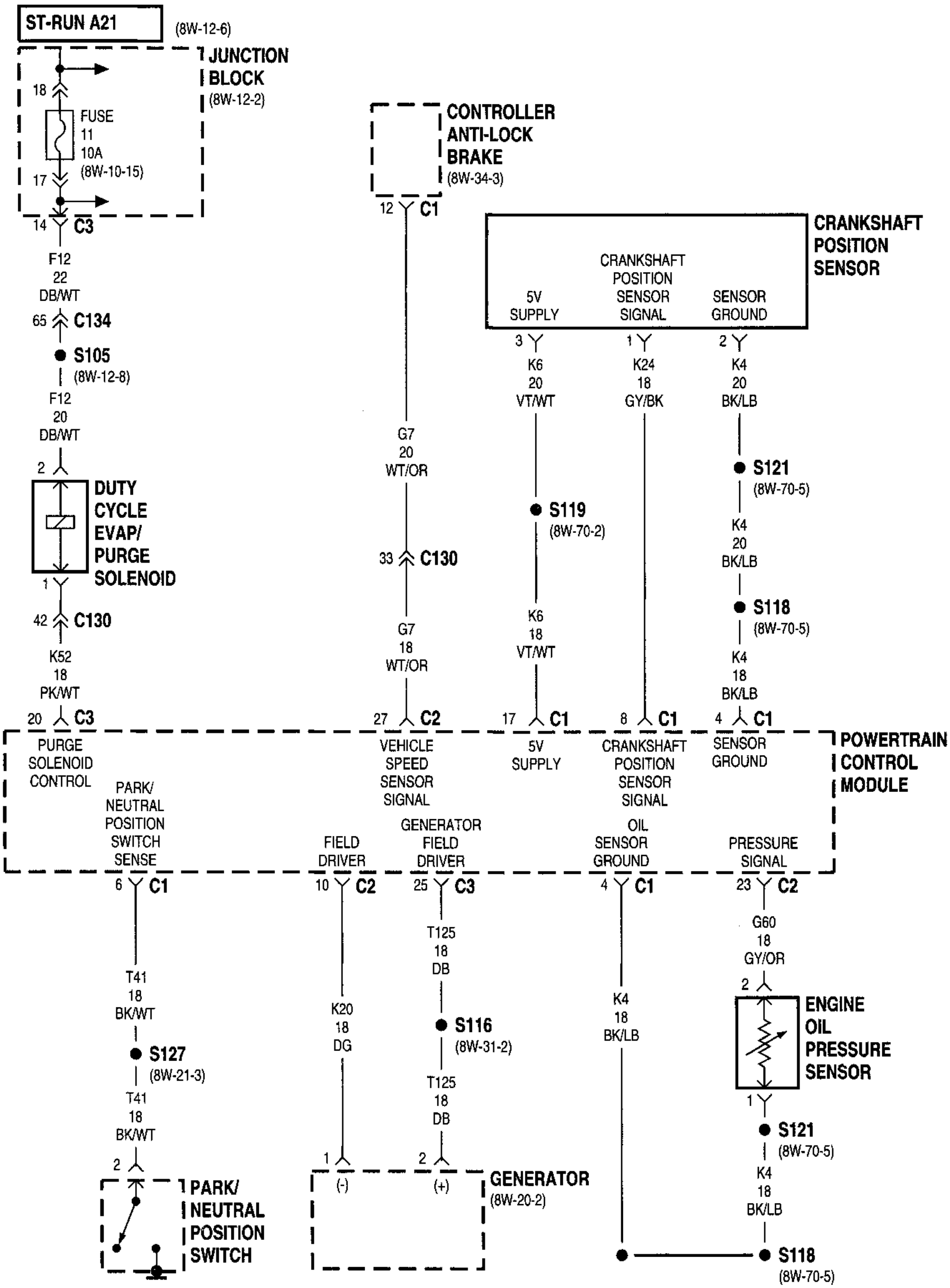
8.0L


BATT A16
(8W-10-12)
30
AUTOMATIC
SHUTDOWN
RELAY
(8W-30-3)
POWER
DISTRIBUTION
CENTER
(8W-10-8)
87
A142
14
DG/OR
7
JOINT
CONNECTOR
NO. 2
(IN PDC)
(8W-10-12)
8
A142
14
DG/OR
4
C130
S123
(8W-70-7)
S131
(8W-70-7)
S117
(8W-70-7)
A142
16
DG/OR
2
FUEL
INJECTOR
NO. 2
FUEL
INJECTOR
NO. 4
FUEL
INJECTOR
NO. 6
FUEL
INJECTOR
NO. 8
FUEL
INJECTOR
NO. 10
1
K12
18
TN
K14
18
LB/BR
K58
18
BR/DB
K28
18
GY/LB
K116
18
WT
15 C2
16 C2
12 C2
13 C2
14 C2
FUEL
INJECTOR
NO. 2
DRIVER
FUEL
INJECTOR
NO. 4
DRIVER
FUEL
INJECTOR
NO. 6
DRIVER
FUEL
INJECTOR
NO. 8
DRIVER
FUEL
INJECTOR
NO. 10
DRIVER
POWERTRAIN
CONTROL
MODULE

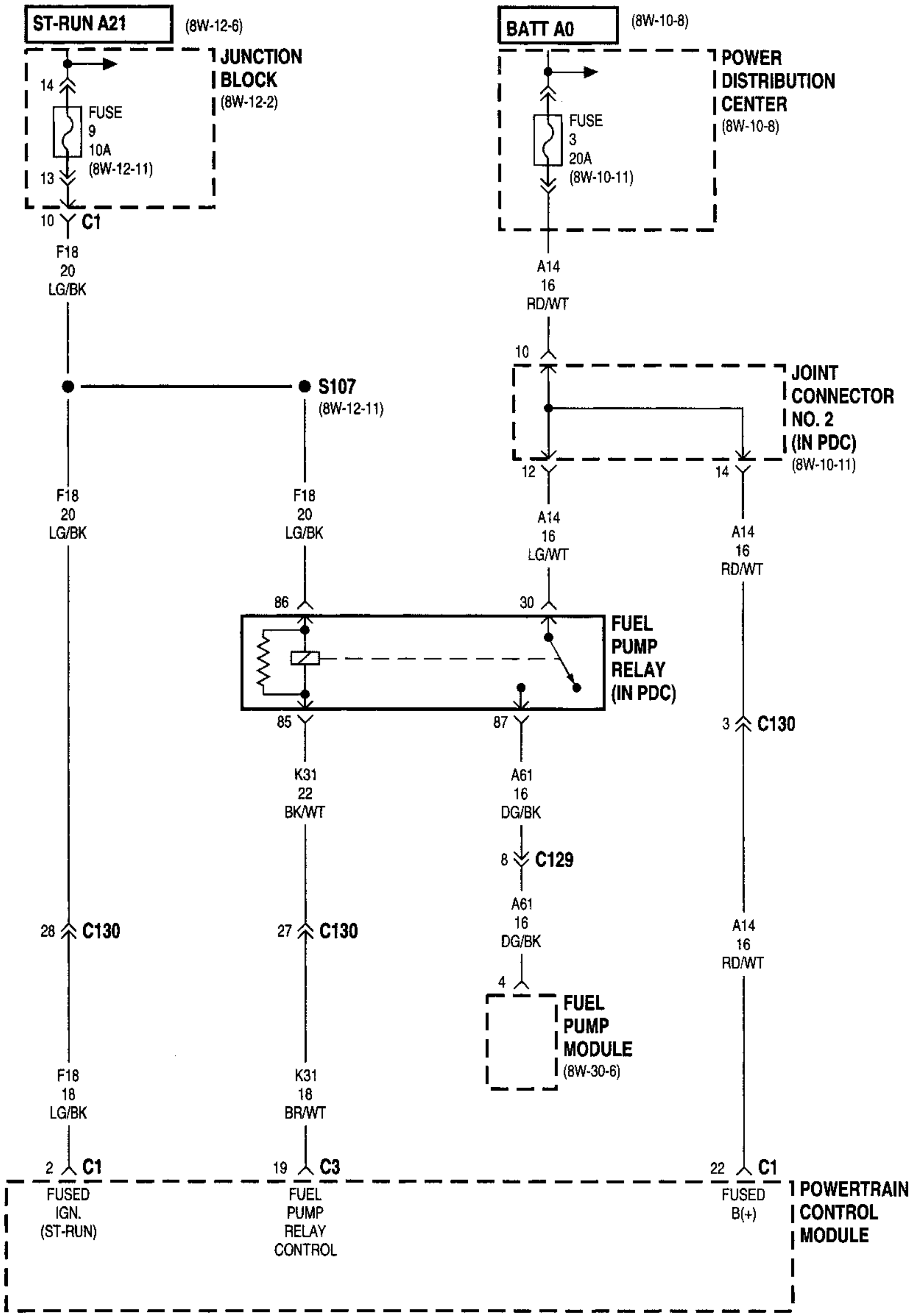
AUTHENTIC RESTORATION PRODUCT

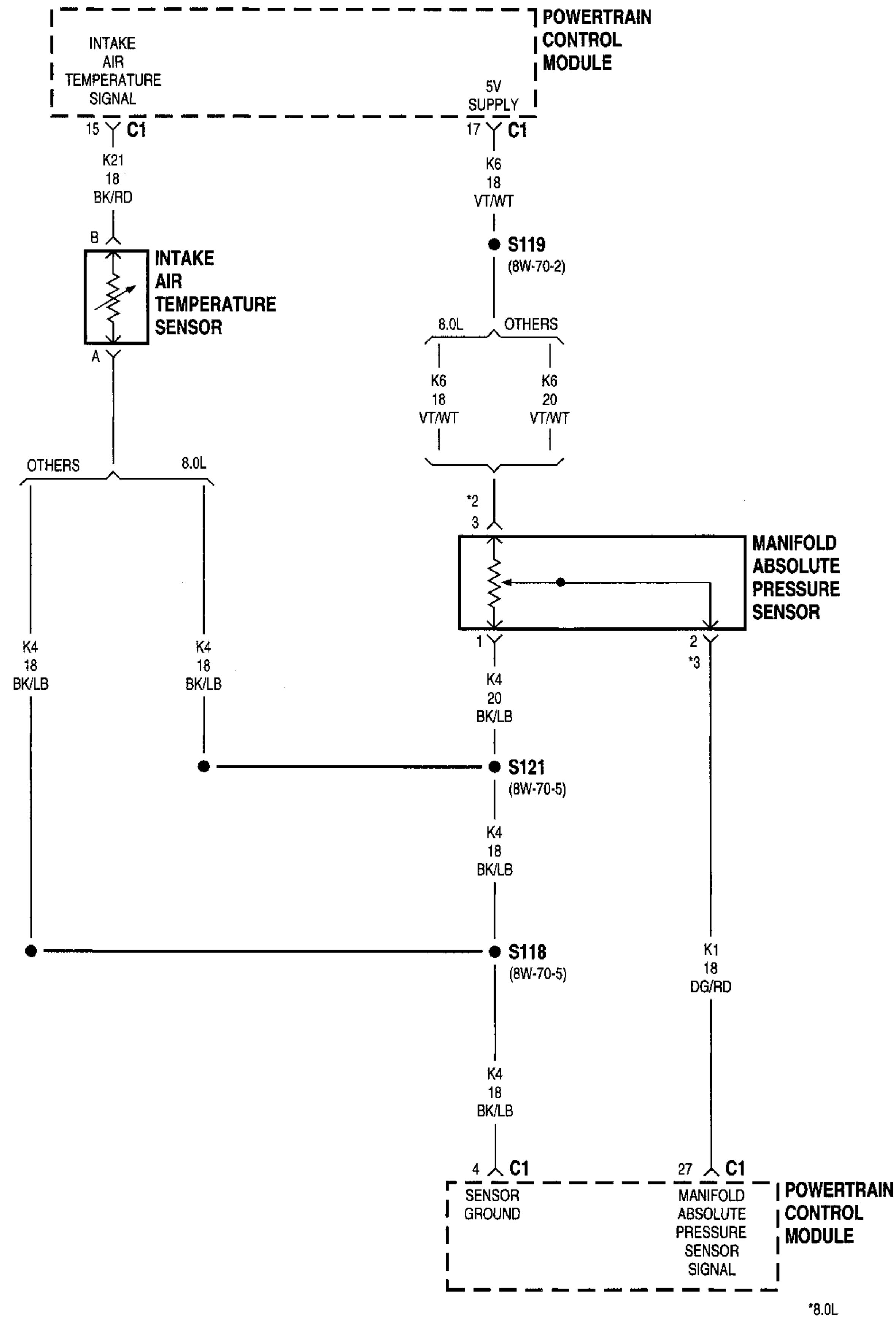


AUTHENTIC RESTORATION PRODUCT

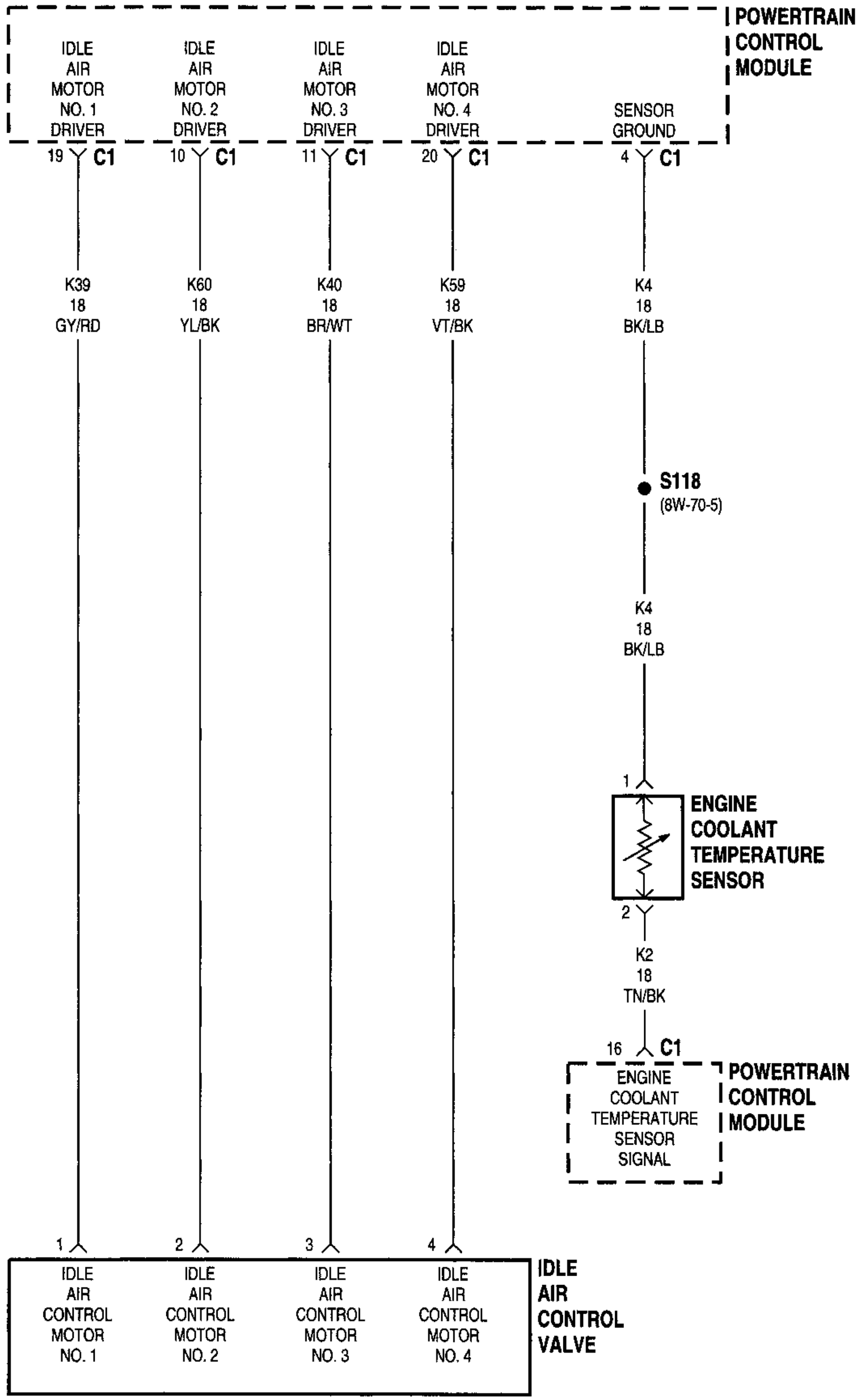


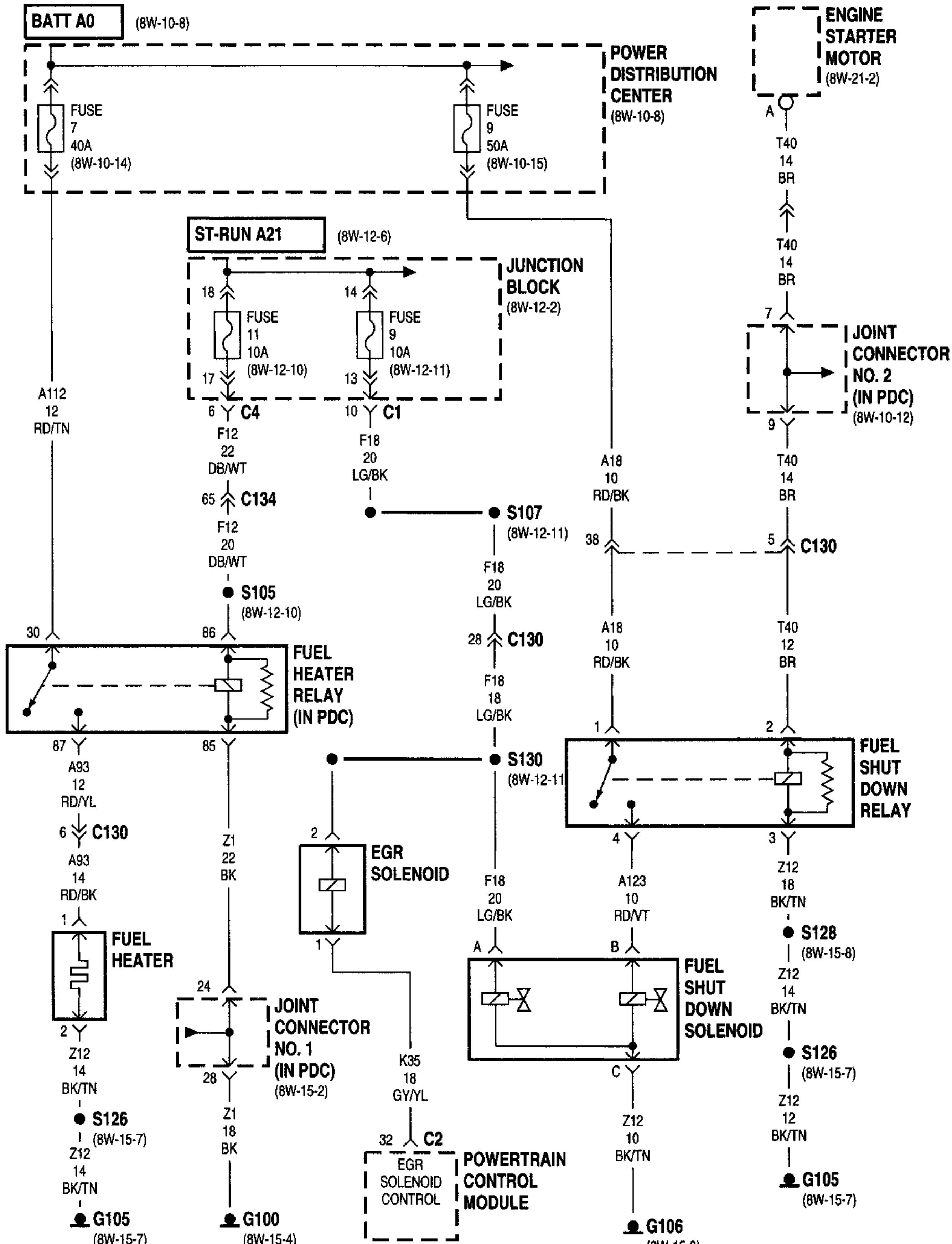
Mopar AUTHENTIC RESTORATION PRODUCT




POWERTRAIN CONTROL MODULE
INTAKE AIR TEMPERATURE SIGNAL
5V SUPPLY
15 C1
17 C1
K21 18 BK/RD
K6 18 VT/WT
B
INTAKE AIR TEMPERATURE SENSOR
A
S119 (8W-70-2)
8.0L
OTHERS
K6 18 VT/WT
K6 20 VT/WT
OTHERS
8.0L
K4 18 BK/LB
K4 18 BK/LB
*2
3
MANIFOLD ABSOLUTE PRESSURE SENSOR
1
2
*3
K4 20 BK/LB
S121 (8W-70-5)
K4 18 BK/LB
S118 (8W-70-5)
K1 18 DG/RD
K4 18 BK/LB
4 C1
27 C1
SENSOR GROUND
MANIFOLD ABSOLUTE PRESSURE SENSOR SIGNAL
POWERTRAIN CONTROL MODULE
*8.0L

AUTHENTIC RESTORATION PRODUCT




BATT A0
(8W-10-8)
POWER DISTRIBUTION CENTER
(8W-10-8)
FUSE 7 40A
(8W-10-14)
FUSE 9 50A
(8W-10-15)
ENGINE STARTER MOTOR
(8W-21-2)
A
T40 14 BR
T40 14 BR
ST-RUN A21
(8W-12-6)
JUNCTION BLOCK
(8W-12-2)
18
FUSE 11 10A
(8W-12-10)
17
14
FUSE 9 10A
(8W-12-11)
13
6 C4
10 C1
7
JOINT CONNECTOR NO. 2 (IN PDC)
(8W-10-12)
9
A112 12 RD/TN
F12 22 DB/WT
F18 20 LG/BK
A18 10 RD/BK
T40 14 BR
65 C134
S107
(8W-12-11)
38
5 C130
F12 20 DB/WT
S105
(8W-12-10)
F18 20 LG/BK
28 C130
A18 10 RD/BK
T40 12 BR
30
86
FUEL HEATER RELAY (IN PDC)
87
85
F18 18 LG/BK
S130
(8W-12-11)
1
2
FUEL SHUT DOWN RELAY
4
3
A93 12 RD/YL
6 C130
A93 14 RD/BK
Z1 22 BK
2
EGR SOLENOID
1
F18 20 LG/BK
A123 10 RD/VT
Z12 18 BK/TN
S128
(8W-15-8)
1
FUEL HEATER
2
A
B
FUEL SHUT DOWN SOLENOID
C
Z12 14 BK/TN
S126
(8W-15-7)
24
JOINT CONNECTOR NO. 1 (IN PDC)
(8W-15-2)
28
K35 18 GY/YL
Z12 14 BK/TN
S126
(8W-15-7)
Z12 14 BK/TN
Z1 18 BK
32 C2
EGR SOLENOID CONTROL
POWERTRAIN CONTROL MODULE
Z12 10 BK/TN
Z12 12 BK/TN
G105
(8W-15-7)
G105
(8W-15-7)
G100
(8W-15-4)
G106
(8W-15-8)

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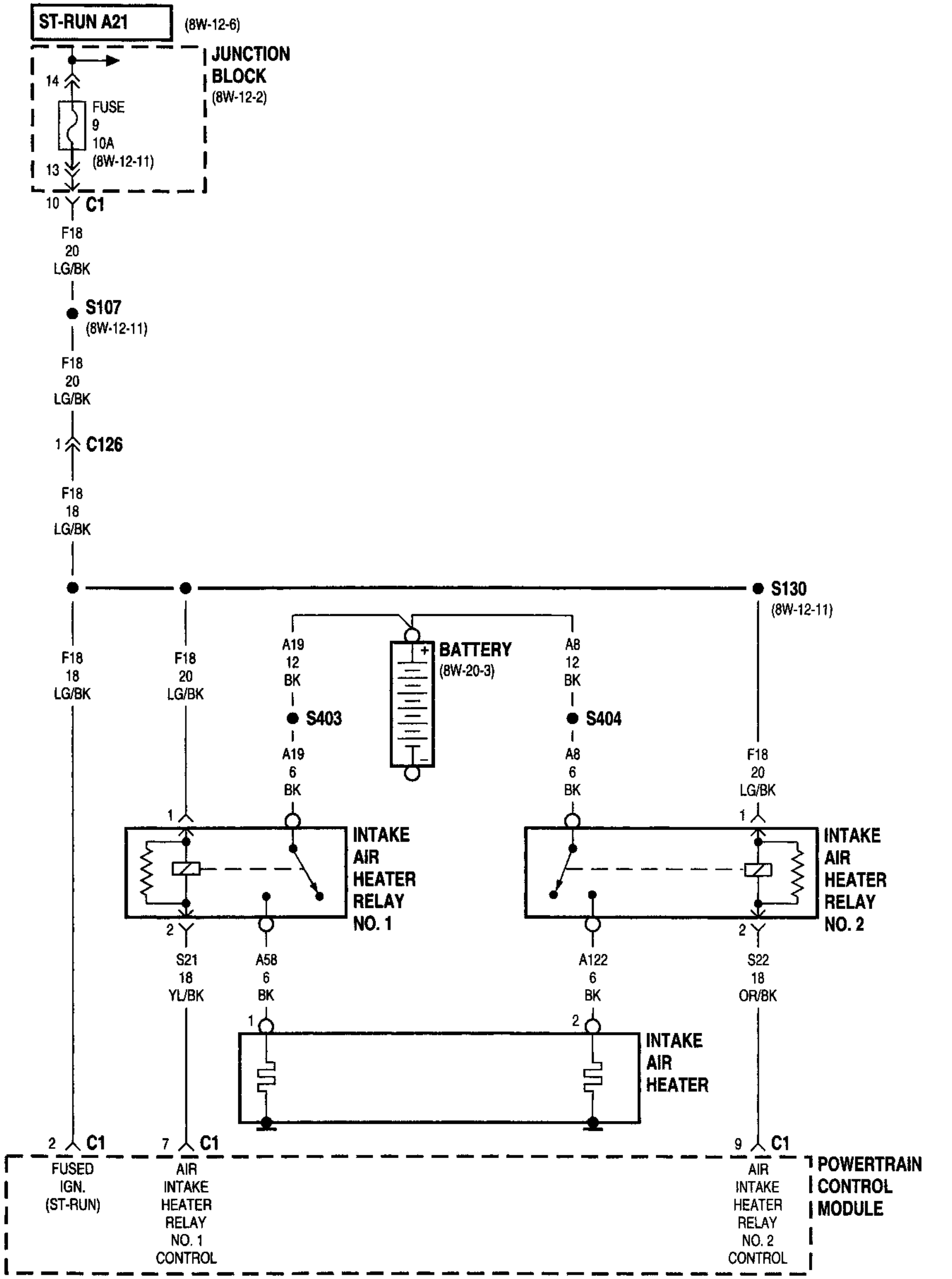

1108 J988W-9

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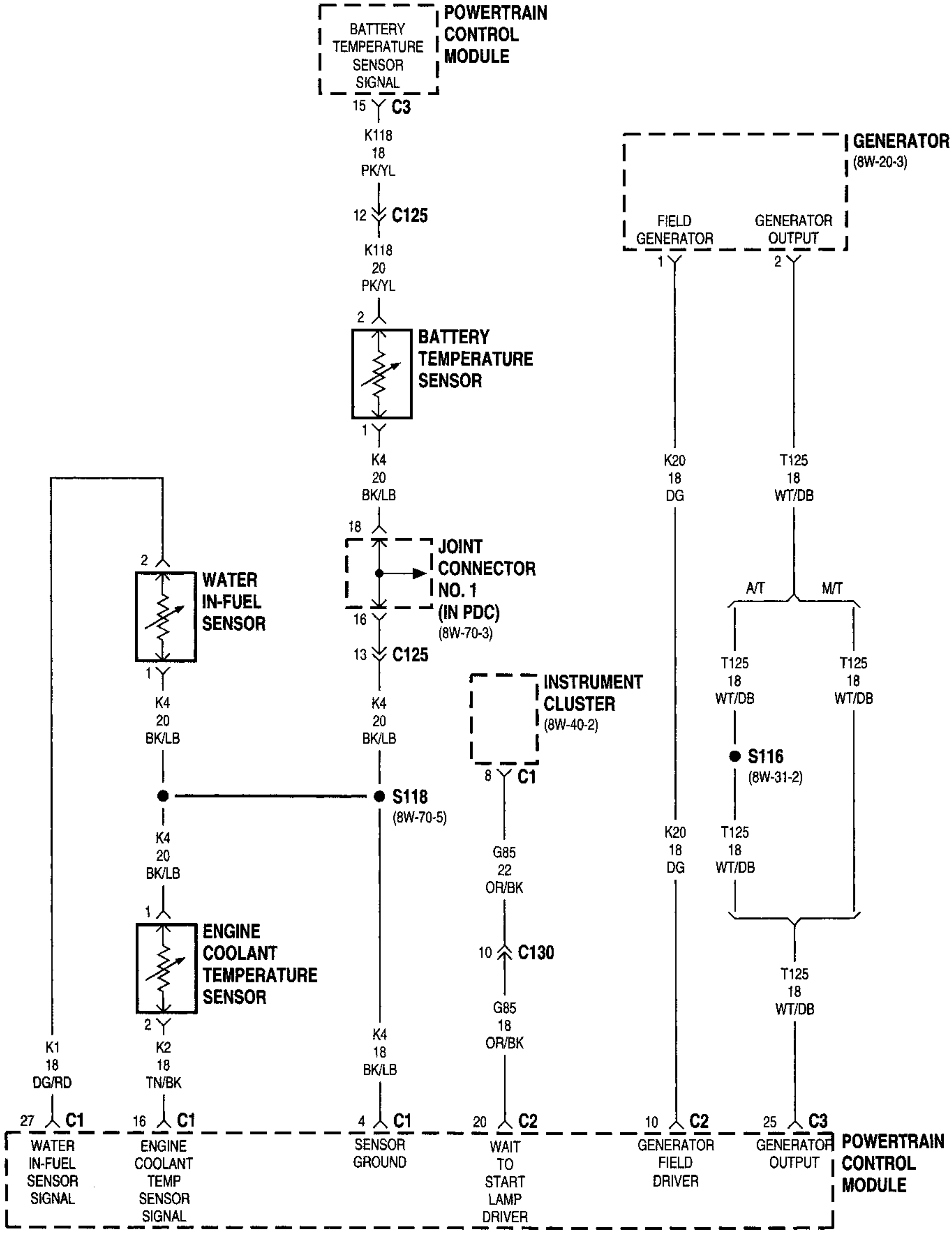

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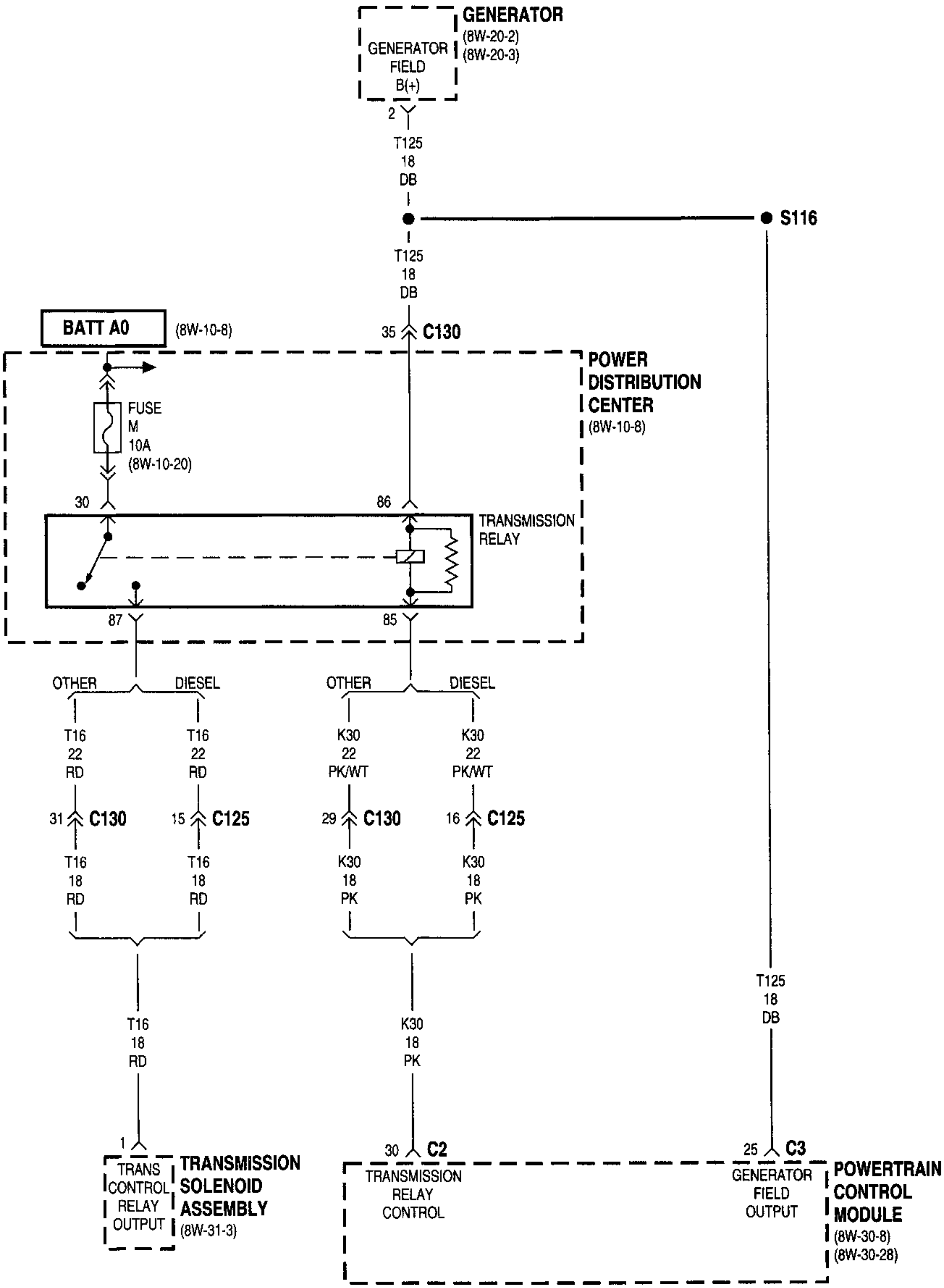
8W-31 TRANSMISSION CONTROLS


GENERATOR
(8W-20-2)
(8W-20-3)
GENERATOR FIELD B(+)
2
T125 18 DB
S116
T125 18 DB
35 C130
BATT A0
(8W-10-8)
POWER DISTRIBUTION CENTER
(8W-10-8)
FUSE M 10A (8W-10-20)
30
86
TRANSMISSION RELAY
87
85
OTHER
DIESEL
OTHER
DIESEL
T16 22 RD
T16 22 RD
K30 22 PK/WT
K30 22 PK/WT
31 C130
15 C125
29 C130
16 C125
T16 18 RD
T16 18 RD
K30 18 PK
K30 18 PK
T16 18 RD
K30 18 PK
T125 18 DB
1
TRANS CONTROL RELAY OUTPUT
TRANSMISSION SOLENOID ASSEMBLY
(8W-31-3)
30 C2
TRANSMISSION RELAY CONTROL
25 C3
GENERATOR FIELD OUTPUT
POWERTRAIN CONTROL MODULE
(8W-30-8)
(8W-30-28)

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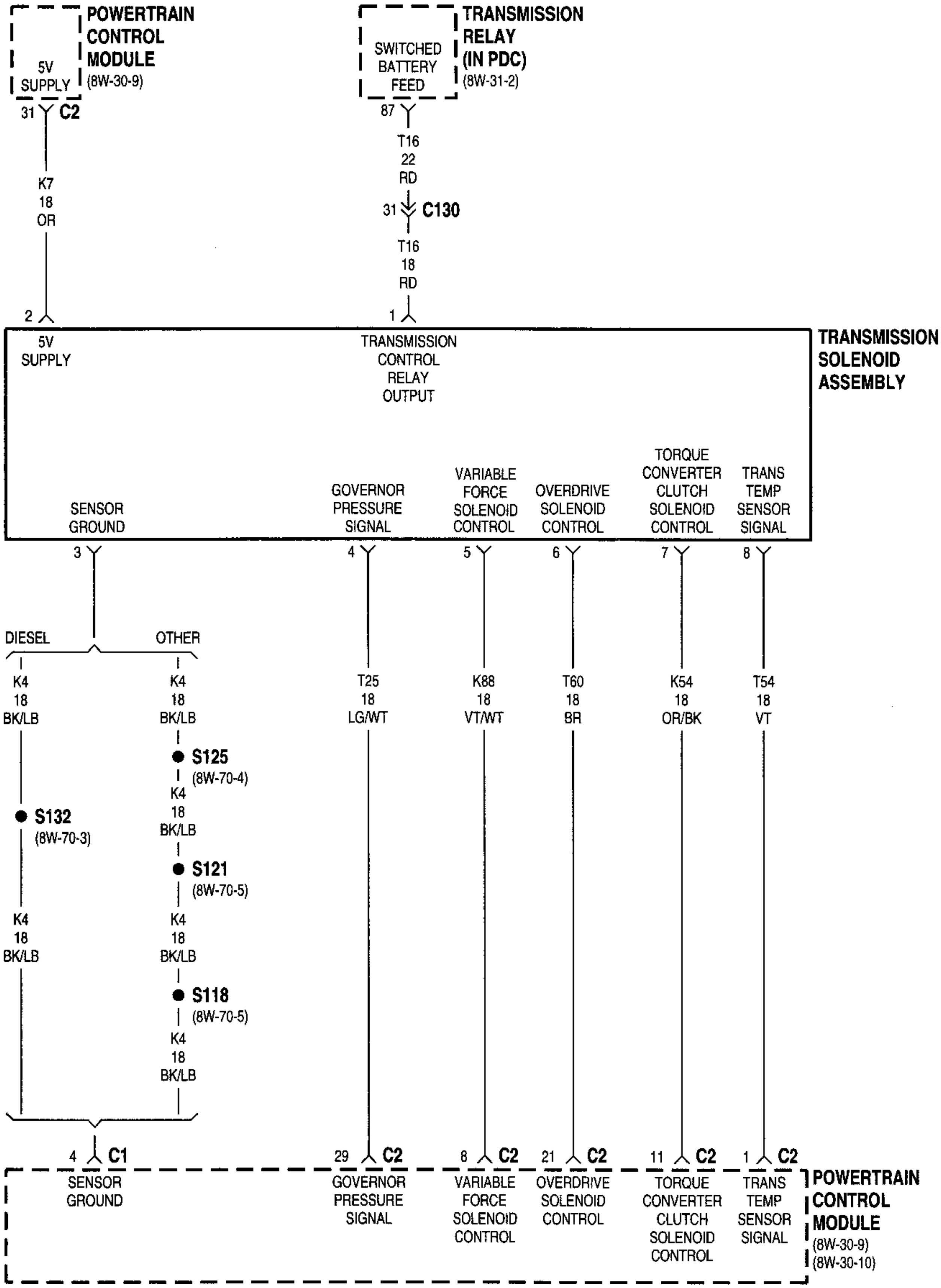
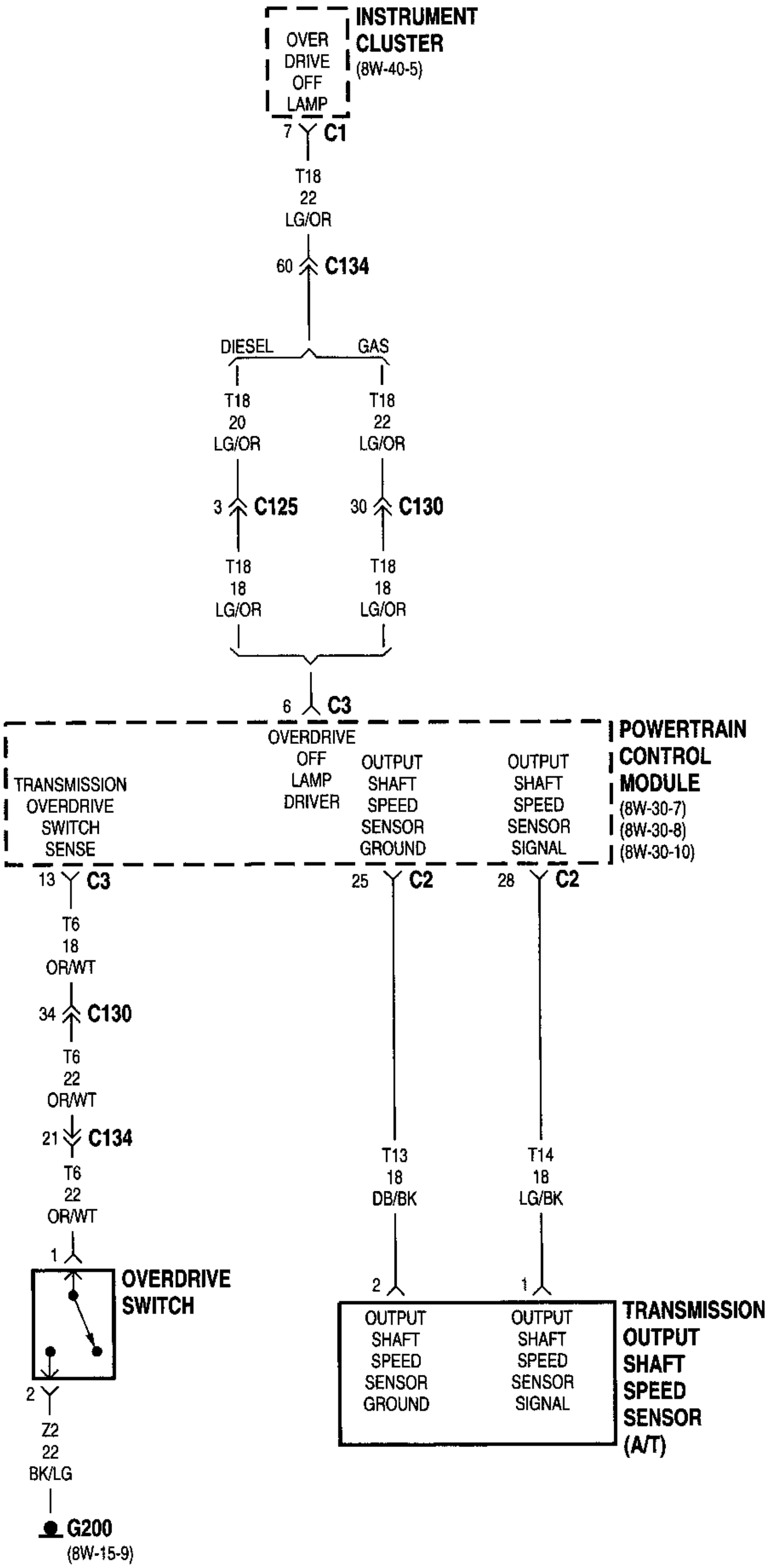
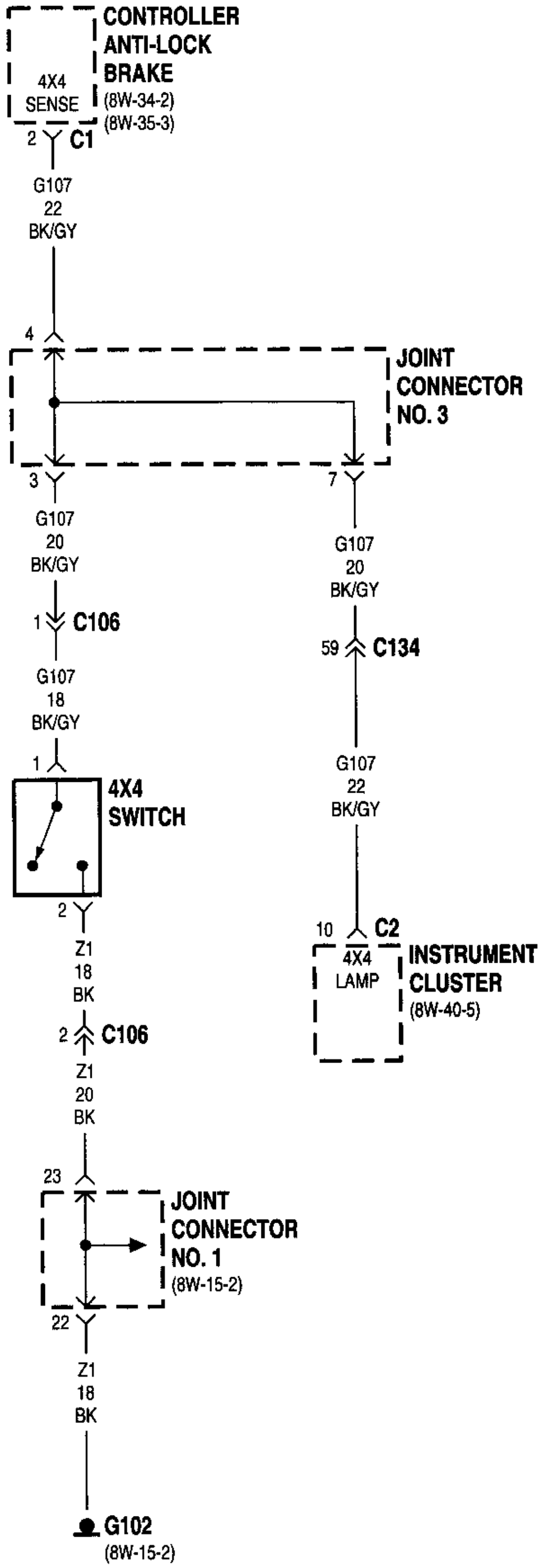



INSTRUMENT CLUSTER
(8W-40-5)
OVER DRIVE OFF LAMP
7 C1
T18 22 LG/OR
60 C134
DIESEL
GAS
T18 20 LG/OR
T18 22 LG/OR
3 C125
30 C130
T18 18 LG/OR
T18 18 LG/OR
6 C3
POWERTRAIN CONTROL MODULE
(8W-30-7)
(8W-30-8)
(8W-30-10)
TRANSMISSION OVERDRIVE SWITCH SENSE
OVERDRIVE OFF LAMP DRIVER
OUTPUT SHAFT SPEED SENSOR GROUND
OUTPUT SHAFT SPEED SENSOR SIGNAL
13 C3
25 C2
28 C2
T6 18 OR/WT
34 C130
T6 22 OR/WT
21 C134
T6 22 OR/WT
T13 18 DB/BK
T14 18 LG/BK
1
OVERDRIVE SWITCH
2
Z2 22 BK/LG
G200
(8W-15-9)
2
1
OUTPUT SHAFT SPEED SENSOR GROUND
OUTPUT SHAFT SPEED SENSOR SIGNAL
TRANSMISSION OUTPUT SHAFT SPEED SENSOR (A/T)

AUTHENTIC RESTORATION PRODUCT



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8W-33 VEHICLE SPEED CONTROL

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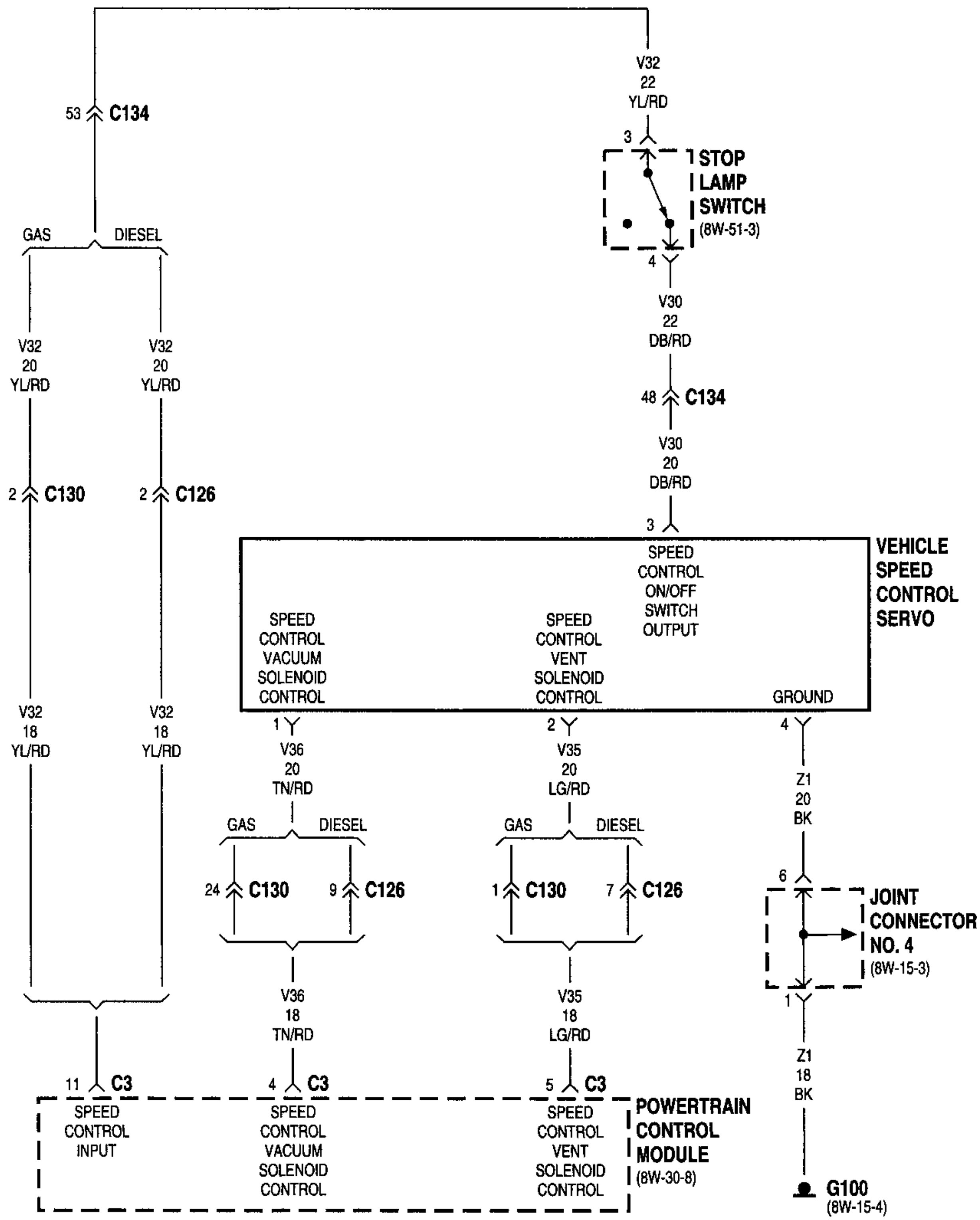

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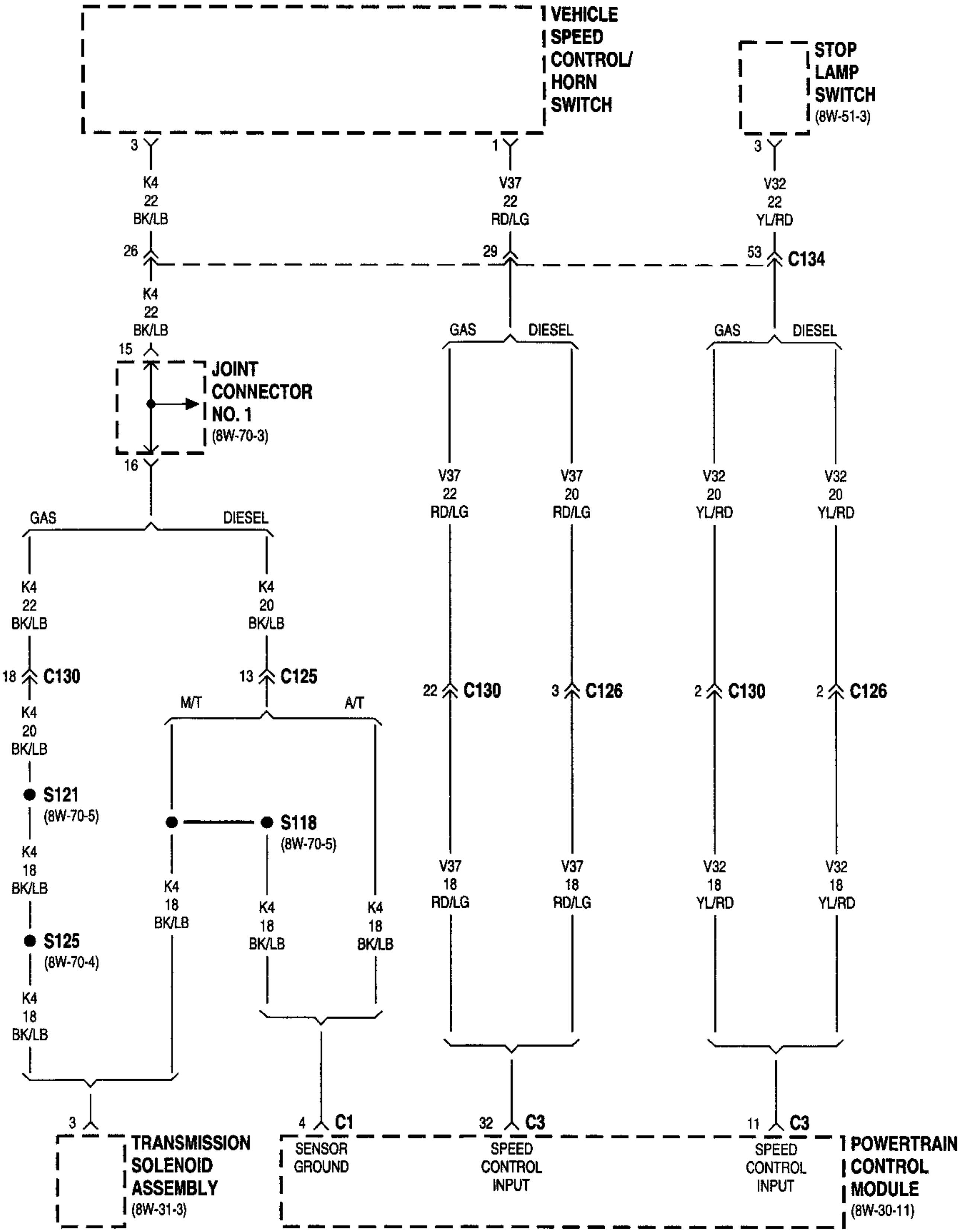

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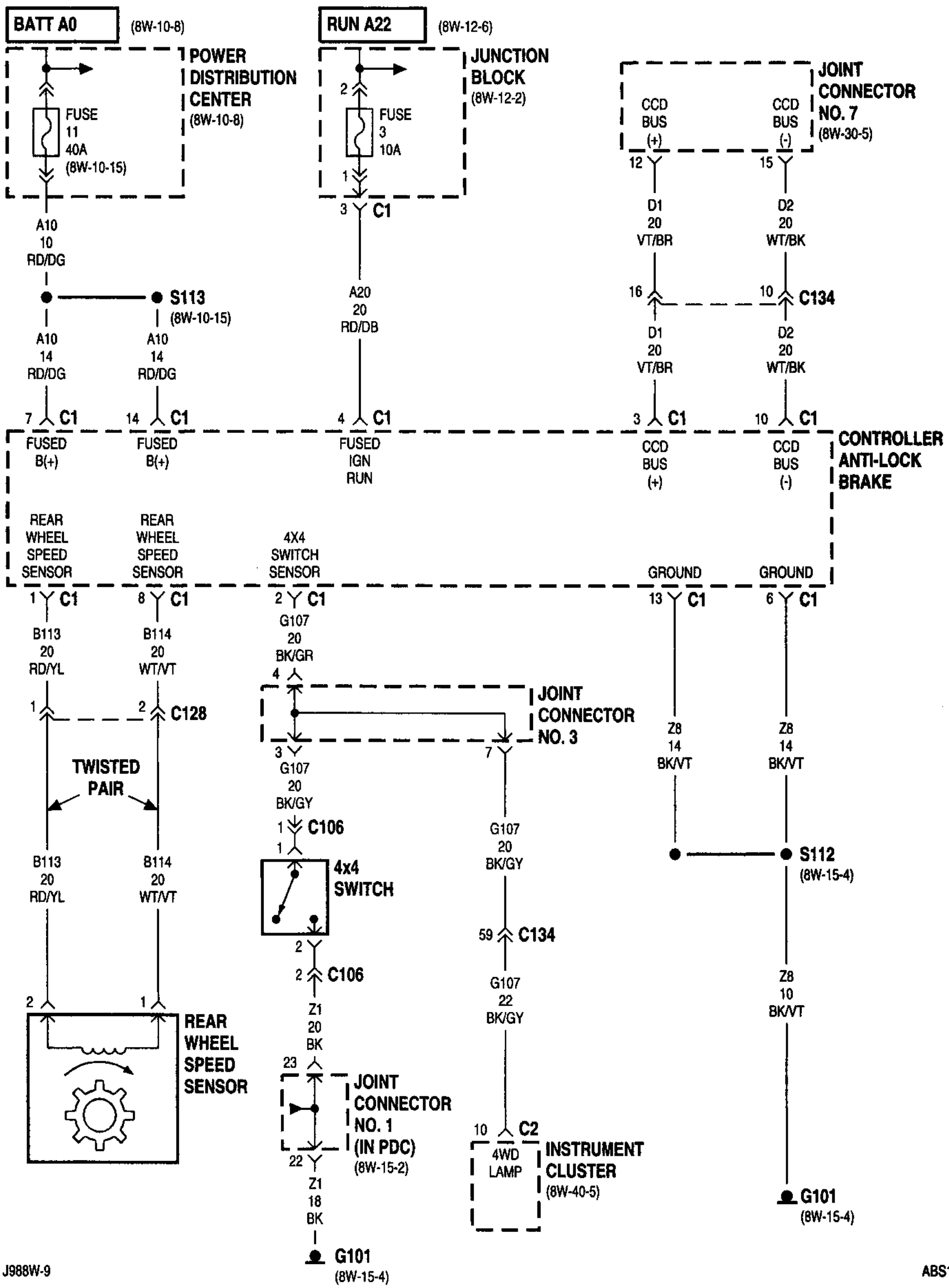
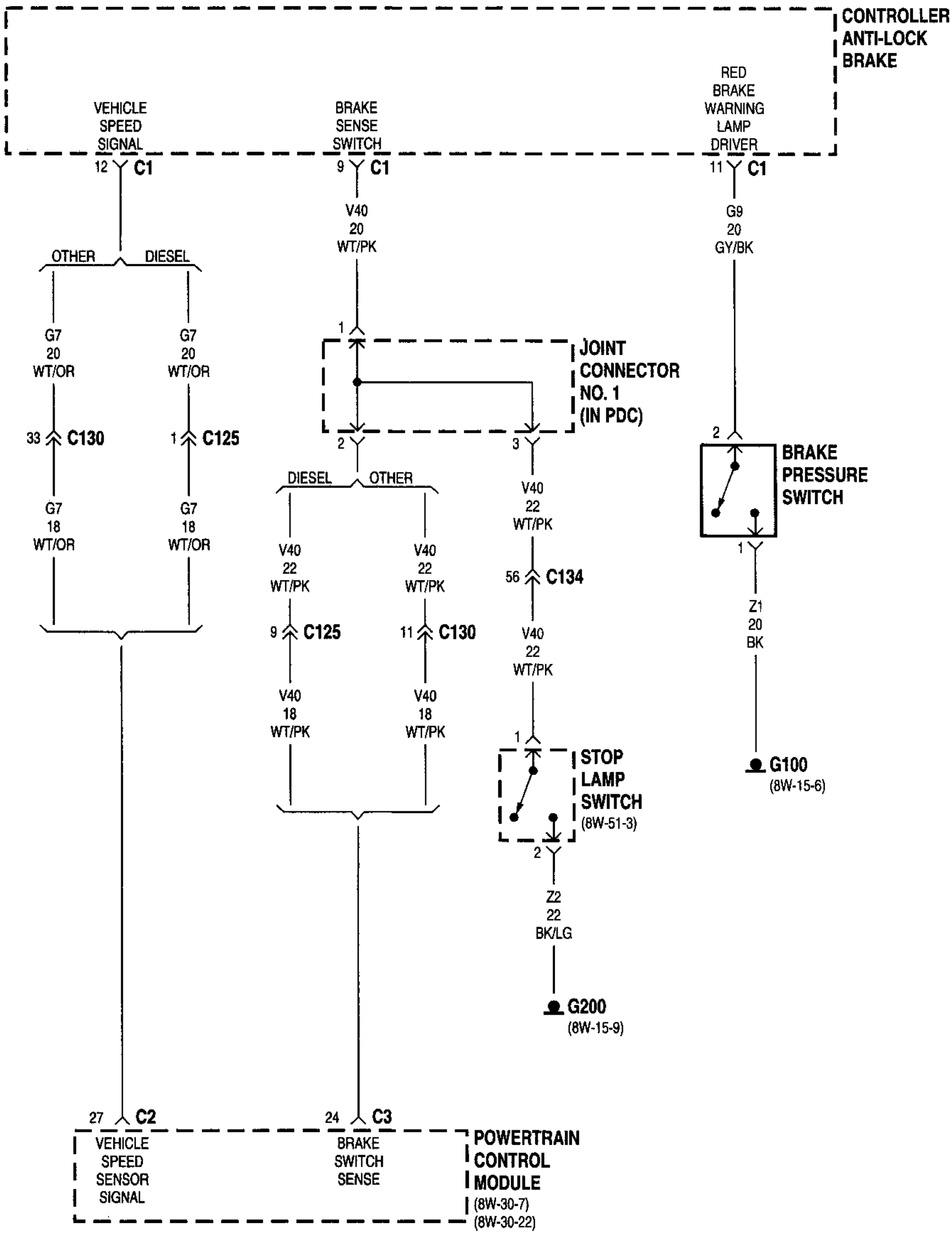
8W-34 REAR WHEEL ANTI-LOCK BRAKES


BATT A0
(8W-10-8)
POWER DISTRIBUTION CENTER
(8W-10-8)
FUSE
11
40A
(8W-10-15)
RUN A22
(8W-12-6)
JUNCTION BLOCK
(8W-12-2)
FUSE
3
10A
JOINT CONNECTOR NO. 7
(8W-30-5)
CCD BUS (+)
CCD BUS (-)
A10
10
RD/DG
S113
(8W-10-15)
A10
14
RD/DG
A20
20
RD/DB
D1
20
VT/BR
D2
20
WT/BK
C134
C1
CONTROLLER ANTI-LOCK BRAKE
FUSED B(+)
FUSED IGN RUN
REAR WHEEL SPEED SENSOR
4X4 SWITCH SENSOR
GROUND
B113
20
RD/YL
B114
20
WT/VT
G107
20
BK/GR
C128
JOINT CONNECTOR NO. 3
TWISTED PAIR
G107
20
BK/GY
C106
4x4 SWITCH
Z8
14
BK/VT
S112
(8W-15-4)
C134
G107
22
BK/GY
Z8
10
BK/VT
Z1
20
BK
REAR WHEEL SPEED SENSOR
JOINT CONNECTOR NO. 1 (IN PDC)
(8W-15-2)
C2
4WD LAMP
INSTRUMENT CLUSTER
(8W-40-5)
Z1
18
BK
G101
(8W-15-4)


CONTROLLER ANTI-LOCK BRAKE
VEHICLE SPEED SIGNAL
BRAKE SENSE SWITCH
RED BRAKE WARNING LAMP DRIVER
12 C1
9 C1
11 C1
V40 20 WT/PK
G9 20 GY/BK
OTHER
DIESEL
G7 20 WT/OR
G7 20 WT/OR
33 C130
1 C125
G7 18 WT/OR
G7 18 WT/OR
JOINT CONNECTOR NO. 1 (IN PDC)
1
2
3
DIESEL
OTHER
V40 22 WT/PK
V40 22 WT/PK
9 C125
11 C130
V40 18 WT/PK
V40 18 WT/PK
V40 22 WT/PK
56 C134
V40 22 WT/PK
STOP LAMP SWITCH (8W-51-3)
Z2 22 BK/LG
G200 (8W-15-9)
BRAKE PRESSURE SWITCH
Z1 20 BK
G100 (8W-15-6)
27 C2
24 C3
VEHICLE SPEED SENSOR SIGNAL
BRAKE SWITCH SENSE
POWERTRAIN CONTROL MODULE (8W-30-7) (8W-30-22)

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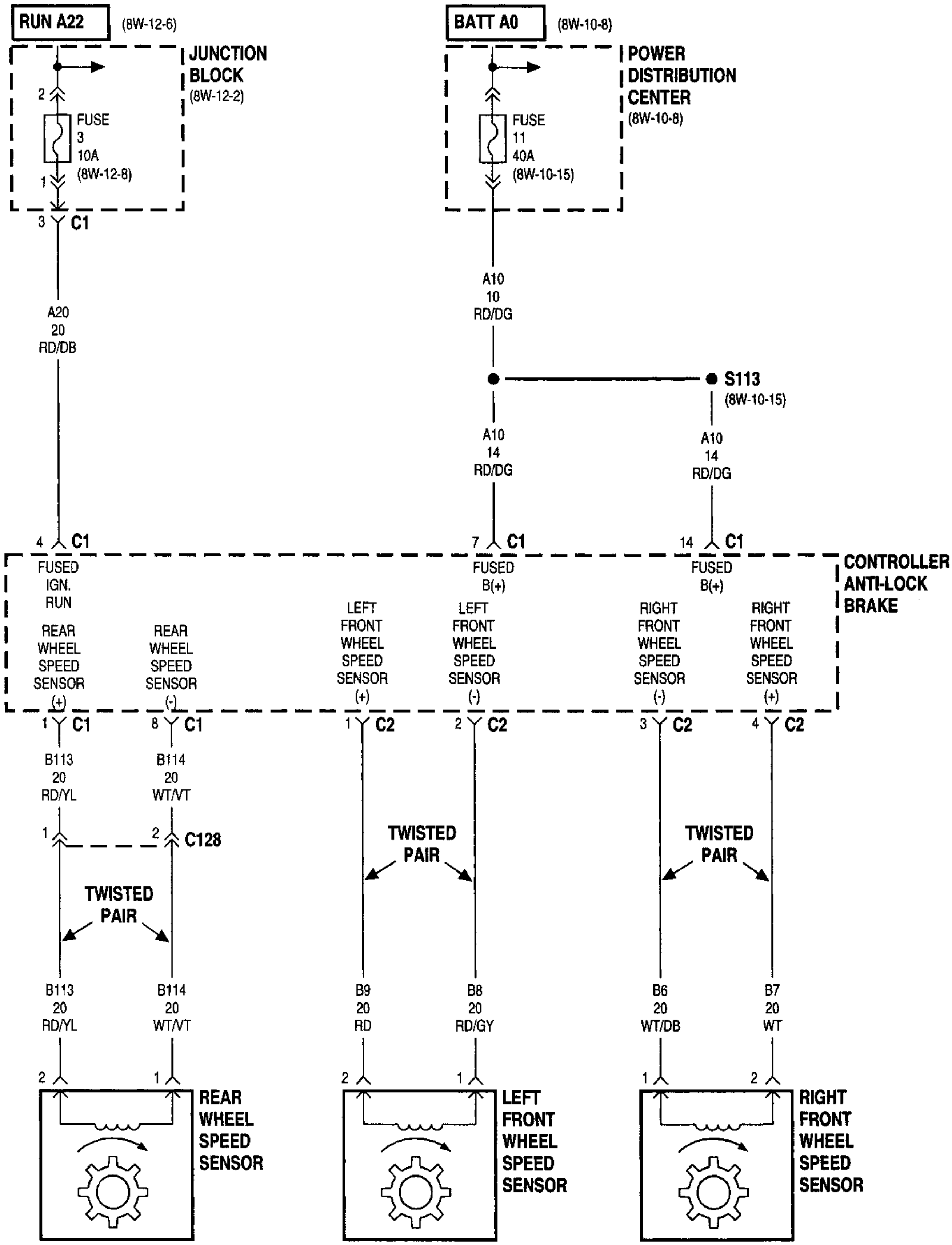
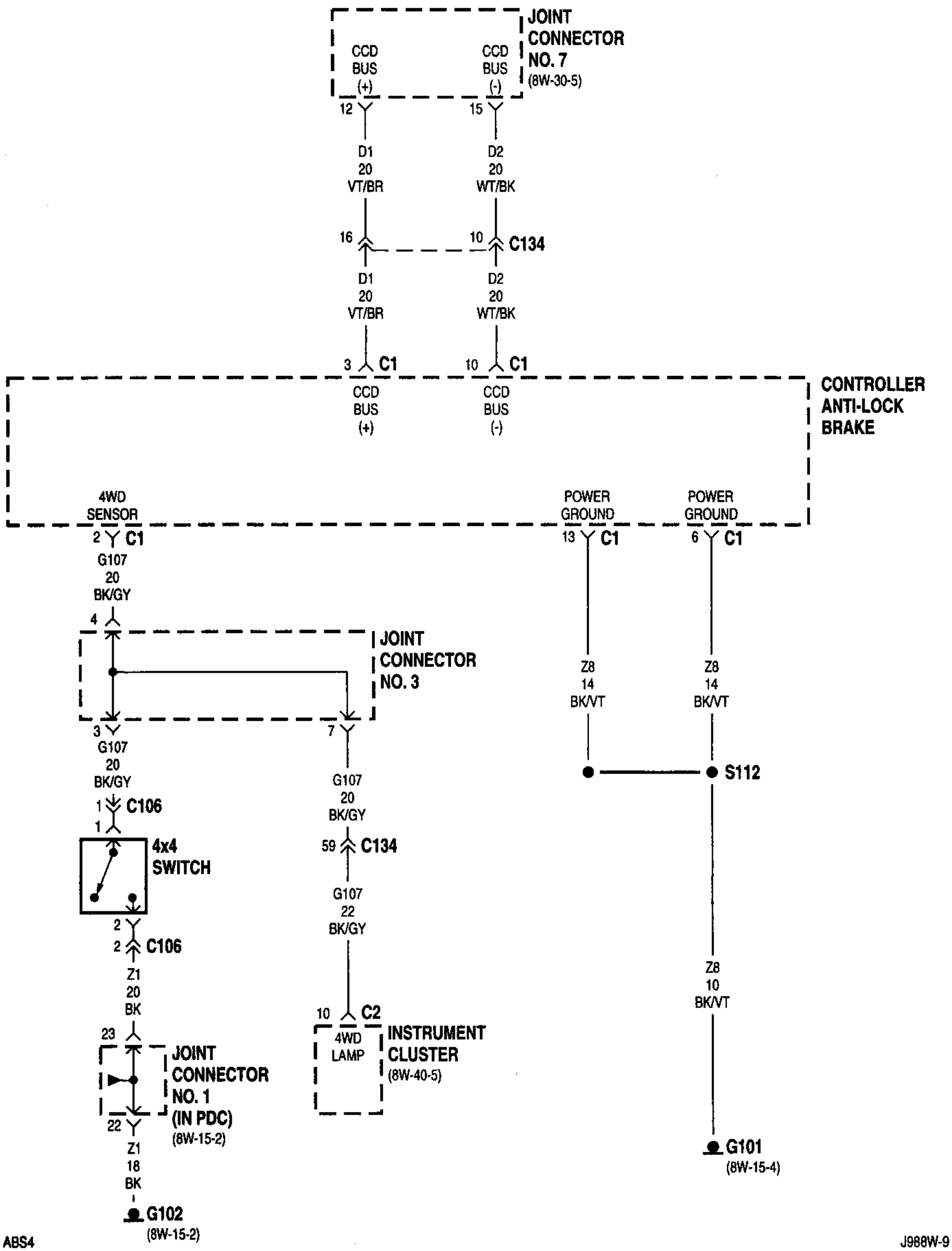
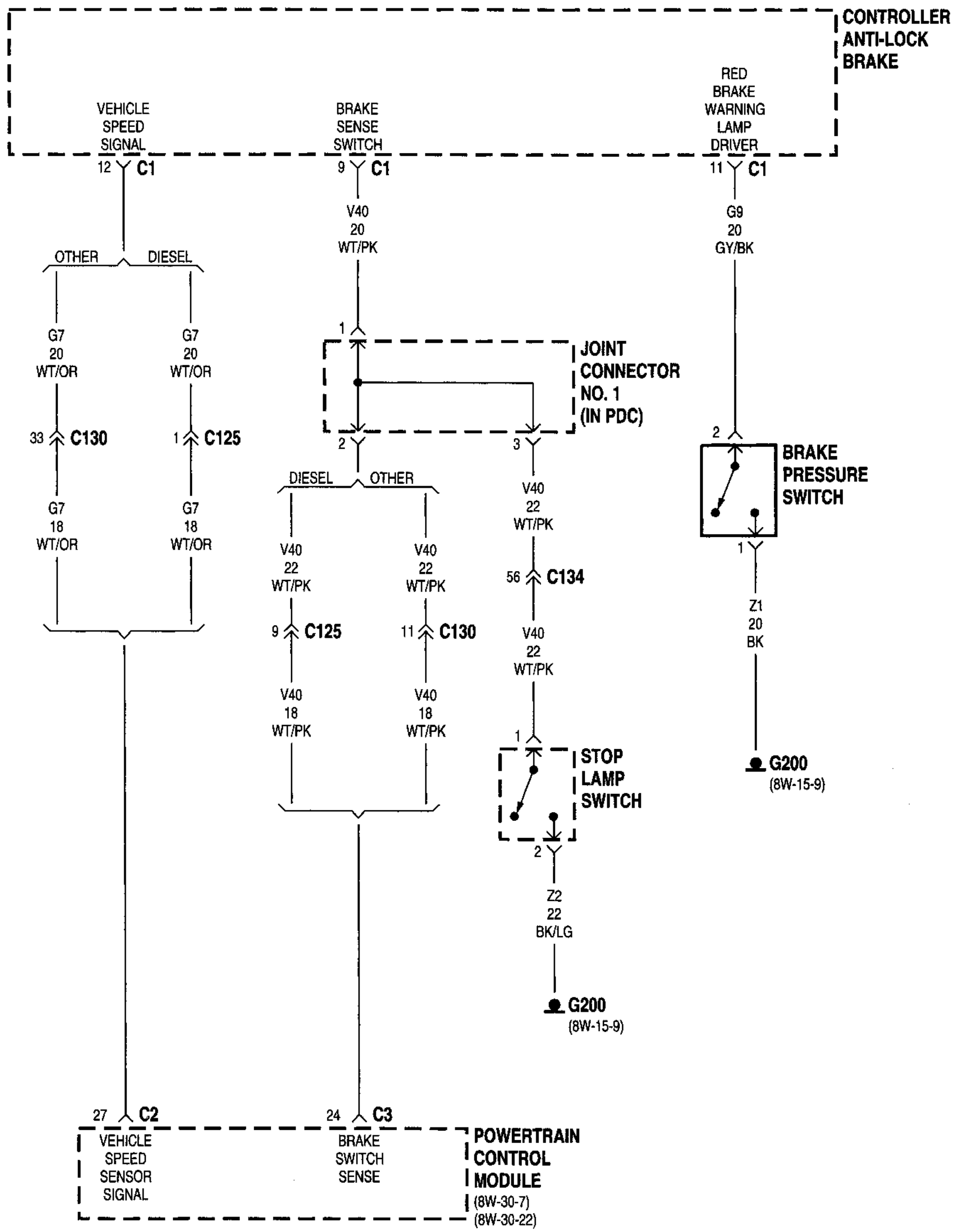
8W-35 ALL-WHEEL ANTI-LOCK BRAKES

AUTHENTIC RESTORATION PRODUCT



AUTHENTIC RESTORATION PRODUCT




CONTROLLER ANTI-LOCK BRAKE
VEHICLE SPEED SIGNAL
BRAKE SENSE SWITCH
RED BRAKE WARNING LAMP DRIVER
12 C1
9 C1
11 C1
V40 20 WT/PK
G9 20 GY/BK
OTHER
DIESEL
G7 20 WT/OR
G7 20 WT/OR
33 C130
1 C125
G7 18 WT/OR
G7 18 WT/OR
1
JOINT CONNECTOR NO. 1 (IN PDC)
2
3
DIESEL
OTHER
V40 22 WT/PK
V40 22 WT/PK
V40 22 WT/PK
9 C125
11 C130
56 C134
V40 18 WT/PK
V40 18 WT/PK
V40 22 WT/PK
2
BRAKE PRESSURE SWITCH
1
Z1 20 BK
G200 (8W-15-9)
1
STOP LAMP SWITCH
2
Z2 22 BK/LG
G200 (8W-15-9)
27 C2
24 C3
VEHICLE SPEED SENSOR SIGNAL
BRAKE SWITCH SENSE
POWERTRAIN CONTROL MODULE
(8W-30-7)
(8W-30-22)

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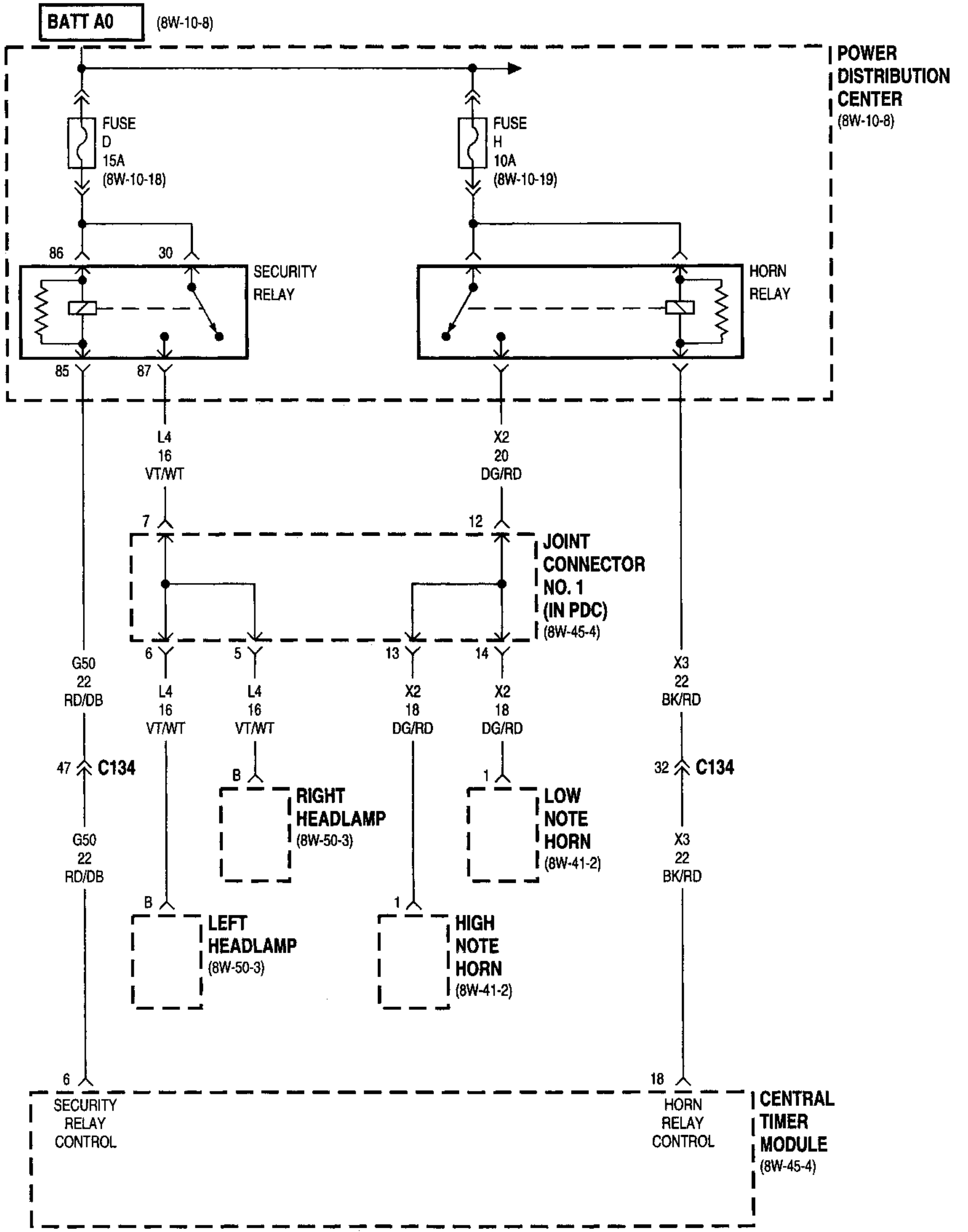
8W-39 VEHICLE THEFT SECURITY SYSTEM



BATT A0
(8W-10-8)
POWER DISTRIBUTION CENTER
(8W-10-8)
FUSE D 15A
(8W-10-18)
FUSE H 10A
(8W-10-19)
86
30
SECURITY RELAY
HORN RELAY
85
87
L4 16 VT/WT
X2 20 DG/RD
7
12
JOINT CONNECTOR NO. 1 (IN PDC)
(8W-45-4)
6
5
13
14
G50 22 RD/DB
L4 16 VT/WT
L4 16 VT/WT
X2 18 DG/RD
X2 18 DG/RD
X3 22 BK/RD
47
C134
32
C134
B
RIGHT HEADLAMP
(8W-50-3)
1
LOW NOTE HORN
(8W-41-2)
G50 22 RD/DB
X3 22 BK/RD
B
LEFT HEADLAMP
(8W-50-3)
1
HIGH NOTE HORN
(8W-41-2)
6
SECURITY RELAY CONTROL
18
HORN RELAY CONTROL
CENTRAL TIMER MODULE
(8W-45-4)

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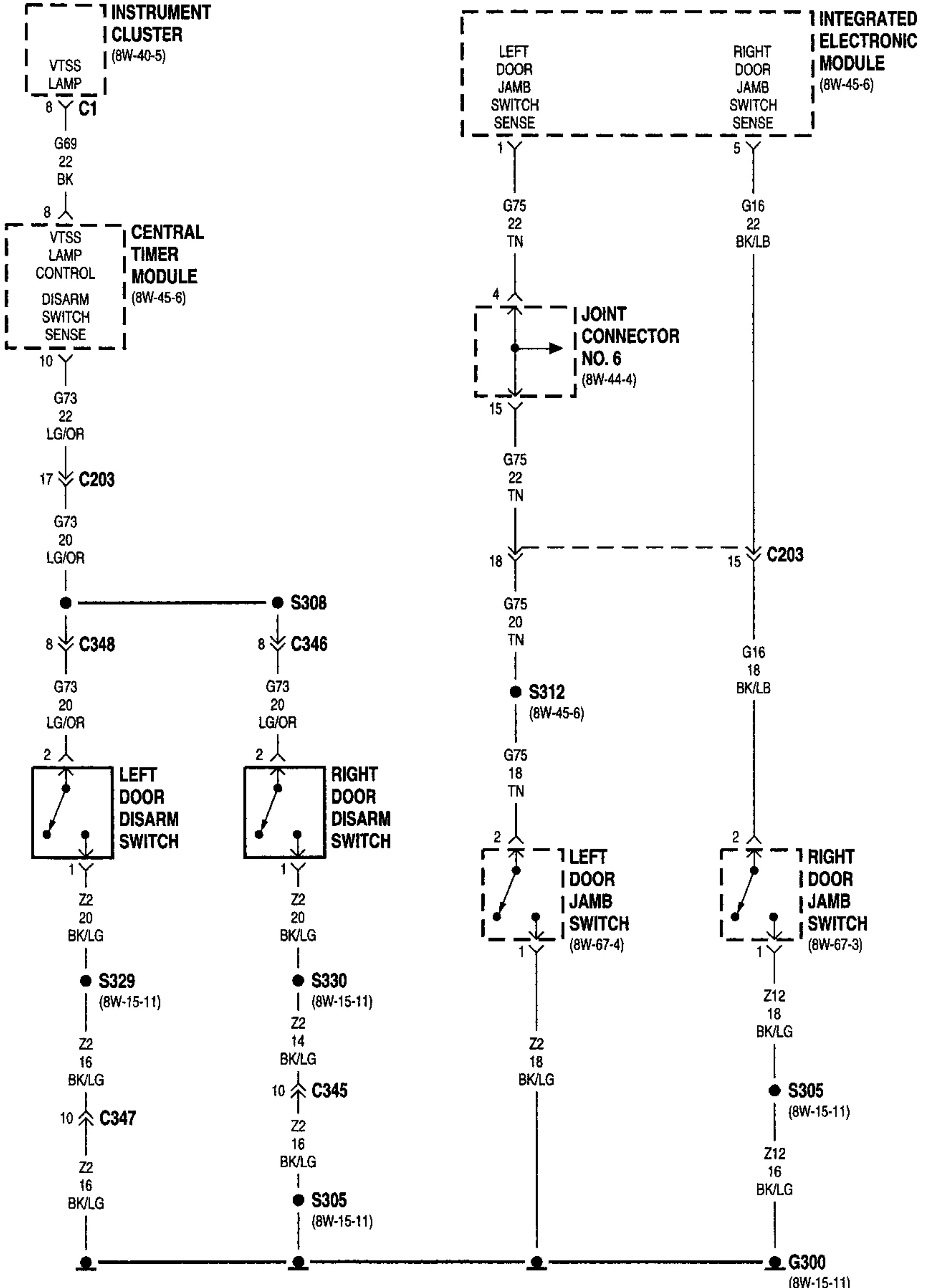

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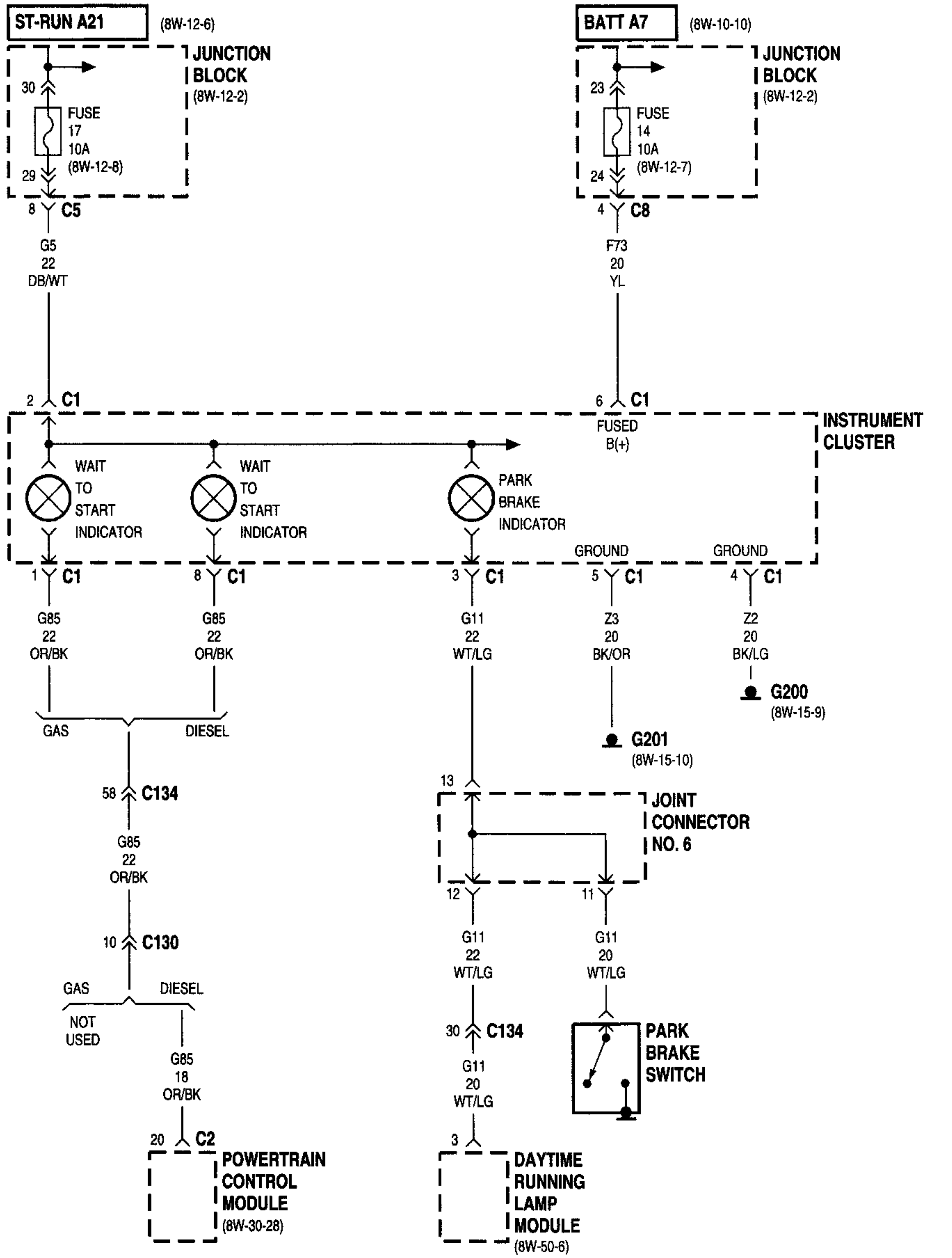
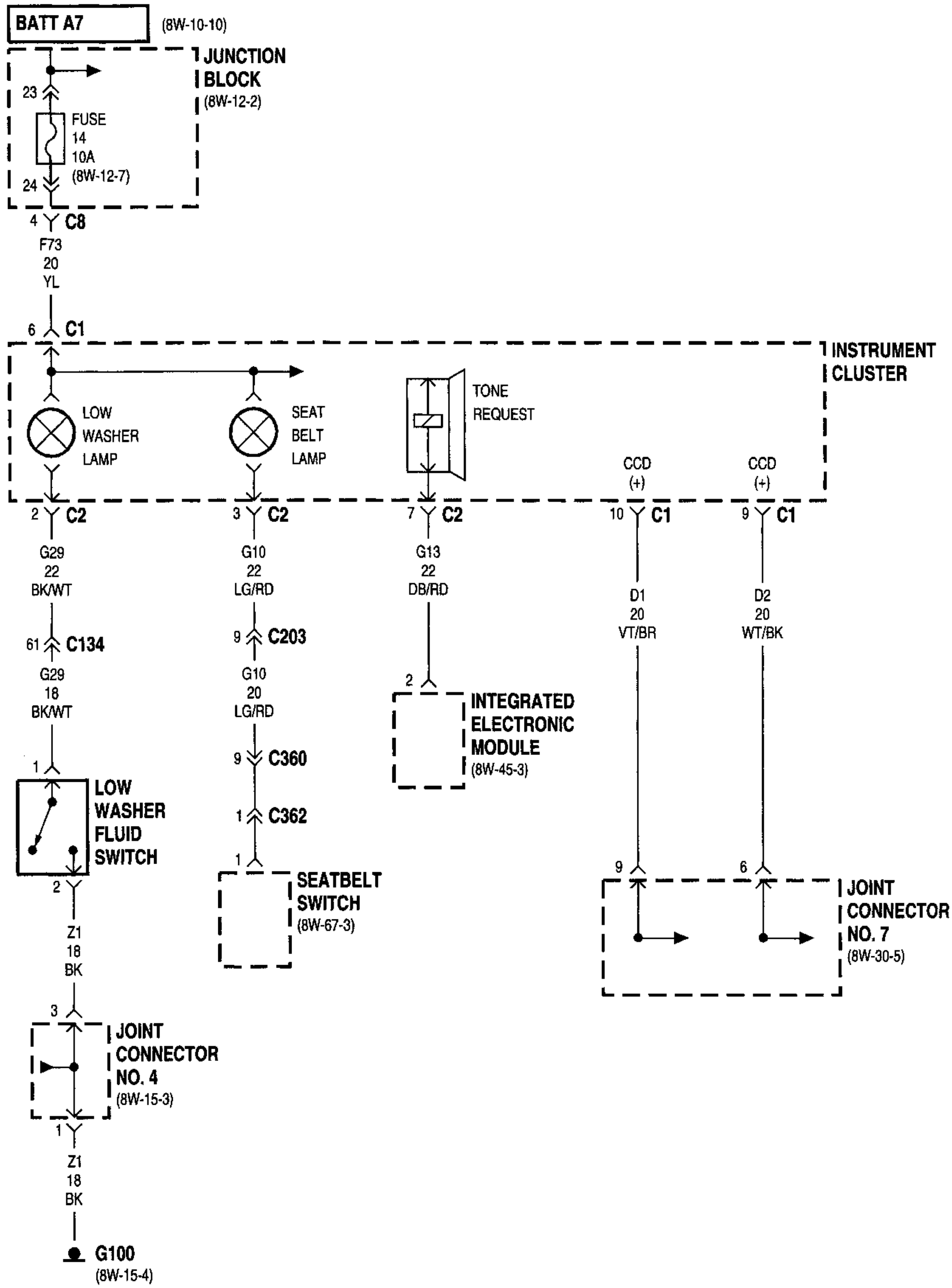
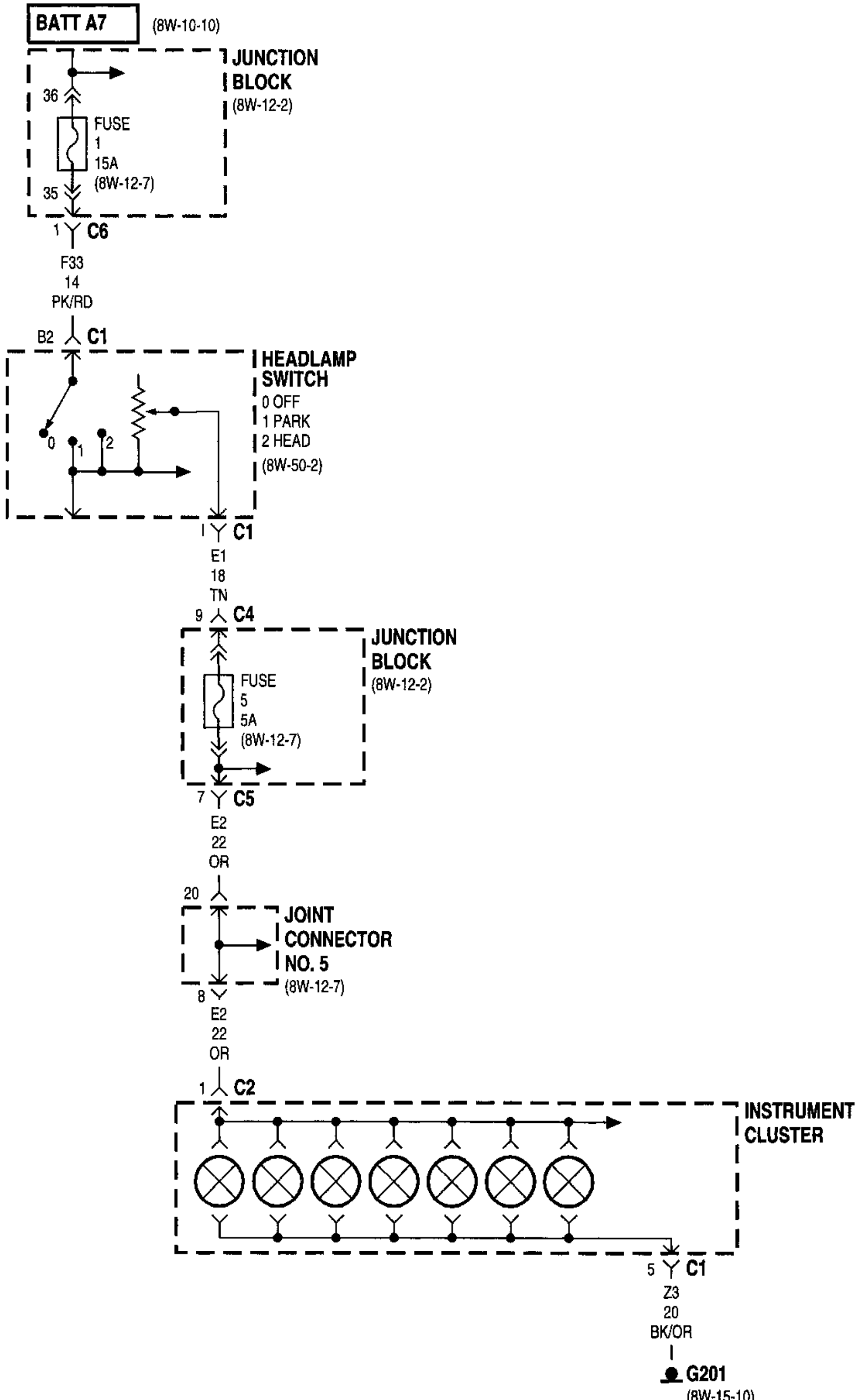
8W-40 INSTRUMENT CLUSTER

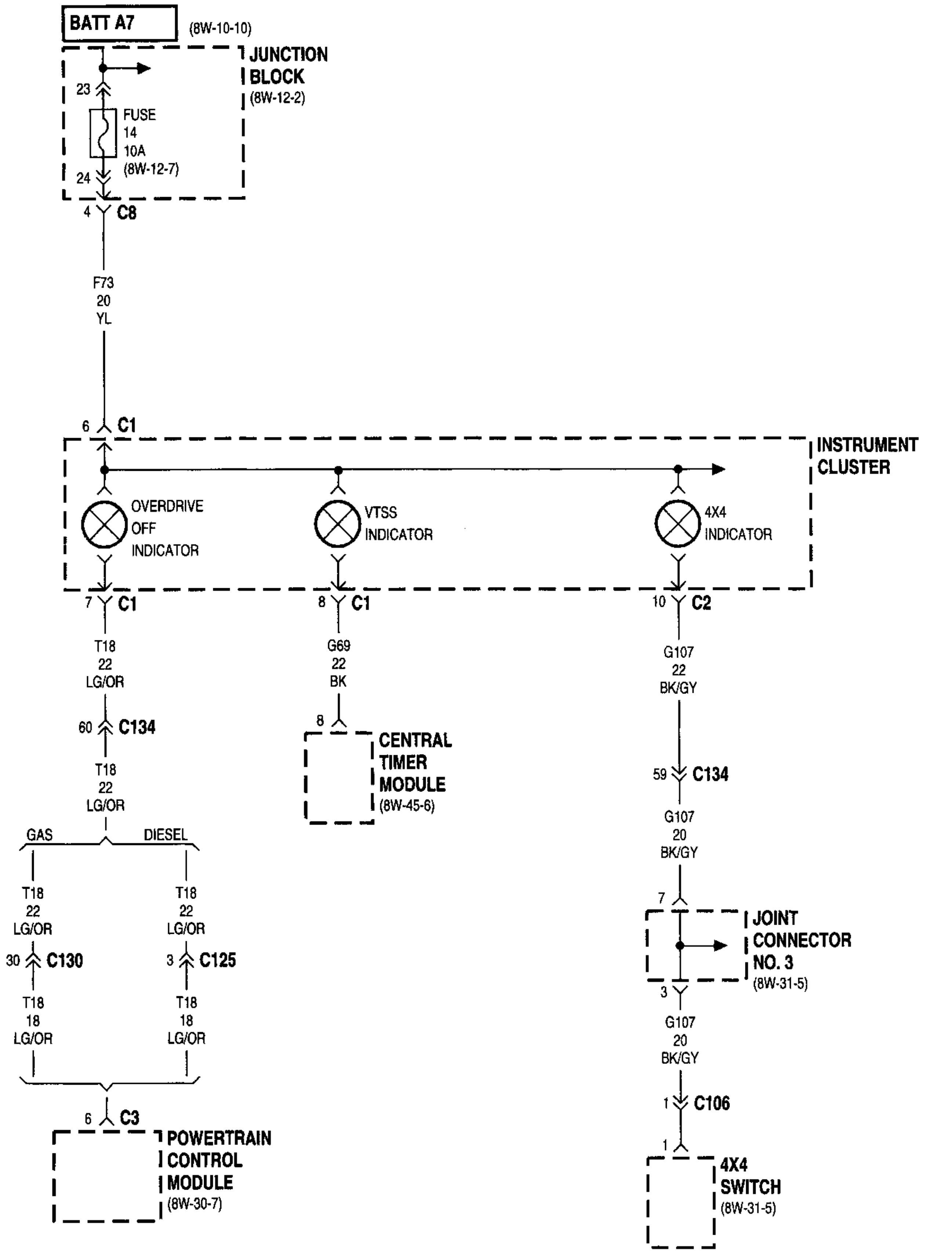


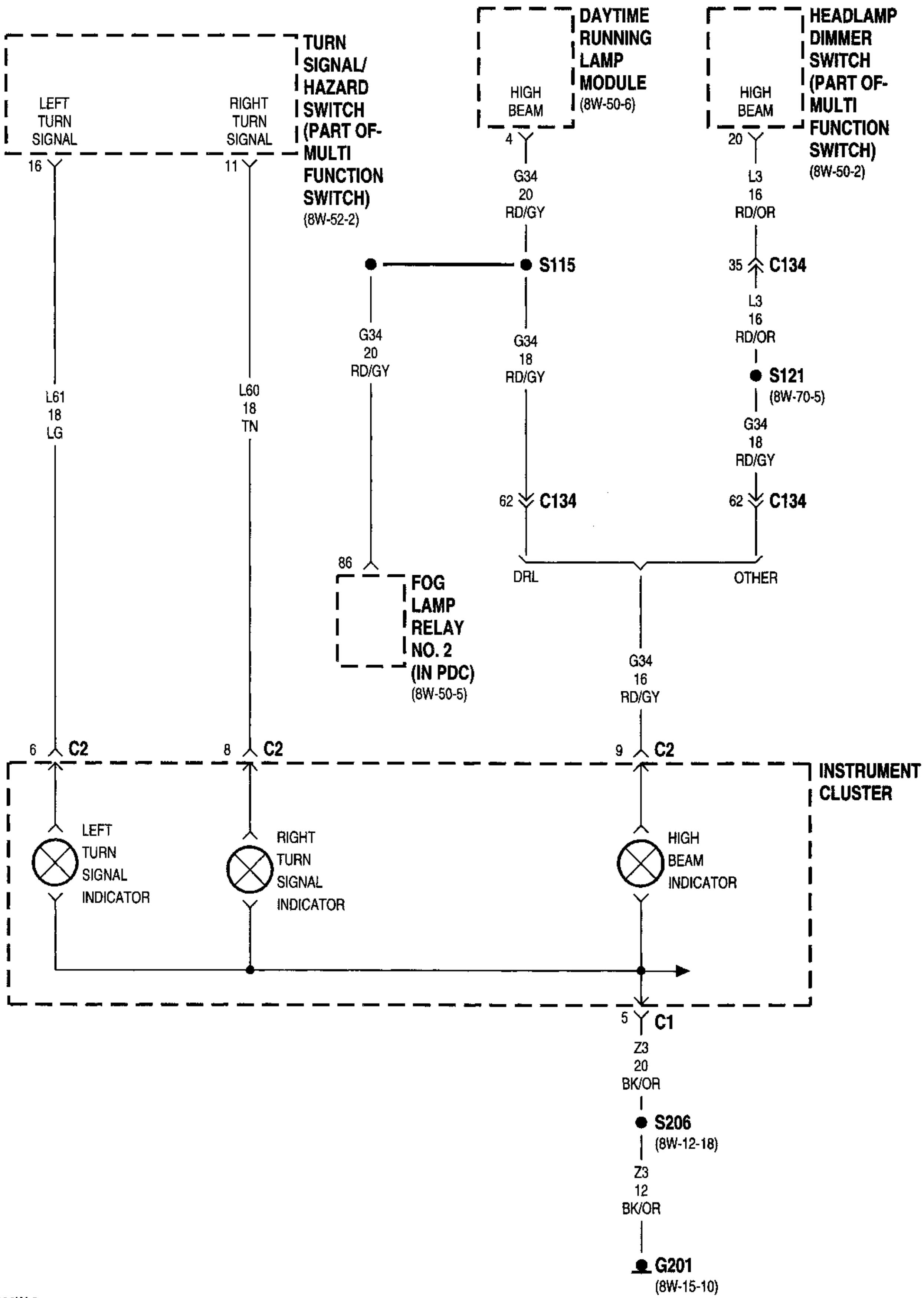
ST-RUN A21
(8W-12-6)
JUNCTION BLOCK
(8W-12-2)
30
FUSE 17 10A (8W-12-8)
29
8 C5
G5 22 DB/WT
BATT A7
(8W-10-10)
JUNCTION BLOCK
(8W-12-2)
23
FUSE 14 10A (8W-12-7)
24
4 C8
F73 20 YL
2 C1
6 C1
FUSED B(+)
INSTRUMENT CLUSTER
WAIT TO START INDICATOR
WAIT TO START INDICATOR
PARK BRAKE INDICATOR
GROUND
GROUND
1 C1
8 C1
3 C1
5 C1
4 C1
G85 22 OR/BK
G85 22 OR/BK
G11 22 WT/LG
Z3 20 BK/OR
Z2 20 BK/LG
G200 (8W-15-9)
G201 (8W-15-10)
GAS
DIESEL
58 C134
G85 22 OR/BK
13
JOINT CONNECTOR NO. 6
12
11
G11 22 WT/LG
G11 20 WT/LG
10 C130
GAS
DIESEL
NOT USED
G85 18 OR/BK
30 C134
G11 20 WT/LG
PARK BRAKE SWITCH
20 C2
POWERTRAIN CONTROL MODULE (8W-30-28)
3
DAYTIME RUNNING LAMP MODULE (8W-50-6)


BATT A7
(8W-10-10)
JUNCTION BLOCK
(8W-12-2)
23
FUSE 14 10A (8W-12-7)
24
4 C8
F73 20 YL
6 C1
INSTRUMENT CLUSTER
LOW WASHER LAMP
SEAT BELT LAMP
TONE REQUEST
CCD (+)
CCD (+)
2 C2
3 C2
7 C2
10 C1
9 C1
G29 22 BK/WT
G10 22 LG/RD
G13 22 DB/RD
D1 20 VT/BR
D2 20 WT/BK
61 C134
9 C203
G29 18 BK/WT
G10 20 LG/RD
2
INTEGRATED ELECTRONIC MODULE
(8W-45-3)
9 C360
1 C362
1
LOW WASHER FLUID SWITCH
2
1
SEATBELT SWITCH
(8W-67-3)
9
6
JOINT CONNECTOR NO. 7
(8W-30-5)
Z1 18 BK
3
JOINT CONNECTOR NO. 4
(8W-15-3)
1
Z1 18 BK
G100
(8W-15-4)

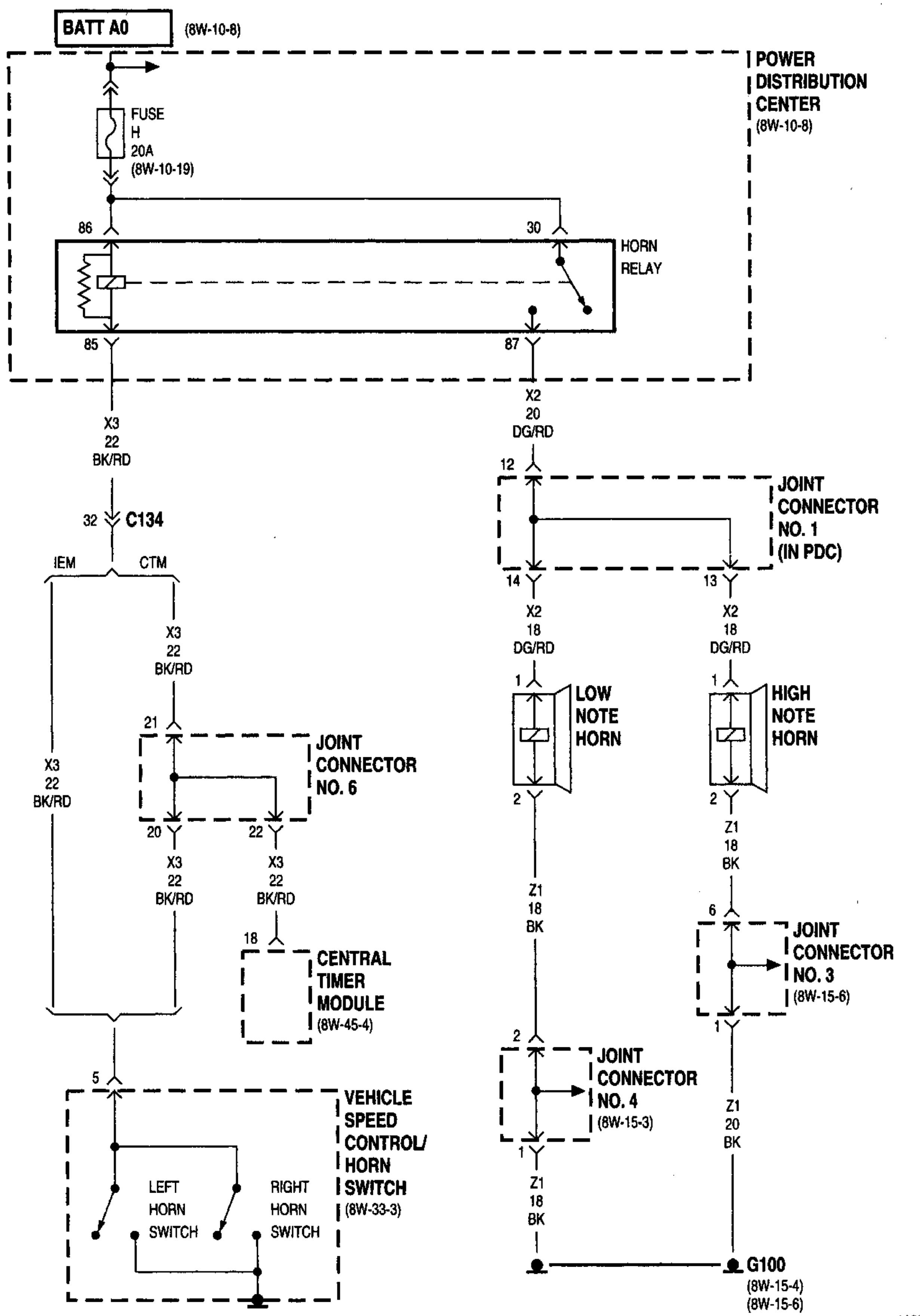
AUTHENTIC RESTORATION PRODUCT




BATT A7
(8W-10-10)
JUNCTION BLOCK
(8W-12-2)
23
FUSE
14
10A
(8W-12-7)
24
4
C8
F73
20
YL
6
C1
INSTRUMENT CLUSTER
OVERDRIVE OFF INDICATOR
VTSS INDICATOR
4X4 INDICATOR
7
C1
8
C1
10
C2
T18
22
LG/OR
60
C134
G69
22
BK
8
CENTRAL TIMER MODULE
(8W-45-6)
G107
22
BK/GY
59
C134
G107
20
BK/GY
GAS
DIESEL
T18
22
LG/OR
30
C130
3
C125
T18
18
LG/OR
7
JOINT CONNECTOR NO. 3
(8W-31-5)
3
G107
20
BK/GY
1
C106
1
4X4 SWITCH
(8W-31-5)
6
C3
POWERTRAIN CONTROL MODULE
(8W-30-7)


TURN SIGNAL/ HAZARD SWITCH (PART OF-MULTI FUNCTION SWITCH)
(8W-52-2)
LEFT TURN SIGNAL
RIGHT TURN SIGNAL
16
11
L61 18 LG
L60 18 TN
DAYTIME RUNNING LAMP MODULE
(8W-50-6)
HIGH BEAM
4
G34 20 RD/GY
S115
G34 20 RD/GY
G34 18 RD/GY
86
FOG LAMP RELAY NO. 2 (IN PDC)
(8W-50-5)
HEADLAMP DIMMER SWITCH (PART OF-MULTI FUNCTION SWITCH)
(8W-50-2)
HIGH BEAM
20
L3 16 RD/OR
35 C134
L3 16 RD/OR
S121
(8W-70-5)
G34 18 RD/GY
62 C134
62 C134
DRL
OTHER
G34 16 RD/GY
6 C2
8 C2
9 C2
INSTRUMENT CLUSTER
LEFT TURN SIGNAL INDICATOR
RIGHT TURN SIGNAL INDICATOR
HIGH BEAM INDICATOR
5 C1
Z3 20 BK/OR
S206
(8W-12-18)
Z3 12 BK/OR
G201
(8W-15-10)

8W-41 HORN/CIGAR LIGHTER/POWER OUTLET


BATT A0
(8W-10-8)
POWER DISTRIBUTION CENTER
(8W-10-8)
FUSE
H
20A
(8W-10-19)
86
30
HORN RELAY
85
87
X3
22
BK/RD
X2
20
DG/RD
12
JOINT CONNECTOR NO. 1 (IN PDC)
32
C134
IEM
CTM
14
13
X2
18
DG/RD
X2
18
DG/RD
1
LOW NOTE HORN
1
HIGH NOTE HORN
2
2
Z1
18
BK
X3
22
BK/RD
21
JOINT CONNECTOR NO. 6
X3
22
BK/RD
20
22
X3
22
BK/RD
X3
22
BK/RD
Z1
18
BK
6
JOINT CONNECTOR NO. 3
(8W-15-6)
18
CENTRAL TIMER MODULE
(8W-45-4)
1
2
JOINT CONNECTOR NO. 4
(8W-15-3)
Z1
20
BK
5
VEHICLE SPEED CONTROL/ HORN SWITCH
(8W-33-3)
LEFT HORN SWITCH
RIGHT HORN SWITCH
1
Z1
18
BK
G100
(8W-15-4)
(8W-15-6)

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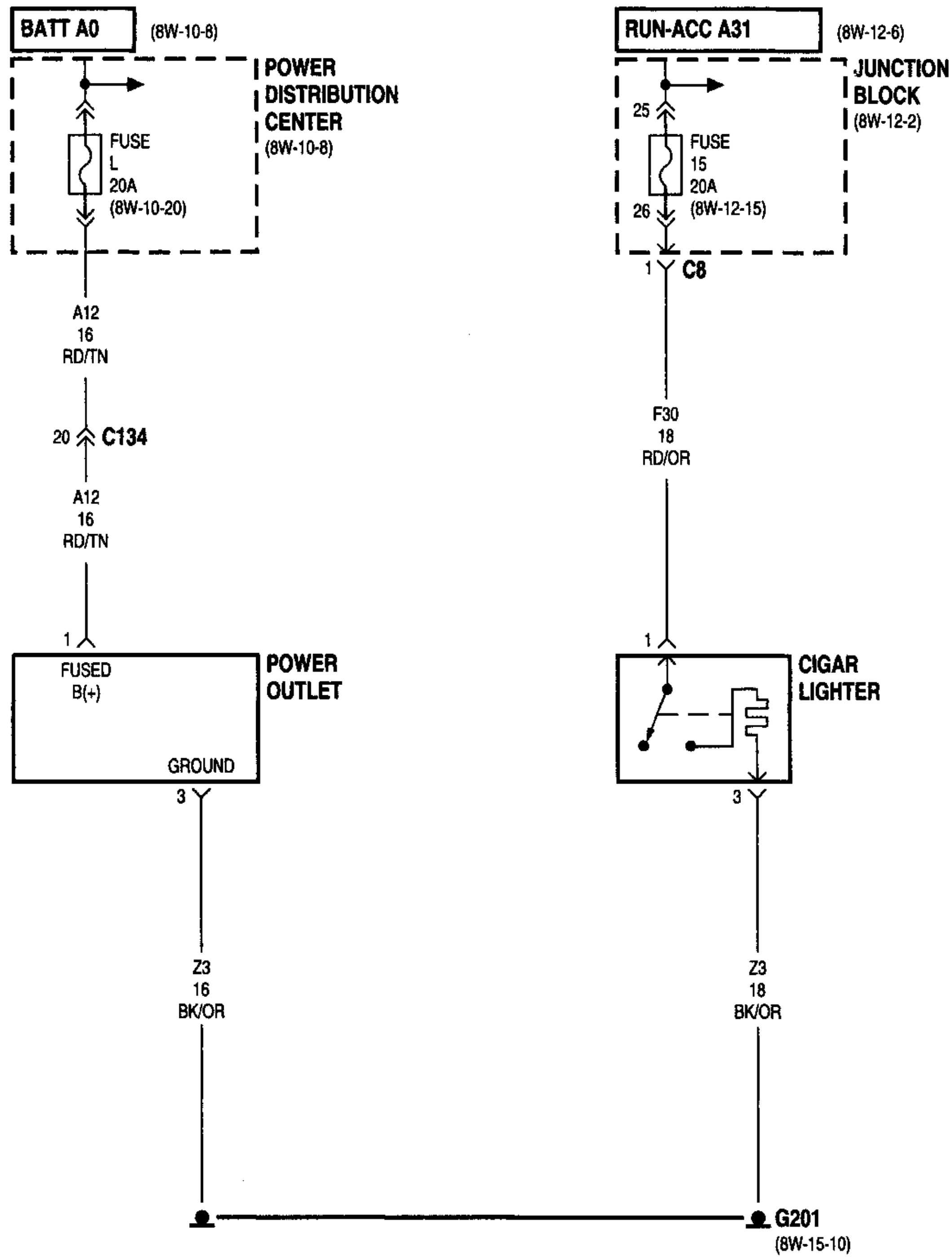

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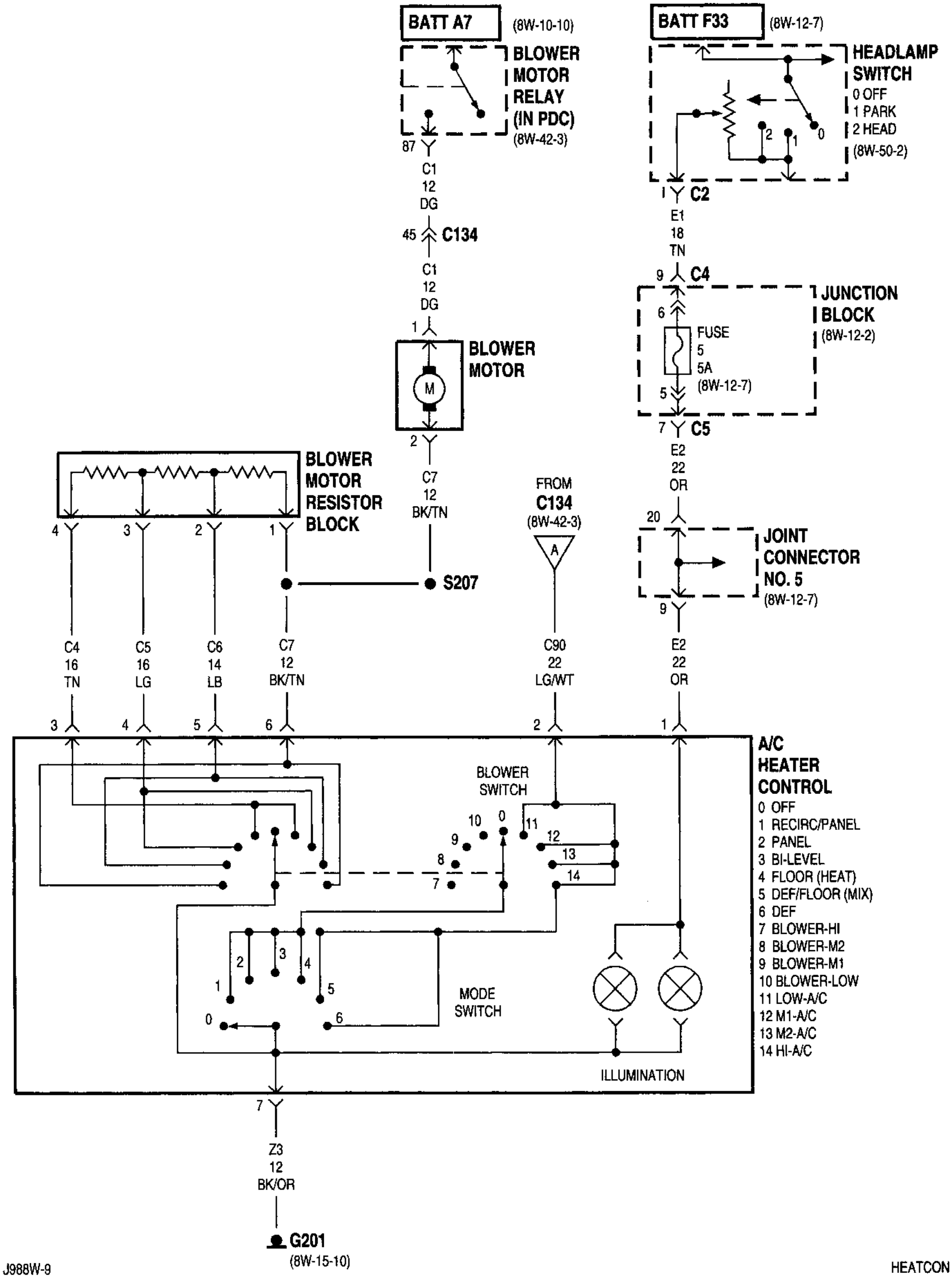
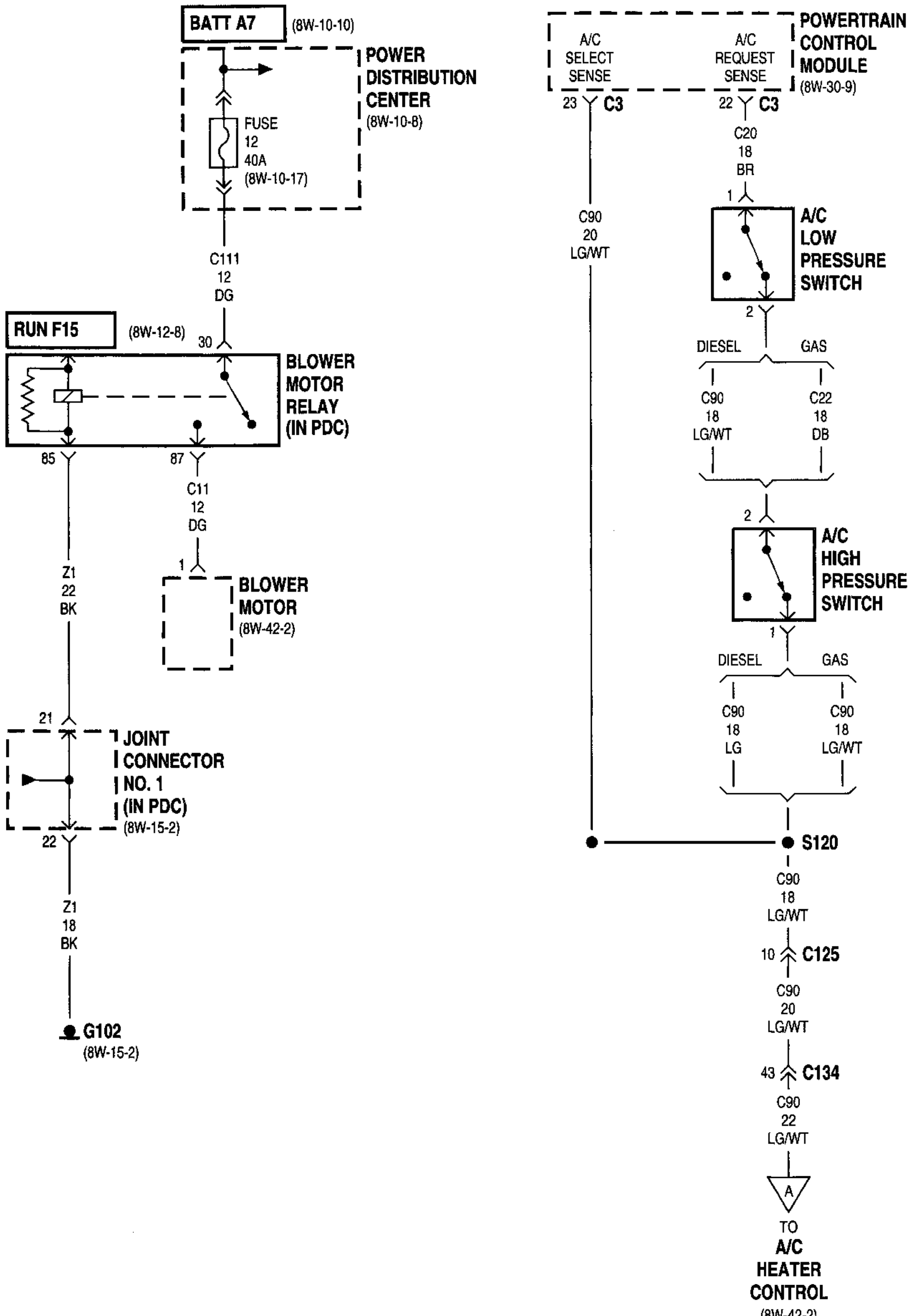
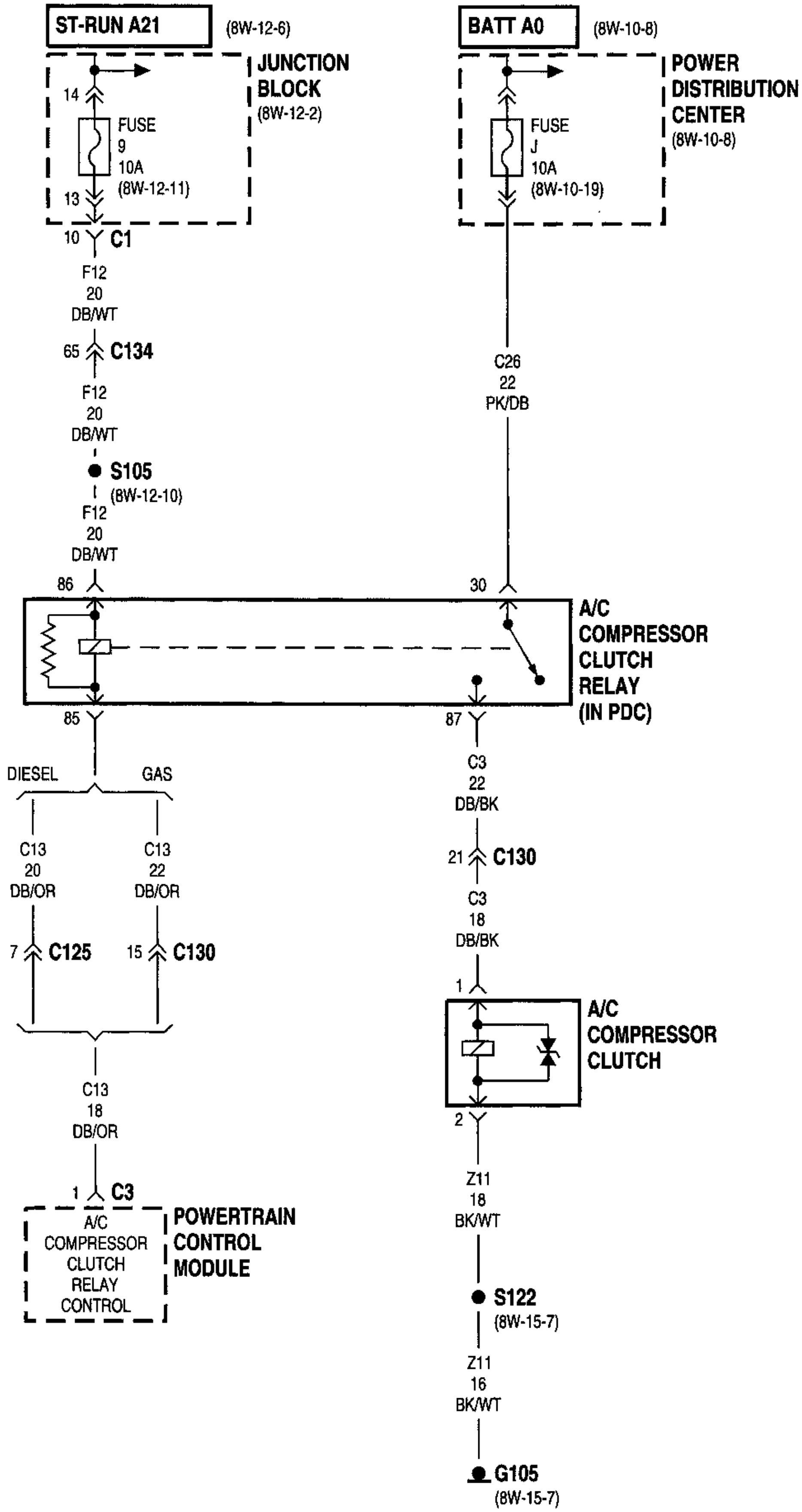
8W-42 AIR CONDITIONING/HEATER


BATT A7
(8W-10-10)
BLOWER MOTOR RELAY (IN PDC)
(8W-42-3)
87
C1
12
DG
45
C134
C1
12
DG
1
BLOWER MOTOR
M
2
C7
12
BK/TN
S207
BATT F33
(8W-12-7)
HEADLAMP SWITCH
0 OFF
1 PARK
2 HEAD
(8W-50-2)
C2
E1
18
TN
9
C4
JUNCTION BLOCK
(8W-12-2)
6
FUSE
5
5A
(8W-12-7)
5
7
C5
E2
22
OR
20
JOINT CONNECTOR NO. 5
(8W-12-7)
9
E2
22
OR
FROM
C134
(8W-42-3)
A
C90
22
LG/WT
BLOWER MOTOR RESISTOR BLOCK
4
3
2
1
C4
16
TN
C5
16
LG
C6
14
LB
C7
12
BK/TN
3
4
5
6
2
1
A/C HEATER CONTROL
0 OFF
1 RECIRC/PANEL
2 PANEL
3 BI-LEVEL
4 FLOOR (HEAT)
5 DEF/FLOOR (MIX)
6 DEF
7 BLOWER-HI
8 BLOWER-M2
9 BLOWER-M1
10 BLOWER-LOW
11 LOW-A/C
12 M1-A/C
13 M2-A/C
14 HI-A/C
BLOWER SWITCH
MODE SWITCH
ILLUMINATION
7
Z3
12
BK/OR
G201
(8W-15-10)


BATT A7
(8W-10-10)
POWER DISTRIBUTION CENTER
(8W-10-8)
FUSE
12
40A
(8W-10-17)
C111
12
DG
RUN F15
(8W-12-8)
30
BLOWER MOTOR RELAY (IN PDC)
85
87
C11
12
DG
1
BLOWER MOTOR
(8W-42-2)
Z1
22
BK
21
JOINT CONNECTOR NO. 1 (IN PDC)
(8W-15-2)
22
Z1
18
BK
G102
(8W-15-2)
A/C SELECT SENSE
A/C REQUEST SENSE
POWERTRAIN CONTROL MODULE
(8W-30-9)
23 C3
22 C3
C20
18
BR
C90
20
LG/WT
1
A/C LOW PRESSURE SWITCH
2
DIESEL
GAS
C90
18
LG/WT
C22
18
DB
2
A/C HIGH PRESSURE SWITCH
1
DIESEL
GAS
C90
18
LG
C90
18
LG/WT
S120
C90
18
LG/WT
10 C125
C90
20
LG/WT
43 C134
C90
22
LG/WT
A
TO
A/C HEATER CONTROL
(8W-42-2)


ST-RUN A21
(8W-12-6)
JUNCTION BLOCK
(8W-12-2)
14
FUSE 9 10A (8W-12-11)
13
10 C1
F12 20 DB/WT
65 C134
F12 20 DB/WT
S105
(8W-12-10)
F12 20 DB/WT
86
85
BATT A0
(8W-10-8)
POWER DISTRIBUTION CENTER
(8W-10-8)
FUSE J 10A (8W-10-19)
C26 22 PK/DB
30
87
A/C COMPRESSOR CLUTCH RELAY (IN PDC)
DIESEL
GAS
C13 20 DB/OR
C13 22 DB/OR
7 C125
15 C130
C13 18 DB/OR
1 C3
A/C COMPRESSOR CLUTCH RELAY CONTROL
POWERTRAIN CONTROL MODULE
C3 22 DB/BK
21 C130
C3 18 DB/BK
1
A/C COMPRESSOR CLUTCH
2
Z11 18 BK/WT
S122
(8W-15-7)
Z11 16 BK/WT
G105
(8W-15-7)

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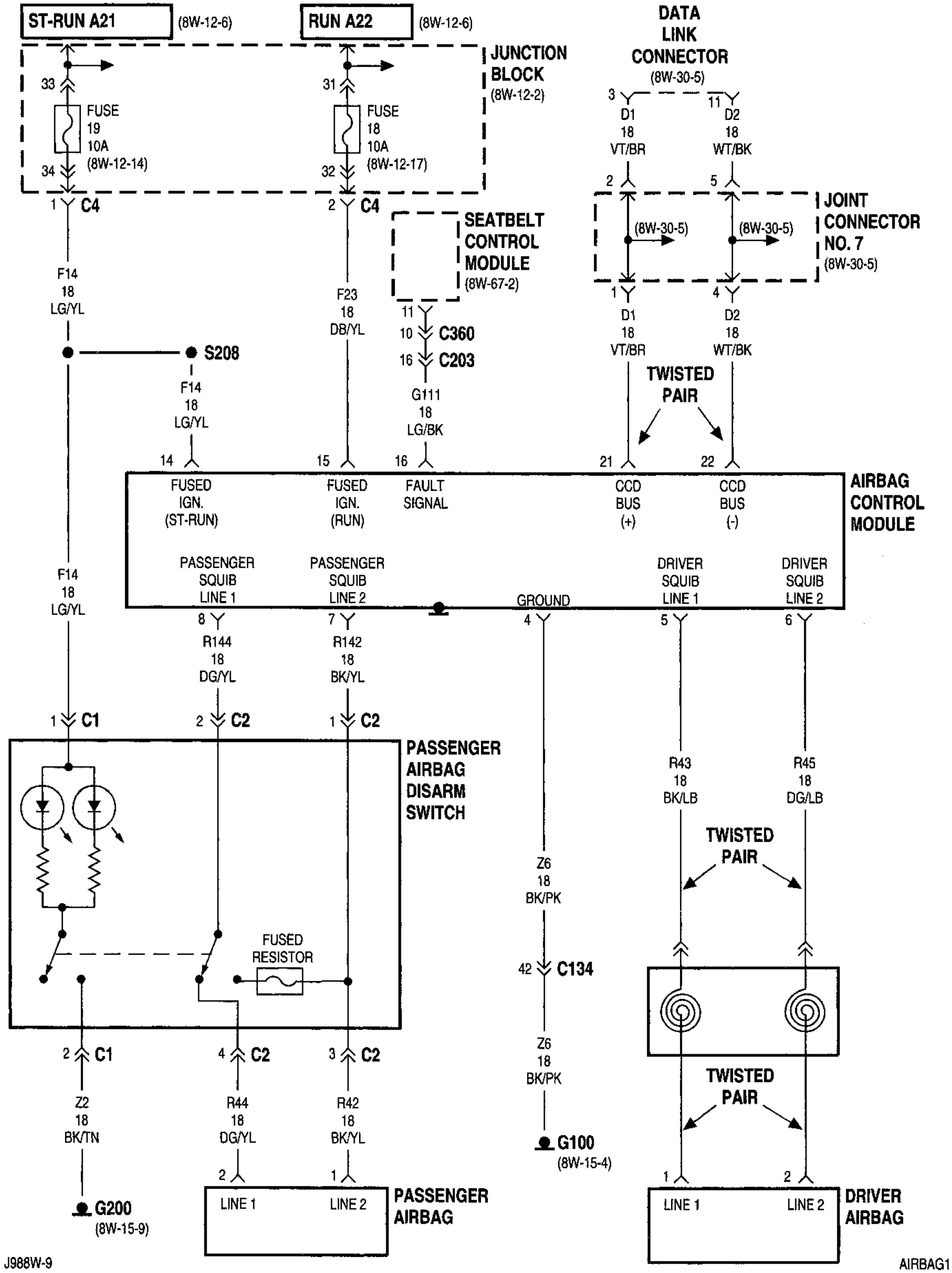
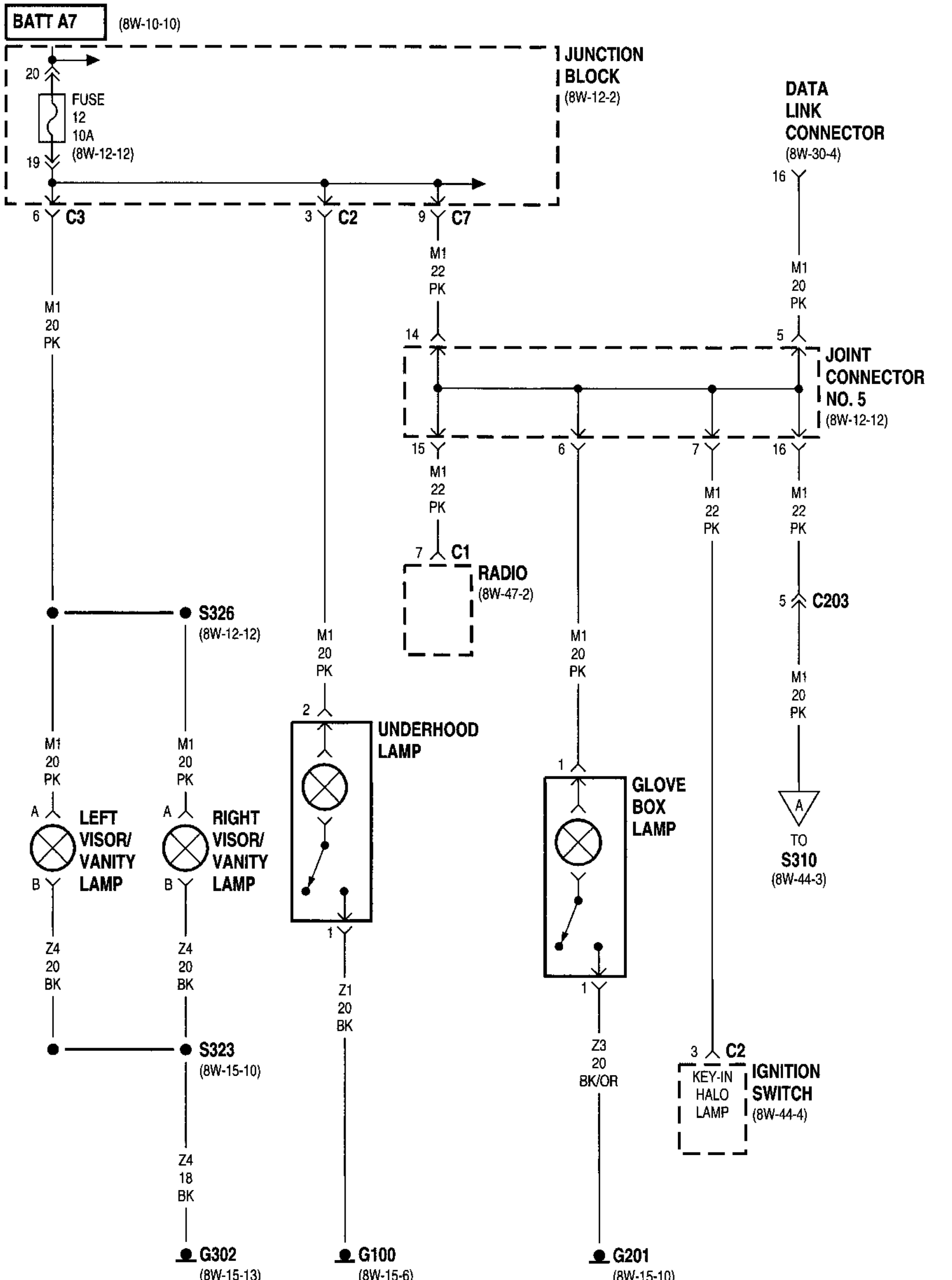
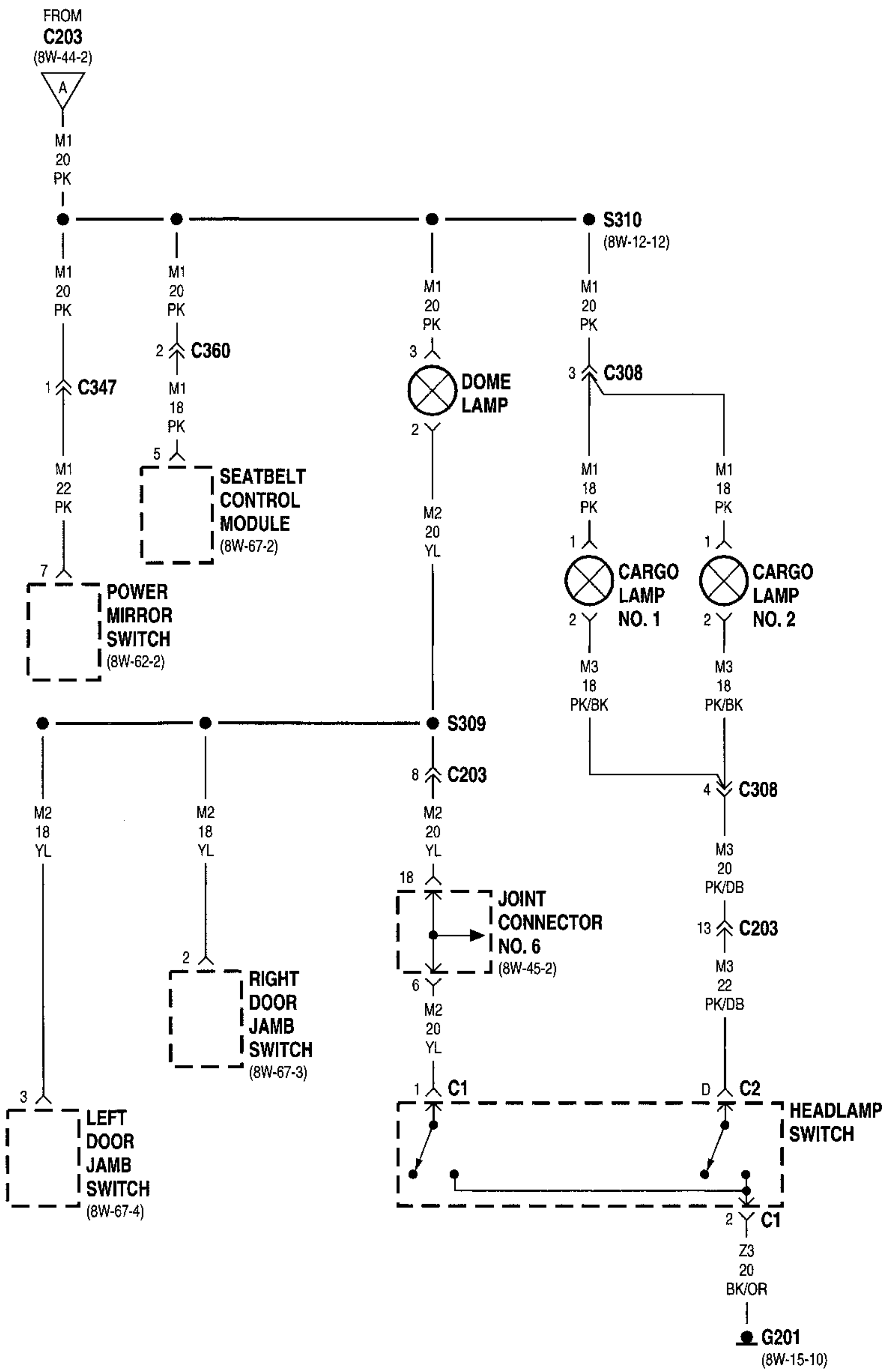
8W-43 AIRBAG SYSTEM


ST-RUN A21
(8W-12-6)
RUN A22
(8W-12-6)
JUNCTION BLOCK
(8W-12-2)
33
FUSE 19 10A
(8W-12-14)
34
31
FUSE 18 10A
(8W-12-17)
32
DATA LINK CONNECTOR
(8W-30-5)
3
11
D1 18 VT/BR
D2 18 WT/BK
2
5
JOINT CONNECTOR NO. 7
(8W-30-5)
(8W-30-5)
(8W-30-5)
1
4
D1 18 VT/BR
D2 18 WT/BK
TWISTED PAIR
1 C4
2 C4
SEATBELT CONTROL MODULE
(8W-67-2)
11
10 C360
16 C203
G111 18 LG/BK
F14 18 LG/YL
S208
F14 18 LG/YL
F23 18 DB/YL
14
15
16
21
22
FUSED IGN. (ST-RUN)
FUSED IGN. (RUN)
FAULT SIGNAL
CCD BUS (+)
CCD BUS (-)
AIRBAG CONTROL MODULE
PASSENGER SQUIB LINE 1
PASSENGER SQUIB LINE 2
GROUND
DRIVER SQUIB LINE 1
DRIVER SQUIB LINE 2
8
7
4
5
6
F14 18 LG/YL
R144 18 DG/YL
R142 18 BK/YL
1 C1
2 C2
1 C2
PASSENGER AIRBAG DISARM SWITCH
FUSED RESISTOR
R43 18 BK/LB
R45 18 DG/LB
TWISTED PAIR
Z6 18 BK/PK
42 C134
Z6 18 BK/PK
G100
(8W-15-4)
2 C1
4 C2
3 C2
Z2 18 BK/TN
R44 18 DG/YL
R42 18 BK/YL
G200
(8W-15-9)
2
1
LINE 1
LINE 2
PASSENGER AIRBAG
TWISTED PAIR
1
2
LINE 1
LINE 2
DRIVER AIRBAG
J988W-9
AIRBAG1

8W-44 INTERIOR LIGHTING

AUTHENTIC RESTORATION PRODUCT




FROM
C203
(8W-44-2)
A
M1
20
PK
S310
(8W-12-12)
M1
20
PK
C360
M1
18
PK
C347
M1
22
PK
SEATBELT CONTROL MODULE
(8W-67-2)
POWER MIRROR SWITCH
(8W-62-2)
DOME LAMP
M2
20
YL
C308
CARGO LAMP NO. 1
CARGO LAMP NO. 2
M3
18
PK/BK
S309
C203
M2
18
YL
JOINT CONNECTOR NO. 6
(8W-45-2)
M3
20
PK/DB
M3
22
PK/DB
RIGHT DOOR JAMB SWITCH
(8W-67-3)
LEFT DOOR JAMB SWITCH
(8W-67-4)
C1
C2
HEADLAMP SWITCH
Z3
20
BK/OR
G201
(8W-15-10)

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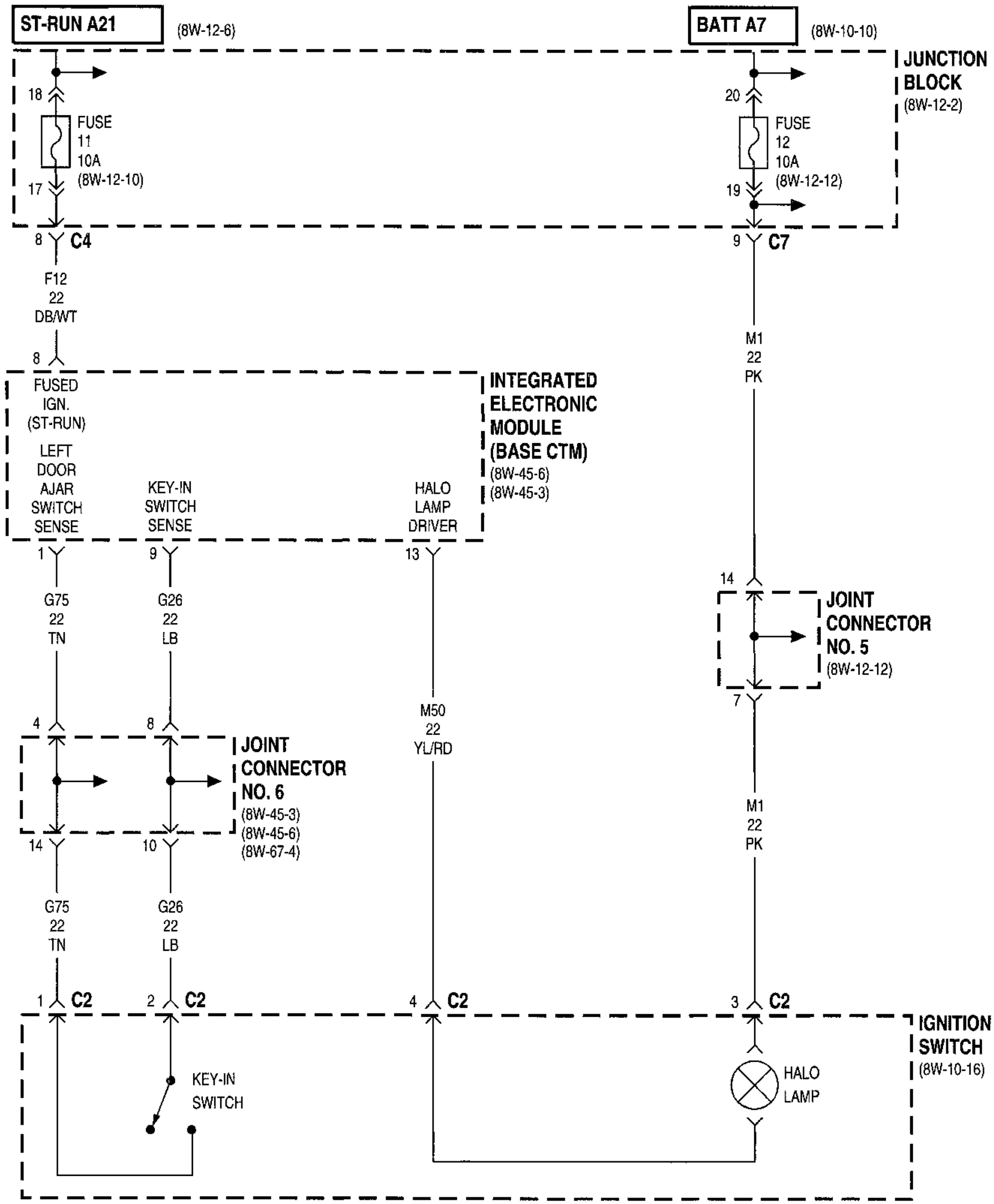

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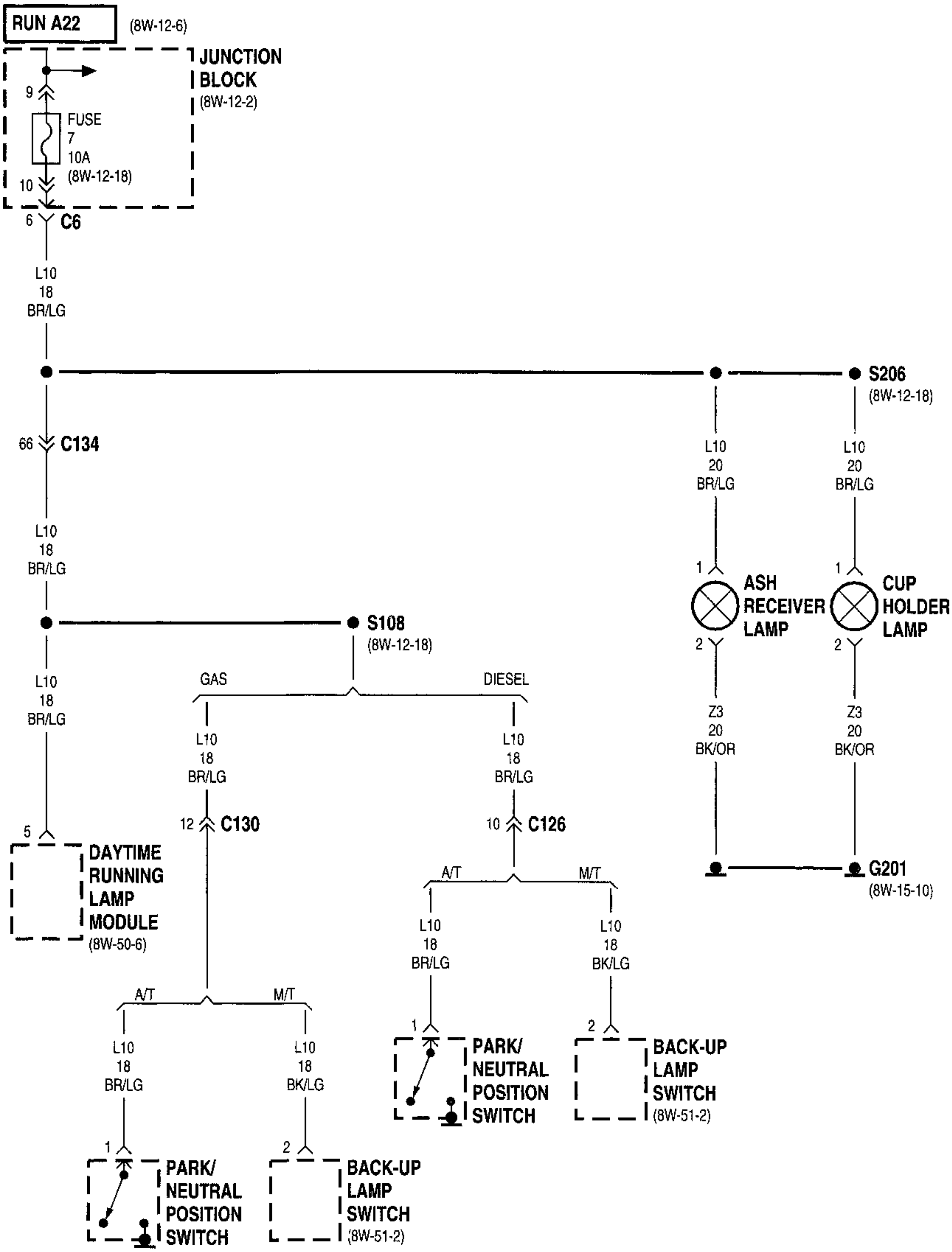
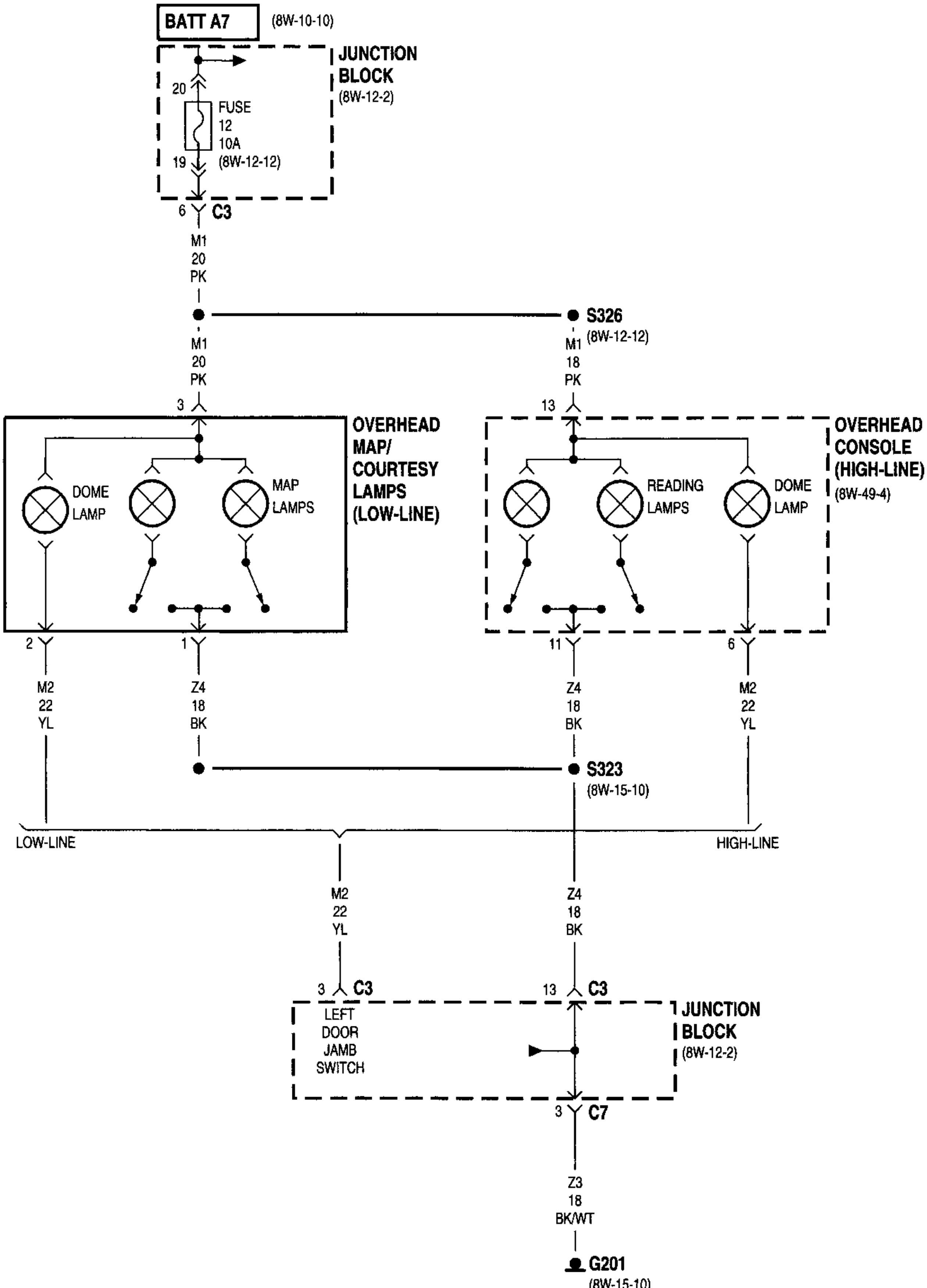
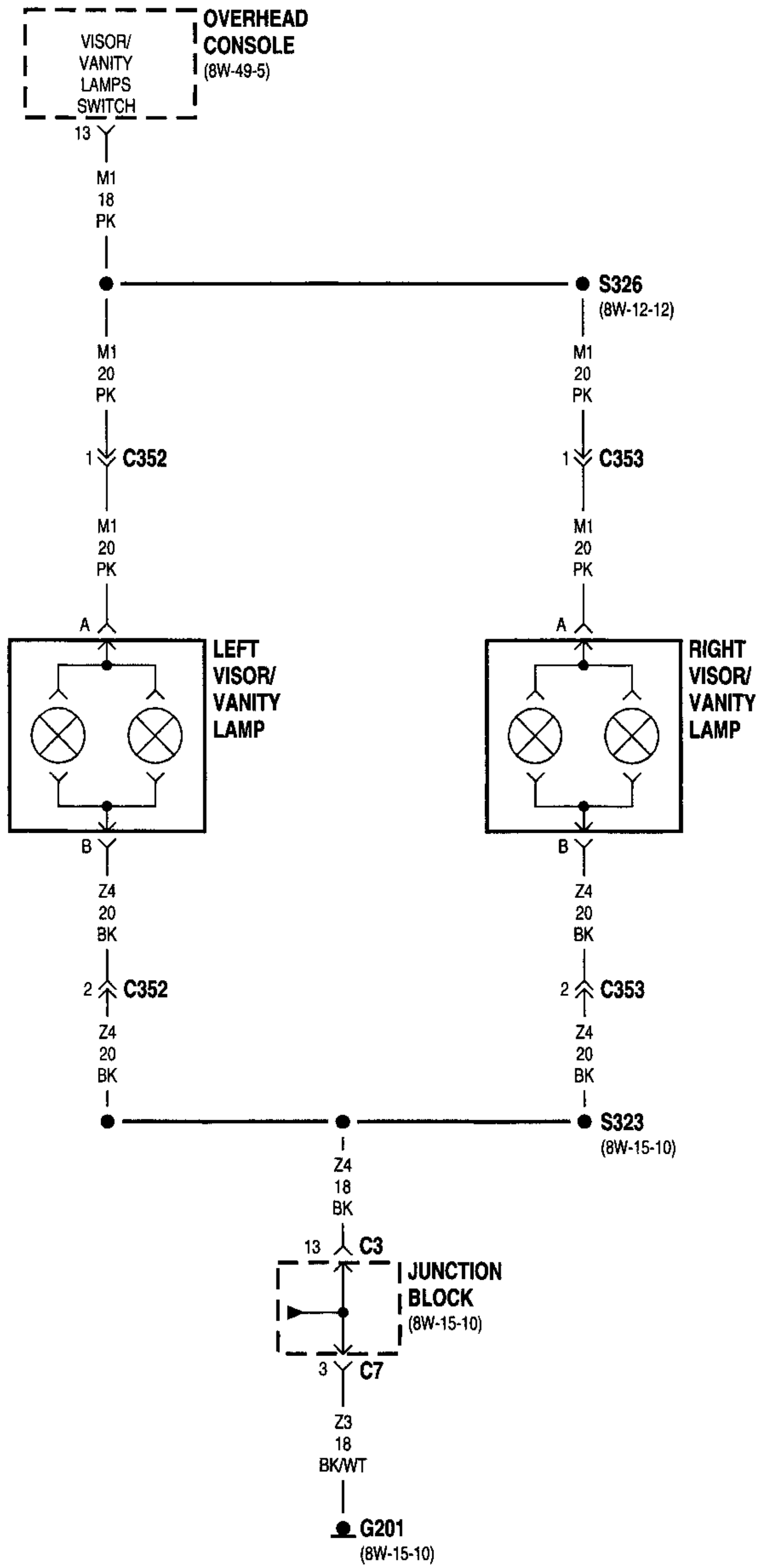


AUTHENTIC RESTORATION PRODUCT



Mopar AUTHENTIC RESTORATION PRODUCT



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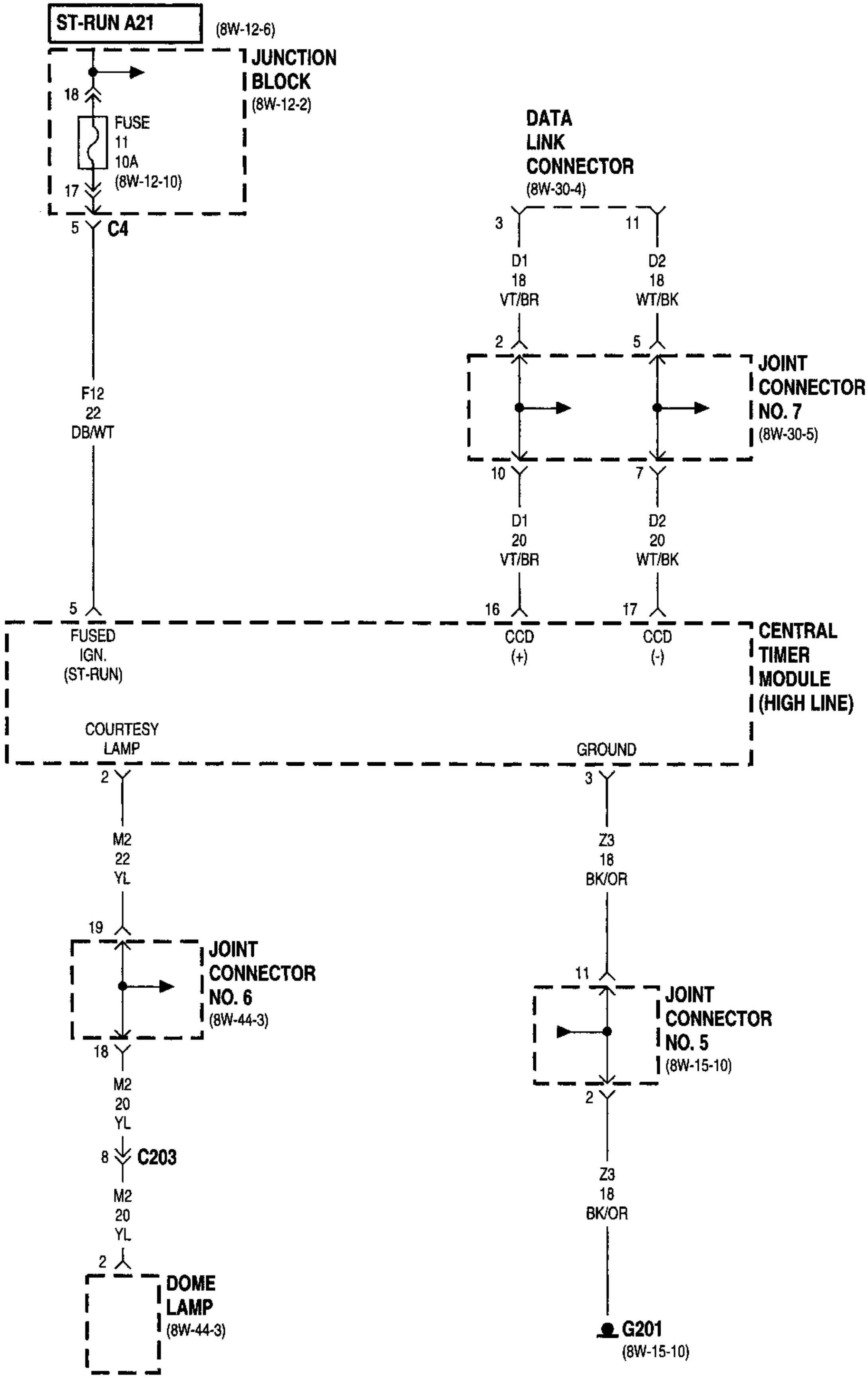
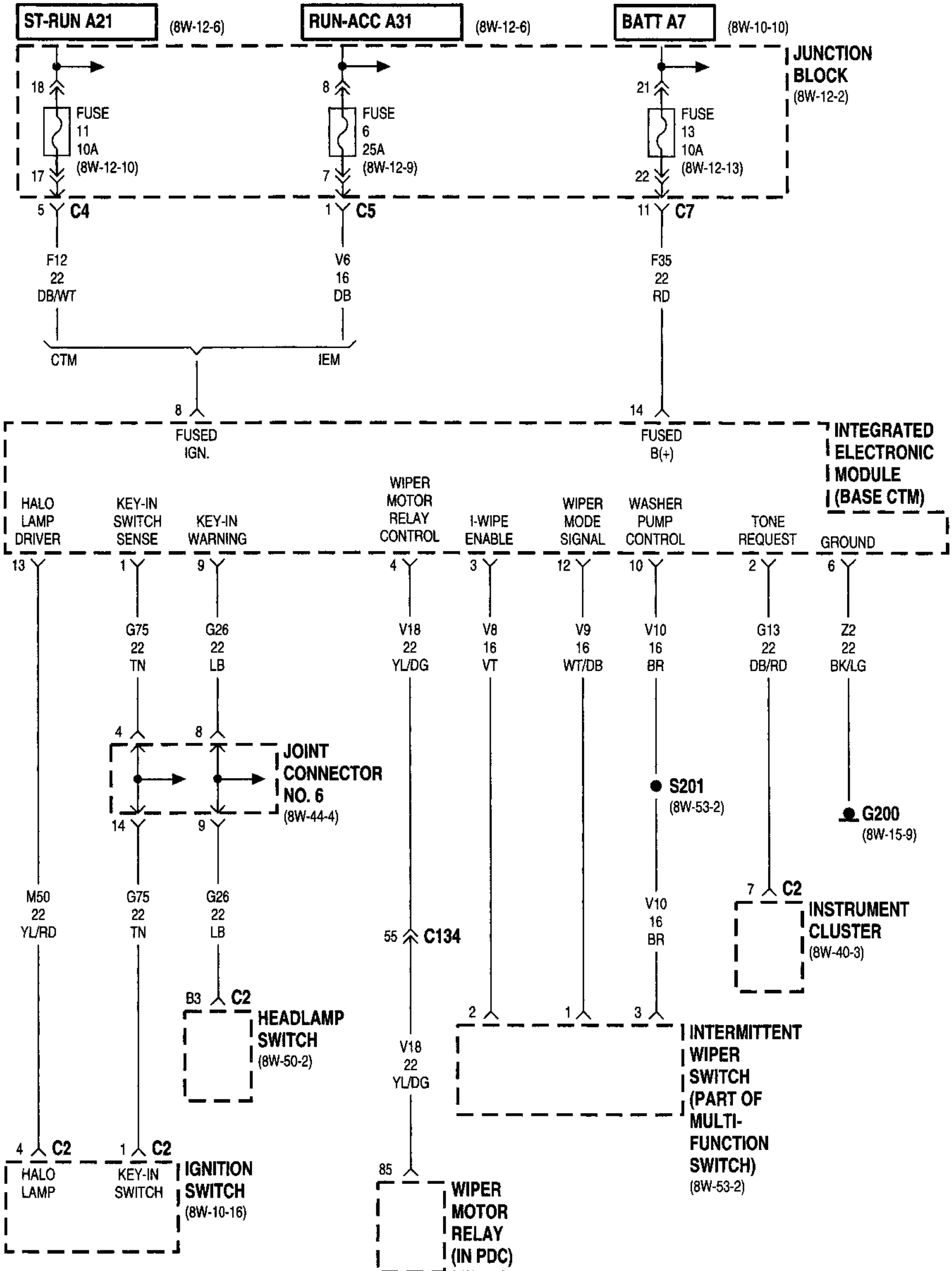
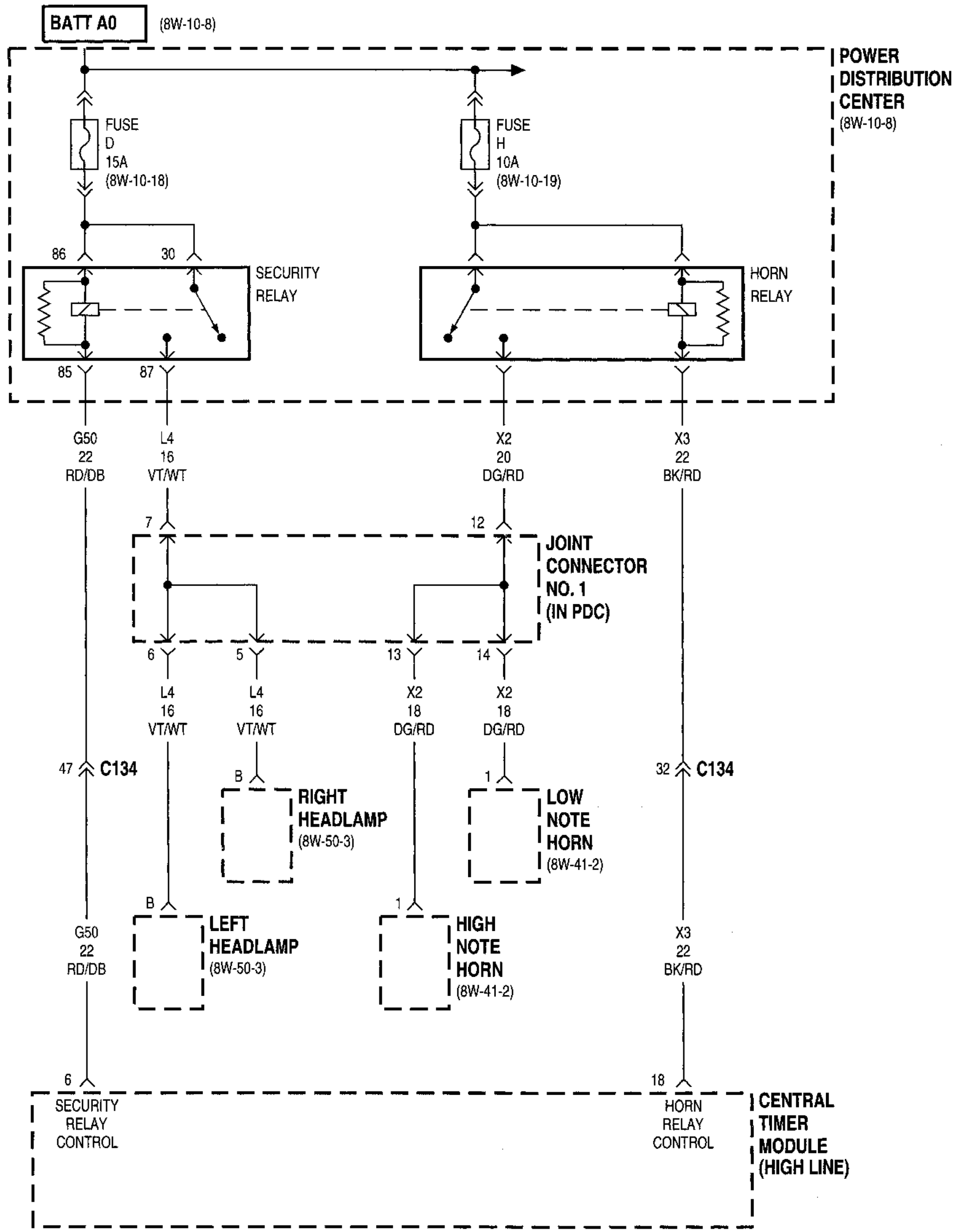
8W-45 CENTRAL TIMER MODULE

Mopar AUTHENTIC RESTORATION PRODUCT

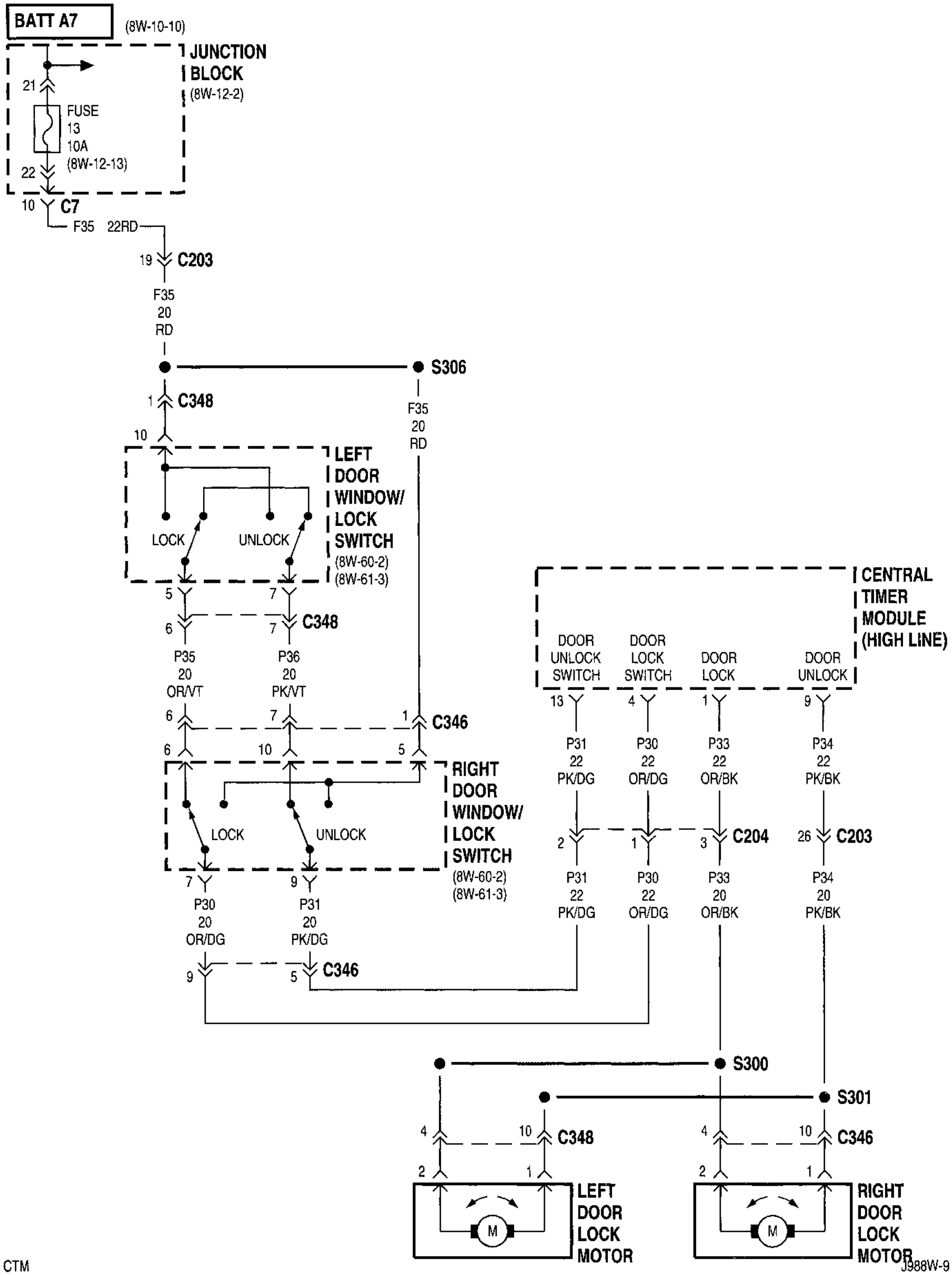



ST-RUN A21
(8W-12-6)
RUN-ACC A31
(8W-12-6)
BATT A7
(8W-10-10)
JUNCTION BLOCK
(8W-12-2)
FUSE 11 10A
(8W-12-10)
FUSE 6 25A
(8W-12-9)
FUSE 13 10A
(8W-12-13)
C4
C5
C7
F12 22 DB/WT
V6 16 DB
F35 22 RD
CTM
IEM
FUSED IGN.
FUSED B(+)
INTEGRATED ELECTRONIC MODULE (BASE CTM)
HALO LAMP DRIVER
KEY-IN SWITCH SENSE
KEY-IN WARNING
WIPER MOTOR RELAY CONTROL
I-WIPE ENABLE
WIPER MODE SIGNAL
WASHER PUMP CONTROL
TONE REQUEST
GROUND
G75 22 TN
G26 22 LB
V18 22 YL/DG
V8 16 VT
V9 16 WT/DB
V10 16 BR
G13 22 DB/RD
Z2 22 BK/LG
JOINT CONNECTOR NO. 6
(8W-44-4)
S201
(8W-53-2)
G200
(8W-15-9)
M50 22 YL/RD
G75 22 TN
G26 22 LB
C134
V10 16 BR
C2
INSTRUMENT CLUSTER
(8W-40-3)
B3 C2
HEADLAMP SWITCH
(8W-50-2)
V18 22 YL/DG
INTERMITTENT WIPER SWITCH (PART OF MULTI-FUNCTION SWITCH)
(8W-53-2)
C2
HALO LAMP
KEY-IN SWITCH
IGNITION SWITCH
(8W-10-16)
WIPER MOTOR RELAY (IN PDC)
(8W-53-3)

IEM J988W-9

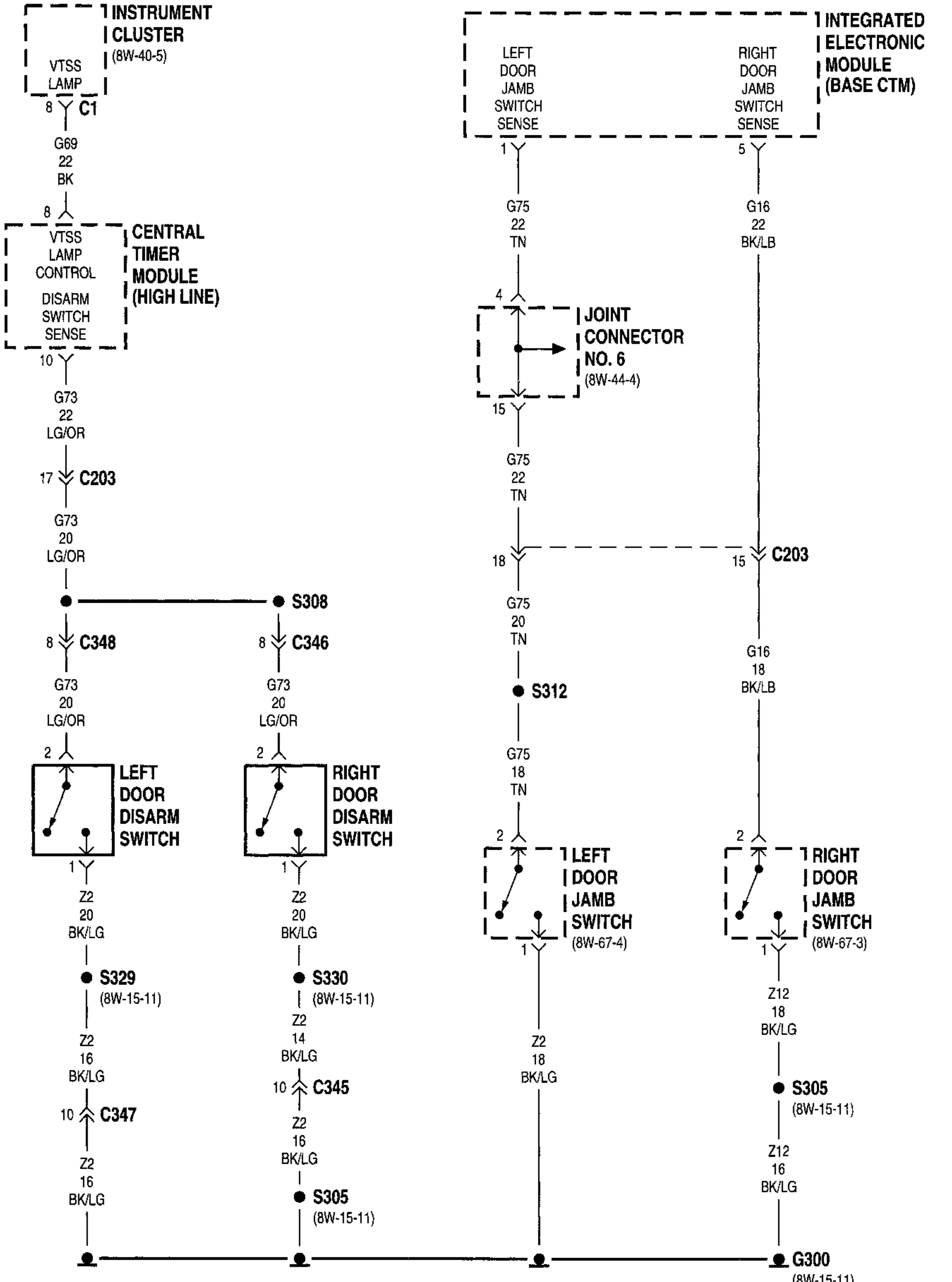


BATT A0
(8W-10-8)
POWER DISTRIBUTION CENTER
(8W-10-8)
FUSE D 15A (8W-10-18)
FUSE H 10A (8W-10-19)
86
30
SECURITY RELAY
HORN RELAY
85
87
G50 22 RD/DB
L4 16 VT/WT
X2 20 DG/RD
X3 22 BK/RD
7
12
JOINT CONNECTOR NO. 1 (IN PDC)
6
5
13
14
L4 16 VT/WT
L4 16 VT/WT
X2 18 DG/RD
X2 18 DG/RD
47
C134
32
C134
B
RIGHT HEADLAMP (8W-50-3)
1
LOW NOTE HORN (8W-41-2)
B
LEFT HEADLAMP (8W-50-3)
1
HIGH NOTE HORN (8W-41-2)
G50 22 RD/DB
X3 22 BK/RD
6
SECURITY RELAY CONTROL
18
HORN RELAY CONTROL
CENTRAL TIMER MODULE (HIGH LINE)



BATT A7
(8W-10-10)
JUNCTION BLOCK
(8W-12-2)
21
FUSE
13
10A
(8W-12-13)
22
10
C7
F35 22RD
19
C203
F35
20
RD
S306
1
C348
F35
20
RD
10
LEFT DOOR WINDOW/ LOCK SWITCH
(8W-60-2)
(8W-61-3)
LOCK
UNLOCK
5
7
6
7
C348
P35
20
OR/VT
P36
20
PK/VT
6
7
1
C346
6
10
5
RIGHT DOOR WINDOW/ LOCK SWITCH
(8W-60-2)
(8W-61-3)
LOCK
UNLOCK
7
9
P30
20
OR/DG
P31
20
PK/DG
9
5
C346
CENTRAL TIMER MODULE (HIGH LINE)
DOOR UNLOCK SWITCH
DOOR LOCK SWITCH
DOOR LOCK
DOOR UNLOCK
13
4
1
9
P31
22
PK/DG
P30
22
OR/DG
P33
22
OR/BK
P34
22
PK/BK
2
1
3
C204
26
C203
P31
22
PK/DG
P30
22
OR/DG
P33
20
OR/BK
P34
20
PK/BK
S300
S301
4
10
C348
4
10
C346
2
1
2
1
M
M
LEFT DOOR LOCK MOTOR
RIGHT DOOR LOCK MOTOR

J988W-9


INSTRUMENT CLUSTER (8W-40-5)
VTSS LAMP
8 C1
G69 22 BK
8
VTSS LAMP CONTROL
DISARM SWITCH SENSE
CENTRAL TIMER MODULE (HIGH LINE)
10
G73 22 LG/OR
17 C203
G73 20 LG/OR
S308
8 C348
8 C346
G73 20 LG/OR
G73 20 LG/OR
2
2
LEFT DOOR DISARM SWITCH
RIGHT DOOR DISARM SWITCH
1
1
Z2 20 BK/LG
Z2 20 BK/LG
S329 (8W-15-11)
S330 (8W-15-11)
Z2 16 BK/LG
Z2 14 BK/LG
10 C347
10 C345
Z2 16 BK/LG
Z2 16 BK/LG
S305 (8W-15-11)
LEFT DOOR JAMB SWITCH SENSE
RIGHT DOOR JAMB SWITCH SENSE
INTEGRATED ELECTRONIC MODULE (BASE CTM)
1
5
G75 22 TN
G16 22 BK/LB
4
JOINT CONNECTOR NO. 6 (8W-44-4)
15
G75 22 TN
18
15 C203
G75 20 TN
S312
G16 18 BK/LB
G75 18 TN
2
2
LEFT DOOR JAMB SWITCH (8W-67-4)
RIGHT DOOR JAMB SWITCH (8W-67-3)
1
1
Z2 18 BK/LG
Z12 18 BK/LG
S305 (8W-15-11)
Z12 16 BK/LG
G300 (8W-15-11)

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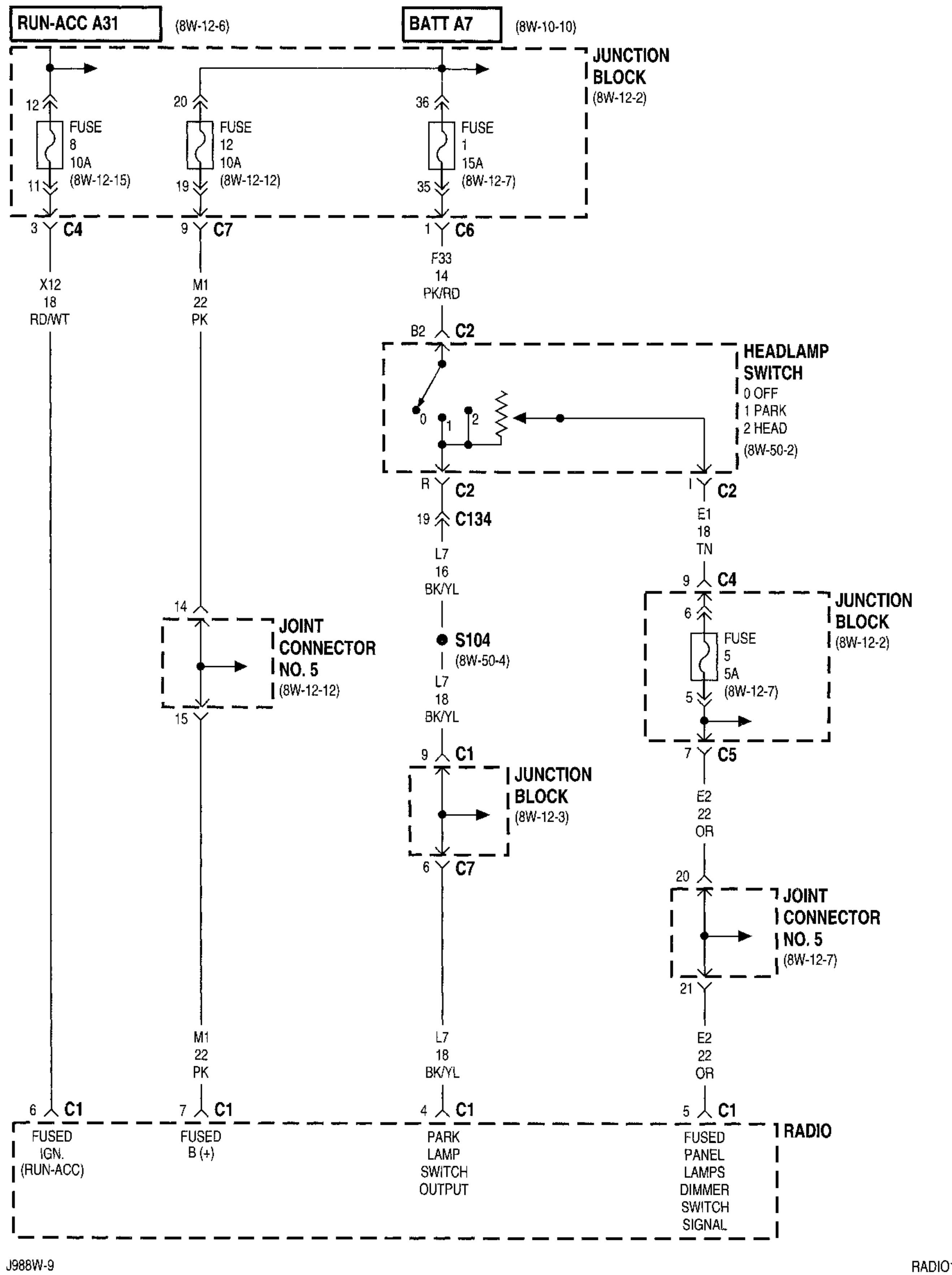
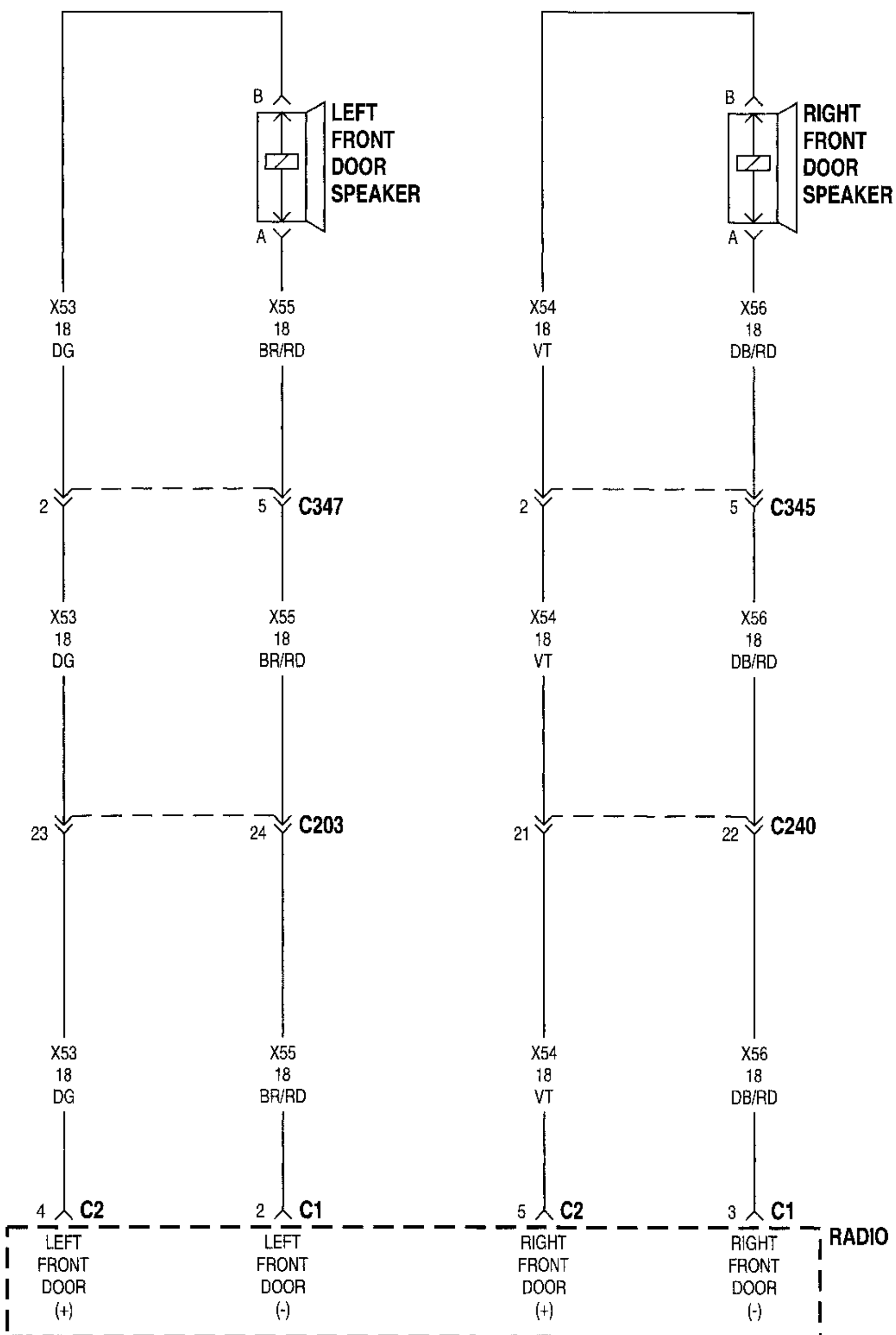
8W-47 AUDIO SYSTEM

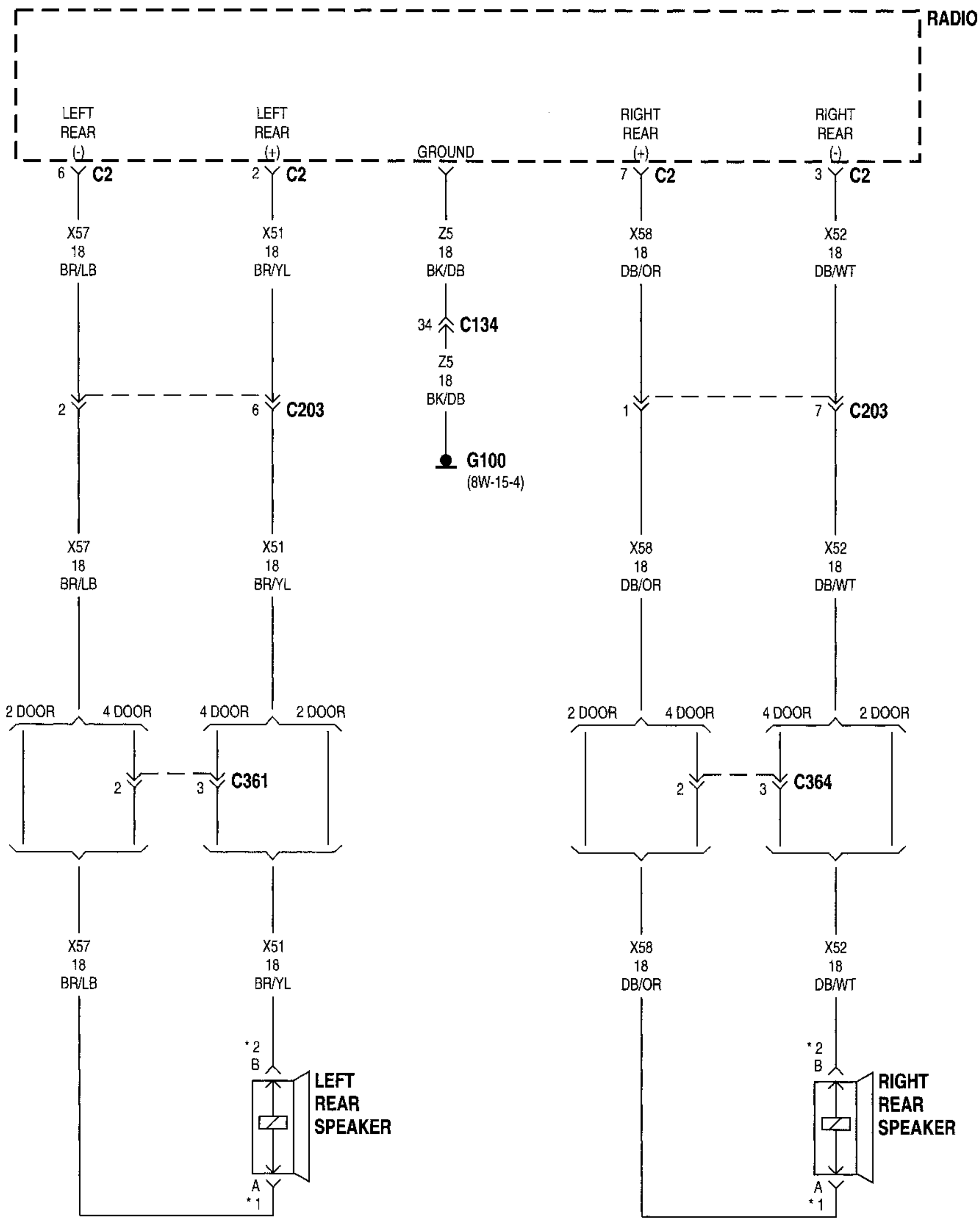


RUN-ACC A31
(8W-12-6)
BATT A7
(8W-10-10)
JUNCTION BLOCK
(8W-12-2)
12
FUSE
8
10A
(8W-12-15)
11
20
FUSE
12
10A
(8W-12-12)
19
36
FUSE
1
15A
(8W-12-7)
35
3 C4
9 C7
1 C6
X12
18
RD/WT
M1
22
PK
F33
14
PK/RD
B2 C2
HEADLAMP SWITCH
0 OFF
1 PARK
2 HEAD
(8W-50-2)
0
1
2
R C2
I C2
19 C134
L7
16
BK/YL
E1
18
TN
9 C4
JUNCTION BLOCK
(8W-12-2)
6
FUSE
5
5A
(8W-12-7)
5
7 C5
14
JOINT CONNECTOR NO. 5
(8W-12-12)
15
S104
(8W-50-4)
L7
18
BK/YL
9 C1
JUNCTION BLOCK
(8W-12-3)
6 C7
E2
22
OR
20
JOINT CONNECTOR NO. 5
(8W-12-7)
21
M1
22
PK
L7
18
BK/YL
E2
22
OR
6 C1
7 C1
4 C1
5 C1
RADIO
FUSED IGN. (RUN-ACC)
FUSED B (+)
PARK LAMP SWITCH OUTPUT
FUSED PANEL LAMPS DIMMER SWITCH SIGNAL
J988W-9
RADIO1



B
LEFT FRONT DOOR SPEAKER
A
B
RIGHT FRONT DOOR SPEAKER
A
X53 18 DG
X55 18 BR/RD
X54 18 VT
X56 18 DB/RD
2
5
C347
2
5
C345
X53 18 DG
X55 18 BR/RD
X54 18 VT
X56 18 DB/RD
23
24
C203
21
22
C240
X53 18 DG
X55 18 BR/RD
X54 18 VT
X56 18 DB/RD
4 C2
2 C1
5 C2
3 C1
RADIO
LEFT FRONT DOOR (+)
LEFT FRONT DOOR (-)
RIGHT FRONT DOOR (+)
RIGHT FRONT DOOR (-)

AUTHENTIC RESTORATION PRODUCT



* PREMIUM

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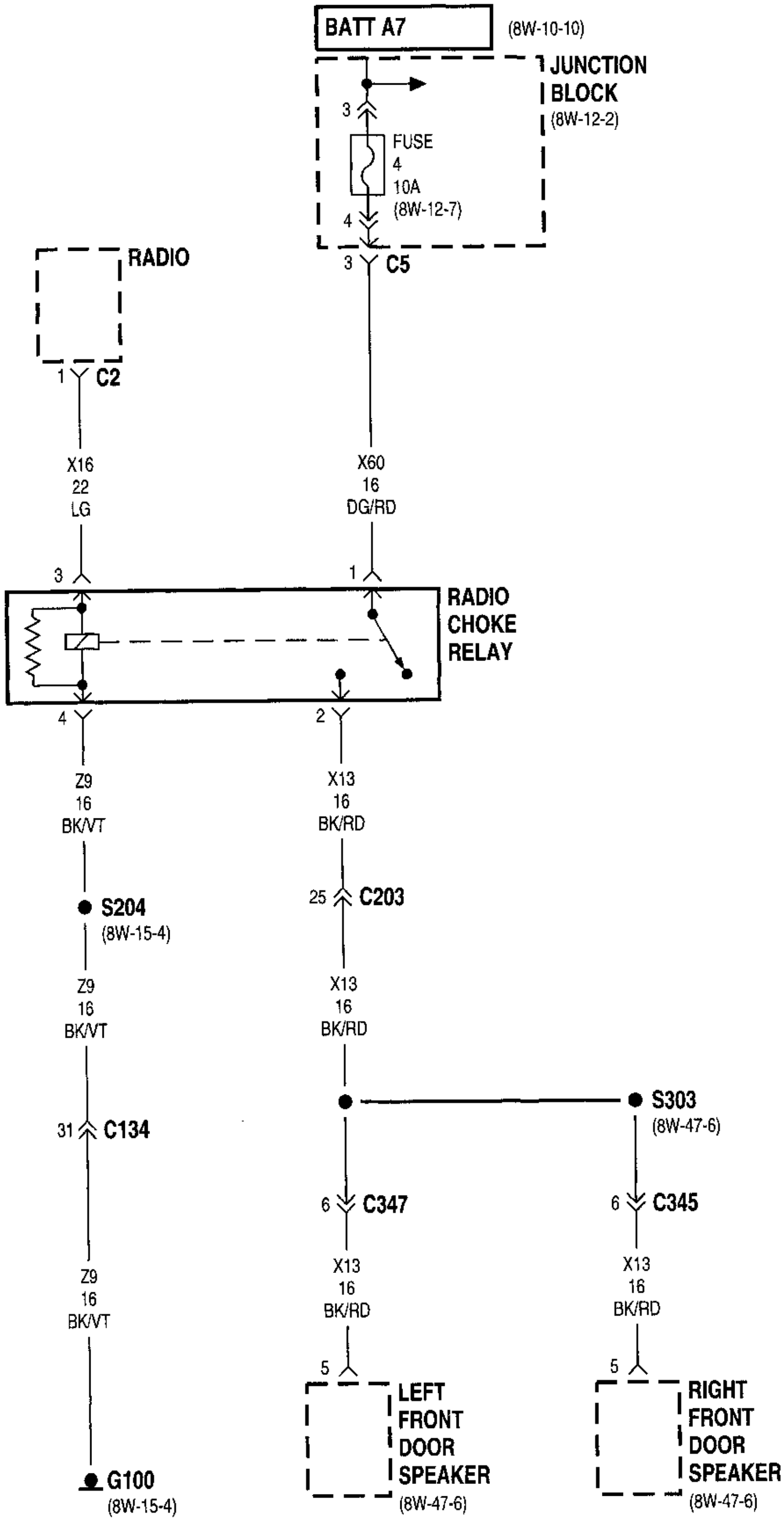
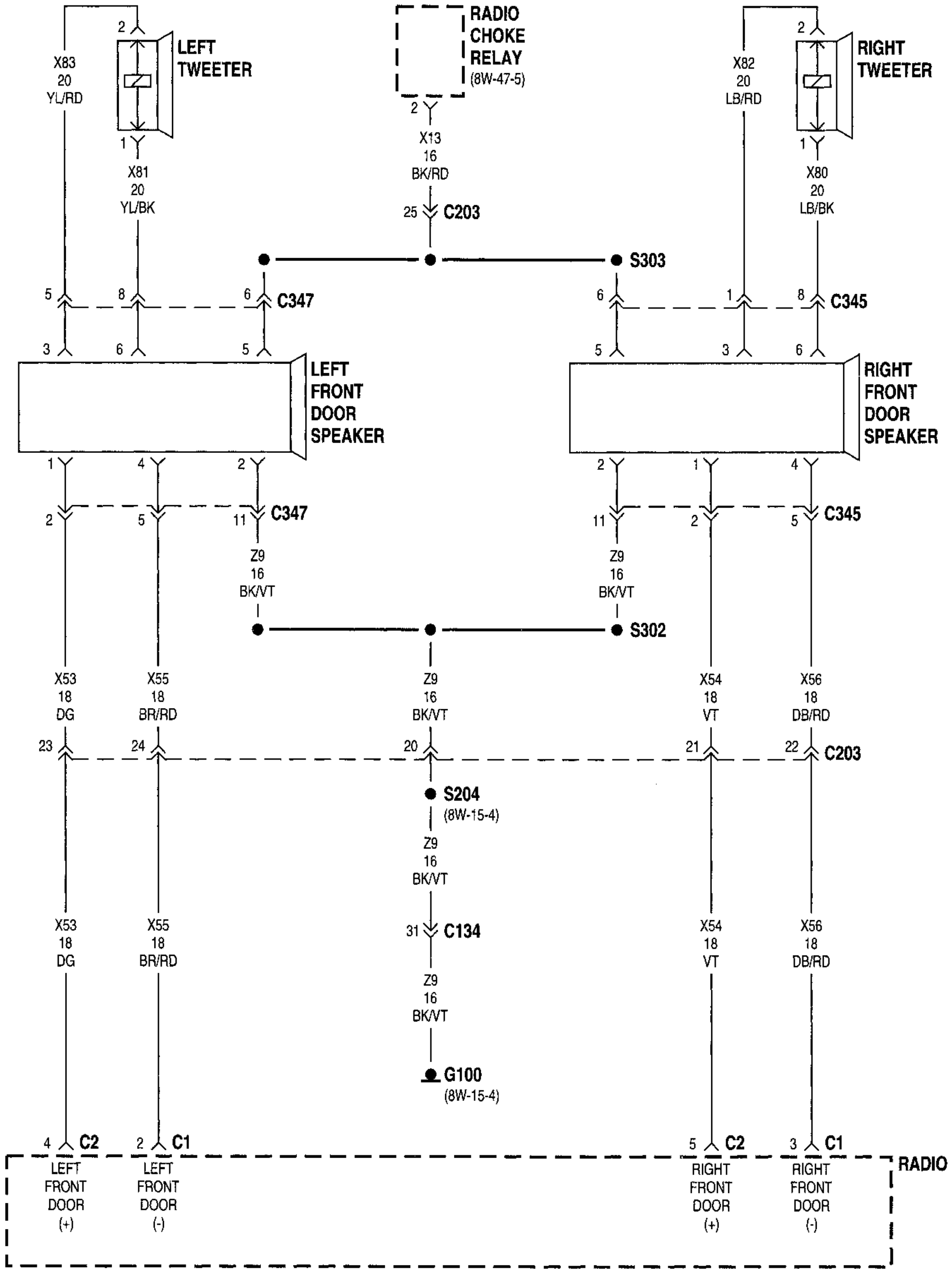


AUTHENTIC RESTORATION PRODUCT



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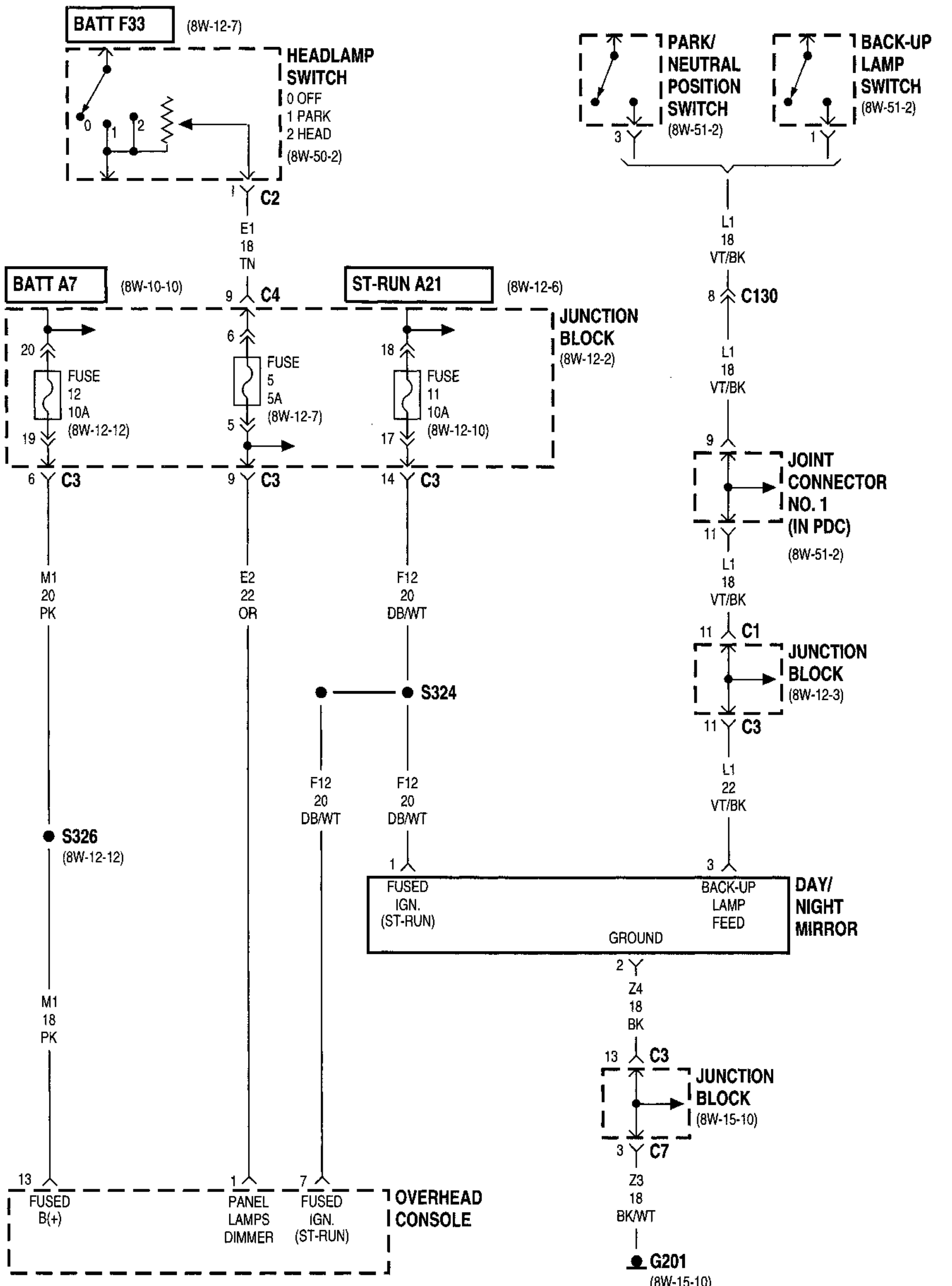
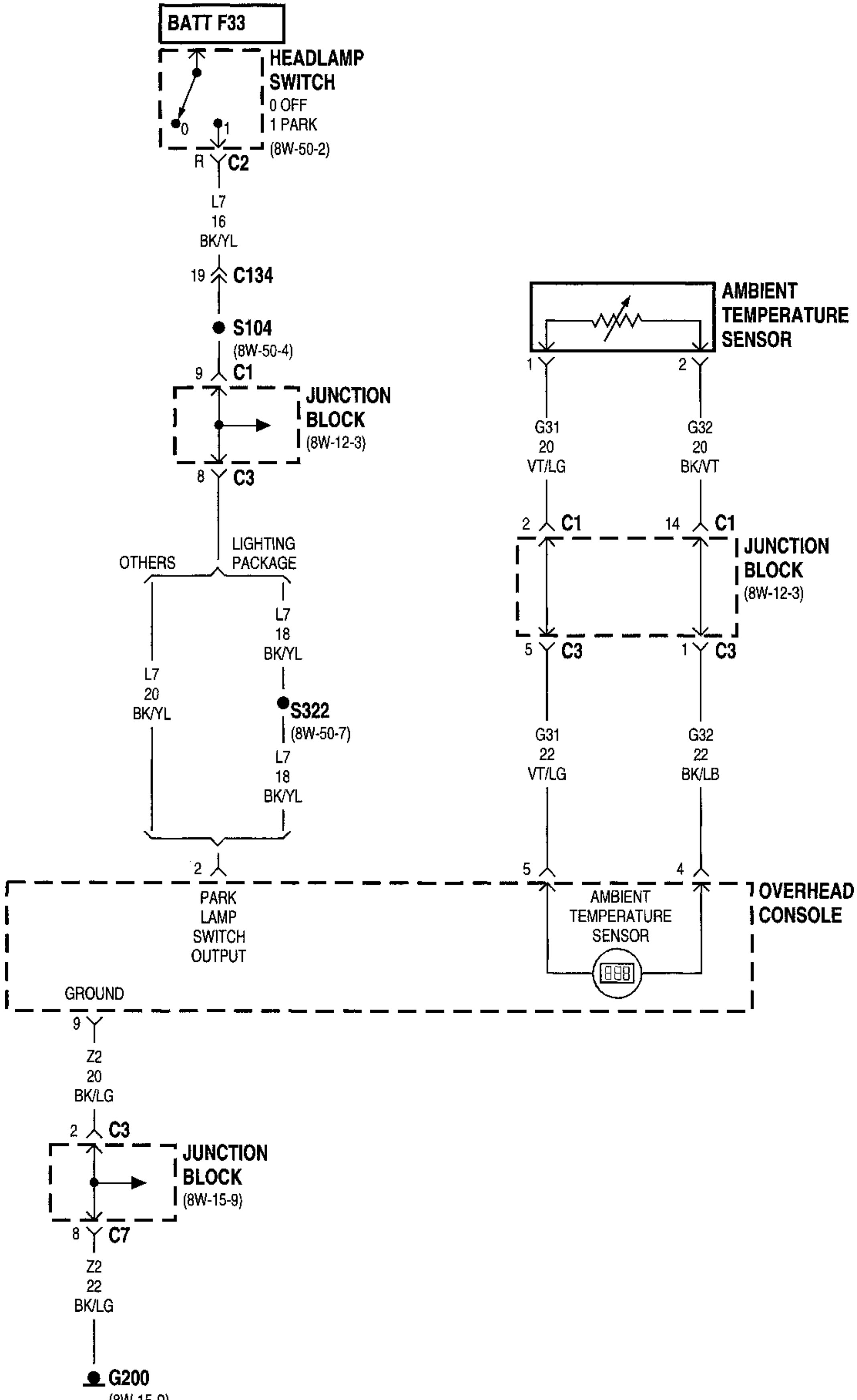
8W-49 OVERHEAD CONSOLE

Mopar AUTHENTIC RESTORATION PRODUCT




BATT F33
HEADLAMP SWITCH
0 OFF
1 PARK
(8W-50-2)
R
C2
L7
16
BK/YL
19
C134
S104
(8W-50-4)
9
C1
JUNCTION BLOCK
(8W-12-3)
8
C3
OTHERS
LIGHTING PACKAGE
L7
18
BK/YL
L7
20
BK/YL
S322
(8W-50-7)
L7
18
BK/YL
AMBIENT TEMPERATURE SENSOR
1
2
G31
20
VT/LG
G32
20
BK/VT
2
C1
14
C1
JUNCTION BLOCK
(8W-12-3)
5
C3
1
C3
G31
22
VT/LG
G32
22
BK/LB
2
5
4
OVERHEAD CONSOLE
PARK LAMP SWITCH OUTPUT
AMBIENT TEMPERATURE SENSOR
GROUND
9
Z2
20
BK/LG
2
C3
JUNCTION BLOCK
(8W-15-9)
8
C7
Z2
22
BK/LG
G200
(8W-15-9)

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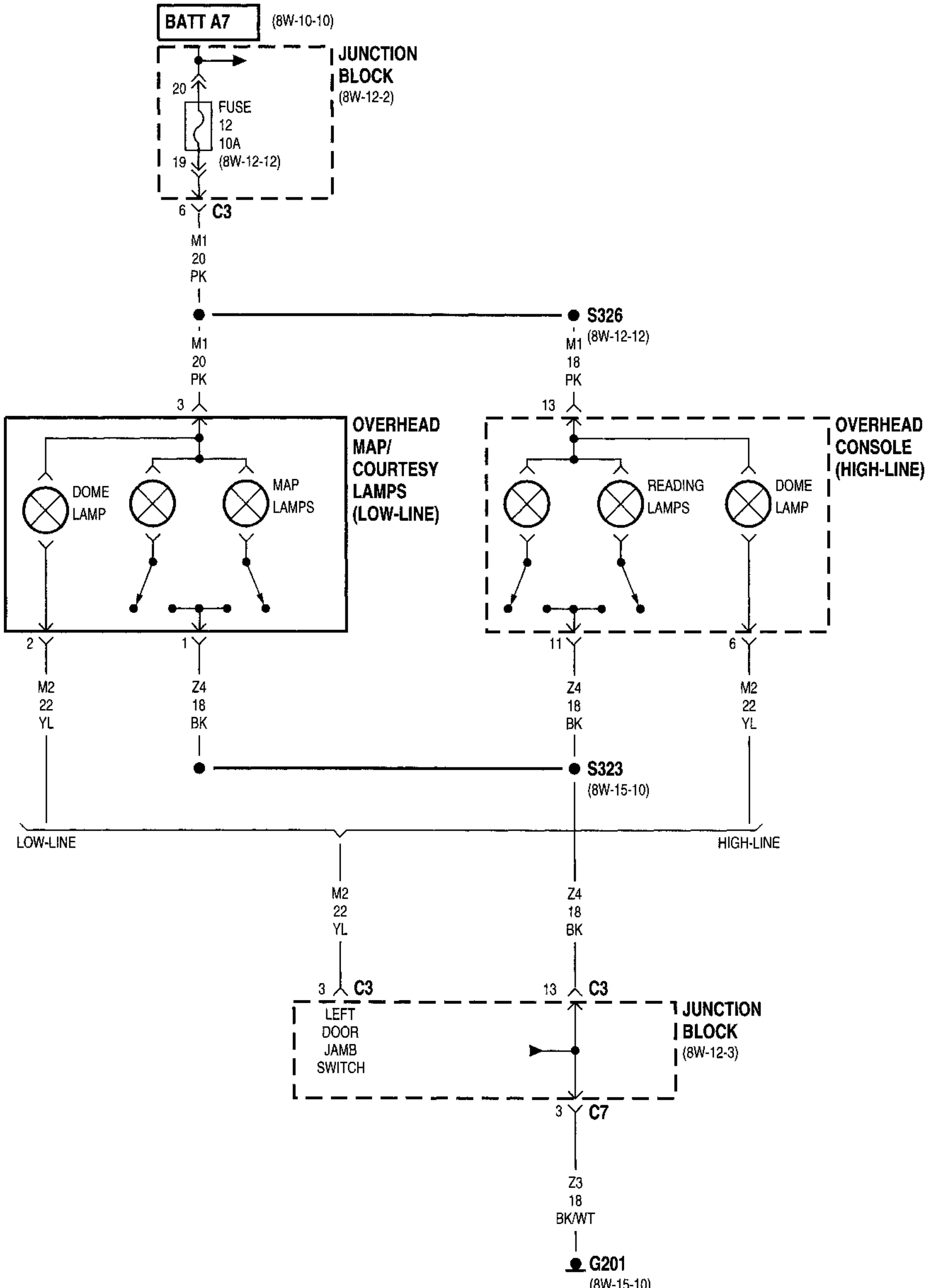

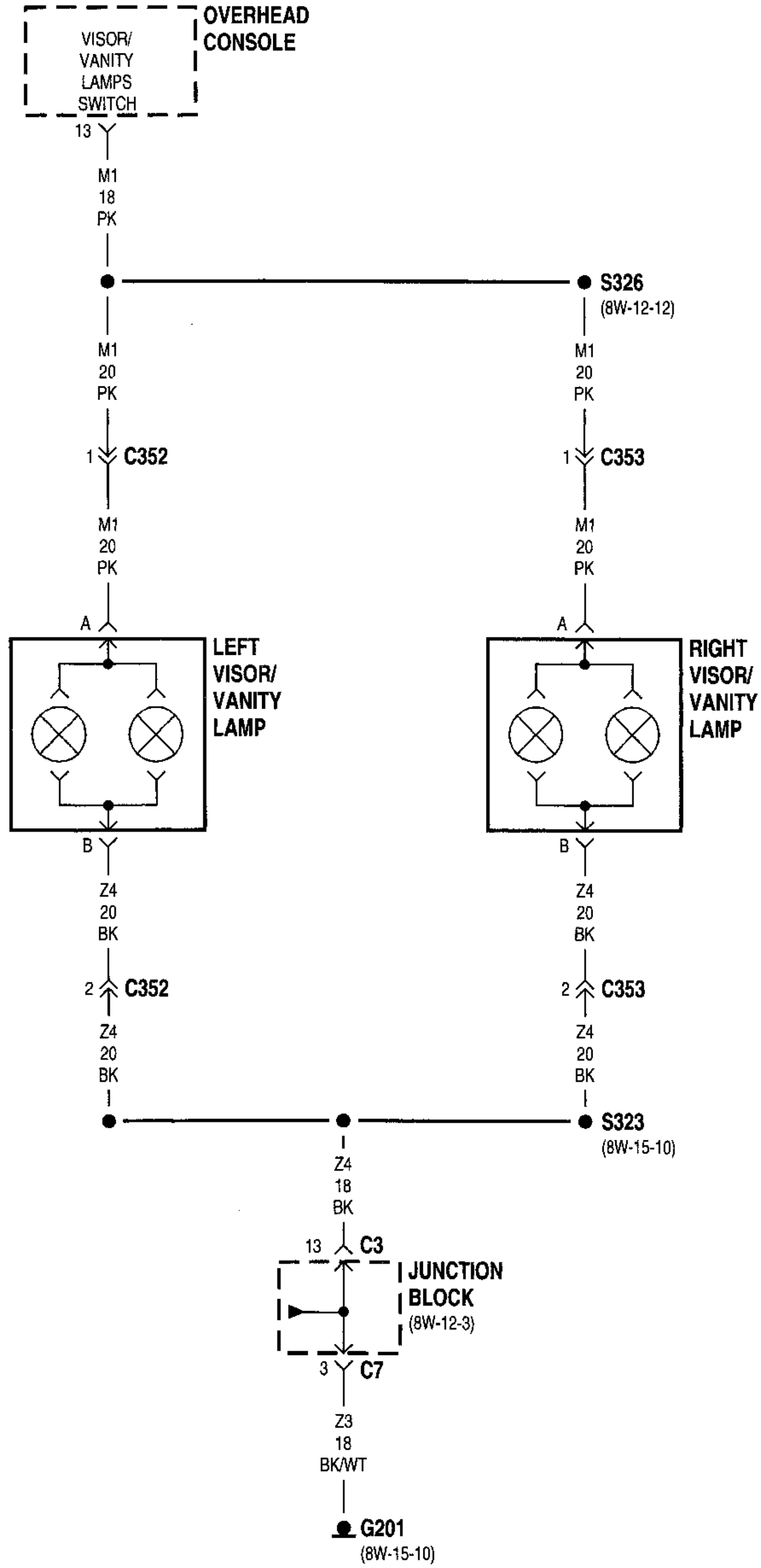
OVERHEAD CONSOLE
VISOR/ VANITY LAMPS SWITCH
13
M1
18
PK
S326
(8W-12-12)
M1
20
PK
1
C352
1
C353
M1
20
PK
A
LEFT VISOR/ VANITY LAMP
RIGHT VISOR/ VANITY LAMP
B
Z4
20
BK
2
C352
2
C353
S323
(8W-15-10)
Z4
18
BK
13
C3
JUNCTION BLOCK
(8W-12-3)
3
C7
Z3
18
BK/WT
G201
(8W-15-10)

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8W-50 FRONT LIGHTING

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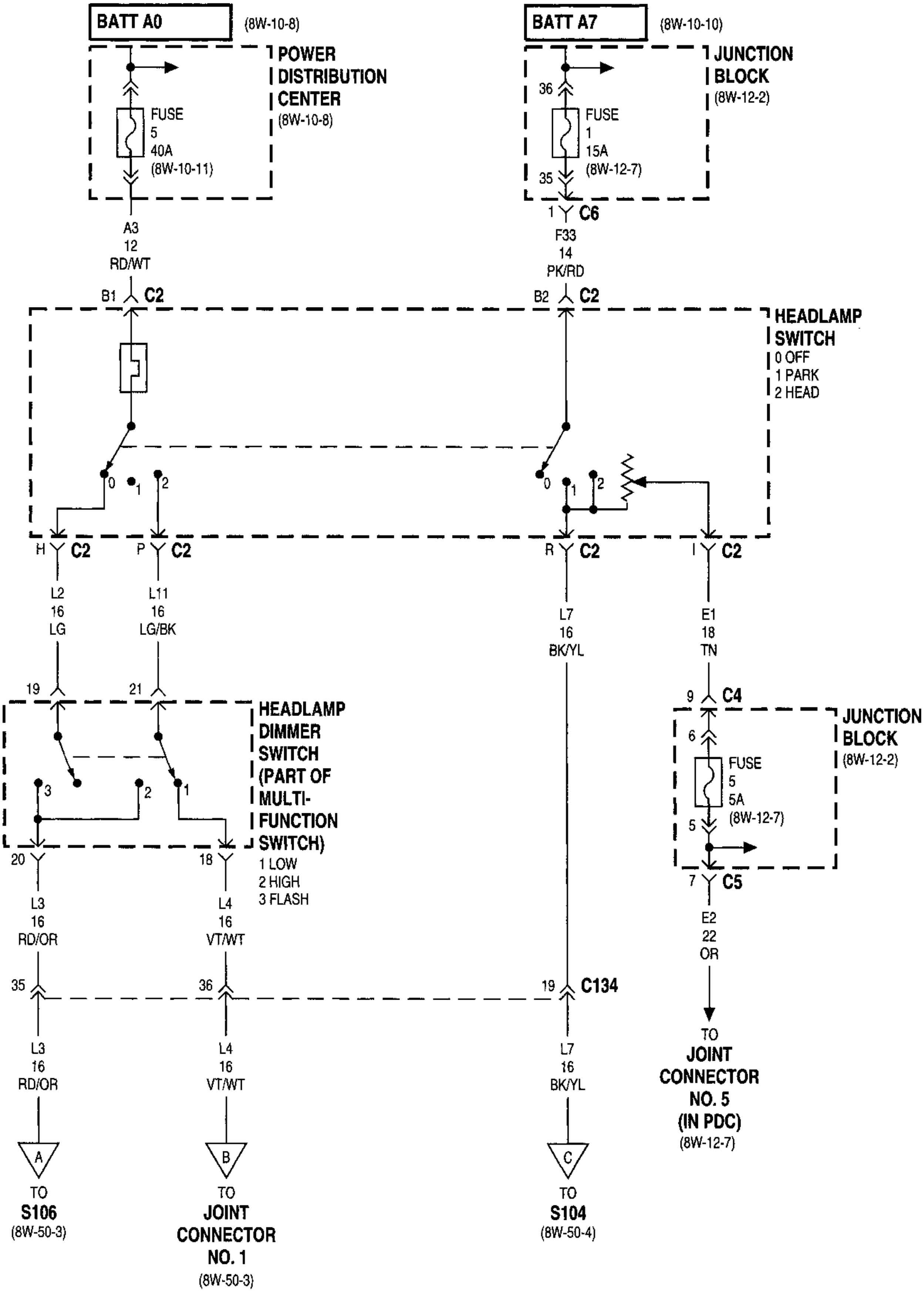
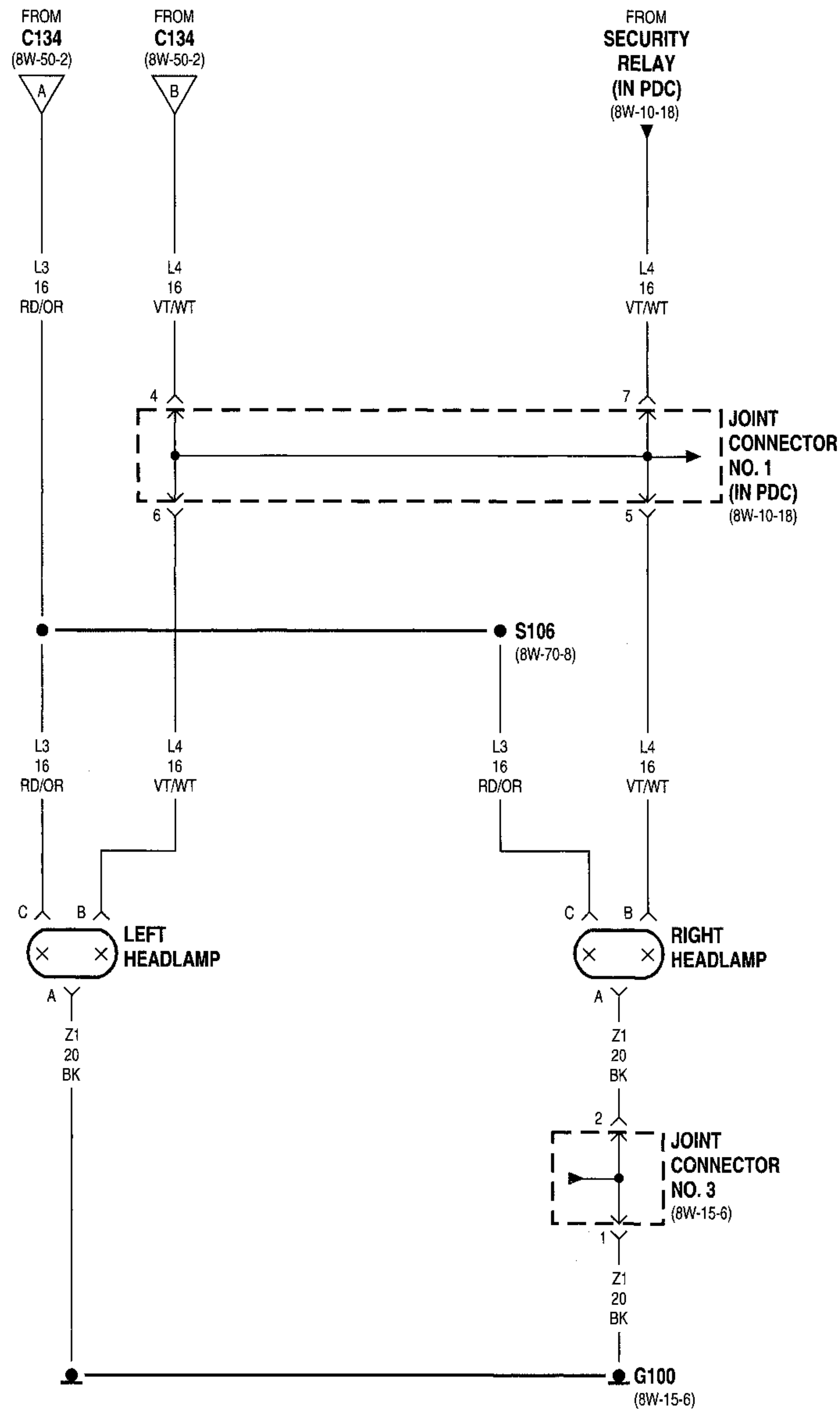
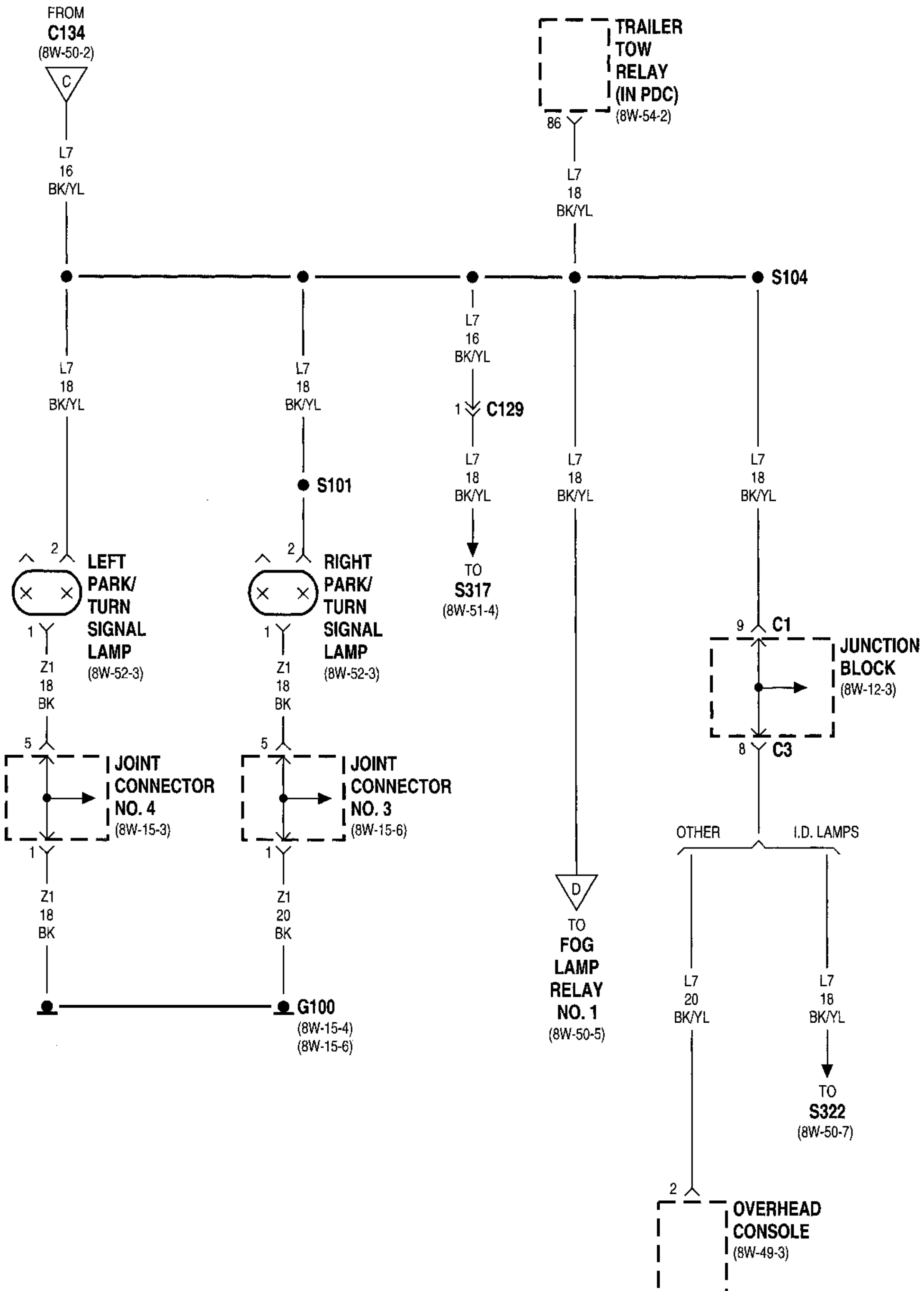


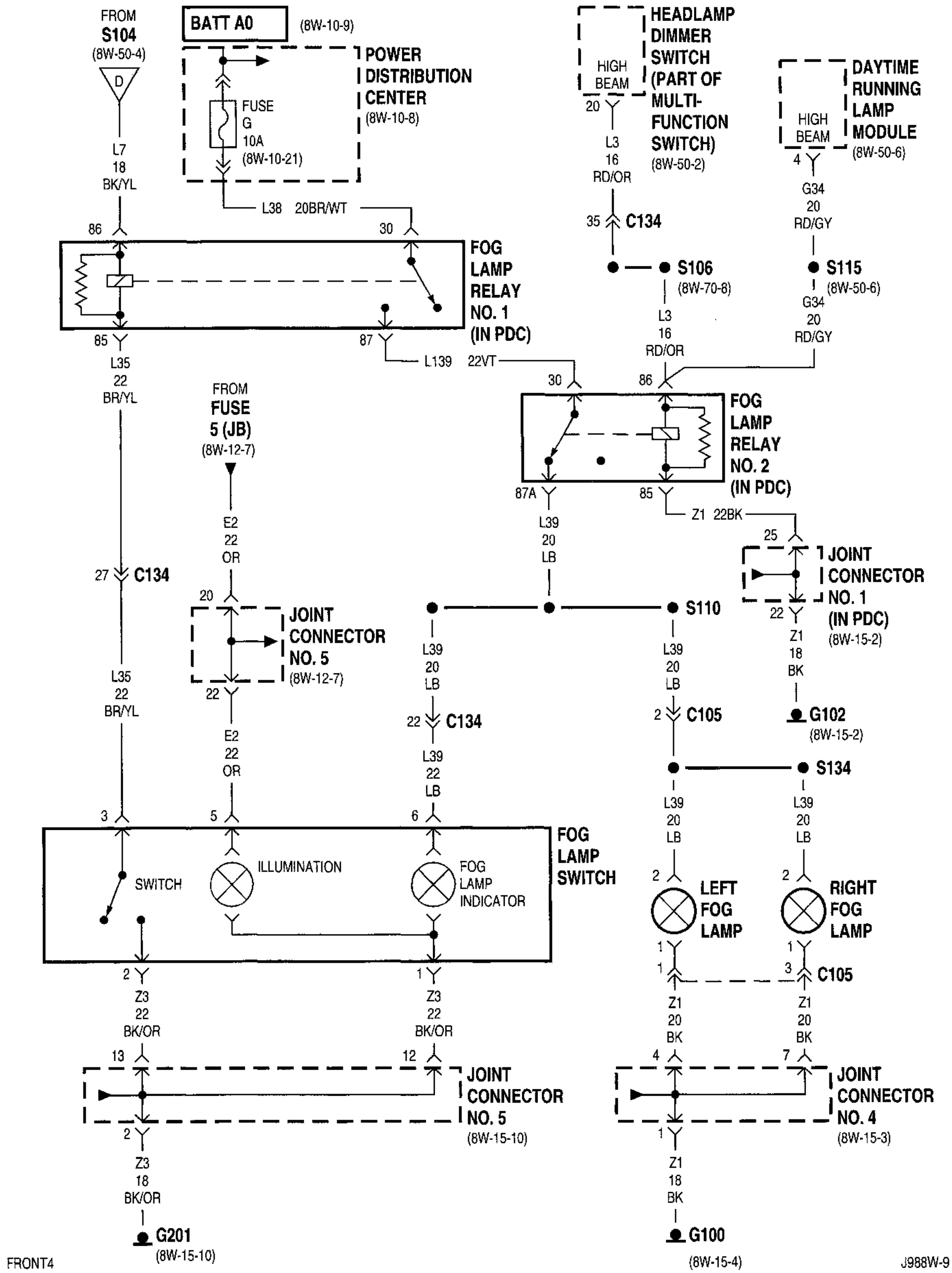
AUTHENTIC RESTORATION PRODUCT



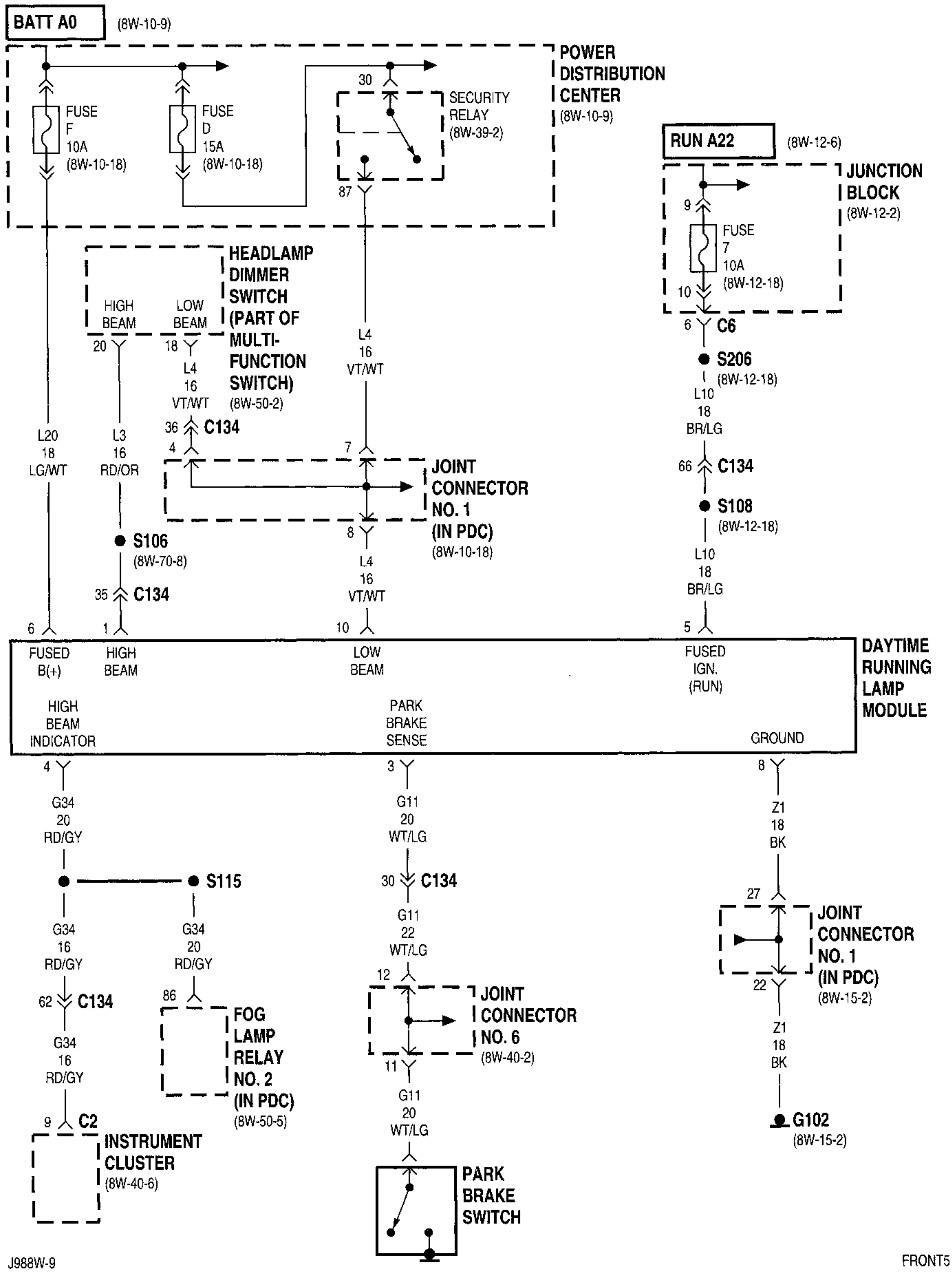

FROM
C134
(8W-50-2)
C
L7
16
BK/YL
TRAILER
TOW
RELAY
(IN PDC)
(8W-54-2)
86
L7
18
BK/YL
S104
L7
18
BK/YL
L7
18
BK/YL
L7
16
BK/YL
1
C129
L7
18
BK/YL
TO
S317
(8W-51-4)
L7
18
BK/YL
L7
18
BK/YL
S101
2
LEFT
PARK/
TURN
SIGNAL
LAMP
(8W-52-3)
1
Z1
18
BK
2
RIGHT
PARK/
TURN
SIGNAL
LAMP
(8W-52-3)
1
Z1
18
BK
9
C1
JUNCTION
BLOCK
(8W-12-3)
8
C3
5
JOINT
CONNECTOR
NO. 4
(8W-15-3)
1
Z1
18
BK
5
JOINT
CONNECTOR
NO. 3
(8W-15-6)
1
Z1
20
BK
OTHER
I.D. LAMPS
D
TO
FOG
LAMP
RELAY
NO. 1
(8W-50-5)
L7
20
BK/YL
L7
18
BK/YL
G100
(8W-15-4)
(8W-15-6)
TO
S322
(8W-50-7)
2
OVERHEAD
CONSOLE
(8W-49-3)

AUTHENTIC RESTORATION PRODUCT

FOG LAMPS



DRL


BATT A0
(8W-10-9)
POWER DISTRIBUTION CENTER
(8W-10-9)
FUSE F 10A (8W-10-18)
FUSE D 15A (8W-10-18)
30
SECURITY RELAY (8W-39-2)
87
RUN A22
(8W-12-6)
JUNCTION BLOCK
(8W-12-2)
9
FUSE 7 10A (8W-12-18)
10
6 C6
S206 (8W-12-18)
L10 18 BR/LG
66 C134
S108 (8W-12-18)
L10 18 BR/LG
5
HEADLAMP DIMMER SWITCH (PART OF MULTI-FUNCTION SWITCH)
(8W-50-2)
HIGH BEAM
LOW BEAM
20
18
L4 16 VT/WT
36 C134
4
L4 16 VT/WT
7
JOINT CONNECTOR NO. 1 (IN PDC)
(8W-10-18)
8
L4 16 VT/WT
10
L20 18 LG/WT
L3 16 RD/OR
S106 (8W-70-8)
35 C134
6
1
DAYTIME RUNNING LAMP MODULE
FUSED B(+)
HIGH BEAM
LOW BEAM
FUSED IGN. (RUN)
HIGH BEAM INDICATOR
PARK BRAKE SENSE
GROUND
4
G34 20 RD/GY
S115
G34 16 RD/GY
62 C134
G34 16 RD/GY
9 C2
INSTRUMENT CLUSTER
(8W-40-6)
G34 20 RD/GY
86
FOG LAMP RELAY NO. 2 (IN PDC)
(8W-50-5)
3
G11 20 WT/LG
30 C134
G11 22 WT/LG
12
JOINT CONNECTOR NO. 6
(8W-40-2)
11
G11 20 WT/LG
PARK BRAKE SWITCH
8
Z1 18 BK
27
JOINT CONNECTOR NO. 1 (IN PDC)
(8W-15-2)
22
Z1 18 BK
G102
(8W-15-2)

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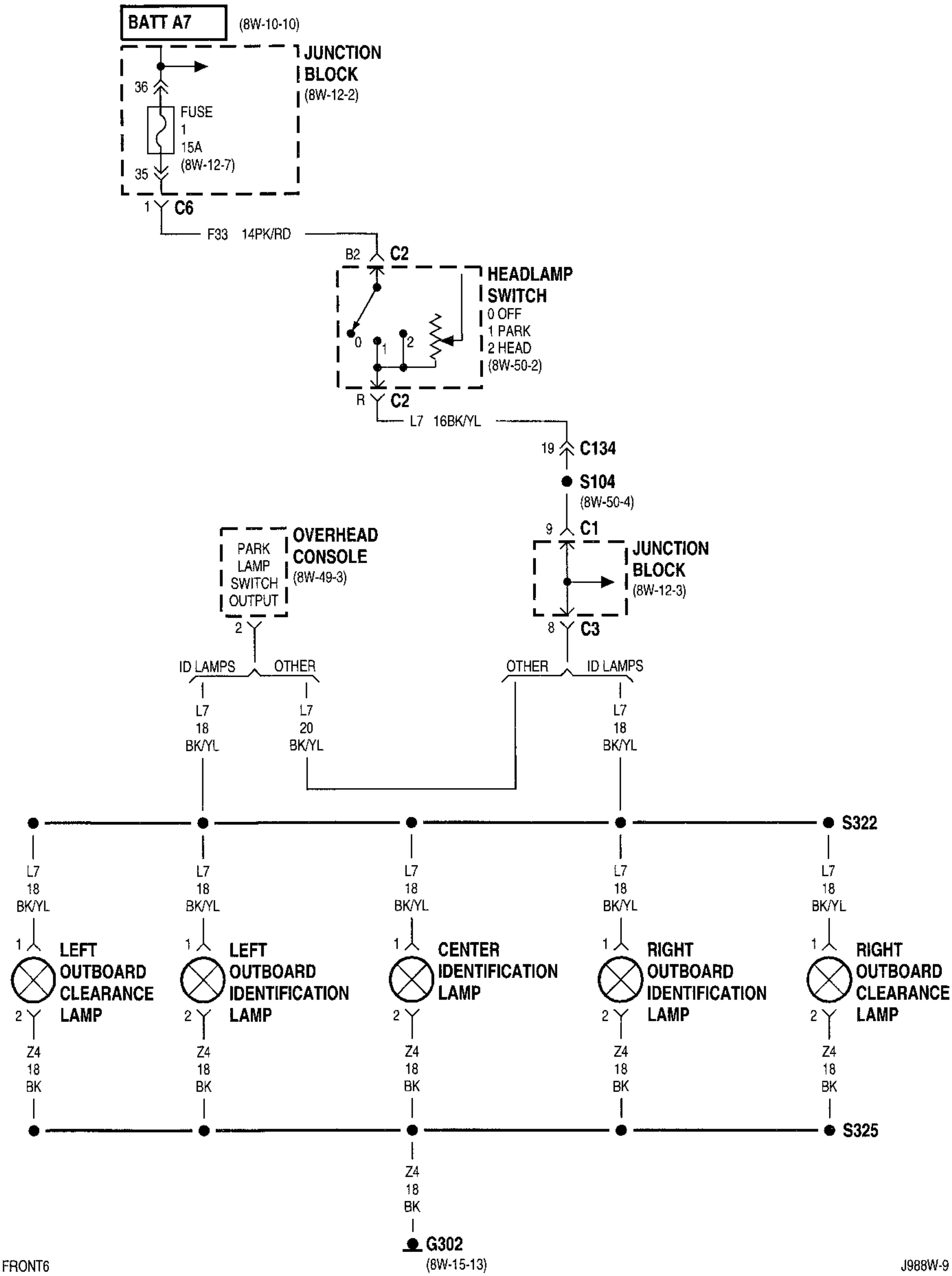

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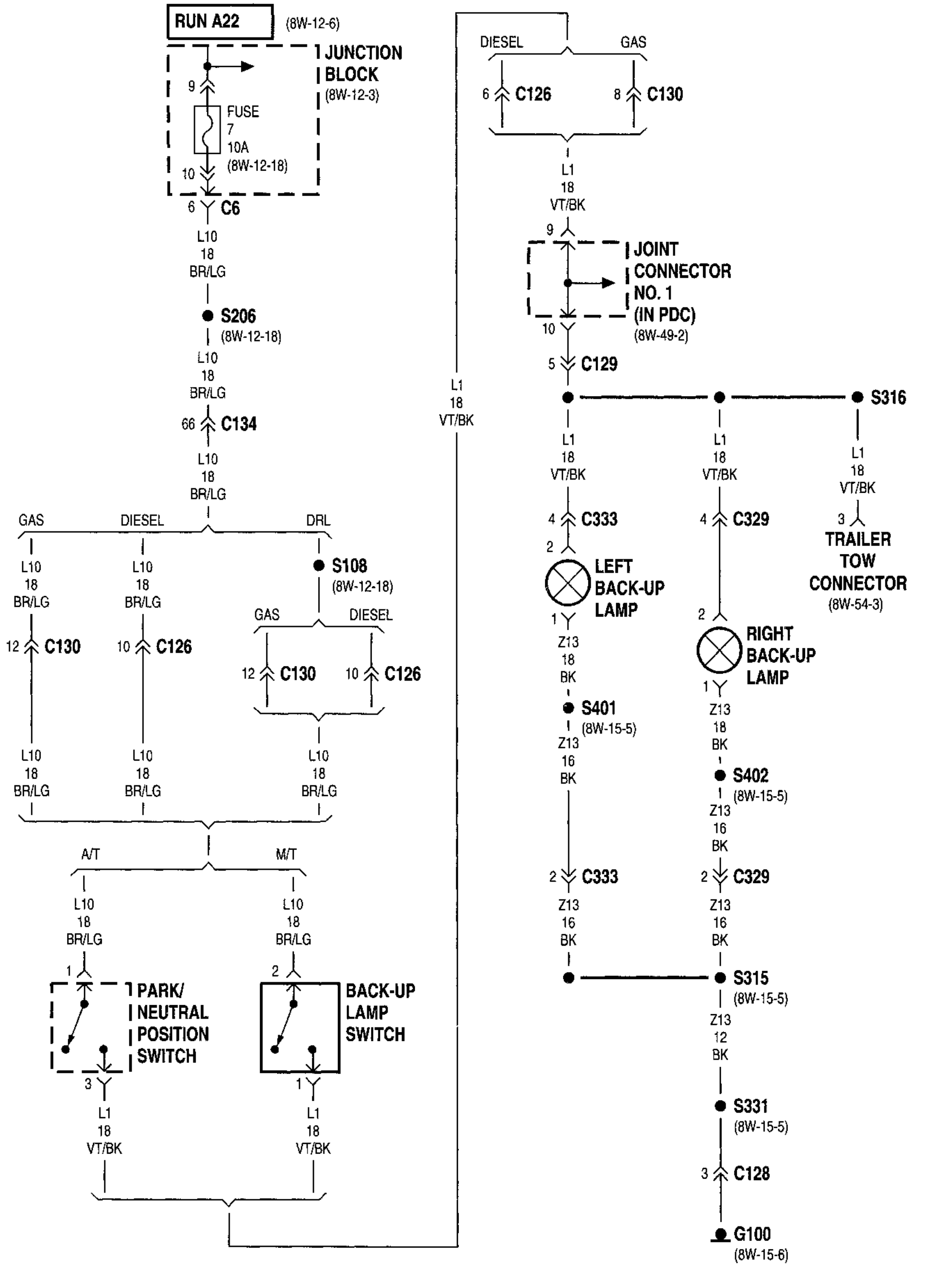
8W-51 REAR LIGHTING

Component **Page**

Component **Page**

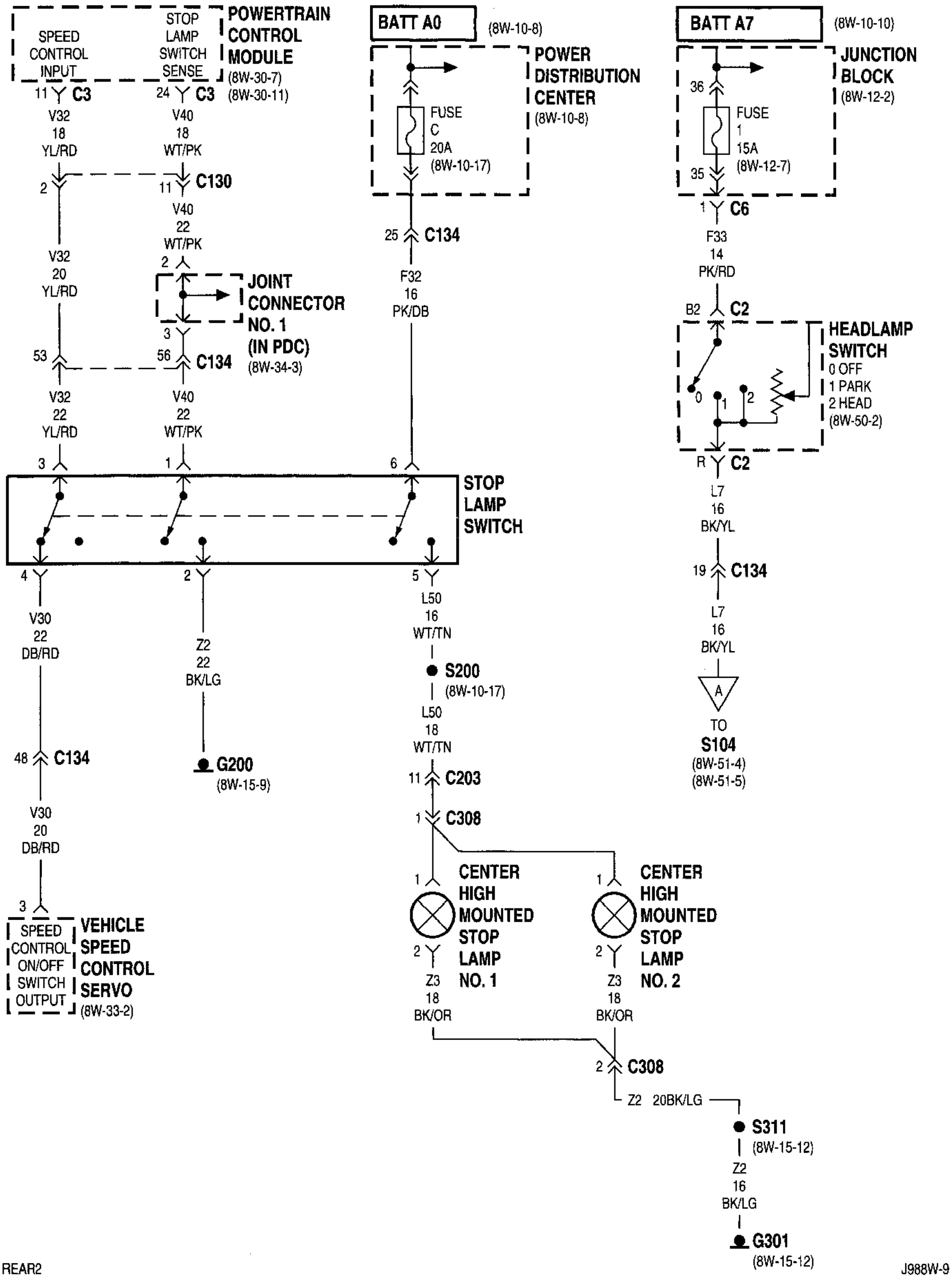
AUTHENTIC RESTORATION PRODUCT

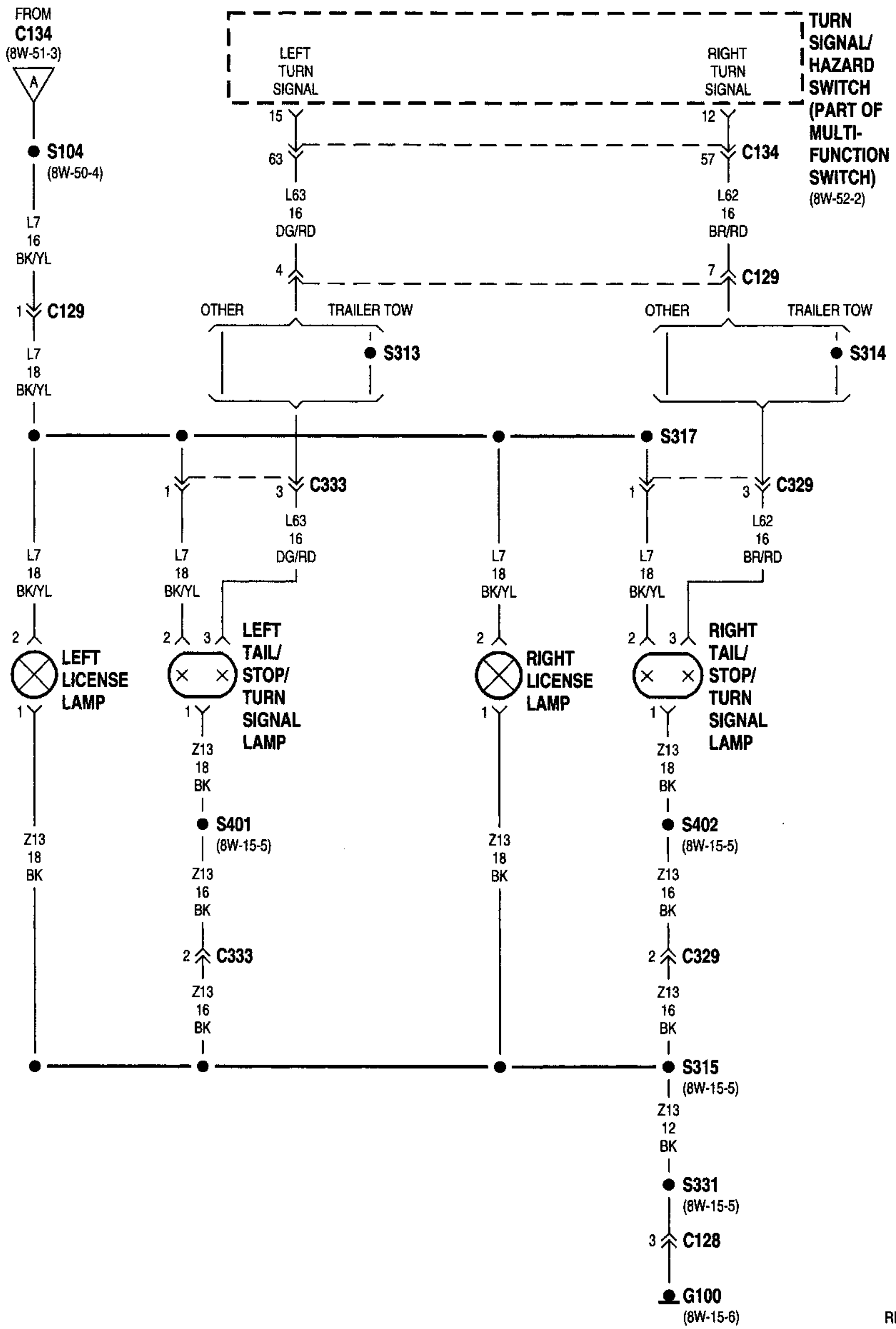


J988W-9

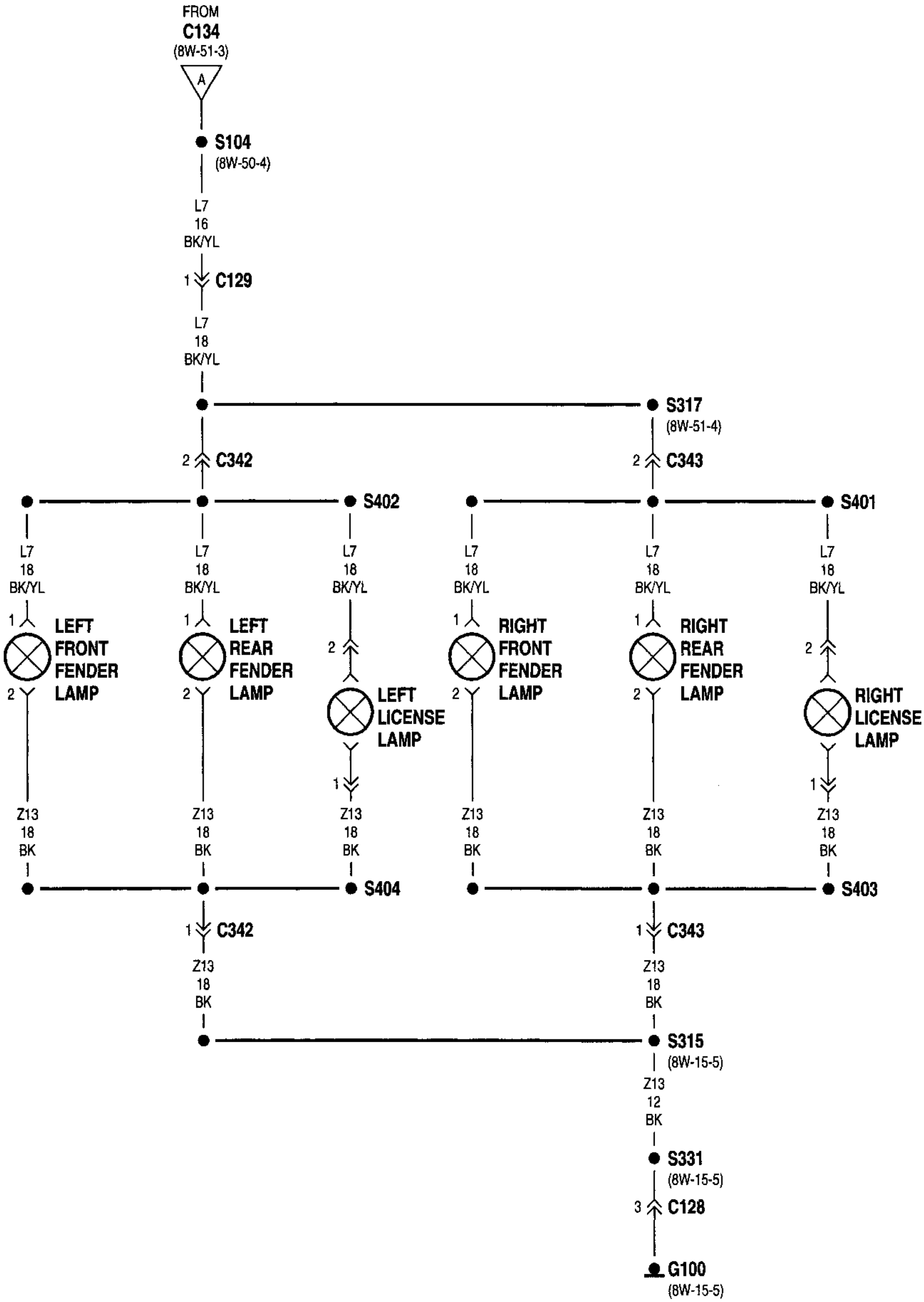
REAR

AUTHENTIC RESTORATION PRODUCT




FROM
C134
(8W-51-3)
A
S104
(8W-50-4)
L7
16
BK/YL
1 C129
L7
18
BK/YL
LEFT
TURN
SIGNAL
RIGHT
TURN
SIGNAL
TURN SIGNAL/ HAZARD SWITCH (PART OF MULTI-FUNCTION SWITCH)
(8W-52-2)
15
12
63
57
C134
L63
16
DG/RD
L62
16
BR/RD
4
7
C129
OTHER
TRAILER TOW
S313
S314
S317
1
3
C333
C329
L7
18
BK/YL
L63
16
DG/RD
L62
16
BR/RD
2
3
LEFT LICENSE LAMP
LEFT TAIL/ STOP/ TURN SIGNAL LAMP
RIGHT LICENSE LAMP
RIGHT TAIL/ STOP/ TURN SIGNAL LAMP
1
Z13
18
BK
S401
(8W-15-5)
S402
(8W-15-5)
Z13
16
BK
2 C333
2 C329
S315
(8W-15-5)
Z13
12
BK
S331
(8W-15-5)
3 C128
G100
(8W-15-6)

AUTHENTIC RESTORATION PRODUCT



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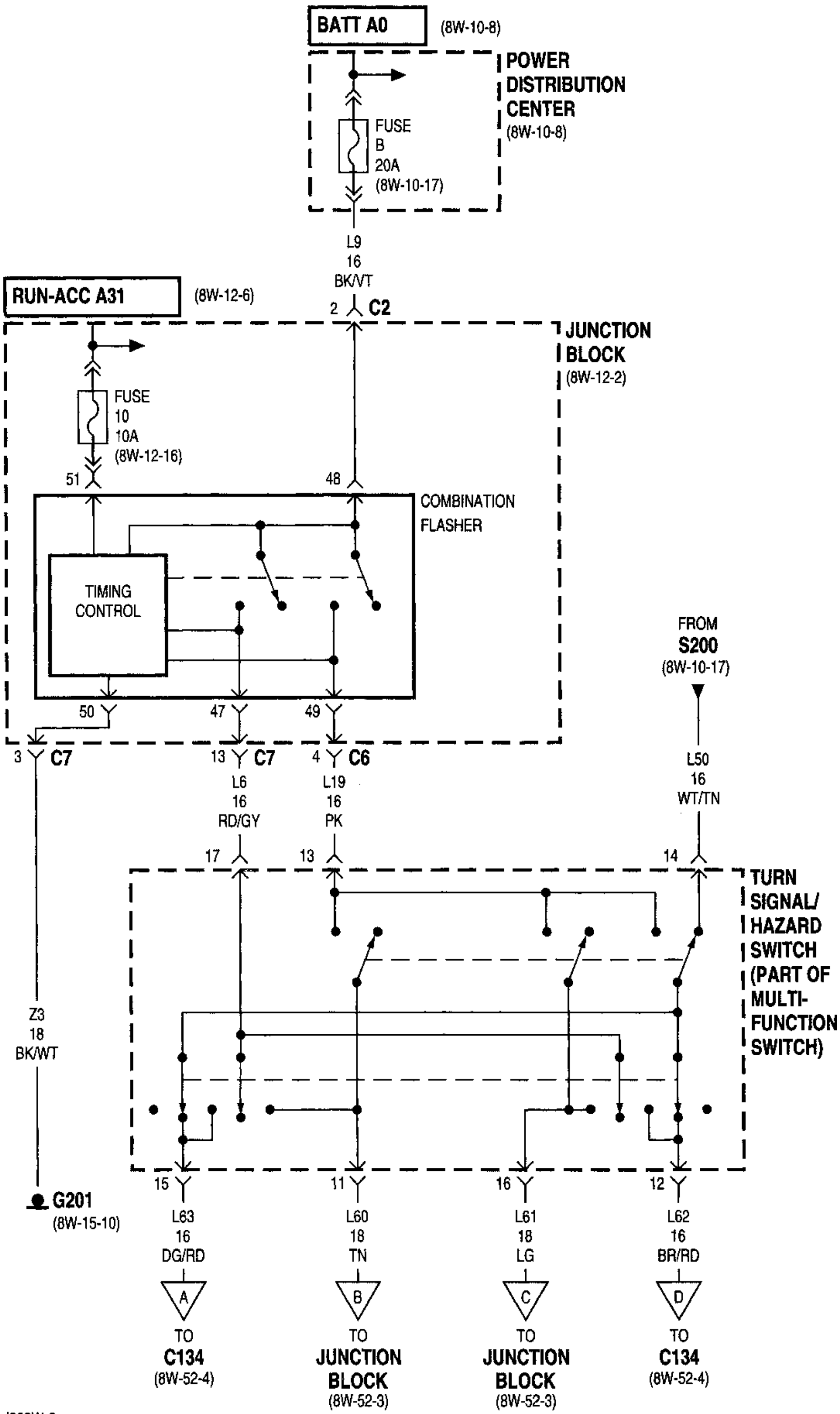
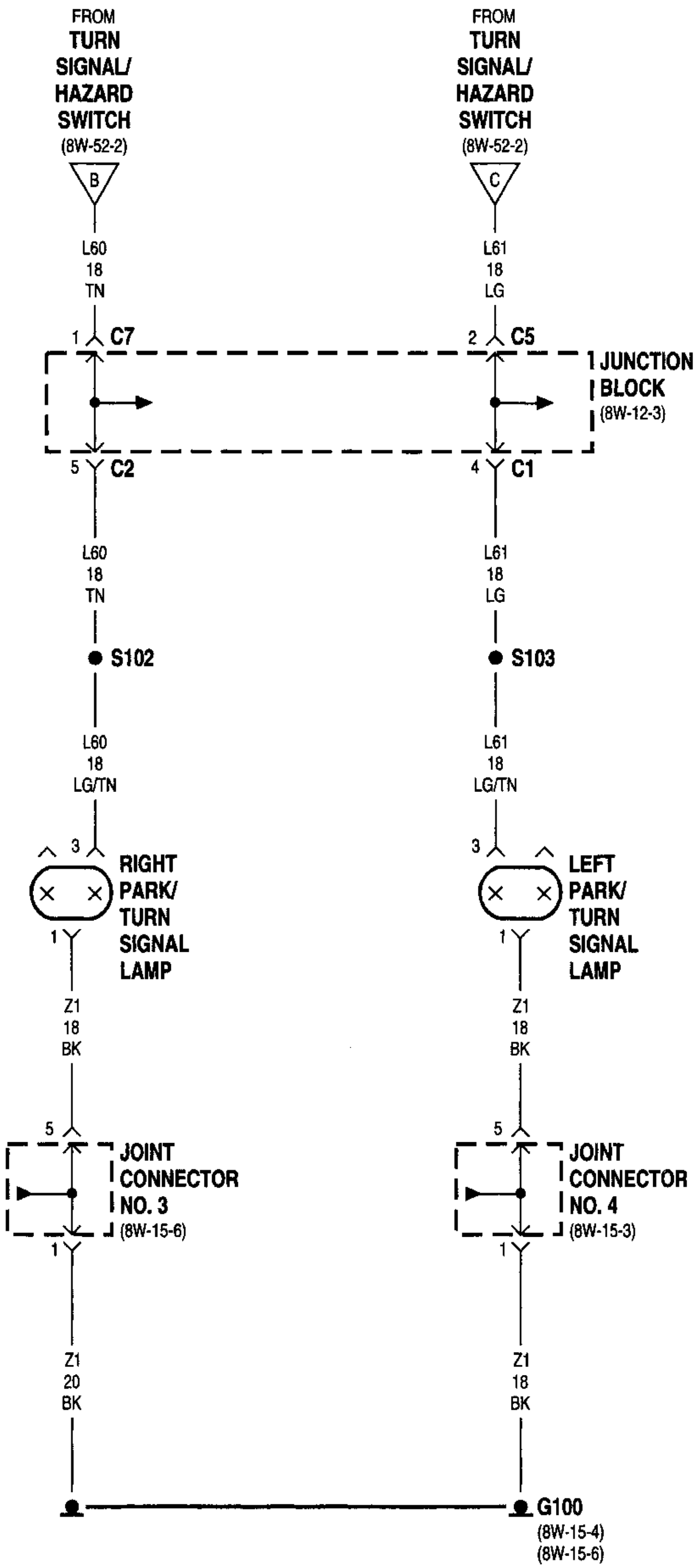
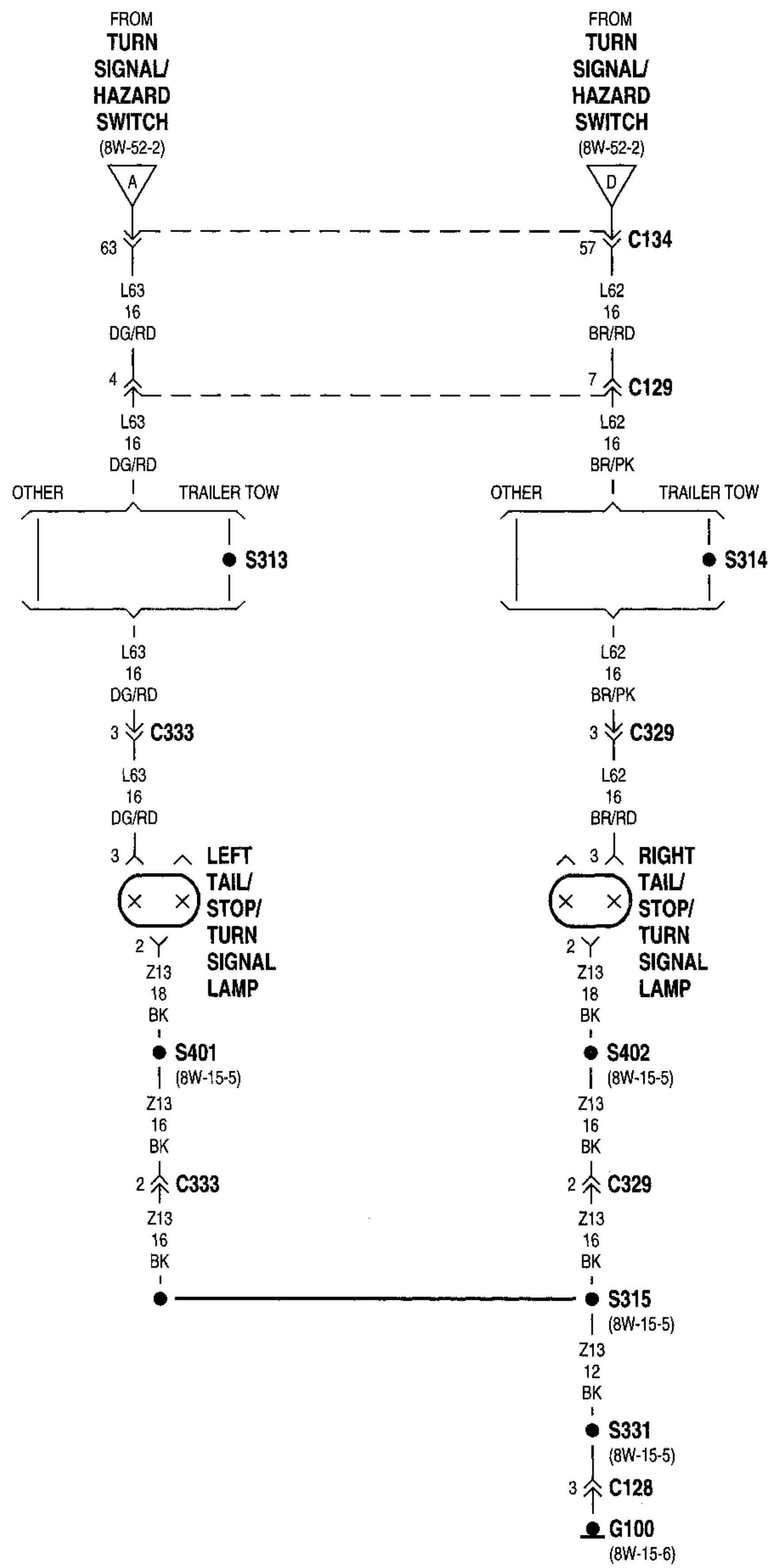
8W-52 TURN SIGNALS

AUTHENTIC RESTORATION PRODUCT




FROM
TURN
SIGNAL/
HAZARD
SWITCH
(8W-52-2)
B
FROM
TURN
SIGNAL/
HAZARD
SWITCH
(8W-52-2)
C
L60
18
TN
L61
18
LG
1
C7
2
C5
JUNCTION
BLOCK
(8W-12-3)
5
C2
4
C1
L60
18
TN
L61
18
LG
S102
S103
L60
18
LG/TN
L61
18
LG/TN
3
RIGHT
PARK/
TURN
SIGNAL
LAMP
3
LEFT
PARK/
TURN
SIGNAL
LAMP
1
1
Z1
18
BK
Z1
18
BK
5
JOINT
CONNECTOR
NO. 3
(8W-15-6)
5
JOINT
CONNECTOR
NO. 4
(8W-15-3)
1
1
Z1
20
BK
Z1
18
BK
G100
(8W-15-4)
(8W-15-6)

J988W-9


FROM
TURN
SIGNAL/
HAZARD
SWITCH
(8W-52-2)
A
FROM
TURN
SIGNAL/
HAZARD
SWITCH
(8W-52-2)
D
63
57
C134
L63
16
DG/RD
L62
16
BR/RD
4
7
C129
L63
16
DG/RD
L62
16
BR/PK
OTHER
TRAILER TOW
S313
OTHER
TRAILER TOW
S314
L63
16
DG/RD
L62
16
BR/PK
3
C333
3
C329
L63
16
DG/RD
L62
16
BR/RD
3
LEFT
TAIL/
STOP/
TURN
SIGNAL
LAMP
3
RIGHT
TAIL/
STOP/
TURN
SIGNAL
LAMP
2
Z13
18
BK
2
Z13
18
BK
S401
(8W-15-5)
S402
(8W-15-5)
Z13
16
BK
Z13
16
BK
2
C333
2
C329
Z13
16
BK
Z13
16
BK
S315
(8W-15-5)
Z13
12
BK
S331
(8W-15-5)
3
C128
G100
(8W-15-6)

8W-53 WIPERS

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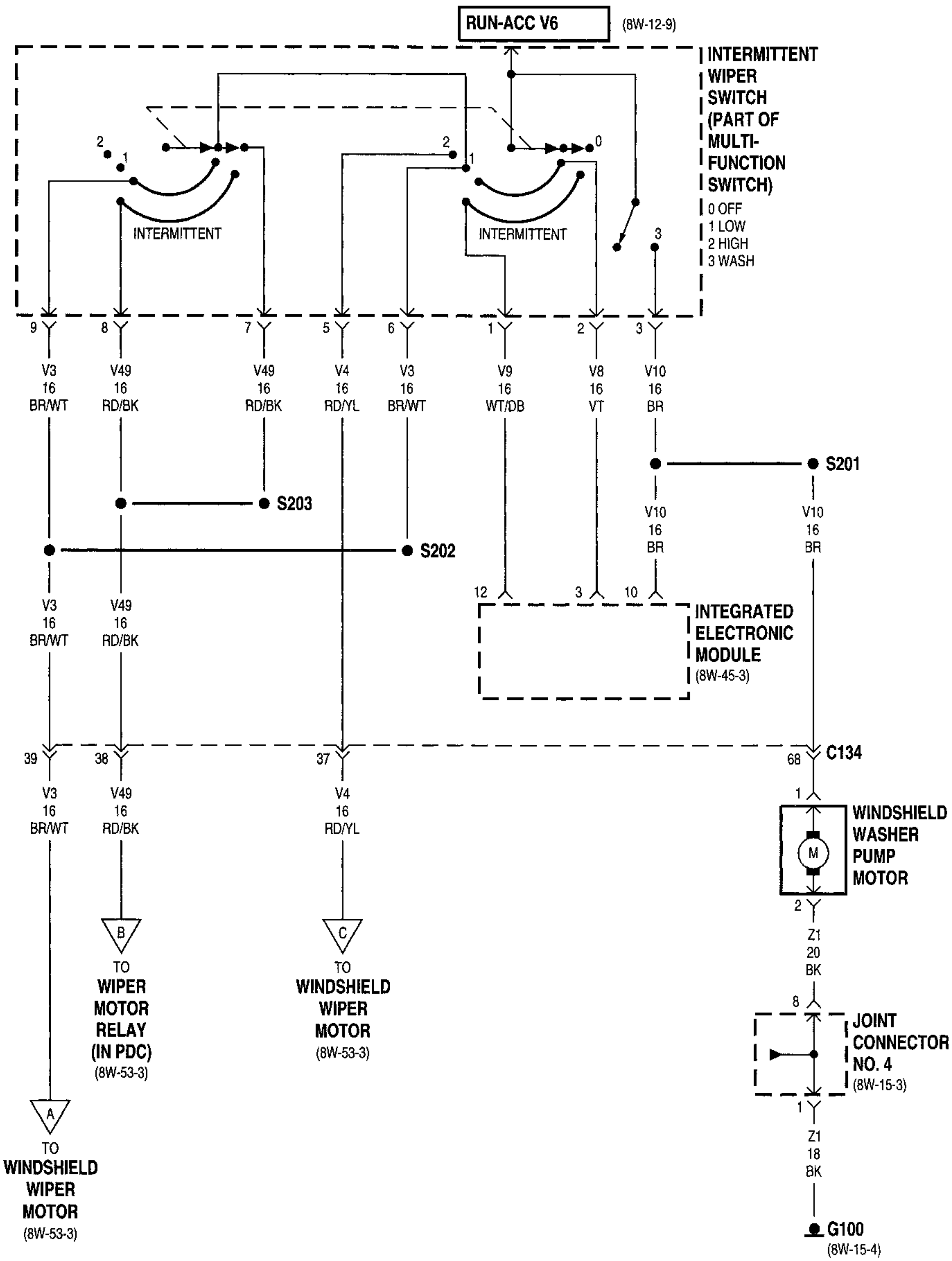
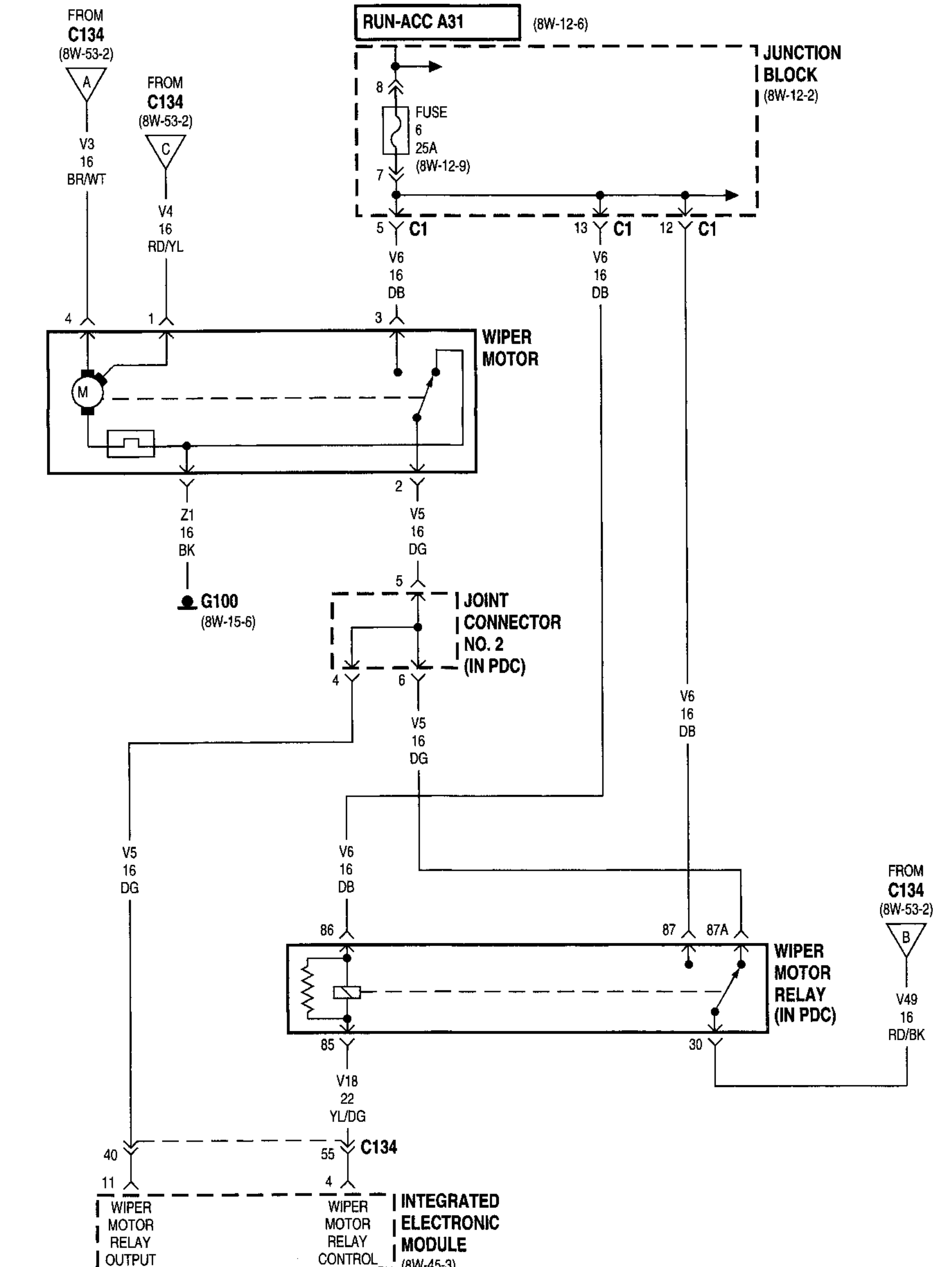


J988W-9

WIPE



WIPE2 J988W-9

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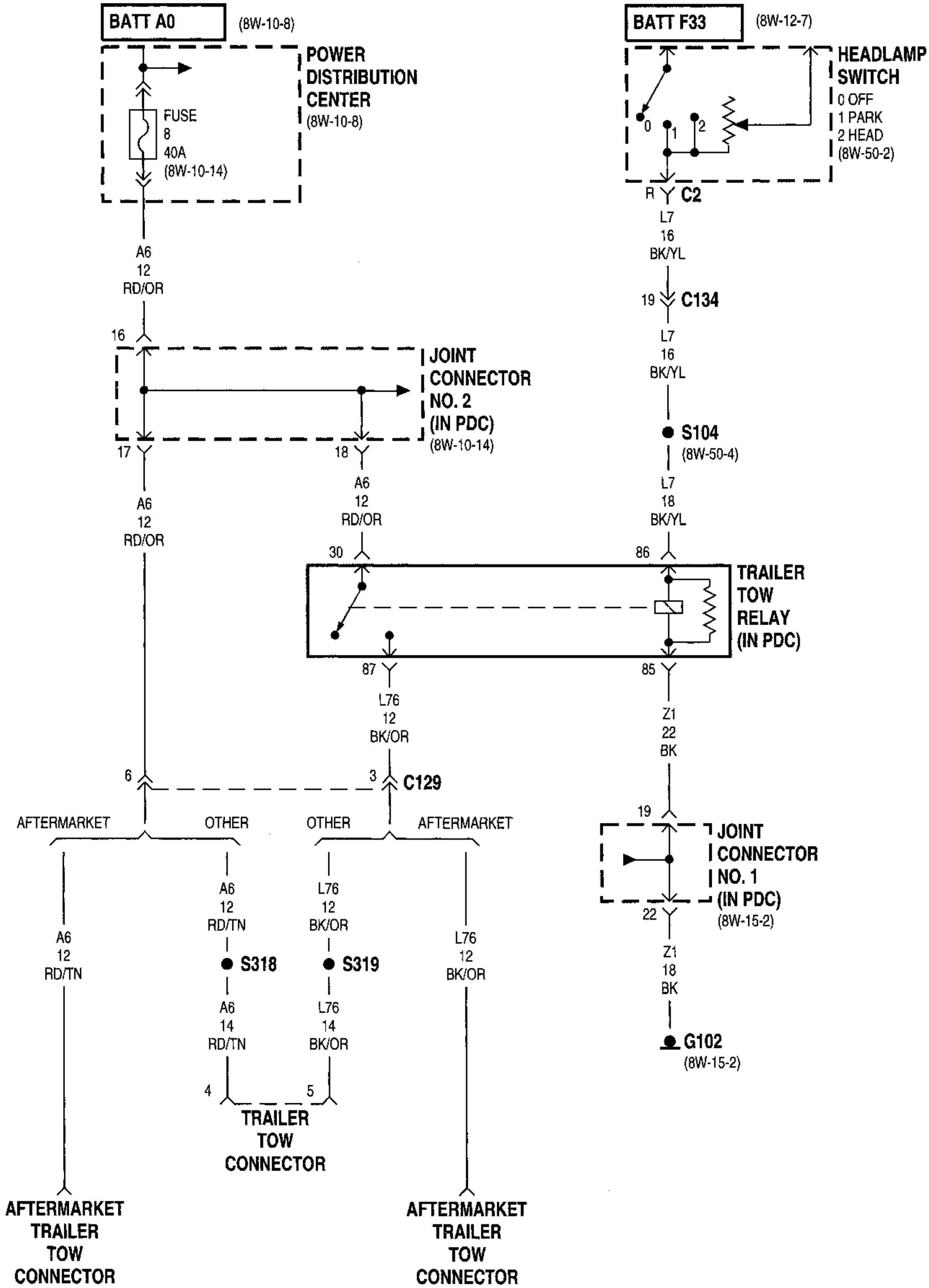
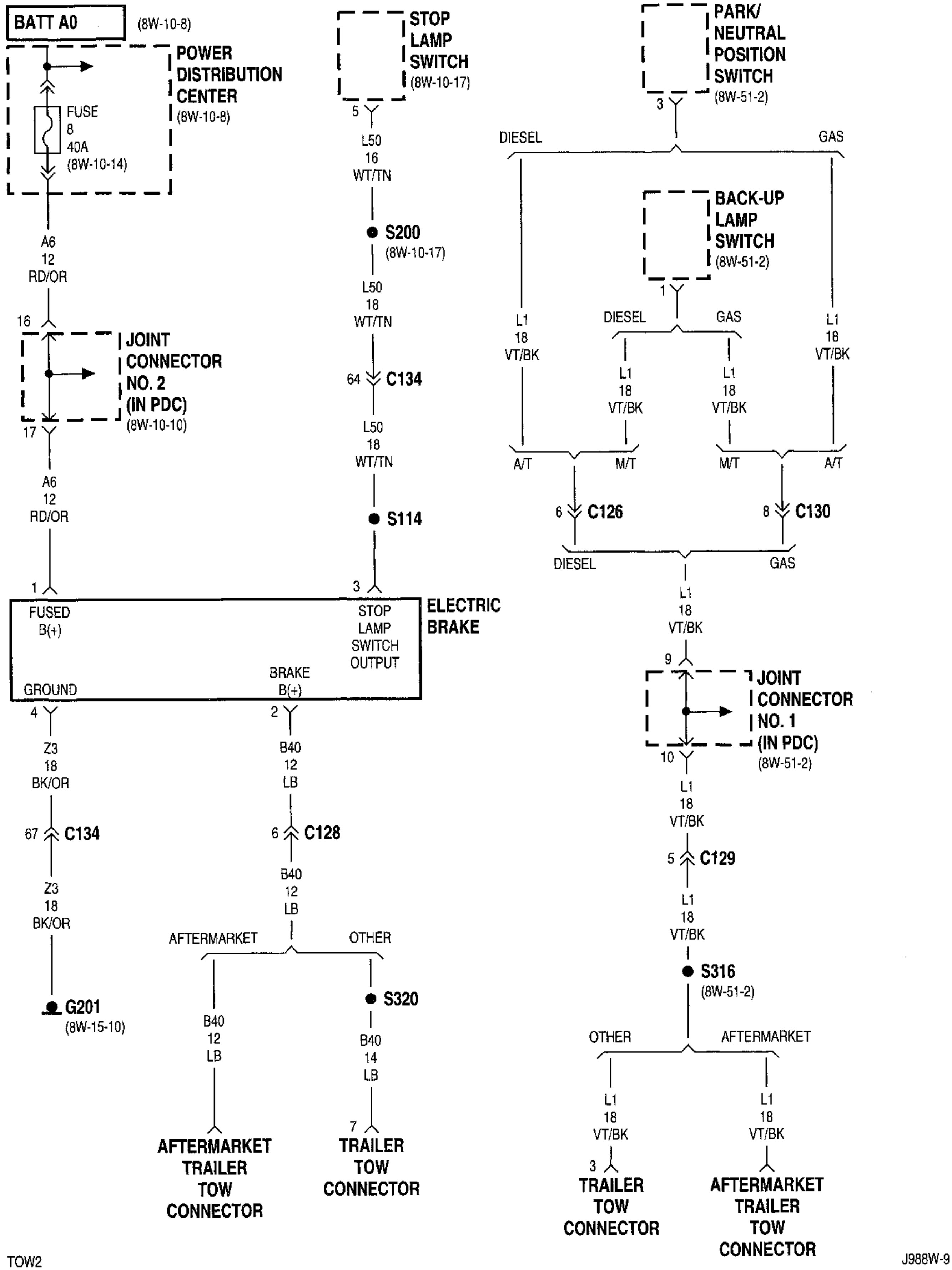
8W-54 TRAILER TOW


BATT A0
(8W-10-8)
POWER
DISTRIBUTION
CENTER
(8W-10-8)
FUSE
8
40A
(8W-10-14)
BATT F33
(8W-12-7)
HEADLAMP
SWITCH
0 OFF
1 PARK
2 HEAD
(8W-50-2)
R
C2
L7
16
BK/YL
19
C134
A6
12
RD/OR
16
JOINT
CONNECTOR
NO. 2
(IN PDC)
(8W-10-14)
17
18
S104
(8W-50-4)
L7
18
BK/YL
30
86
TRAILER
TOW
RELAY
(IN PDC)
87
85
L76
12
BK/OR
Z1
22
BK
6
3
C129
AFTERMARKET
OTHER
OTHER
AFTERMARKET
19
JOINT
CONNECTOR
NO. 1
(IN PDC)
(8W-15-2)
22
A6
12
RD/TN
S318
S319
A6
14
RD/TN
L76
14
BK/OR
Z1
18
BK
G102
(8W-15-2)
4
5
TRAILER
TOW
CONNECTOR
AFTERMARKET
TRAILER
TOW
CONNECTOR
AFTERMARKET
TRAILER
TOW
CONNECTOR

Mopar AUTHENTIC RESTORATION PRODUCT



TOW2 J988W-9

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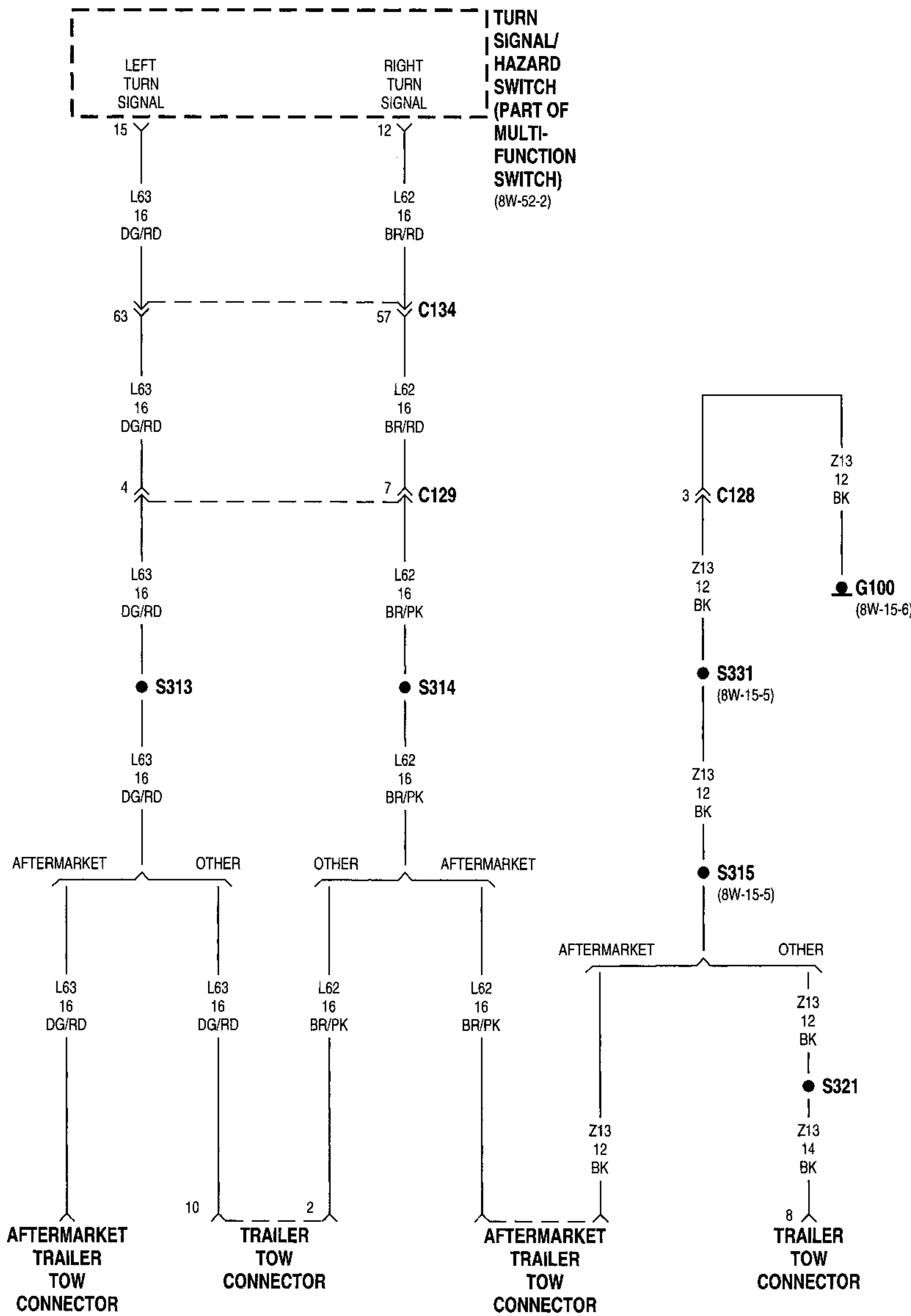

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8W-60 POWER WINDOWS

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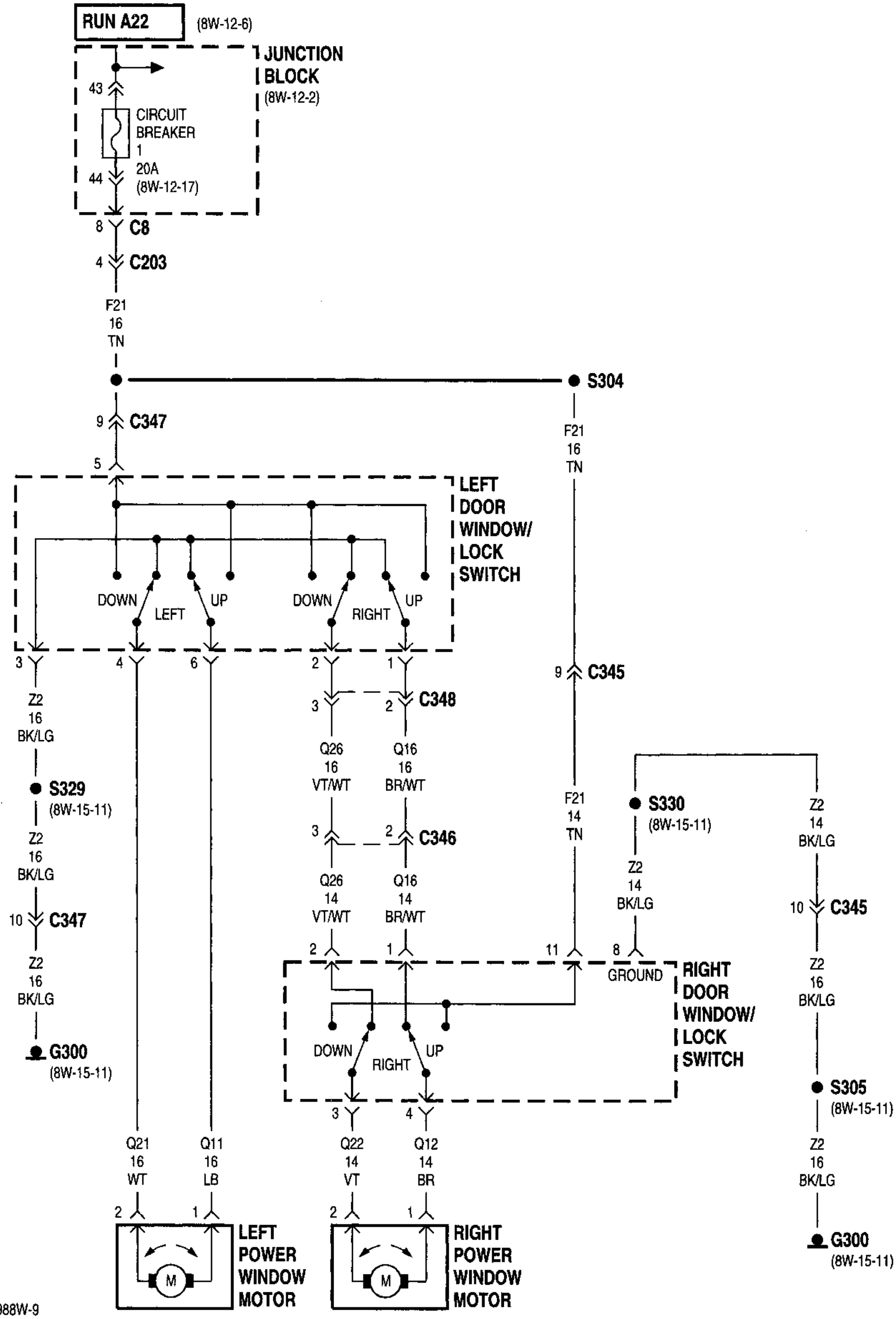
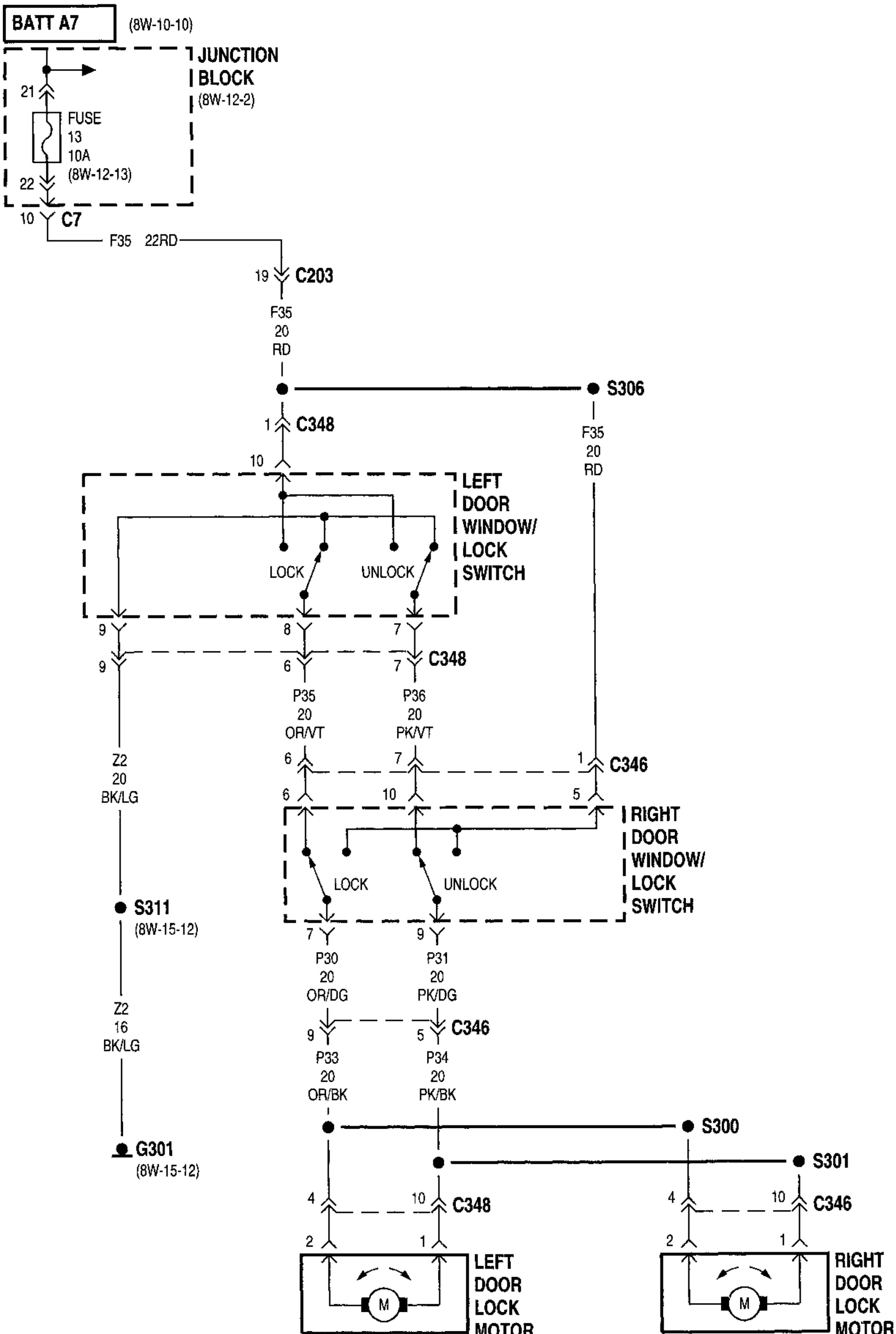
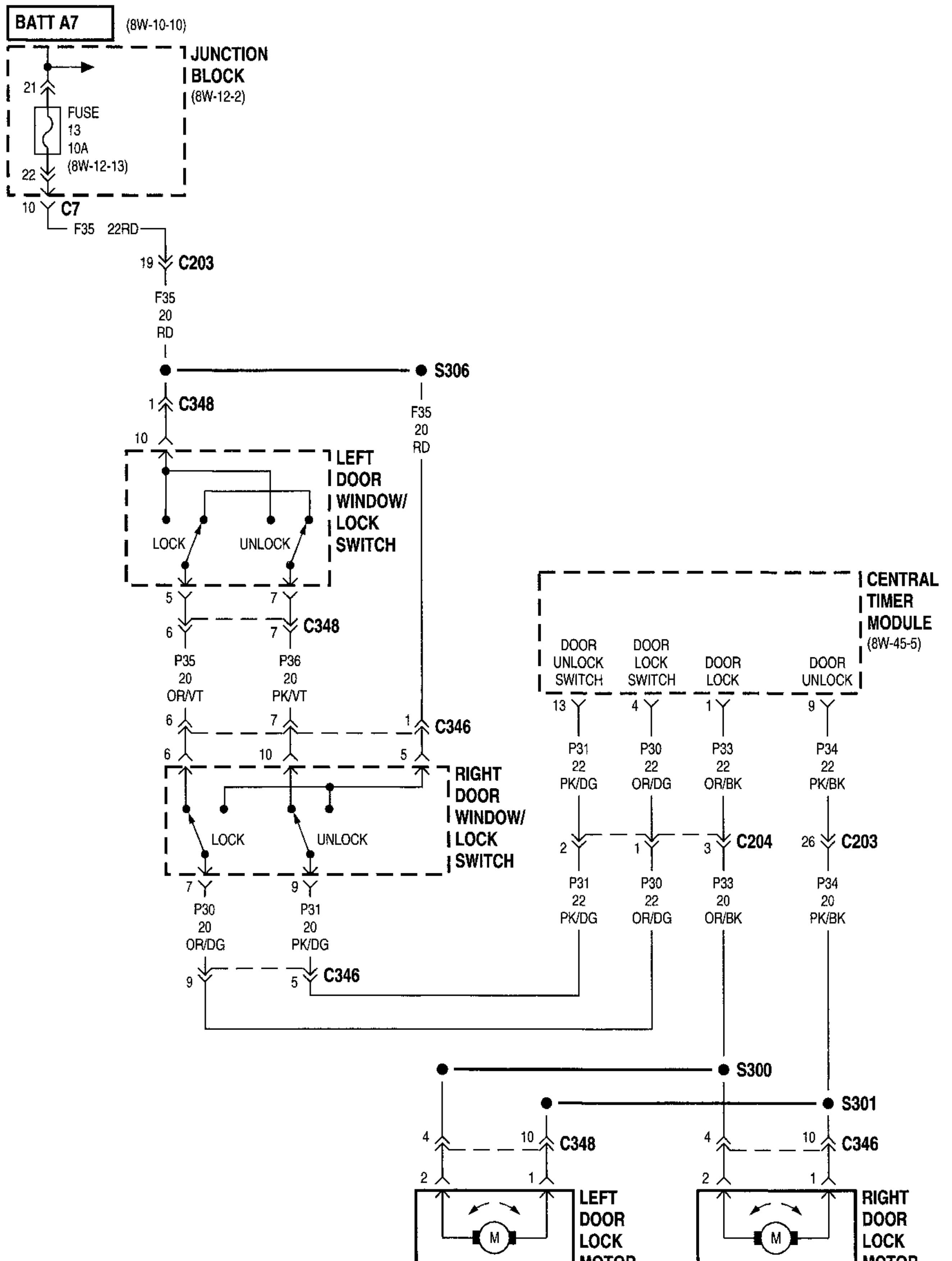


AUTHENTIC RESTORATION PRODUCT

8W-61 POWER DOOR LOCKS


BATT A7
(8W-10-10)
JUNCTION BLOCK
(8W-12-2)
21
FUSE
13
10A
(8W-12-13)
22
10
C7
F35 22RD
19
C203
F35
20
RD
S306
1
C348
10
F35
20
RD
LEFT DOOR WINDOW/ LOCK SWITCH
LOCK
UNLOCK
9
8
7
9
6
7
C348
P35
20
OR/VT
P36
20
PK/VT
Z2
20
BK/LG
6
7
1
C346
6
10
5
RIGHT DOOR WINDOW/ LOCK SWITCH
LOCK
UNLOCK
S311
(8W-15-12)
7
9
P30
20
OR/DG
P31
20
PK/DG
Z2
16
BK/LG
9
5
C346
P33
20
OR/BK
P34
20
PK/BK
S300
G301
(8W-15-12)
S301
4
10
C348
4
10
C346
2
1
2
1
M
M
LEFT DOOR LOCK MOTOR
RIGHT DOOR LOCK MOTOR

AUTHENTIC RESTORATION PRODUCT



LOCKS2 J988W-9

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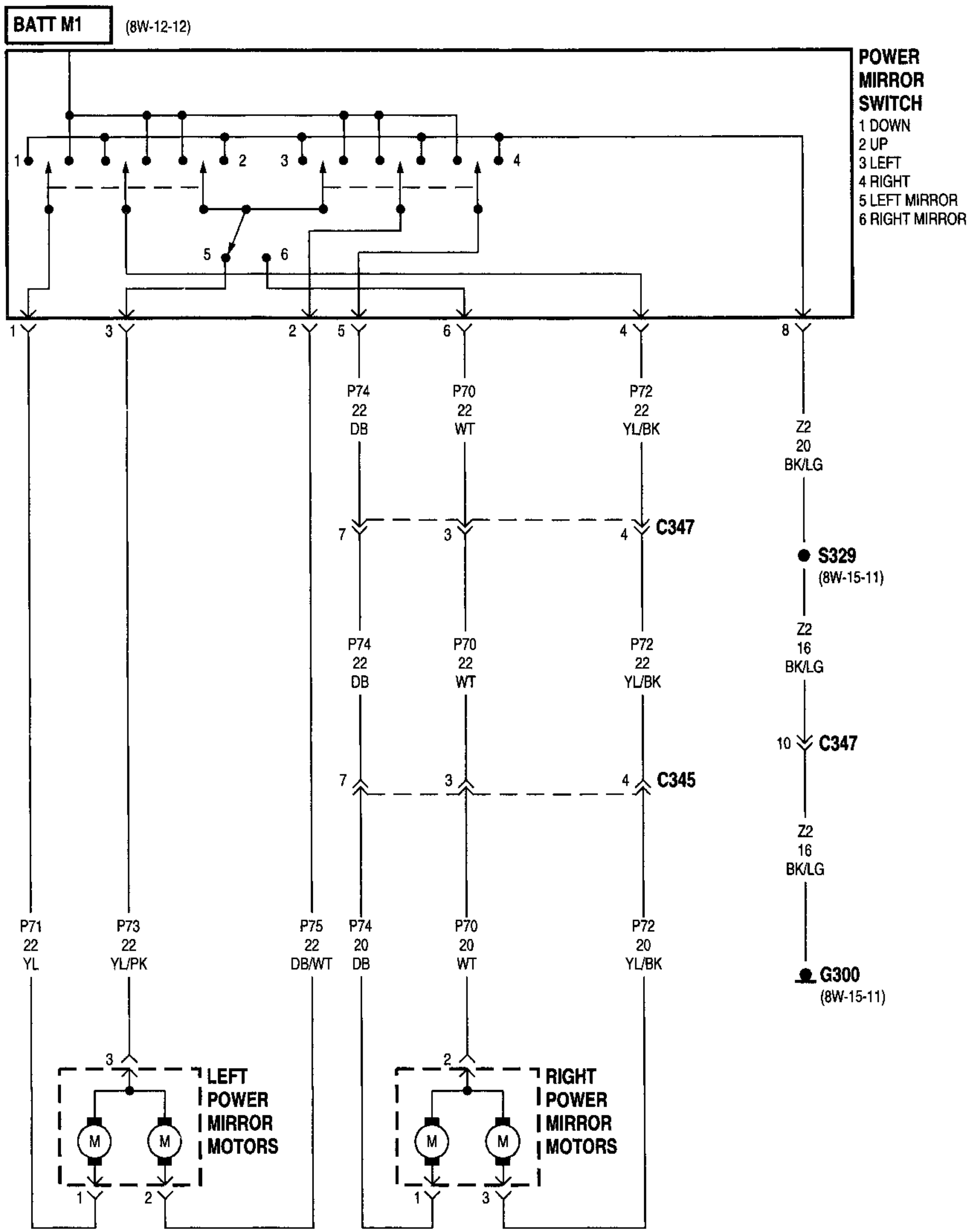
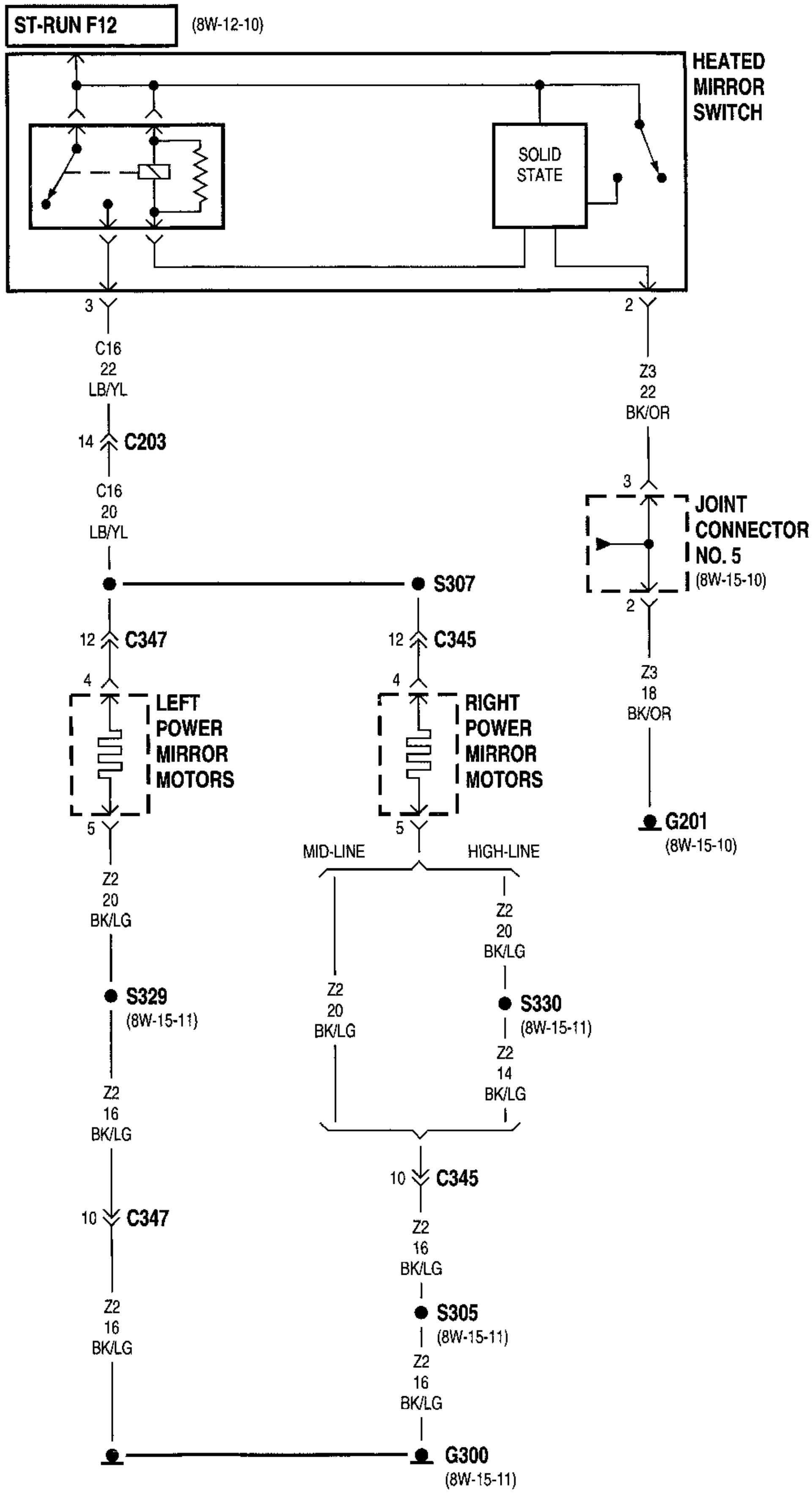
8W-62 POWER MIRRORS


BATT M1
(8W-12-12)
POWER
MIRROR
SWITCH
1 DOWN
2 UP
3 LEFT
4 RIGHT
5 LEFT MIRROR
6 RIGHT MIRROR
P74
22
DB
P70
22
WT
P72
22
YL/BK
Z2
20
BK/LG
C347
S329
(8W-15-11)
Z2
16
BK/LG
C347
C345
P71
22
YL
P73
22
YL/PK
P75
22
DB/WT
P74
20
DB
P70
20
WT
P72
20
YL/BK
G300
(8W-15-11)
LEFT
POWER
MIRROR
MOTORS
RIGHT
POWER
MIRROR
MOTORS
M


ST-RUN F12
(8W-12-10)
HEATED MIRROR SWITCH
SOLID STATE
3
2
C16
22
LB/YL
14
C203
C16
20
LB/YL
Z3
22
BK/OR
3
JOINT CONNECTOR NO. 5
(8W-15-10)
2
Z3
18
BK/OR
G201
(8W-15-10)
S307
12
C347
12
C345
4
LEFT POWER MIRROR MOTORS
4
RIGHT POWER MIRROR MOTORS
5
5
MID-LINE
HIGH-LINE
Z2
20
BK/LG
S329
(8W-15-11)
Z2
16
BK/LG
10
C347
Z2
16
BK/LG
Z2
20
BK/LG
Z2
20
BK/LG
S330
(8W-15-11)
Z2
14
BK/LG
10
C345
Z2
16
BK/LG
S305
(8W-15-11)
Z2
16
BK/LG
G300
(8W-15-11)

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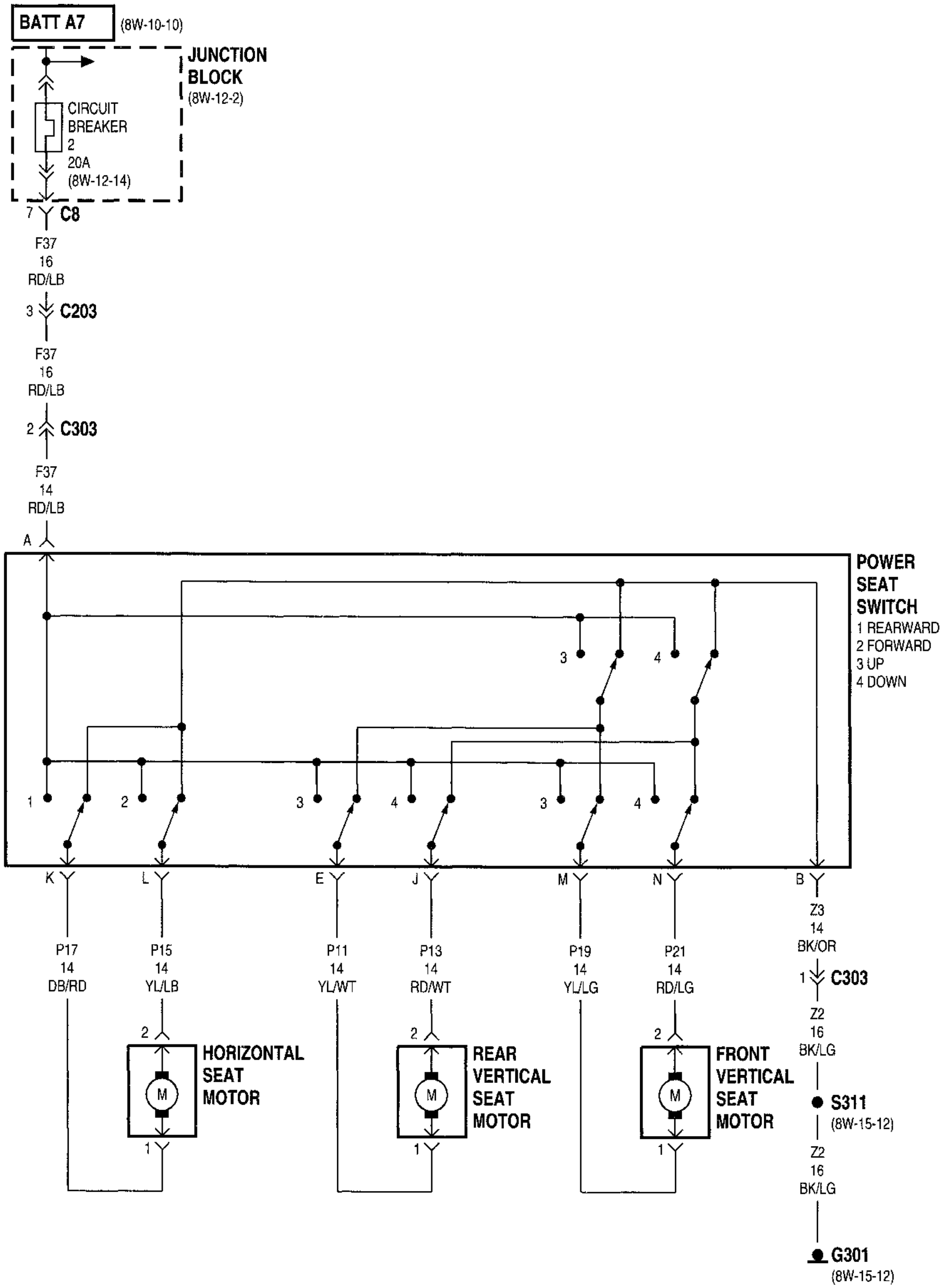
8W-63 POWER SEAT

Mopar AUTHENTIC RESTORATION PRODUCT



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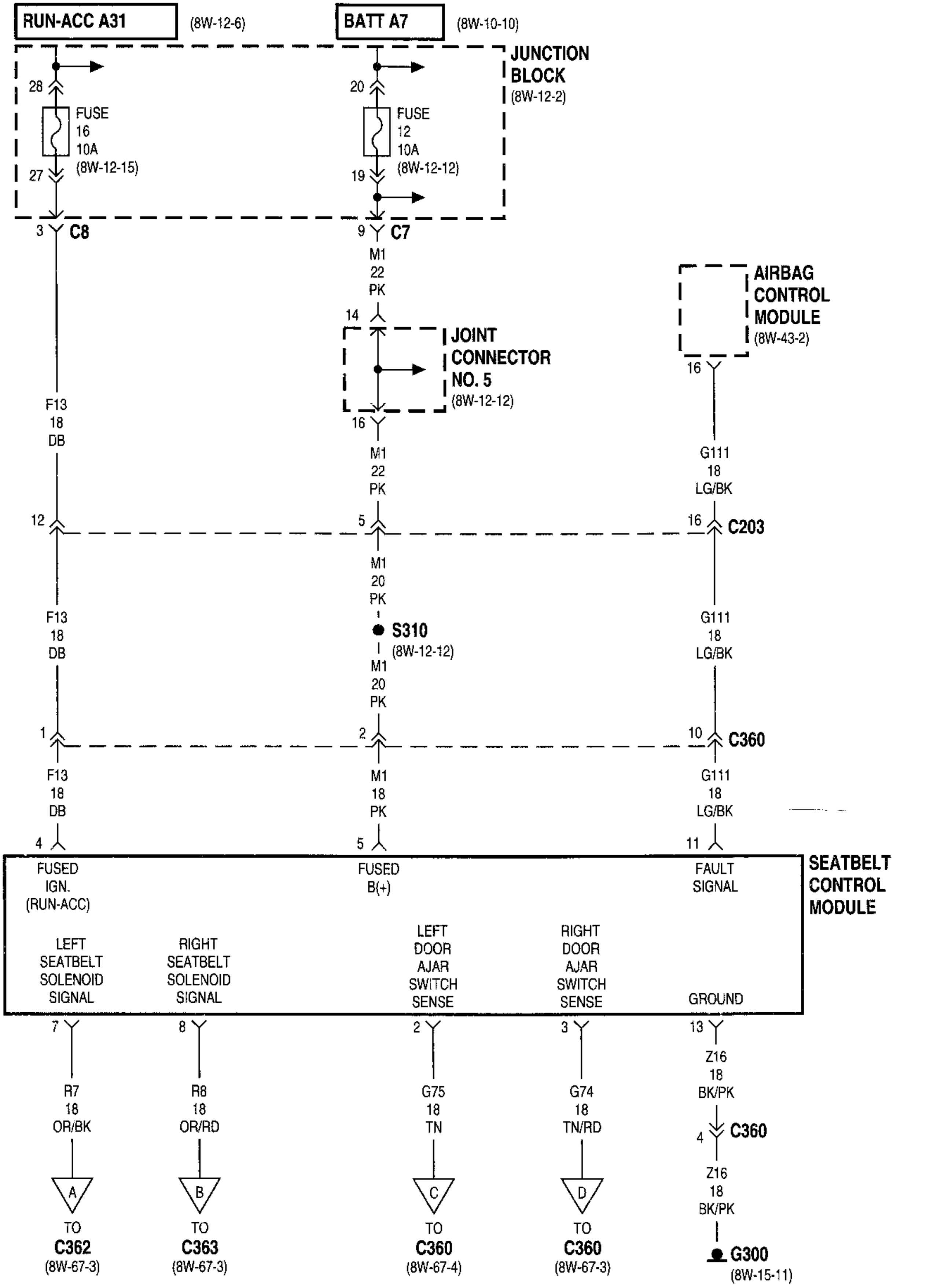
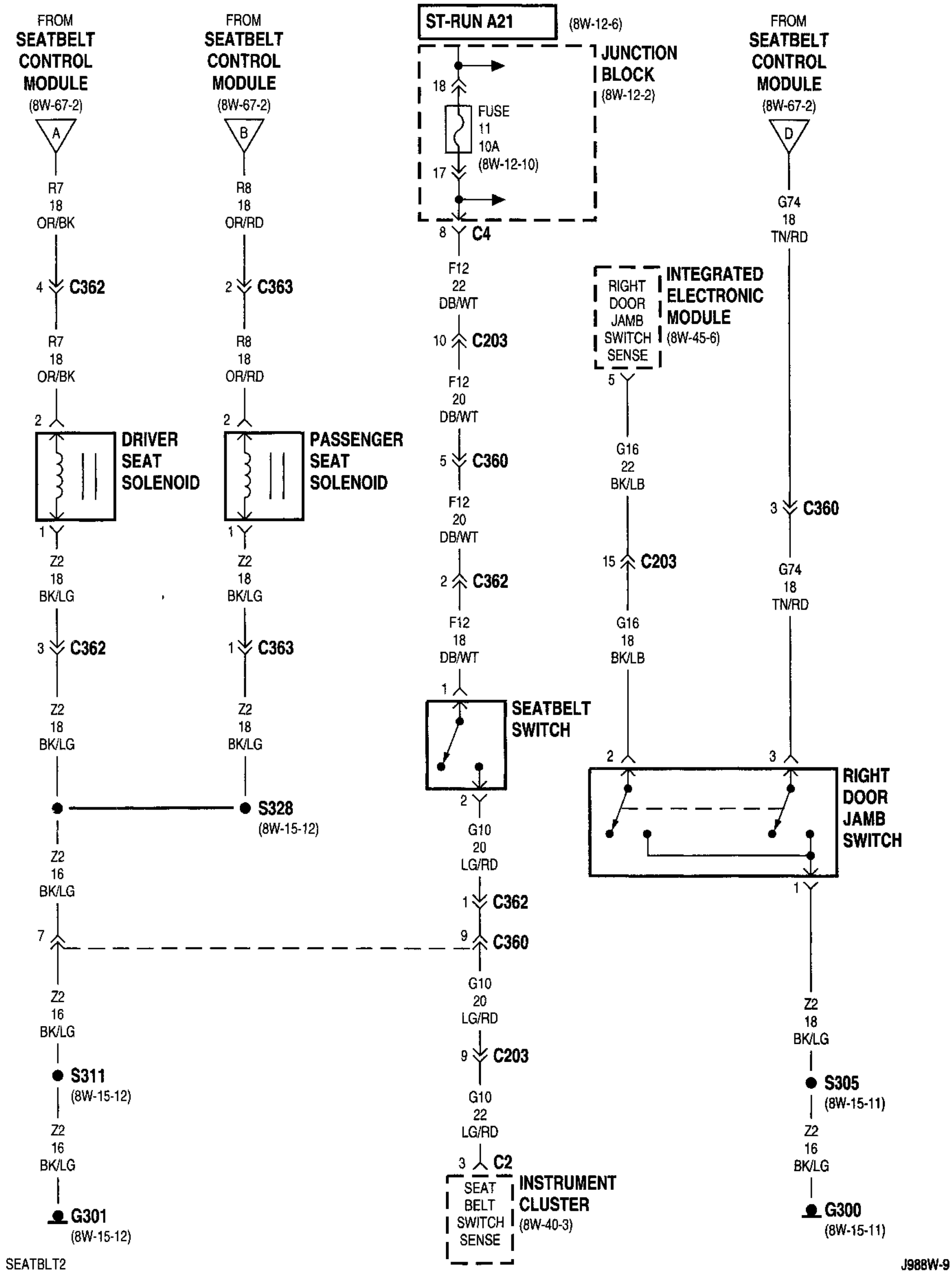
8W-67 RESTRAINT SYSTEM

AUTHENTIC RESTORATION PRODUCT

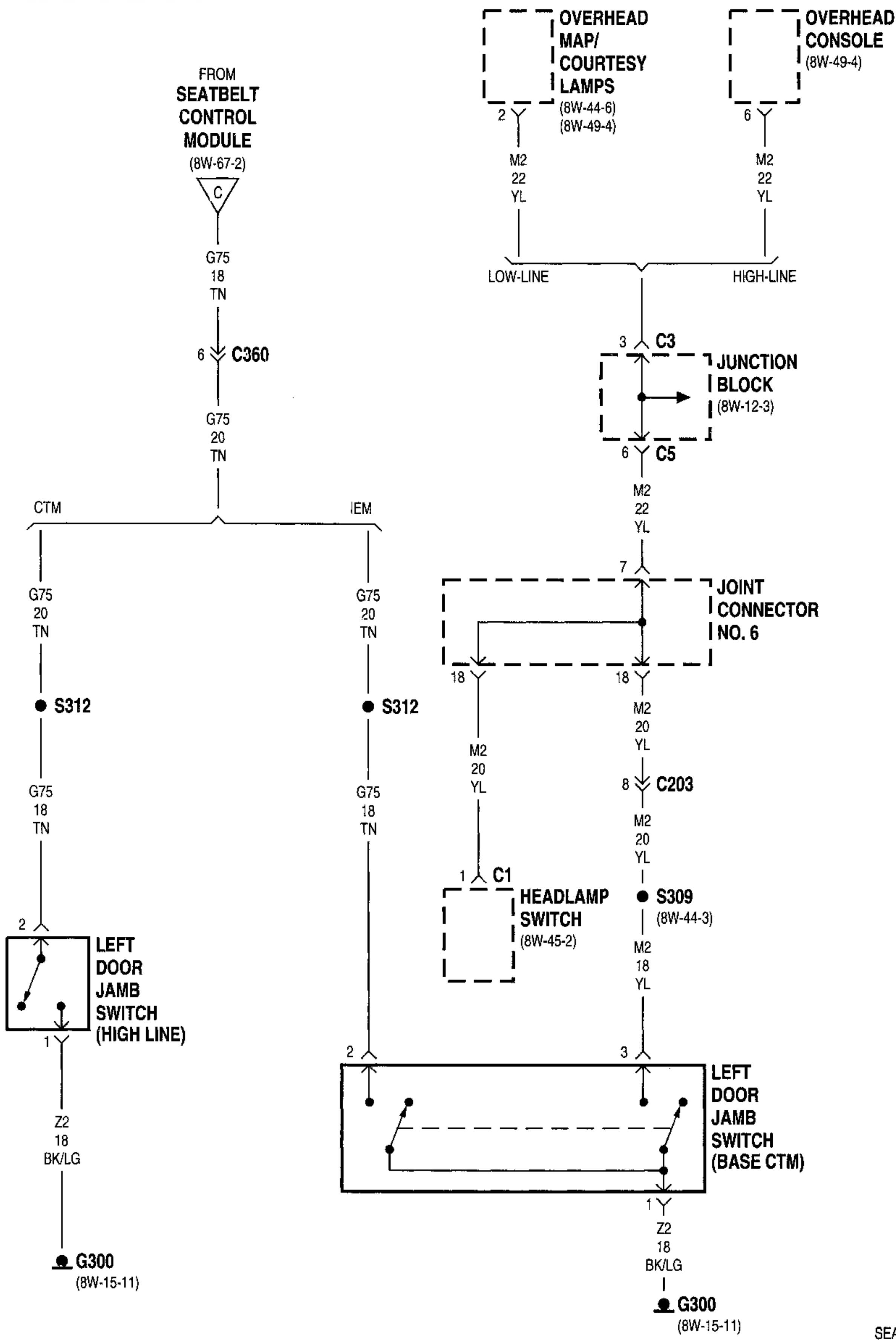


J988W-9 SEATBELT

Mopar AUTHENTIC RESTORATION PRODUCT

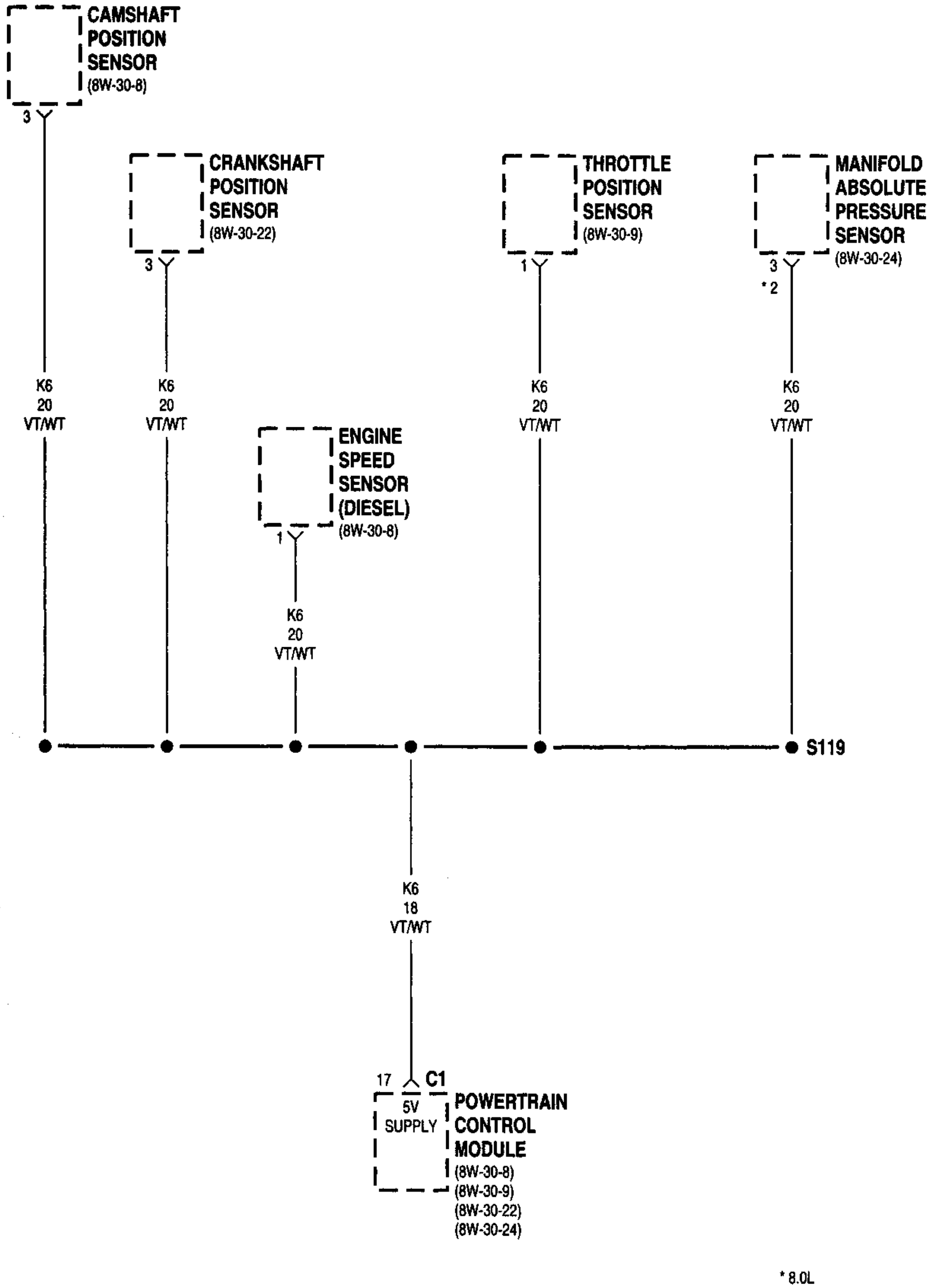


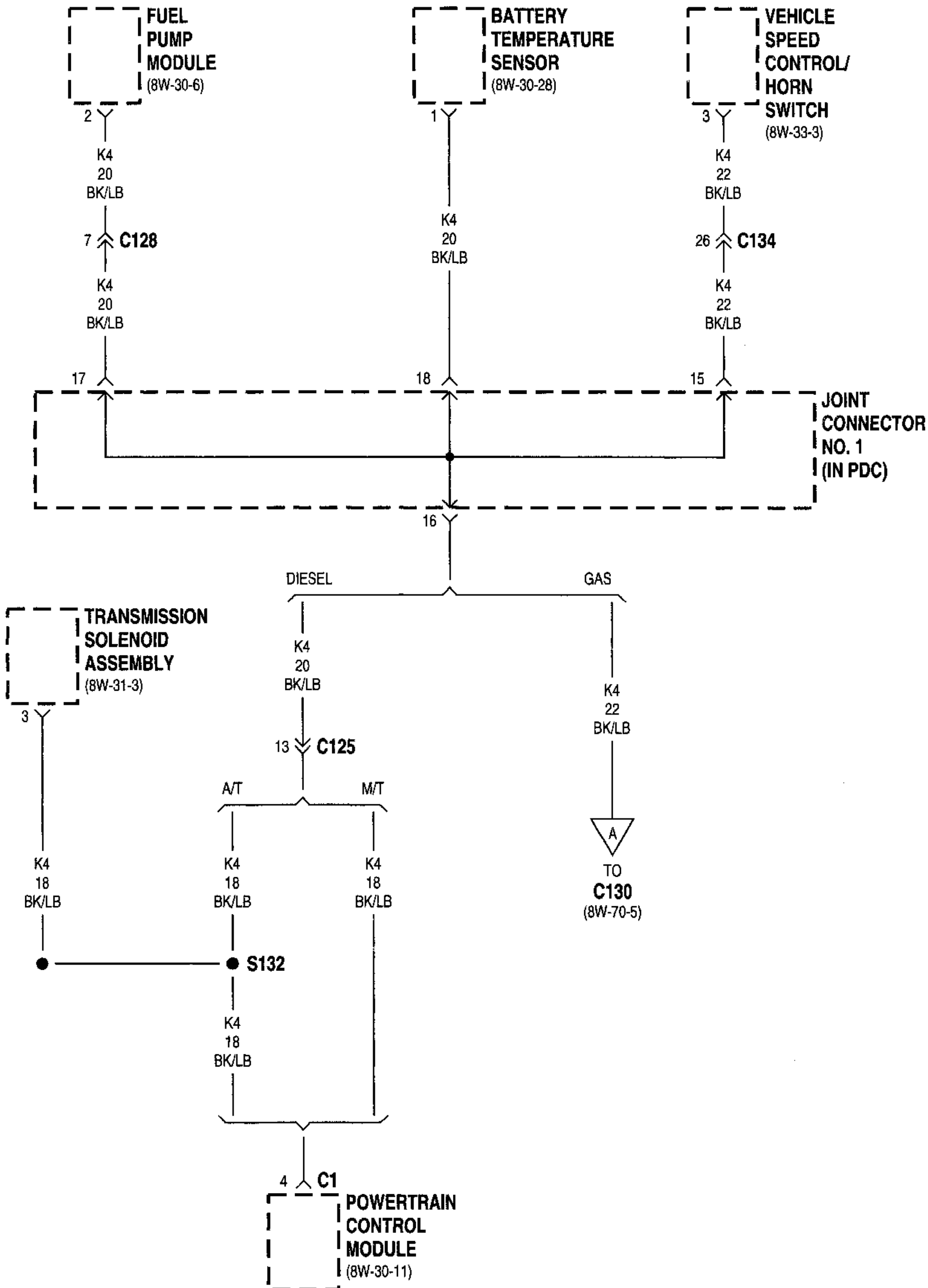
AUTHENTIC RESTORATION PRODUCT



AUTHENTIC RESTORATION PRODUCT

8W-70 SPLICE INFORMATION


CAMSHAFT POSITION SENSOR (8W-30-8)
3
K6 20 VT/WT
CRANKSHAFT POSITION SENSOR (8W-30-22)
3
K6 20 VT/WT
THROTTLE POSITION SENSOR (8W-30-9)
1
K6 20 VT/WT
MANIFOLD ABSOLUTE PRESSURE SENSOR (8W-30-24)
3
* 2
K6 20 VT/WT
ENGINE SPEED SENSOR (DIESEL) (8W-30-8)
1
K6 20 VT/WT
S119
K6 18 VT/WT
17
C1
5V SUPPLY
POWERTRAIN CONTROL MODULE (8W-30-8) (8W-30-9) (8W-30-22) (8W-30-24)
* 8.0L


FUEL PUMP MODULE (8W-30-6)
2
K4 20 BK/LB
7 C128
K4 20 BK/LB
17
BATTERY TEMPERATURE SENSOR (8W-30-28)
1
K4 20 BK/LB
18
VEHICLE SPEED CONTROL/ HORN SWITCH (8W-33-3)
3
K4 22 BK/LB
26 C134
K4 22 BK/LB
15
JOINT CONNECTOR NO. 1 (IN PDC)
16
DIESEL
GAS
K4 20 BK/LB
13 C125
K4 22 BK/LB
A
TO C130 (8W-70-5)
TRANSMISSION SOLENOID ASSEMBLY (8W-31-3)
3
A/T
M/T
K4 18 BK/LB
K4 18 BK/LB
K4 18 BK/LB
S132
K4 18 BK/LB
4 C1
POWERTRAIN CONTROL MODULE (8W-30-11)

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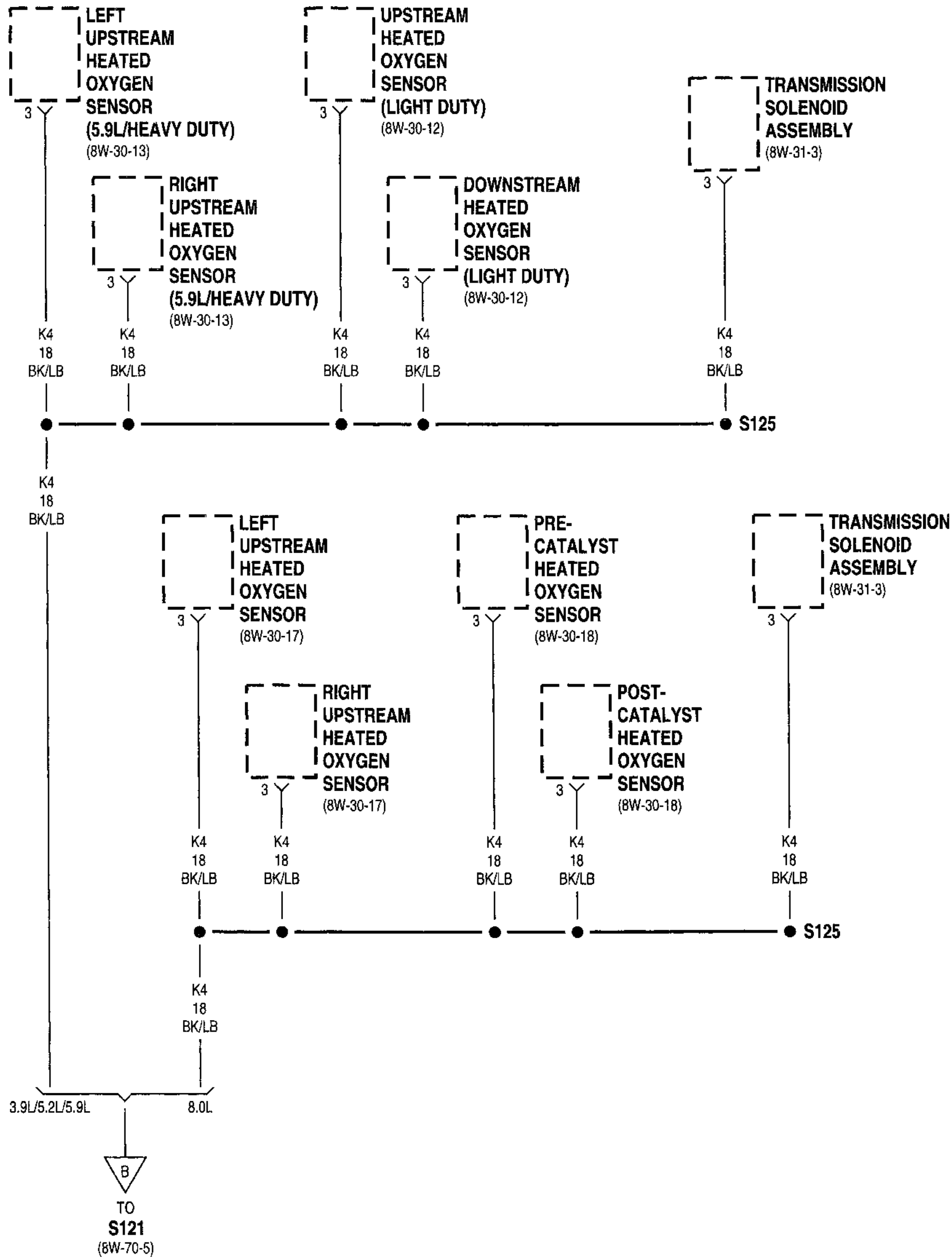

J988W-9 SPLICE4

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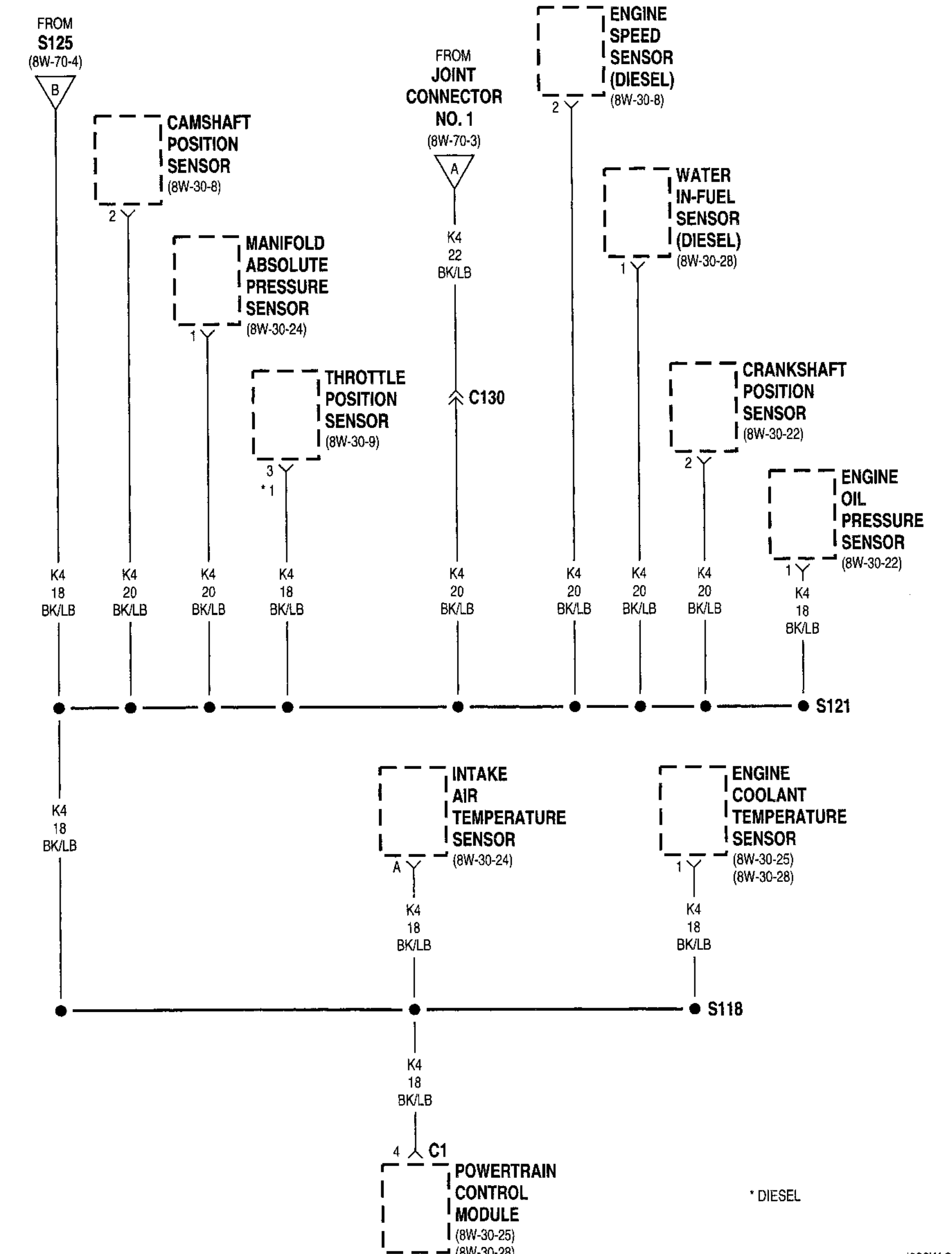
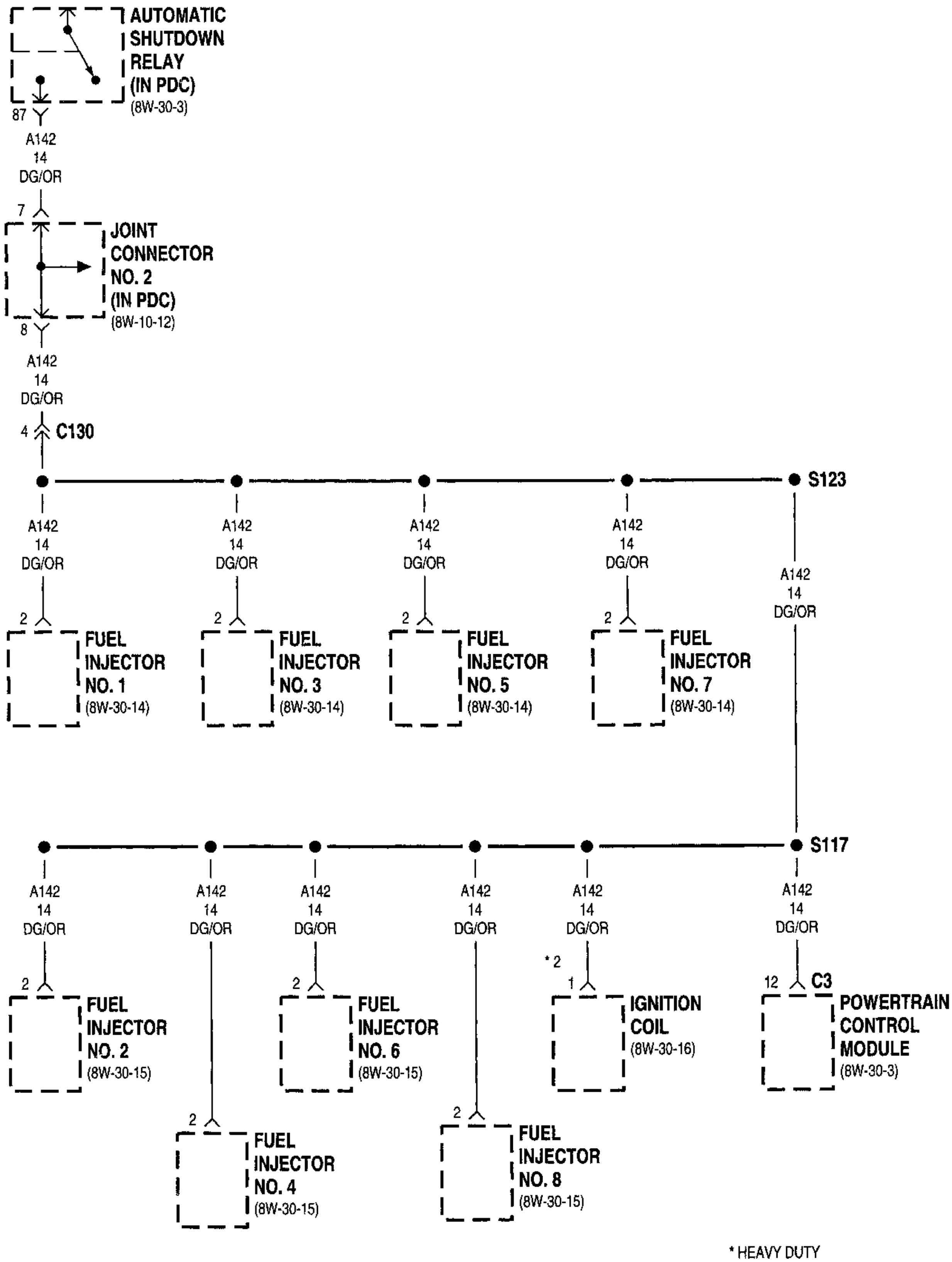


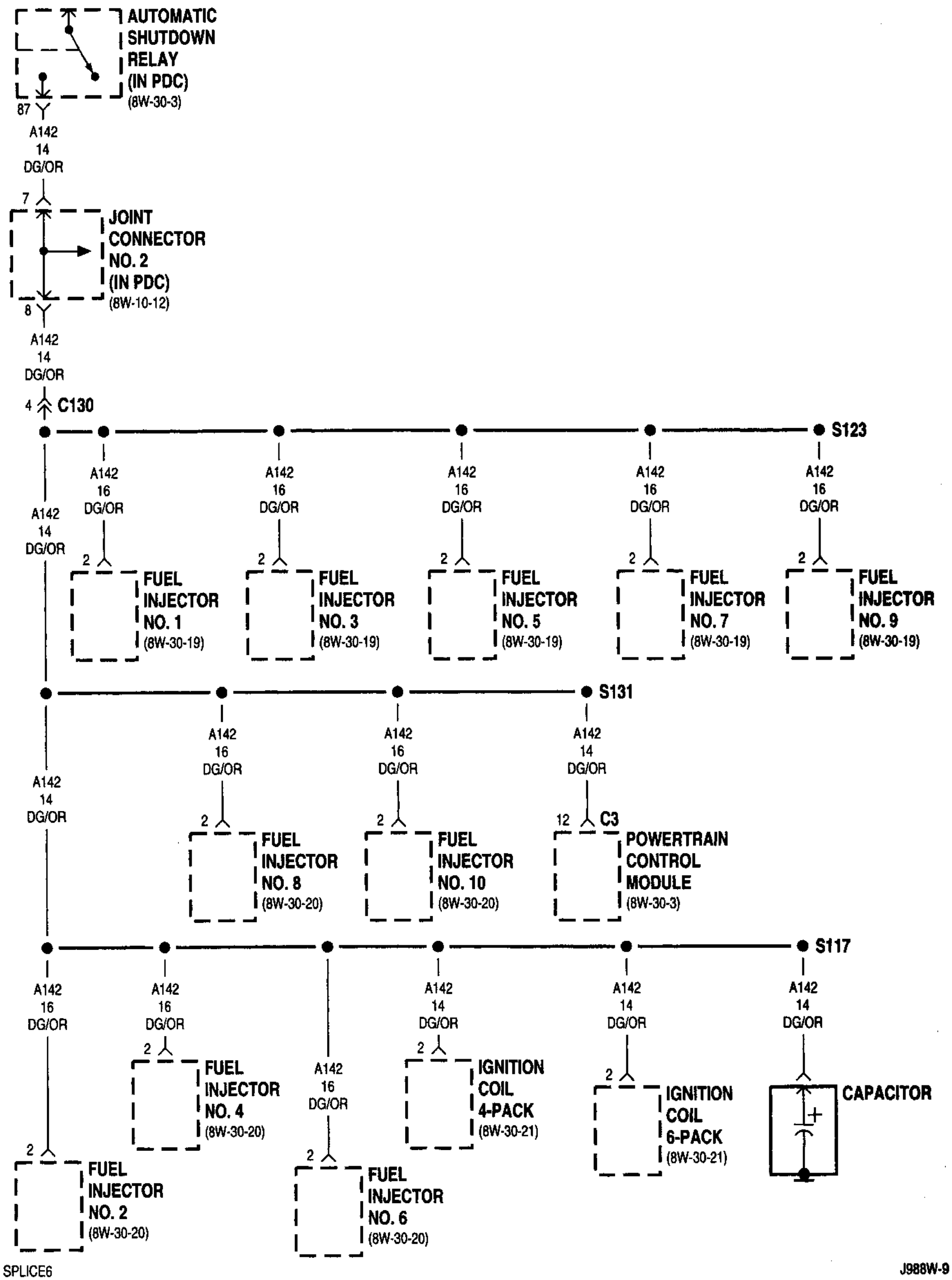
SPLICE3

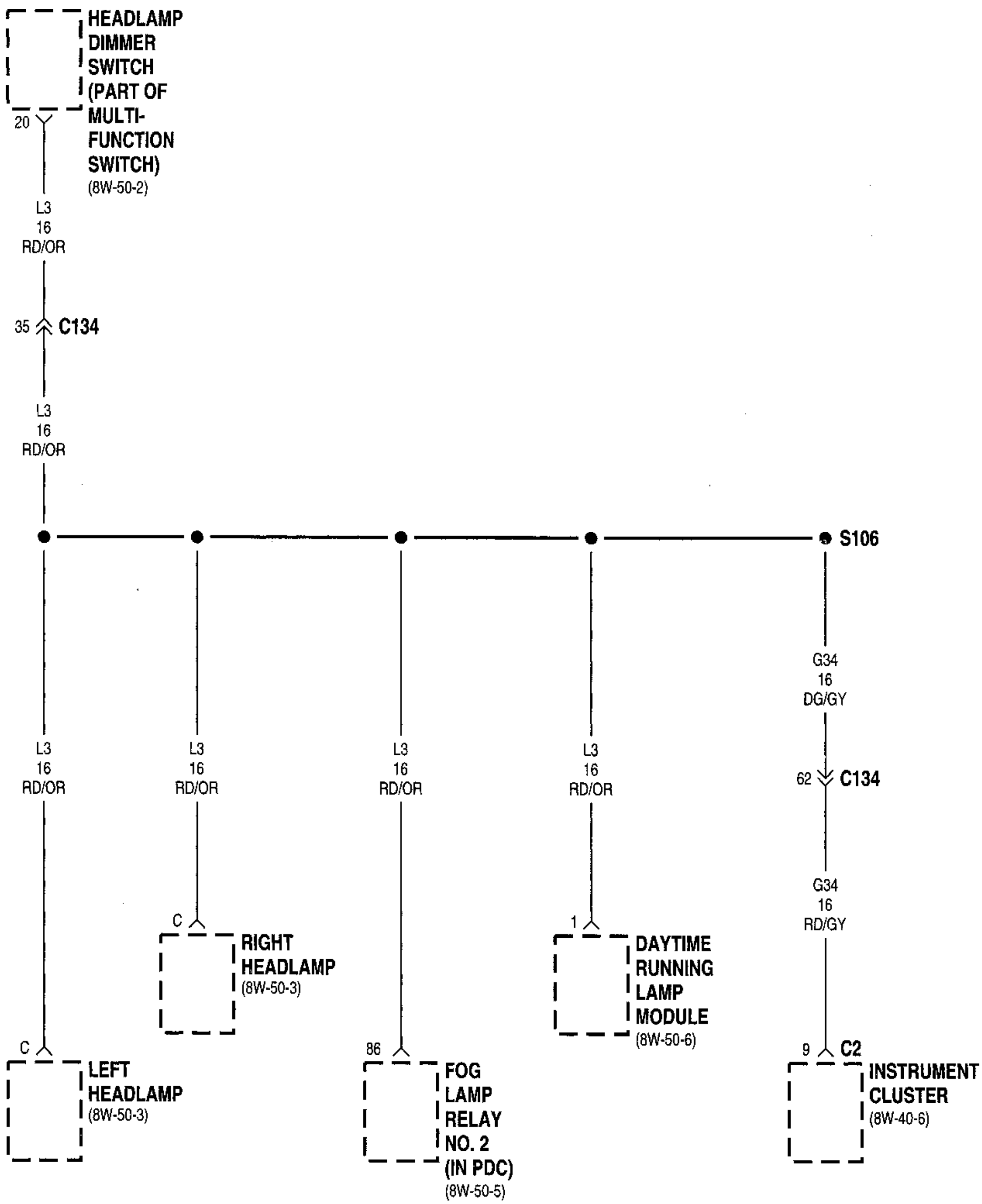
J988W-9


AUTOMATIC SHUTDOWN RELAY (IN PDC) (8W-30-3)
87
A142 14 DG/OR
7
JOINT CONNECTOR NO. 2 (IN PDC) (8W-10-12)
8
A142 14 DG/OR
4 C130
S123
A142 14 DG/OR
2
FUEL INJECTOR NO. 1 (8W-30-14)
FUEL INJECTOR NO. 3 (8W-30-14)
FUEL INJECTOR NO. 5 (8W-30-14)
FUEL INJECTOR NO. 7 (8W-30-14)
S117
FUEL INJECTOR NO. 2 (8W-30-15)
FUEL INJECTOR NO. 4 (8W-30-15)
FUEL INJECTOR NO. 6 (8W-30-15)
FUEL INJECTOR NO. 8 (8W-30-15)
* 2
1
IGNITION COIL (8W-30-16)
12 C3
POWERTRAIN CONTROL MODULE (8W-30-3)
* HEAVY DUTY

Mopar AUTHENTIC RESTORATION PRODUCT

8.0L




HEADLAMP DIMMER SWITCH (PART OF MULTI-FUNCTION SWITCH)
(8W-50-2)
20
L3
16
RD/OR
35
C134
L3
16
RD/OR
S106
L3
16
RD/OR
L3
16
RD/OR
L3
16
RD/OR
L3
16
RD/OR
G34
16
DG/GY
62
C134
G34
16
RD/GY
C
RIGHT HEADLAMP
(8W-50-3)
1
DAYTIME RUNNING LAMP MODULE
(8W-50-6)
C
LEFT HEADLAMP
(8W-50-3)
86
FOG LAMP RELAY NO. 2 (IN PDC)
(8W-50-5)
9
C2
INSTRUMENT CLUSTER
(8W-40-6)

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8W-80 CONNECTOR PIN-OUTS

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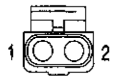
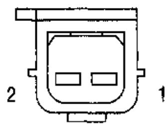
AUTHENTIC RESTORATION PRODUCT

AUTHENTIC RESTORATION PRODUCT



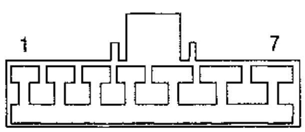
4X4 SWITCH

CAV	CIRCUIT	FUNCTION
1	G107 18BK/GY	4WD SENSE
2	Z1 18BK	GROUND



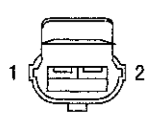
A/C COMPRESSOR CLUTCH

CAV	CIRCUIT	FUNCTION
1	C3 18DB/BK	A/C CLUTCH RELAY OUTPUT B(+)
2	Z11 18BK/WT	GROUND



A/C HEATER CONTROL

CAV	CIRCUIT	FUNCTION
1	E2 22OR	FUSED PANEL LAMPS DIMMER SWITCH SIGNAL
2	C90 22LG/WT	A/C PRESSURE SWITCH OUTPUT
3	C4 16TN	M1 BLOWER MOTOR SPEED
4	C5 16LG	L0 BLOWER MOTOR SPEED
5	C6 14LB	M2 BLOWER MOTOR SPEED
6	C7 12BK/TN	HIGH BLOWER MOTOR SPEED
7	Z3 12BK/OR	GROUND



A/C HIGH PRESSURE SWITCH

CAV	CIRCUIT	FUNCTION
1	C90 18LG/WT*	A/C HIGH PRESSURE SWITCH OUT
1	C90 18LG**	A/C HIGH PRESSURE SWITCH OUT
2	C22 18DB	A/C HIGH PRESSURE SWITCH IN
2	C90 18LG/WT**	A/C HIGH PRESSURE SWITCH IN

* GAS
** DIESEL

BR008005 J988W-9

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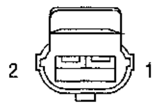
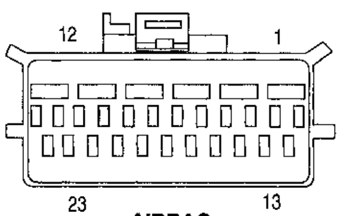


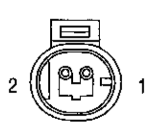
A/C LOW PRESSURE SWITCH

CAV	CIRCUIT	FUNCTION
1	C20 18BR	A/C SWITCH SENSE IN
2	C22 18DB	A/C LOW PRESSURE SWITCH OUT
2	C90 18LG/WT*	A/C LOW PRESSURE SWITCH OUT



AIRBAG CONTROL MODULE

CAV	CIRCUIT	FUNCTION
1	-	-
2	-	-
3	-	-
4	Z6 18BK/PK	GROUND
5	R43 18BK/LB	DRIVER AIRBAG LINE 1
6	R45 18DG/LB	DRIVER AIRBAG LINE 2
7	R142 18BK/YL	PASSENGER AIRBAG LINE 1
8	R144 18DG/YL	PASSENEGR AIRBAG LINE 2
9	-	-
10	-	-
11	-	-
12		-
13	-	-
14	F14 18LG/YL	FUSED IGN. (ST-RUN)
15	F23 18DB/YL	FUSED IGN. (RUN)
16	G111 18LG/BK	SBCM FAULT SIGNAL
17	-	-
18	-	-
19	-	-
20	-	-
21	D1 18VT/BR	CCD BUS (+)
22	D2 18WT/BK	CCD BUS (-)
23	-	-



AMBIENT TEMPERATURE SENSOR

CAV	CIRCUIT	FUNCTION
1	G31 20VT/LG	AMBIENT TEMPERATURE SENSOR SIGNAL
2	G32 20BK/VT	SENSOR GROUND

* W/ DIESEL

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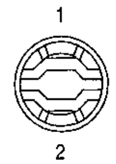
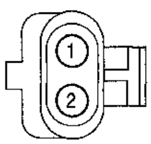


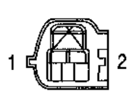
ASH RECEIVER LAMP

CAV	CIRCUIT	FUNCTION
1	L10 20BR/LG	FUSED IGN. (RUN)
2	Z3 20BK/OR	GROUND



BACK-UP LAMP SWITCH (MTX)

CAV	CIRCUIT	FUNCTION
1	L1 18VT/BK	BACK-UP LAMP FEED
2	L10 18BR/LG	TRS REVERSE SENSE



BATTERY TEMPERATURE SENSOR

CAV	CIRCUIT	FUNCTION
1	K4 20BK/LB	SENSOR GROUND
2	K118 20PK/YL	BATTERY TEMPERATURE SENSOR SIGNAL TO ENGINE

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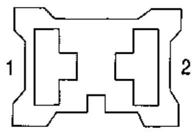
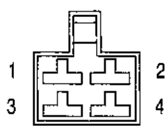


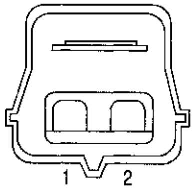
BLOWER MOTOR

CAV	CIRCUIT	FUNCTION
1	C1 12DG	BLOWER MOTOR FEED
2	C7 12BK/TN	BLOWER MOTOR SPEED CONTROL



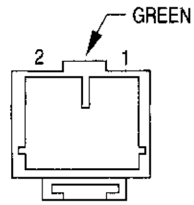
BLOWER MOTOR RESISTOR BLOCK

CAV	CIRCUIT	FUNCTION
1	C7 12BK/TN	HI SPEED BLOWER MOTOR/SPEED CONTROL
2	C6 14LB	M2 SPEED BLOWER MOTOR
3	C5 16LG	M1 SPEED BLOWER MOTOR
4	C4 16TN	LO SPEED BLOWER MOTOR



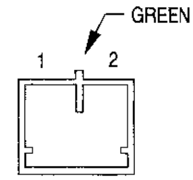
BRAKE PRESSURE SWITCH

CAV	CIRCUIT	FUNCTION
1	Z1 20BK	GROUND
2	G9 20GY/BK	RED BRAKE WARNING LAMP DRIVER



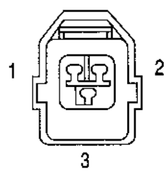
BYPASS JUMPER
(ATX)

CAV	CIRCUIT
1	T141 14YL/RD
2	A41 14YL



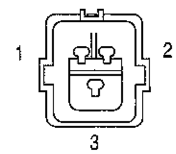
BYPASS JUMPER
(ATX)

CAV	CIRCUIT
1	T141 14YL/RD
2	T141 14YL/RD



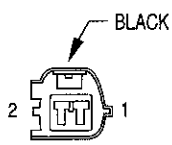
C105

CAV	CIRCUIT
1	Z1 20BK
2	L39 20LB
3	Z1 20BK



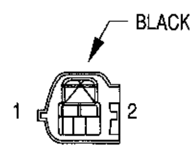
C105

CAV	CIRCUIT
1	Z1 20BK
2	L39 20LB
3	Z1 20BK



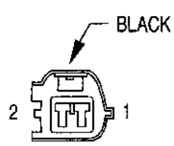
C106

CAV	CIRCUIT
1	G107 18BK/GY
2	Z1 18BK



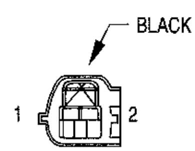
C106

CAV	CIRCUIT
1	G107 20BK/GY
2	Z1 20BK



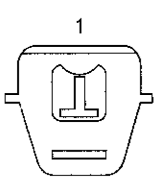
C114

CAV	CIRCUIT
1	G31 20VTLG
2	G32 20BK/VT



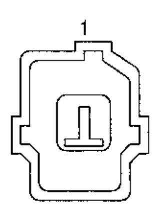
C114

CAV	CIRCUIT
1	G31 20VT/LG
2	G32 20BK/VT



C119

CAV	CIRCUIT
1	T40 12BR
2	-



C119

CAV	CIRCUIT
1	T40 14BR
2	T40 14BR

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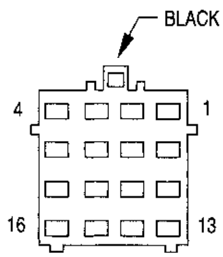
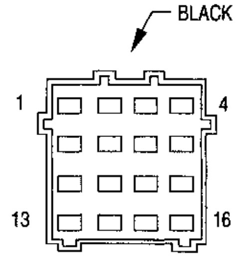


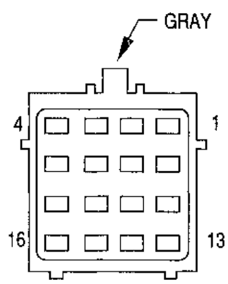
C125
(DIESEL)

CAV	CIRCUIT
1	G7 18WT/OR
2	T6 20OR/WT
3	T18 18LG/OR
4	T41 20BK/WT
5	C22 18DB
6	K22 18OR/DB
7	C13 18DB/OR
8	K24 18GY/BK
9	V40 18WT/PK
10	C90 18LG/WT
11	Z12 14BK/TN
	Z12 14BK/TN
12	K118 18PK/YL
13	K4 20BK/LB
14	Z12 14BK/TN
15	T16 18RD
16	K30 18PK



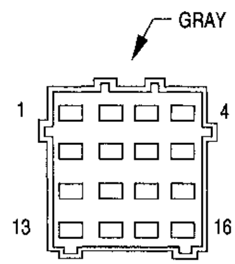
C125
(DIESEL)

CAV	CIRCUIT
1	G7 20WT/OR
2	T6 20OR/WT
3	T18 22LG/OR
4	T41 20BK/WT
5	C22 20DB
6	K22 20OR/DB
7	C13 20DB/OR
8	K24 20GY/BK
9	V40 22WT/PK
10	C90 20LG/WT
11	Z12 14BK/TN
12	K118 20PK/YL
13	K4 18BK/LB
14	Z12 14BK/TN
15	T16 22RD
16	K30 22PK/WT



C126
(DIESEL)

CAV	CIRCUIT
1	F18 20LG/BK
2	V32 20YL/RD
3	V37 20RD/LG
4	T125 18WT/DB
5	K20 18DG
6	L1 18VT/BK
7	V35 20LG/RD
8	K226 20DB/WT
9	V36 20TN/RD
10	L10 18BR/LG
11	D220 20WT/VT
12	D21 20PK/DB
13	-
14	D1 20VT/BR
15	D2 20WT/BK
16	A14 16RD/WT



C126
(DIESEL)

CAV	CIRCUIT
1	F18 18LG/BK
2	V32 18YL/RD
3	V37 18RD/LG
4	T125 18DB
5	K20 18DG
6	L1 18VT/BK
7	V35 18LG/RD
8	K226 18DB/WT
9	V36 18TN/RD
10	L10 18BR/LG
11	D220 18LG
12	D21 18PK/DB
13	G113 18OR
14	D1 18VT/BR
15	D2 18WT/BK
16	A14 14RD/WT

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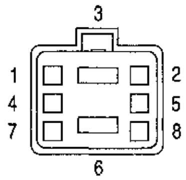
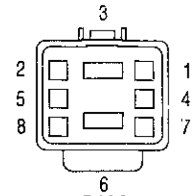


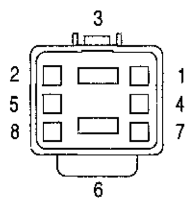
C128

CAV	CIRCUIT
1	B113 20RD/VT
2	B114 20WT/VT
3	Z13 12BK
4	-
5	-
6	B40 12LB
7	K4 20BK/LB
8	K226 20DB/WT



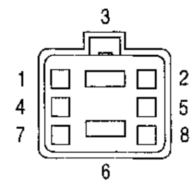
C128

CAV	CIRCUIT
1	B113 20RD/VT
2	B114 20WT/VT
3	Z13 12BK
4	-
5	-
6	B40 12LB
7	K4 20BK/LB
8	K226 20DB/WT



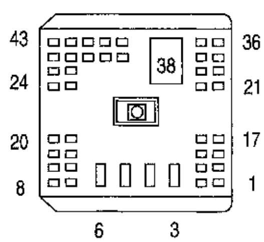
C129

CAV	CIRCUIT
1	L7 18BK/YL
2	-
3	L76 12BK/OR
4	L63 16DG/RD
5	L1 18VT/BK
6	A6 12RD/TN
7	L62 16BR/PK
8	A61 16DG/BK



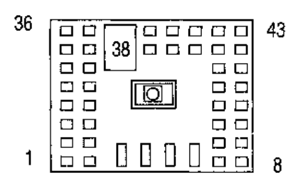
C129

CAV	CIRCUIT
1	L7 16BK/YL
2	-
3	L76 12BK/OR
4	L63 16DG/RD
5	L1 18VT/BK
6	A6 12RD/OR
7	L62 16BR/RD
8	A61 16DG/BK



C130

CAV	CIRCUIT
1	V35 18LG/RD
2	V32 18YL/RD
3	A14 16RD/WT
4	A142 14DG/OR
5	T40 12BR*
6	A93 14RD/BK*
7	K118 18PK/YL
8	L1 18VT/BK
9	-
10	G85 18OR/BK*
11	V40 18WT/PK
12	L10 18BR/LG
13	D1 18VT/BR
14	K51 18DB/YL
15	C13 18DB/YL
16	D20 16DG
17	D2 18WT/BK
18	K4 20BK/LB



C130
(IN PDC)

CAV	CIRCUIT
1	V35 20LG/RD
2	V32 20YL/RD
3	A14 16RD/WT
4	A142 14DG/OR
5	A14 16RD/WT
5	T40 14BR
6	A93 12RD/YL*
7	K118 20PK/YL
7	K24 20GY/BK
8	K22 20OR/DB
8	L1 18VT/BK
9	K131 22BR/WT
10	G85 22OR/BK
11	V40 22WT/PK
12	L10 18BR/LG
13	D1 20VT/BR
14	K51 22DB/YL
15	C13 22DB/OR
16	D20 20DG
17	D2 20WT/BK
18	K4 18BK/LB*
18	K4 22BK/LB

CONTINUED

* DIESEL

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CONTINUED

C130

CAV	CIRCUIT
19	C90 18LG*
19	C90 18LG/WT**
20	D21 18PK/DB
21	C3 18DB/BK
22	V37 18RD/LG
23	K226 18DB/WT
24	V36 18TN/RD
25	Z12 20BK/TN
26	T41 20BK/WT ●●
26	Z11 20BK/WT ●
26	Z12 20BK/TN*
27	K31 18BR/WT**
28	F18 18LG/BK
29	K30 18PK
30	T18 18LG/OR
31	T16 18RD
32	-
33	G7 18WT/OR
34	T6 18OR/WT
35	T125 18WT/DB*
35	T125 18DB**
36	K106 18WT/DG**
37	K107 18OR**
38	A18 10RD/BK*
39	Z12 20BK/TN*
39	Z12 18BK/TN**
40	-
41	-
42	K52 18PK/WT**
43	A141 18DG/WT
43	A141 18DG/WT ○

C130 (IN PDC)

CAV	CIRCUIT
19	C90 22LG/WT
19	C90 20LG/WT
20	D21 20PK/DB
21	C3 22DB/BK
22	V37 22RD/LG
23	K226 20DB/WT
24	V36 20TN/RD
25	Z12 20BK/TN
26	T41 22BK/WT
26	T41 20BK/WT*
27	K31 22BR/WT
28	F18 20LG/BK
29	K30 22PK/WT
30	T18 22LG/OR
31	T16 22RD
32	C22 20DB
33	G7 20WT/OR
34	T6 22OR/WT
35	T125 18WT/DB
35	T125 18WT/DB
36	K106 18WT/DG
37	K107 18OR**
38	A18 10RD/BK*
39	Z12 18BK/TN
40	G113 20OR
41	Z12 14BK/TN
42	K52 18PK/WT**
43	A141 20DG/WT

* DIESEL
** GAS
*** V6/V8
● M/T
●● A/T
○ HEAVY DUTY

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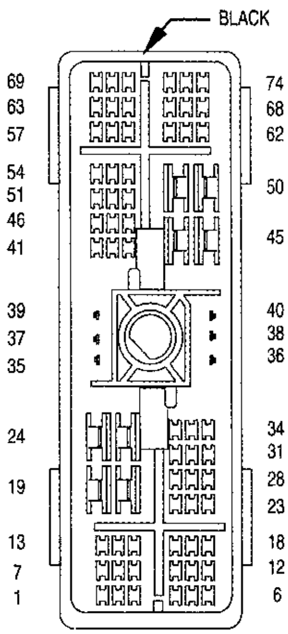
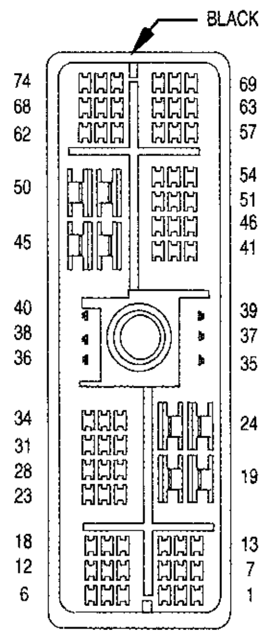


C134

CAV	CIRCUIT
1	-
2	D21 20PK/DB
3	D220 20WT/VT
4	-
5	-
6	-
7	-
8	Z12 18BK/TN
9	Z12 20BK/TN
10	D2 20WT/BK
11	D1 20VT/BR
12	D2 20WT/BK
13	D20 20LG
14	D21 20PK/DB
15	-
16	D1 20VT/BR
17	D2 20WT/BK
18	D1 20VT/BR
19	L7 16BK/YL
20	A12 16RD/TN
21	T6 22OR/WT
22	L39 22LB
23	F15 20DB
23	F18 18DB
24	A3 12RD/WT
25	F32 16PK/DB
26	K4 22BK/LB
27	L35 22BR/YL
28	-
29	V37 22RD/LG
30	G11 22WT/LG
31	Z9 16BK/VT
32	X3 22BK/RD
33	-
34	Z5 18BK/DB
35	L3 16RD/OR
36	L4 16VT/WT
37	V4 16RD/YL
38	V49 16RD/BK
39	V3 16BR/WT
40	V5 16DG
41	Z2 16BK/LG
42	Z6 18BK/PK
43	C90 22LG/WT
44	A1 10RD
45	C1 12DG
46	-
47	G50 22RD/DB
48	V30 22DB/RD
49	-
50	A2 14PK/BK
51	A41 14YL
52	-
53	V32 22YL/RD



C134

CONTINUED

CAV	CIRCUIT
1	-
2	D21 20PK/DB
3	D220 20WT/VT
4	-
5	-
6	-
7	-
8	Z12 18BK/TN
9	Z12 20BK/TN
10	D2 20WT/BK
11	D1 20VT/BR
12	D2 20WT/BK
13	D20 20DG
14	D21 20PK/DB
15	-
16	D1 20VT/BR
17	D2 20WT/BK
18	D1 20VT/BR
19	L7 16BK/YL
20	A12 16RD/TN
21	T6 22OR/WT
22	L39 20LB
23	F15 22DB
24	A3 12RD/YL
25	F32 16PK/DB
26	K4 22BK/LB
27	L35 22BR/YL
28	-
29	V37 22RD/LG
29	V37 20RD/LG*
30	G11 20WT/LG
31	Z9 16BK/VT
32	X3 22BK/RD
33	-
34	Z5 18BK/DB
35	L3 16RD/OR
36	L4 16VT/WT
37	V4 16RD/YL
38	V49 16RD/BK
39	V3 16BR/WT
40	V5 16DG
41	Z2 16BK/LG
42	Z6 18BK/PK
43	C90 22LG/WT
43	C90 20LG/WT
44	A1 10RD
45	C1 12DG
46	-
47	G50 22RD/DB
48	V30 20DB/RD
49	-
50	A2 14PK/BK
51	A41 14YL
52	-
53	V32 20YL/RD

* DIESEL

BR008013

J988W-9

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CONTINUED

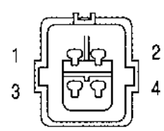
C134

CAV	CIRCUIT
54	-
55	V18 22YL/DG
56	V40 22WT/PK
57	L62 16BR/RD
58	G85 22OR/BK
59	G107 22BK/GY
60	T18 22LG/OR
61	G29 22BK/WT
62	G34 16RD/GY
63	L63 16DG/RD
64	L50 18WT/TN
65	F12 20DB/WT
66	L10 18BR/LG
67	Z3 18BK/OR
68	V10 16BR
69	-
70	-
71	-
72	-
73	-
74	-

C134

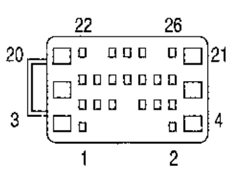
CAV	CIRCUIT
54	-
55	V18 22YL/DG
56	V40 22WT/PK
57	L62 16BR/RD
58	G85 22OR/BK
59	G107 20BK/GY
60	T18 22LG/OR
61	G29 18BK/WT
62	G34 16RD/GY
63	L63 16DG/RD
64	L50 18WT/TN
	L50 18WT/TN
65	F12 20DB/WT
66	L10 18BR/LG
67	Z3 18BK/OR
68	V10 16BR
69	-
70	-
71	-
72	-
73	-
74	-

-OPTIONAL-
CHMSL JUMPER
(FOR FUTURE USE)



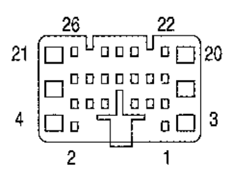
C183

CAV	CIRCUIT
1	M1 20PK
2	M2 20YL
3	L50 18WT/TN
3	L50 18WT/TN
4	Z1 20BK



C203

CAV	CIRCUIT
1	X58 18DB/OR
2	X57 18BR/LB
3	F37 16RD/LB
4	F21 16TN
5	M1 20PK
6	X51 18BR/YL
7	X52 18DB/WT
8	M2 20YL
9	G10 20LG/RD
10	F12 20DB/WT
11	L50 18WT/TN
12	F13 18DB
13	M3 20PK/DB
14	C16 20LB/YL
15	G16 18BK/LB



C203

CAV	CIRCUIT
1	X58 18DB/OR
2	X57 18BR/LB
3	F37 16RD/LB
4	F21 16TN
5	M1 22PK
6	X51 18BR/YL
7	X52 18DB/WT
8	M2 20YL
9	G10 22LG/RD
10	F12 22DB/WT
11	L50 18WT/TN
12	F13 18DB
13	M3 22PK/DB
14	C16 22LB/YL
15	G16 22BK/LB

CONTINUED

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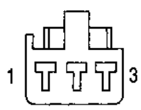
C203

CAV	CIRCUIT
16	G111 18LG/BK
17	G73 20LG/OR
18	G75 20TN
19	F35 20RD
20	Z9 16BK/VT
21	X54 18VT
22	X56 18DB/RD
23	X53 18DG
24	X55 18BR/RD
25	X13 16BK/RD
26	P34 20PK/BK

CONTINUED

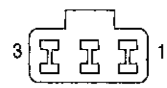
C203

CAV	CIRCUIT
16	G111 18LG/BK
17	G73 22LG/OR
18	G75 22TN
19	F35 22RD
20	Z9 16BK/VT
21	X54 18VT
22	X56 18DB/RD
23	X53 18DG
24	X55 18BR/RD
25	X13 16BK/RD
26	P34 22PK/BK



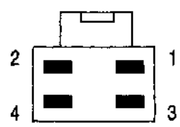
C204

CAV	CIRCUIT
1	P30 22OR/DG
2	P31 22PK/DG
3	P33 22OR/BK



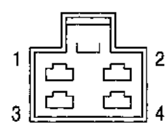
C204

CAV	CIRCUIT
1	P30 22OR/DG
2	P31 22PK/DG
3	P33 20OR/BK



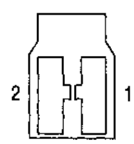
C237

CAV	CIRCUIT
1	C7 12BK/TN
2	C6 14LB
3	C5 16LG
4	C4 16TN



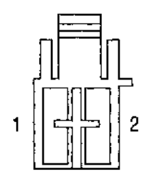
C237

CAV	CIRCUIT
1	C7 12BK/TN
2	C6 14LB
3	C5 16LG
4	C4 16TN



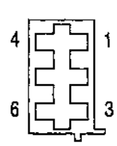
C303

CAV	CIRCUIT
1	Z3 14BK/OR
2	F37 14RD/LB



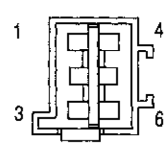
C303

CAV	CIRCUIT
1	Z2 16BK/LG
2	F37 16RD/LB



C308

CAV	CIRCUIT
1	L50 18WT/TN
2	Z2 20BK/LG
3	M1 20PK
4	M3 20PK/DB
5	-
6	-



C308

CAV	CIRCUIT
1	L50 18WT/TN
1	L50 18WT/TN
2	Z3 18BK/OR
2	Z3 18BK/OR
3	M1 18PK
3	M1 18PK
4	M3 18PK/DB
4	M3 18PK/DB
5	-
6	-

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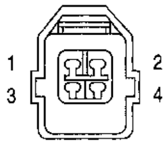
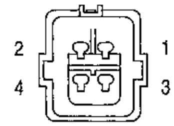


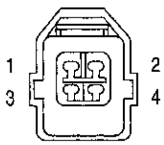
C329

CAV	CIRCUIT
1	L7 18BK/YL
2	Z13 16BK
3	L62 16BR/RD
4	L1 18VT/BK



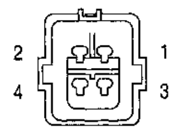
C329

CAV	CIRCUIT
1	L7 18BK/YL
2	Z13 16BK
3	L62 16BR/PK
4	L1 18VT/BK



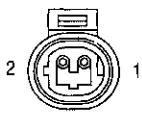
C333

CAV	CIRCUIT
1	L7 18BK/YL
2	Z13 16BK
3	L63 18DG/RD
4	L1 18VT/BK



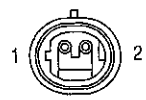
C333

CAV	CIRCUIT
1	L7 18BK/YL
2	Z13 16BK
3	L63 18DG/RD
4	L1 18VT/BK



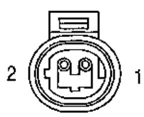
C342

CAV	CIRCUIT
1	Z13 18BK
2	L7 18BK/YL



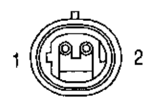
C342

CAV	CIRCUIT
1	Z13 18BK
2	L7 18BK/YL



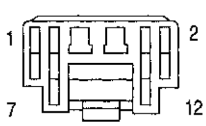
C343

CAV	CIRCUIT
1	Z13 18BK
2	L7 18BK/YL



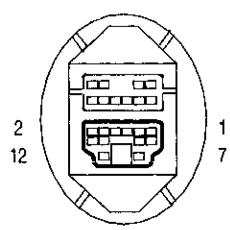
C343

CAV	CIRCUIT
1	Z13 18BK
2	L7 18BK/YL



C345

CAV	CIRCUIT
1	X82 20LB/RD
2	X54 18VT
3	P70 22WT
4	P72 22YL/BK
5	X56 18DB/RD
6	X13 16BK/RD
7	P74 22DB
8	X80 20LB/BK
9	F21 16TN
10	Z2 16BK/LG
11	Z9 16BK/VT
12	C16 20LB/YL



C345

CAV	CIRCUIT
1	X82 20LB/RD
2	X54 18VT
3	P70 20WT
4	P72 20YL/BK
5	X56 20DB/RD
6	X13 16BK/RD
7	P74 20DB
8	X80 20LB/BK
9	F21 14TN
10	Z2 20BK/LG*
10	Z2 14BK/LG**
11	Z9 16BK/VT
12	C16 20LB/YL

* MID-LINE
** HIGH-LINE

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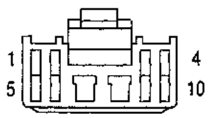
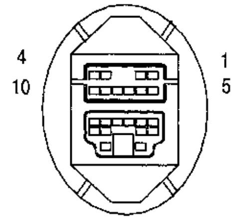


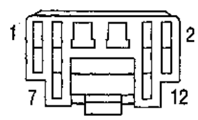
C346

CAV	CIRCUIT
1	F35 20RD
2	Q16 16BR/WT
3	Q26 16VT/WT
4	P33 20OR/BK
5	P34 20PK/BK**
5	P31 22PK/DG*
6	P35 20OR/VT
7	P36 20PK/VT
8	G73 20LG/OR
9	P30 22OR/DG*
9	P33 20OR/BK**
10	P34 20PK/BK



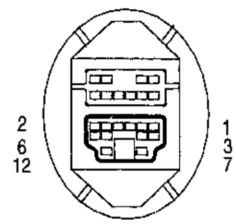
C346

CAV	CIRCUIT
1	F35 20RD
2	Q16 14BR/WT
3	Q26 14VT/WT
4	P33 20OR/BK
5	P31 20PK/DG
6	P35 20OR/VT
7	P36 20PK/VT
8	G73 20LG/OR
9	P30 20OR/DG
10	P34 20PK/BK



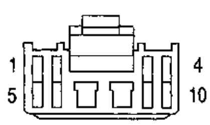
C347

CAV	CIRCUIT
1	M1 20PK
2	X53 18DG
3	P70 22WT
4	P72 22YL/BK
5	X55 18BR/RD
6	X13 16BK/RD
7	P74 22DB
8	X81 20YL/BK
9	F21 16TN
10	Z2 16BK/LG
11	Z9 16BK/VT
12	C16 20LB/YL



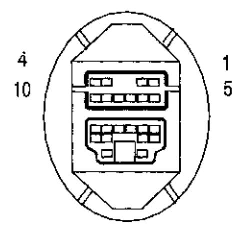
C347

CAV	CIRCUIT
1	M1 22PK
2	X53 18DG
3	P70 22WT
4	P72 22YL/BK
5	X55 18BR/RD
6	X13 16BK/RD
7	P74 22DB
8	X81 20YL/BK
9	F21 16TN
10	Z2 16BK/LG
11	Z9 16BK/VT
12	C16 20LB/YL



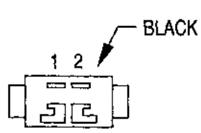
C348

CAV	CIRCUIT
1	F35 20RD
2	Q16 16BR/WT
3	Q26 16VT/WT
4	P33 20OR/BK
5	X83 20YL/RD
6	P35 20OR/VT
7	P36 20PK/VT
8	G73 20LG/OR
9	Z2 20BK/LG
10	P34 20PK/BK



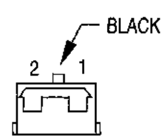
C348

CAV	CIRCUIT
1	F35 20RD
2	Q16 16BR/WT
3	Q26 16VT/WT
4	P33 20OR/BK
5	X83 20YL/RD
6	P35 20OR/VT
7	P36 20PK/VT
8	G73 20LG/OR
9	Z2 20BK/LG
10	P34 20PK/BK



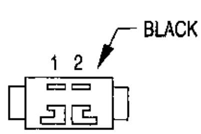
C352

CAV	CIRCUIT
1	M1 20PK
2	Z4 20BK



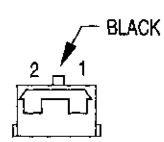
C352

CAV	CIRCUIT
1	M1 20PK
2	Z4 20BK



C353

CAV	CIRCUIT
1	M1 20PK
2	Z4 20BK



C353

CAV	CIRCUIT
1	M1 20PK
2	Z4 20BK

* CTM
** IEM

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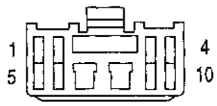
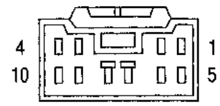


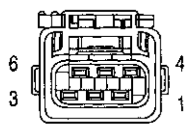
C360

CAV	CIRCUIT
1	F13 18DB
2	M1 20PK
3	G74 18TN/RD
4	Z16 18BK/PK
5	F12 20DB/WT
6	G75 20TN
7	Z2 16BK/LG
8	F37 16RD/LB
9	G10 20LG/RD
10	G111 18LG/BK



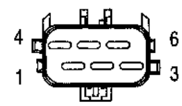
C360

CAV	CIRCUIT
1	F13 18DB
2	M1 18PK
3	G74 18TN/RD
4	Z16 18BK/PK
5	F12 20DB/WT
6	G75 18TN
7	Z2 16BK/LG
8	F37 16RD/LB
9	G10 20LG/RD
10	G111 18LG/BK



C361

CAV	CIRCUIT
1	-
2	X57 18BR/LB
3	X51 18BR/YL
4	-
5	-
6	-



C361

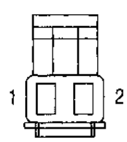
CAV	CIRCUIT
1	-
2	X57 18BR/LB
3	X51 18BR/YL
4	-
5	-
6	-

C362

CAV	CIRCUIT
1	G10 20LG/RD
2	F12 20DG/WT
3	Z2 18BK/LG
4	R7 18OR/BK

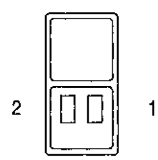
C362

CAV	CIRCUIT
1	G10 20LG/RD
2	F12 18DB/WT
3	Z2 18BK/LG
4	R7 18OR/BK



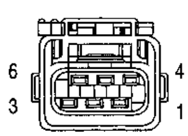
C363

CAV	CIRCUIT
1	Z2 18BK/LG
2	R8 18OR/RD



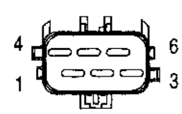
C363

CAV	CIRCUIT
1	Z2 18BK/LG
2	R8 18OR/RD



C364

CAV	CIRCUIT
1	-
2	X58 18DB/OR
3	X52 18DB/WT
4	-
5	-
6	-



C364

CAV	CIRCUIT
1	-
2	X58 18DB/OR
3	X52 18DB/WT
4	-
5	-
6	-

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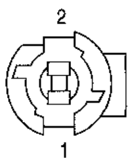
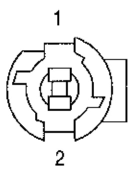
CAMSHAFT POSITION SENSOR

CAV	CIRCUIT	FUNCTION
1	K44 18TN/YL	CAMSHAFT POSITION SENSOR SIGNAL
2	K4 20BK/LB	SENSOR GROUND
3	K6 20VT/WT	5V SUPPLY



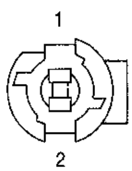
CARGO LAMP NO. 1

CAV	CIRCUIT	FUNCTION
1	M1 18PK	FUSED B (+)
2	M3 18PK/DB	CARGO LAMP DRIVER



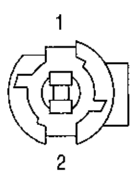
CARGO LAMP NO. 2

CAV	CIRCUIT	FUNCTION
1	M1 18PK	FUSED B (+)
2	M3 18PK/DB	CARGO LAMP DRIVER



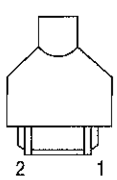
CENTER HIGH MOUNTED STOP LAMP NO. 1

CAV	CIRCUIT	FUNCTION
1	L50 18WT/TN	STOP LAMP SWITCH OUTPUT B(+)
2	Z3 18BK/OR	GROUND



CENTER HIGH MOUNTED STOP LAMP NO. 2

CAV	CIRCUIT	FUNCTION
1	L50 18WT/TN	STOP LAMP SWITCH OUTPUT
2	Z3 18BK/OR	GROUND



CENTER IDENTIFICATION LAMP

CAV	CIRCUIT	FUNCTION
1	L7 18BK/YL	HEADLAMP SWITCH OUTPUT
2	Z4 18BK	GROUND

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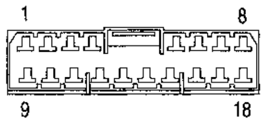
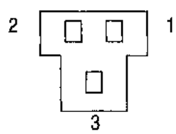


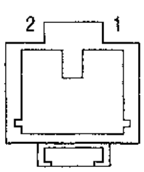
CENTRAL TIMER MODULE

CAV	CIRCUIT	FUNCTION
1	P33 22OR/BK	FEED FOR DOOR LOCK
2	M2 22YL	COURTESY LAMPS DRIVER
3	Z3 18BK/OR	FEED FOR DOOR LOCK SWITCH
4	P30 22OR/DG	POWER GROUND
5	F12 22DB/WT	FUSED IGN. (ST-RUN)
6	G50 22RD/DB	HEADLAMP RELAY CONTROL
7	-	-
8	G69 22BK	VTSS INDICATOR LAMP DRIVER
9	P34 22PK/BK	DOOR UNLOCK DRIVER
10	G73 22LG/OR	KEY DISARM SWITCH
11	-	-
12	-	-
13	P31 22PK/DG	POWER DOOR LOCK MOTOR B(+) UNLOCK
14	-	-
15	-	-
16	D1 20VT/BR	CCD BUS (+)
17	D2 20WT/BK	CCD BUS (-)
18	X3 22BK/RD	HORN RELAY CONTROL



CIGAR LIGHTER

CAV	CIRCUIT	FUNCTION
1	F30 18RD/OR	FUSED IGN. (RUN - ACC)
2	-	-
3	Z3 18BR/OR	GROUND



CLUTCH PEDAL POSITION SWITCH (MTX)

CAV	CIRCUIT	FUNCTION
1	T141 14YL/RD	IGN. SWITCH OUPUT (ST)
2	A41 14YL	IGN. SWITCH OUTPUT (ST)

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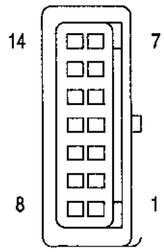
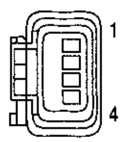


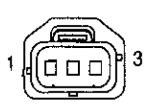
CONTROLLER ANTI-LOCK BRAKE - C1

CAV	CIRCUIT	FUNCTION
1	B113 20RD/YL	RIGHT REAR WHEEL SPEED SENSOR (+)
2	G107 20BK/GY	FOUR WHEEL DRIVE SENSE
3	D1 20VT/BR	CCD BUS (+)
4	A20 20RD/DB	FUSED B (+)
5	-	-
6	Z8 14BK/VT	GROUND
7	A10 14RD/DG	FUSED (+)
8	B114 20WT/VT	RIGHT REAR WHEEL SPEED SENSOR (-)
9	V40 20WT/PK	BRAKE SWITCH SENSE
10	D2 20WT/BK	CCD BUS (-)
11	G9 20GY/BK	RED BRAKE WARNING LAMP DRIVER
12	G7 20WT/OR	VEHICLE SPEED SENSOR SIGNAL
13	Z8 14BK/VT	GROUND
14	A10 14RD/DG	FUSED B (+)



CONTROLLER ANTI-LOCK BRAKE - C2 (ABS)

CAV	CIRCUIT	FUNCTION
1	B9 20RD	LEFT FRONT WHEEL SPEED SENSOR (+)
2	B8 20RD/GY	LEFT FRONT WHEEL SPEED SENSOR (-)
3	B6 20WT/DB	RIGHT FRONT WHEEL SPEED SENSOR (-)
4	B7 20WT	RIGHT FRONT WHEEL SPEED SENSOR (+)



CRANKSHAFT POSITION SENSOR

CAV	CIRCUIT	FUNCTION
1	K24 18GY/BK	CRANK POSITION SENSOR SIGNAL
2	K4 20BK/LB	SENSOR GROUND
3	K6 20VT/WT	5 VOLT SUPPLY

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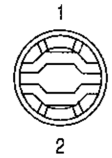
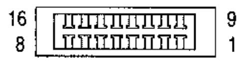


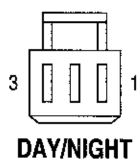
CUP HOLDER LAMP

CAV	CIRCUIT	FUNCTION
1	L10 20BR/LG	CUP HOLDER LAMP FEED
2	Z3 20BK/OR	GROUND



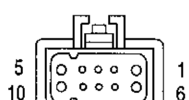
DATA LINK CONNECTOR

CAV	CIRCUIT	FUNCTION
1	-	-
2	-	-
3	D1 18VT/BR	CCD BUS (+)
4	Z12 20BK/TN	GROUND
5	Z12 18BK/TN	GROUND
6	D20 20LG	SCI RECIEVE
7	D21 20PK/DB	SCI TRANSMIT
8	-	-
9	-	-
10	-	-
11	D2 18WT/BK	CCD BUS (-)
12	-	-
13	-	-
14	D220 20WT/VT *	SCI RECEIVE
15	-	-
16	M1 20PK	FUSED B (+)



DAY/NIGHT MIRROR

CAV	CIRCUIT	FUNCTION
1	F12 20DB/WT	FUSED IGN. (ST-RUN)
2	Z4 20BK	GROUND
3	L1 22VT/BK	BACK-UP LAMP SENSE



DAYTIME RUNNING LAMP MODULE

CAV	CIRCUIT	FUNCTION
1	L3 16RD/OR	HIGH BEAM OUTPUT
2	-	-
3	G11 20WT/LG	PARKING BRAKE SWITCH SENSE
4	G34 20RD/GY	HIGH BEAM INDICATOR
5	L10 18BR/LG	FUSED IGN. (RUN)
6	L20 18LG/WT	FUSED B (+)
7	-	-
8	Z1 18BK	GROUND
9	-	-
10	L4 16VT/WT	LOW BEAM OUTPUT

* DIESEL

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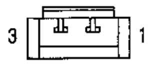
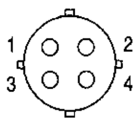


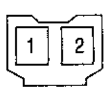
DOME LAMP

CAV	CIRCUIT	FUNCTION
1	-	-
2	M2 20YL	DOOR JAMB SWITCH
3	M1 20PK	FUSED B (+)



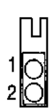
DOWNSTREAM HEATED OXYGEN SENSOR

CAV	CIRCUIT	FUNCTION
1	A141 18DG/WT	AUTO SHUTDOWN RELAY OUPUT
2	Z11 18BK/WT	GROUND
3	K4 18BK/LB	SENSOR GROUND
4	K341 18OR/BK	HEATED OXYGEN SENSOR SIGNAL



DRIVER AIRBAG

CAV	CIRCUIT	FUNCTION
1	R43 18BK/LB	DRIVER AIRBAG LINE 1
2	R45 18DG/LB	DRIVER AIRBAG LINE 2



DRIVER SEAT SOLENOID

CAV	CIRCUIT	FUNCTION
1	Z2 18BK/LG	GROUND
2	R7 18OR/BK	SIGNAL FROM SBCM

* W/CENTRAL TIMER MODULE

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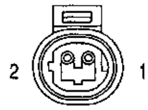
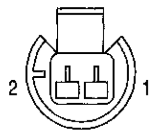


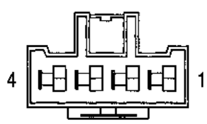
DUTY CYCLE EVAP/PURGE SOLENOID

CAV	CIRCUIT	FUNCTION
1	K52 18PK/WT	EVAPORATIVE EMISSION SOLENOID CONTROL
2	F12 20DB/WT	FUSED IGN. (ST-RUN)



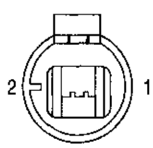
EGR SOLENOID (DIESEL)

CAV	CIRCUIT	FUNCTION
1	K35 18GY/YL	EGR SOLENOID CONTROL
2	F18 18LG/BK	IGN. FEED FOR EVIC



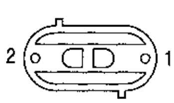
ELECTRIC BRAKE

CAV	CIRCUIT	FUNCTION
1	A6 12RD/OR	FUSED B (+)
2	B40 12LB	TRAILER TOW B (+)
3	L50 18WT/TN	STOP LAMP SWITCH OUTPUT
4	Z3 18BK/OR	GROUND



ENGINE COOLANT TEMPERATURE SENSOR (DIESEL)

CAV	CIRCUIT	FUNCTION
1	K4 20BK/LB	SENSOR GROUND
2	K2 18TN/BK	ENGINE COOLANT TEMPERATURE SENSOR SIGNAL



ENGINE COOLANT TEMPERATURE SENSOR (GAS)

CAV	CIRCUIT	FUNCTION
1	K4 18BK/LB	SENSOR GROUND
2	K2 18TN/BK	ENGINE COOLANT TEMPERATURE SENSOR SIGNAL

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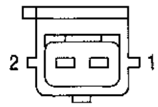
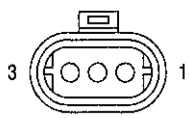


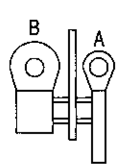
ENGINE OIL
PRESSURE SENSOR

CAV	CIRCUIT	FUNCTION
1	K4 18BK/LB	SENSOR GROUND
2	G60 18GY/OR	ENGINE OIL PRESSURE SENSE TO PCM



ENGINE
SPEED SENSOR
(DIESEL)

CAV	CIRCUIT	FUNCTION
1	K6 20VT/WT	5 VOLT SUPPLY
2	K4 20BK/LB	SENSOR GROUND
3	K24 18GY/BK	CRANK POSITION SENSOR SIGNAL



ENGINE STARTER
MOTOR

CAV	CIRCUIT	FUNCTION
A	T40 14BR	STARTER RELAY OUPUT
B	A0 6RD	B (+)

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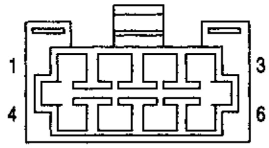
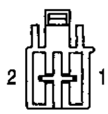


FOG LAMP SWITCH

CAV	CIRCUIT	FUNCTION
1	Z3 22BK/OR	GROUND
2	Z3 22BK/OR	GROUND
3	L35 22BR/YL	FOG LAMP RELAY CONTROL
4	L39 22LB	FRONT FOG LAMP SWITCH OUPUT
5	E2 22OR	FUSED PANEL LAMPS DIMMER SWITCH SENSE
6	-	-



FRONT VERTICAL SEAT MOTOR

CAV	CIRCUIT	FUNCTION
1	P19 14YL/LG	LEFT FRONT POWER SEAT FRONT VERTICAL UP
2	P21 14RD/LG	LEFT FRONT POWER SEAT FRONT DOWN

FUEL HEATER (DIESEL)

CAV	CIRCUIT	FUNCTION
1	A93 14RD/BK	FUEL HEATER RELAY OUTPUT
2	Z12 14BK/TN	GROUND

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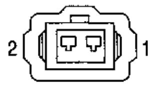
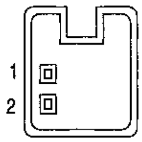


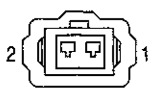
FUEL INJECTOR NO. 1 (3.9L/5.2L/5.9L)

CAV	CIRCUIT	FUNCTION
1	K11 18WT/DB	INJECTOR NO. 1 DRIVER
2	A142 14DG/OR	AUTO SHUTDOWN RELAY OUPUT



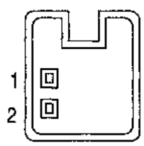
FUEL INJECTOR NO. 1 (8.0L)

CAV	CIRCUIT	FUNCTION
1	K11 18WT/DB	INJECTOR NO.1 DRIVER
2	A142 16DG/OR	AUTO SHUTDOWN RELAY OUPUT



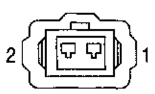
FUEL INJECTOR NO. 2 (3.9L/5.2L/5.9L)

CAV	CIRCUIT	FUNCTION
1	K12 18TN	INJECTOR NO. 2 DRIVER
2	A142 14DG/OR	AUTO SHUTDOWN RELAY OUTPUT



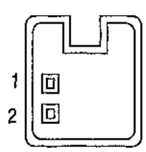
FUEL INJECTOR NO. 2 (8.0L)

CAV	CIRCUIT	FUNCTION
1	K12 18TN	INJECTOR NO. 2 DRIVER
2	A142 16DG/OR	AUTO SHUTDOWN RELAY OUPUT



FUEL INJECTOR NO. 3 (3.9L/5.2L/5.9L)

CAV	CIRCUIT	FUNCTION
1	K13 18YL/WT	INJECTOR NO. 3 DRIVER
2	A142 14DG/OR	AUTO SHUTDOWN RELAY OUPUT



FUEL INJECTOR NO. 3 (8.0L)

CAV	CIRCUIT	FUNCTION
1	K13 18YL/WT	AUTO SHUTDOWN RELAY OUTPUT
2	A142 16DG/OR	INJECTOR NO. 3 DRIVER

BR008027 J988W-9

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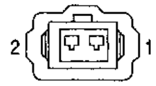
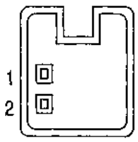


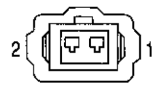
FUEL INJECTOR
NO. 4
(3.9L/5.2L/5.9L)

CAV	CIRCUIT	FUNCTION
1	K14 18LB/BR	INJECTOR NO. 4 DRIVER
2	A142 14DG/OR	AUTO SHUTDOWN RELAY OUTPUT



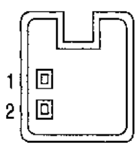
FUEL INJECTOR
NO. 4
(8.0L)

CAV	CIRCUIT	FUNCTION
1	K14 18LB/BR	AUTO SHUTDOWN RELAY OUTPUT
2	A142 16DG/OR	INJECTOR NO. 4 DRIVER



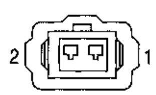
FUEL INJECTOR
NO. 5
(3.9L/5.2L/5.9L)

CAV	CIRCUIT	FUNCTION
1	K38 18GY	INJECTOR NO. 5 DRIVER
2	A142 14DG/OR	AUTO SHUTDOWN RELAY OUTPUT



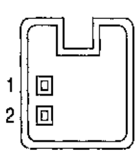
FUEL INJECTOR
NO. 5
(8.0L)

CAV	CIRCUIT	FUNCTION
1	K38 18GY	AUTO SHUTDOWN RELAY OUTPUT
2	A142 16DG/OR	INJECTOR NO. 5 DRIVER



FUEL INJECTOR
NO. 6
(3.9L/5.2L/5.9L)

CAV	CIRCUIT	FUNCTION
1	K58 18BR/DB	INJECTOR NO. 6 DRIVER
2	A142 14DG/OR	AUTO SHUTDOWN RELAY OUTPUT



FUEL INJECTOR
NO. 6
(8.0L)

CAV	CIRCUIT	FUNCTION
1	K58 18BR/DB	AUTO SHUTDOWN RELAY OUTPUT
2	A142 16DG/OR	INJECTOR NO. 6 DRIVER

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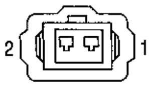
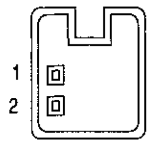


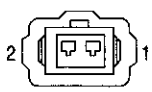
FUEL INJECTOR NO. 7 (5.2L/5.9L)

CAV	CIRCUIT	FUNCTION
1	K26 18VT/TN **	INJECTOR NO. 7 DRIVER
	K38 18GY *	INJECTOR NO. 5 DRIVER
2	A142 14DG/OR	AUTO SHUTDOWN RELAY OUTPUT



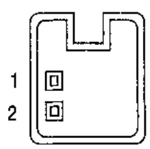
FUEL INJECTOR NO. 7 (8.0L)

CAV	CIRCUIT	FUNCTION
1	K26 18VT/TN	INJECTOR NO. 7 DRIVER
2	A142 16DG/OR	AUTO SHUTDOWN RELAY OUTPUT



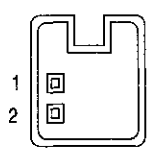
FUEL INJECTOR NO. 8 (5.2L/5.9L)

CAV	CIRCUIT	FUNCTION
1	K28 18GY/LB	INJECTOR NO. 8 DRIVER
2	A142 14DG/OR	AUTO SHUTDOWN RELAY OUTPUT



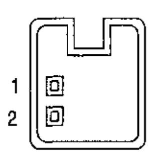
FUEL INJECTOR NO. 8 (8.0L)

CAV	CIRCUIT	FUNCTION
1	K28 18GY/LB	INJECTOR NO. 8 DRIVER
2	A142 16DG/OR	AUTO SHUTDOWN RELAY OUTPUT



FUEL INJECTOR NO. 9 (8.0L)

CAV	CIRCUIT	FUNCTION
1	K115 18TN/BK	INJECTOR NO. 9 DRIVER
2	A142 16DG/OR	AUTO SHUTDOWN RELAY OUPUT



FUEL INJECTOR NO. 10 (8.0L)

CAV	CIRCUIT	FUNCTION
1	K116 18WT	INJECTOR NO. 10 DRIVER
2	A142 16DG/OR	AUTO SHUTDOWN RELAY OUTPUT

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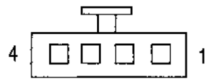
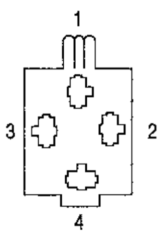


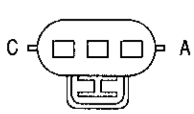
FUEL PUMP MODULE

CAV	CIRCUIT	FUNCTION
1	Z13 16BK	GROUND
2	K4 20BK/LB	SENSOR GROUND
3	K226 20DB/WT	FUEL LEVEL SENSOR
4	A61 16DG/BK	AUTO SHUTDOWN RELAY OUPUT



FUEL SHUT DOWN RELAY

CAV	CIRCUIT	FUNCTION
1	A18 10RD/BK	FUSED B(+)
2	T40 12BR	ENGINE STARTER MOTOR RELAY OUTPUT
3	Z12 18BK/TN	GROUND
4	A123 10RD/VT	FUEL SHUT DOWN RELAY OUTPUT



FUEL SHUT DOWN SOLENOID

CAV	CIRCUIT	FUNCTION
A	F18 20LG/BK	FUSED IGN. (ST-RUN)
B	A123 10RD/VT	FUEL SHUT DOWN RELAY OUTPUT
C	Z12 10BK/TN	GROUND

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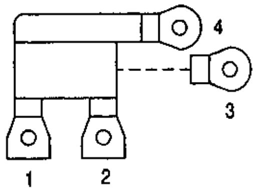
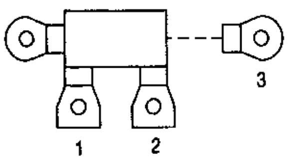


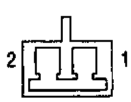
GENERATOR (DIESEL)

CAV	CIRCUIT	FUNCTION
1	K20 18DG	GENERATOR FIELD DRIVER
2	T125 18WT/DB	GENERATOR FIELD B(+)
3	A11 4BK	GENERATOR OUTPUT
4	Z1 6BK	GROUND



GENERATOR (GAS)

CAV	CIRCUIT	FUNCTION
1	K20 18DG	GENERATOR FIELD DRIVER
2	T125 18DB	GENERATOR FIELD B(+)
3	Z1 6BK	GROUND



GLOVE BOX LAMP

CAV	CIRCUIT	FUNCTION
1	M1 20PK	FUSED B(+)
2	Z3 20BK/OR	GROUND

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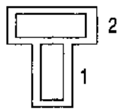
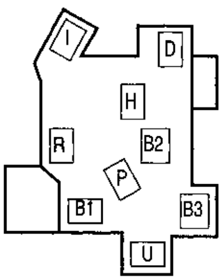


HEADLAMP SWITCH - C1

CAV	CIRCUIT	FUNCTION
1	M2 20YL	COURTESY LAMPS SWITCH OUTPUT
2	Z3 20BK/OR	GROUND



HEADLAMP SWITCH - C2

CAV	CIRCUIT	FUNCTION
B1	A3 12RD/WT	FUSED B (+)
B2	F33 14PK/RD	FUSED B (+)
B3	G26 22LB	KEY-IN IGN. SWITCH SENSE
D	M3 22PK/DB	CARGO LAMP DRIVER
H	L2 16LG	HEADLAMP SWITCH OUTPUT
I	E1 18TN	PANEL LAMPS DIMMER SWITCH SIGNAL
P	L11 16LG/BK	FLASH TO PASS DRIVER
R	L7 16BK/YL	PARK LAMP SWITCH OUPUT
U	G75 22TN	LEFT DOOR AJAR SWITCH SENSE

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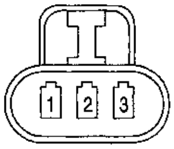
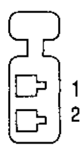


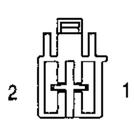
HEATED
MIRROR SWITCH

CAV	CIRCUIT	FUNCTION
1	F15 20DB	FUSED IGN. (RUN)
2	Z3 22BK/OR	GROUND
3	C16 22LB/YL	REAR DEFOGGER LAMP DRIVER



HIGH NOTE
HORN

CAV	CIRCUIT	FUNCTION
1	X2 18DG/RD	HORN RELAY OUTPUT
2	Z1 18BK	GROUND



HORIZONTAL
SEAT MOTOR

CAV	CIRCUIT	FUNCTION
1	P17 14DB/RD	LEFT POWER SEAT HORIZONTAL REARWARD
2	P15 14YL/LB	LEFT POWER SEAT HORIZONTAL FORWARD

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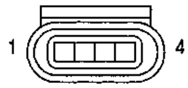
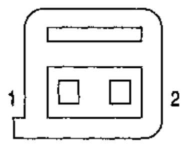


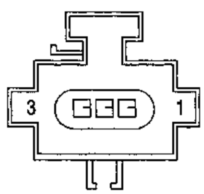
IDLE AIR CONTROL

CAV	CIRCUIT	FUNCTION
1	K39 18GY/RD	IDLE AIR CONTROL NO. 1 DRIVER
2	K60 18YL/BK	IDLE AIR CONTROL NO. 2 DRIVER
3	K40 18BR/WT	IDLE AIR CONTROL NO. 3 DRIVER
4	K59 18VT/BK	IDLE AIR CONTROL NO. 4 DRIVER



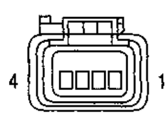
IGNITION COIL (3.9L/5.2L/5.9L)

CAV	CIRCUIT	FUNCTION
1	A142 14DG/OR	AUTO SHUTDOWN RELAY OUTPUT
1	K19 16BK/GY*	IGNITION COIL DRIVER
2	K19 16BK/GY	IGNITION COIL DRIVER
2	A142 14DG/OR*	AUTO SHUTDOWN RELAY OUTPUT



IGNITION COIL 4 - PACK (8.0L)

CAV	CIRCUIT	FUNCTION
1	K17 18DB/WT	IGNITION COIL NO. 2 DRIVER
2	A142 14DG/OR	AUTO SHUTDOWN RELAY OUTPUT
3	K18 18RD/BK	IGNITION COIL NO. 3 DRIVER



IGNITION COIL 6 - PACK (8.0L)

CAV	CIRCUIT	FUNCTION
1	K19 18BK/GY	IGNITION COIL NO. 1 DRIVER
2	A142 14DG/OR	AUTO SHUTDOWN RELAY OUTPUT
3	K32 18YL/GY	IGNITION COIL NO. 4 DRIVER
4	K43 18DG/GY	IGNITION COIL NO. 5 DRIVER

* 5.9L HEAVY DUTY

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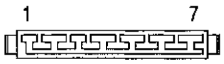
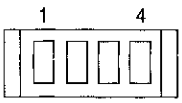


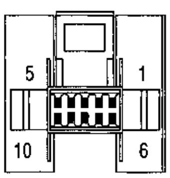
IGNITION SWITCH - C1

CAV	CIRCUIT	FUNCTION
1	A41 14YL	IGN. SWITCH OUTPUT (ST)
2	A21 10DB	IGN SWITCH OUTPUT (ST-RUN)
3	-	-
4	A2 14PK/BK	FUSED B (+)
5	A22 14BK/OR	IGN SWITCH OUTPUT (RUN)
6	A31 10BK/WT	IGN SWITCH OUTPUT (RUN-ACC)
7	A1 10RD	FUSED B (+)



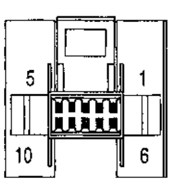
IGNITION SWITCH - C2

CAV	CIRCUIT	FUNCTION
1	G75 22TN	LEFT DOOR AJAR SWITCH SENSE
2	G26 22LB	KEY-IN IGNITION SWITCH SENSE
3	M1 22PK	FUSED B (+)
4	M50 22YL/RD	HALO LAMP DRIVER



INSTRUMENT CLUSTER - C1

CAV	CIRCUIT	FUNCTION
1	G85 22OR/BK	WAIT-TO-START WARNING LAMP DRIVER
2	G5 22DB/WT	FUSED IGN. (ST-RUN)
3	G11 22WT/LG	PARK BRAKE SWITCH SENSE
4	Z2 20BK/LG	GROUND
5	Z3 20BK/OR	GROUND
6	F73 20YL	FUSED B (+)
7	T18 22LG/OR	TRS OVERDRIVE SENSE
8	G69 22BK*	VTSS INDICATOR LAMP DRIVER
	G85 22OR/BK**	WAIT-TO-START WARNING LAMP DRIVER
9	D2 20WT/BK	CCD BUS (-)
10	D1 20VT/BR	CCD BUS (+)



INSTRUMENT CLUSTER - C2

CAV	CIRCUIT	FUNCTION
1	E2 22OR	PANEL LAMPS FEED
2	G29 22BK/WT	LOW WASHER FLUID SENSE
3	G10 22LG/RD	SEAT BELT SWITCH SENSE
4	-	-
5	L7 18BK/YL	PARK LAMP RELAY OUTPUT
6	L61 18LG	LEFT TURN SIGNAL
7	G13 22DB/RD	TONE REQUEST
8	L60 18TN	RIGHT TURN SIGNAL
9	G34 16RD/GY	HIGH BEAM INDICATOR DRIVER
10	G107 22BK/GY	4WD SWITCH SENSE

*CTM MODULE
** DIESEL

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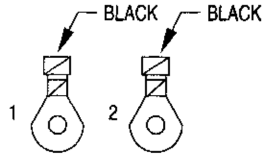
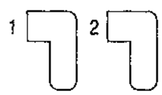


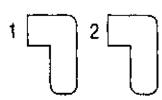
INTAKE AIR HEATER (DIESEL)

CAV	CIRCUIT	FUNCTION
1	A58 6BK	FUSED B(+)
2	A122 6BK	FUSED B(+)



INTAKE AIR HEATER RELAY NO. 1 (DIESEL)

CAV	CIRCUIT	FUNCTION
1	F18 20LG/BK	FUSED IGN. (ST-RUN)
2	S21 18YL/BK	AIR INTAKE HEATER RELAY NO. 1 CONTROL



INTAKE AIR HEATER RELAY NO. 2 (DIESEL)

CAV	CIRCUIT	FUNCTION
1	F18 20LG/BK	FUSED IGN. (ST-RUN)
2	S22 18OR/BK	AIR INTAKE HEATER RELAY NO. 2 CONTROL

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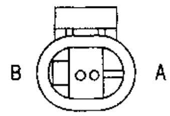
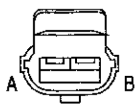


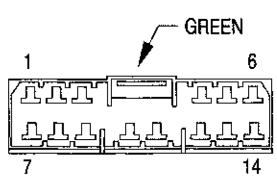
INTAKE AIR TEMPERATURE SENSOR (DIESEL)

CAV	CIRCUIT	FUNCTION
A	K4 18BK/LB	SENSOR GROUND
B	K21 18BK/RD	INTAKE AIR TEMPERATURE SIGNAL



INTAKE AIR TEMPERATURE SENSOR (GAS)

CAV	CIRCUIT	FUNCTION
A	K4 18BK/LB	SENSOR GROUND
B	K21 18BK/RD	INTAKE AIR TEMPERATURE SIGNAL



INTEGRATED ELECTRONIC MODULE (BASE CTM)

CAV	CIRCUIT	FUNCTION
1	G75 22TN	LEFT DOOR AJAR SWITCH SENSE
2	G13 22DB/RD	SEAT BELT LAMP DRIVER
3	V8 16VT	INTERMITTENT WIPER SENSE
4	V18 22YL/DG	WIPER RELAY
5	G16 22BK/LB	RIGHT DOOR JAMB SWITCH SENSE
6	Z2 22BK/LG	GROUND
7	-	-
8	V6 16DB	WIPER PARK SWITCH FEED
8	F12 22DB/WT*	FUSED IGN. (ST-RUN)
9	G26 22LB	KEY-IN IGNITION SWITCH SENSE
10	V10 16BR	WASHER PUMP CONTROL
11	V5 16DG	WIPER SWITCH MODE SENSE
12	V9 16WT/DB	WIPER SWITCH MODE SIGNAL
13	M50 22YL/RD	KEY-IN LAMP DRIVER
14	F35 22RD	FUSED B(+)

* CTM

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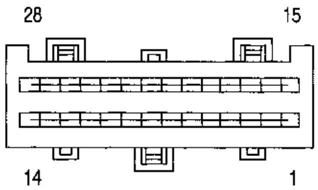
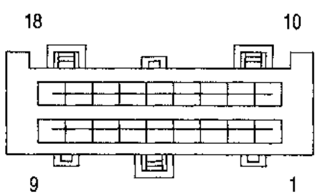


JOINT CONNECTOR NO. 1 (IN PDC)

CAV	CIRCUIT	FUNCTION
1	V40 20WT/PK	BRAKE SWITCH SENSE
2	V40 22WT/PK	BRAKE SWITCH SENSE
3	V40 22WT/PK	BRAKE SWITCH SENSE
4	L4 16VT/WT	SENSOR RETURN
5	L4 16VT/WT	SENSOR RETURN
6	L4 16VT/WT	SENSOR RETURN
7	L4 16VT/WT	SENSOR RETURN
8	L4 16VT/WT	SENSOR RETURN
9	L1 18VT/BK	FUSED IGN. (ST)
10	L1 18VT/BK	FUSED IGN. (ST)
11	L1 18VT/BK	FUSED IGN. (ST)
12	X2 20DG/RD	HORN RELAY OUTPUT
13	X2 18DG/RD	HORN RELAY OUTPUT
14	X2 18DG/RD	HORN RELAY OUTPUT
15	K4 22BK/LB	SENSOR GROUND
16	K4 22BK/LB*	SENSOR GROUND
16	K4 20BK/LB**	SENSOR GROUND
17	K4 20BK/LB	SENSOR GROUND
18	K4 20BK/LB	SENSOR GROUND
19	Z1 22BK	GROUND
20	Z1 22BK	GROUND
21	Z1 22BK	GROUND
22	Z1 18BK	GROUND
23	Z1 20BK	GROUND
24	Z1 22BK	GROUND
25	Z1 22BK	GROUND
26	-	-
27	Z1 18BK	GROUND
28	Z1 18BK	GROUND



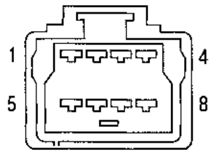
JOINT CONNECTOR NO. 2 (IN PDC)

CAV	CIRCUIT	FUNCTION
1	A2 14PK/BK	FUSED B(+)
2	A2 14PK/BK	FUSED B(+)
3	A2 14PK/BK	FUSED B(+)
4	V5 16DG	WIPER SWITCH MODE SENSE
5	V5 16DG	WIPER SWITCH MODE SENSE
6	V5 16DG	WIPER SWITCH MODE SENSE
7	A142 14DG/OR*	AUTO SHUT DOWN RELAY OUTPUT
7	T40 14BR**	STARTER RELAY OUTPUT
8	A142 14DG/OR*	AUTO SHUT DOWN RELAY OUTPUT
8	T40 14BR**	STARTER RELAY OUTPUT
9	A142 14DG/OR*	AUTO SHUT DOWN RELAY OUTPUT
9	T40 14BR**	STARTER RELAY OUTPUT
10	A14 16RD/WT	FUSED B(+)
11	-	-
12	A14 16RD/WT	FUSED B(+)
12	A14 16RD/WT	FUSED B(+)
13	A14 16RD/WT	FUSED B(+)
14	A14 16RD/WT	FUSED B(+)
15	A6 12RD/OR	FUSED B(+)
16	A6 12RD/OR	FUSED B(+)
17	A6 12RD/OR	FUSED B(+)
18	A6 12RD/OR	FUSED B(+)

* GAS
** DIESEL

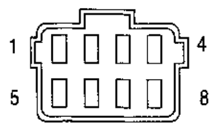
J988W-9 BR008038

AUTHENTIC RESTORATION PRODUCT



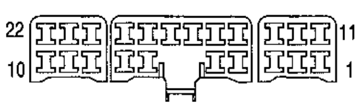
JOINT CONNECTOR NO. 3

CAV	CIRCUIT	FUNCTION
1	Z1 20BK	GROUND
2	Z1 20BK	GROUND
3	G107 20BK/GY	4WD SENSE
4	G107 20BK/GY	4WD SENSE
5	Z1 18BK	GROUND
6	Z1 18BK	GROUND
7	G107 20BK/GY	4WD SENSE
8	-	-



JOINT CONNECTOR NO. 4

CAV	CIRCUIT	FUNCTION
1	Z1 18BK	GROUND
2	Z1 18BK	GROUND
3	Z1 18BK	GROUND
4	Z1 20BK	GROUND
5	Z1 18BK	GROUND
6	Z1 20BK	GROUND
7	Z1 20BK	GROUND
8	Z1 20BK	GROUND



JOINT CONNECTOR NO. 5

CAV	CIRCUIT	FUNCTION
1	Z3 20BK/OR	GROUND
2	Z3 18BK/OR	GROUND
3	Z3 22BK/OR	GROUND
4		
5	M1 20PK	FUSED B(+)
6	M1 20PK	FUSED B(+)
7	M1 22PK	FUSED B(+)
8	E2 22OR	PANEL LAMPS FEED
9	E2 22OR	PANEL LAMPS FEED
10	-	-
11	Z3 18BK/OR	GROUND
12	Z3 22BK/OR	GROUND
13	Z3 22BK/OR	GROUND
14	M1 22PK	FUSED B(+)
15	M1 22PK	FUSED B(+)
16	M1 22PK	FUSED B(+)
17	-	-
18	-	-
19	-	-
20	E2 22OR	PANEL LAMPS FEED
21	E2 22OR	PANEL LAMPS FEED
22	E2 22OR	PANEL LAMPS FEED

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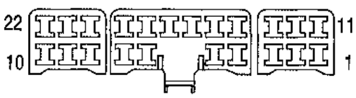
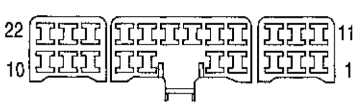


JOINT CONNECTOR NO. 6

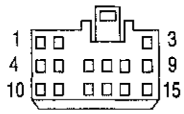
CAV	CIRCUIT	FUNCTION
1	D21 20PK/DB	SCI TRANSMIT
2	D21 20PK/DB	SCI TRANSMIT
3	D21 20PK/DB	SCI TRANSMIT
4	G75 22TN	LEFT DOOR AJAR SWITCH SENSE
5	G75 22TN	LEFT DOOR AJAR SWITCH SENSE
6	M2 20YL	COURTESY LAMP SWITCH OUTPUT
7	M2 22YL	COURTESY LAMP SWITCH OUTPUT
8	G26 22LB	KEY-IN IGN. SWITCH SENSE
9	G26 22LB	KEY-IN IGN. SWITCH SENSE
10	G26 22LB	KEY-IN IGN. SWITCH SENSE
11	G11 20WT/LG	PARKING BRAKE SWITCH SENSE
12	G11 22WT/LG	PARKING BRAKE SWITCH SENSE
13	G11 22WT/LG	PARKING BRAKE SWITCH SENSE
14	G75 22TN	LEFT DOOR AJAR SWITCH SENSE
15	G75 22TN	LEFT DOOR AJAR SWITCH SENSE
16	-	-
17	-	-
18	M2 20YL	COURTESY LAMP SWITCH OUTPUT
19	M2 22YL	COURTESY LAMP SWITCH OUTPUT
20	X3 22BK/RD	HORN RELAY CONTROL
21	X3 22BK/RD	HORN RELAY CONTROL
22	X3 22BK/RD	HORN RELAY CONTROL



JOINT CONNECTOR NO. 7

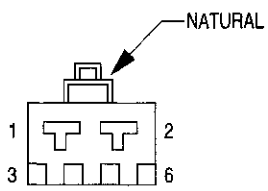
CAV	CIRCUIT	FUNCTION
1	D1 18VT/BR	CCD BUS(+)
2	D1 18VT/BR	CCD BUS(+)
3	D1 20VT/BR	CCD BUS(+)
4	D2 18WT/BK	CCD BUS(-)
5	D2 18WT/BK	CCD BUS(-)
6	D2 20WT/BK	CCD BUS(-)
7	D2 20WT/BK	CCD BUS(-)
8	D1 20VT/BR	CCD BUS(+)
9	D1 20VT/BR	CCD BUS(+)
10	D1 20VT/BR	CCD BUS(+)
11	D1 20VT/BR	CCD BUS(+)
12	D1 20VT/BR	CCD BUS(+)
13	D1 20VT/BR	CCD BUS(+)
14	D2 20WT/BK	CCD BUS(-)
15	D2 20WT/BK	CCD BUS(-)
16	D2 20WT/BK	CCD BUS(-)
17	-	-
18	-	-
19	-	-
20	-	-
21	-	-
22	-	-

AUTHENTIC RESTORATION PRODUCT



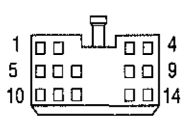
JUNCTION BLOCK - C1

CAV	CIRCUIT	FUNCTION
1	M2 20YL	DOOR LATCH SWITCH SENSE
2	G31 20VT/LG	AMBIENT TEMPERATURE SENSOR SIGNAL
3	A20 20RD/DB	FUSED B(+)
4	L61 18LG	LEFT TURN SIGNAL
5	V6 16DB	FUSED IGN. (RUN-ACC)
6	-	-
7	-	-
8	-	-
9	L7 18BK/YL	PARK LAMP RELAY OUTPUT
10	F18 20LG/BK	FUSED IGN. (ST-RUN)
11	L1 18VT/BK	BACK-UP LAMP FEED
12	V6 16DB	FUSED IGN. (RUN-ACC)
13	V6 16DB	FUSED IGN. (RUN-ACC)
14	G32 20BK/VT	SENSOR GROUND
15	-	-



JUNCTION BLOCK - C2

CAV	CIRCUIT	FUNCTION
1	A7 10RD/BK	FUSED B(+)
2	L9 16BK/VT	FUSED FLASHER FEED
3	M1 20PK	FUSED B(+)
4	M1 20PK	FUSED B(+)
5	L60 18TN	RIGHT TURN SIGNAL
6	-	-



JUNCTION BLOCK - C3

CAV	CIRCUIT	FUNCTION
1	G32 22BK/LB	SENSOR GROUND
2	Z2 20BK/LG	GROUND
3	M2 22YL	COURTESY LAMP DRIVER
4	-	-
5	G31 22VT/LG	ATC BLOWER MODULE (-)
6	M1 20PK	FUSED B(+)
7	-	-
8	L7 18BK/YL •	PARK LAMP RELAY OUTPUT
	L7 20BK/YL	PARK LAMP RELAY OUTPUT
9	E2 22OR	PANEL LAMPS FEED
10	-	-
11	L1 22VT/BK	BACK-UP LAMP FEED
12	-	-
13	Z4 18BK	GROUND
14	F12 20DB/WT	FUSED IGN. (ST-RUN)

• CLEARANCE AND ID LAMPS

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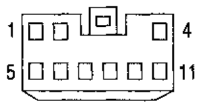
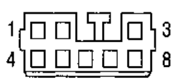


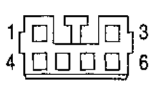
JUNCTION BLOCK - C4

CAV	CIRCUIT	FUNCTION
1	F14 18LG/YL	FUSED IGN. (ST-RUN)
2	F23 18DB/YL	FUSED IGN. (RUN)
3	X12 18RD/WT	FUSED IGN. (RUN-ACC)
4	L61 18LG	LEFT TURN SIGNAL
5	F12 22DB/WT	FUSED IGN. (ST-RUN)
6	F12 22DB/WT	FUSED IGN. (ST-RUN)
7	-	-
8	F12 22DB/WT	FUSED IGN. (ST-RUN)
9	E1 18TN	PANEL LAMPS DIMMER SWITCH SIGNAL
10	-	-
11	-	-



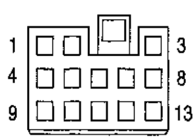
JUNCTION BLOCK - C5

CAV	CIRCUIT	FUNCTION
1	V6 16DB	FUSED IGN. (RUN-ACC)
2	L61 18LG	LEFT TURN SIGNAL
3	X60 16DG/RD	RADIO 12 VOLT SUPPLY
4	V6 16DB	FUSED IGN. (RUN-ACC)
5	-	-
6	M2 22YL	COURTESY LAMPS SWITCH OUTPUT
7	E2 22OR	FUSED PANEL LAMPS DIMMER SWITCH SIGNAL
8	G5 22DB/WT	FUSED IGN. (ST-RUN)



JUNCTION BLOCK - C6

CAV	CIRCUIT	FUNCTION
1	F33 14PK/RD	FUSED IGN. (ST-RUN)
2	-	-
3	-	-
4	L19 16PK	HAZARD FLASHER SIGNAL
5	-	-
6	L10 18BR/LG	BACK-UP LAMP FEED



JUNCTION BLOCK - C7

CAV	CIRCUIT	FUNCTION
1	L60 18TN	RIGHT TURN SIGNAL
2	-	-
3	Z3 18BK/WT	GROUND
4	L60 18TN	RIGHT TURN SIGNAL
5	L7 18BK/YL	PARK LAMP RELAY OUTPUT
6	L7 18BK/YL	PARK LAMP RELAY OUTPUT
7	-	-
8	Z2 22BK/LG	GROUND
9	M1 22PK	FUSED B(+)
10	F35 22RD	FUSED B(+)
11	F35 22RD	FUSED B(+)
12	-	-
13	L6 16RD/GY	FLASHER OUTPUT

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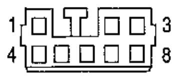
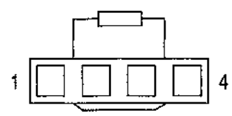


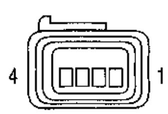
JUNCTION BLOCK - C8

CAV	CIRCUIT	FUNCTION
1	F30 18RD/OR	FUSED IGN. (RUN-ACC)
2	-	-
3	F13 18DB	FUSED IGN. (RUN-ACC)
4	F73 20YL	FUSED IGN. (ST-RUN)
5	-	-
6	-	-
7	F37 16RD/LB	FUSED HEADLAMP SWITCH OUTPUT
8	F21 16TN	FUSED IGN. (RUN)



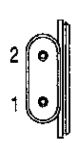
JUNCTION BLOCK - C9

CAV	CIRCUIT	FUNCTION
1	A31 10BK/WT	IGN. SWITCH OUTPUT (RUN-ACC)
2	A21 10DB	IGN. SWITCH OUTPUT (ST-RUN)
3	A22 14BK/OR	IGN. SWITCH OUTPUT (RUN)
4	F15 18DB	FUSED IGN. (RUN)



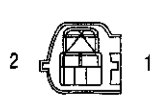
LEAK DETECTION PUMP

CAV	CIRCUIT	FUNCTION
1	-	-
2	F12 20DB/WT	FUSED IGN. (ST-RUN)
3	K106 18WT/DG	LEAK DETECTION PUMP SOLENOID CONTROL
4	K107 18OR	LEAK DETECTION PUMP SWITCH SENSE



LEFT BACK-UP LAMP

CAV	CIRCUIT	FUNCTION
1	Z13 18BK	GROUND
2	L1 18VT/BK	BACK-UP LAMPS FEED



LEFT DOOR DISARM SWITCH

CAV	CIRCUIT	FUNCTION
1	Z2 20BK/LG	GROUND
2	G73 20LG/OR	LEFT DOOR KEY CYLINDER SWITCH SENSE

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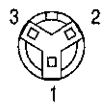
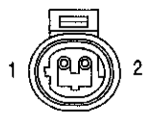
LEFT DOOR JAMB SWITCH (CTM)

CAV	CIRCUIT	FUNCTION
1	Z2 18BK/LG	GROUND
2	G75 18TN	LEFT DOOR AJAR SWITCH SENSE



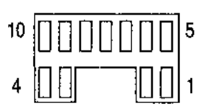
LEFT DOOR JAMB SWITCH (IEM)

CAV	CIRCUIT	FUNCTION
1	Z2 18BK/LG	GROUND
2	G75 18TN	LEFT DOOR AJAR SWITCH SENSE
3	M2 18YL	DOOR LATCH SWITCH SENSE



LEFT DOOR LOCK MOTOR

CAV	CIRCUIT	FUNCTION
1	P34 20PK/BK	DOOR UNLOCK DRIVER
2	P33 20OR/BK	DOOR LOCK DRIVER



LEFT DOOR WINDOW/LOCK SWITCH

CAV	CIRCUIT	FUNCTION
1	Q16 16BR/WT	WINDOW SWITCH RIGHT FRONT UP
2	Q26 16VT/WT	WINDOW SWITCH RIGHT FRONT DOWN
3	Z2 16BK/LG	GROUND
4	Q21 16WT	LEFT FRONT WINDOW DRIVER DOWN
5	F21 16TN	FUSED IGN. (RUN-ON)
6	Q11 16LB	LEFT FRONT WINDOW DRIVER UP
7	P36 20PK/VT	DOOR UNLOCK SWITCH SENSE
8	P35 20OR/VT	DOOR LOCK SWITCH SENSE
9	Z2 20BK/LG	GROUND
10	F35 20RD	FUSED B(+)

LEFT FOG LAMP

CAV	CIRCUIT	FUNCTION
1	Z1 20BK	GROUND
2	L39 20LB	FRONT FOG LAMP SWITCH OUTPUT

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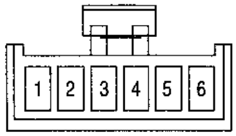
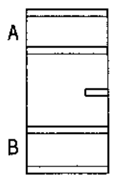


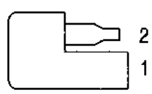
LEFT FRONT DOOR SPEAKER (PREMIUM)

CAV	CIRCUIT	FUNCTION
1	X53 18DG	LEFT FRONT SPEAKER (+)
2	Z9 16BK/VT	GROUND
3	X83 20YL/RD	AMPLIFIED LEFT INSTRUMENT PANEL (+)
4	X55 18BR/RD	LEFT FRONT SPEAKER (-)
5	X13 16BK/RD	RADIO CHOKE OUTPUT
6	X81 20YL/BK	AMPLIFIED LEFT INSTRUMENT PANEL (-)



LEFT FRONT DOOR SPEAKER (STANDARD)

CAV	CIRCUIT	FUNCTION
A	X55 18BR/RD	LEFT DOOR SPEAKER (-)
B	X53 18DG	LEFT DOOR SPEAKER (+)

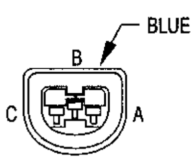


LEFT FRONT FENDER LAMP (DUAL REAR WHEELS)

CAV	CIRCUIT	FUNCTION
1	Z13 18BK	GROUND
2	L7 18BK/YL	PARK LAMP SWITCH OUTPUT

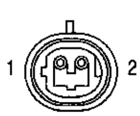
LEFT FRONT WHEEL SPEED SENSOR (ABS)

CAV	CIRCUIT	FUNCTION
1	B8 20RD/GY	LEFT FRONT WHEEL SPEED SENSOR (-)
2	B9 20RD	LEFT FRONT WHEEL SPEED SENSOR (+)



LEFT HEADLAMP

CAV	CIRCUIT	FUNCTION
A	Z1 20BK	GROUND
B	L4 16VT/WT	DIMMER SWITCH LOW BEAM OUTPUT
C	L3 16RD/OR	DIMMER SWITCH HIGH BEAM OUTPUT



LEFT LICENSE LAMP

CAV	CIRCUIT	FUNCTION
1	Z13 18BK	GROUND
2	L7 18BK/YL	PARK LAMP SWITCH OUTPUT

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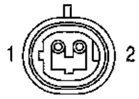
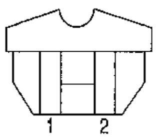


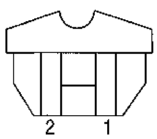
LEFT LICENSE LAMP (DUAL REAR WHEELS)

CAV	CIRCUIT	FUNCTION
1	L7 18BK/YL	PARK LAMP SWITCH OUTPUT
2	Z13 18BK	GROUND



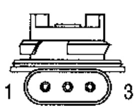
LEFT OUTBOARD CLEARANCE LAMP

CAV	CIRCUIT	FUNCTION
1	L7 18BK/YL	PARK LAMP SWITCH OUTPUT
2	Z4 18BK	GROUND



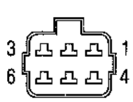
LEFT OUTBOARD IDENTIFICATION LAMP

CAV	CIRCUIT	FUNCTION
1	L7 18BK/YL	PARK LAMP SWITCH OUTPUT
2	Z4 18BK	GROUND



LEFT PARK/ TURN SIGNAL LAMP

CAV	CIRCUIT	FUNCTION
1	Z1 18BK	GROUND
2	L7 18BK/YL	PARK LAMP SWITCH OUTPUT
3	L61 18LG/TN	LEFT TURN SIGNAL



LEFT POWER MIRROR MOTORS

CAV	CIRCUIT	FUNCTION
1	P71 22YL	LEFT POWER MIRROR LEFT MOVEMENT
2	P75 22DB/WT	LEFT POWER MIRROR UP MOVEMENT
3	P73 22YL/PK	LEFT POWER MIRROR RIGHT/DOWN MOVEMENT
4	C16 20LB/YL	REAR DEFOGGER LAMP DRIVER
5	Z2 20BK/LG	GROUND
6	-	-

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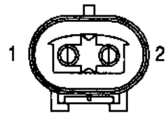
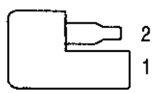


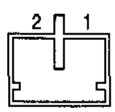
LEFT POWER WINDOW MOTOR

CAV	CIRCUIT	FUNCTION
1	Q11 16LB	POWER WINDOW UP CONTROL
2	Q21 16WT	POWER WINDOW DOWN CONTROL



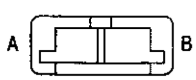
LEFT REAR FENDER LAMP (DUAL REAR WHEELS)

CAV	CIRCUIT	FUNCTION
1	Z13 18BK	GROUND
2	L7 18BK/YL	PARK LAMP SWITCH OUTPUT



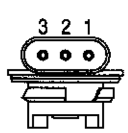
LEFT REAR SPEAKER (PREMIUM)

CAV	CIRCUIT	FUNCTION
1	X57 18BR/LB	LEFT REAR SPEAKER (-)
2	X51 18BR/YL	LEFT REAR SPEAKER (+)



LEFT REAR SPEAKER (STANDARD)

CAV	CIRCUIT	FUNCTION
A	X57 18BR/LB	LEFT REAR SPEAKER (-)
B	X51 18BR/YL	LEFT REAR SPEAKER (+)



LEFT TAIL/ STOP/TURN SIGNAL LAMP

CAV	CIRCUIT	FUNCTION
1	Z13 18BK	GROUND
2	L7 18BK/YL	PARK LAMP SWITCH OUTPUT
3	L63 16DG/RD	LEFT REAR TURN SIGNAL

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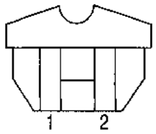
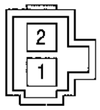


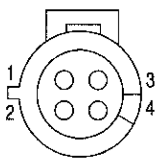
LEFT TAILGATE LAMP (DUAL REAR WHEELS)

CAV	CIRCUIT	FUNCTION
1	Z13 18BK	GROUND
2	L7 18BK/YL	PARK LAMP SWITCH OUTPUT



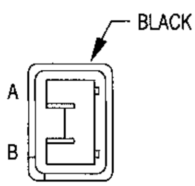
LEFT TWEETER (PREMIUM)

CAV	CIRCUIT	FUNCTION
1	X81 20YL/BK	AMPLIFIED LEFT INSTUMENT PANEL SPEAKER(-)
2	X83 20YL/RD	AMPLIFIED LEFT INSTRUMENT PANEL SPEAKER(+)



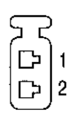
LEFT UPSTREAM HEATED OXYGEN SENSOR (5.9L (HD)/8.0L)

CAV	CIRCUIT	FUNCTION
1	A141 18DG/WT	AUTO SHUT DOWN RELAY OUTPUT
2	Z11 18BK/WT	GROUND
3	K4 18BK/LB	SENSOR GROUND
4	K41 18OR/BK	LEFT UPSTREAM HEATED OXYGEN SENSOR SIGNAL
4	K41 18BK/DG*	LEFT UPSTREAM HEATED OXYGEN SENSOR SIGNAL



LEFT VISOR/ VANITY LAMP

CAV	CIRCUIT	FUNCTION
A	M1 20PK	FUSED B(+)
B	Z4 20BK	GROUND



LOW NOTE HORN

CAV	CIRCUIT	FUNCTION
1	X2 18DG/RD	HORN RELAY OUTPUT
2	Z1 18BK	GROUND

* 8.0L

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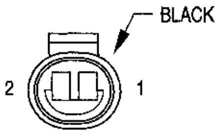
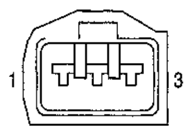


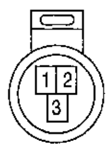
LOW WASHER FLUID SWITCH

CAV	CIRCUIT	FUNCTION
1	G29 18BK/WT	WASHER FLUID SWITCH SENSE
2	Z1 18BK	GROUND



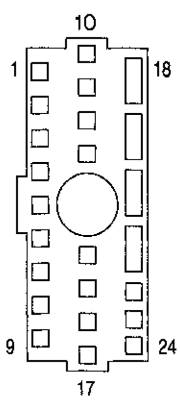
MANIFOLD ABSOLUTE PRESSURE SENSOR (3.9L/5.2L/5.9L)

CAV	CIRCUIT	FUNCTION
1	K4 20BK/LB	SENSOR GROUND
2	K1 18DG/RD	MAP SENSOR SIGNAL
3	K6 20VT/WT	5V SUPPLY



MANIFOLD ABSOLUTE PRESSURE SENSOR (8.0L)

CAV	CIRCUIT	FUNCTION
1	K4 20BK/LB	SENSOR GROUND
2	K6 18VT/WT	MAP SENSOR SIGNAL
3	K1 18DG/RD	5V SUPPLY



MULTI-FUNCTION SWITCH

CAV	CIRCUIT	FUNCTION
1	V9 16WT/DB	WIPER SWITCH MODE SIGNAL
2	V8 16VT	WIPER SWITCH MODE SIGNAL
3	V10 16BR	WIPER SWITCH MODE SIGNAL
4	V6 16DB	FUSED IGN. (RUN-ACC)
5	V4 16RD/YL	WIPER SWITCH HIGH SPEED OUTPUT
6	V3 18BR/WT	WIPER SWITCH LOW SPEED OUTPUT
7	V49 16RD/BK	WIPER PARK SWITCH SENSE
8	V49 16RD/BK	WIPER SWITCH DELAY OUTPUT
9	V3 16BR/WT	WIPER SWITCH LOW SPEED OUTPUT
10	-	-
11	L60 18TN	RIGHT TURN SIGNAL
12	L62 16BR/RD	RIGHT REAR TURN SIGNAL
13	L19 16PK	HAZARD FLASHER OUTPUT
14	L50 16WT/TN	STOP LAMP SWITCH OUTPUT
15	L63 16DG/RD	LEFT REAR TURN SIGNAL
16	L61 18LG	LEFT TURN SIGNAL
17	L6 16RD/GY	TURN SIGNAL FLASHER OUTPUT
18	L4 16VT/WT	DIMMER SWITCH LOW BEAM OUTPUT
19	L2 16LG	HEADLAMP SWITCH OUTPUT
20	L3 16RD/OR	DIMMER SWITCH HIGH BEAM OUTPUT
21	L11 16LG/BK	FLASH TO PASS CONTROL
22	-	-
23	-	-
24	-	-

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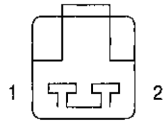
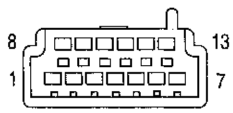


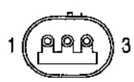
OVERDRIVE SWITCH

CAV	CIRCUIT	FUNCTION
1	T6 22OR/WT	TRANSMISSION OVERDRIVE SWITCH SENSE
2	Z2 22BK/LG	GROUND



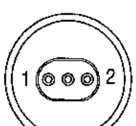
OVERHEAD CONSOLE

CAV	CIRCUIT	FUNCTION
1	E2 22OR	FUSED PANEL LAMPS DIMMER SWITCH SIGNAL
2	L7 20BK/YL	PARK LAMP SWITCH OUTPUT
2	L7 18BK/YL*	PARK LAMP SWITCH OUTPUT
3	-	-
4	G32 22BK/LB	SENSOR GROUND
5	G31 22VT/LG	AMBIENT TEMPERATURE SENSOR SIGNAL
6	M2 22YL	COURTESY LAMPS DRIVER
7	F12 20DB/WT	FUSED IGN. (ST-RUN)
8	-	-
9	Z2 20BK/LG	GROUND
10	-	-
11	Z4 18BK	GROUND
12	-	-
13	M1 18PK	VISOR/VANITY LAMPS SWITCH



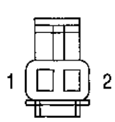
OVERHEAD MAP/COURTESY LAMP

CAV	CIRCUIT	FUNCTION
1	Z4 18BK	GROUND
2	M2 22YL	COURTESY LAMPS DRIVER
3	M1 20PK	FUSED B(+)



PARK/NEUTRAL POSITION SWITCH (ATX)

CAV	CIRCUIT	FUNCTION
1	L10 18BR/LG	FUSED IGN. SWITCH OUTPUT
2	T41 18BK/WT	PARK/NEUTRAL POSITION SWITCH SENSOR
3	L1 18VT/BK	BACK-UP LAMP SWITCH OUTPUT



PASSENGER AIRBAG

CAV	CIRCUIT	FUNCTION
1	R42 18BK/YL	PASSENGER AIRBAG LINE 1
2	R44 18DG/YL	PASSENGER AIRBAG LINE 2

* CLEARANCE AND I.D. LAMPS

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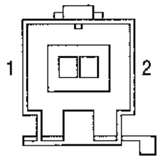
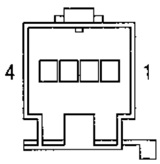


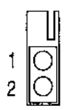
PASSENGER AIRBAG DISARM SWITCH - C1

CAV	CIRCUIT	FUNCTION
1	F14 18LG/YL	FUSED IGN. (ST-RUN)
2	Z2 18BK/TN	GROUND



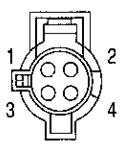
PASSENGER AIRBAG DISARM SWITCH - C2

CAV	CIRCUIT	FUNCTION
1	R142 18BK/YL	PASSENGER SQUIB LINE 2
2	R144 18DG/YL	PASSENGER SQUIB LINE 1
3	R42 18BK/YL	PASSENGER SQUIB LINE 2
4	R44 18DG/YL	PASSENGER SQUIB LINE 1



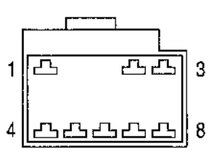
PASSENGER SEAT SOLENOID

CAV	CIRCUIT	FUNCTION
1	Z2 18BK/LG	GROUND
2	R8 18OR/RD	SIGNAL FROM SCTM



POST CATALYST HEATED OXYGEN SENSOR (8.0L/CAL.)

CAV	CIRCUIT	FUNCTION
1	A141 18DG/WT	AUTO SHUT DOWN RELAY OUTPUT
2	Z11 18BK/WT	GROUND
3	K4 18BK/LB	SENSOR GROUND
4	K341 18OR/BK	POST CATALYST HEATED OXYGEN SENSOR SIGNAL



POWER MIRROR SWITCH

CAV	CIRCUIT	FUNCTION
1	P71 22YL	POWER MIRROR LEFT CONTROL
2	P75 22DB/WT	POWER MIRROR UP CONTROL
3	P73 22YL/PK	POWER MIRROR RIGHT/DOWN CONTROL
4	P72 22YL/BK	POWER MIRROR UP CONTROL
5	P74 22DB	POWER MIRROR LEFT CONTROL
6	P70 22WT	POWER MIRROR RIGHT/DOWN CONTROL
7	M1 22PK	FUSED B(+)
8	Z2 20BK/LG	GROUND

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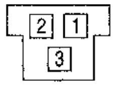
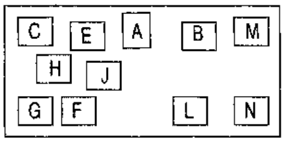


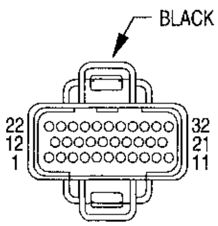
POWER OUTLET

CAV	CIRCUIT	FUNCTION
1	A12 16RD/TN	POWER OUTLET FEED
2	-	-
3	Z3 16BK/OR	GROUND



POWER SEAT SWITCH

CAV	CIRCUIT	FUNCTION
A	F37 14RD/LB	FUSED B(+)
B	Z3 14BK/OR	GROUND
C	-	-
D	-	-
E	P11 14YL/WT	POWER SEAT REAR UP
F	-	-
G	-	-
H	-	-
I	-	-
J	P13 14RD/WT	POWER SEAT REAR DOWN
K	P17 14DB/RD	POWER SEAT HORIZONTAL BACKWARD
L	P15 14YL/LB	POWER SEAT HORIZONTAL FORWARD
M	P19 14YL/LG	POWER SEAT FRONT UP
N	P21 14RD/LG	POWER SEAT FRONT DOWN



POWERTRAIN CONTROL MODULE - C1 (3.9L/5.2L/5.9L)

CAV	CIRCUIT	FUNCTION
1	-	-
2	F18 18LG/BK	FUSED IGN. (ST-RUN)
3	-	-
4	K4 18BK/LB	SENSOR GROUND
5	-	-
6	T41 18BK/WT	PARK/NEUTRAL POSITION SWITCH SENSE
7	K19 16BK/GY	IGN. COIL NO. 1 DRIVER
7	K19 16BK/GY	IGN. COIL NO. 1 DRIVER
8	K24 18GY/BK	CRANK POSITION SENSOR SIGNAL
9	-	-
10	K60 18YL/BK	IDLE AIR CONTROL NO. 2 DRIVER
11	K40 18BR/WT	IDLE AIR CONTROL NO. 3 DRIVER
12	-	-
13	G113 18OR	PTO SWITCH SENSE
14		
15	K21 18BK/RD	INTAKE AIR TEMPERATURE SIGNAL
16	K2 18TN/BK	ENGINE COOLANT TEMPERATURE SENSOR SIGNAL
17	K6 18VT/WT	5 VOLT SUPPLY
18	K44 18TN/YL	CAMSHAFT POSITION SENSOR SIGNAL
19	K39 18GY/RD	IDLE AIR CONTROL NO. 1 DRIVER
20	K59 18VT/BK	IDLE AIR CONTROL NO. 4 DRIVER
21	-	-
22	A14 16RD/WT	FUSED B(+)
23	K22 18OR/DB	THROTTLE POSITION SENSOR SIGNAL
24	K141 18TN/WT	UPSTREAM HEATED OXYGEN SENSOR SIGNAL
24	K41 18OR/BK*	DOWNSTREAM HEATED OXYGEN SENSOR SIGNAL
25	K341 18OR/BK	DOWNSTREAM HEATED OXYGEN SENSOR SIGNAL
26	K241 18LG/RD	UPSTREAM HEATED OXYGEN SENSOR SIGNAL
27	K1 18DG/RD	MAP SENSOR SIGNAL
28	-	-
29	-	-
30	-	-
31	Z12 14BK/TN	GROUND
32	Z12 14BK/TN	GROUND

* HEAVY DUTY

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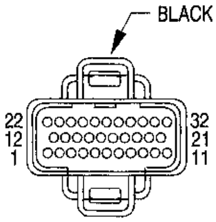

POWERTRAIN CONTROL MODULE - C1 (8.0L)

CAV	CIRCUIT	FUNCTION
1	K32 18YL/GY	IGN. COIL NO. 4 DRIVER
2	F18 18LG/BK	FUSED IGN. (ST-RUN
3	K18 18RD/BK	IGN. COIL NO. 3 DRIVER
4	K4 18BK/LB	SENSOR GROUND
5	K43 18DG/GY	IGN. COIL NO. 5 DRIVER
6	T41 18BK/WT	PARK/NEUTRAL POSITION SWITCH SENSE
7	K19 16BK/GY	IGN. COIL NO. 1 DRIVER
8	K24 18GY/BK	CRANK POSITION SENSOR SIGNAL
9	K17 18DB/WT	IGN. COIL NO. 2 DRIVER
10	K60 18YL/BK	IDLE AIR CONTROL NO. 2 DRIVER
11	K40 18BR/WT	IDLE AIR CONTROL NO. 3 DRIVER
12	-	-
13	G113 18OR	PTO SWITCH SENSE
14	-	-
15	K21 18BK/RD	INTAKE AIR TEMPERATURE SIGNAL
16	K2 18TN/BK	ENGINE COOLANT TEMPERATURE SENSOR SIGNAL
17	K6 18VT/WT	5 VOLT SUPPLY
18	K44 18TN/YL	CAMSHAFT POSITION SENSOR SIGNAL
19	K39 18GY/RD	IDLE AIR CONTROL NO. 1 DRIVER
20	K59 18VT/BK	IDLE AIR CONTROL NO. 4 DRIVER
21	-	-
22	A14 16RD/WT	FUSED B(+)
23	K22 18OR/DB	THROTTLE POSITION SENSOR SIGNAL
24	K41 18BK/DG	DOWNSTREAM HEATED OXYGEN SENSOR SIGNAL
25	K341 18OR/BK	DOWNSTREAM HEATED OXYGEN SENSOR SIGNAL
26	K241 18LG/RD	UPSTREAM HEATED OXYGEN SENSOR SIGNAL
27	K1 18DG/RD	MAP SENSOR SIGNAL
28	-	-
29	K141 18TN/WT	UPSTREAM HEATED OXYGEN SENSOR SIGNAL
30	-	-
31	Z12 14BK/TN	GROUND
32	Z12 14BK/TN	GROUND

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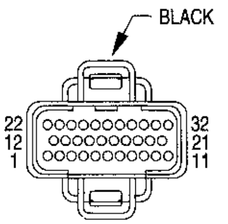
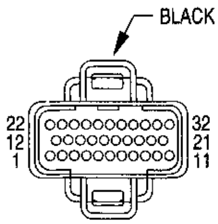


POWERTRAIN CONTROL MODULE - C1 (DIESEL)

CAV	CIRCUIT	FUNCTION
1	-	-
2	F18 18LG/BK	FUSED IGN. (ST-RUN)
3	-	-
4	K4 18BK/LB	SENSOR GROUND
5	-	-
6	T41 18BK/WT	PARK/NEUTRAL POSITION SENSOR SIGNAL
7	S21 18YL/BK	AIR INTAKE HEATER RELAY NO. 1 CONTROL
8	K24 18GY/BK	ENGINE SPEED SENSOR SIGNAL
9	S22 18OR/BK	AIR INTAKE HEATER RELAY NO. 1 CONTROL
10	-	-
11	-	-
12	-	-
13	-	-
14	-	-
15	K21 16BK/RD	INTAKE AIR TEMPERATURE SENSOR SIGNAL
16	K2 18TN/BK	ENGINE COOLANT TEMPERATURE SENSOR SIGNAL
17	K6 18VT/WT	5 VOLT SUPPLY
18	-	-
19	-	-
20	-	-
21	-	-
22	A14 14RD/WT	FUSED B(+)
23	K22 18OR/DB	THROTTLE POSITION SENSOR SIGNAL
24	-	-
25	-	-
26	-	-
27	K1 18DG/RD	WATER IN-FUEL SENSOR SIGNAL
28	-	-
29	-	-
30	-	-
31	Z12 14BK/TN	GROUND
32	Z12 14BK/TN	GROUND



POWERTRAIN CONTROL MODULE - C2 (3.9L/5.2L/5.9L)

CAV	CIRCUIT	FUNCTION
1	T54 18VT	TRANSMISSION TEMPERATURE SENSOR SIGNAL
2	K26 18VT/TN	INJECTOR NO. 7 DRIVER
3	-	-
4	K11 18WT/DB	INJECTOR NO. 1 DRIVER
5	K13 18YL/WT	INJECTOR NO. 3 DRIVER
6	K38 18GY*	INJECTOR NO. 5 DRIVER
6	K38 18GY**	INJECTOR NO. 7 DRIVER
7	-	-
8	K88 18VT/WT	VARIBLE FORCE SOLENOID
9	-	-
10	K20 18DG	GENERATOR FEILD DRIVER
11	K54 18OR/BK	TORQUE CONVERTOR CLUTCH SOLENOID/RELAY CONTROL
12	K58 18BR/DB	INJECTOR NO. 6 DRIVER
13	K28 18GY/LB	INJECTOR NO. 8 DRIVER
14	-	-
15	K12 18TN	INJECTOR NO. 2 DRIVER
16	K14 18LB/BR	INJECTOR NO. 4 DRIVER
17	-	-
18	-	-
19	-	-
20	-	-
21	T60 18BR	OVERDRIVE SOLENOID CONTROL
22	-	-
23	G60 18GY/OR	ENGINE OIL PRESSURE SENSOR SIGNAL
24	-	-
25	T13 18DB/BK	SPEED SENSOR GROUND
26	-	-
27	G7 18WT/OR	VEHICLE SPEED SENSOR SIGNAL
28	T14 18LG/BK	OUTPUT SPEED SENSOR SIGNAL
29	T25 18LG/WT	GOVERNOR PRESSURE SIGNAL
30	K30 18PK	TRANSMISSION RELAY CONTROL
31	K7 18OR	5 VOLT SUPPLY
32	-	-

* 3.9L
** 5.2L/5.9L/5.9L H/D

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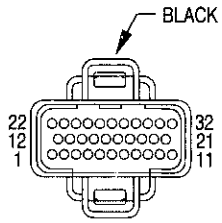
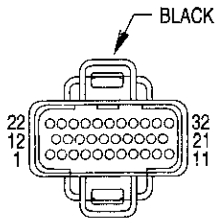


POWERTRAIN CONTROL MODULE - C2 (8.0L)

CAV	CIRCUIT	FUNCTION
1	T54 18VT	TRANSMISSION TEMPERATURE SENSOR SIGNAL
2	K26 18VT/TN	INJECTOR NO. 7 DRIVER
3	K115 18TN/BK	INJECTOR NO. 2 DRIVER
4	K11 18WT/DB	INJECTOR NO. 1 DRIVER
5	K13 18YL/WT	INJECTOR NO. 3 DRIVER
6	K38 18GY	INJECTOR NO. 5 DRIVER
7	-	-
8	K88 18VT/WT	VARIABLE FORCE SOLENOID
9	-	-
10	K20 18DG	GENERATOR FIELD DRIVER
11	K54 18OR/BK	TORQUE CONVERTOR CLUTCH SOLENOID/RELAY CONTROL
12	K58 18BR/DB	INJECTOR NO. 6 DRIVER
13	K28 18GY/LB	INJECTOR NO. 8 DRIVER
14	K116 18WT	INJECTOR NO. 10 DRIVER
15	K12 18TN	INJECTOR NO. 2 DRIVER
16	K14 18LB/BR	INJECTOR NO. 4 DRIVER
17	-	-
18	-	-
19	-	-
20	-	-
21	T60 18BR	SOLENOID NO. 2 CONTROL
22	-	-
23	G60 18GY/OR	ENGINE OIL PRESSURE SENSOR SIGNAL
24	-	-
25	T13 18DB/BK	SHAFT SPEED SIGNAL (-)
26	-	-
27	G7 18WT/OR	VEHICLE SPEED SENSOR SIGNAL
28	T14 18LG/BK	OUTPUT SPEED SENSOR SIGNAL
29	T25 18LG/WT	GOVERNOR PRESSURE SIGNAL
30	K30 18PK	TRANSMISSION RELAY CONTROL
31	K7 18OR	5 VOLT SUPPLY
32	-	-



POWERTRAIN CONTROL MODULE - C2 (DIESEL)

CAV	CIRCUIT	FUNCTION
1	T54 18VT	TRANSMISSION TEMPERATURE SENSOR SIGNAL
2	-	-
3	-	-
4	-	-
5	-	-
6	-	-
7	-	-
8	K88 18VT/WT	TRANSMISSION VARIBLE FORCE SOLENOID
9	-	-
10	K20 18DG	GENERATOR FIELD DRIVER
11	K54 18OR/BK	TORQUE CONVERTOR CLUTCH SOLENOID/RELAY CONTROL
12	-	-
13	-	-
14	-	-
15	-	-
16	-	-
17	-	-
18	-	-
19	-	-
20	G85 18OR/BK	WAIT-TO-START WARNING LAMP DRIVER
21	T60 18BR	SOLENOID NO. 2 CONTROL
22	-	-
23	G60 18GY/OR	ENGINE OIL PRESSURE SENSOR SIGNAL
24	-	-
25	T13 18DB/BK	SHAFT SPEED SIGNAL(-)
26	-	-
27	C7 18WT/OR	VEHICLE SPEED SENSOR SIGNAL
28	T14 18LG/BK	OUTPUT SPEED SENSOR SIGNAL
29	T25 18LG/WT	GOVERNOR PRESSURE SIGNAL
30	K30 18PK	TRANSMISSION RELAY CONTROL
31	K7 18OR	5 VOLT SUPPLY
32	K35 18GY/YL	EGR SOLENOID CONTROL

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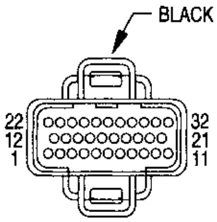

POWERTRAIN CONTROL MODULE - C3 (3.9L/5.2L/5.9L)

CAV	CIRCUIT	FUNCTION
1	C13 18DB/OR	A/C COMPRESSOR CLUTCH RELAY CONTROL
2	-	-
3	K51 18DB/YL	AUTO SHUT DOWN RELAY CONTROL
4	V36 18TN/RD	SPEED CONTROL VACUUM SOLENOID CONTROL
5	V35 18LG/RD	SPEED CONTROL VENT SOLENOID CONTROL
6	T18 18LG/OR	OVERDRIVE LAMP DRIVER
7	-	-
8	-	-
9	-	-
10	K106 18WT/DG	LEAK DETECTION PUMP SOLENOID CONTROL
11	V32 18YL/RD	SPEED CONTROL ON/OFF SWITCH SENSE
12	A142 14DG/OR	AUTO SHUT DOWN RELAY OUTPUT
13	T6 18OR/WT	TRANSMISSION O/D SWITCH SENSE
14	K107 18OR	LEAK DETECTION PUMP SWITCH SENSE
15	K118 18PK/YL	BATTERY TEMPERATURE SENSOR SIGNAL
16	-	-
17	-	-
18	-	-
19	K31 18BR/WT	FUEL PUMP RELAY CONTROL
20	K52 18PK/WT	EVAPORATIVE EMISSION SOLENOID CONTROL
21	-	-
22	C20 18BR	A/C SWITCH SENSE
23	C90 18LG/WT	A/C SELECT INPUT
24	V40 18WT/PK	BRAKE SWITCH SENSE
25	T125 18DB	GENERATOR SOURCE
26	K226 18DB/WT	FUEL LEVEL SENSOR
27	D21 18PK/DB	SCI TRANSMIT
28	D2 18WT/BK	CCD BUS(-)
29	D20 18DG	SCI RECIEVE
30	D1 18VT/BR	CCD BUS (+)
31	-	-
32	V37 18RD/LG	SPEED CONTROL SWITCH SIGNAL

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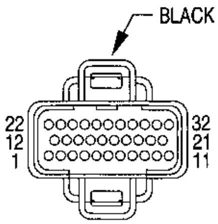

POWERTRAIN CONTROL MODULE - C3 (8.0L)

CAV	CIRCUIT	FUNCTION
1	C13 18DB/OR	A/C COMPRESSOR CLUTCH RELAY CONTROL
2	-	-
3	K51 18DB/YL	AUTO SHUTDOWN RELAY CONTROL
4	V36 18TN/RD	SPEED CONTROL VACUUM SOLENOID CONTROL
5	V35 18LG/RD	SPEED CONTROL VENT SOLENOID CONTROL
6	T18 18LG/OR	OVERDRIVE LAMP DRIVER
7	-	-
8	-	-
9	-	-
10	K106 18WT/DG	LEAK DETECTION PUMP SOLENOID CONTROL
11	V32 18YL/RD	SPEED CONTROL ON/OFF SWITCH SENSE
12	A142 14DG/OR	AUTO SHUTDOWN RELAY OUTPUT
13	T6 22OR/WT	TRANSMISSION O/D SWITCH SENSE
14	K107 18OR	LEAK DETECTION PUMP SWITCH SENSE
15	K118 18PK/YL	BATTERY TEMPERATURE SENSOR SIGNAL
16	-	-
17	-	-
18	-	-
19	K31 18BR/WT	FUEL PUMP RELAY CONTROL
20	K52 18PK/WT	EVAPORATIVE EMISSION SOLENOID CONTROL
21	-	-
22	C20 18BR	A/C SWITCH SENSE
23	C90 18LG/WT	A/C SELECT INPUT
24	V40 18WT/PK	BRAKE SWITCH SENSE
25	T125 18DB	GENERATOR SOURCE
26	K226 18DB/WT	FUEL LEVEL SENSOR
27	D21 18PK/DB	SCI TRANSMIT
28	D2 18WT/BK	CCD BUS(-)
29	D20 18DG	SCI RECIEVE
30	D1 18VT/BR	CCD BUS(+)
31	-	-
32	V37 18RD/LG	SPEED CONTROL SWITCH SIGNAL

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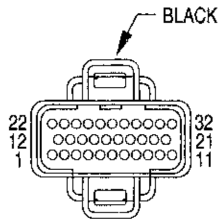
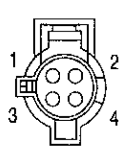


POWERTRAIN CONTROL MODULE - C3 (DIESEL)

CAV	CIRCUIT	FUNCTION
1	C13 18DB/OR	A/C COMPRESSOR CLUTCH RELAY CONTROL
2	-	-
3	K51 18DB/YL	AUTO SHUTDOWN RELAY CONTROL
4	V36 18TN/RD	SPEED CONTROL VACUUM SOLENOID CONTROL
5	V35 18LG/RD	SPEED CONTROL VENT SOLENOID CONTROL
6	T18 18LG/OR	OVERDRIVE LAMP DRIVER
7	-	-
8	-	-
9	-	-
10	-	-
11	V32 18YL/RD	SPEED CONTROL ON/OFF SWITCH SENSE
12	F18 18LG/BK	FUSED IGN. (ST-RUN)
13	T6 20OR/WT	TRANSMISSION O/D SWITCH SENSE
14	-	-
15	K118 18PK/YL	BATTERY TEMPERATURE SENSOR SIGNAL
16	-	-
17	-	-
18	-	-
19	-	-
20	-	-
21	-	-
22	C20 18BR	A/C SWITCH SENSE
23	C90 18LG	A/C SELECT INPUT
24	V40 18WT/PK	BRAKE SWITCH SENSE
25	T125 18WT/DB	GENERATOR SOURCE
26	K226 18DB/WT	FUEL LEVEL SENSOR
27	D21 18PK/DB	SCI TRANSMIT
28	D2 18WT/BK	CCD BUS (-)
29	D220 18DG	SCI RECEIVE
30	D1 18VT/BR	CCD BUS(+)
31	-	-
32	V37 18RD/LG	SPEED CONTROL SWITCH SIGNAL



PRE-CATALYST HEATED OXYGEN SENSOR (8.0L/CAL.)

CAV	CIRCUIT	FUNCTION
1	A141 18DG/WT	AUTO SHUT DOWN RELAY OUTPUT
2	Z11 18BK/WT	GROUND
3	K4 18BK/LB	SENSOR GROUND
4	K141 18TN/WT	PRE-CATALYST HEATED OXYGEN SENSOR SIGNAL

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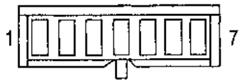
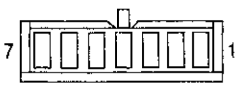


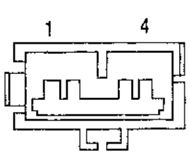
RADIO - C1

CAV	CIRCUIT	FUNCTION
1	-	-
2	X55 18BR/RD	LEFT FRONT DOOR SPEAKER (-)
3	X56 18DB/RD	RIGHT FRONT DOOR SPEAKER (-)
4	L7 18BK/YL	PARK LAMP SWITCH OUTPUT
5	E2 22OR	FUSED PANEL LAMPS DIMMER SWITCH SIGNAL
6	X12 18RD/WT	FUSED IGN. (RUN-ACC)
7	M1 22PK	FUSED B(+)



RADIO - C2

CAV	CIRCUIT	FUNCTION
1	X16 22LG	POWER ANTENNA RELAY OUTPUT
2	X51 18BR/YL	LEFT REAR SPEAKER (+)
3	X52 18DB/WT	RIGHT REAR SPEAKER (+)
4	X53 18DG	LEFT FRONT DOOR SPEAKER (+)
5	X54 18VT	RIGHT FRONT DOOR SPEAKER (+)
6	X57 18BR/LB	LEFT REAR SPEAKER (-)
7	X58 18DB/OR	RIGHT REAR SPEAKER (-)



RADIO CHOKE RELAY

CAV	CIRCUIT	FUNCTION
1	X60 16DG/RD	RADIO 12 VOLT OUTPUT
2	X13 16BK/RD	PREMIUM SPEAKER AMPLIFIER
3	X16 22LG	POWER ANTENNA RELAY OUTPUT
4	Z9 16BK/VT	GROUND

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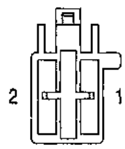
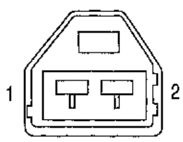


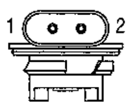
REAR VERTICAL SEAT MOTOR

CAV	CIRCUIT	FUNCTION
1	P11 14YL/WT	POWER SEAT REAR UP
2	P13 14RD/WT	POWER SEAT REAR DOWN



REAR WHEEL SPEED SENSOR (ABS)

CAV	CIRCUIT	FUNCTION
1	B114 20WT/VT	RIGHT REAR WHEEL SPEED SENSOR (-)
2	B113 20RD/YL	RIGHT REAR WHEEL SPEED SENSOR (+)

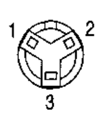


RIGHT BACK-UP LAMP

CAV	CIRCUIT	FUNCTION
1	Z13 18BK	GROUND
2	L1 18VT/BK	BACK-UP LAMP SWITCH OUTPUT

RIGHT DOOR DISARM SWITCH

CAV	CIRCUIT	FUNCTION
1	Z2 20BK/LG	GROUND
2	G73 20LG/OR	LEFT DOOR KEY CYLINDER SWITCH SENSE



RIGHT DOOR JAMB SWITCH

CAV	CIRCUIT	FUNCTION
1	Z2 18BK/LG	GROUND
2	M2 18YL*	COURTESY LAMPS DRIVER
2	G16 18BK/LB	DOOR JAMB SWITCH SENSE
3	G74 18TN/RD	SEATBELT CONTROL MODULE

* BASE

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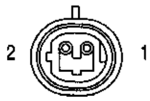
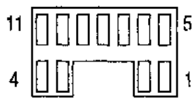


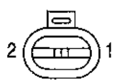
RIGHT DOOR LOCK MOTOR

CAV	CIRCUIT	FUNCTION
1	P34 20PK/BK	DOOR UNLOCK DRIVER
2	P33 20OR/BK	DOOR LOCK DRIVER



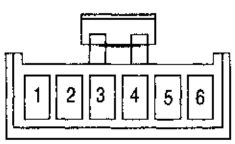
RIGHT DOOR WINDOW/LOCK SWITCH

CAV	CIRCUIT	FUNCTION
1	Q16 14BR/WT	MASTER WINDOW SWITCH RIGHT FRONT UP
2	Q26 14VT/WT	MASTER WINDOW SWITCH RIGHT FRONT DOWN
3	Q22 14VT	RIGHT FRONT WINDOW DRIVER DOWN
4	Q12 14BR	RIGHT FRONT WINDOW DRIVER UP
5	F35 20RD	FUSED B(+)
6	P35 20OR/VT	DOOR LOCK SWITCH OUTPUT (LOCK)
7	P30 20OR/DG	POWER DOOR LOCK MOTOR B(+) LOCK
8	Z2 14/BK/LG	GROUND
9	P31 20PK/DG	POWER DOOR LOCK MOTOR B(+) UNLOCK
10	P36 20PK/VT	POWER LOCK SWITCH OUTPUT (UNLOCK)
11	F21 14TN	FUSED IGN. (RUN)



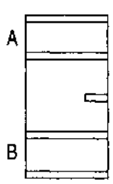
RIGHT FOG LAMP

CAV	CIRCUIT	FUNCTION
1	Z1 20BK	GROUND
2	L39 20LB	FRONT FOG LAMP SWITCH OUTPUT



RIGHT FRONT DOOR SPEAKER (PREMIUM)

CAV	CIRCUIT	FUNCTION
1	X54 18VT	RIGHT DOOR SPEAKER (+)
2	Z9 16BK/VT	GROUND
3	X82 20LB/RD	AMPLIFIED RIGHT DOOR SPEAKER (+)
4	X56 18DB/RD	RIGHT DOOR SPEAKER (-)
5	X13 16BK/RD	PREMIUM SPEAKER AMPLIFIER
6	X80 20LB/BK	AMPLIFIED RIGHT DOOR SPEAKER (-)



RIGHT FRONT DOOR SPEAKER (STANDARD)

CAV	CIRCUIT	FUNCTION
A	X56 18DB/RD	RIGHT DOOR SPEAKER (-)
B	X54 18VT	RIGHT DOOR SPEAKER (+)

RIGHT FRONT FENDER LAMP (DUAL REAR WHEELS)

CAV	CIRCUIT	FUNCTION
1	Z13 18BK	GROUND
2	L7 18BK/YL	PARK LAMP SWITCH OUTPUT

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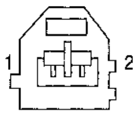
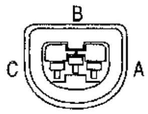


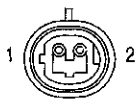
RIGHT FRONT WHEEL SPEED SENSOR (ABS)

CAV	CIRCUIT	FUNCTION
1	B6 20WT/DB	RIGHT FRONT WHEEL SPEED SENSOR (-)
2	B7 20WT	RIGHT FRONT WHEEL SPEED SENSOR (+)



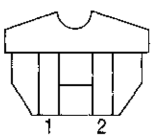
RIGHT HEADLAMP

CAV	CIRCUIT	FUNCTION
A	Z1 20BK	GROUND
B	L4 16VT/WT	DIMMER SWITCH LOW BEAM OUTPUT
C	L3 16RD/OR	DIMMER SWITCH HIGH BEAM OUTPUT



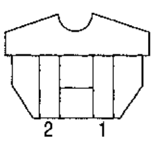
RIGHT LICENSE LAMP

CAV	CIRCUIT	FUNCTION
1	Z13 18BK	GROUND
2	L7 18BK/YL	PARK LAMP SWITCH OUTPUT



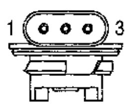
RIGHT OUTBOARD CLEARANCE LAMP

CAV	CIRCUIT	FUNCTION
1	L7 18BK/YL	PARK LAMP SWITCH OUTPUT
2	Z4 18BK	GROUND



RIGHT OUTBOARD IDENTIFICATION LAMP

CAV	CIRCUIT	FUNCTION
1	L7 18BK/YL	PARK LAMP SWITCH OUTPUT
2	Z4 18BK	GROUND



RIGHT PARK/ TURN SIGNAL LAMP

CAV	CIRCUIT	FUNCTION
1	Z1 18BK	GROUND
2	L7 18BK/YL	PARK LAMP SWITCH OUTPUT
3	L60 LG/TN	RIGHT TURN SIGNAL

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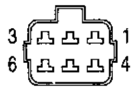
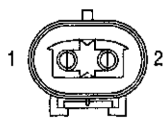


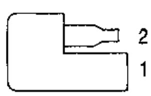
RIGHT POWER MIRROR MOTORS

CAV	CIRCUIT	FUNCTION
1	P74 20DB	POWER MIRROR LEFT CONTROL
2	P70 20WT	POWER MIRROR RIGHT/DOWN CONTROL
3	P72 20YL/BK	POWER MIRROR UP CONTROL
4	C16 20LB/YL	REAR DEFOGGER LAMP DRIVER
5	Z2 20BK/LG	GROUND
6	-	-



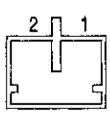
RIGHT POWER WINDOW MOTOR

CAV	CIRCUIT	FUNCTION
1	Q12 14BR	POWER WINDOW UP CONTROL
2	Q22 14VT	POWER WINDOW DOWN CONTROL



RIGHT REAR FENDER LAMP (DUAL REAR WHEELS)

CAV	CIRCUIT	FUNCTION
1	Z13 18BK	GROUND
2	L7 18BK/YL	PARK LAMP SWITCH OUTPUT



RIGHT REAR SPEAKER (PREMIUM)

CAV	CIRCUIT	FUNCTION
1	X58 18DB/OR	RIGHT REAR SPEAKER (-)
2	X52 18DB/WT	RIGHT REAR SPEAKER (+)

RIGHT REAR SPEAKER (STANDARD)

CAV	CIRCUIT	FUNCTION
A	X58 18DB/OR	RIGHT REAR SPEAKER (-)
B	X52 18DB/WT	RIGHT REAR SPEAKER (+)

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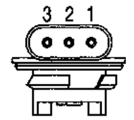
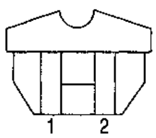


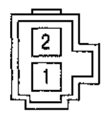
RIGHT TAIL/ STOP/TURN SIGNAL LAMP

CAV	CIRCUIT	FUNCTION
1	Z13 18BK	GROUND
2	L7 18BK/YL	PARK LAMP SWITCH OUTPUT
3	L62 16BR/RD	RIGHT REAR TURN SIGNAL



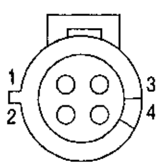
RIGHT TAILGATE LAMP (DUAL REAR WHEELS)

CAV	CIRCUIT	FUNCTION
1	Z13 18BK	GROUND
2	L7 18BK/YL	PARK LAMP SWITCH OUTPUT



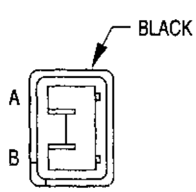
RIGHT TWEETER (PREMIUM)

CAV	CIRCUIT	FUNCTION
1	X80 20LB/BK	RIGHT DOOR SPEAKER (-)
2	X82 20LB/RD	RIGHT DOOR SPEAKER (+)



RIGHT UPSTREAM HEATED OXYGEN SENSOR (5.9L (HD)/ 8.0L)

CAV	CIRCUIT	FUNCTION
1	A141 18DG/WT	AUTO SHUT DOWN RELAY OUTPUT
2	Z11 18BK/WT	GROUND
3	K4 18BK/LB	SENSOR GROUND
4	K241 18LG/RD	RIGHT UPSTREAM HEATED OXYGEN SENSOR SIGNAL
4	K141 18TN/WT*	RIGHT UPSTREAM HEATED OXYGEN SENSOR SIGNAL



RIGHT VISOR/VANITY LAMP

CAV	CIRCUIT	FUNCTION
A	M1 20PK	FUSED B(+)
B	Z4 20BK	GROUND

* 8.0L

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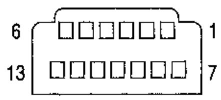
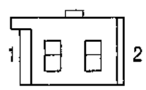


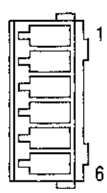
SEATBELT CONTROL MODULE

CAV	CIRCUIT	FUNCTION
1	-	-
2	G75 18TN	LEFT DOOR AJAR SWITCH SENSE
3	G74 18TN/RD	RIGHT DOOR AJAR SWITCH SENSE
4	F13 18DB	FUSED IGN. (RUN-ACC)
5	M1 18PK	FUSED B(+)
6	-	-
7	R7 18OR/BK	LEFT SEATBELT SOLENOID SIGNAL FROM (SBCM)
8	R8 18OR/RD	RIGHT SEATBELT SOLENOID SIGNAL FROM (SBCM)
9	-	-
10	-	-
11	G111 18LG/BK	SBCM FAULT INDICATOR
12	-	-
13	Z16 18BK/PK	GROUND



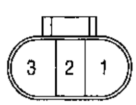
SEATBELT SWITCH

CAV	CIRCUIT	FUNCTION
1	G10 20LG/RD	SEATBELT SWITCH SENSE
2	F12 18DB/WT	FUSED IGN. (ST-RUN)



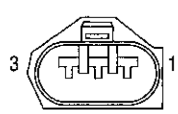
STOP LAMP SWITCH

CAV	CIRCUIT	FUNCTION
1	V40 22WT/PK	BRAKE SWITCH SENSE
2	Z2 22BK/LG	GROUND
3	V32 22YL/RD	SPEED CONTROL FEED
4	V30 22DB/RD	SPEED CONTROL ON/OFF SWITCH OUTPUT
5	L50 16WT/TN	STOP LAMP SWITCH OUTPUT
6	F32 16PK/DB	FUSED B(+)



THROTTLE POSITION SENSOR (DIESEL)

CAV	CIRCUIT	FUNCTION
1	K4 20BK/LB	SENSOR GROUND
2	K22 18OR/DB	THROTTLE POSITION SENSOR SIGNAL
3	K6 20VT/WT	5 VOLT SUPPLY



THROTTLE POSITION SENSOR (GAS)

CAV	CIRCUIT	FUNCTION
1	K6 20VT/WT	5 VOLT OUTPUT
2	K22 18OR/DB	THROTTLE POSITION SENSOR SIGNAL
3	K4 18BK/LB	5 VOLT SUPPLY

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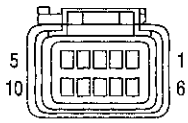
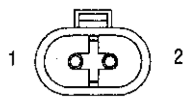


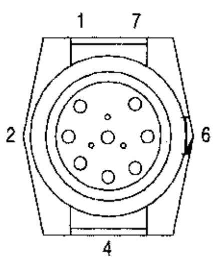
TRAILER TOW CONNECTOR

CAV	CIRCUIT	FUNCTION
1	-	-
2	L62 16BR/PK	RIGHT TURN SIGNAL
3	L1 18VT/BK	BACK-UP LAMP FEED
4	A6 14RD/TN	FUSED B(+)
5	L76 14BK/OR	TRAILER TOW RELAY OUTPUT
6	-	-
7	B40 14LB	TRAILER TOW BRAKE B(+)
8	Z13 14BK	GROUND
9	-	-
10	L63 16DG/RD	LEFT TURN SIGNAL



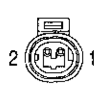
TRANSMISSION OUTPUT SHAFT SPEED SENSOR

CAV	CIRCUIT	FUNCTION
1	T14 18LG/BK	OUTPUT SHAFT SPEED SENSOR SIGNAL
2	T13 18DB/BK	OUTPUT SHAFT SPEED SENSOR GROUND



TRANSMISSION SOLENOID ASSEMBLY

CAV	CIRCUIT	FUNCTION
1	T16 18RD	TRANS CONTROL RELAY OUTPUT
2	K7 18OR	5V SUPPLY
3	K4 18BK/LB	SENSOR GROUND
4	T25 18LG/WT	GOVENOR PRESSURE SIGNAL
5	K88 18VT/WT	VARIBLE FORCE SOLENOID CONTROL
6	T60 18BR	OVERDRIVE SOLENOID CONTROL
7	K54 18OR/BK	TORQUE CONVERTOR CLUTCH SOLENOID CONTROL
8	T54 18VT	TRANS TEMPERATURE SENSOR SIGNAL



UNDERHOOD LAMP

CAV	CIRCUIT	FUNCTION
1	Z1 20BK	GROUND
2	M1 20PK	FUSED B(+)

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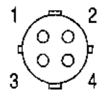
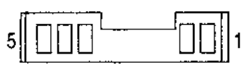


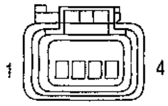
UPSTREAM HEATED OXYGEN SENSOR

CAV	CIRCUIT	FUNCTION
1	A141 18DG/WT	AUTO SHUT DOWN RELAY OUTPUT
2	Z11 18BK/WT	GROUND
3	K4 18BK/LB	SENSOR GROUND
4	K141 18TN/WT	UPSTREAM HEATED OXYGEN SENSOR SIGNAL



VEHICLE SPEED CONTROL/HORN SWITCH

CAV	CIRCUIT	FUNCTION
1	V37 22RD/LG	SPEED CONTROL SWITCH SIGNAL
2	-	-
3	K4 22BK/LB	SENSOR GROUND
4	-	-
5	X3 22BK/RD	HORN RELAY CONTROL



VEHICLE SPEED CONTROL SERVO

CAV	CIRCUIT	FUNCTION
1	V36 20TN/RD	SPEED CONTROL VACUUM SOLENOID CONTROL
2	V35 20LG/RD	SPEED CONTROL VENT SOLENOID CONTROL
3	V30 20DB/RD	SPEED CONTROL ON/OFF SWITCH OUTPUT
4	Z1 20BK	GROUND

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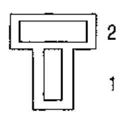
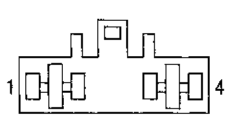
WATER IN FUEL SENSOR (DIESEL)

CAV	CIRCUIT	FUNCTION
1	K1 18DG/RD	WATER IN FUEL SENSOR SIGNAL
2	K4 20BK/LB	SENSOR GROUND



WINDSHIELD WASHER PUMP MOTOR

CAV	CIRCUIT	FUNCTION
1	V10 16BR	WASHER PUMP CONTROL SWITCH OUTPUT
2	Z1 20BK	GROUND



WIPER MOTOR

CAV	CIRCUIT	FUNCTION
1	V4 16RD/YL	WIPER SWITCH HIGH SPEED OUTPUT
2	V5 16DG	WIPER SWITCH MODE SENSE
3	V6 16DB	FUSED IGN. SWITCH OUTPUT
4	V3 16BR/WT	WIPER SWITCH LOW SPEED OUTPUT

8W-90 CONNECTOR LOCATIONS

DESCRIPTION AND OPERATION

INTRODUCTION

This section provides illustrations identifying component and connector locations in the vehicle. A connector index is provided. Use the wiring diagrams in each section for connector number identification. Refer to the index for the proper figure number.

CONNECTOR/GROUND LOCATIONS

For items that are not shown in this section, N/S is placed in the Fig. column.

Connector Name/Number	Color	Location	Fig.
A/C Compressor Clutch	BK	Rear of A/C Compressor	4, 5, 6
A/C Heater Control Switch	BK	Rear of HVAC Switch	25
A/C High Pressure Switch	BK	At A/C Compressor	4, 5, 6
A/C Low Pressure Switch	BK	A/C Low Pressure Cut-Out Switch	1, 2
Airbag Control Module		Center of I.P. at Airbag Control Module	23
Ambient Temperature Sensor	BK	Radiator Left Support	15
Ash Receiver Lamp		Behind Ash Receiver	25, 26
Backup Lamp Switch	BK	Top of Transmission	13
Battery Temperature Sensor	BK	Below Battery Tray	16
Blower Motor	BK	Bottom Right of I.P.	23
Blower Motor Resistor Block	BK	Below I.P., Right Side	23, 26
Brake Pressure Switch		At Master Cylinder	14
Bypass Jumper	GN	Top Of Clutch Pedal	
C105		Rear of Front Bumper	
C106	BK	On Front Axle	17
C114			
C119		Near Power Distribution Center	14
C125	BK	Left Side of Dash Panel	
C126	GY	Left Side of Dash Panel	
C128	BK	Above Left Front Body Cushion	15
C129	BK	Above Left Front Body Cushion	15
C130		Headlamp and Dash to Engine at Power Distribution Center	N/S
C132		Clutch Switch Jumper	N/S
C134		Left Cowl	23, 25
C183		To Center High Mounted Lamp Jumper	14
C203		Left Cowl	23, 25
C204		Left Cowl	25
C205		To Airbag Squib	23, 24
C237	BK	Bottom Right of I.P.	26
C303		Below Driver's Seat	N/S
C308		Center Rear of Headliner	N/S
C329	BK	Below Right Tail Lamp	21

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DESCRIPTION AND OPERATION (Continued)

Connector Name/Number	Color	Location	Fig.
C333	BK	Below Left Tail Lamp	21
C342	BK	Left Rear of Frame	21
C343	BK	Left Rear of Frame	21
C345		Right Door	N/S
C346		Right Door	N/S
C347		Left Door	N/S
C348		Left Door	N/S
C352	BK	Left A-Pillar	N/S
C353	BK	Right A-Pillar	N/S
C360		To Body Wiring	N/S
C361		To Body Wiring	N/S
C363		To Passenger Seat Jumper	N/S
C364		Rear Speakers	N/S
Camshaft Position Sensor		Rear of Distributor	6
Cargo Lamp No. 1	BK	Rear of Lamp	N/S
Cargo Lamp No. 2	BK	Rear of Lamp	N/S
Center High Mounted Stop Lamp No. 1	BK	Rear of Lamp	18
Center High Mounted Stop Lamp No. 2	BK	Rear of Lamp	18
Center Identification Lamp		Behind Front of Headliner	N/S
Central Timer Module		Left Side Under Instrument Panel	23, 24
Cigar Lighter Illumination		Behind Cigar Lighter Lamp	23, 25
Clockspring		Steering Column	24
Clutch Pedal Position Switch		Top of Clutch Pedal	N/S
Controller Anti-Lock Brake C1		At Controller, Anti-Lock Brakes	14

Connector Name/Number	Color	Location	Fig.
Controller Anti-Lock Brake C2		At Controller, Anti-Lock Brakes	14
Crankshaft Position Sensor		Rear of Engine Block V6-V8 Right Side of Engine Block V10	3, 6
Cup Holder Lamp		At Cup Holder	25, 26
Data Link Connector	BL	Left Bottom of I.P.	23
Day/Night Mirror		Day/Night Mirror	N/S
Daytime Running Lamp Module	BK	Left Fender Side Shield	14
Distributor		At Distributor	3
Dome Lamp		Behind Dome Lamp	18
Downstream Heated Oxygen Sensor	BK	At Sensor	N/S
Driver Airbag		Driver Airbag	N/S
Driver Seat Solenoid		Drivers Seat	N/S
Duty Cycle EVAP/Purge Solenoid	BK	Rear of Intake Manifold	17
Electric Brake		Trailer Tow	N/S
Engine Coolant Temperature Sensor (Diesel)	BK	Left Rear of Cylinder Head (Diesel)	11
Engine Coolant Temperature Sensor (Gas)	BK	On Thermostat Housing	3, 6
Engine Oil Pressure Sensor	BK	Near Distributor V6-V8 Near Oil Filter V10 Left Side of Engine Diesel	3, 10
Engine Speed Sensor (Diesel)	BK	Front of Engine (Diesel)	12
Exhaust Gas Recirculation Solenoid		On EGR Solenoid	6,12

AUTHENTIC RESTORATION PRODUCT

DESCRIPTION AND OPERATION (Continued)

Connector Name/Number	Color	Location	Fig.
Front Vertical Seat Motor		Under Seat	N/S
Fuel Heater (Diesel)		Above Engine Starter Motor	10
Fuel Injector #1	BK	At Fuel Injector	4, 5
Fuel Injector #2	BK	At Fuel Injector	4, 5
Fuel Injector #3	BK	At Fuel Injector	4, 5, 6
Fuel Injector #4	BK	At Fuel Injector	4, 5, 6
Fuel Injector #5	BK	At Fuel Injector	4, 5, 6
Fuel Injector #6	BK	At Fuel Injector	4, 5, 6
Fuel Injector #7	BK	At Fuel Injector	4, 6
Fuel Injector #8	BK	At Fuel Injector	4, 6
Fuel Injector #9	BK	At Fuel Injector	6
Fuel Injector #10	BK	At Fuel Injector	6
Fuel Pump Module	GY	Top of Fuel Tank	N/S
Fuel Shut Down Relay	BK	On Dash Panel, Near Master Cylinder	2
Fuel Shut Down Solenoid	BK	Near Rear of Injection Pump	11, 12
G100		Left Fender Side Shield	16
G101		Left Fender Side Shield	16
G102		Left Fender Side Shield (RWAL Ground)	N/S
G103		Near Wiper Motor (Wiper Motor Ground)	14
G104		Near Generator (Generator Ground)	8
G105		Front of Engine (Engine Ground)	4, 5, 6, 9
G106		Front of Engine (Fuel Shut Down Solenoid Ground)	N/S
G200		Left Cowl	23, 24
G201		I. P. Right Center Support	23

Connector Name/Number	Color	Location	Fig.
G300		Lower Rear Cab	18
G301		Below Left Rear Speaker	18
G302		At Overhead Console	20
Generator	BK	Front of Engine	7, 8
Headlamp Switch C1	BK	Near Headlamp Switch	23, 24, 26
Headlamp Switch C2	GY	Rear of Headlamp Switch	23, 24, 26
Heated Mirror Switch			N/S
High Note Horn		Front Bumper Left Support	17
Horizontal Seat Motor		At Seat	18
Idle Air Control	BK	On Throttle Body	9
Ignition Coil	GY	Right Front of Engine	4, 5, 9
Ignition Coil 4 Pack	BK	Right Side of Engine	9
Ignition Coil 6 Pack	BK	Right Side of Engine	9
Ignition Switch C1		Steering Column	24
Ignition Switch C2		Steering Column	24
Instrument Cluster C1		Rear of Instrument Cluster	N/S
Instrument Cluster C2		At Instrument Cluster	N/S
Intake Air Heater	BK	At Intake Heater	12
Intake Air Heater Relay No. 1			N/S
Intake Air Heater Relay No. 2			N/S
Intake Air Temperature Sensor (Diesel)			11

DESCRIPTION AND OPERATION (Continued)

Connector Name/Number	Color	Location	Fig.
Intake Air Temperature Sensor (Gas)	GY	Below Left Side of Intake Manifold V10	4, 5, 6
Integrated Electronic Module			N/S
Intermittent Wiper Control Module	BK	Top Center of I.P.	N/S
Joint Connector No. 1			N/S
Joint Connector No. 2			N/S
Joint Connector No. 3			N/S
Joint Connector No. 4			N/S
Joint Connector No. 5			24
Joint Connector No. 6			24
Joint Connector No. 7			24
Junction Block C1			23
Junction Block C2			23
Junction Block C3			23
Junction Block C4			23
Junction Block C5			23
Junction Block C6			23
Junction Block C7			23
Junction Block C8			23
Junction Block C9			23
Leak Detection Pump			17
Left Airbag Sensor		Left Fender Side Shield	N/S
Left Back-Up Lamp		Rear of Lamp	N/S

Connector Name/Number	Color	Location	Fig.
Left Door Disarm Switch			19
Left Door Jamb Switch	BK	Rear of Left Door Jamb Switch	N/S
Left Fog Lamp	BK	Rear of Fog Lamp	N/S
Left Front Door Speaker (Premium)	BK	Left Door	19
Left Front Door Speaker (Standard)	BK	Left Door	19
Left Front Fender Lamp			N/S
Left Front Wheel Speed Sensor	BK	Left Fender Side Shield	14
Left Headlamp	BK	At Headlamp	N/S
Left License Lamp	BK	Left License Lamp	21
Left Outboard Clearance Lamp	BK	Behind Front of Headliner	N/S
Left Outboard Identification Lamp	BK	Behind Front of Headliner	N/S
Left Park/Turn Signal Lamp	BK	At Lamp	N/S
Left Power Door Lock Motor	BK	Left Door	19
Left Power Door Lock/Window Lift Switch		Left Door	19
Left Power Mirror Motors	BK	Left Door	N/S
Left Power Mirror Switch			19
Left Power Window Motor	BK	Left Door	19
Left Rear Fender Lamp	BK	Rear of Lamp	N/S
Left Rear Speaker			18
Left Tail/Stop and Turn Signal LampLamp	BK	Rear of Lamp	21

AUTHENTIC RESTORATION PRODUCT

DESCRIPTION AND OPERATION (Continued)

Connector Name/Number	Color	Location	Fig.
Left Tailgate Lamp	BK	Rear of Lamp	N/S
Left Tweeter			N/S
Left Upstream Heated Oxygen Sensor	BK	At Sensor	N/S
Left Visor/Vanity Lamp	BK	Left A-Pillar	N/S
Low Note Horn		Front Bumper Left Support	17
Low Washer Fluid Switch	BK	Side of Washer Fluid Reservoir	16
Manifold Absolute Pressure Sensor	BK	On Throttle Body	4, 5
Multi-Function Switch		On Steering Column	24
Overdrive Switch		Rear of Overdrive Switch	24
Overhead Console	BK	Behind lkFront of Headliner	20
Overhead Map/Courtesy Lamp		In Overhead Console	20′
Park/Neutral Position Switch	BK	Left Side of Transmission	13
Passenger Airbag			23, 26
Passenger Airbag Disarm Switch			N/S
Post Catalyst Heated Oxygen Sensor	BK	At Sensor	13
Power Outlet	BK	Center of I.P.	23, 25
Power Seat Switch		Left Side of Driver's Seat	N/S
Powertrain Control Module C1		At Powertrain Control Module	1, 2
Powertrain Control Module C2		At Powertrain Control Module	1, 2
Powertrain Control Module C3		At Powertrain Control Module	1, 2

Connector Name/Number	Color	Location	Fig.
Pre-Catalyst Heated Oxygen Sensor	BK	At Sensor	N/S
Radio C1	GY	Rear of Radio	25
Radio C2	BK	Rear of Radio	25
Radio Choke Relay	BK	I.P. Center Support	23
Rear Wheel Speed Sensor	BK	Left Frame Rail, Near Fuel Tank	21, 22
Rear/Vertical Seat Motor		Below Driver's Seat	N/S
Right Tweeter			N/S
Right Back-Up Lamp	BK	Rear of Lamp	N/S
Right Door Disarm Switch			N/S
Right Door Jamb Switch	BK	Rear of Right Door Jamb Switch	N/S
Right Fog Lamp	BK	Rear of Fog Lamp	N/S
Right Forward Fender Lamp	BK	Rear of Lamp	N/S
Right Front Door Speaker(Premium	BK	Right Door	N/S
Right Front Door Speaker(Standard	BK	Right Door	N/S
Right Front Fender Lamp			N/S
Right Front Wheel Speed Sensor	BK	Right Fender Side Shield	17
Right Headlamp	BL	At Headlamp	N/S
Right License Lamp	BK	At Rear Bumper	21
Right Outboard Clearance Lamp	BK	Behind Front of Headliner	20
Right Outboard Identification Lamp	BK	Behind Front of Headliner	N/S
Right Park/Turn Signal Lamp	BK	At Lamp	N/S

DESCRIPTION AND OPERATION (Continued)

Connector Name/Number	Color	Location	Fig.
Right Power Door Lock Motor	BK	Right Door	N/S
Right Power Door Lock/ Window Lift Switch	BK	Right Door	N/S
Right Power Mirror Motors	BK	Right Door	N/S
Right Power Window Motor	RD	Right Door	N/S
Right Rear Fender Lamp			N/S
Right Rear Speaker			18
Right Tail/Stop and Turn Signal Lamp	BK	Rear of Lamp	21
Right Tailgate Lamp	BK	Rear of Lamp	N/S
Right Upstream Heated Oxygen Sensor	BK	At Sensor	N/S
Right Visor/ Vanity Lamp	BK	Right A-Pillar	20
Seatbelt Control Module			N/S
Seatbelt Switch			18
Stop Lamp Switch	GY	Top of Brake Pedal Arm	23
Throttle Position Sensor		Throttle Body	4, 5

Connector Name/Number	Color	Location	Fig.
Throttle Position Sensor	BK	On Injection Pump (Diesel)	10
Trailer Tow Connector	BK	On Trailer Hitch	21
Transmission Output Shaft Speed Sensor	BK	Left Side of Transmission	13
Transmission Solenoid Assembly	BK	Side of Transmission	13
Under Hood Lamp	BK	Underside of Hood	15
Upstream Heated Oxygen Sensor	BK	Exhaust Pipe	N/S
Vacuum Sensor (Diesel)	BK	Left Fender Side Shield (Diesel)	N/S
Vehicle Speed Control Servo	BK	Below Battery	16
Vehicle Speed Control/Horn Switch		Behind Switch	N/S
Water-In-Fuel Sensor	BK	Bottom of Fuel Filter/Water Separator	11
Windshield Washer Pump Motor	BK	Bottom of Washer Fluid Reservior	16
Windshield Wiper Motor	BK	At Wiper Motor	14

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DESCRIPTION AND OPERATION (Continued)

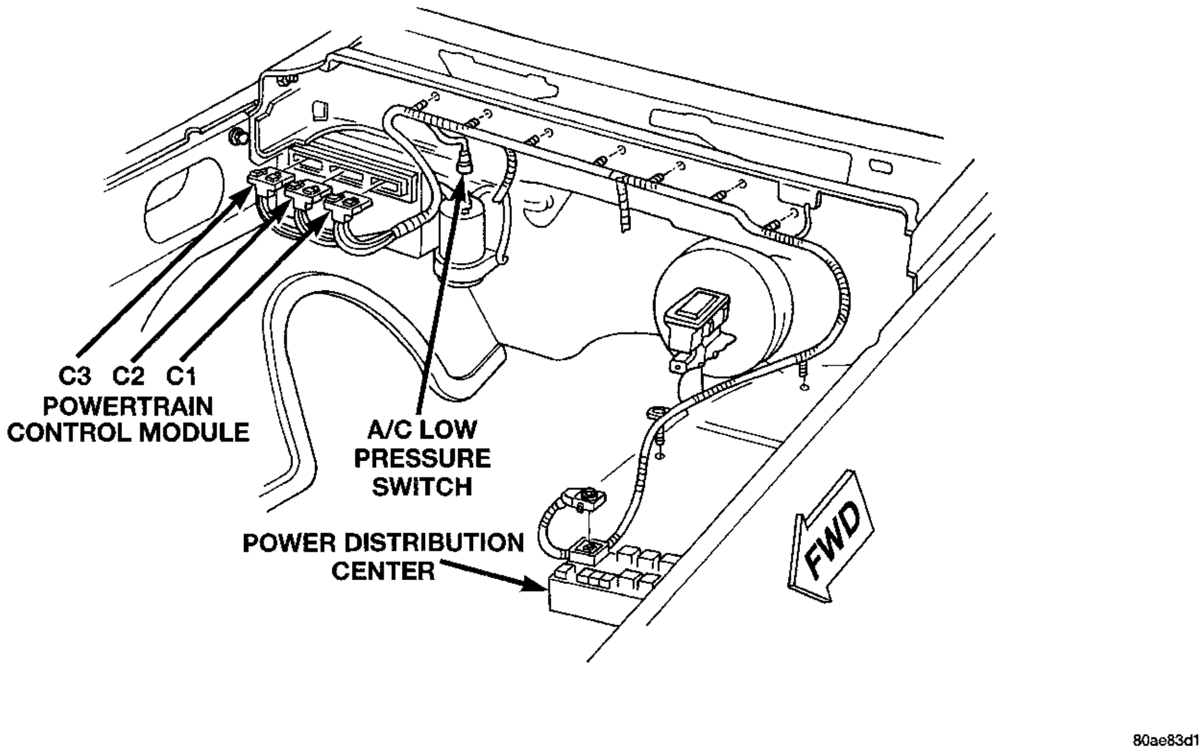

Fig. 1 Dash Panel Connectors (Gas Engines)

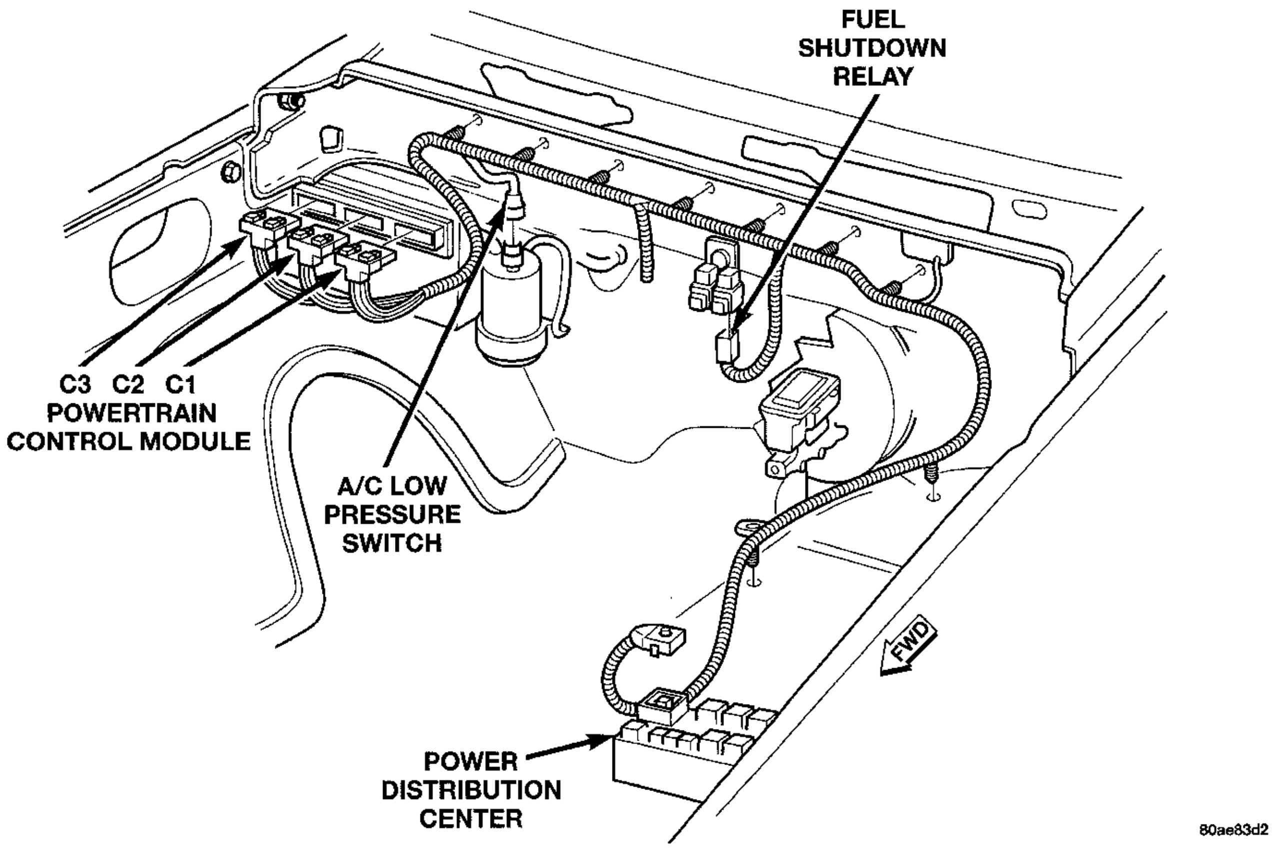

Fig. 2 Dash Panel Connectors (Diesel Engine)

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DESCRIPTION AND OPERATION (Continued)

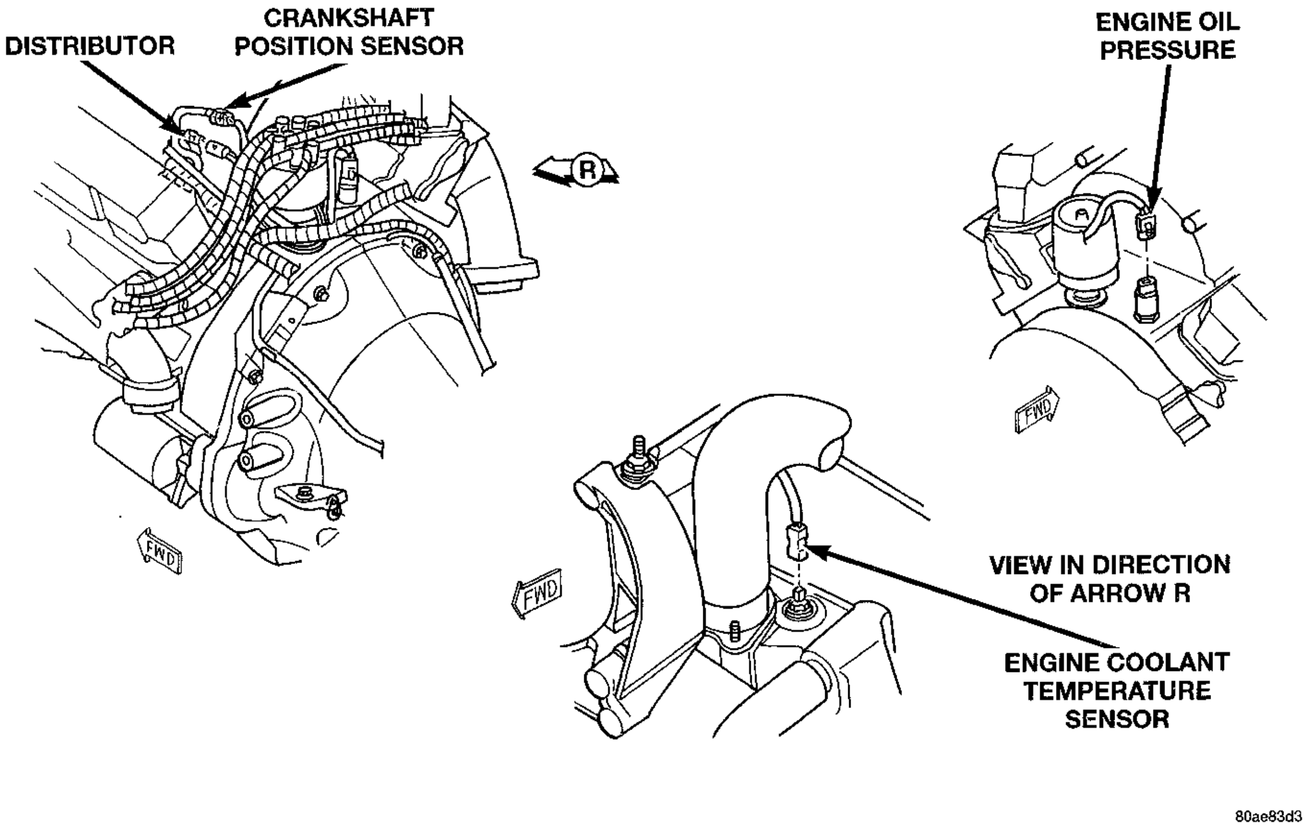

Fig. 3 5.2–5.9 Liter Engines

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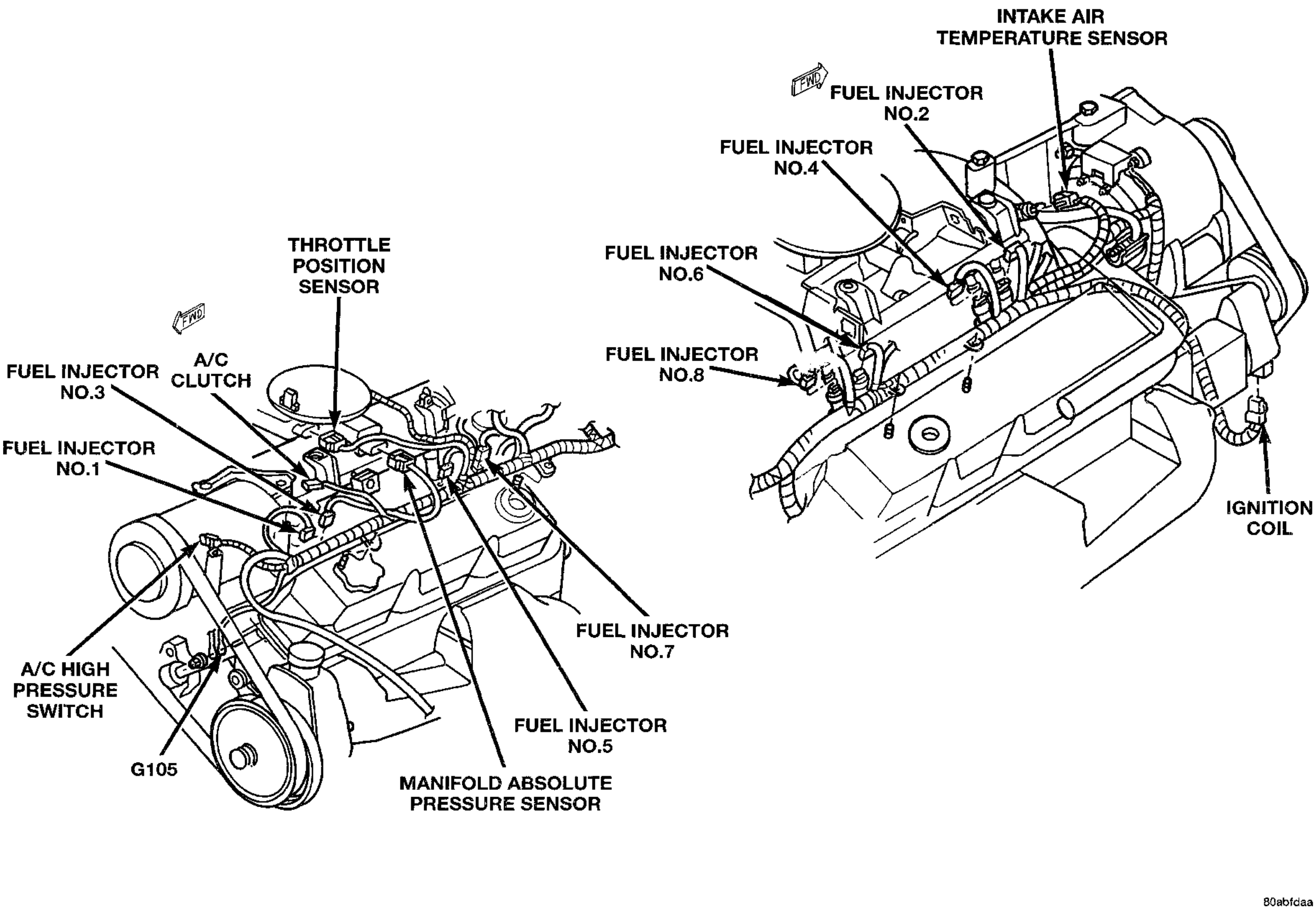

Fig. 4 5.2–5.9 Liter Engines

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DESCRIPTION AND OPERATION (Continued)

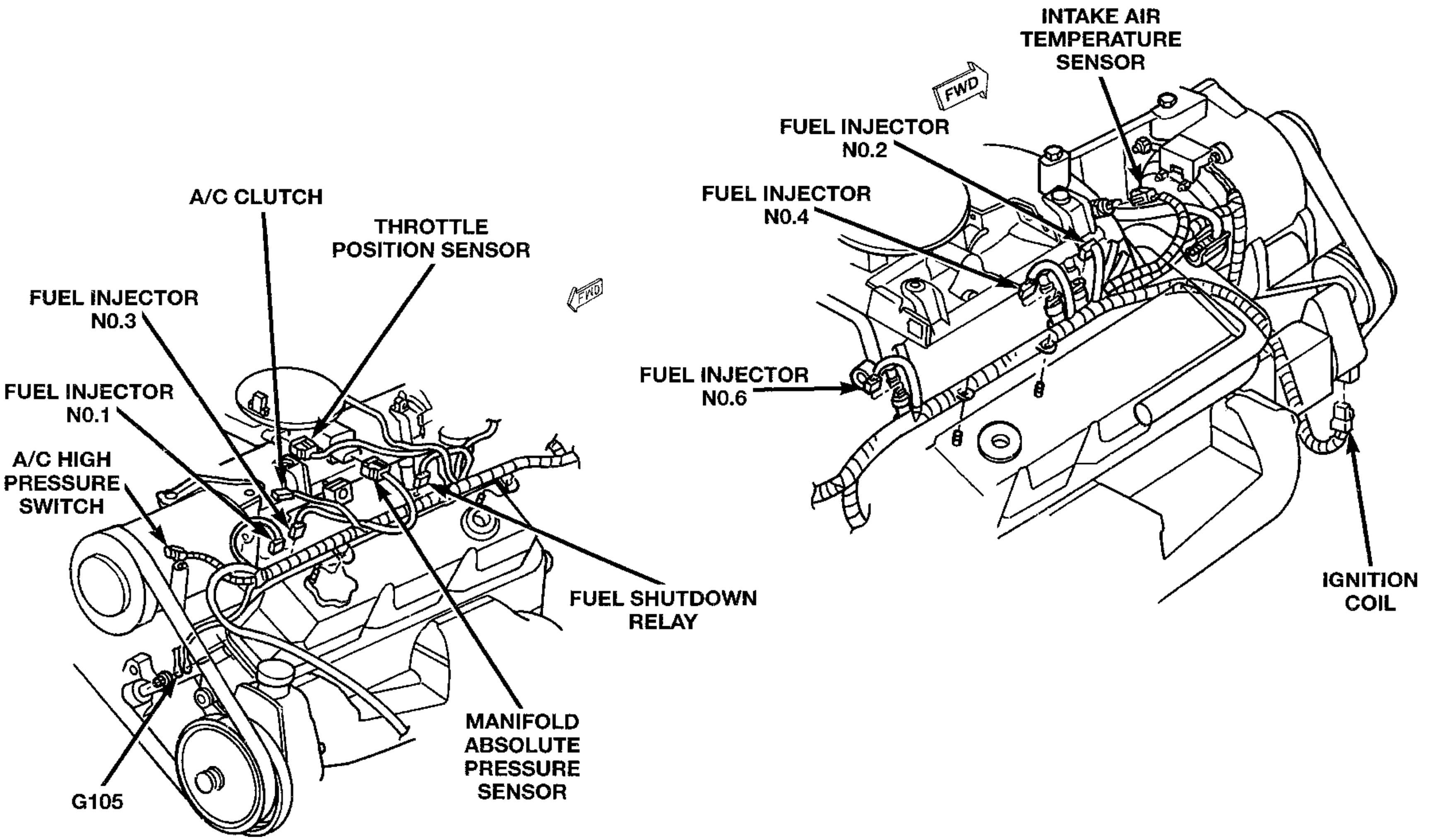

Fig. 5 3.9 Liter Engine

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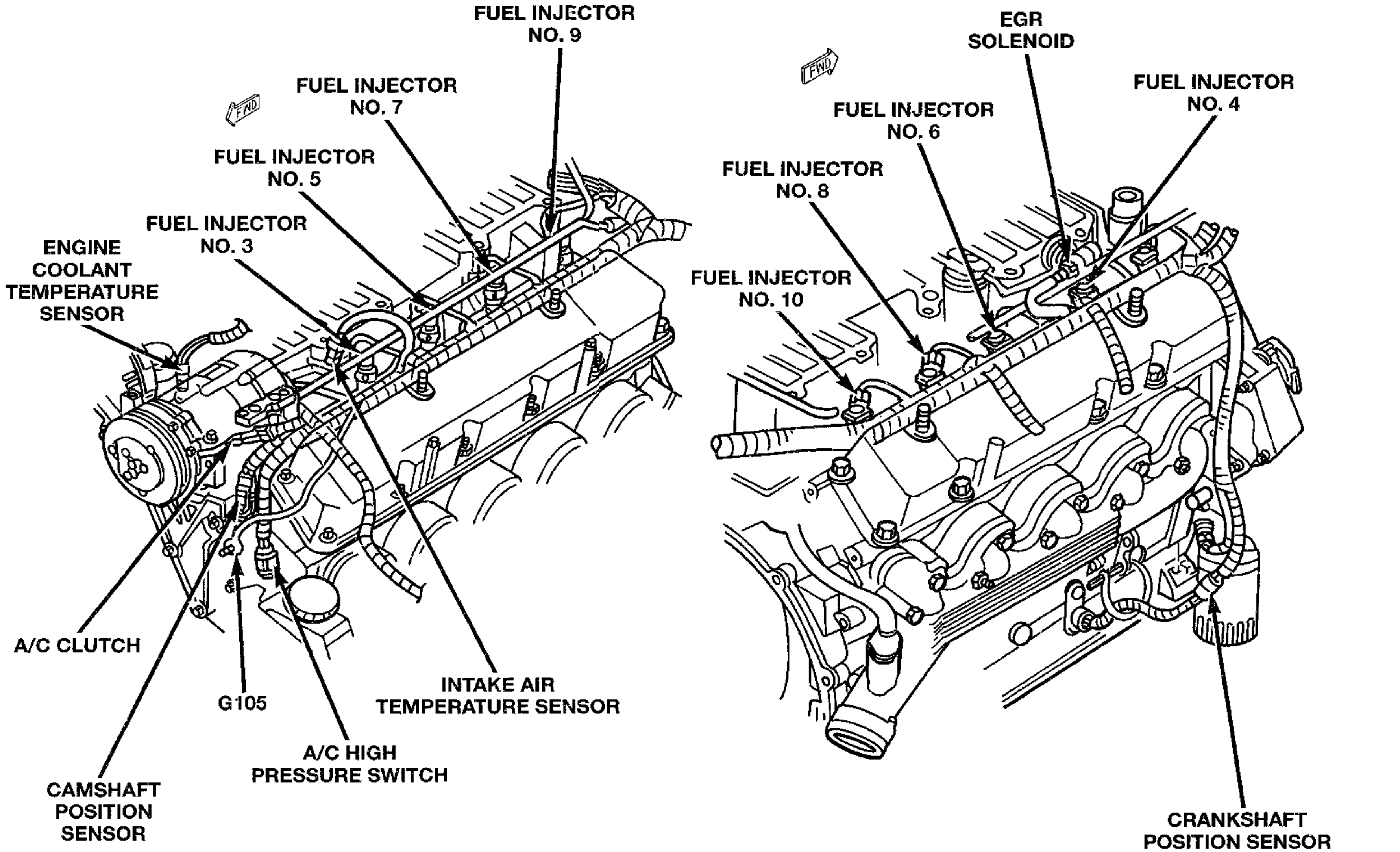

Fig. 6 8.0 Liter Engine

DESCRIPTION AND OPERATION (Continued)

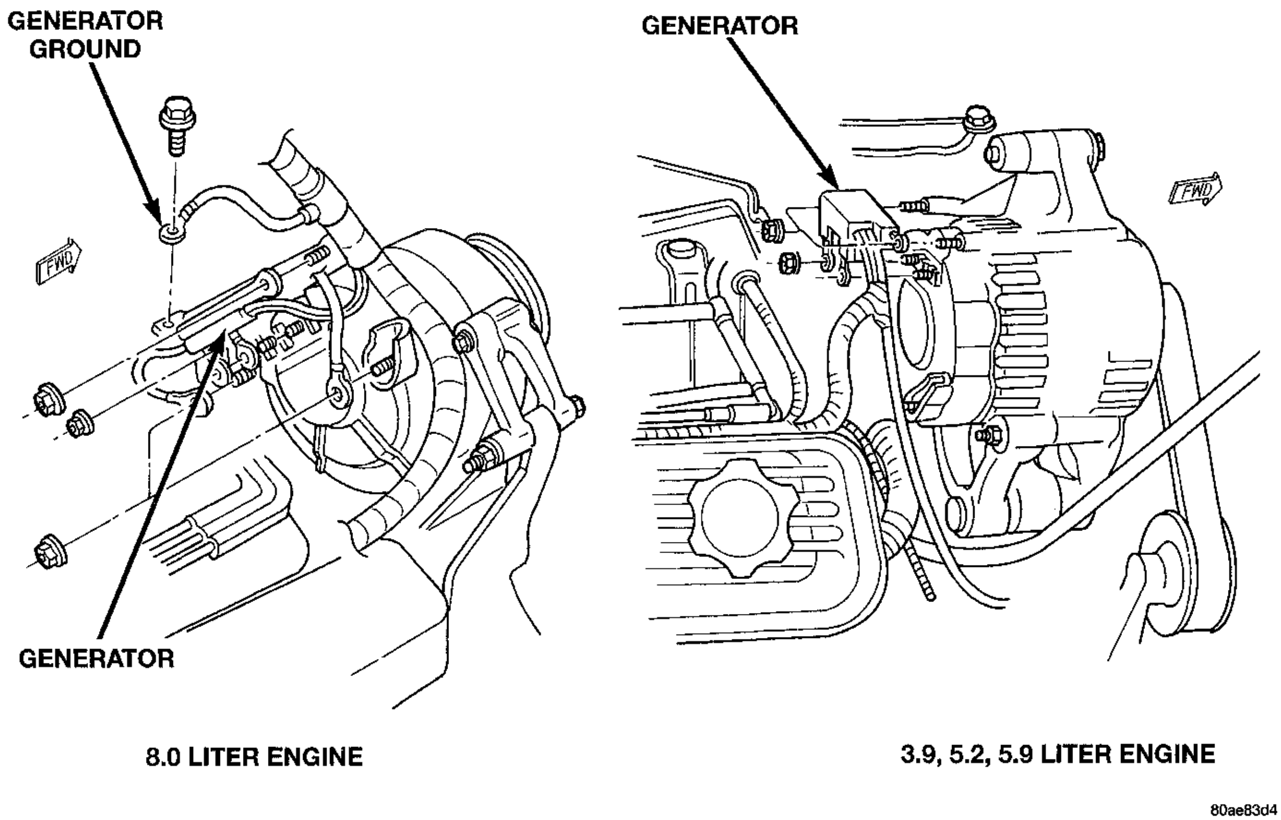

Fig. 7 Generator (Gas Engine)

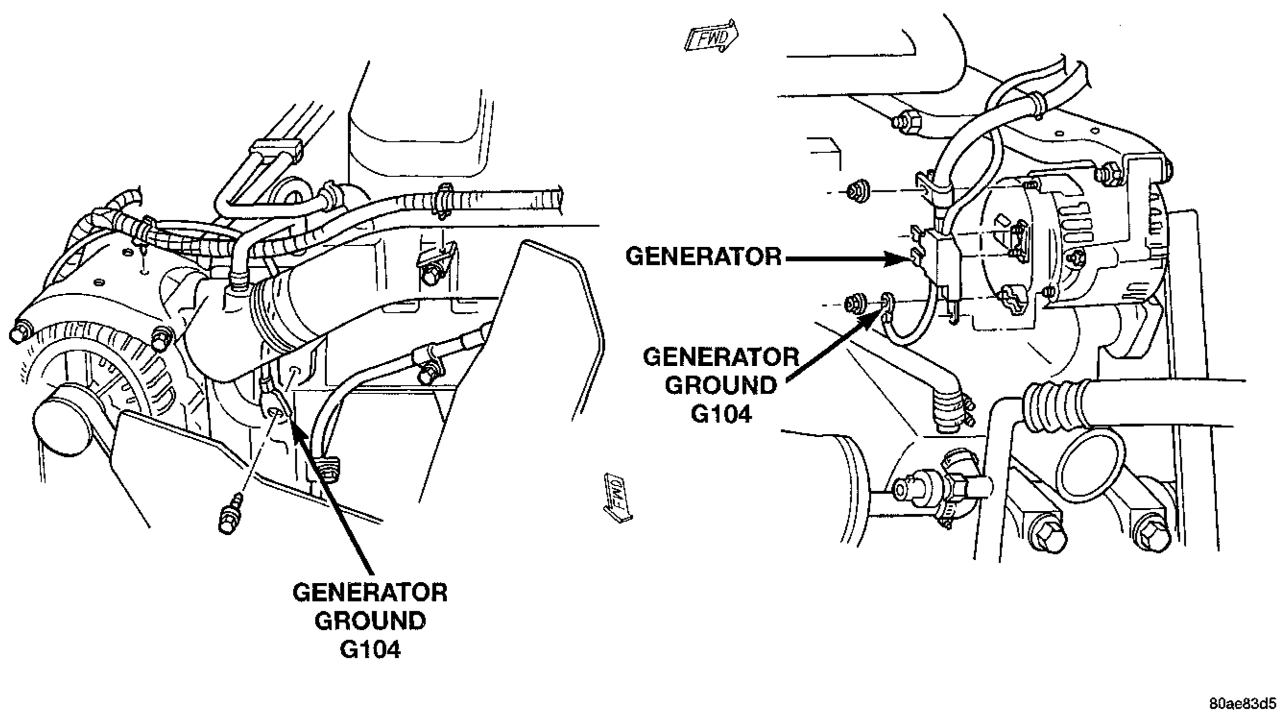

Fig. 8 Generator (Diesel Engine)

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DESCRIPTION AND OPERATION (Continued)

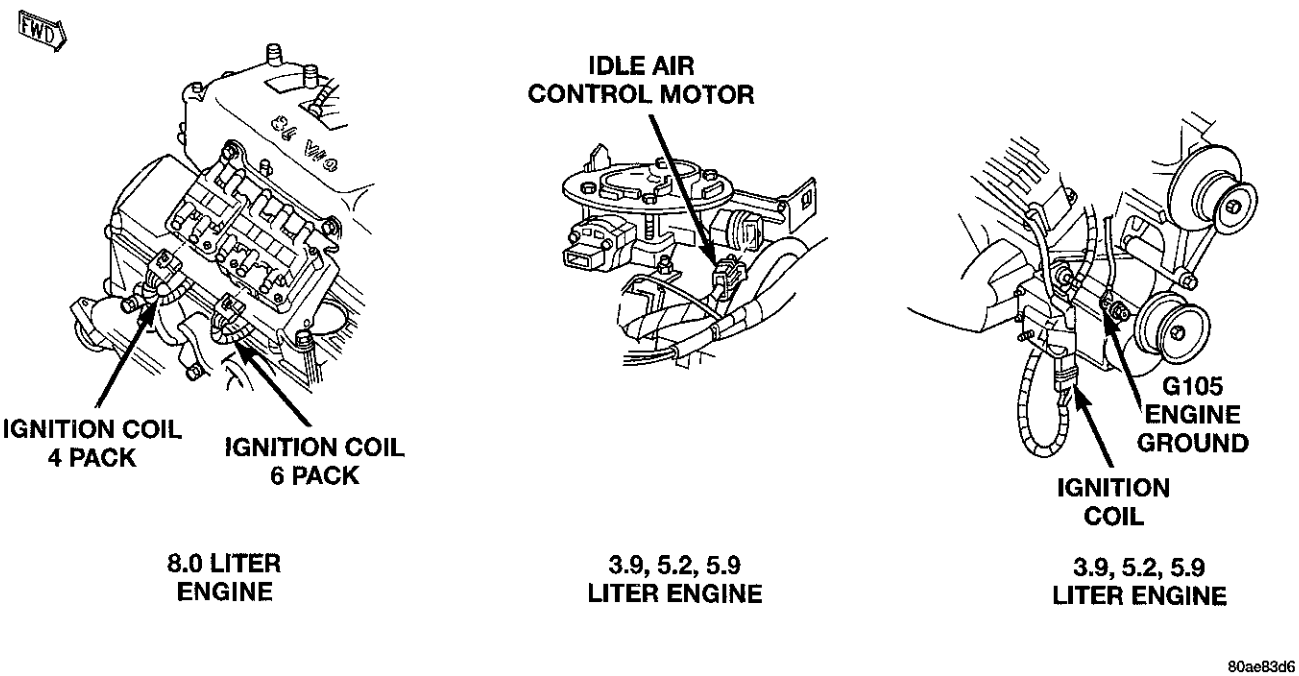

Fig. 9 Ignition Coil (Gas Engine)

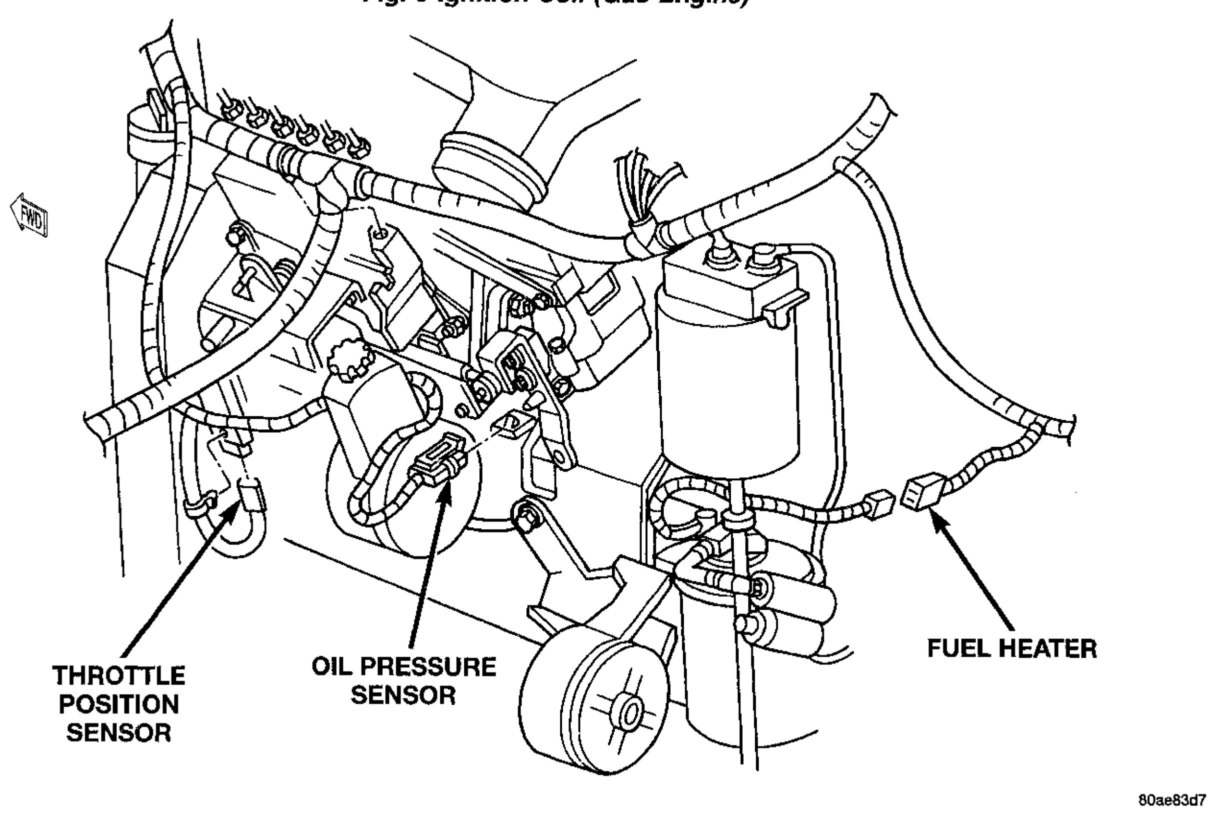

Fig. 10 Diesel Components

DESCRIPTION AND OPERATION (Continued)

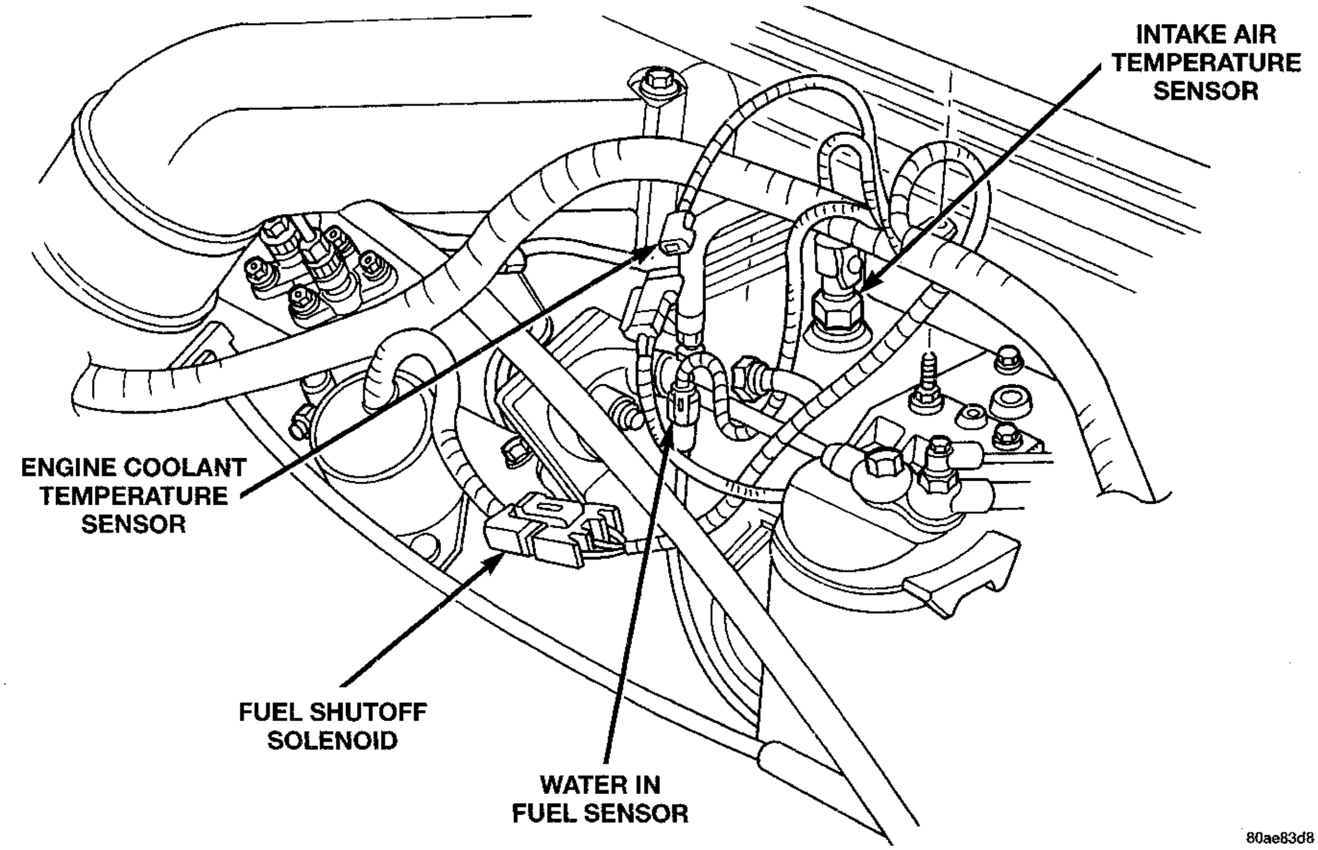

Fig. 11 Diesel Components

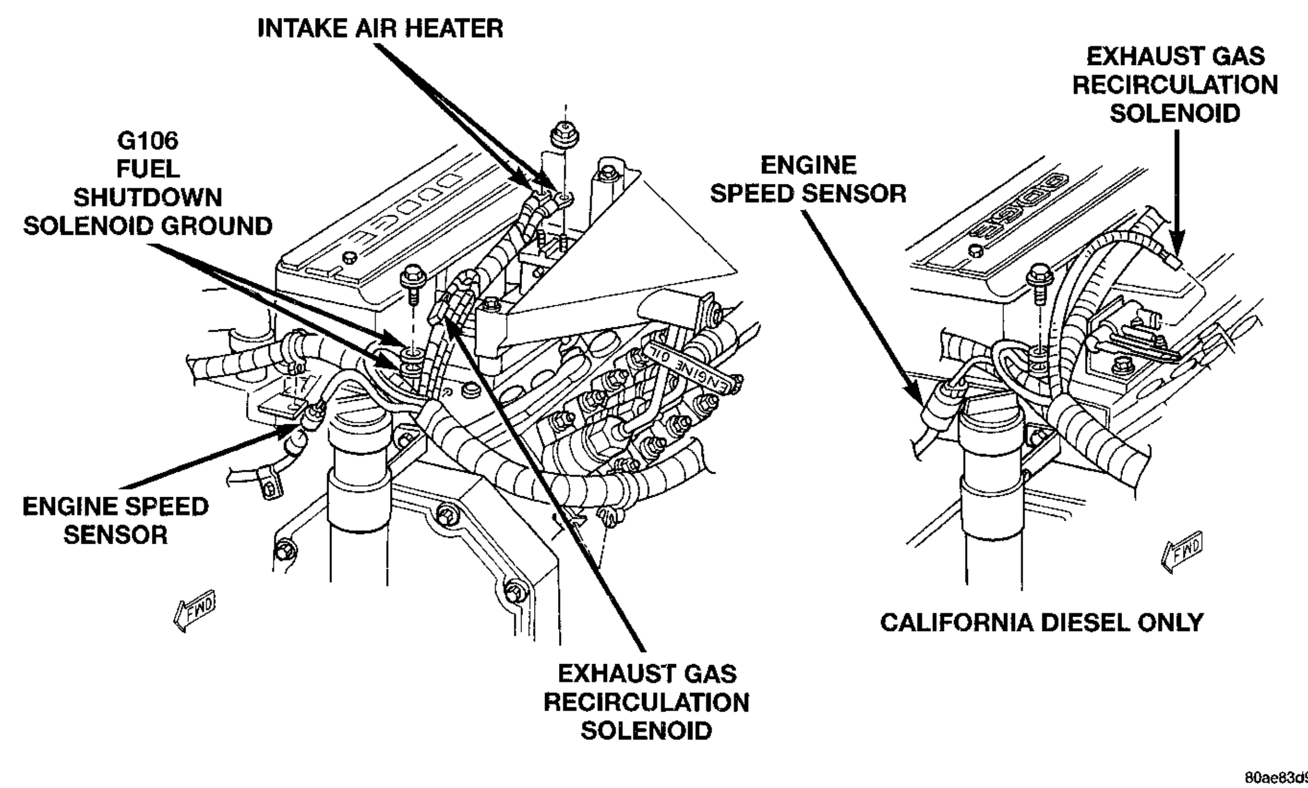

Fig. 12 Diesel Components

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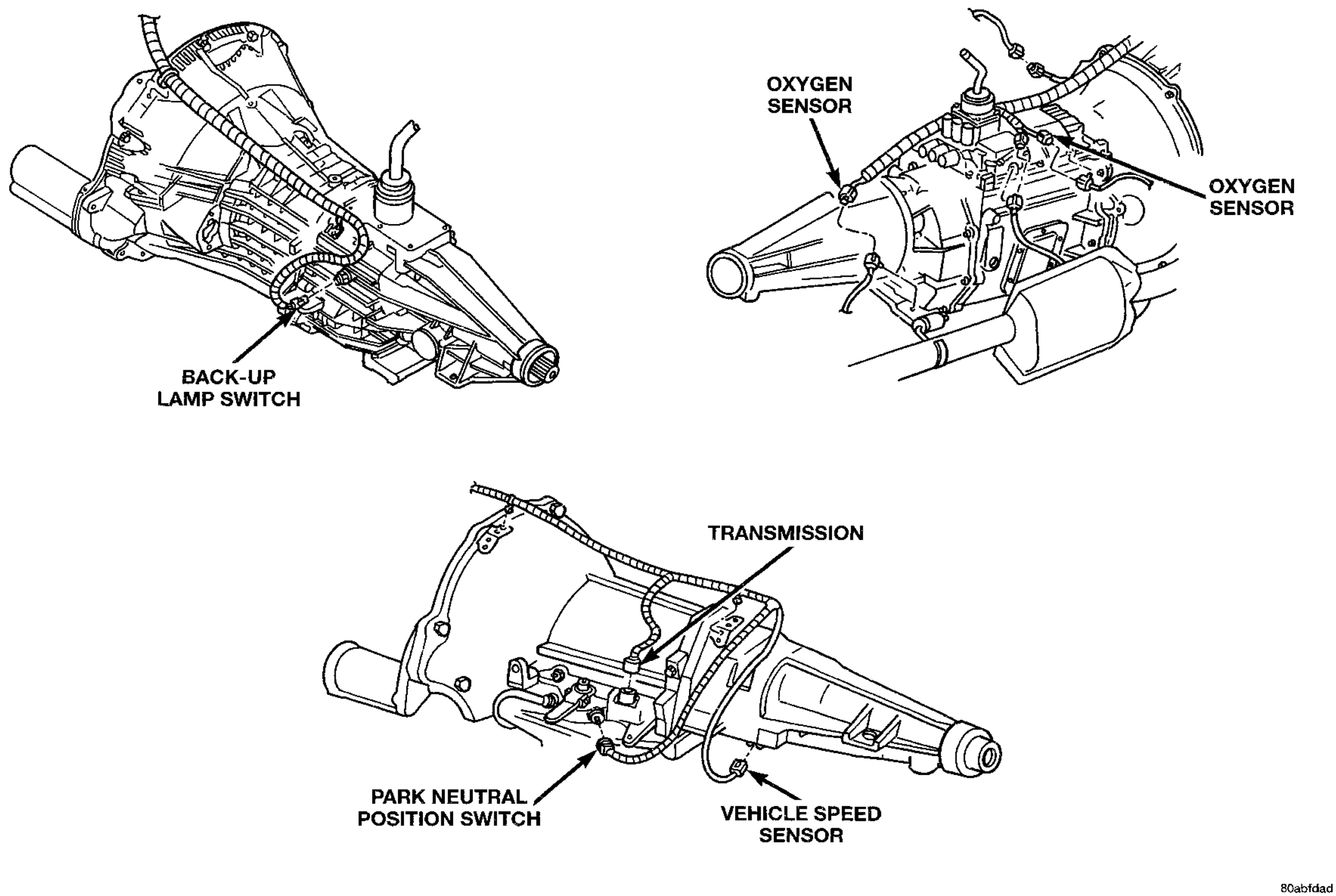

Fig. 13 Transmission Connectors

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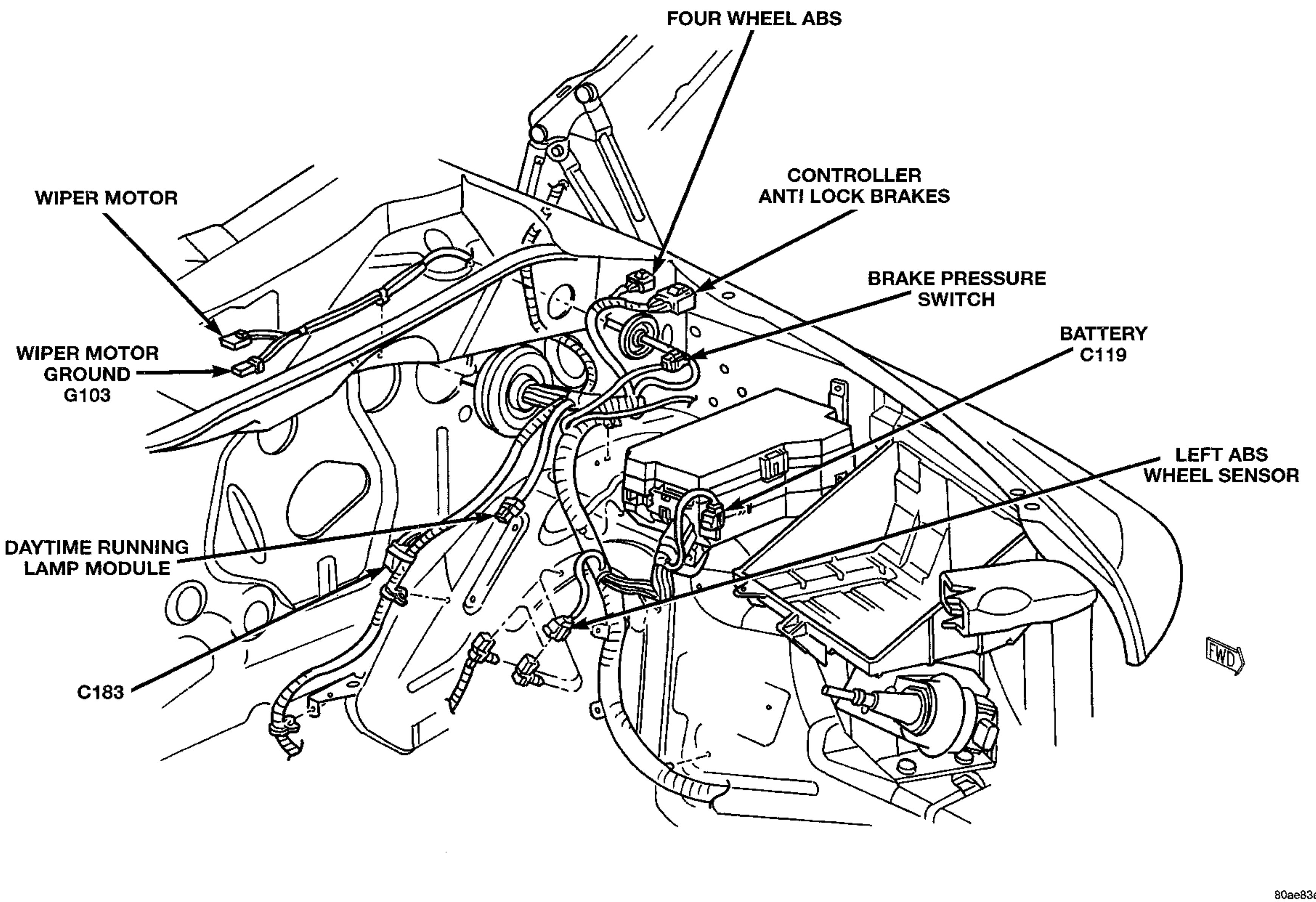

Fig. 14 Left Side Engine Compartment

DESCRIPTION AND OPERATION (Continued)

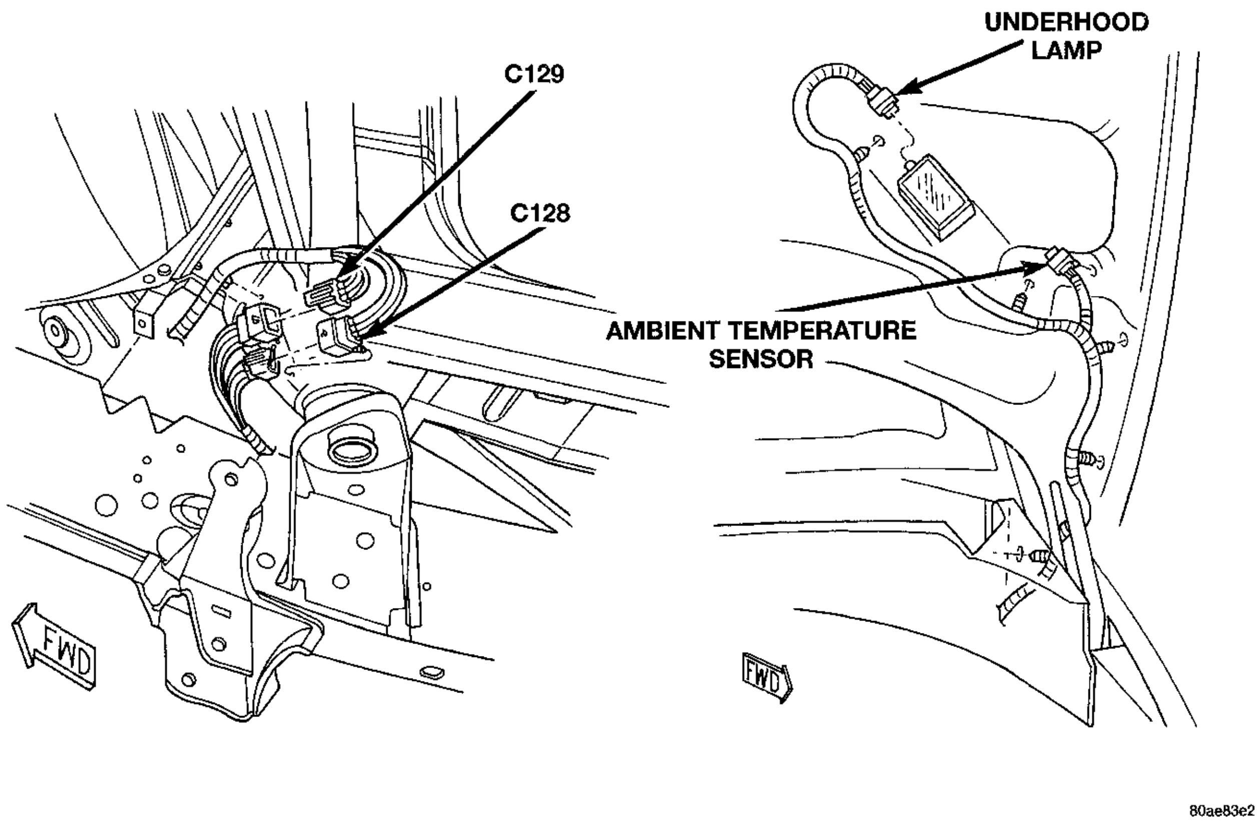

Fig. 15 Under Hood

Mopar AUTHENTIC RESTORATION PRODUCT

DESCRIPTION AND OPERATION (Continued)

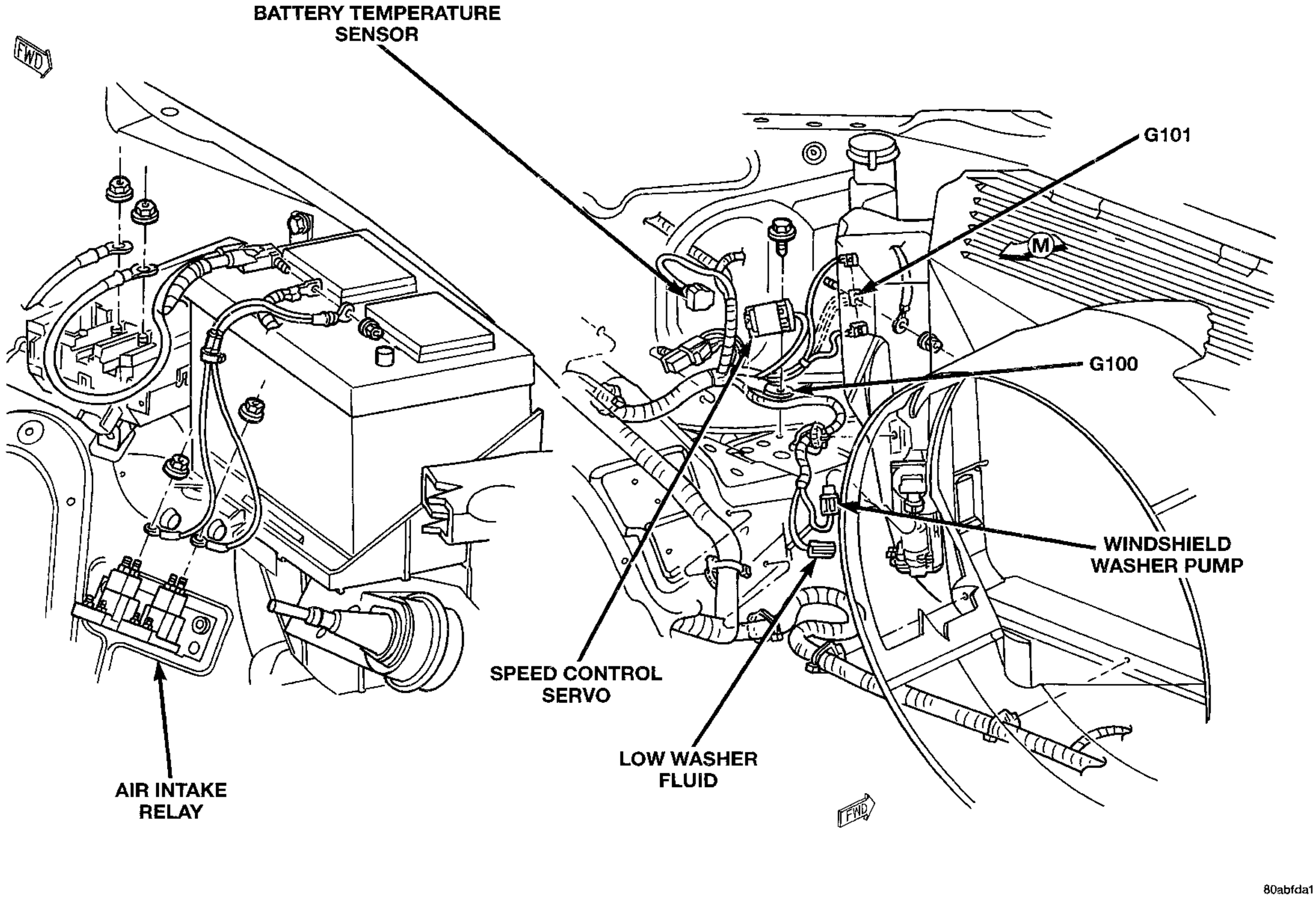

Fig. 16 Under Hood

mopar AUTHENTIC RESTORATION PRODUCT

DESCRIPTION AND OPERATION (Continued)

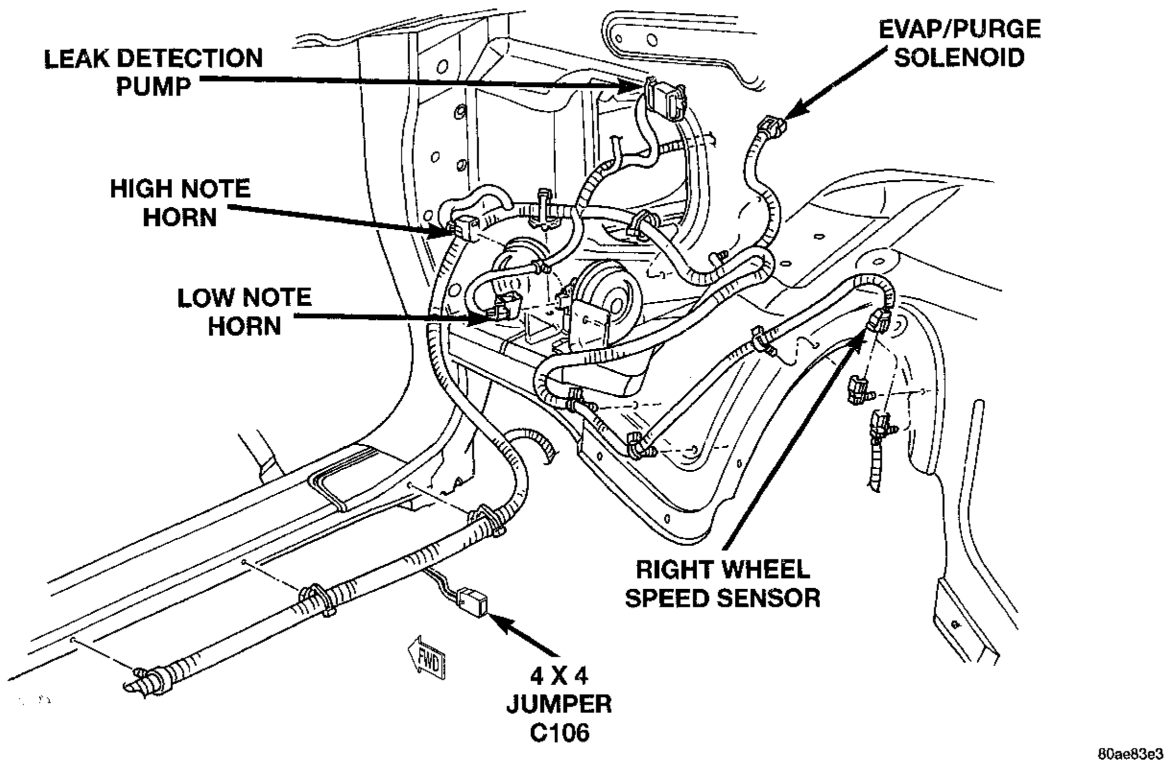

Fig. 17 Right Fender Shield

Mopar AUTHENTIC RESTORATION PRODUCT

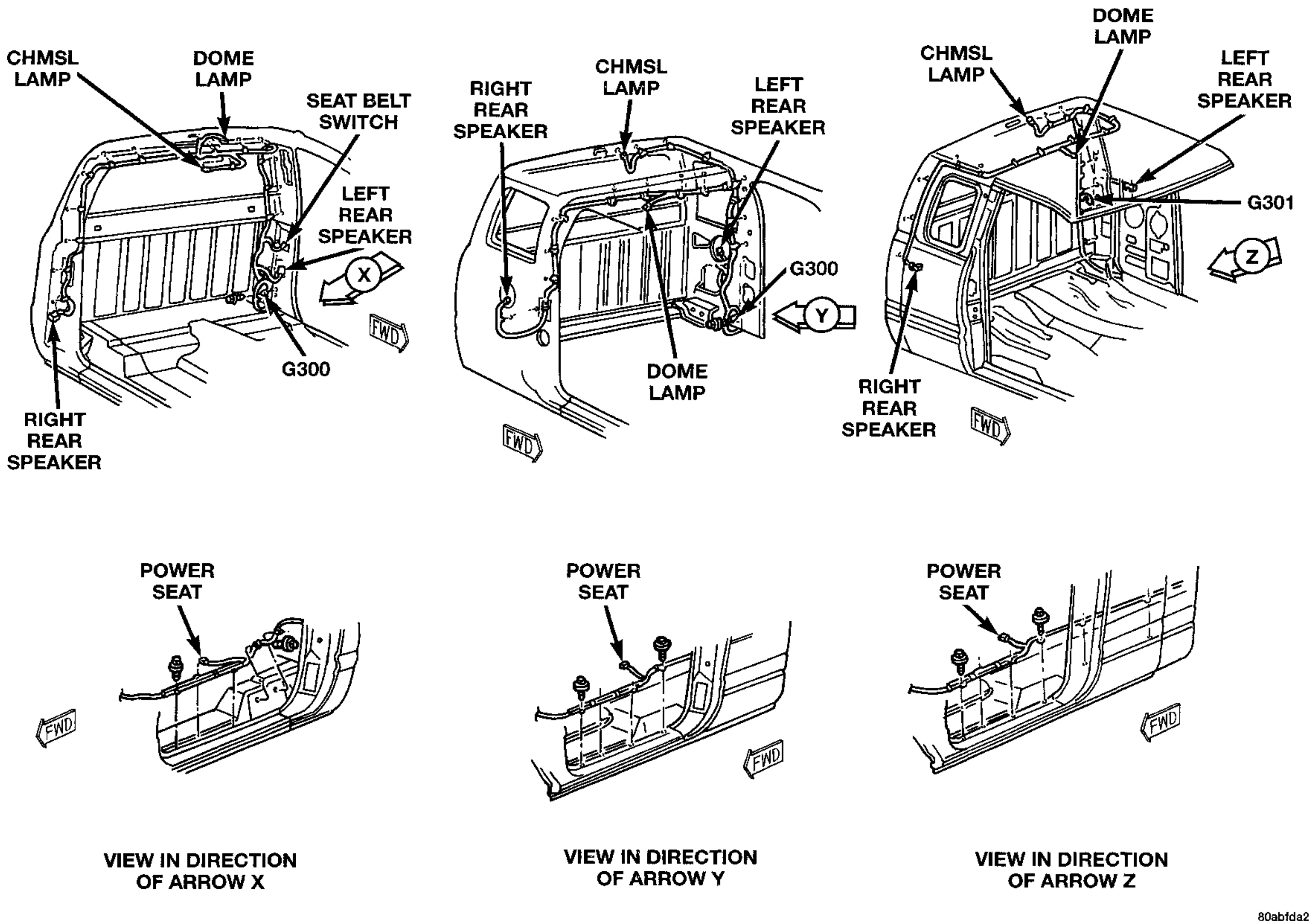

Fig. 18 Center High Mounted Stop Lamp

DESCRIPTION AND OPERATION (Continued)

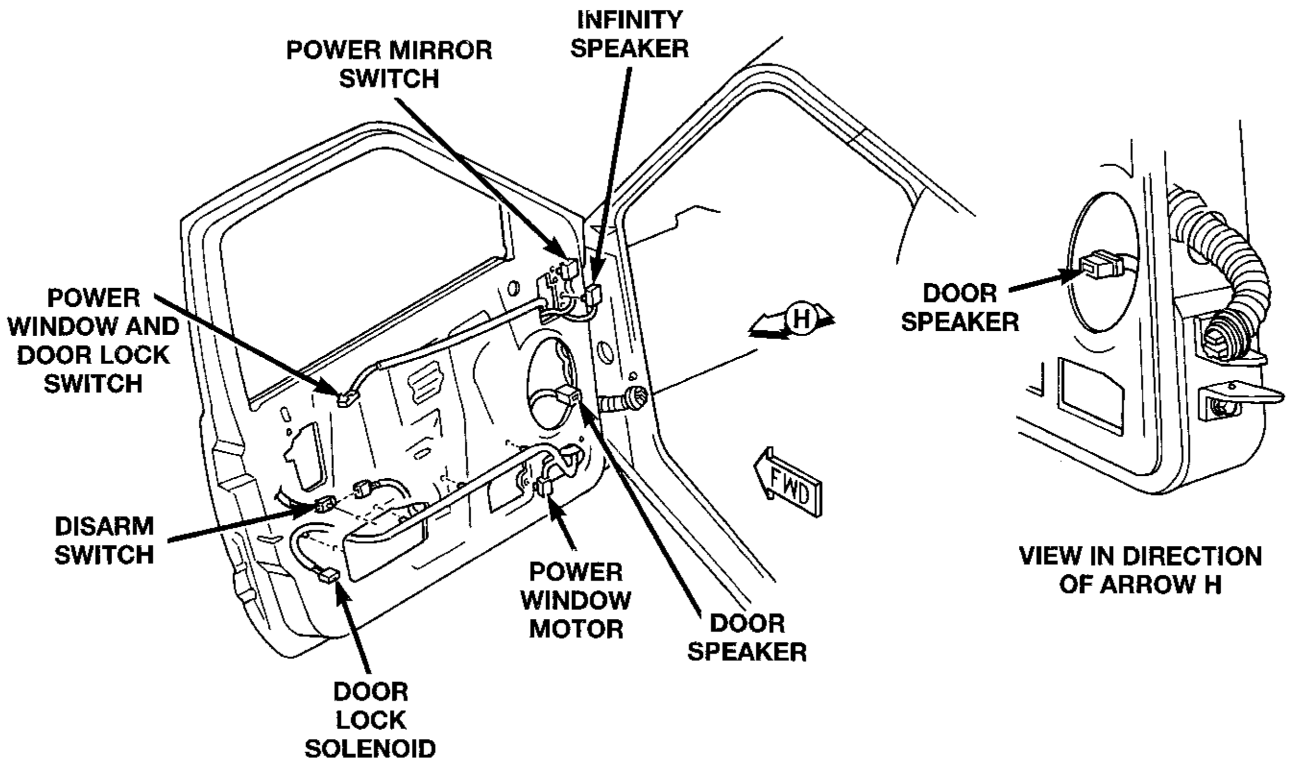

Fig. 19 Door

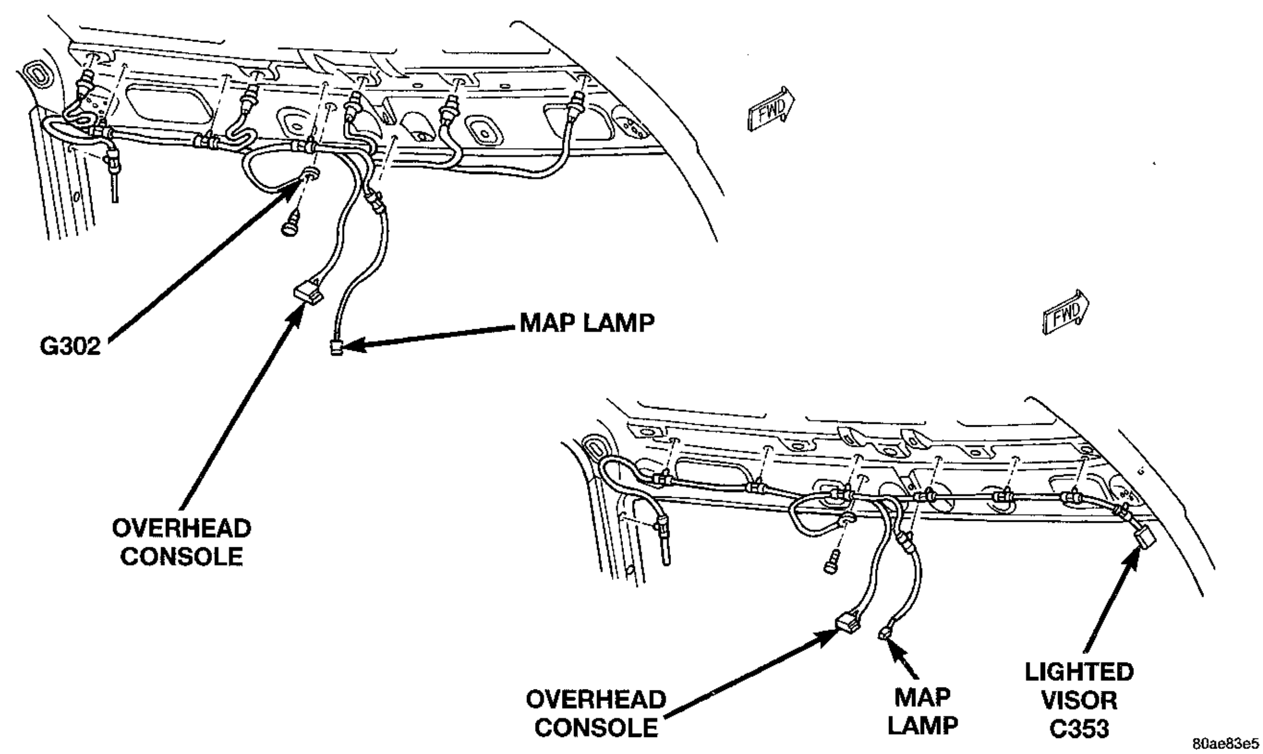

Fig. 20 Overhead Console

AUTHENTIC RESTORATION PRODUCTS

DESCRIPTION AND OPERATION (Continued)

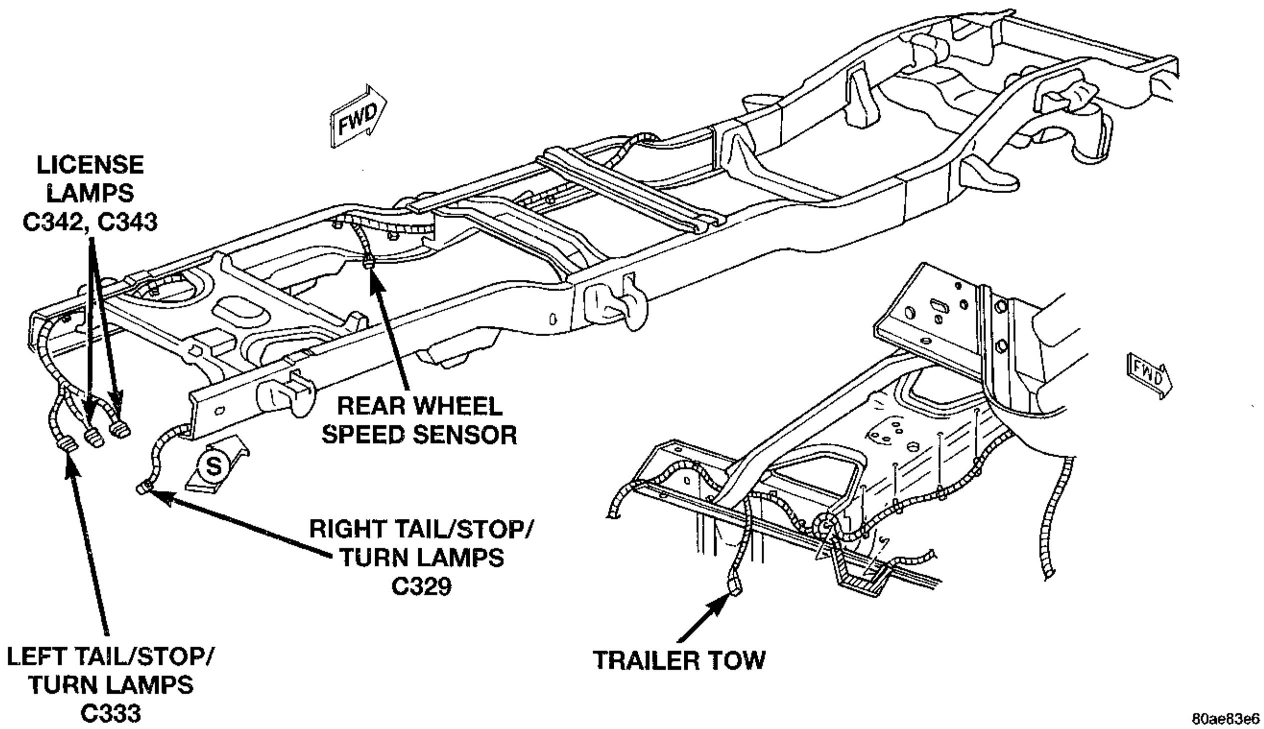

Fig. 21 Tail Lamps

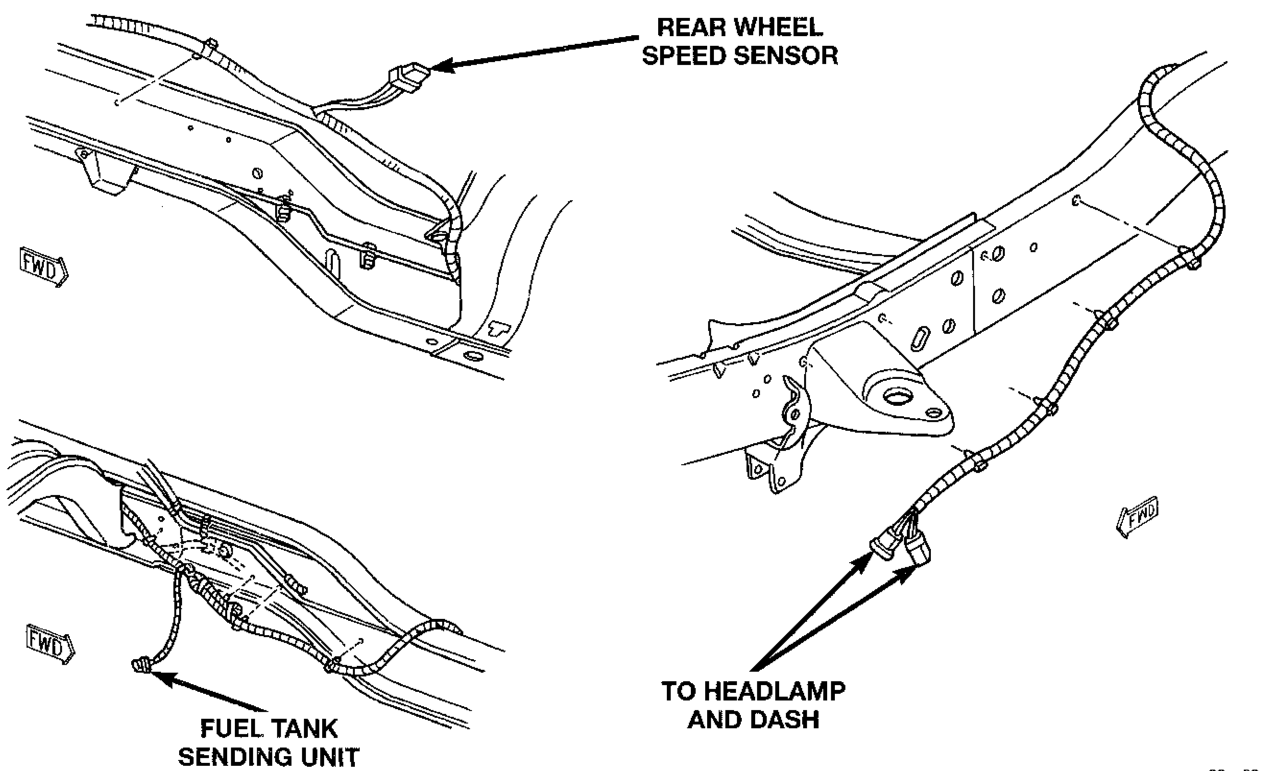

Fig. 22 Frame Rail

Mopar AUTHENTIC RESTORATION™ PRODUCT

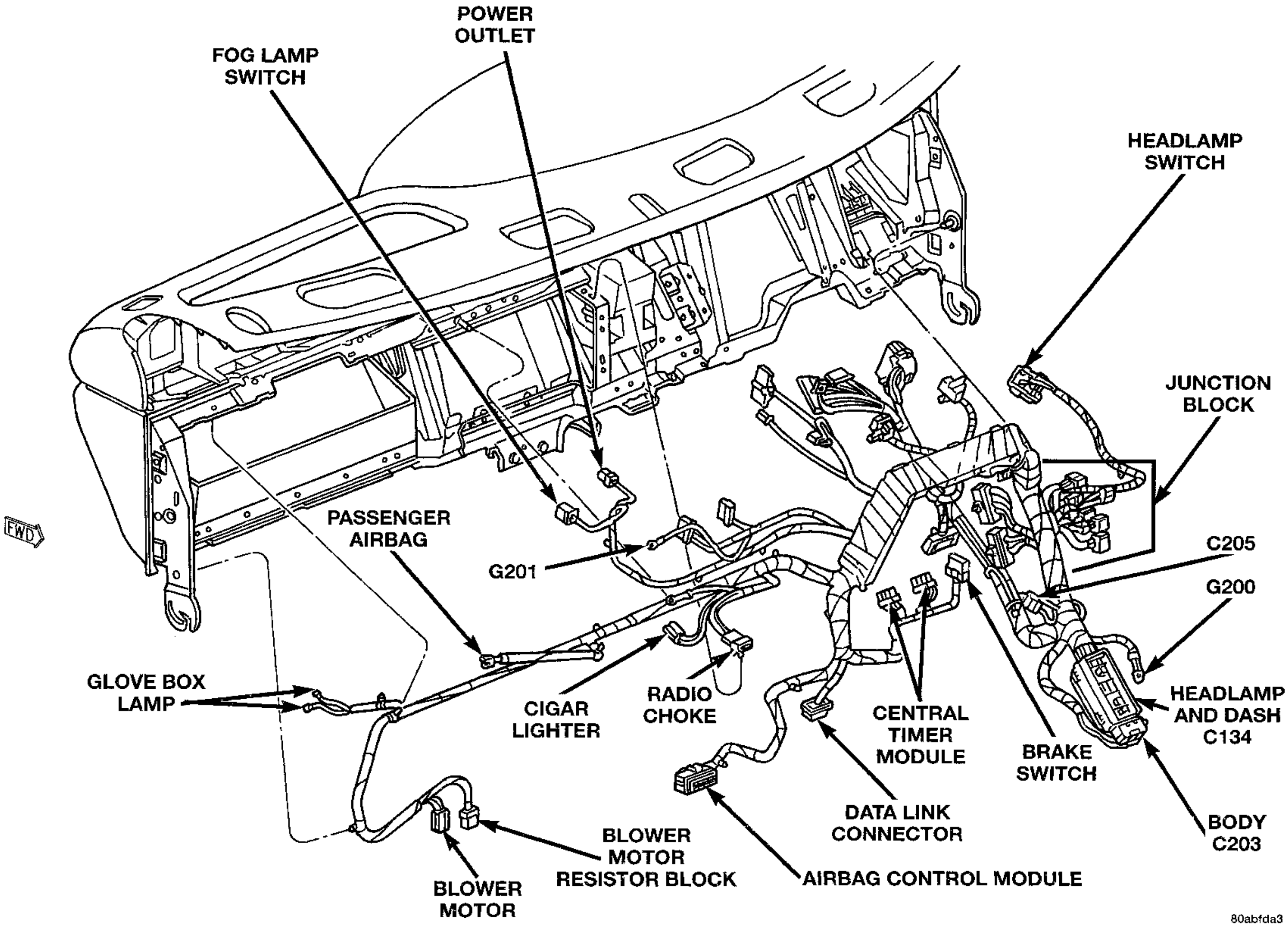

Fig. 23 Instrument Panel

Mopar AUTHENTIC RESTORATION PRODUCT

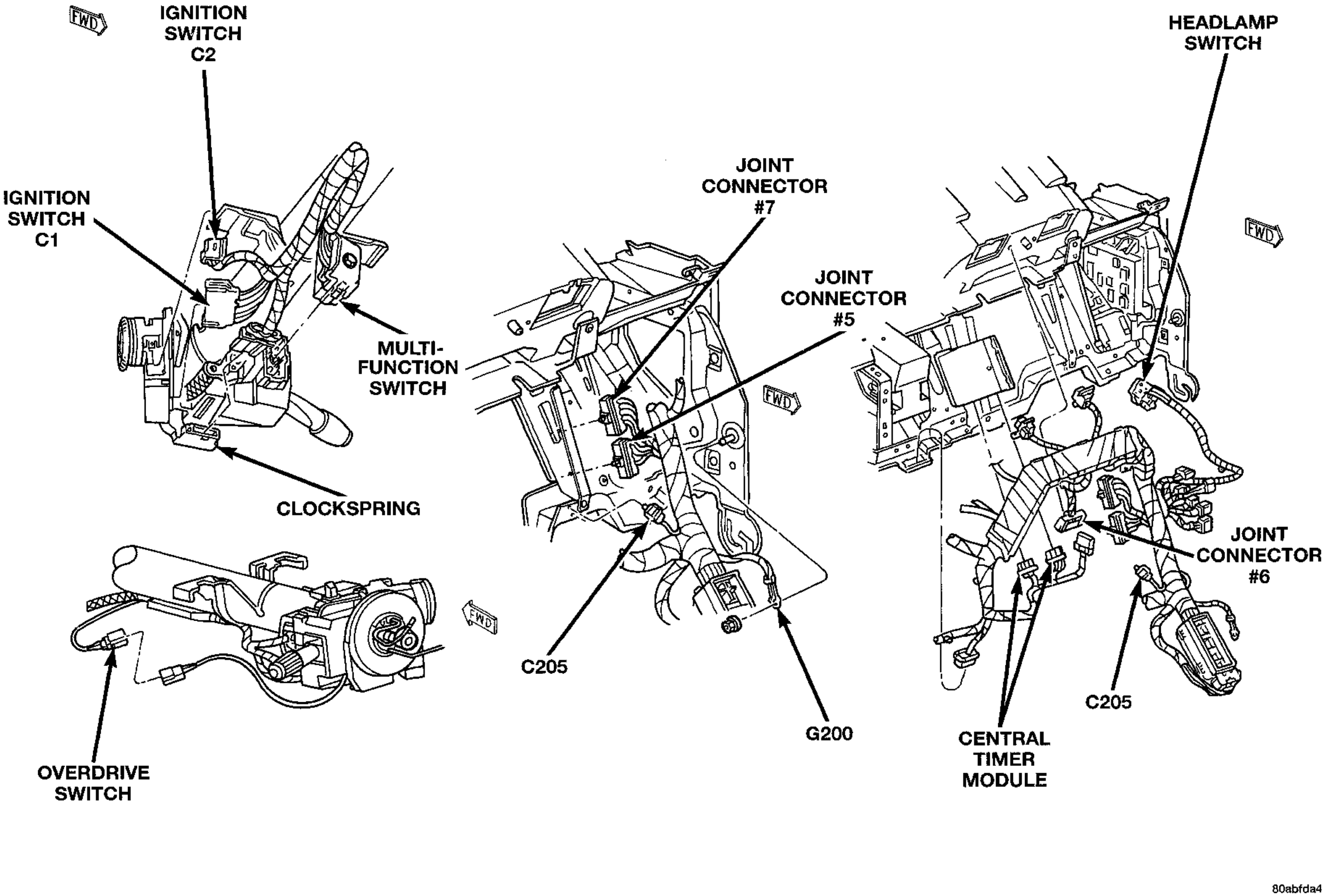

Fig. 24 Steering Column

Mopar AUTHENTIC RESTORATION PRODUCT

DESCRIPTION AND OPERATION (Continued)

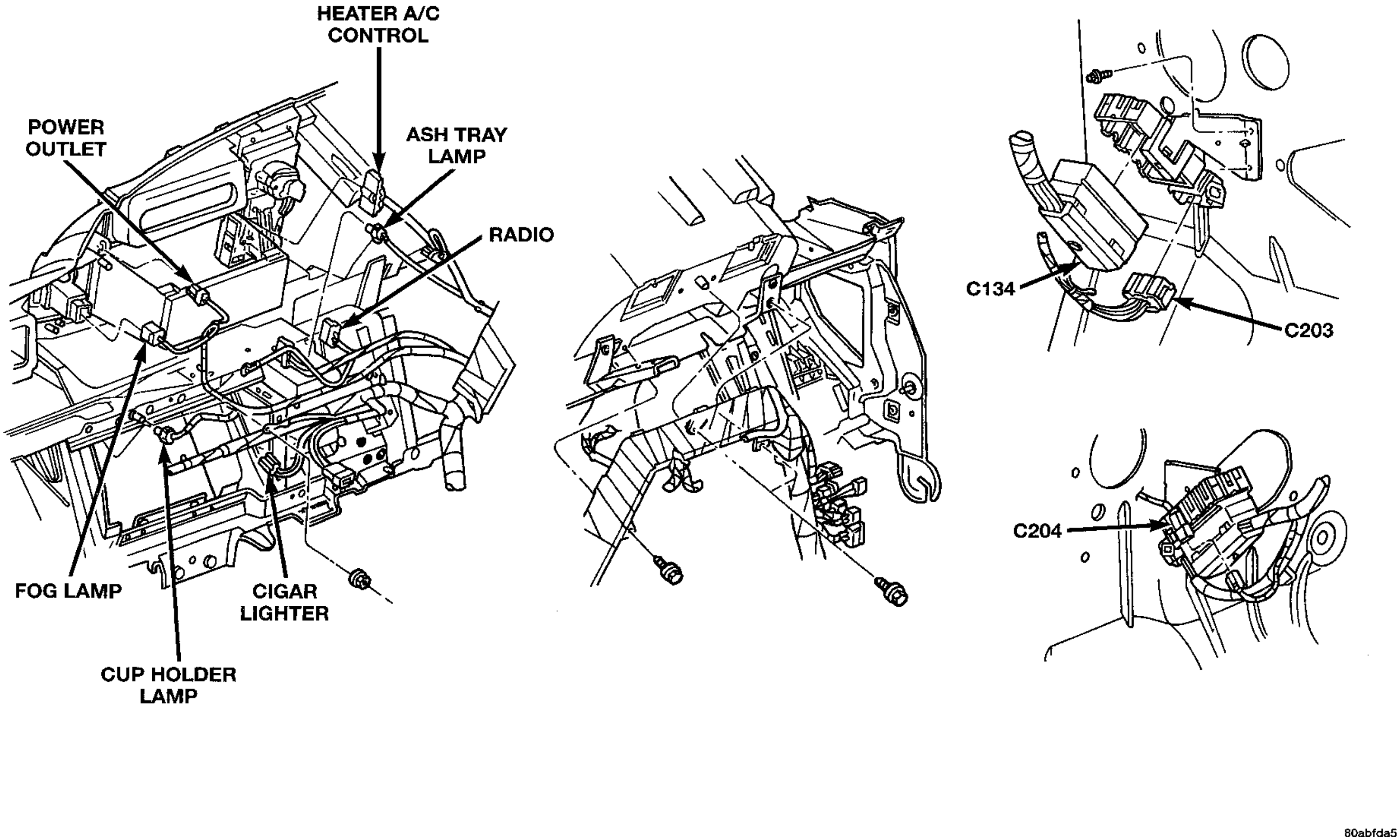

Fig. 25 Instrument Panel

Mopar AUTHENTIC RESTORATION PRODUCT

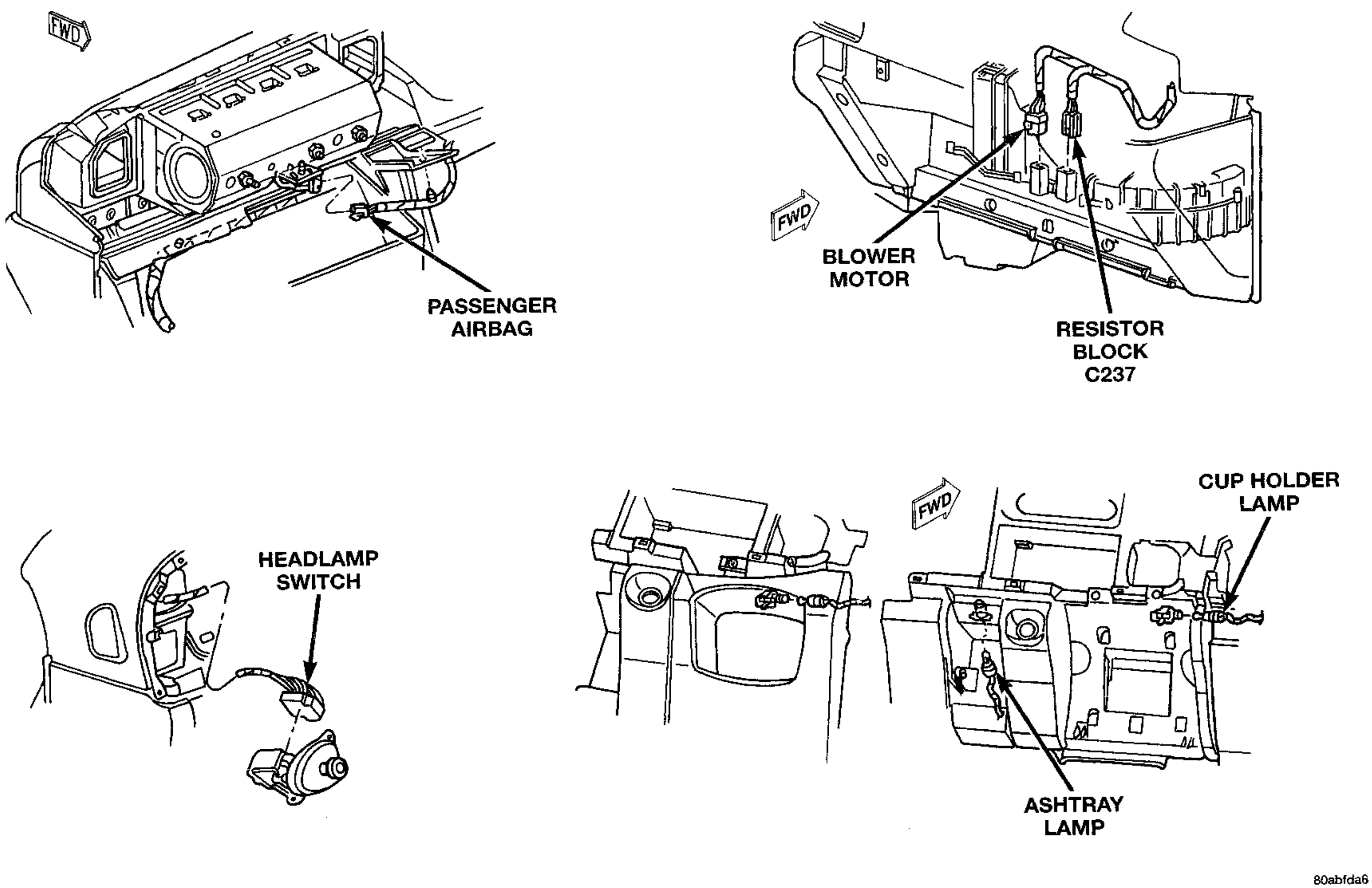

Fig. 26 Instrument Panel

Mopar AUTHENTIC RESTORATION PRODUCT

8W-95 SPLICE LOCATIONS

DESCRIPTION AND OPERATION

INTRODUCTION

This section provides illustrations identifying the general location of the splices in this vehicle. A splice index is provided. Use the wiring diagrams in each section for splice number identification. Refer to the index for proper splice number.

SPLICE LOCATIONS

For splices that are not shown in the figures in this section, N/S is placed in the Fig. column.

Splice Number	Location	Fig.
S101	Right of Radiator	9
S102	Right/Park/Turn T/O	9
S103	Left/Park/Turn T/O	N/S
S104	Left Front Fender Area	N/S
S105	Headlamp and Dash Harness Near Left Wheel Speed sensor	8
S106	Headlamp and Dash Harness Near Left Wheel Speed sensor	8
S107	Headlamp and Dash Harness Near Left Wheel Speed sensor	8
S108	Near Antilock Brake T/O	8
S109	Near Antilock Brake T/O	8
S110	Near Antilock Brake T/O	8
S111	Near Antilock Brake T/O	8
S112	Antilock Brake Controller T/O	8
S113	Antilock Brake Controller T/O	8
S114	In T/O to Chassis Harness	8
S115	In T/O to DRL Module	8
S116(V6, V8)	Rear of Engine on Dash Panel	1
S116 (V10)	Engine Harness Rear of Engine	4
S116 (Diesel)	Rear of Engine on Dash Panel	2
S117 (V6, V8)	Rear of Engine on Dash Panel	1
S117 (V10)	Engine Harness Rear of Engine	4
S118 (V6, V8)	Rear of Engine on Dash Panel	1
S118 (V10)	Engine Harness Rear of Engine	N/S
S118 (Diesel)	Near Branch to Fuel Heater	6
S119 (V6, V8)	Rear of Engine on Dash Panel	1
S119 (V10)	Engine Harness Rear of Engine	N/S
S119 (Diesel)	Rear of Engine on Dash Panel	2
S120 (V6, V8)	Rear of Engine on Dash Panel	1
S120 (V10)	Engine Harness Rear of Engine	N/S
S120 (Diesel)	Engine Harness Rear of Engine	2
S121 (V6, V8)	Near T/O for No. 5 Fuel Injector	3
S121 (V10)	Near T/O for No. 5 Fuel Injector	4
S121 (Diesel)	Engine Harness Top of Engine	6
S122 (V6, V8)	Top of Transmission	5
S122 (V10)	Rear of Engine in Branch to Transmission	N/S
S123 (V6, V8)	Near T/O for No. 3 Fuel Injector	3, 4
S123 (V10)	Near T/O for No. 1 Fuel Injector	N/S
S124 (V6, V8)	Top of Transmission	5
S124 (V10)	Rear of Engine in Branch to Transmission	N/S
S125 (V6, V8)	Top of Transmission	5
S125 (V10)	Rear of Engine in Branch to Transmission	N/S
S126 (V6, V8)	Near T/O for No. 1 Fuel Injector	3
S126 (V10)	Near Engine Ground	4

AUTHENTIC RESTORATION

DESCRIPTION AND OPERATION (Continued)

Splice Number	Location	Fig.
S126 (Diesel)	Engine Harness Top of Engine	N/S
S127 (V6, V8)	At Transmission	7
S127 (V10)	At transmission	7
S127 (Diesel)	Rear of Engine on Dash Panel	2
S128	Near Fuel Shutdown Relay	N/S
S129	Near A/C Low Pressure T/O	2
S130 (Diesel)	Engine Harness Rear of Engine	2
S131	Engine Harness Rear of Engine	N/S
S132 (Diesel)	Transmission Harness	N/S
S133 (Diesel)	Transmission Harness	N/S
S134	Near Fog Lamps	N/S
S200	Near Cluster T/O	13
S201	Near Cluster T/O	13
S202	Near Overdrive Switch	13
S203	Near Overdrive Switch	13
S204	Near Cluster T/O	13
S205	Near Cluster T/O	13
S206	Near Cluster T/O	13
S207	Near Blower Motor	N/S
S208	Near Passenger Airbag Disarm Switch	N/S
S300	Left Side Instrument Panel	N/S
S301	Left Side Instrument Panel	N/S
S302	Left Side Instrument Panel	N/S
S303	Left Side Instrument Panel	N/S
S304	Left Side Instrument Panel	N/S
S305	Right Side Instrument Panel	N/S
S306	Left Side Instrument Panel	N/S
S307	Left Cowl	11

Splice Number	Location	Fig.
S308	Left Cowl	11
S309	Left Cowl	11
S310	Near Left Rear Speaker	N/S
S311	At Left Body Ground	N/S
S312	Left Door	N/S
S313	Left Frame Rail	N/S
S314	Left Frame Rail	12
S315	Left Frame Rail	12
S316	Left Frame Rail	12
S317	Left Frame Rail	12
S318	In Trailer Tow T/O	12
S319	In Trailer Tow T/O	12
S320	In Trailer Tow T/O	12
S321	In Trailer Tow T/O	N/S
S322	At Roof Lamps	10
S323	At Roof Lamps	10
S324	At Roof Lamps	10
S325	At Roof Lamps	10
S326	At Roof Lamps	10
S327	Power Seat Harness Near Switch	N/S
S328	Power Seat Harness Near T/O to Switch	N/S
S329	Left Door Near Grommet	N/S
S330	Right Door Near Grommet	N/S
S331	Near T/O to Fuel Tank Sending Unit	N/S
S401	Right Fender Lamps	N/S
S402	Left Fender Lamps	N/S
S403	Right Fender Lamps	N/S
S404	Left Fender Lamps	N/S

AUTHENTIC RESTORATION PRODUCT

DESCRIPTION AND OPERATION (Continued)

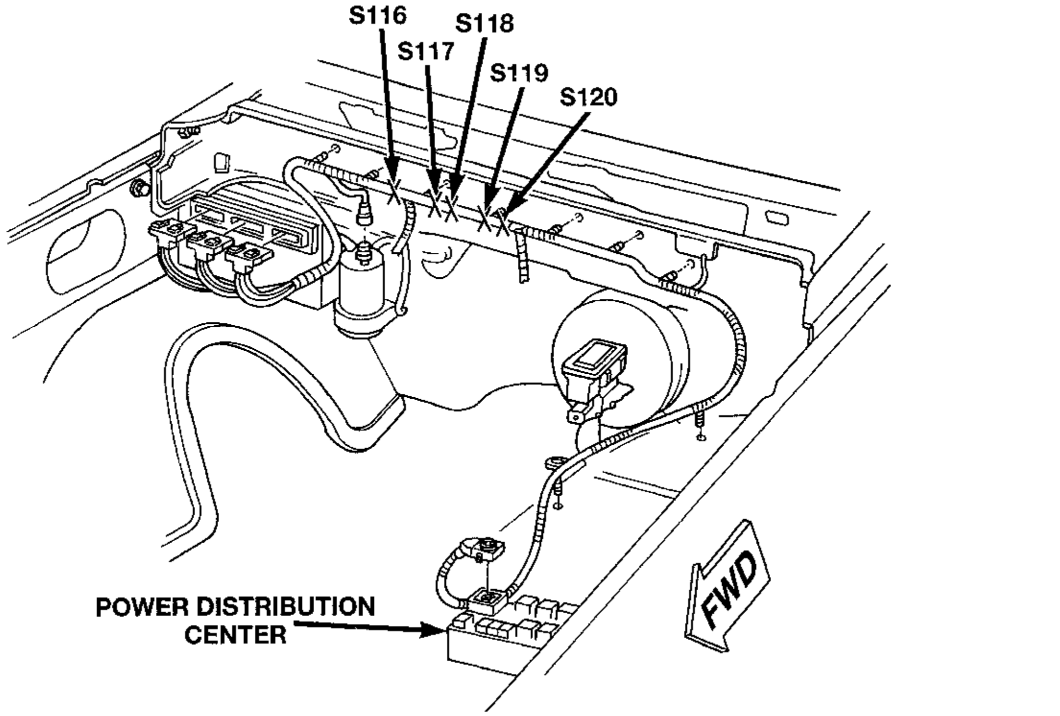

Fig. 1 Dash Panel (Gas Engines)

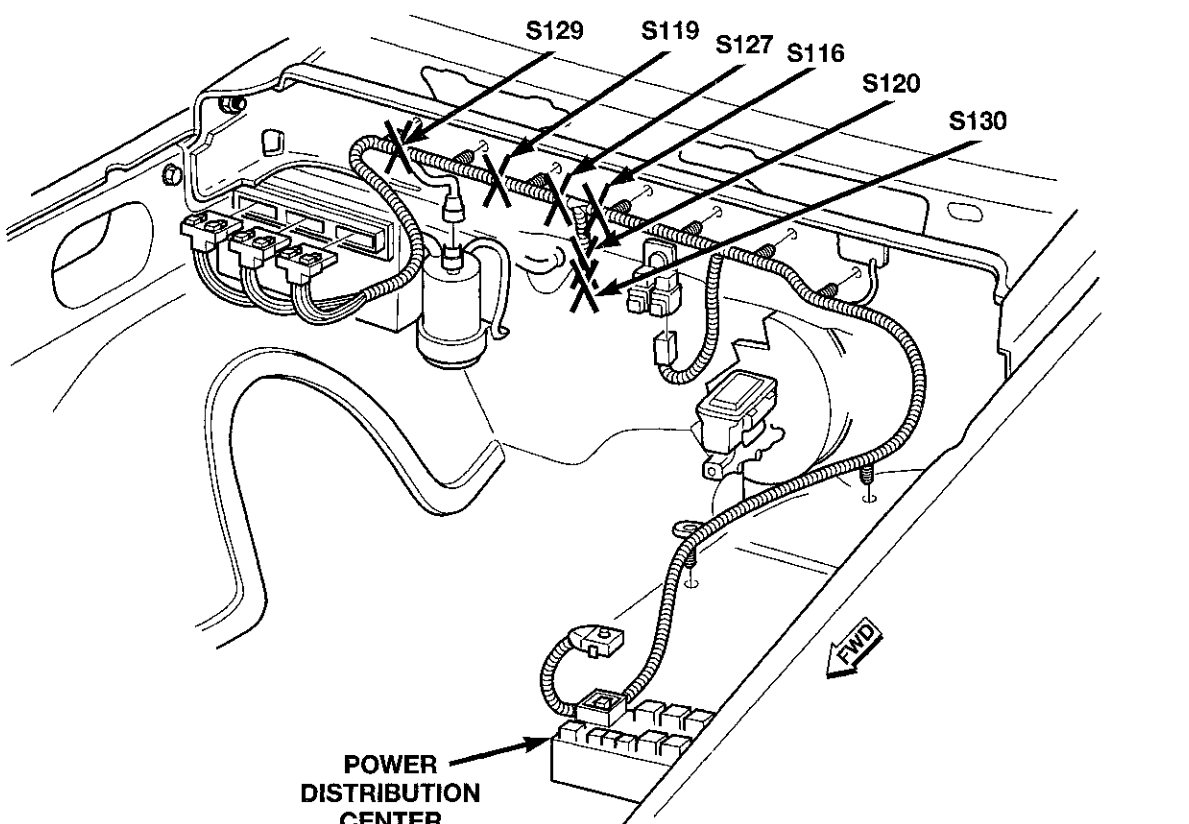

Fig. 2 Dash Panel (Diesel Engine)

Mopar AUTHENTIC RESTORATION PRODUCT

DESCRIPTION AND OPERATION (Continued)

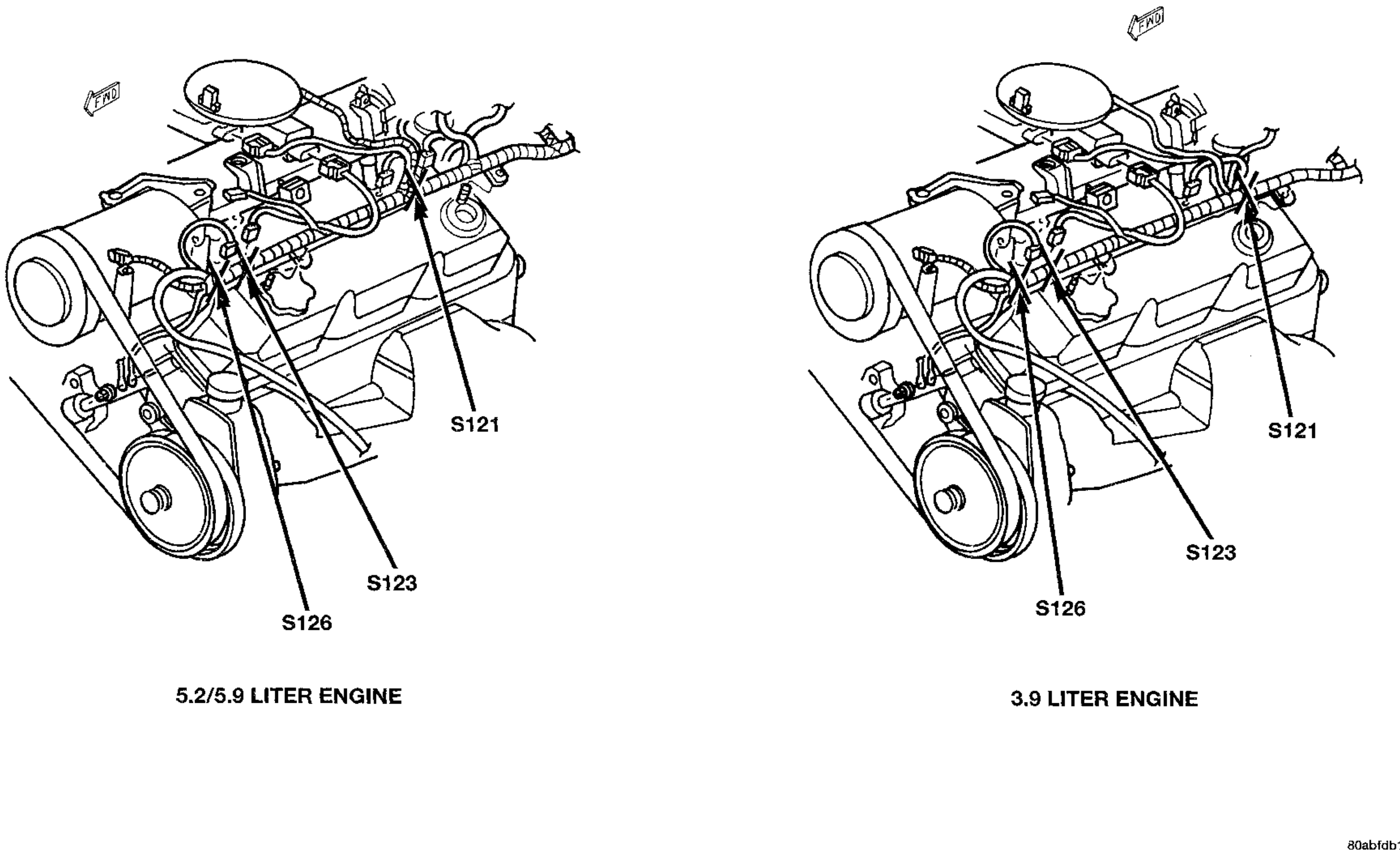

Fig. 3 3.9–5.2–5.9 Liter Engine

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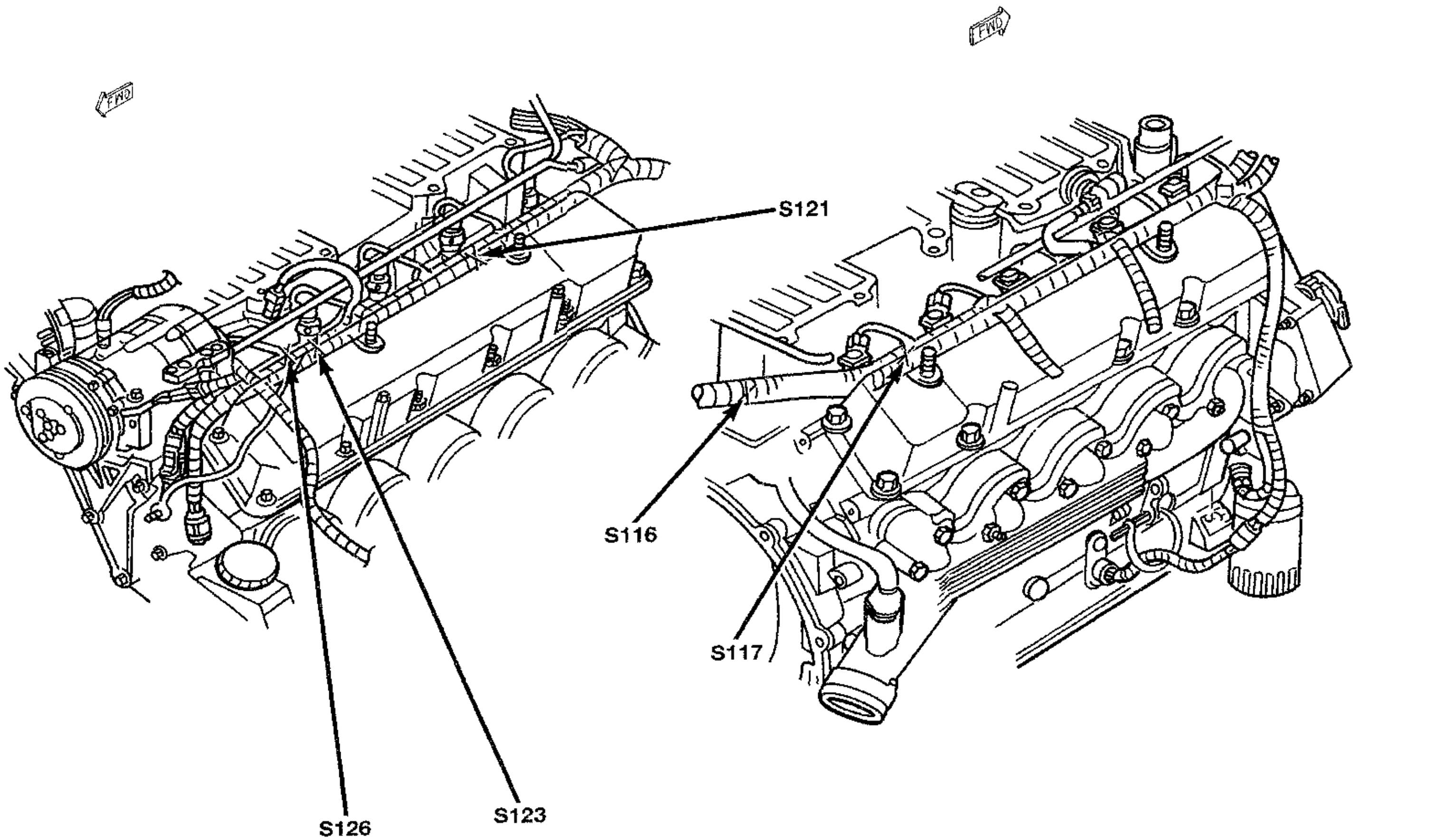

Fig. 4 8.0 Liter Engine

AUTHENTIC RESTORATION

DESCRIPTION AND OPERATION (Continued)

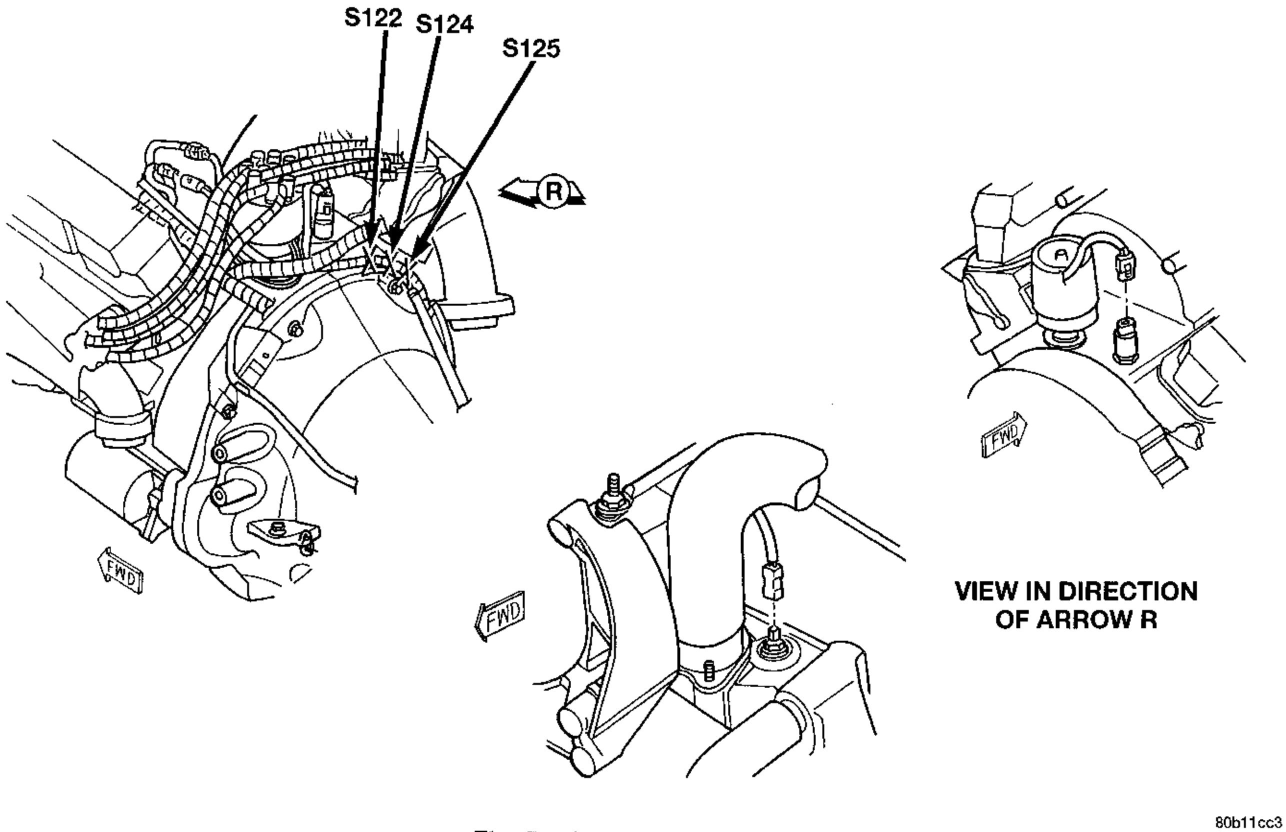

Fig. 5 5.2–5.9 Liter Engine

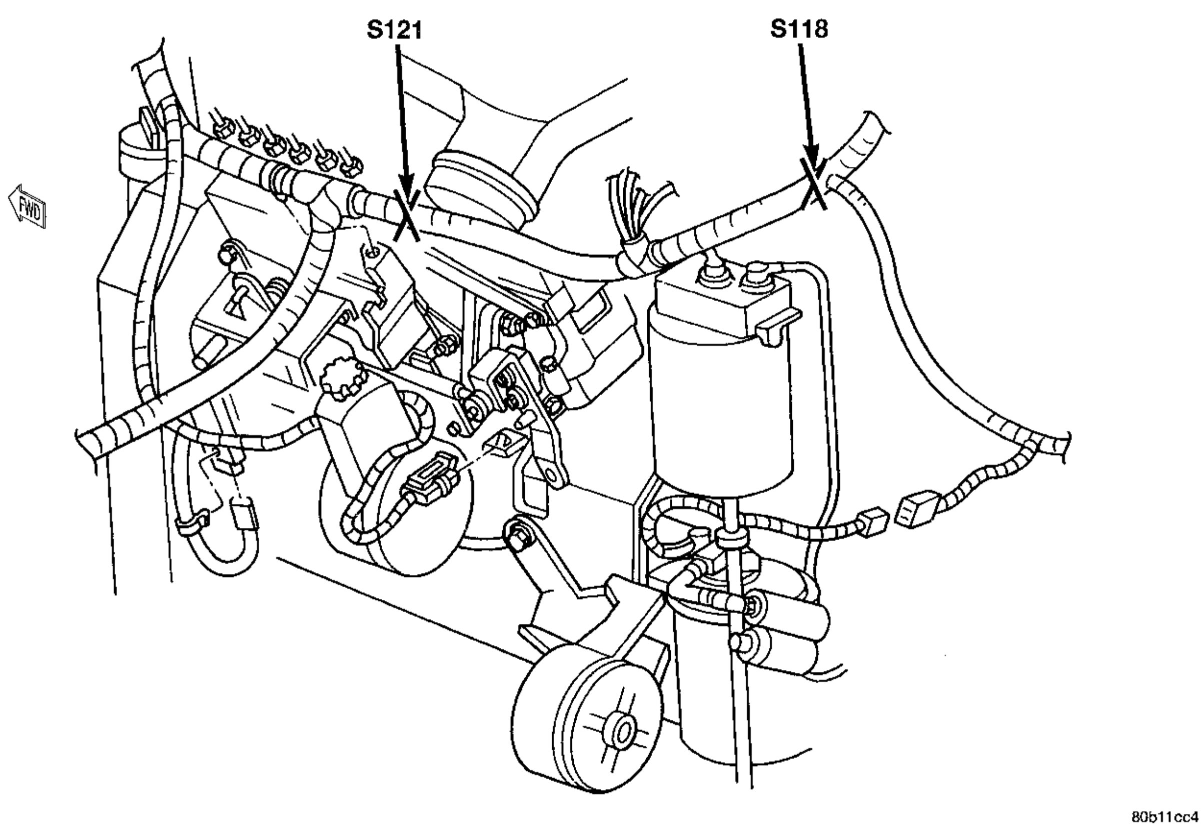

Fig. 6 Left Side Diesel Engine

AUTHENTIC RESTORATION PRODUCT

DESCRIPTION AND OPERATION (Continued)

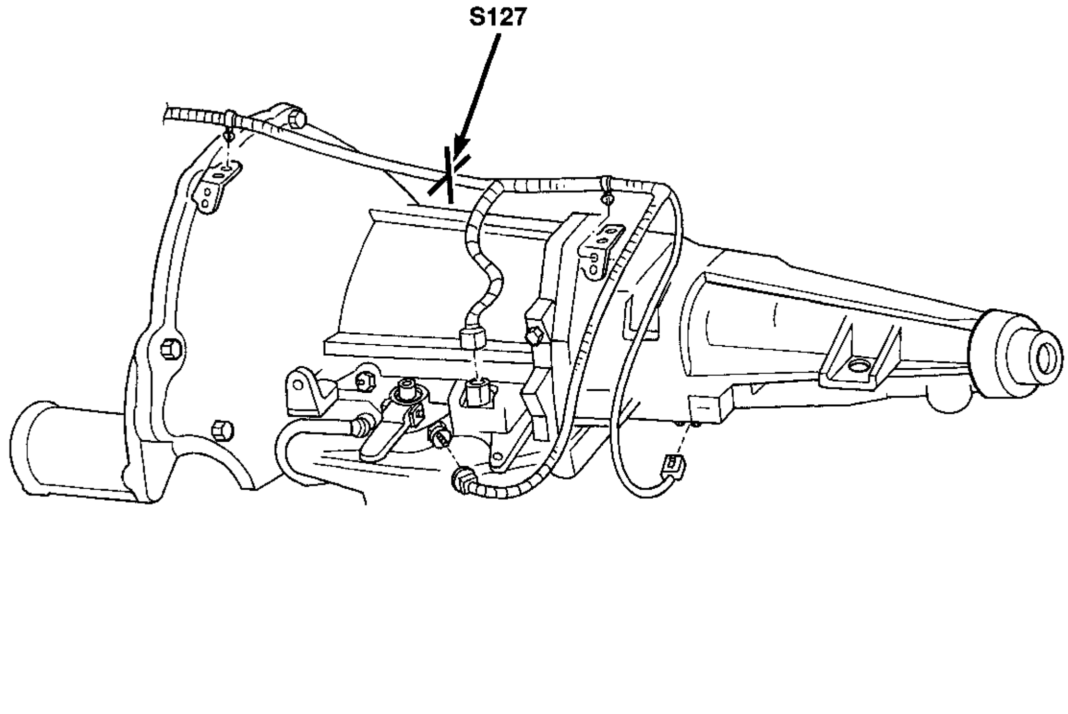

Fig. 7 Left Side Transmission

Mopar AUTHENTIC RESTORATION PRODUCT

DESCRIPTION AND OPERATION (Continued)

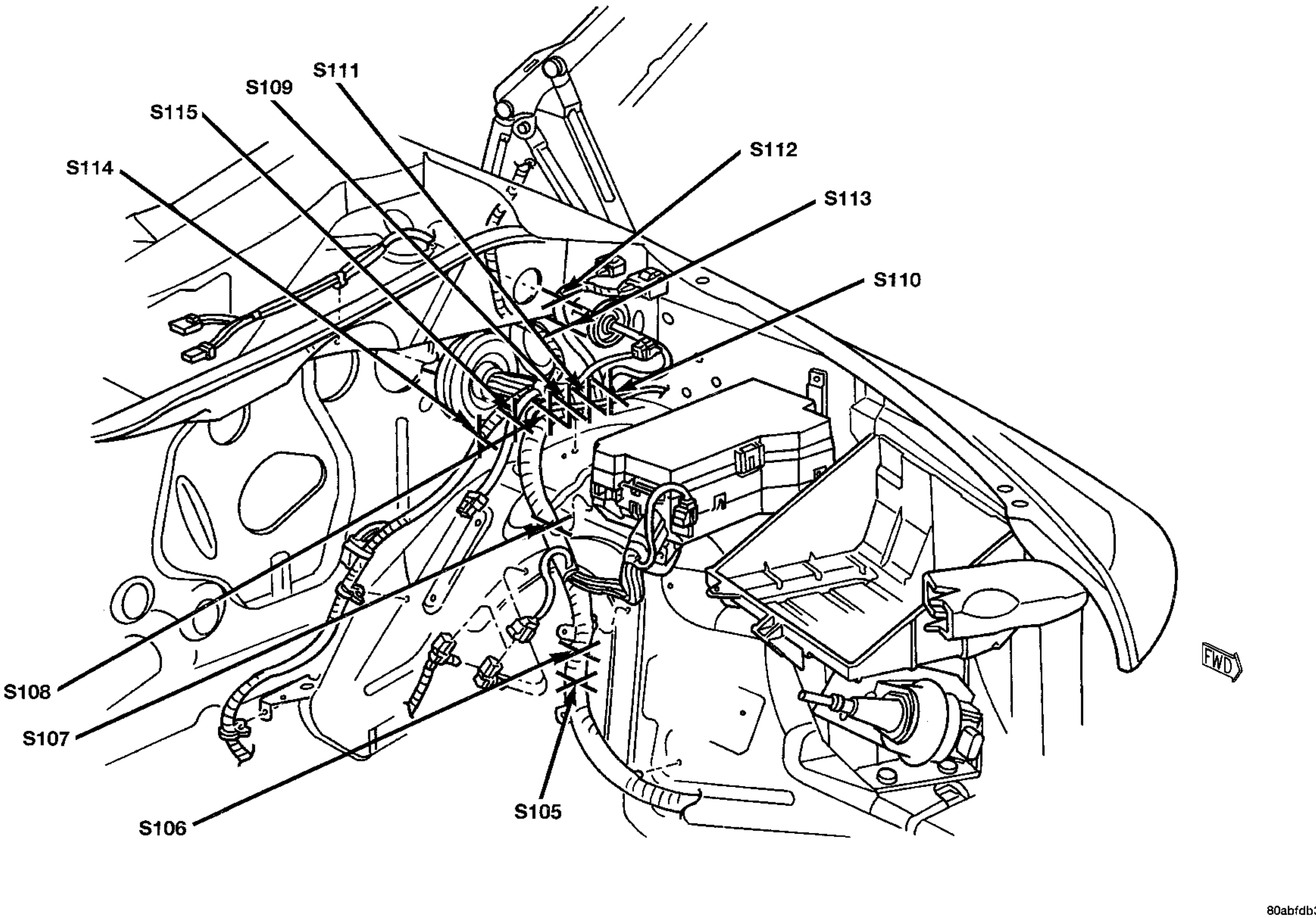

Fig. 8 Left Side Engine Compartment

AUTHENTIC RESTORATION PRODUCT

DESCRIPTION AND OPERATION (Continued)

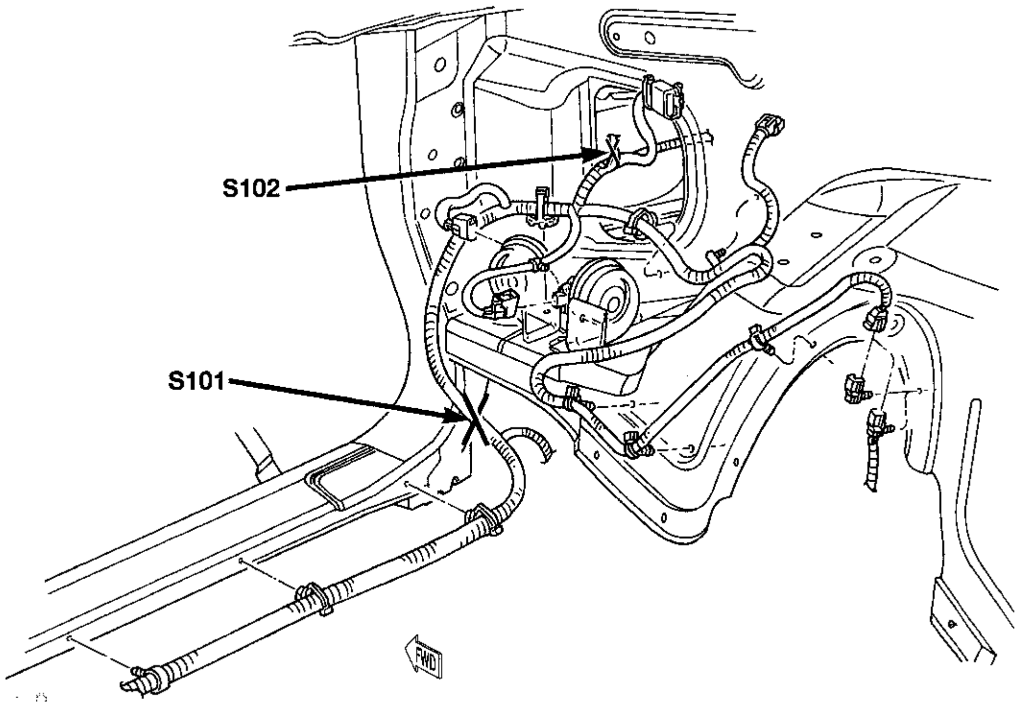

Fig. 9 Right Fender Side Shield

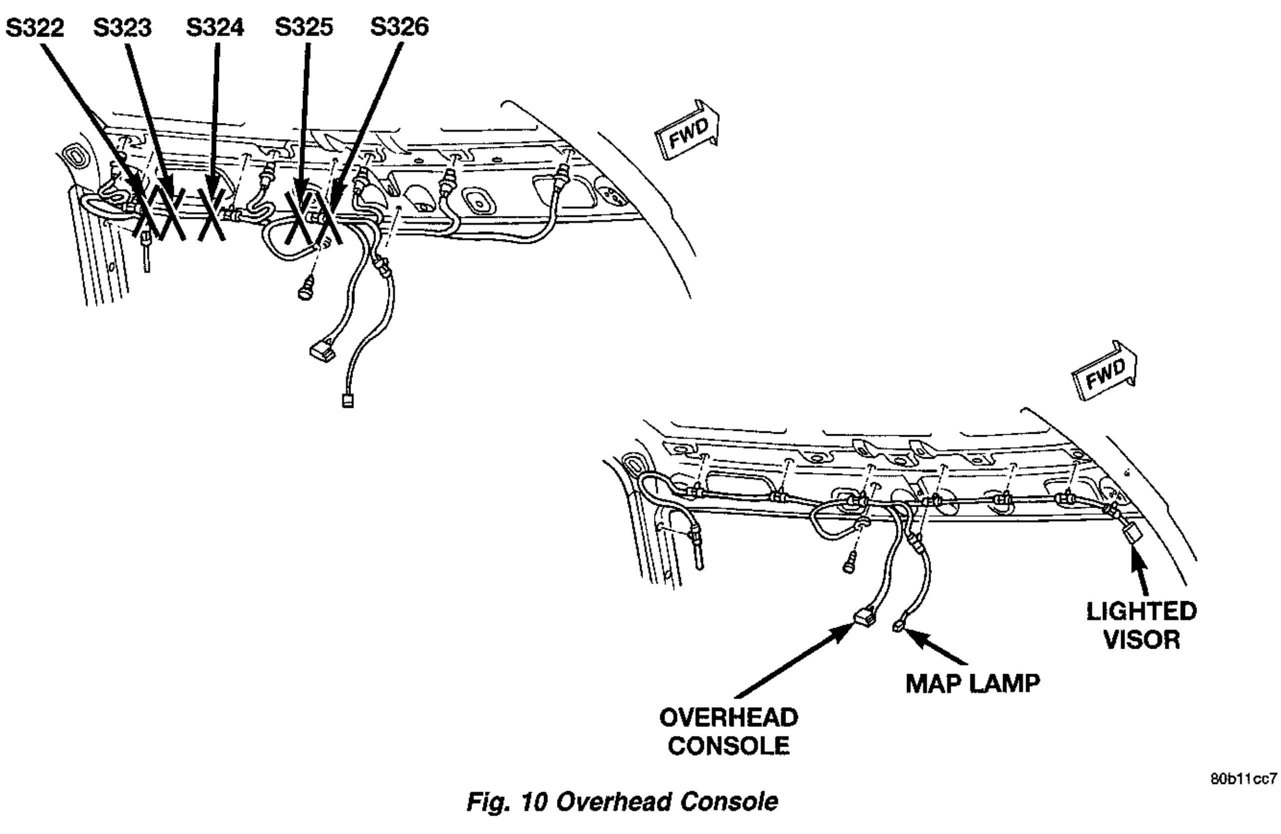

Fig. 10 Overhead Console

Mopar AUTHENTIC RESTORATION PRODUCT

DESCRIPTION AND OPERATION (Continued)

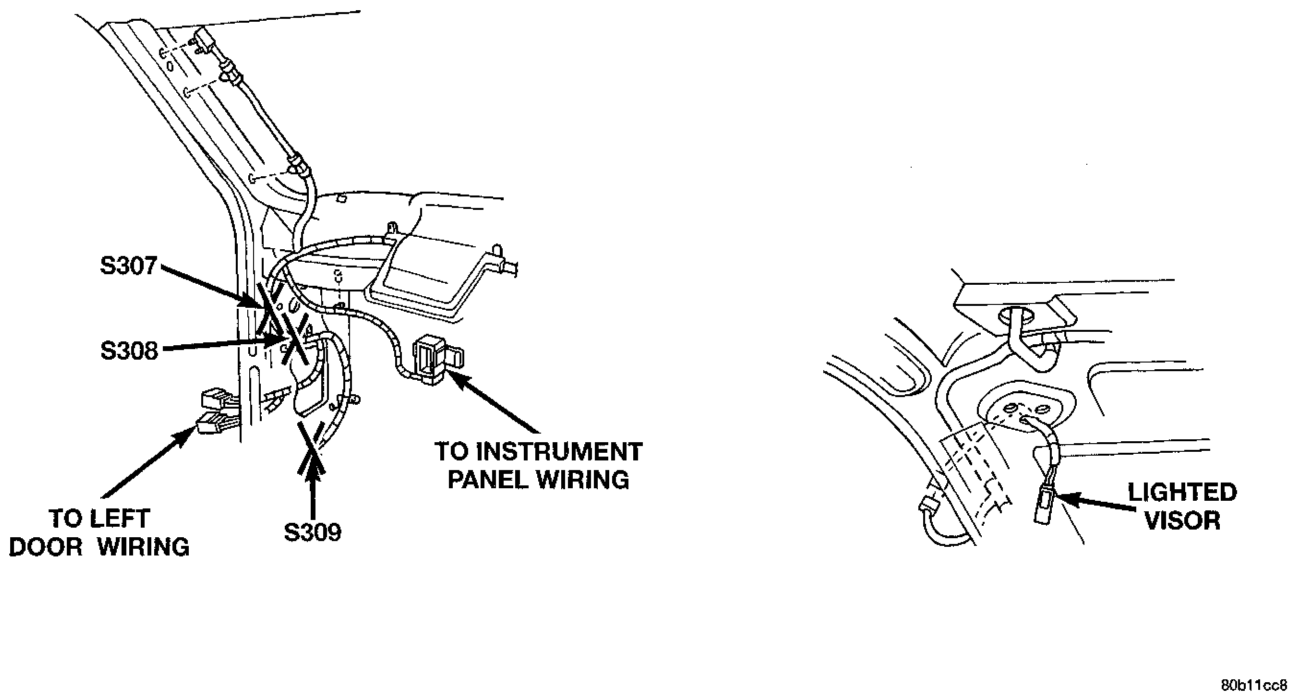

Fig. 11 Left Cowl Panel

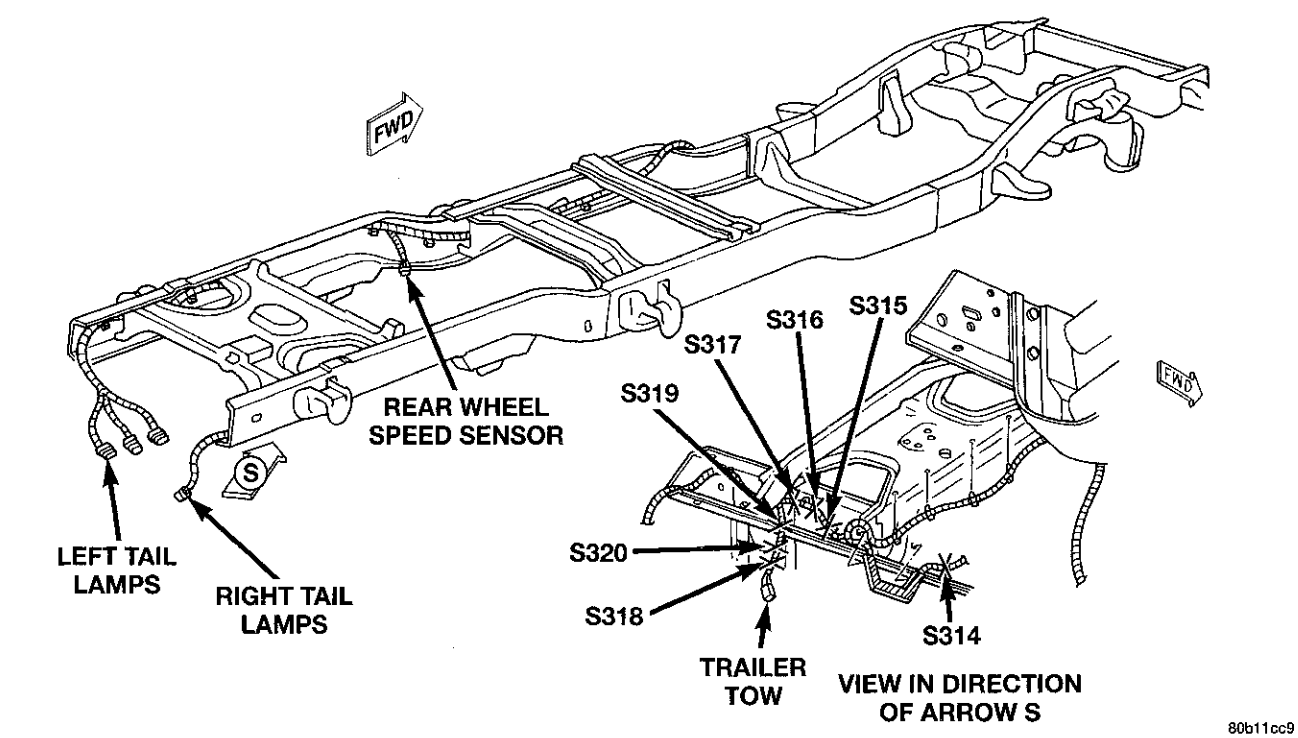

Fig. 12 Chassis

Mopar AUTHENTIC RESTORATION PRODUCT

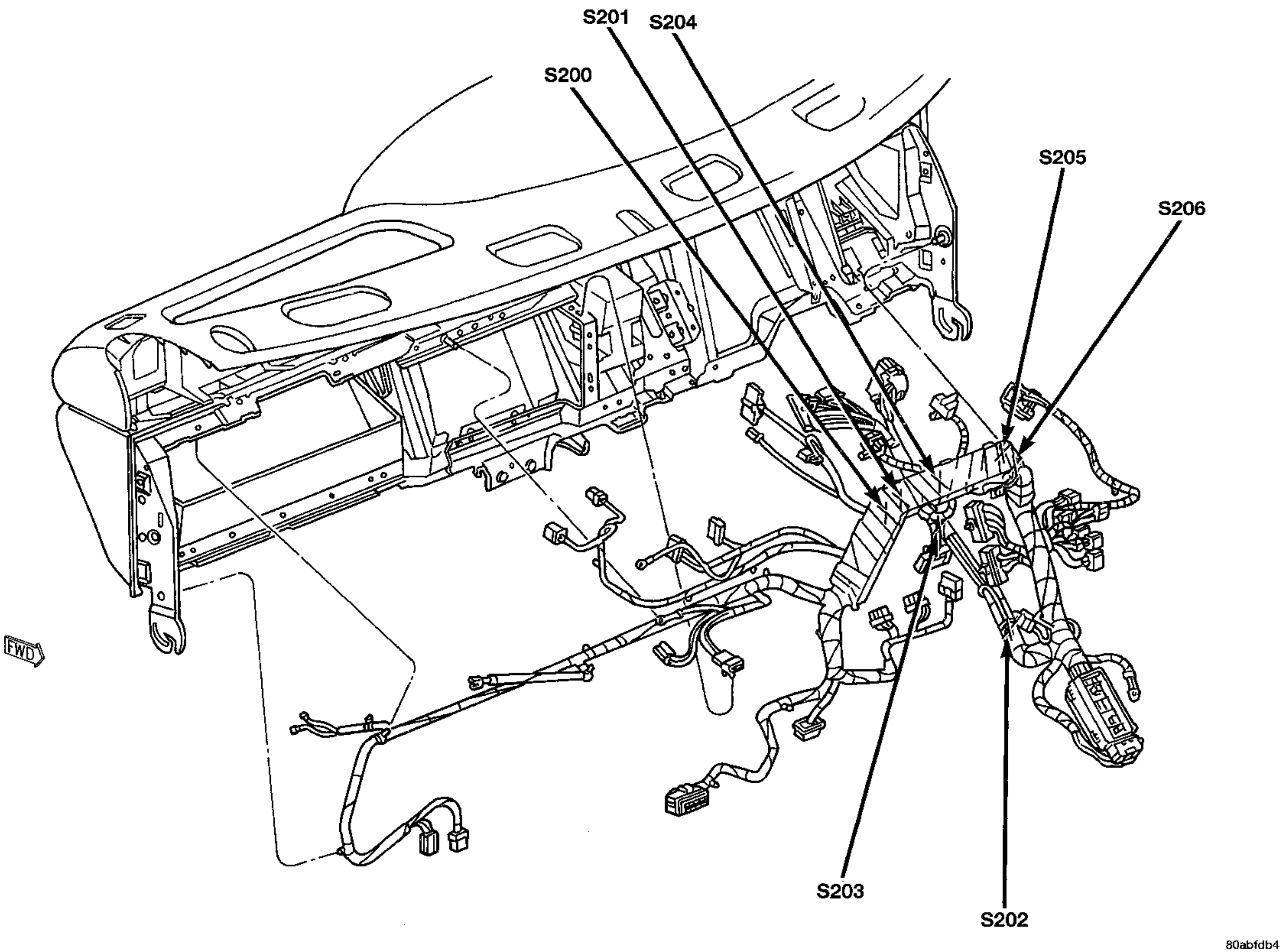

Fig. 13 Instrument Panel

AUTHENTIC RESTORATION PRODUCTS

ENGINE

CONTENTS

STANDARD SERVICE INFORMATION

INDEX

GENERAL INFORMATION

FORM-IN-PLACE GASKETS—GASOLINE ENGINES

There are several places where form-in-place gaskets are used on the engine. **DO NOT use form-in-place gasket material unless specified.** Care must be taken when applying form-in-place gaskets. Bead size, continuity, and location are of great importance. Too-thin a bead can result in leakage, while too much can result in spill-over. A continuous bead of the proper width is essential to obtain a leak-free joint.

Two types of form-in-place gasket materials are used in the engine area (Mopar® Silicone Rubber Adhesive Sealant and Mopar® Gasket Maker). Each has different properties and they cannot be used interchangeably.

MOPAR® SILICONE RUBBER ADHESIVE SEALANT

Mopar® Silicone Rubber Adhesive Sealant, normally black in color, is available in both three ounce tubes and four and one-half ounce power tubes. Moisture in the air causes the sealant material to cure. This material is normally used on flexible metal flanges. The regular tubes have a shelf life of one year and the power tubes a two year shelf life, and will not properly cure if over-aged. Always inspect the package for the expiration date before use.

MOPAR® GASKET MAKER

Mopar® Gasket Maker, normally red in color, is available in six-cc tubes. This anaerobic type gasket material cures in the absence of air when squeezed between smooth machined metallic surfaces. It will not cure if left in the uncovered tube. DO NOT use on flexible metal flanges.

SURFACE PREPARATION

Parts assembled with form-in-place gaskets may be disassembled without unusual effort. In some instances, it may be necessary to lightly tap the part with a mallet, or other suitable tool, to break the seal between the mating surfaces. A flat gasket-scraper may also be lightly tapped into the joint, but care must be taken not to damage the mating surfaces.

Scrape or wire brush all gasket surfaces to remove all loose material. Inspect stamped parts to ensure that gasket rails are flat. Flatten rails with a hammer on a flat plate, if required. Gasket surfaces must be free of oil and dirt. Be sure the old gasket material is removed from blind attaching holes.

Mopar AUTHENTIC RESTORATION PRODUCT

GENERAL INFORMATION (Continued)

GASKET APPLICATION

Assembling parts using a form-in-place gasket requires care.

Mopar® Silicone Rubber Adhesive Sealant should be applied in a continuous bead approximately 3 mm (0.12 inch) in diameter. All mounting holes must be circled. For corner sealing, a 3 or 6 mm (1/8 or 1/4 inch) drop is placed in the center of the gasket contact area. Uncured sealant may be removed with a shop towel. Components should be torqued in place while the sealant is still wet to the touch (within ten minutes). The use of a locating dowel is recommended during assembly to prevent smearing the material off location.

Mopar® Gasket Maker should be applied sparingly to one gasket surface. The sealant diameter should be 1.00 mm (0.04 inch) or less. Be certain the material surrounds each mounting hole. Excess material can be easily wiped off. Components should be torqued in place within 15 minutes. The use of a locating dowel is recommended during assembly to prevent smearing the material off location.

ENGINE PERFORMANCE—GASOLINE ENGINES

It is important that the vehicle is operating to its optimum performance level to maintain fuel economy and the lowest emission levels.

(1) Test cranking amperage draw. Refer to Group 8B, Battery/Starter/Generator Service, for the proper procedures.

(2) Tighten the intake manifold bolts. Refer to Group 11, Exhaust System and Intake Manifold, for the proper procedure and torque specifications.

(3) Clean or replace spark plugs as necessary. Adjust gap. Refer to Group 8D, Ignition System, for gap adjustment and torque specifications.

(4) Test resistance of spark plug cables. Refer to Group 8D, Ignition System, for procedure.

(5) Inspect the primary wire. Test coil output voltage, primary and secondary resistance. Replace parts as necessary. Refer to Group 8D, Ignition System, and make necessary adjustment.

(6) Set ignition timing to specifications. Refer to Specification Label on engine compartment hood. (This step does not apply to 8.0L engines.)

(7) Perform a combustion analysis.

(8) Test fuel pump for pressure and vacuum. Refer to Group 14, Fuel System, for the proper specifications.

(9) Inspect air filter element. Refer to Group 0, Lubrication and Maintenance, for the proper procedure.

(10) Inspect crankcase ventilation system. Refer to Group 0, Lubrication and Maintenance, for the proper procedure.

(11) For emissions controls, refer to Group 25, Emissions Controls System for service procedures.

(12) Inspect accessory belt drives. Refer to Group 7, Cooling System, for the proper adjustments.

(13) Road-test vehicle as a final test.

MEASURING WITH PLASTIGAGE

CRANKSHAFT MAIN BEARING CLEARANCE

Engine crankshaft bearing clearances can be determined by use of Plastigage, or equivalent. The following is the recommended procedure for the use of Plastigage:

(1) Remove oil film from surface to be checked. Plastigage is soluble in oil.

(2) The total clearance of the main bearings can be determined only by removing the weight of the crankshaft. This can be accomplished by either of two methods:

METHOD - 1 (PREFERRED)

Shim the bearings adjacent to the bearing to be checked. This will remove the clearance between upper bearing shell and the crankshaft. Place a minimum of 0.254 mm (0.010 in.) shim between the bearing shell and the adjacent bearing cap. Tighten the bolts to 18 N·m (13 ft. lbs.) torque.

- **CHECK NO. 1 BEARING:** Shim No. 2 main bearing.
- **CHECK NO. 2 BEARING:** Shim No. 1 and No. 3 main bearing.
- **CHECK NO. 3 BEARING:** Shim No. 2 and No. 4 main bearing.
- **CHECK NO. 4 BEARING:** Shim No. 3 main bearing (3.9L). Shim No. 3 and No. 5 main bearing (5.2L, 5.9L, 8.0L and 5.9L-Diesel).
- **CHECK NO.5 BEARING:** Shim No. 4 main bearing (5.2L and 5.9L). Shim No. 4 and No. 6 main bearing (8.0L and 5.9L-Diesel).
- **CHECK NO. 6 BEARING:** Shim No. 5 main bearing (8.0L). Shim No. 5 and No. 7 main bearing (5.9L-Diesel).
- **CHECK NO. 7 BEARING:** Shim No. 6 main bearing (5.9L-Diesel).

NOTE: Remove all shims before assembling engine.

METHOD - 2 (ALTERNATIVE)

Support the weight of the crankshaft with a jack placed under the counterweight adjacent to the bearing being checked.

(1) Place a piece of Plastigage across the entire width of the bearing cap shell (Fig. 1). Position the Plastigage approximately 6.35 mm (1/4 in.) off center and away from the oil holes. In addition, suspect

GENERAL INFORMATION (Continued)

areas can be checked by placing the Plastigage in that area. Tighten the bearing cap bolts of the bearing being checked to 115 N·m (85 ft. lbs.) torque. **DO NOT rotate the crankshaft or the Plastigage may be smeared, giving inaccurate results.**

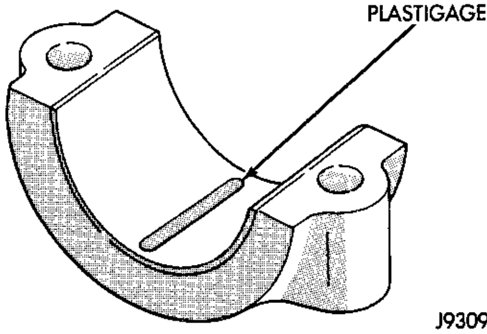

Fig. 1 Placement of Plastigage in Bearing Shell

(2) Remove the bearing cap and compare the width of the flattened Plastigage with the scale provided on the package (Fig. 2). Plastigage generally comes in two scales (one scale is in inches and the other is a metric scale). Locate the band closest to the same width. This band shows the amount of clearance. Differences in readings between the ends indicate the amount of taper present. Record all readings taken. Refer to Engine Specifications.

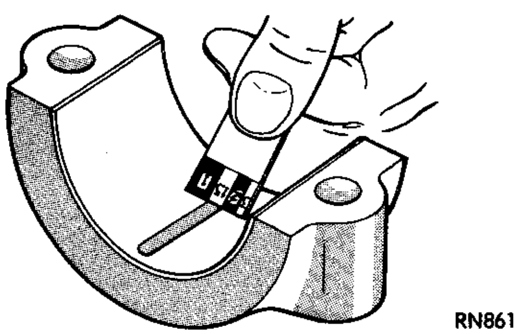

Fig. 2 Clearance Measurement

(3) Plastigage is available in a variety of clearance ranges. The 0.025-0.076 mm (0.001-0.003 in.) range is usually the most appropriate for checking engine bearing clearances.

CONNECTING ROD BEARING CLEARANCE

Engine connecting rod bearing clearances can be determined by use of Plastigage, or equivalent. The following is the recommended procedure for the use of Plastigage:

(1) Remove oil film from surface to be checked. Plastigage is soluble in oil.

(2) Place a piece of Plastigage across the entire width of the bearing cap shell (Fig. 1). Position the Plastigage approximately 6.35 mm (1/4 inch) off center and away from the oil holes. In addition, suspect areas can be checked by placing the Plastigage in the suspect area.

(3) The crankshaft must be rotated until the connecting rod to be checked starts moving toward the top of the engine. Only then should the rod cap, with Plastigage in place, be assembled. Tighten the rod cap nut to 61 N·m (45 ft. lbs.) torque. **DO NOT rotate the crankshaft or the Plastigage may be smeared, giving inaccurate results.**

(4) Remove the bearing cap and compare the width of the flattened Plastigage with the scale provided on the package (Fig. 2). Plastigage generally comes in two scales (one scale is in inches and the other is a metric scale). Locate the band closest to the same width. This band shows the amount of clearance. Differences in readings between the ends indicate the amount of taper present. Record all readings taken. Refer to Engine Specifications.

(5) Plastigage is available in a variety of clearance ranges. The 0.025-0.076 mm (0.001-0.003 in.) range is usually the most appropriate for checking engine bearing clearances.

ENGINE OIL SERVICE

WARNING: NEW OR USED ENGINE OIL CAN BE IRRITATING TO THE SKIN. AVOID PROLONGED OR REPEATED SKIN CONTACT WITH ENGINE OIL. CONTAMINANTS IN USED ENGINE OIL, CAUSED BY INTERNAL COMBUSTION, CAN BE HAZARDOUS TO YOUR HEALTH. THOROUGHLY WASH EXPOSED SKIN WITH SOAP AND WATER. DO NOT WASH SKIN WITH GASOLINE, DIESEL FUEL, THINNER, OR SOLVENTS, HEALTH PROBLEMS CAN RESULT. DO NOT POLLUTE. DISPOSE OF USED ENGINE OIL PROPERLY.

ENGINE OIL SPECIFICATION

CAUTION: Do not use non-detergent or straight mineral oil when adding or changing crankcase lubricant. Engine failure can result.

API SERVICE GRADE CERTIFIED

In gasoline engines, use an engine oil that is API Service Grade Certified (Fig. 3). In diesel engines, use an engine oil that conforms to API Service Grade CF-4 or CG-4/SH (Fig. 4). MOPAR provides engine oils that conform to all of these service grades.

Standard engine-oil identification notations have been adopted to aid in the proper selection of engine oil. The identifying notations are located on the label of engine oil plastic bottles and the top of engine oil cans.

GENERAL INFORMATION (Continued)

Fig. 3 API Service Grade Certification Label—Gasoline Engine Oil

Fig. 4 API Service Grade Certification Label—Diesel Engine Oil

SAE VISCOSITY

An SAE viscosity grade is used to specify the viscosity of engine oil. SAE 10W–30 specifies a multiple viscosity engine oil.

When choosing an engine oil, consider the range of temperatures the vehicle will be operated in before the next oil change. Select an engine oil that is best suited to your area's particular ambient temperature range and variation. For gasoline engines, refer to (Fig. 5). For diesel engines, refer to (Fig. 6).

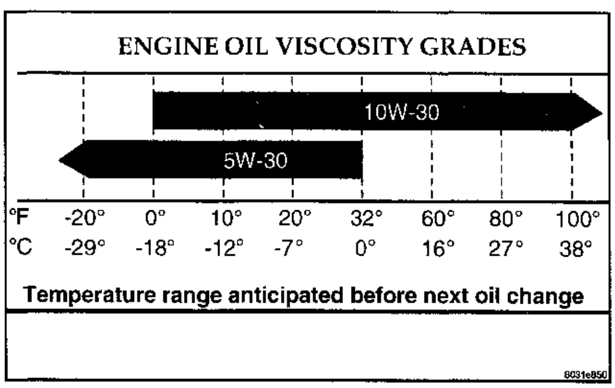

Fig. 5 Engine Oil Viscosity Recommendation—Gasoline Engines

ENERGY-CONSERVING OIL

An Energy Conserving type oil is recommended for gasoline engines. They are designated as either ENERGY CONSERVING or ENERGY CONSERVING II.

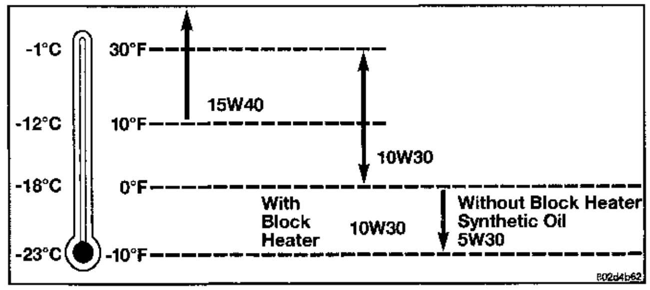

Fig. 6 Engine Oil Viscosity Recommendation—Diesel Engines

CRANKCASE OIL LEVEL INSPECTION

CAUTION: Do not overfill crankcase with engine oil, oil foaming and oil pressure loss can result.

To ensure proper lubrication of an engine, the engine oil must be maintained at an acceptable level. The acceptable oil level is in the SAFE RANGE on the engine oil dipstick (Fig. 7).

Unless the engine has exhibited loss of oil pressure, run the engine for about five minutes before checking oil level. Checking engine oil level of a cold engine is not accurate.

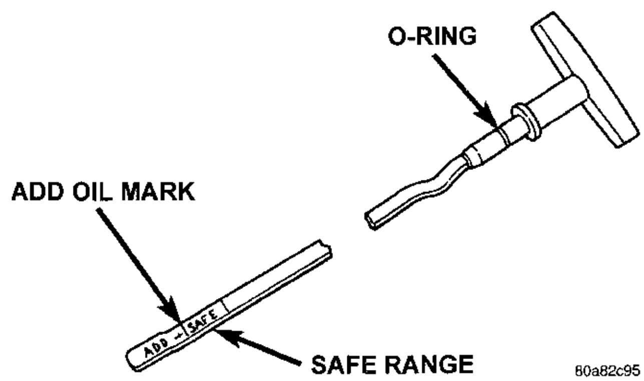

Fig. 7 Oil Level Indicator (Dipstick)

(1) Position vehicle on level surface.

(2) With engine OFF, allow approximately ten minutes for oil to settle to bottom of crankcase, remove engine oil dipstick.

(3) Wipe dipstick clean.

(4) Replace dipstick and verify it is seated in the tube.

(5) Remove dipstick, with handle held above the tip, take oil level reading.

(6) Add oil only if level is below the SAFE RANGE area on the dipstick.

(7) Replace dipstick

ENGINE OIL CHANGE

Change engine oil at mileage and time intervals described in the Maintenance Schedule.

GENERAL INFORMATION (Continued)

TO CHANGE ENGINE OIL

Run engine until normal operating temperature is achieved.

(1) Position the vehicle on a level surface and turn off engine.

(2) Hoist and support vehicle on safety stands. Refer to Hoisting and Jacking Recommendations.

(3) Remove oil fill cap.

(4) Place a suitable drain pan under crankcase drain.

(5) Remove drain plug from crankcase and allow oil to drain into pan. Inspect drain plug threads for stretching or other damage. Replace drain plug and gasket, if damaged.

(6) Install drain plug in crankcase.

(7) Lower vehicle and fill crankcase with specified type and amount of engine oil described in this section.

(8) Install oil fill cap.

(9) Start engine and inspect for leaks.

(10) Stop engine and inspect oil level.

ENGINE OIL FILTER CHANGE

FILTER SPECIFICATION

All Dodge Ram engines are equipped with a high quality full-flow, disposable type oil filter. Chrysler Corporation recommends a Mopar, or equivalent, oil filter be used.

OIL FILTER REMOVAL

(1) Position a drain pan under the oil filter.

(2) Using a suitable oil filter wrench, loosen filter.

(3) Rotate the oil filter counterclockwise to remove it from the cylinder block oil filter boss (Fig. 8).

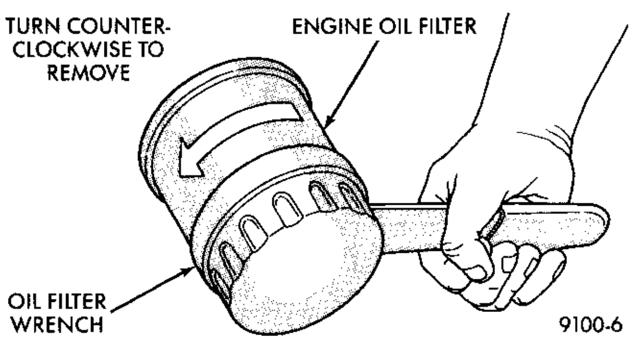

Fig. 8 Oil Filter Removal—Typical

(4) When filter separates from adapter nipple, tip gasket end upward to minimize oil spill. Remove filter from vehicle.

(5) With a wiping cloth, clean the gasket sealing surface (Fig. 9) of oil and grime.

OIL FILTER INSTALLATION

(1) Lightly lubricate oil filter gasket with engine oil or chassis grease.

(2) Thread filter onto adapter nipple. When gasket makes contact with sealing surface, (Fig. 9) hand tighten filter one full turn, do not over tighten.

(3) Add oil, verify crankcase oil level, and start engine. Inspect for oil leaks.

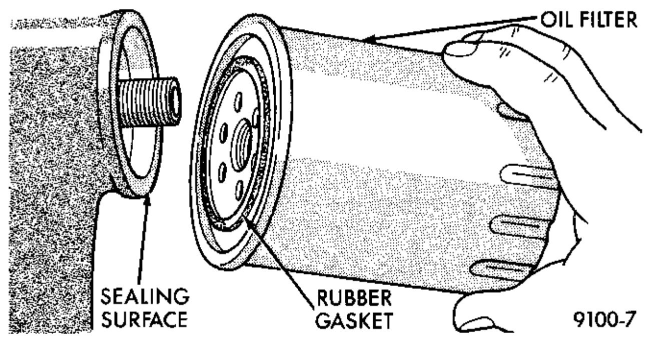

Fig. 9 Oil Filter Sealing Surface—Typical

USED ENGINE OIL DISPOSAL

Care should be exercised when disposing of used engine oil after it has been drained from a vehicle's engine.

SERVICE PROCEDURES

REPAIR DAMAGED OR WORN THREADS

Damaged or worn threads can be repaired. Essentially, this repair consists of:

- Drilling out worn or damaged threads.
- Tapping the hole with a special Heli-Coil Tap, or equivalent.
- Installing an insert into the tapped hole to bring the hole back to its original thread size.

CAUTION: Be sure that the tapped holes maintain the original center line.

Heli-Coil tools and inserts are readily available from automotive parts jobbers.

HONING CYLINDER BORES

Before honing, stuff plenty of clean shop towels under the bores and over the crankshaft to keep abrasive materials from entering the crankshaft area.

(1) Used carefully, the Cylinder Bore Sizing Hone C-823, equipped with 220 grit stones, is the best tool for this job. In addition to deglazing, it will reduce taper and out-of-round, as well as removing light scuffing, scoring and scratches. Usually, a few strokes will clean up a bore and maintain the required limits.

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SERVICE PROCEDURES (Continued)

CAUTION: DO NOT use rigid type hones to remove cylinder wall glaze.

(2) Deglazing of the cylinder walls may be done if the cylinder bore is straight and round. Use a cylinder surfacing hone, Honing Tool C-3501, equipped with 280 grit stones (C-3501-3810). about 20-60 strokes, depending on the bore condition, will be sufficient to provide a satisfactory surface. Using honing oil C-3501-3880, or a light honing oil, available from major oil distributors.

CAUTION: DO NOT use engine or transmission oil, mineral spirits, or kerosene.

(3) Honing should be done by moving the hone up and down fast enough to get a crosshatch pattern. The hone marks should INTERSECT at 50° to 60° for proper seating of rings (Fig. 10).

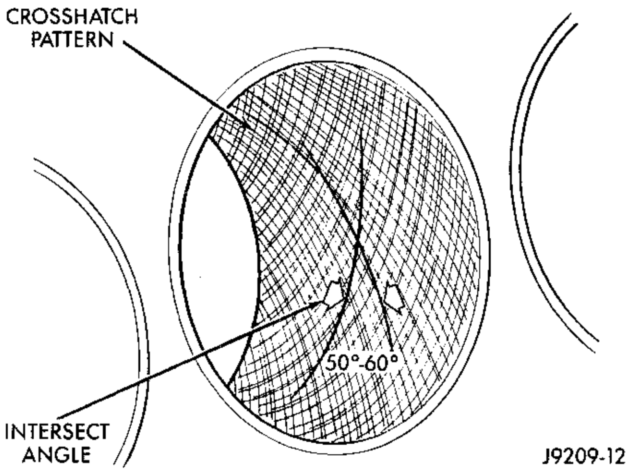

Fig. 10 Cylinder Bore Crosshatch Pattern

(4) A controlled hone motor speed between 200 and 300 RPM is necessary to obtain the proper crosshatch angle. The number of up and down strokes per minute can be regulated to get the desired 50° to 60° angle. Faster up and down strokes increase the crosshatch angle.

(5) After honing, it is necessary that the block be cleaned to remove all traces of abrasive. Use a brush to wash parts with a solution of hot water and detergent. Dry parts thoroughly. Use a clean, white, lint-free cloth to check that the bore is clean. Oil the bores after cleaning to prevent rusting.

HYDROSTATIC LOCK

When an engine is suspected of hydrostatic lock (regardless of what caused the problem), follow the steps below.

(1) Perform the Fuel Pressure Release Procedure. Refer to Group 14, Fuel System.

(2) Disconnect the negative cable from the battery.

(3) Inspect air cleaner, induction system, and intake manifold to ensure system is dry and clear of foreign material.

(4) Place a shop towel around the spark plugs or fuel injectors (diesel engine) to catch any fluid that may possibly be under pressure in the cylinder head. Remove the spark plugs or fuel injectors (diesel engine).

CAUTION: DO NOT use the starter motor to rotate the crankshaft. Severe damage could occur.

(5) With all spark plugs and injectors (diesel engine) removed, rotate the crankshaft using a breaker bar and socket.

(6) Identify the fluid in the cylinders (coolant, fuel, oil, etc.).

(7) Be sure all fluid has been removed from the cylinders.

(8) Repair engine or components as necessary to prevent this problem from occurring again.

(9) Squirt engine oil into the cylinders to lubricate the walls. This will prevent damage on restart.

(10) Install new spark plugs or fuel injectors (diesel engine). Tighten the spark plugs to 41 N·m (30 ft. lbs.) torque. Tighten the fuel injector nuts to 60 N·m (44 ft. lbs.) torque.

(11) Drain engine oil. Remove and discard the oil filter.

(12) Install the drain plug. Tighten the plug to 34 N·m (25 ft. lbs.) torque.

(13) Install a new oil filter.

(14) Fill engine crankcase with the specified amount and grade of oil. Refer to Group 0, Lubrication and Maintenance.

(15) Connect the negative cable to the battery.

(16) Start the engine and check for any leaks.

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ENGINE DIAGNOSIS

INDEX

DIAGNOSIS AND TESTING

GENERAL INFORMATION

Engine diagnosis is helpful in determining the causes of malfunctions not detected and remedied by routine maintenance.

These malfunctions may be classified as either mechanical (e.g., a strange noise), or performance (e.g., engine idles rough and stalls).

Refer to the Service Diagnosis—Mechanical Chart and the Service Diagnosis—Performance Chart, for possible causes and corrections of malfunctions. Refer to Group 14, Fuel System, for the fuel system diagnosis.

Additional tests and diagnostic procedures may be necessary for specific engine malfunctions that cannot be isolated with the Service Diagnosis charts. Information concerning additional tests and diagnosis is provided within the following:

- Cylinder Compression Pressure Test
- Cylinder Combustion Pressure Leakage Test
- Engine Cylinder Head Gasket Failure Diagnosis
- Intake Manifold Leakage Diagnosis

INTAKE MANIFOLD LEAKAGE DIAGNOSIS

An intake manifold air leak is characterized by lower than normal manifold vacuum. Also, one or more cylinders may not be functioning.

WARNING: USE EXTREME CAUTION WHEN THE ENGINE IS OPERATING. DO NOT STAND IN A DIRECT LINE WITH THE FAN. DO NOT PUT YOUR HANDS NEAR THE PULLEYS, BELTS, OR THE FAN. DO NOT WEAR LOOSE CLOTHING.

(1) Start the engine.

(2) Spray a small stream of water at the suspected leak area.

(3) If a change in RPMs, the area of the suspected leak has been found.

(4) Repair as required.

CYLINDER COMPRESSION PRESSURE TEST

The results of a cylinder compression pressure test can be utilized to diagnose several engine malfunctions.

Ensure the battery is completely charged and the engine starter motor is in good operating condition. Otherwise, the indicated compression pressures may not be valid for diagnosis purposes.

(1) Clean the spark plug recesses with compressed air.

(2) Remove the spark plugs.

(3) Secure the throttle in the wide-open position.

(4) Disconnect the ignition coil.

(5) Insert a compression pressure gauge and rotate the engine with the engine starter motor for three revolutions.

(6) Record the compression pressure on the third revolution. Continue the test for the remaining cylinders.

Refer to Engine Specifications for the correct engine compression pressures.

ENGINE CYLINDER HEAD GASKET FAILURE DIAGNOSIS

A leaking engine cylinder head gasket usually results in loss of power, loss of coolant, and engine misfiring.

An engine cylinder head gasket leak can be located between adjacent cylinders or between a cylinder and the adjacent water jacket.

- An engine cylinder head gasket leaking between adjacent cylinders is indicated by a loss of power and/or engine misfire.
- An engine cylinder head gasket leaking between a cylinder and an adjacent water jacket is indicated by coolant foaming or overheating and loss of coolant.

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DIAGNOSIS AND TESTING (Continued)

CYLINDER-TO-CYLINDER LEAKAGE TEST

To determine if an engine cylinder head gasket is leaking between adjacent cylinders, follow the procedures outlined in Cylinder Compression Pressure Test. An engine cylinder head gasket leaking between adjacent cylinders will result in approximately a 50-70% reduction in compression pressure.

CYLINDER-TO-WATER JACKET LEAKAGE TEST

WARNING: USE EXTREME CAUTION WHEN THE ENGINE IS OPERATING. DO NOT STAND IN A DIRECT LINE WITH THE FAN. DO NOT PUT YOUR HANDS NEAR THE PULLEYS, BELTS, OR THE FAN. DO NOT WEAR LOOSE CLOTHING.

Remove the radiator cap.

Start the engine and allow it to warm up until the engine thermostat opens.

If a large combustion/compression pressure leak exists, bubbles will be visible in the coolant.

If bubbles are not visible, install a radiator pressure tester and pressurize the coolant system.

If a cylinder is leaking combustion pressure into the water jacket, the tester pointer will pulsate with every combustion stroke of the cylinder.

CYLINDER COMBUSTION PRESSURE LEAKAGE TEST

The combustion pressure leakage test provides an accurate means for determining engine condition.

Combustion pressure leakage testing will detect:

- Exhaust and intake valve leaks (improper seating)
- Leaks between adjacent cylinders or into water jacket
- Any causes for combustion/compression pressure loss

WARNING: DO NOT REMOVE THE RADIATOR CAP WITH THE SYSTEM HOT AND UNDER PRESSURE. SERIOUS BURNS FROM HOT COOLANT CAN OCCUR.

Check the coolant level and fill as required. DO NOT install the radiator cap.

Start and operate the engine until it attains normal operating temperature, then turn OFF the engine.

Remove the spark plugs.

Remove the oil filler cap.

Remove the air cleaner.

Calibrate the tester according to the manufacturer's instructions. The shop air source for testing should maintain 483 kPa (70 psi) minimum, 1,379 kPa (200 psi) maximum and 552 kPa (80 psi) recommended.

Perform the test procedure on each cylinder according to the tester manufacturer's instructions. While testing, listen for pressurized air escaping through the throttle body, tailpipe or oil filler cap opening. Check for bubbles in the radiator coolant.

All gauge pressure indications should be equal, with no more than 25% leakage.

FOR EXAMPLE: At 552 kPa (80 psi) input pressure, a minimum of 414 kPa (60 psi) should be maintained in the cylinder.

Refer to the Cylinder Combustion Pressure Leakage Test Diagnosis chart.

INSPECTION (ENGINE OIL LEAKS IN GENERAL)

Begin with a through visual inspection of the engine, particularly at the area of the suspected leak. If an oil leak source is not readily identifiable, the following steps should be followed:

(1) Do not clean or degrease the engine at this time because some solvents may cause rubber to swell, temporarily stopping the leak.

(2) Add an oil-soluble dye (use as recommended by manufacturer). Start the engine and let idle for approximately 15 minutes. Check the oil dipstick to be sure the dye is thoroughly mixed as indicated with a bright yellow color under a black light source.

(3) Using a black light, inspect the entire engine for fluorescent dye, particularly at the suspected area of oil leak. If the oil leak is found and identified, repair per service manual instructions.

(4) If dye is not observed, drive the vehicle at various speeds for approximately 24km (15 miles), and repeat previous step.

(5) If the oil leak source is not positively identified at this time, proceed with the air leak detection test method as follows:

(6) Disconnect the breather cap to air cleaner hose at the breather cap end. Cap or plug breather cap nipple.

(7) Remove the PCV valve from the cylinder head cover. Cap or plug the PCV valve grommet.

(8) Attach an air hose with pressure gauge and regulator to the dipstick tube.

CAUTION: Do not subject the engine assembly to more than 20.6 kpa (3 PSI) of test pressure.

(9) Gradually apply air pressure from 1 psi to 2.5 psi maximum while applying soapy water at the suspected source. Adjust the regulator to the suitable test pressure that provide the best bubbles which will pinpoint the leak source. If the oil leak is detected and identified, repair per service manual procedures.

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DIAGNOSIS AND TESTING (Continued)

(10) If the leakage occurs at the rear oil seal area, refer to the section, Inspection for Rear Seal Area Leak.

(11) If no leaks are detected, turn off the air supply and remove the air hose and all plugs and caps. Install the PCV valve and breather cap hose. Proceed to next step.

(12) Clean the oil off the suspect oil leak area using a suitable solvent. Drive the vehicle at various speeds approximately 24 km (15 miles). Inspect the engine for signs of an oil leak by using a black light.

INSPECTION FOR REAR SEAL AREA LEAKS

Since it is sometimes difficult to determine the source of an oil leak in the rear seal area of the engine, a more involved inspection is necessary. The following steps should be followed to help pinpoint the source of the leak.

If the leakage occurs at the crankshaft rear oil seal area:

(1) Disconnect the battery.

(2) Raise the vehicle.

(3) Remove torque converter or clutch housing cover and inspect rear of block for evidence of oil. Use a black light to check for the oil leak:

(a) Circular spray pattern generally indicates seal leakage or crankshaft damage.

(b) Where leakage tends to run straight down, possible causes are a porous block, distributor seal, camshaft bore cup plugs, oil galley pipe plugs, oil filter runoff, and main bearing cap to cylinder block mating surfaces. See Group 9, Engines, for proper repair procedures of these items.

(4) If no leaks are detected, pressurized the crankcase as outlined in the section, Inspection (Engine oil Leaks in general)

CAUTION: Do not exceed 20.6 kPa (3 psi).

(5) If the leak is not detected, very slowly turn the crankshaft and watch for leakage. If a leak is detected between the crankshaft and seal while slowly turning the crankshaft, it is possible the crankshaft seal surface is damaged. The seal area on the crankshaft could have minor nicks or scratches that can be polished out with emery cloth.

CAUTION: Use extreme caution when crankshaft polishing is necessary to remove minor nicks or scratches. The crankshaft seal flange is specially machined to complement the function of the rear oil seal.

(6) For bubbles that remain steady with shaft rotation, no further inspection can be done until disassembled. Refer to the service Diagnosis—Mechanical, under the Oil Leak row, for components inspections on possible causes and corrections.

(7) After the oil leak root cause and appropriate corrective action have been identified, Refer to Group 9, Engines—Crankshaft Rear Oil Seals, for proper replacement procedures.

HYDRAULIC TAPPETS

Before disassembling any part of the engine to correct tappet noise, check the oil pressure. If vehicle has no oil pressure gauge, install a reliable gauge at the pressure sending-unit. The pressure should be between 207-552 kPa (30-80 psi) at 3,000 RPM.

Check the oil level after the engine reaches normal operating temperature. Allow 5 minutes to stabilize oil level, check dipstick. The oil level in the pan should never be above the FULL mark or below the ADD OIL mark on dipstick. Either of these two conditions could be responsible for noisy tappets.

OIL LEVEL

HIGH

If oil level is above the FULL mark, it is possible for the connecting rods to dip into the oil. With the engine running, this condition could create foam in the oil pan. Foam in oil pan would be fed to the hydraulic tappets by the oil pump causing them to lose length and allow valves to seat noisily.

LOW

Low oil level may allow oil pump to take in air. When air is fed to the tappets, they lose length, which allows valves to seat noisily. Any leaks on intake side of oil pump through which air can be drawn will create the same tappet action. Check the lubrication system from the intake strainer to the pump cover, including the relief valve retainer cap. When tappet noise is due to aeration, it may be intermittent or constant, and usually more than one tappet will be noisy. When oil level and leaks have been corrected, operate the engine at fast idle. Run engine for a sufficient time to allow all of the air inside the tappets to be bled out.

TAPPET NOISE DIAGNOSIS

(1) To determine source of tappet noise, operate engine at idle with cylinder head covers removed.

(2) Feel each valve spring or rocker arm to detect noisy tappet. The noisy tappet will cause the affected spring and/or rocker arm to vibrate or feel rough in operation.

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DIAGNOSIS AND TESTING (Continued)

NOTE: Worn valve guides or cocked springs are sometimes mistaken for noisy tappets. If such is the case, noise may be dampened by applying side thrust on the valve spring. If noise is not appreciably reduced, it can be assumed the noise is in the tappet. Inspect the rocker arm push rod sockets and push rod ends for wear.

(3) Valve tappet noise ranges from light noise to a heavy click. A light noise is usually caused by excessive leak-down around the unit plunger, or by the plunger partially sticking in the tappet body cylinder. The tappet should be replaced. A heavy click is caused by a tappet check valve not seating, or by foreign particles wedged between the plunger and the tappet body. This will cause the plunger to stick in the down position. This heavy click will be accompanied by excessive clearance between the valve stem and rocker arm as valve closes. In either case, tappet assembly should be removed for inspection and cleaning.

(4) The valve train generates a noise very much like a light tappet noise during normal operation. Care must be taken to ensure that tappets are making the noise. If more than one tappet seems to be noisy, it's probably not the tappets.

ENGINE OIL PRESSURE

(1) Remove oil pressure sending unit.

(2) Install Oil Pressure Line and Gauge Tool C-3292. Start engine and record pressure. Refer to Oil Pressure in Engine Specifications for the proper pressures.

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DIAGNOSIS AND TESTING (Continued)

SERVICE DIAGNOSIS—GASOLINE ENGINES

PERFORMANCE DIAGNOSIS CHART—GASOLINE ENGINES

CONDITION	POSSIBLE CAUSES	CORRECTION
ENGINE WILL NOT CRANK	1. Weak or dead battery	1. Charge/Replace Battery. Refer to Group 8A, Battery, for correct procedures. Check charging system. Refer to Group 8C, Charging Systems, for correct procedures.
	2. Corroded or loose battery connections	2. Clean/tighten suspect battery/ starter connections
	3. Faulty starter or related circuit(s)	3. Check starting system. Refer to Group 8B, Starting Systems, for correct diagnostics/procedures
	4. Seized accessory drive component	4. Remove accessory drive belt and attempt to start engine. If engine starts, repair/replace seized component.
	5. Engine internal mechanical failure or hydro-static lock	5. Refer to Group 9, Engine, for correct diagnostics/procedures
ENGINE CRANKS BUT WILL NOT START	1. No spark	1. Check for spark. Refer to Group 8D, Ignition System, for correct procedures.
	2. No fuel	2. Perform fuel pressure test, and if necessary, inspect fuel injector(s) and driver circuits. Refer to Group 14, Fuel System, for correct procedures.
	3. Low or no engine compression	3. Perform cylinder compression pressure test. Refer to Group 9, Engine, for correct procedures.
ENGINE LOSS OF POWER	1. Worn or burned distributor rotor	1. Install new distributor rotor
	2. Worn distributor shaft	2. Remove and repair distributor (Refer to group 8D, Ignition System
	3. Worn or incorrect gapped spark plugs	3. Clean plugs and set gap. (Refer to group 8D, Ignition System)
	4. Dirt or water in fuel system	4. Clean system and replace fuel filter
	5. Faulty fuel pump	5. Install new fuel pump
	6. Incorrect valve timing	6. Correct valve timing
	7. Blown cylinder head gasket	7. Install new cylinder head gasket
	8. Low compression	8. Test cylinder compression
	9. Burned, warped, or pitted valves	9. Install/Reface valves as necessary
	10. Plugged or restricted exhaust system	10. Install new parts as necessary
	11. Faulty ignition cables	11. Replace any cracked or shorted cables
	12. Faulty ignition coil	12. Test and replace, as necessary (Refer to Group 8D, ignition system)

DIAGNOSIS AND TESTING (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
ENGINE STALLS OR ROUGH IDLE	1. Carbon build-up on throttle plate	1. Remove throttle body and de-carbon. (Refer to Group 14 for correct procedures)
	2. Engine idle speed too low	2. Check Idle Air Control circuit. (Refer to Group 14, Fuel System)
	3. Worn or incorrectly gapped spark plugs	3. Replace or clean and re-gap spark plugs (Refer to group 8D, Ignition System)
	4. Worn or burned distributor rotor	4. Install new distributor rotor
	5. Spark plug cables defective or crossed	5. Check for correct firing order or replace spark plug cables. (Refer to Group 8D, Ignition System for correct procedures.)
	6. Faulty coil	6. Test and replace, if necessary (Refer to group 8D, Ignition System)
	7. Intake manifold vacuum leak	7. Inspect intake manifold gasket and vacuum hoses. Replace if necessary (Refer to Group 11, Exhaust System & Intake Manifold)
	8. EGR valve leaking or stuck open	8. Test and replace, if necessary (Refer to group 25, Emission Control Systems)
ENGINE MISSES ON ACCELERATION	1. Worn or incorrectly gapped spark plugs	1. Replace spark plugs or clean and set gap. (Refer to group 8D, Ignition System)
	2. Spark plug cables defective or crossed	2. Replace or rewire secondary ignition cables. Refer to Group 8D, Ignition System
	3. Dirt in fuel system	3. Clean fuel system
	4. Burned, warped or pitted valves	4. Install new valves
	5. Faulty coil	5. Test and replace as necessary (refer to group 8D, Ignition System)

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DIAGNOSIS AND TESTING (Continued)

MECHANICAL DIAGNOSIS CHART—GASOLINE ENGINES

CONDITION	POSSIBLE CAUSES	CORRECTION
NOISY VALVES/LIFTERS	1. High or low oil level in crankcase	1. Check for correct oil level. Adjust oil level by draining or adding as needed
	2. Thin or diluted oil	2. Change oil (Refer to Engine Oil Service in this group)
	3. Low oil pressure	3. Check engine oil level. If ok, Perform oil pressure test. Refer to this group for engine oil pressure test/specifications
	4. Dirt in tappets/lash adjusters	4. Clean/replace hydraulic tappets/lash adjusters
	5. Bent push rod(s)	5. Install new push rods
	6. Worn rocker arms	6. Inspect oil supply to rocker arms and replace worn arms as needed
	7. Worn tappets/lash adjusters	7. Install new hydraulic tappets/lash adjusters
	8. Worn valve guides	8. Inspect all valve guides and replace as necessary
	9. Excessive runout of valve seats or valve faces	9. Grind valves and seats
CONNECTING ROD NOISE	1. Insufficient oil supply	1. Check engine oil level. (Refer to group 0, Lubrication and Maintenance)
	2. Low oil pressure	2. Check engine oil level. If ok, Perform oil pressure test. Refer to this group for engine oil pressure test/specifications
	3. Thin or diluted oil	3. Change oil to correct viscosity. Refer to this group for correct procedure/engine oil specifications
	4. Excessive connecting rod bearing clearance	Measure bearings for correct clearance with plasti-gage. Repair as necessary
	5. Connecting rod journal out of round	5. Replace crankshaft or grind journals
	6. Misaligned connecting rods	6. Replace bent connecting rods
MAIN BEARING NOISE	1. Insufficient oil supply	1. Check engine oil level. (Refer to group 0, Lubrication and Maintenance)
	2. Low oil pressure	2. Check engine oil level. If ok, Perform oil pressure test. Refer to this group for engine oil pressure test/specifications
	3. Thin or diluted oil	3. Change oil to correct viscosity. Refer to this group for correct procedure/engine oil specifications
	4. Excessive main bearing clearance	4. Measure bearings for correct clearance. Repair as necessary
	5. Excessive end play	5. Check crankshaft thrust bearing for excessive wear on flanges

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DIAGNOSIS AND TESTING (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
	6. Crankshaft main journal out of round or worn 7. Loose flywheel or torque converter	6. Grind journals or replace crankshaft 7. Inspect crankshaft, flexplate/ flywheel and bolts for damage. Tighten to correct torque
LOW OIL PRESSURE	1. Low oil level 2. Faulty oil pressure sending unit 3. Clogged oil filter 4. Worn oil pump 5. Thin or diluted oil 6. Excessive bearing clearance 7. Oil pump relief valve stuck 8. Oil pump suction tube loose, broken, bent or clogged 9. Oil pump cover warped or cracked	1. Check oil level and fill if necessary 2. Install new sending unit 3. Install new oil filter 4. Replace worn gears or oil pump assy 5. Change oil to correct viscosity. Refer to this group for correct procedure/engine oil specifications 6. Measure bearings for correct clearance 7. Remove valve to inspect, clean and reinstall 8. Inspect suction tube and clean or replace if necessary 9. Install new oil pump
OIL LEAKS	1. Misaligned or deteriorated gaskets 2. Loose fastener, broken or porous metal part 3. Front or rear crankshaft oil seal leaking 4. Leaking oil gallery plug or cup plug	1. Replace gasket 2. Tighten, repair or replace the part 3. Replace seal 4. Remove and reseal threaded plug. Replace cup style plug
EXCESSIVE OIL CONSUMPTION OR SPARK PLUGS OIL FOULED	1. PCV System malfunction 2. Defective valve stem seal(s) 3. Worn or broken piston rings 4. Scuffed pistons/cylinder walls 5. Carbon in oil control ring groove 6. Worn valve guides 7. Piston rings fitted too tightly in grooves	1. Refer to group 25, Emission Control System for correct operation 2. Repair or replace seal(s) 3. Hone cylinder bores. Install new rings 4. Hone cylinder bores and replace pistons as required 5. Remove rings and de-carbon piston 6. Inspect/replace valve guides as necessary 7. Remove rings and check ring end gap and side clearance. Replace if necessary

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DIAGNOSIS AND TESTING (Continued)

SERVICE DIAGNOSIS—DIESEL ENGINES

PERFORMANCE DIAGNOSIS CHART—DIESEL ENGINES

CONDITION	POSSIBLE CAUSES	CORRECTION
ENGINE WILL NOT CRANK OR CRANKS SLOWLY	1. Batteries weak or dead.	1. Check battery voltage. Replace battery if charge cannot be held.
	2. No voltage to starter solenoid or inoperative solenoid.	2. Check voltage to the solenoid. If necessary, replace starter solenoid.
	3. Starting circuit connections loose or corroded.	3. Clean and tighten connections
	4. Neutral safety switch or starter relay inoperative.	4. Check starter relay supply voltage and proper operation of neutral safety switch if equipped. Replace defective parts.
	5. Starting motor operating, but not cranking the engine	5. Remove the starter motor. check for broken flywheel teeth or a broken starter motor spring.
	6. Crankshaft rotation restricted.	6. Attempt to rotate engine with barring tool. If engine does not turn, suspect internal mechanical failure.
ENGINE CRANKS BUT WILL NOT START—NO SMOKE FROM EXHAUST	1. No Fuel in supply tank.	1. Fill fuel supply.
	2. Air intake or exhaust systems plugged.	2. Remove obstruction.
	3. Fuel filter plugged.	3. Drain fuel canister and replace filter.
	4. Excessive fuel inlet restriction.	4. Check fuel inlet restriction. Correct cause.
	5. Injection pump is not getting fuel or fuel is aerated.	5. Check fuel flow/bleed fuel system.
	6. Inoperative fuel transfer (lift) pump.	6. Check fuel lines for restrictions and fuel pressure.
	7. One or more injectors worn or not working properly.	7. Check/replaced bad or improperly operating injectors.
	8. Worn or inoperative injection pump.	8. Visually check delivery with externally connected injector to one of the pump outlets. Repair or replace the pump if fuel is not being delivered.
	9. Internal pump timing incorrect.	9. Time the injection pump. Refer to group 14, fuel system.
	10. Camshaft out of time.	10 Check/correct gear train timing alignment.
ENGINE HARD TO START OR WILL NOT START—SMOKE FROM EXHAUST	1. Incorrect starting procedure.	1. the fuel shut off solenoid control must be in the run position.
	2. Cranking speed too slow.	2. Check the battery, starter motor and wiring for loose connections.
	3. Intake heater system not working.	3. Verify system is working. Repair/replace inoperative parts.
	4. Insufficient intake air.	4. Inspect or replace filter and check for obstructions to the air supply tube.

AUTHENTIC RESTORATION PRODUCT

DIAGNOSIS AND TESTING (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
	5. Air in fuel system or fuel supply is inadequate. 6. Fuel transfer (lift) pump 7. Injection pump throttle linkage loose or damaged. 8. Contaminated fuel 9. Fuel screen plugged. 10. One or more injectors worn or not operating properly. 11. Worn or inoperative injection pump. 12. Injection pump out of time. 13. Valves incorrectly adjusted. 14. Engine compression low.	5. Check the flow through the filter and bleed the system. 6. Measure transfer pump outlet pressure. If needed, repair or replace the pump. 7. Visually check the linkage. Adjust/replace linkage. 8. Verify by operating the engine with clean fuel from a temporary tank. Check for presence of diesel fuel. Drain and flush the fuel supply tank. Replace fuel/water separator filter. 9. Check fuel screen. 10. Check/replace improperly operating injectors. 11. Visually check delivery with externally connected injector to one of the pump outlets. Repair or replace the pump if fuel is not being delivered. 12. Check/Time the pump. Refer to group 14, Fuel Systems 13. Adjust valves. 14. Check compression to identify the problem.
ENGINE STARTS, BUT WILL NOT KEEP RUNNING	1. Idle speed too low for the accessories. 2. Intake air or exhaust system restricted. 3. Air in the fuel system or the fuel supply is in adequate. 4. Fuel waxing due to extremely cold weather. 5. Contaminated fuel	1. Adjust the idle speed. 2. Visually check for exhaust restriction and inspect the air intake. Repair/Replace restricting parts. 3. Check flow through the filter and bleed the system. Locate and eliminate the air source. 4. Verify by inspecting the fuel filter. Clean the system and use climatized fuel. Replace fuel/water separator filter. Check fuel heater for proper operation. 5. Verify by operating the engine with clean fuel from a temporary supply tank. Check for presence of gasoline.
SURGING (SPEED CHANGE)	1. If the condition occurs at idle, the idle speed is set too low for the accessories. 2. Improperly operating injection pump.	1. Adjust the idle speed. 2. Replace the injection pump.

AUTHENTIC RESTORATION PRODUCT

DIAGNOSIS AND TESTING (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
ROUGH IDLE (IRREGULARLY FIRING OR ENGINE SHAKING)	1. If engine is cold, intake heater system defective.	1. Refer to intake heater system (see Group 14, Fuel System)
	2. Idle speed too low for the accessories.	2. Adjust the idle speed.
	3. Low pressure fuel problem.	3. Check for proper lift pump pressure.
	4. Engine mounts damaged or loose.	4. Repair or replace mounts.
	5. High pressure fuel leaks.	5. Correct leaks in the high pressure lines, fittings or delivery valves.
	6. Air in the fuel system.	6. Bleed the fuel system and eliminate the source of the air.
	7. Sticking needle valve in an injector.	7. Check and replace the injector with the sticking needle valve.
ENGINE RUNS ROUGH	1. Fuel injection line(s) leaking.	1. Correct leaks in high pressure lines, fittings, injector sealing washers or delivery valves.
	2. Air in the fuel or the fuel supply is inadequate.	2. Check the flow through the filter and bleed the system. Locate and eliminate the air source. Check pressures.
	3. Contaminated fuel	3. Verify by operating the engine with clean fuel from a temporary supply tank. Check for presence of gasoline. replace fuel/water separator filter.
	4. Incorrect valve operation.	4. Check for a bent push rod and adjust valves. Replace push rod if necessary.
	5. Injection pump timing incorrect.	5. Check and time pump if necessary. Refer to group 14, Fuel System.
	6. Improperly operating injectors.	6. Replace inoperative injectors.
	7. Defective injection pump delivery valve.	7. Repair or replace injection pump.
	8. Camshaft out of time.	8. Check/correct gear train timing alignment.
	9. Damaged camshaft or tappets.	9. Inspect camshaft valve lift. Replace camshaft and tappets.
ENGINE RPM WILL NOT REACH RATED SPEED	1. Intake air system leaks	1. Verify air duct connections are tight and secure.
	2. Engine overload	2. Verify high idle speed without the load. Investigate operation to be sure correct gear is being used.
	3. Improperly operating tachometer.	3. Verify engine speed with hand-held tachometer, correct as required.
	4. Throttle linkage worn or incorrectly adjusted.	4. Adjust linkage for stop to stop fuel control lever travel. Replace linkage if necessary.

AUTHENTIC RESTORATION

DIAGNOSIS AND TESTING (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
	5. Inadequate fuel supply	5. Check the fuel flow through the system to locate the reason for inadequate fuel supply, correct as supplied.
	6. Air/fuel controls leak.	6. Check and repair leak. Check AFC tubing for obstruction.
	7. Improperly operating injection pump.	7. Repair or replace injection pump.
LOW POWER	1. Air leak between the turbocharger and the intake manifold.	1. Check/correct leaks in hoses, gaskets, charge air cooler and around mounting capscrews or through holes in the manifold cover.
	2. High oil level.	2. Check correct oil/level
	3. Engine overloaded	3. Check for added loading from accessories or driven units, brakes dragging and other changes in vehicle loading. Repair/replace as needed.
	4. Slow throttle response caused by leaking or obstructed air control tube or improperly operating control in the pump.	4. Check for leaks and obstructions. Tighten the fittings. Repair or replace the pump if the controls are not functioning.
	5. Inadequate intake air flow	5. Inspect/replace air cleaner element. Look for other restrictions.
	6. Inadequate fuel supply. Air in the fuel.	6. Inspect/correct leaks in the high pressure lines, fittings, injector sealing washers or delivery valve seals.
	7. Excessive exhaust restriction.	7. Check/correct the restriction in the exhaust system.
	8. High fuel temperature	8. Verify that fuel heater is off when the engine is warm. Check for restricted fuel drain tube. Repair/ replace as necessary.
	9. Poor quality fuel or fuel contaminated with gasoline.	9. Verify by operating from a temporary tank with good fuel. Check for presence of gasoline. replace fuel/water separator filter.
	10. Exhaust leak at the manifold or turbocharger	10. Check/correct leaks in the manifold or turbocharger gaskets. If manifold is cracked, replace manifold.
	11. Turbocharger wastegate operation	11. Check wastegate operation.
	12. Intake/Exhaust valve not opening	12. Inspect for bent push rod, replace if necessary.
	13. Worn or improperly operating injectors.	13. Check/replace injectors
	14. Injection pump timing incorrect.	14. Verify injection pump timing. Refer to group 14, Fuel System
	15. Improperly operating injection pump.	15. Repair or replace injection pump.

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DIAGNOSIS AND TESTING (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
EXCESSIVE EXHAUST SMOKE	1. Engine running too cold (white smoke)	1. Refer to troubleshooting for coolant temperature below normal. Refer to group 7, Cooling System. Inspect intake manifold heater system for proper operation.
	2. Improper starting procedure (white smoke)	2. Use proper starting procedures.
	3. Fuel supply inadequate.	3. Check fuel supply pressure and inlet restriction
	4. Injection pump timing.	4. Check and time pump. Refer to Group 14, Fuel System.
	5. Inadequate intake air.	5. Inspect/change air filter. Look for other restriction. Check charge air cooler for obstructions.
	6. Air leak between turbocharger and intake manifold.	6. Check/correct leaks in the air crossover tube, hoses, gaskets, mounting capscrews, or through holes in the manifold cover.
	7. Exhaust leak at the manifold or turbocharger.	7. Check/correct leaks in the manifold or turbocharger gaskets. If cracked, replace manifold.
	8. Improperly operating turbocharger.	8. Inspect/replace turbocharger.
	9. Improperly operating injectors.	9. Check and replace inoperative injectors.
	10. Improperly operating injector pump.	10. Repair or replace injection pump.
	11. Piston rings not sealing (blue smoke)	11. Perform blow-by check. Correct as required.
ENGINE WILL NOT SHUT OFF	1. Fuel shut off solenoid or solenoid relay inoperative.	1. Check/replace fuel shut off solenoid or relay.
	2. Engine running on fumes drawn into the air intake.	2. Check the air intake ducts for the source of fumes. **WARNING: In case of engine runaway due to flammable fumes from gasoline spills or turbocharger oil leaks being sucked into the engine, shut off engine ignition switch first and then use a CO2 fire extinguisher and direct the spray under the front bumper to remove the oxygen supply. The air intake is on the passenger side behind the bumper. The fire extinguisher must be directed at this location for emergency shutdown situations.**
	3. Fuel injection pump malfunction.	3. Repair or replace fuel injection pump.

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DIAGNOSIS AND TESTING (Continued)

MECHANICAL DIAGNOSIS CHART—DIESEL ENGINES

CONDITION	POSSIBLE CAUSES	CORRECTION
LUBRICATING OIL PRESSURE LOW	1. Low oil level.	1. A. Check and fill with clean engine oil. B. Check for a severe external oil leak that could reduce the pressure.
	2. Oil viscosity thin, diluted or wrong specification.	2. Verify the correct oil is being used. Check for oil dilution. Refer to Contaminated Lube Oil (Engine Diagnosis Mechanical).
	3. Improperly operating pressure switch/gauge.	3. Verify the pressure switch is functioning correctly. If not, replace switch/gauge.
	4. Relief valve stuck open.	4. Check/replace valve.
	5. Plugged oil filter.	5. Change oil filter. Oil filter change interval may need to be revised.
	6. If cooler was replaced, shipping plugs left in cooler.	6. Check/remove shipping plugs.
	7. Worn oil pump.	7. Check and replace oil pump.
	8. Suction tube loose or seal leaking.	8. Check and replace seal.
	9. Loose main bearing cap.	9. Check and install new bearing and tighten cap to proper torque.
	10. Worn bearings or wrong bearings installed.	10. Inspect and replace connecting rod or main bearings. Check and replace piston cooling nozzles.
	11. Oil jet under piston bad fit into main carrier.	11. Check oil jet position.
LUBRICATING OIL PRESSURE TOO HIGH	1. Pressure switch/gauge not operating properly.	1. Verify the pressure switch is functioning correctly. If not, replace switch/gauge.
	2. Engine running to cold.	2. Refer to Coolant Temperature Below Normal (Engine Diagnosis Performance).
	3. Oil viscosity too thick.	3. Make sure the correct oil being used, (Refer to Group 0, Lubrication and Maintenance).
	4. Oil pressure relief valve stuck closed or binding.	4. Check and replace valve.
LUBRICATING OIL LOSS	1. External leaks.	1. Visually inspect for oil leaks. Repair as required.
	2. Crankcase being overfilled.	2. Verify that the correct dipstick is being used.
	3. Incorrect oil specification or viscosity.	3. A. Make sure the correct oil is being used. B. Look for reduced viscosity from dilution with fuel. C. Review/reduce the oil change intervals.
	4. Oil cooler leak.	4. Check and replace the oil cooler.
	5. High blow-by forcing oil out the breather.	5. Check the breather tube area for signs of oil loss. Perform the required repairs.
	6. Turbocharger leaking oil to the air intake.	6. Inspect the air ducts for evidence of oil transfer. Repair as required.
	7. Piston rings not sealing (oil being consumed by the engine).	7. Perform blow-by check. Repair as required.

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DIAGNOSIS AND TESTING (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
COMPRESSION KNOCKS	1. Air in the fuel system.	1. Bleed the fuel system (refer to Group 14, Fuel System).
	2. Poor quality fuel or water/ gasoline contaminated fuel.	2. Verify by operating from a temporary tank with good fuel. Clean and flush the fuel supply tanks. Replace fuel/water separator filter.
	3. Engine overloaded.	3. Verify the engine load rating is not being exceeded.
	4. Incorrect injection pump timing.	4. Check and time injection pump (refer to Group 14, Fuel System).
	5. Improperly operating injectors.	5. Check and replace inoperative injectors.
EXCESSIVE VIBRATION	1. Loose or broken engine mounts.	1. Replace engine mounts.
	2. Damaged fan or improperly operating accessories.	2. Check and replace the vibrating components.
	3. Improperly operating vibration damper.	3. Inspect/replace the vibration damper.
	4. Improperly operating viscous fan drive.	4. Inspect/replace the fan drive.
	5. Worn or damaged generator bearing.	5. Check/replace the generator.
	6. Flywheel housing misaligned.	6. Check/correct flywheel alignment.
	7. Loose or broken power component.	7. Inspect the crankshaft and rods for damage that causes an unbalance. repair/replace as required.
	8. Worn or unbalanced driveline components.	8. Check/repair driveline components.
EXCESSIVE ENGINE NOISES	1. Drive belt squeal, insufficient tension or abnormally high loading.	1. Check the automatic tensioner and inspect the drive belt. Make sure water pump, tensioner pulley, fan hub and generator turn freely.
	2. Intake air or exhaust leaks.	2. Refer to Excessive Exhaust smoke (Engine Diagnosis Performance).
	3. Excessive valve lash.	3. Adjust valves. Make sure the push rods are not bent and rocker levers or adjusting screws are not severely worn. Replace bent or severely worn pads.
	4. Turbocharger noise.	4. Check turbocharger impeller and turbine wheel for housing contact. Repair/replace as required.
	5. Gear train noise.	5. Visually inspect and measure gear backlash. Replace gears as required.
	6. Power function knock.	6. Check/replace rod and main bearings.
GENERATOR NOT CHARGING OR INSUFFICIENT CHARGING	1. Loose or corroded battery.	1. Clean/tighten battery connection.
	2. Generator belt slipping.	2. Check/replace automatic belt tensioner. Check/replace drive belt.
	3. Generator pulley loose on shaft.	3. Tighten pulley.
	4. Improperly operating generator.	4. Check/replace generator.

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VACUUM PUMP OUTPUT—DIESEL ENGINE

The vacuum pump supplies necessary vacuum to components in the following systems:

- HEVAC system
- Speed Control System
- EGR System

A quick check to determine if the vacuum pump is the cause of the problem in any of these systems is to road test the vehicle and verify that all of these systems are fuctioning properly. If only one of these has a vacuum related failure, then it is likely the vacuum pump is not the cause.

A standard vacuum gauge can be used to check pump output when necessary. Simply disconnect the pump supply hose and connect a vacuum gauge to the outlet port for testing purposes. With the engine running, vacuum output should be a minimum of 25 inches, depending on engine speed.

DIAGNOSING LOW VACUUM OUTPUT CONDITION

If the vacuum pump is suspected of low vacuum output, check the pump and vacuum harnesses as follows:

(1) Visually inspect the vacuum harness for obvious failures (i.e. disconnected, cracks, breaks etc.)

(2) Disconnect the vacuum supply hose at the vacuum pump check valve. Connect vacuum gauge to this valve and run engine at various throttle openings. Output should be a minimum 25 inches of vacuum. If vacuum is consistently below 25 inches, the vacuum pump should be replaced. If output is within specified limits, the vacuum harness should be suspected as the cause.

(3) Disconnect and isolate the vacuum supply harness. Cap off open ends and apply roughly 15 inches of vacuum to the harness. If the vacuum gauge does not hold its reading, then there is an open in the harness and it should be repaired or replaced.

(4) If the vacuum loss is still not detected at this point, then the pump and harness are not the cause of the low vacuum condition. Apply vacuum to the related components of the vacuum supply system (i.e. valves, servos, solenoids, etc.) to find the source of the vacuum loss.

AUTHENTIC RESTORATION PRODUCT

3.9L ENGINE

INDEX

GENERAL INFORMATION

VALVES AND VALVE SPRINGS

The valves are arranged in-line and are inclined 18°. The rocker pivot support and the valve guides are cast integral with the heads.

OIL PUMP PRESSURE

The MINIMUM oil pump pressure is 41.4 kPa (6 psi) at curb idle. The NORMAL oil pump pressure is 207-552 kPa (30-80 psi) at 3,000 RPM or more.

CAUTION: If oil pressure is ZERO at curb idle, DO NOT run engine.

PISTON AND CONNECTING ROD ASSEMBLY

The pistons are elliptically turned so that the diameter at the pin boss is less than its diameter across the thrust face. This allows for expansion under normal operating conditions. Under operating temperatures, expansion forces the pin bosses away from each other, causing the piston to assume a more nearly round shape.

All pistons are machined to the same weight, regardless of size, to maintain piston balance.

The piston pin rotates in the piston only and is retained by the press interference fit of the piston pin in the connecting rod.

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DESCRIPTION AND OPERATION

ENGINE DESCRIPTION/IDENTIFICATION

The 3.9 Liter (238 CID) six-cylinder engine is a V-Type, lightweight, single cam, overhead valve engine with hydraulic roller tappets. This engine is designed to use unleaded fuel.

The engine lubrication system consists of a rotor type oil pump and a full-flow oil filter.

The cylinders are numbered from front to rear; 1, 3, 5 on the left bank and 2, 4, 6 on the right bank. The firing order is 1-6-5-4-3-2 (Fig. 1).

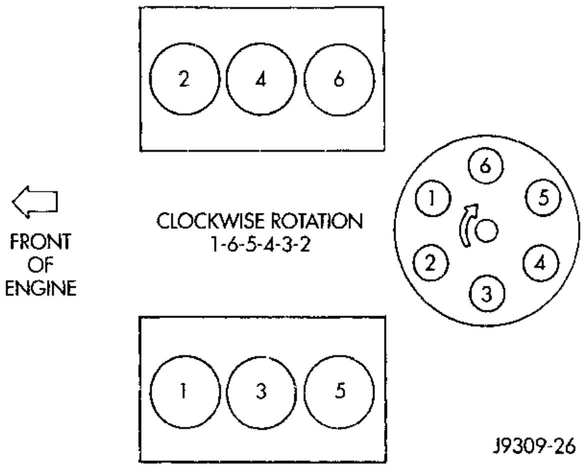

Fig. 1 Firing Order

The engine serial number is stamped into a machined pad located on the left front corner of the cylinder block. When component part replacement is necessary, use the engine type and serial number for reference (Fig. 2).

X M 3.9L T XXXX XXXXXXXX

X = Last Digit of Model Year
M = Plant - M Mound Road
S Saltillo
T Trenton
K Toluca
3.9L = Engine Displacement
T = Usage - T Truck
XXXX = Month/Day
XXXXXXXX = Serial Code - Last 8 Digits of VIN No.

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Fig. 2 Engine Identification Number

ENGINE LUBRICATION SYSTEM

A gear-type positive displacement pump is mounted at the underside of the rear main bearing cap. The pump draws oil through the screen and inlet tube from the sump at the rear of the oil pan. The oil is driven between the drive and idler gears and pump body, then forced through the outlet to the block. An oil gallery in the block channels the oil to the inlet side of the full flow oil filter. After passing through the filter element, the oil passes from the center outlet of the filter through an oil gallery that channels the oil up to the main gallery, which extends the entire length on the right side of the block. The oil then goes down to the No. 1 main bearing, back up to the left side of the block, and into the oil gallery on the left side of the engine.

Galleries extend downward from the main oil gallery to the upper shell of each main bearing. The crankshaft is drilled internally to pass oil from the main bearing journals to the connecting rod journals. Each connecting rod bearing has half a hole in it, oil passes through the hole when the rods rotate and the hole lines up, oil is then thrown off as the rod rotates. This oil throwoff lubricates the camshaft lobes, distributor drive gear, cylinder walls, and piston pins.

The hydraulic valve tappets receive oil directly from the main oil gallery. The camshaft bearings receive oil from the main bearing galleries. The front camshaft bearing journal passes oil through the camshaft sprocket to the timing chain. Oil drains back to the oil pan under the No. 1 main bearing cap.

The oil supply for the rocker arms and bridged pivot assemblies is provided by the hydraulic valve tappets, which pass oil through hollow push rods to a hole in the corresponding rocker arm. Oil from the rocker arm lubricates the valve train components. The oil then passes down through the push rod guide holes and the oil drain-back passages in the cylinder head, past the valve tappet area, and then returns to the oil pan.

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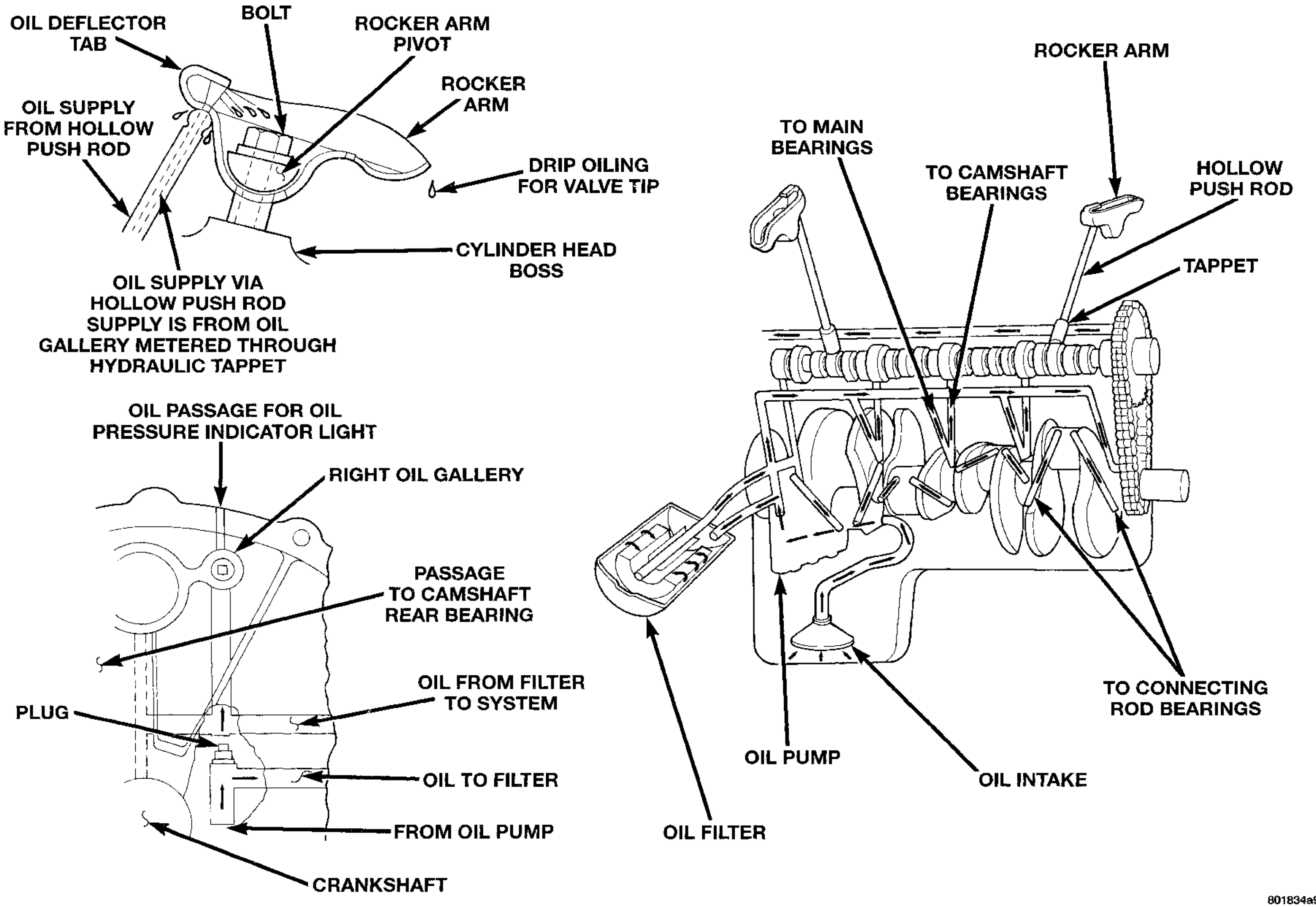


Fig. 3 Oil Lubrication System

DESCRIPTION AND OPERATION (Continued)

ENGINE COMPONENTS

CYLINDER HEAD COVER

A steel-backed silicone gasket is used with the cylinder head cover. This gasket is reuseable.

CYLINDER HEADS

The alloy cast iron cylinder heads are held in place by eight bolts. The spark plugs are located in at peak of the wedge between the valves (Fig. 4).

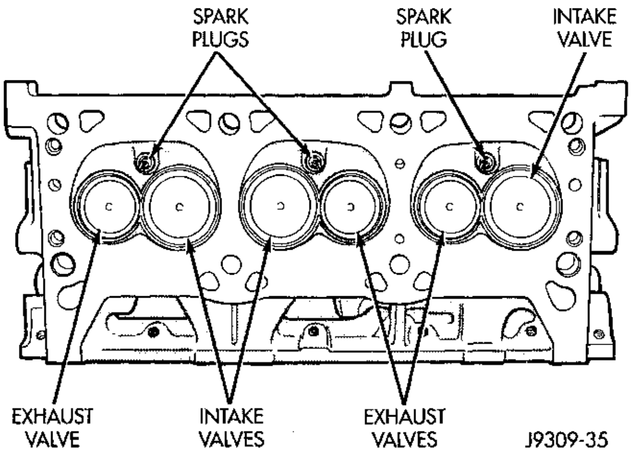


Fig. 4 Cylinder Head Assembly

VALVES AND VALVE SPRINGS

The valves are arranged in-line and inclined 18°. The rocker pivot support and the valve guides are cast integral with the heads.

TIMING CHAIN TENSIONER

A stamped steel mechanical chain tensioner is mounted to the front of the engine, behind the timing drive, and maintains chain tension by way of a pivoting nylon covered spring steel arm. A fixed, nylon covered pad is used on the opposite side of the tensioner. This tensioner design reduces noise generated by typical chain driven systems.

OIL PUMP

OIL PUMP PRESSURE

The MINIMUM oil pump pressure is 41.4 kPa (6 psi) at curb idle. The NORMAL oil pump pressure is 207-552 kPa (30-80 psi) at 3,000 RPM or more.

CAUTION: If oil pressure is ZERO at curb idle, DO NOT run engine.

PISTON AND CONNECTING ROD ASSEMBLY

The pistons are elliptically turned so that the diameter at the pin boss is less than its diameter across the thrust face. This allows for expansion under normal operating conditions. Under operating temperatures, expansion forces the pin bosses away from each other, causing the piston to assume a more nearly round shape.

All pistons are machined to the same weight, regardless of size, to maintain piston balance.

The piston pin rotates in the piston only and is retained by the press interference fit of the piston pin in the connecting rod.

CRANKSHAFT

A crankshaft that has undersize journals is stamped with 1/4 inch letters near the notch of the No. 6 crankshaft counterweight.

FOR EXAMPLE: R2 stamped on the No. 6 crankshaft counterweight indicates that the No.2 rod journal is 0.025 mm (0.001 in) undersize. M4 indicates that the No. 4 main journal is 0.025 mm (0.001 in) undersize. R3 M2 indicates that the No. 3 rod journal and the No. 2 main journal are both 0.025 mm (0.001 in) undersize.

When a crankshaft is replaced, all main and connecting rod bearings, should be replaced with new bearings. Therefore, selective fitting of the bearings is not required when a crankshaft and bearings are replaced.

CRANKSHAFT MAIN BEARINGS

Bearing caps are NOT interchangeable and should be marked at removal to ensure correct assembly. Upper and lower bearing halves are NOT interchangeable. Lower main bearing halves of No.1 and 3 are interchangeable.

Upper and lower No. 2 bearing halves are flanged to carry the crankshaft thrust loads. They are NOT interchangeable with any other bearing halves in the engine. Bearing shells are available in standard and the following undersizes: 0.25 mm (0.001 in.), 0.051 mm (0.002 in.), 0.076 mm (0.003 in.), 0.254 mm (0.010 in.) and 0.305 mm (0.012 in.). Never install an undersize bearing that will reduce clearance below specifications.

CRANKSHAFT REAR OIL SEALS

The service seal is a two piece, Viton seal. The upper seal half can be installed with crankshaft removed from engine or with crankshaft installed. When a new upper seal is installed, install a new lower seal. The lower seal half can be installed only with the rear main bearing cap removed.

SERVICE PROCEDURES

VALVE TIMING

(1) Turn crankshaft until the No. 6 exhaust valve is closing and No. 6 intake valve is opening.

SERVICE PROCEDURES (Continued)

(2) Insert a 6.350 mm (1/4 in.) spacer between rocker arm pad and stem tip of No. 1 intake valve. Allow spring load to bleed tappet down giving, in effect, a solid tappet.

(3) Install a dial indicator so plunger contacts valve spring retainer as nearly perpendicular as possible. Zero the indicator.

(4) Rotate the crankshaft clockwise (normal running direction) until the valve has lifted 0.254 mm (0.010 inch). The timing of the crankshaft should now read from 10° before top dead center to 2° after top dead center. Remove spacer.

CAUTION: DO NOT turn crankshaft any further clockwise, as valve spring might bottom and result in serious damage.

(5) If reading is not within specified limits:

(a) Check sprocket index marks.

(b) Inspect timing chain for wear.

(c) Check accuracy of DC mark on timing indicator.

TIMING CHAIN STRETCH

NOTE: Timing chain tensioner must be removed for this operation.

(1) Place a scale next to the timing chain so that any movement of the chain can be measured.

(2) Place a torque wrench and socket over camshaft sprocket attaching bolt. Apply torque in the direction of crankshaft rotation to take up slack; 41 N·m (30 ft. lbs.) torque with cylinder head installed or 20 N·m (15 ft. lbs.) torque with cylinder head removed. With torque applied to the camshaft sprocket bolt, crankshaft should not be permitted to move. It may be necessary to block the crankshaft to prevent rotation.

(3) Hold a scale with dimensional reading even with the edge of a chain link. With cylinder heads installed, apply 14 N·m (30 ft. lbs.) torque in the reverse direction. With the cylinder heads removed, apply 20 N·m (15 ft. lbs.) torque in the reverse direction. Note the amount of chain movement (Fig. 5).

(4) Install a new timing chain, if its movement exceeds 3.175 mm (1/8 inch).

FITTING PISTONS

Check the cylinder block bore for out-of-round, taper, scoring, or scuffing.

Check the pistons for taper and elliptical shape before they are fitted into the cylinder bore (Fig. 6).

Piston and cylinder wall must be clean and dry. Specified clearance between the piston and the cylinder wall is 0.013-0.038 mm (0.0005-0.0015 in.) at 21°C (70°F).

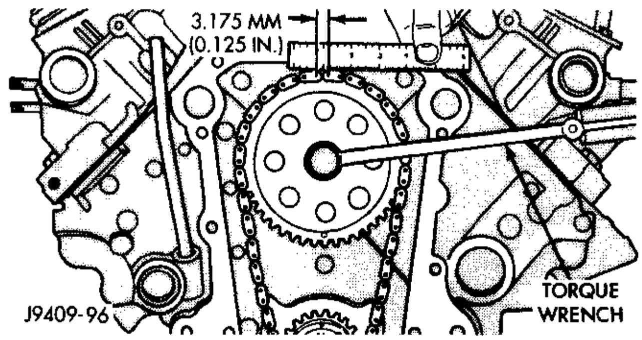
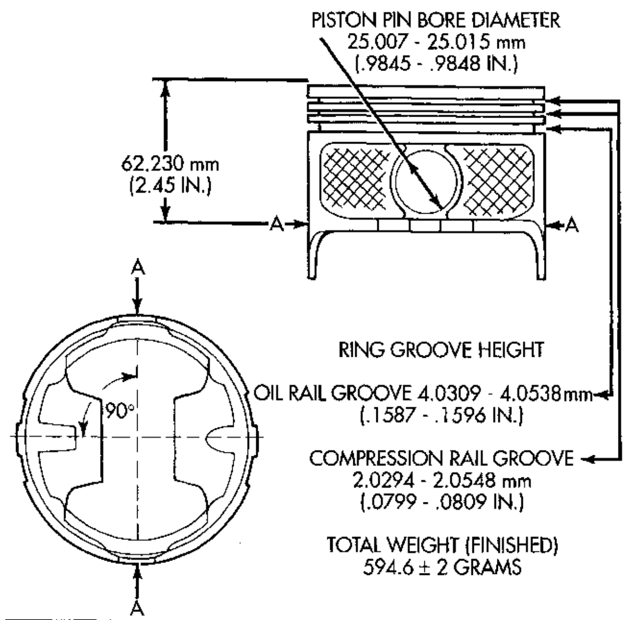


Fig. 5 Measuring Timing Chain Wear and Stretch

Piston diameter should be measured at the top of skirt, 90° to piston pin axis. Cylinder bores should be measured halfway down the cylinder bore and transverse to the engine crankshaft center line.

Pistons and cylinder bores should be measured at normal room temperature, 21°C (70°F).



PISTON SIZE	A DIA = PISTON DIAMETER		BORE DIAMETER	
	MIN. mm (IN.)	MAX. mm (IN.)	MIN. mm (IN.)	MAX. mm (IN.)
A	99.280 (3.9087)	99.294 (3.9092)	99.306 (3.9097)	99.319 (3.9102)
B	99.294 (3.9092)	99.306 (3.9097)	99.319 (3.9102)	99.332 (3.9107)
C	99.306 (3.9097)	99.319 (3.9102)	99.332 (3.9107)	99.344 (3.9112)
D	99.319 (3.9102)	99.332 (3.9107)	99.344 (3.9112)	99.357 (3.9117)
E	99.332 (3.9107)	99.344 (3.9112)	99.357 (3.9117)	99.370 (3.9122)

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Fig. 6 Piston Measurements

FITTING RINGS

(1) Measurement of end gaps:

(a) Measure piston ring gap 2 in. from bottom of cylinder bore. An inverted piston can be used to push the rings down to ensure positioning rings squarely in the cylinder bore before measuring.

(b) Insert feeler gauge in the gap. The top compression ring gap should be between 0.254-0.508

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SERVICE PROCEDURES (Continued)

mm (0.010-0.020 in.). The second compression ring gap should be between 0.508-0.762 mm (0.020-0.030 in.). The oil ring gap should be 0.254-1.270 mm (0.010-0.050 in.).

(c) Rings with insufficient end gap may be properly filed to the correct dimension. Rings with excess gaps should not be used.

(2) Install rings, and confirm ring side clearance:

(a) Install oil rings being careful not to nick or scratch the piston. Install the oil control rings according to instructions in the package. It is not necessary to use a tool to install the upper and lower rails. Insert oil rail spacer first, then side rails.

(b) Install the second compression rings using Installation Tool C-4184. The compression rings must be installed with the identification mark face up (toward top of piston) and chamfer facing down. An identification mark on the ring is a drill point, a stamped letter "O", an oval depression, or the word "TOP" (Fig. 7) (Fig. 9).

(c) Using a ring installer, install the top compression ring with the chamfer facing up (Fig. 8) (Fig. 9). An identification mark on the ring is a drill point, a stamped letter "O", an oval depression or the word "TOP" facing up.

(d) Measure side clearance between piston ring and ring land. Clearance should be 0.074-0.097 mm (0.0029-0.0038 in.) for the compression rings. The steel rail oil ring should be free in groove, but should not exceed 0.246 mm (0.0097 in.) side clearance.

(e) Pistons with insufficient, or excessive, side clearance should be replaced.

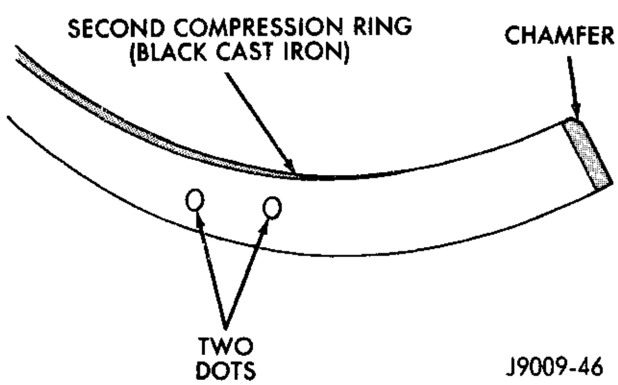

Fig. 7 Second Compression Ring Identification (Typical)

(3) Orient the rings:

(a) Arrange top compression ring 90° counterclockwise from the oil ring rail gap (Fig. 10).

(b) Arrange second compression ring 90° clockwise from the oil ring rail gap (Fig. 10).

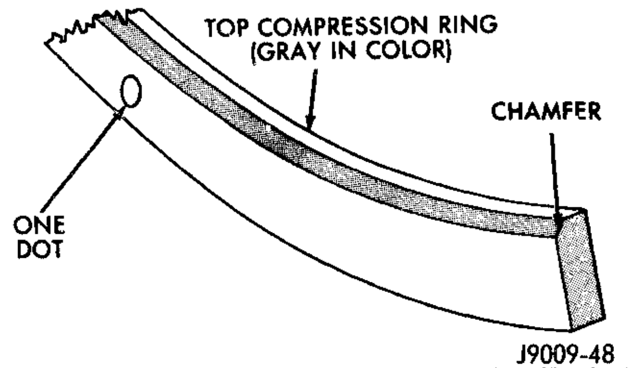

Fig. 8 Top Compression Ring Identification (Typical)

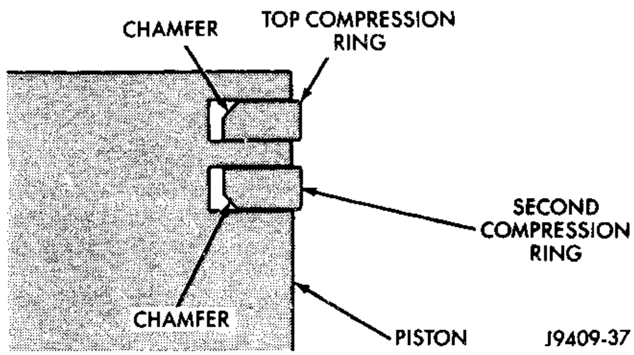

Fig. 9 Compression Ring Chamfer Location (Typical)

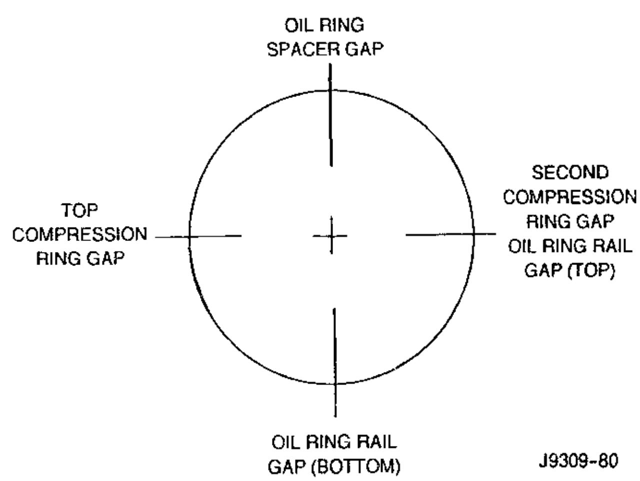

Fig. 10 Proper Ring Installation

CONNECTING ROD BEARINGS

Fit all rods on a bank until completed. DO NOT alternate from one bank to another, because connecting rods and pistons are not interchangeable from one bank to another.

The bearing caps are not interchangeable and should be marked at removal to ensure correct assembly.

Each bearing cap has a small V-groove across the parting face. When installing the lower bearing shell, be certain that the V-groove in the shell is in line with the V-groove in the cap. This provides lubrication of the cylinder wall in the opposite bank.

SERVICE PROCEDURES (Continued)

The bearing shells must be installed so that the tangs are in the machined grooves in the rods and caps.

Limits of taper or out-of-round on any crankshaft journals should be held to 0.025 mm (0.001 in.). Bearings are available in 0.025 mm (0.001 in.), 0.051 mm (0.002 in.), 0.076 mm (0.003 in.), 0.254 mm (0.010 in.) and 0.305 mm (0.012 in.) undersize. **Install the bearings in pairs. DO NOT use a new bearing half with an old bearing half. DO NOT file the rods or bearing caps.**

CRANKSHAFT MAIN BEARINGS

Bearing caps are NOT interchangeable and should be marked at removal to ensure correct assembly. Upper and lower bearing halves are NOT interchangeable. Lower main bearing halves of No. 1 and 3 are interchangeable.

Upper and lower No. 2 bearing halves are flanged to carry the crankshaft thrust loads. They are NOT interchangeable with any other bearing halves in the engine (Fig. 11). Bearing shells are available in standard and the following undersizes: 0.25 mm (0.001 in.), 0.051 mm (0.002 in.), 0.076 mm (0.003 in.), 0.254 mm (0.010 in.) and 0.305 mm (0.012 in.). Never install an undersize bearing that will reduce clearance below specifications.

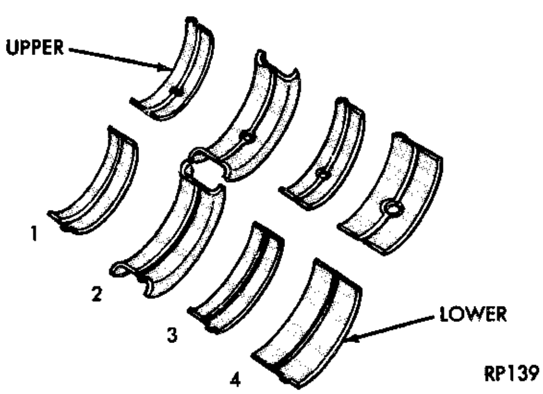

Fig. 11 Main Bearing Identification

CRANKSHAFT

A crankshaft that has undersize journals will be stamped with 1/4 inch letters near the notch of the No.6 crankshaft counterweight (Fig. 12).

FOR EXAMPLE: R2 stamped on the No. 6 crankshaft counterweight indicates that the No. 2 rod journal is 0.025 mm (0.001 in.) undersize. M4 indicates that the No. 4 main journal is 0.025 mm (0.001 in.) undersize. R3 M2 indicates that the No. 3 rod journal and the No. 2 main journal are 0.025 mm (0.001 in.) undersize.

When a crankshaft is replaced, all main and connecting rod bearings should be replaced with new bearings.

Undersize Journal	Identification Stamp
ROD – 0.025mm (0.001 in.)	R1-R2-R3-Etc.
MAIN – 0.025mm (0.001 in.)	M1-M2-M3 or M4

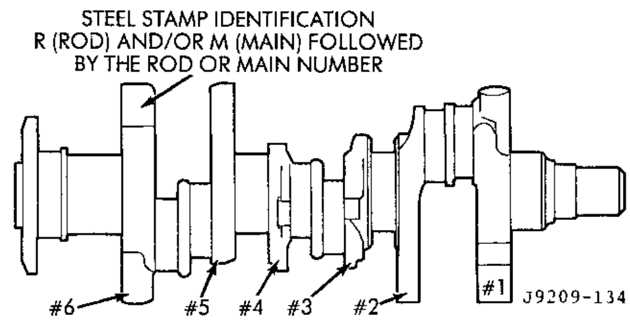

Fig. 12 Location of Crankshaft Identification

Therefore, selective fitting of the bearings is not required when a crankshaft and bearings are replaced.

REMOVAL AND INSTALLATION

ENGINE MOUNTS—FRONT

REMOVAL

(1) Disconnect the battery negative cable.

(2) Position fan to ensure clearance for radiator top tank and hose.

CAUTION: DO NOT lift the engine by the intake manifold.

(3) Install engine support/lifting fixture.

(4) Raise vehicle on hoist.

(5) Lift the engine SLIGHTLY and remove the thru-bolt and nut (Fig. 13).

(6) Remove engine support bracket/cushion bolts (Fig. 13). Remove the support bracket/cushion and heat shields.

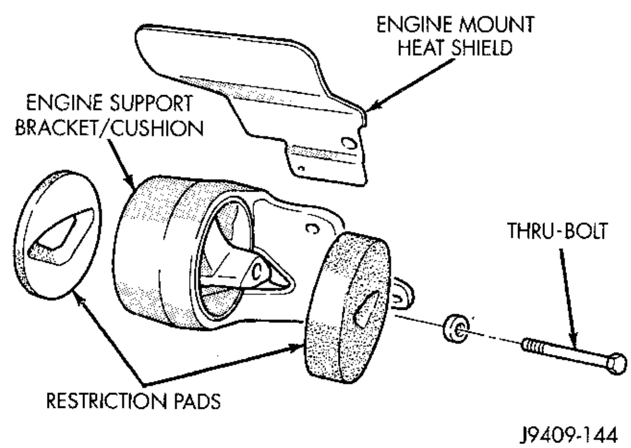

Fig. 13 Engine Front Mounts

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REMOVAL AND INSTALLATION (Continued)

INSTALLATION

(1) With engine raised SLIGHTLY, position the engine support bracket/cushion and heat shields to the block. Install new bolts and tighten to 81 N·m (60 ft. lbs.) torque.

(2) Install the through-bolt into the engine support bracket/cushion.

(3) Lower engine with support/lifting fixture while guiding the engine bracket/cushion and through-bolt into support cushion brackets (Fig. 14).

(4) Install through-bolt nuts and tighten the nuts to 102 N·m (75 ft. lbs.) torque.

(5) Lower the vehicle.

(6) Remove lifting fixture.

ENGINE MOUNT— REAR

REMOVAL

(1) Raise the vehicle on a hoist.

(2) Position a transmission jack in place.

(3) Remove support cushion stud nuts (Fig. 15).

(4) Raise rear of transmission and engine SLIGHTLY.

(5) Remove the bolts holding the support cushion to the transmission support bracket. Remove the support cushion.

(6) If necessary, remove the bolts holding the transmission support bracket to the transmission.

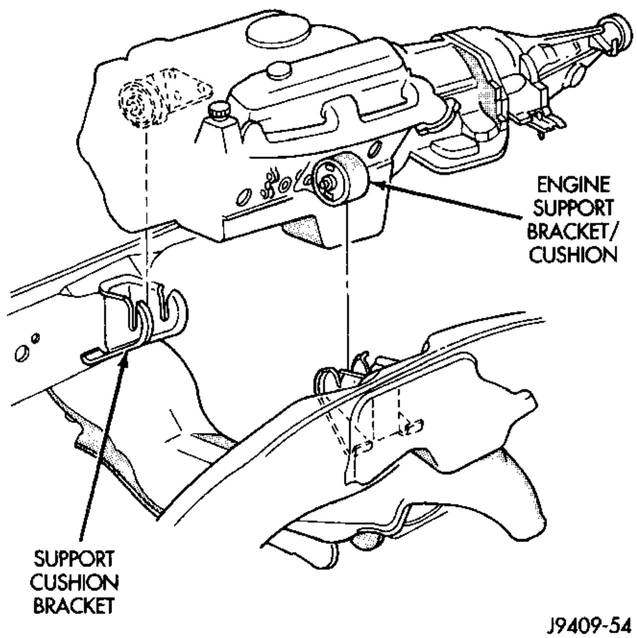

Fig. 14 Positioning Engine Front Mounts

INSTALLATION

(1) If removed, position the transmission support bracket to the transmission. Install new attaching bolts and tighten to 88 N·m (65 ft. lbs.) torque.

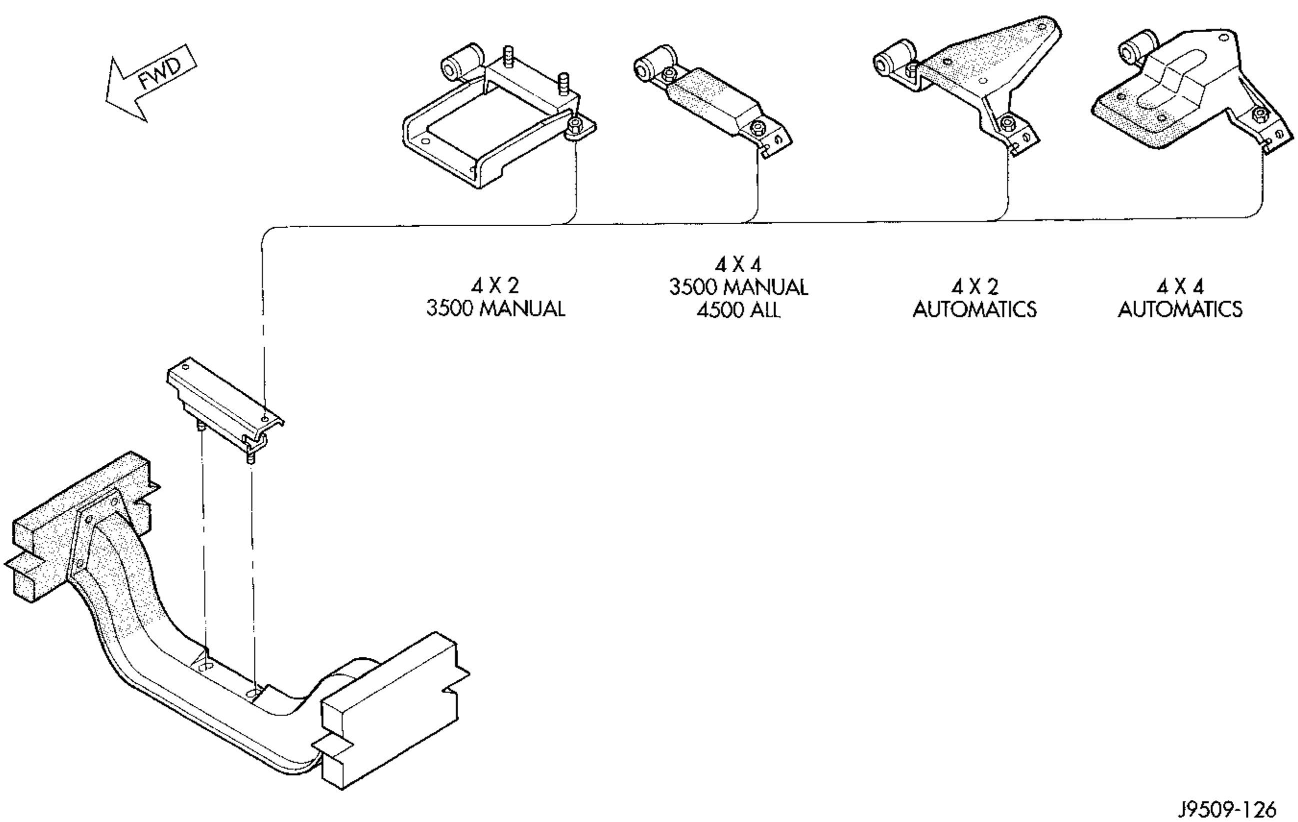

Fig. 15 Engine Rear Support Cushion Assemblies

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REMOVAL AND INSTALLATION (Continued)

(2) Position support cushion to transmission support bracket. Install stud nuts and tighten to 41 N·m (30 ft. lbs.) torque.

(3) Using the transmission jack, lower the transmission and support cushion onto the crossmember (Fig. 15).

(4) Install the support cushion bolts and tighten to 41 N·m (30 ft. lbs.) torque.

(5) Remove the transmission jack.

(6) Lower the vehicle.

ENGINE ASSEMBLY

REMOVAL

(1) Remove the battery.

(2) Drain cooling system. Refer to Group 7, Cooling System, for the proper procedure.

(3) Remove the upper crossmember and top core support.

(4) Remove the transmission oil cooler.

(5) Discharge the air conditioning system, if equipped. Refer to Group 24, Heating and Air Conditioning for service procedures.

(6) Remove the serpentine belt. Refer to Group 7, Cooling System.

(7) Remove the A/C compressor with the lines attached. Set aside.

(8) If equipped, remove the condenser.

(9) Remove the washer bottle.

(10) Disconnect the top radiator hose.

(11) Remove the fan.

(12) Remove the fan shroud.

(13) Disconnect the lower radiator hose.

(14) Remove radiator. Refer to Group 7, Cooling System.

(15) Remove the generator with the wire connections. Refer to Group 8B, Battery/Starter/Generator Service.

(16) Remove the air cleaner box.

(17) Disconnect the throttle linkage.

(18) Remove throttle body.

(19) Remove the intake manifold. Refer to Group 11, Exhaust System and Intake Manifold.

(20) Remove the distributor cap and wiring.

(21) Disconnect the heater hoses.

(22) Disconnect the power steering hoses, if equipped.

(23) Disconnect the transmission cooler lines.

(24) Perform the Fuel System Pressure release procedure. Refer to group 14, Fuel system. Disconnect the fuel line.

(25) On Manual Transmission vehicles, remove the shift lever. Refer to Group 21, Transmissions.

(26) Raise and support the vehicle on a hoist.

(27) Remove the drain plug and drain the engine oil.

(28) Remove engine front mount through-bolt nuts.

(29) Remove the transmission cooler line brackets from oil pan.

(30) Disconnect exhaust pipe at manifold.

(31) Disconnect the starter wires. Remove starter motor. Refer to Group 8B, Battery/Starter/Generator Service.

(32) Remove the dust shield and transmission cover.

(33) Refer to Group 21, Transmissions for transmission removal.

(34) Lower the vehicle.

CAUTION: DO NOT lift the engine by the intake manifold.

(35) Install an engine lifting fixture.

(36) Remove engine from vehicle and install engine assembly on a repair stand.

INSTALLATION

(1) Remove engine from the repair stand and position in the engine compartment. Position the through-bolt into the support cushion brackets.

(2) Install an engine support fixture.

(3) Raise and support the vehicle on a hoist.

(4) Refer to Group 21, Transmissions for transmission installation.

(5) Install the prop shaft. Refer to Group 16, Propeller Shaft.

(6) Install the dust shield and transmission cover.

(7) Install the starter and connect the starter wires. Refer to Group 8B, Battery/Starter/Generator Service.

(8) Install exhaust pipe to manifold.

(9) Install the transmission cooler line brackets from oil pan.

(10) Install engine front mount through-bolt nuts. Tighten the nuts.

(11) Install the drain plug and tighten to 34 N·m (25 ft. lbs.) torque.

(12) Lower the vehicle.

(13) Remove engine-lifting fixture.

(14) On Manual Transmission vehicles, install the shift lever. Refer to Group 21, Transmissions.

(15) Connect the fuel lines.

(16) Connect the transmission cooler lines.

(17) Connect the power steering hoses, if equipped.

(18) Connect the heater hoses.

(19) Install the distributor cap and wiring.

(20) Install the intake manifold. Refer to Group 11, Exhaust System and Intake Manifold.

(21) Using a new gasket, install throttle body. Tighten the throttle body bolts to 23 N·m (200 in. lbs.) torque.

(22) Connect the throttle linkage.

(23) Install the air cleaner box.

REMOVAL AND INSTALLATION (Continued)

(24) Install the generator and wire connections. Refer to Group 8B, Battery/Starter/Generator Service.
(25) Install radiator. Refer to Group 7, Cooling System.
(26) Connect the lower radiator hose.
(27) Install the fan shroud.
(28) Install the fan.
(29) Connect the top radiator hose.
(30) Install the washer bottle.
(31) If equipped, install the condenser.
(32) Install the A/C compressor with the lines attached.
(33) Install the serpentine belt. Refer to Group 7, Cooling System.
(34) Evacuate and charge the air conditioning system, if equipped. Refer to Group 24, Heating and Air Conditioning for service procedures.
(35) Install the transmission oil cooler.
(36) Install the upper crossmember and top core support.
(37) Add coolant to the cooling system. Refer to Group 7, Cooling System for the proper procedure.
(38) Install the battery.
(39) Road test vehicle.

CYLINDER HEAD COVER

A steel-backed silicone gasket is used with the cylinder head cover (Fig. 16). This gasket can be used again.

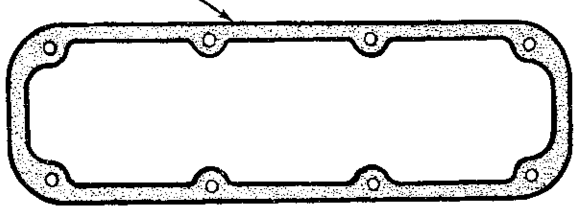

Fig. 16 Cylinder Head Cover Gasket

REMOVAL

(1) Disconnect the negative cable from the battery.
(2) Disconnect closed ventilation system and evaporation control system from cylinder head cover.
(3) Remove cylinder head cover and gasket. The gasket may be used again.

INSTALLATION

(1) Install the cylinder head cover gasket onto the head rail.
(2) Position the cylinder head cover onto the gasket. Tighten the bolts to 11 N·m (95 in. lbs.) torque.
(3) Install closed crankcase ventilation system and evaporation control system.
(4) Connect the negative cable to the battery.

CYLINDER HEAD COMPONENTS—IN VEHICLE SERVICE

ROCKER ARMS AND PUSH RODS

REMOVAL

(1) Disconnect spark plug wires by pulling on the boot straight out in line with plug.
(2) Remove cylinder head cover and gasket.
(3) Remove the rocker arm bolts and pivots (Fig. 17). Place them on a bench in the same order as removed.
(4) Remove the push rods and place them on a bench in the same order as removed.

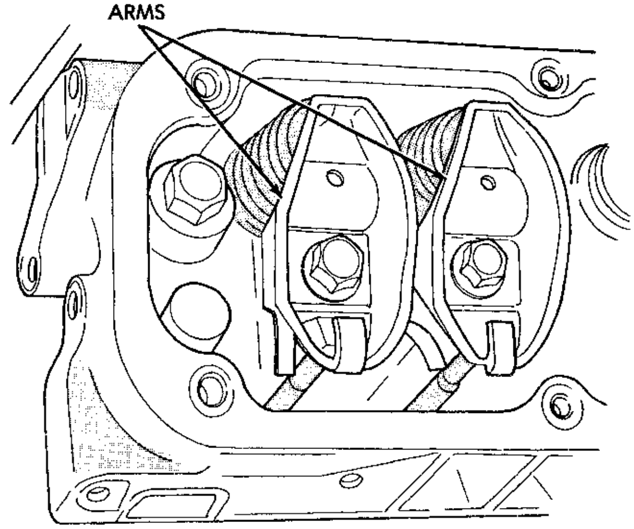

Fig. 17 Rocker Arms

INSTALLATION

(1) Rotate the crankshaft until the V6 mark lines up with the TDC mark on the timing chain case cover. This mark is located 147° ATDC from the No.1 firing position.

CAUTION: DO NOT rotate or crank the engine during or immediately after rocker arm installation. Allow the hydraulic roller tappets adequate time to bleed down (about 5 minutes).

(2) Install the push rods in the same order as removed.
(3) Install rocker arm and pivot assemblies in the same order as removed. Tighten the rocker arm bolts to 28 N·m (21 ft. lbs.) torque.
(4) Install cylinder head cover.

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REMOVAL AND INSTALLATION (Continued)

(5) Connect spark plug wires.

VALVE STEM SHIELDS AND SPRINGS

REMOVAL

(1) Set engine basic timing to Top Dead Center (TDC).
(2) Remove the air cleaner.
(3) Remove cylinder head covers and spark plugs.
(4) Remove coil wire from distributor and secure to good ground to prevent engine from starting.
(5) Using suitable socket and flex handle at crankshaft retaining bolt, turn engine so the No.1 piston is at TDC on the compression stroke.
(6) Remove rocker arms.
(7) With air hose attached to an adapter installed in No.1 spark plug hole, apply 620-689 kPa (90-100 psi) air pressure.
(8) Using Valve Spring Compressor Tool MD-998772A and adapter 6716A, compress valve spring and remove retainer valve locks and valve spring.

INSTALLATION

(1) Install seals on the exhaust valve stem and position down against valve guides.
(2) The intake valve stem seals should be pushed firmly and squarely over the valve guide using the valve stem as a guide. DO NOT force seal against top of guide. When installing the valve retainer locks, compress the spring only enough to install the locks.
(3) Follow the same procedure on the remaining 5 cylinders using the firing sequence 1-6-5-4-3-2. Make sure piston in cylinder is at TDC on the valve spring that is being removed.
(4) Remove adapter from the No.1 spark plug hole.
(5) Install rocker arms.
(6) Install covers and coil wire to distributor.
(7) Install air cleaner.
(8) Road test vehicle.

CYLINDER HEADS

The alloy cast iron cylinder heads (Fig. 18) are held in place by eight bolts. The spark plugs are located at the peak of the wedge between the valves.

REMOVAL

(1) Disconnect the battery negative cable from the battery.
(2) Drain cooling system. Refer to Group 7, Cooling System for the proper procedures.
(3) Remove the intake manifold-to-generator bracket support rod. Remove the generator.
(4) Remove closed crankcase ventilation system.
(5) Disconnect the evaporation control system.
(6) Remove the air cleaner.

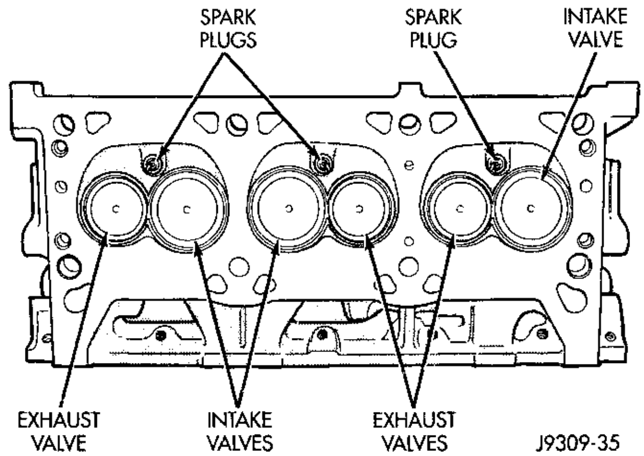

Fig. 18 Cylinder Head Assembly

(7) Perform fuel system pressure release procedure. Refer to Group 14, Fuel Systems for the correct procedure.
(8) Disconnect the fuel supply line from the fuel rail. Refer to Group 14, Fuel Systems for the correct procedure.
(9) Disconnect accelerator linkage and if so equipped, the speed control and transmission kickdown cables.
(10) Remove distributor cap and wires.
(11) Disconnect the coil wires.
(12) Disconnect heat indicator sending unit wire.
(13) Disconnect heater hoses and bypass hose.
(14) Remove cylinder head covers and gaskets.
(15) Remove intake manifold and throttle body as an assembly. Discard the flange side gaskets and the front and rear cross-over gaskets.
(16) Remove exhaust manifolds.
(17) Remove rocker arm assemblies and push rods. Identify to ensure installation in original locations.
(18) Remove the head bolts from each cylinder head and remove cylinder heads. Discard the cylinder head gasket.
(19) Remove spark plugs.

INSTALLATION

(1) Position the new cylinder head gaskets onto the cylinder block.
(2) Position the cylinder heads onto head gaskets and cylinder block.
(3) Starting at top center, tighten all cylinder head bolts, in sequence, to 68 N·m (50 ft. lbs.) torque (Fig. 19). Repeat procedure, tighten all cylinder head bolts to 143 N·m (105 ft. lbs.) torque. Repeat procedure to confirm that all bolts are at 143 N·m (105 ft. lbs.) torque.

REMOVAL AND INSTALLATION (Continued)

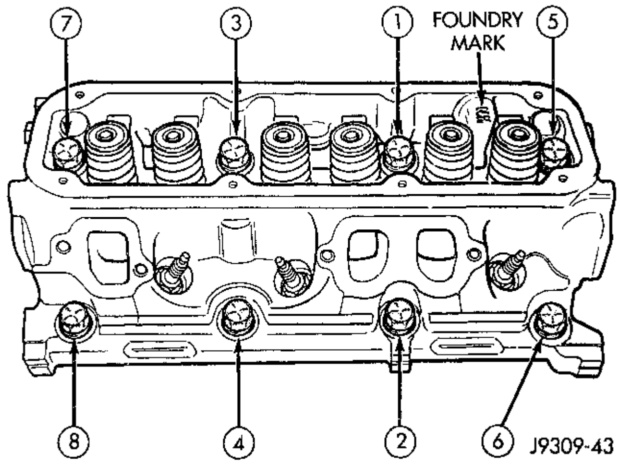

Fig. 19 Cylinder Head Bolt -Tightening Sequence

CAUTION: When tightening the rocker arm bolts, be sure the piston in that cylinder is NOT at TDC. Contact between the valves and piston could occur.

(4) Install push rods and rocker arm assemblies in their original positions. Tighten the bolts to 28 N·m (21 ft. lbs.) torque.

(5) Install the intake manifold and throttle body assembly. Refer to Group 11, Exhaust System and Intake Manifold.

(6) Install exhaust manifolds. Tighten the bolts and nuts to 34 N·m (25 ft. lbs.) torque.

(7) Adjust spark plugs to specifications. Refer to Group 8D, Ignition System. Install the plugs and tighten to 41 N·m (30 ft. lbs.) torque.

(8) Install coil wires.

(9) Connect heat indicator sending unit wire.

(10) Connect the heater hoses and bypass hose.

(11) Install distributor cap and wires.

(12) Connect the accelerator linkage and, if so equipped, the speed control and transmission kick-down cables.

(13) Install the fuel supply line.

(14) Install the generator and accessory drive belt. Tighten generator mounting bolt to 41 N·m (30 ft. lbs.) torque.

(15) Install the intake manifold-to-generator bracket support rod. Tighten the bolts.

(16) Place the cylinder head cover gaskets in position and install cylinder head covers. Tighten the bolts to 11 N·m (95 in. lbs.) torque.

(17) Install closed crankcase ventilation system.

(18) Connect the evaporation control system.

(19) Install the air cleaner.

(20) Install the heat shields. Tighten the bolts to 41 N·m (30 ft. lbs.) torque.

(21) Fill cooling system. Refer to Group 7, Cooling System for proper procedure.

(22) Connect the battery negative cable.

VALVES AND VALVE SPRINGS—CYLINDER HEAD REMOVED

REMOVAL

(1) Compress valve springs using Valve Spring Compressor Tool MD-998772-A and adapter 6716A.

(2) Remove valve retaining locks, valve spring retainers, valve stem seals, and valve springs.

(3) Before removing valves, remove any burrs from valve stem lock grooves to prevent damage to the valve guides. Identify valves to ensure installation in original locations.

INSTALLATION

(1) Coat valve stems with lubrication oil and insert them in cylinder head.

(2) If valves or seats are reground, check valve stem height. If valve is too long, replace cylinder head.

(3) Install new seals on all valve guides. Install valve springs and valve retainers.

(4) Compress valve springs with Valve Spring Compressor Tool MD-998772A and adapter 6716A, install locks and release tool. If valves and/or seats are ground, measure the installed height of springs. Be sure the measurement is taken from bottom of spring seat in cylinder head to the bottom surface of spring retainer. If spacers are installed, measure from the top of spacer. If height is greater than 42.86 mm (1-11/16 inches), install a 1.587 mm (1/16 in.) spacer in head counterbore. This should bring spring height back to normal 41.27 to 42.86 mm (1-5/8 to 1-11/16 in.).

HYDRAULIC TAPPETS

REMOVAL

(1) Remove the air cleaner.

(2) Remove cylinder head cover.

(3) Remove rocker assembly and push rods. Identify push rods to ensure installation in original locations.

(4) Remove intake manifold.

(5) Remove yoke retainer and aligning yokes.

(6) Slide Hydraulic Tappet Remover/Installer Tool C-4129-A through opening in cylinder head and seat tool firmly in the head of tappet.

(7) Pull tappet out of bore with a twisting motion. If all tappets are to be removed, identify tappets to ensure installation in original location.

(8) If the tappet or bore in cylinder block is scored, scuffed, or shows signs of sticking, ream the bore to next oversize. Replace with oversize tappet.

INSTALLATION

(1) Lubricate tappets.

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REMOVAL AND INSTALLATION (Continued)

(2) Install tappets and push rods in their original positions. Ensure that the oil feed hole in the side of the tappet body faces up (away from the crankshaft).

(3) Install aligning yokes with ARROW toward camshaft.

(4) Install yoke retainer. Tighten the bolts to 23 N·m (200 in. lbs.) torque. Install intake manifold.

(5) Install push rods in original positions.

(6) Install rocker arms.

(7) Install cylinder head cover.

(8) Start and operate engine. Warm up to normal operating temperature.

CAUTION: To prevent damage to valve mechanism, engine must not be run above fast idle until all hydraulic tappets have filled with oil and have become quiet.

DISTRIBUTOR DRIVE SHAFT BUSHING

REMOVAL

(1) Remove distributor. Refer to Group 8D, Ignition Systems for the proper procedure.

(2) Remove the intake manifold. Refer to Group 11, Exhaust System and Intake Manifold.

(3) Insert Distributor Drive Shaft Bushing Puller Tool C-3052 into old bushing and thread down until a tight fit is obtained (Fig. 20).

(4) Hold puller screw and tighten puller nut until bushing is removed.

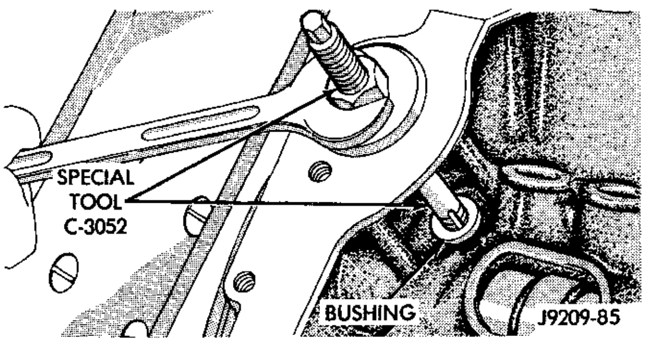

Fig. 20 Distributor Driveshaft Bushing Removal

INSTALLATION

(1) Slide new bushing over burnishing end of Distributor Drive Shaft Bushing Driver/Burnisher Tool C-3053. Insert the tool and bushing into the bore.

(2) Drive bushing and tool into position, using a hammer (Fig. 21).

(3) As the burnisher is pulled through the bushing, the bushing is expanded tight in the block and burnished to correct size (Fig. 22). **DO NOT ream this bushing.**

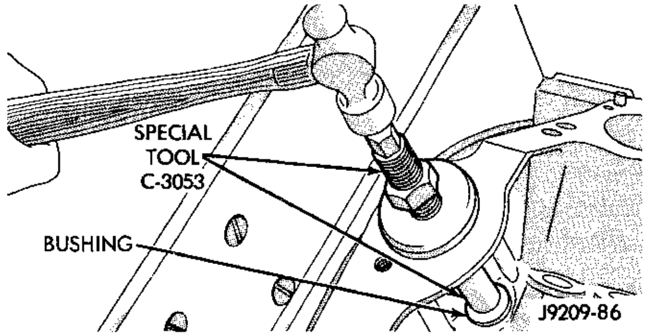

Fig. 21 Distributor Driveshaft Bushing Installation

CAUTION: This procedure MUST be followed when installing a new bushing or seizure to shaft may occur.

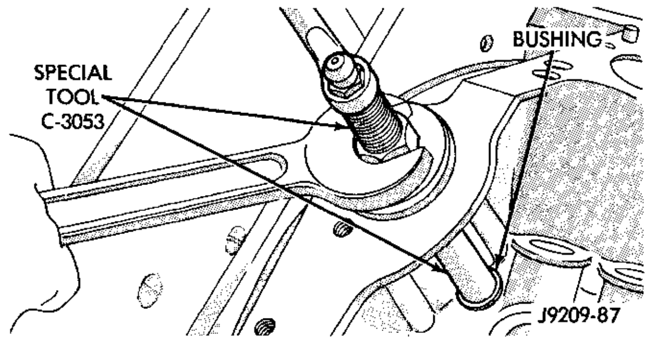

Fig. 22 Burnishing Distributor Driveshaft Bushing

(4) Install the intake manifold. Refer to Group 11, Exhaust System and Intake Manifold.

DISTRIBUTOR INSTALLATION

NOTE: Before installing the distributor, the oil pump drive shaft must be aligned to number one cylinder.

(1) Rotate crankshaft until No. 1 cylinder is at top dead center on the firing stroke.

(2) When in this position, the timing mark of vibration damper should be under "0" on the timing indicator.

(3) Install the shaft so that after the gear spirals into place, it will index with the oil pump shaft. The slot on top of oil pump shaft should be aligned toward the left front intake manifold attaching bolt hole (Fig. 23).

(4) Install distributor. Refer to Group 8D, Ignition Systems for the proper procedure.

After the distributor has been installed, its rotational position must be set using the **SET SYNC** mode of the DRB scan tool. Refer to Checking Distributor Position following the Distributor Installation section in Group 8D, Ignition System.

Do not attempt to adjust ignition timing by rotating the distributor. It has no effect on igni-

REMOVAL AND INSTALLATION (Continued)

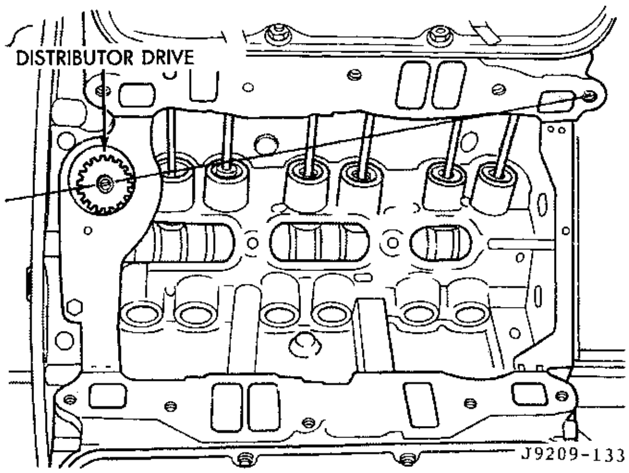

Fig. 23 Position of Oil Pump Shaft Slot

tion timing. Adjusting distributor position will affect fuel synchronization only.

VIBRATION DAMPER

REMOVAL

(1) Disconnect the negative cable from the battery.

(2) Remove fan shroud retainer bolts and set shroud back over engine.

(3) Remove the cooling system fan.

(4) Remove the serpentine belt. Refer to Group 7, Cooling System.

(5) Remove the vibration damper pulley.

(6) Remove vibration damper bolt and washer from end of crankshaft.

(7) Install bar and screw from Puller Tool Set C-3688. Install two bolts with washers through the puller tool and into the vibration damper (Fig. 24).

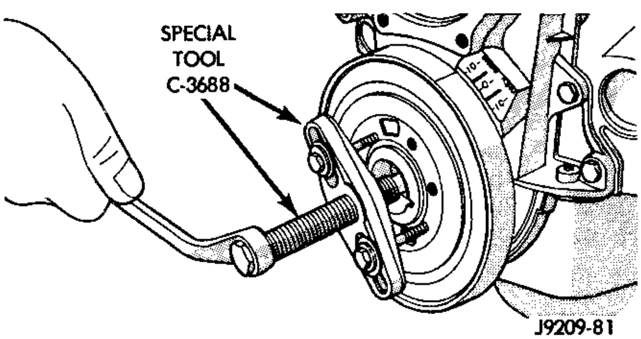

Fig. 24 Vibration Damper Assembly

(8) Pull vibration damper off of the crankshaft.

INSTALLATION

(1) Position the vibration damper onto the crankshaft.

(2) Place installing tool, part of Puller Tool Set C-3688, in position and press the vibration damper onto the crankshaft (Fig. 25).

(3) Install the crankshaft bolt and washer. Tighten the bolt to 183 N·m (135 ft. lbs.) torque.

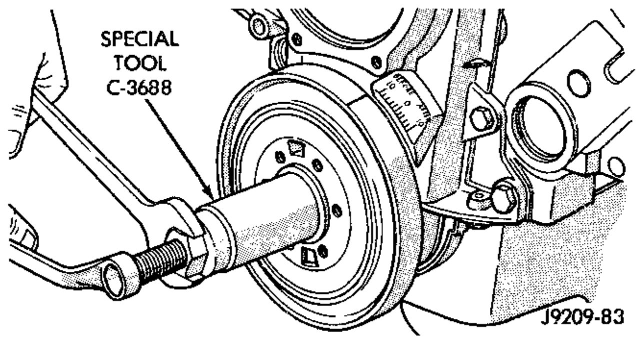

Fig. 25 Installing Vibration Damper

(4) Install the crankshaft pulley. Tighten the pulley bolts to 23 N·m (200 in. lbs.) torque.

(5) Install the serpentine belt. Refer to Group 7, Cooling System.

(6) Install the cooling system fan. Tighten the bolts to 23 N·m (17 ft. lbs.) torque.

(7) Position the fan shroud and install the bolts. Tighten the retainer bolts to 11 N·m (95 in. lbs.) torque.

(8) Connect the negative cable to the battery.

TIMING CHAIN COVER

REMOVAL

(1) Disconnect the battery negative cable.

(2) Drain cooling system. Refer to Group 7, Cooling System.

(3) Remove the serpentine belt. Refer to Group 7, Cooling System.

(4) Remove water pump. Refer to Group 7, Cooling System.

(5) Remove power steering pump. Refer to Group 19, Steering.

(6) Remove vibration damper.

(7) Loosen oil pan bolts and remove the front bolt at each side.

(8) Remove the cover bolts.

(9) Remove chain case cover and gasket using extreme caution to avoid damaging oil pan gasket.

(10) From the inside of the cover tap the front crankshaft oil seal outward. Be careful not to damage the timing cover sealing surface.

INSTALLATION

(1) Be sure mating surfaces of chain case cover and cylinder block are clean and free from burrs.

(2) Using a new cover gasket, carefully install chain case cover to avoid damaging oil pan gasket. Use a small amount of Mopar Silicone Rubber Adhesive Sealant, or equivalent, at the joint between timing chain cover gasket and the oil pan gasket. Finger tighten the timing chain cover bolts at this time.

CAUTION: If chain cover is replaced for any reason, be sure the oil hole (passenger side of cover) is plugged.

REMOVAL AND INSTALLATION (Continued)

(3) Place the smaller diameter of the oil seal over Front Oil Seal Installation Tool 6635 (Fig. 26). Seat the oil seal in the groove of the tool.

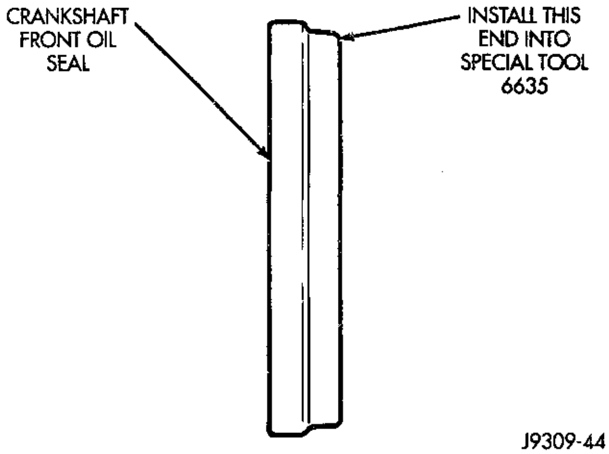

Fig. 26 Placing Oil Seal on Installation Tool 6635

(4) Position the seal and tool onto the crankshaft (Fig. 27).

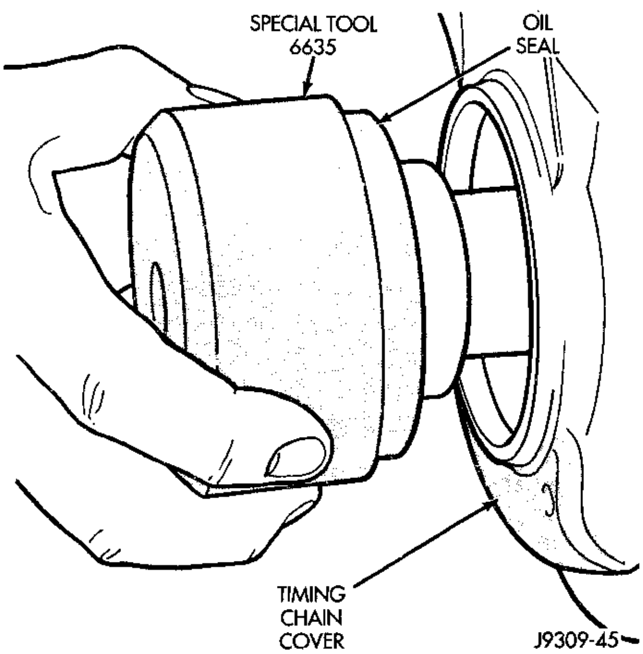

Fig. 27 Position Tool and Seal onto Crankshaft

(5) Tighten the four lower chain case cover bolts to 13N·m (10 ft.lbs.) to prevent the cover from tipping during seal installation.

(6) Using the vibration damper bolt, tighten the bolt to draw the seal into position on the crankshaft (Fig. 28).

(7) Loosen the four bolts tightened in Step 4 to allow realignment of front cover assembly.

(8) Tighten chain case cover bolts to 41 N·m (30 ft. lbs.) torque. Tighten oil pan bolts to 24 N·m (215 in. lbs.) torque.

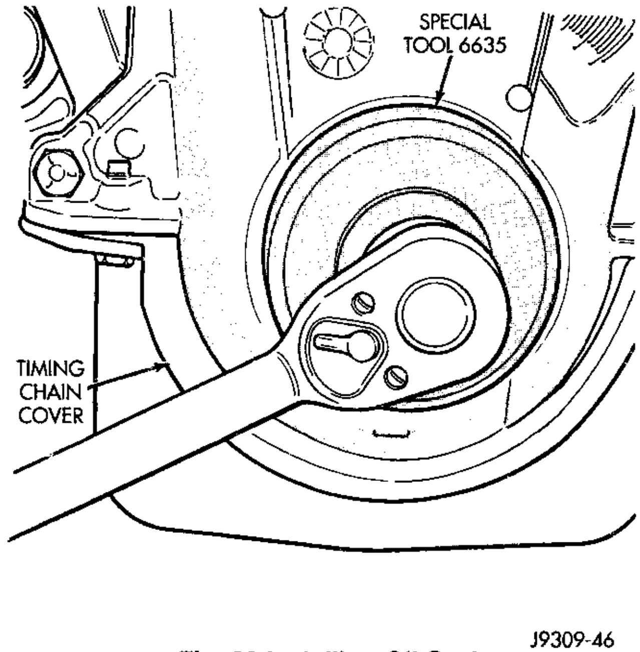

Fig. 28 Installing Oil Seal

(9) Remove the vibration damper bolt and seal installation tool.

(10) Inspect the seal flange on the vibration damper.

(11) Install vibration damper.

(12) Install water pump and housing assembly using new gaskets. Refer to Group 7, Cooling System. Tighten bolts to 41 N·m (30 ft. lbs.) torque.

(13) Install power steering pump. Refer to Group 19, Steering.

(14) Install the serpentine belt. Refer to Group 7, Cooling System.

(15) Install the cooling system fan. Tighten the bolts to 23 N·m (17 ft. lbs.) torque.

(16) Position the fan shroud and install the bolts. Tighten the bolts to 11 N·m (95 in. lbs.) torque.

(17) Fill cooling system. Refer to Group 7, Cooling System for the proper procedure.

(18) Connect the negative cable to the battery.

TIMING CHAIN AND TENSIONER

REMOVAL

(1) Disconnect battery negative cable.

(2) Drain cooling system. Refer to Group 7, Cooling System for the correct procedure.

(3) Remove timing chain cover. Refer to procedure in this group.

(4) Rotate crankshaft to align timing marks (Fig. 30) to #1 TDC.

(5) Remove camshaft sprocket attaching bolt and remove timing chain with crankshaft and camshaft sprockets.

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REMOVAL AND INSTALLATION (Continued)

(6) Slip crankshaft sprocket onto crankshaft and compress tensioner shoe by placing a large screwdriver between crankshaft sprocket and tensioner shoe (Fig. 29). Compress shoe until hole in shoe lines up with hole in bracket. Slide a suitable pin into the holes (Fig. 29) and remove screwdriver.

(7) If tensioner assembly is to be replaced, remove the three tensioner to block bolts and remove tensioner assembly.

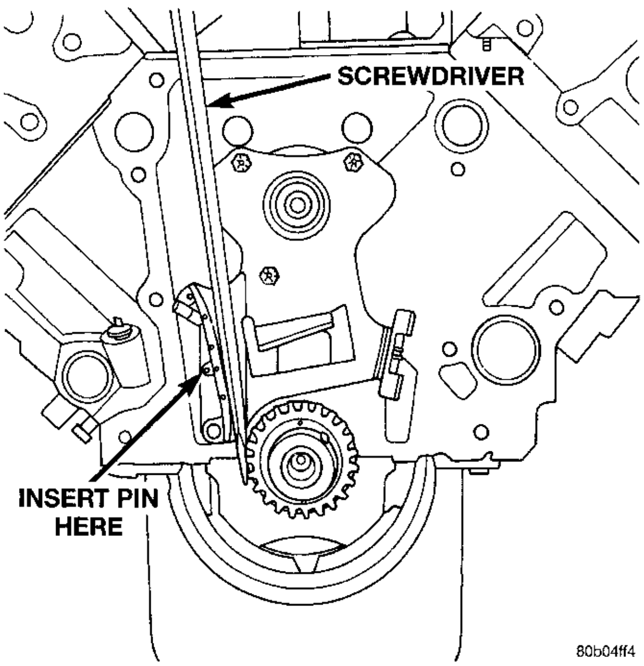

Fig. 29 Compressing Tensioner For Chain Installation

INSTALLATION

(1) If tensioner assembly is being replaced, install tensioner and mounting bolts. Torque bolts to 24 N·m (210 in. lbs.).

(2) Place both camshaft sprocket and crankshaft sprocket on the bench with timing marks on an exact imaginary center line through both camshaft and crankshaft bores.

(3) Place timing chain around both sprockets.

(4) Lift sprockets and chain (keep sprockets tight against the chain in position as described).

(5) Slide both sprockets evenly over their respective shafts and verify alignment of timing marks (Fig. 30) with a straight-edge if necessary.

(6) Install the camshaft bolt. Tighten the bolt to 68 N·m (50 ft. lbs.) torque.

(7) **Remove tensioner pin.** Again, verify alignment of timing marks.

(8) Install timing cover.

(9) Fill cooling system. Refer to Group 7, Cooling System for the correct procedure.

(10) Connect battery negative cable.

(11) Start engine and check for oil and coolant leaks.

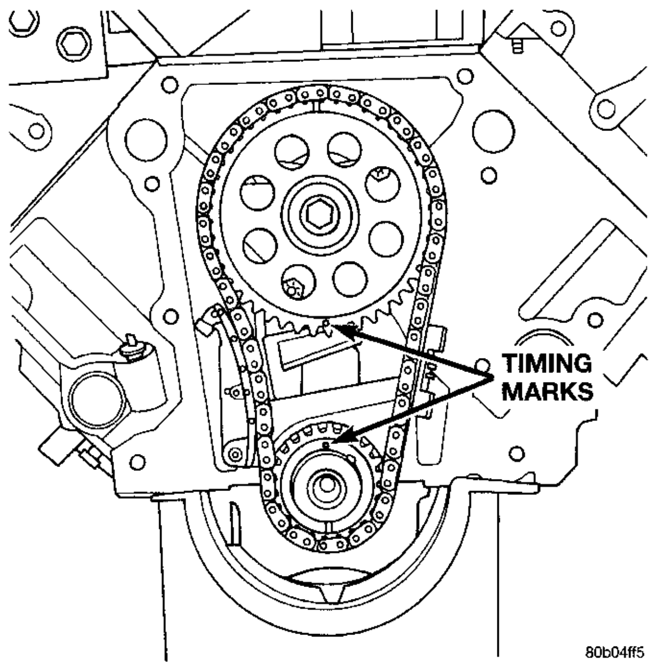

Fig. 30 Alignment of Timing Marks

CAMSHAFT

REMOVAL

(1) Disconnect battery negative cable.

(2) Drain cooling system. Refer to Group 7, Cooling for the correct procedure.

(3) Remove radiator.

(4) Remove intake manifold. Refer to Group 11, Exhaust System and Intake Manifold for the correct procedures.

(5) Remove distributor assembly. Refer to Group 8D, Ignition Systems for the correct procedure.

(6) Remove cylinder head covers.

(7) Remove timing chain cover. Refer to procedure in this group.

(8) Remove rocker arms.

(9) Remove push rods and tappets. Identify each part so it can be installed in the original locations.

(10) Remove distributor and lift out the oil pump and distributor drive shaft.

(11) Remove the three tensioner to block mounting bolts and remove tensioner.

(12) Install a long bolt into front of camshaft to facilitate removal of the camshaft. Remove camshaft, being careful not to damage cam bearings with the cam lobes.

INSTALLATION

(1) Lubricate camshaft lobes and camshaft bearing journals and insert the camshaft to within 51 mm (2 inches) of its final position in cylinder block.

(2) Install Camshaft Gear Installer Tool C-3509 with tongue back of distributor drive gear (Fig. 31).

REMOVAL AND INSTALLATION (Continued)

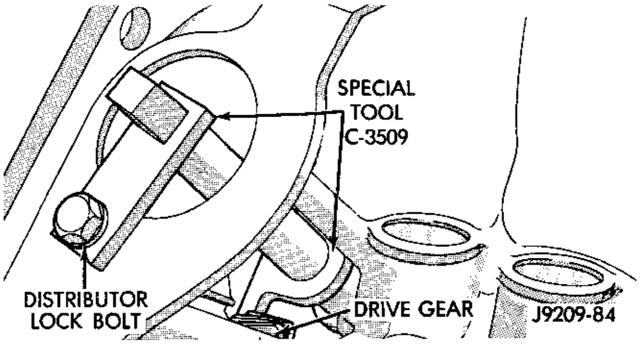

Fig. 31 Camshaft Holding Tool C-3509 (Installed Position)

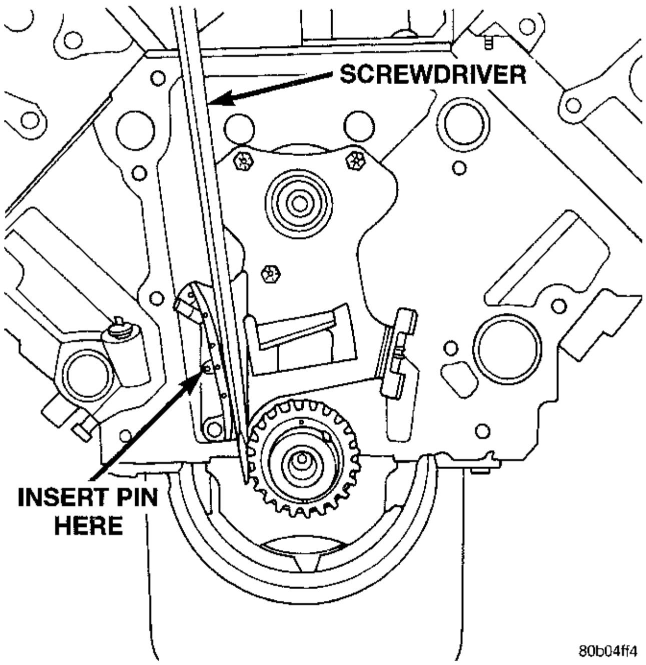

Fig. 32 Compressing Tensioner Shoe For Timing Chain Installation

(3) Hold tool in position with a distributor lock-plate bolt. This tool will restrict camshaft from being pushed in too far and prevent knocking out the welch plug in rear of cylinder block. **Tool should remain installed until the camshaft and crankshaft sprockets and timing chain have been installed.**

(4) Install timing chain tensioner. Torque bolts to 24 N·m (210 in. lbs.) torque.

(5) Compress tensioner shoe (Fig. 32) and install a suitable sized pin to retain shoe for chain installation.

(6) Place both camshaft sprocket and crankshaft sprocket on the bench with timing marks on an exact imaginary center line through both camshaft and crankshaft bores.

(7) Place timing chain around both sprockets.

(8) Turn crankshaft and camshaft to line up with keyway location in crankshaft sprocket and in camshaft sprocket.

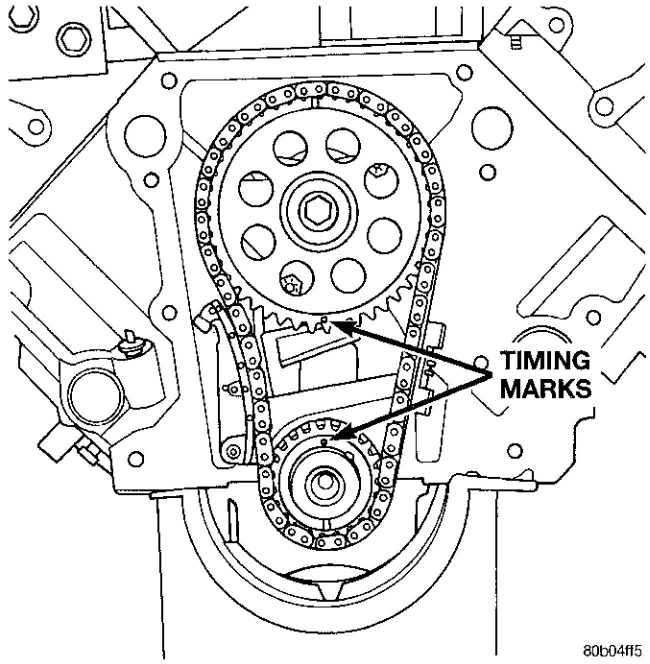

Fig. 33 Alignment of Timing Marks

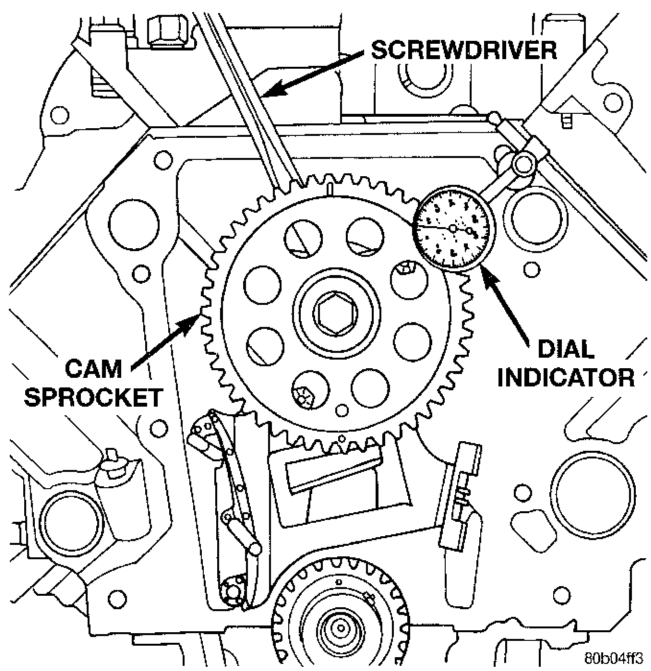

Fig. 34 Checking Camshaft End Play

(9) Lift sprockets and chain (keep sprockets tight against the chain in position as described).

(10) Slide both sprockets evenly over their respective shafts and use a straightedge to check alignment of timing marks (Fig. 33).

(11) Install the camshaft bolt/cup washer. Tighten bolt to 68 N·m (50 ft. lbs.) torque.

(12) Measure camshaft end play (Fig. 34). Refer to Specifications for proper clearance. If not within limits, install a new timing chain tensioner.

REMOVAL AND INSTALLATION (Continued)

(13) Each tappet reused must be installed in the same position at which it was removed. **When camshaft is replaced, all of the tappets must be replaced.**

(14) Install timing chain cover

(15) Install intake manifold. Refer to Group 11, Exhaust System and Intake Manifold for the correct procedure.

(16) Install distributor. Refer to Group 8D, Ignition System for the correct procedure.

(17) Install cylinder head covers.

(18) Install radiator.

(19) Fill cooling system. Refer to Group 7, Cooling System for the correct procedure.

(20) Connect battery negative cable.

(21) Start engine and check for leaks.

CAMSHAFT BEARINGS

REMOVAL

(1) With engine completely disassembled, drive out rear cam bearing core hole plug.

(2) Install proper size adapters and horseshoe washers (part of Camshaft Bearing Remover/Installer Tool C-3132-A) at back of each bearing shell. Drive out bearing shells (Fig. 35).

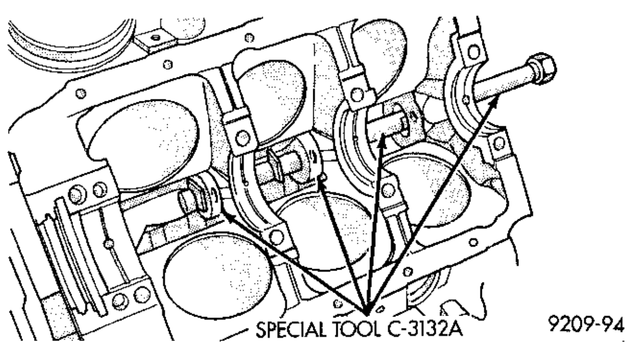

Fig. 35 Camshaft Bearings Removal and Installation with Tool C-3132-A

INSTALLATION

(1) Install new camshaft bearings with Camshaft Bearing Remover/Installer Tool C-3132-A by sliding the new camshaft bearing shell over proper adapter.

(2) Position rear bearing in the tool. Install horseshoe lock and, by reversing removal procedure, carefully drive bearing shell into place.

(3) Install remaining bearings in the same manner. Bearings must be carefully aligned to bring oil holes into full register with oil passages from the main bearing. If the camshaft bearing shell oil holes are not in exact alignment, remove and install them correctly. Install a new core hole plug at the rear of camshaft. **Be sure this plug does not leak.**

CRANKSHAFT MAIN BEARINGS

REMOVAL

(1) Remove the oil pan.

(2) Remove the oil pump from the rear main bearing cap.

(3) Identify bearing caps before removal. Remove bearing caps one at a time.

(4) Remove upper half of bearing by inserting Crankshaft Main Bearing Remover/Installer Tool C-3059 into the oil hole of crankshaft (Fig. 36).

(5) Slowly rotate crankshaft clockwise, forcing out upper half of bearing shell.

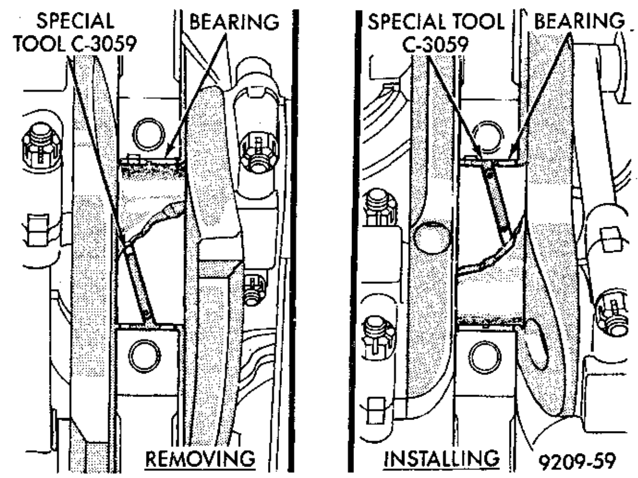

Fig. 36 Upper Main Bearing Removal and Installation with Tool C-3059

INSTALLATION

Only one main bearing should be selectively fitted while all other main bearing caps are properly tightened. All bearing capbolts removed during service procedures are to be cleaned and oiled before installation. DO NOT use a new bearing half with an old bearing half.

When installing a new upper bearing shell, slightly chamfer the sharp edges from the plain side.

(1) Start bearing in place, and insert Crankshaft Main Bearing Remover/Installer Tool C-3059 into oil hole of crankshaft (Fig. 36).

(2) Slowly rotate crankshaft counterclockwise sliding the bearing into position. Remove Tool C-3059.

(3) Install the bearing caps. Clean and oil the bolts. Tighten the capbolts to 115 N·m (85 ft. lbs.) torque.

(4) Install the oil pump.

(5) Install the oil pan.

REMOVAL AND INSTALLATION (Continued)

OIL PAN

REMOVAL

(1) Disconnect the negative cable from the battery.
(2) Remove engine oil dipstick.
(3) Raise vehicle.
(4) Drain engine oil.
(5) Remove exhaust pipe.
(6) Remove left engine to transmission strut.
(7) Loosen the right side engine support bracket cushion through-bolt nut and raise the engine slightly. Remove oil pan by sliding backward and out.
(8) Remove the one-piece gasket.

INSTALLATION

(1) Clean the block and pan gasket surfaces.
(2) Fabricate four alignment dowels from 5/16 X 1 1/2 inch bolts. Cut the head off the bolts and cut a slot into the top of the dowel. This will allow easier installation and removal with a screwdriver (Fig. 37).

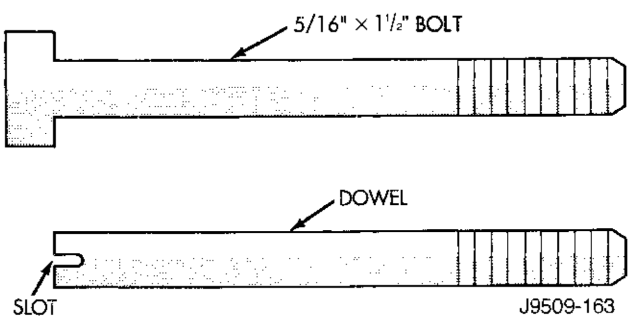

Fig. 37 Fabrication of Alignment Dowels

(3) Install the dowels in the cylinder block (Fig. 38).

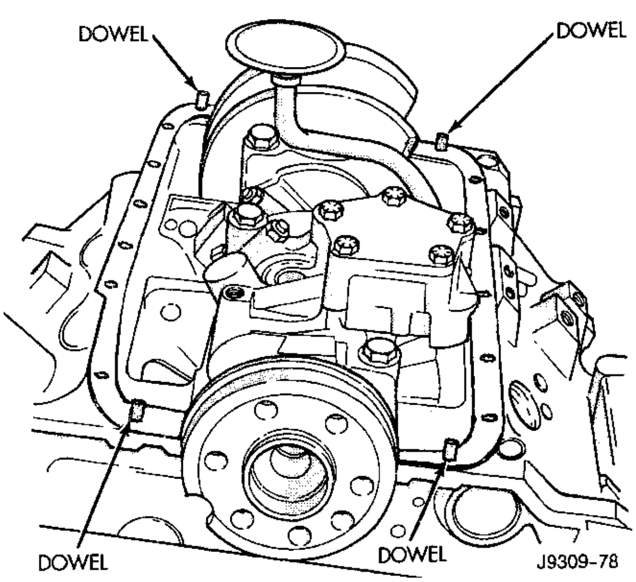

Fig. 38 Position of Dowels in Cylinder Block

(4) Apply small amount of Mopar® Silicone Rubber Adhesive Sealant, or equivalent, in the corner of the cap and the cylinder block.
(5) Slide the one-piece gasket over the dowels and onto the block.
(6) Position the oil pan over the dowels and onto the gasket.
(7) Install the oil pan bolts. Tighten the bolts to 24 N·m (215 in. lbs.) torque.
(8) Remove the dowels. Install the remaining oil pan bolts. Tighten these bolts to 24 N·m (215 in. lbs.) torque.
(9) Lower the engine into the support cushion brackets and tighten the through-bolt nut to the proper torque.
(10) Install the drain plug. Tighten drain plug to 34 N·m (27 ft. lbs.) torque.
(11) Install the engine to transmission strut.
(12) Install exhaust pipe.
(13) Lower vehicle.
(14) Install dipstick.
(15) Connect the negative cable to the battery.
(16) Fill crankcase with oil to proper level.

OIL PUMP

REMOVAL

(1) Remove the oil pan.
(2) Remove the oil pump from rear main bearing cap.

INSTALLATION

(1) Install oil pump. During installation, slowly rotate pump body to ensure driveshaft-to-pump rotor shaft engagement.
(2) Hold the oil pump base flush against mating surface on No. 4 main bearing cap. Finger-tighten pump attaching bolts. Tighten attaching bolts to 41 N·m (30 ft. lbs.) torque.
(3) Install the oil pan.

PISTON AND CONNECTING ROD ASSEMBLY

REMOVAL

(1) Remove the engine from the vehicle.
(2) Remove the cylinder head.
(3) Remove the oil pan.
(4) Remove top ridge of cylinder bores with a reliable ridge reamer before removing pistons from cylinder block. Be sure to keep tops of pistons covered during this operation.
(5) Be sure each connecting rod and connecting rod cap is identified with the cylinder number. Remove connecting rod cap. Install connecting rod bolt guide set on connecting rod bolts.
(6) Pistons and connecting rods must be removed from top of cylinder block. When removing the

REMOVAL AND INSTALLATION (Continued)

assemblies from the engine, rotate crankshaft so that the connecting rod is centered in cylinder bore and at BDC. **Be careful not to nick crankshaft journals.**

(7) After removal, install bearing cap on the mating rod.

INSTALLATION

(1) Be sure that compression ring gaps are staggered so that neither is in line with oil ring rail gap.

(2) Before installing the ring compressor, be sure the oil ring expander ends are butted and the rail gaps located properly (Fig. 39).

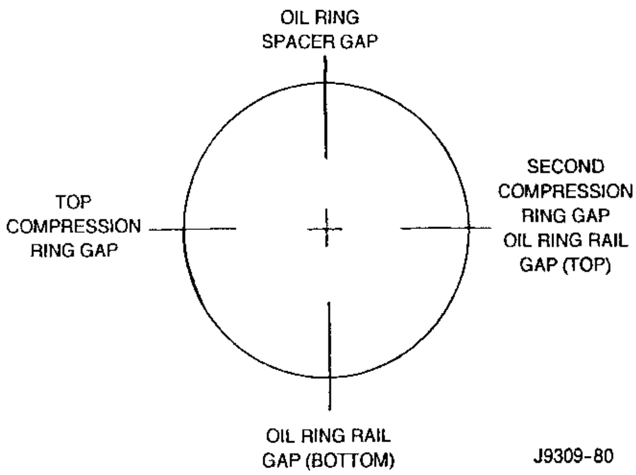

Fig. 39 Proper Ring Installation

(3) Immerse the piston head and rings in clean engine oil. Slide Piston Ring Compressor Tool C-385 over the piston and tighten with the special wrench (part of Tool C-385). **Be sure position of rings does not change during this operation.**

(4) Install connecting rod bolt protectors on rod bolts. The long protector should be installed on the numbered side of the connecting rod.

(5) Rotate crankshaft so that the connecting rod journal is on the center of the cylinder bore. Be sure connecting rod and cylinder bore number are the same. Insert rod and piston into cylinder bore and guide rod over the crankshaft journal.

(6) Tap the piston down in cylinder bore, using a hammer handle. At the same time, guide connecting rod into position on crankshaft journal.

(7) The notch, or groove, on top of piston must be pointing toward front of engine. The larger chamfer of the connecting rod bore must be installed toward crankshaft journal fillet.

(8) Install rod caps. Be sure connecting rod, connecting rod cap, and cylinder bore number are the same. Install nuts on cleaned and oiled rod bolts and tighten nuts to 61 N·m (45 ft. lbs.) torque.

(9) Install the oil pan.

(10) Install the cylinder head.

(11) Install the engine into the vehicle.

CRANKSHAFT

REMOVAL

(1) Remove the oil pan.

(2) Remove the oil pump from the rear main bearing cap.

(3) Identify bearing caps before removal. Remove bearing caps and bearings one at a time.

(4) Lift the crankshaft out of the block.

(5) Remove and discard the crankshaft rear oil seals.

(6) Remove and discard the front crankshaft oil seal.

INSTALLATION

(1) Lightly oil the new upper seal lips with engine oil.

(2) Install the new upper rear bearing oil seal with the white paint facing towards the rear of the engine.

(3) Position the crankshaft into the cylinder block.

(4) Lightly oil the new lower seal lips with engine oil.

(5) Install the new lower rear bearing oil seal into the bearing cap with the white paint facing towards the rear of the engine.

(6) Apply 5 mm (0.20 in.) drop of Loctite 518, or equivalent, on each side of the rear main bearing cap (Fig. 40). DO NOT over-apply sealant or allow the sealant to contact the rubber seal. Assemble bearing cap to cylinder block immediately after sealant application.

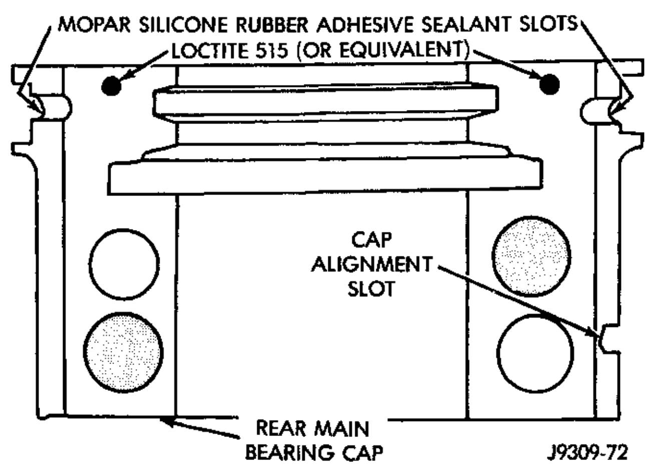

Fig. 40 Sealant Application to Bearing Cap

(7) To align the bearing cap, use cap slot, alignment dowel, and cap bolts. DO NOT remove excess material after assembly. DO NOT strike rear cap more than two times for proper engagement.

(8) Clean and oil all cap bolts. Install all main bearing caps. Install all cap bolts and alternately tighten to 115 N·m (85 ft. lbs.) torque.

(9) Install oil pump.

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REMOVAL AND INSTALLATION (Continued)

(10) Apply Mopar Silicone Rubber Adhesive Sealant, or equivalent, at bearing cap-to-block joint to provide cap-to-block and oil pan sealing (Fig. 41). Apply enough sealant so that a small amount is squeezed out. Withdraw nozzle and wipe excess sealant off the oil pan seal groove.

(11) Install new front crankshaft oil seal.

(12) Immediately install the oil pan.

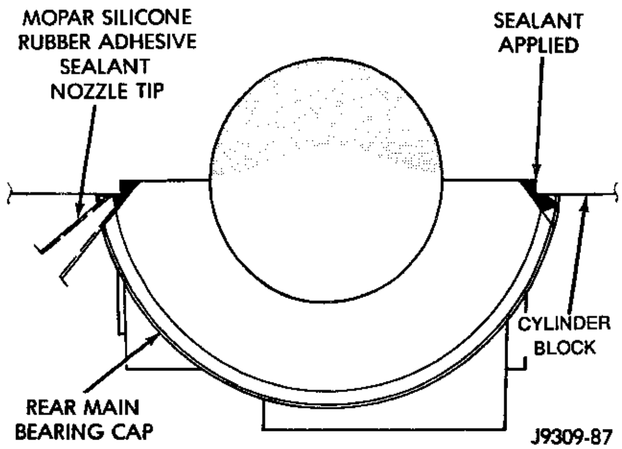

Fig. 41 Apply Sealant to Bearing Cap-to-Block Joint

CRANKSHAFT FRONT OIL SEAL

REMOVAL

The oil seal can be replaced without removing the timing chain cover, provided that the cover is not misaligned.

(1) Disconnect the negative cable from the battery.

(2) Remove vibration damper.

(3) If front seal is suspected of leaking, check front oil seal alignment to crankshaft. The seal installation/alignment Tool 6635, should fit with minimum interference. If tool does not fit, the cover must be removed and installed properly.

(4) Place a suitable tool behind the lips of the oil seal to pry the oil seal outward. Be careful not to damage the crankshaft seal bore of cover.

INSTALLATION

(1) Place the smaller diameter of the oil seal over Front Oil Seal Installation Tool 6635 (Fig. 42). Seat the oil seal in the groove of the tool.

(2) Position the seal and tool onto the crankshaft (Fig. 43).

(3) Using the vibration damper bolt, tighten the bolt to draw the seal into position on the crankshaft (Fig. 44).

(4) Remove the vibration damper bolt and seal installation tool.

(5) Inspect the seal flange on the vibration damper.

(6) Install the vibration damper.

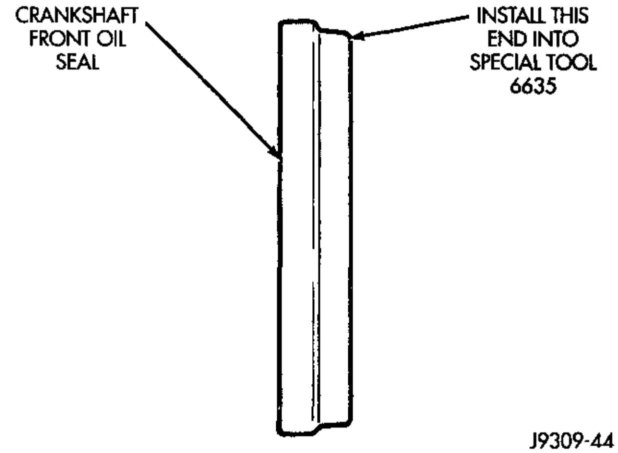

Fig. 42 Placing Oil Seal on Installation Tool 6635

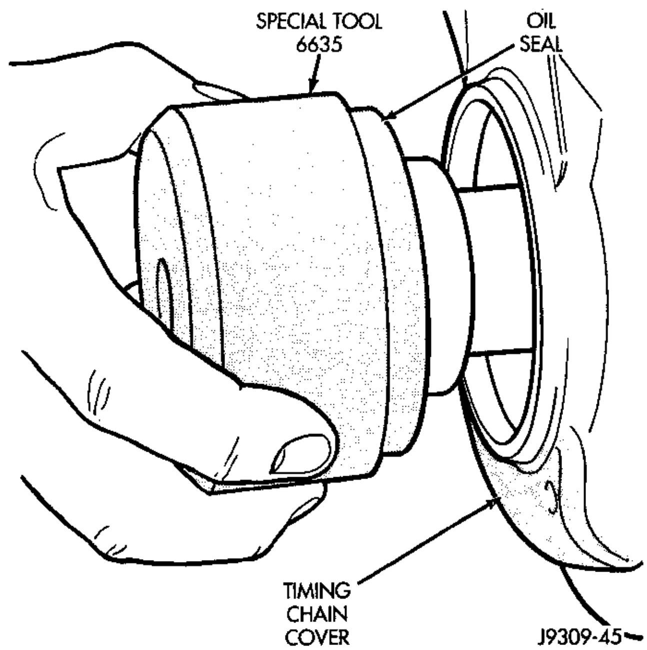

Fig. 43 Position Tool and Seal onto Crankshaft

(7) Connect the negative cable to the battery.

CRANKSHAFT REAR OIL SEALS

The service seal is a two piece, Viton seal. The upper seal half can be installed with crankshaft removed from engine or with crankshaft installed. When a new upper seal is installed, install a new lower seal. The lower seal half can be installed only with the rear main bearing cap removed.

UPPER SEAL —CRANKSHAFT REMOVED

REMOVAL

(1) Remove the crankshaft. Discard the old upper seal.

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REMOVAL AND INSTALLATION (Continued)

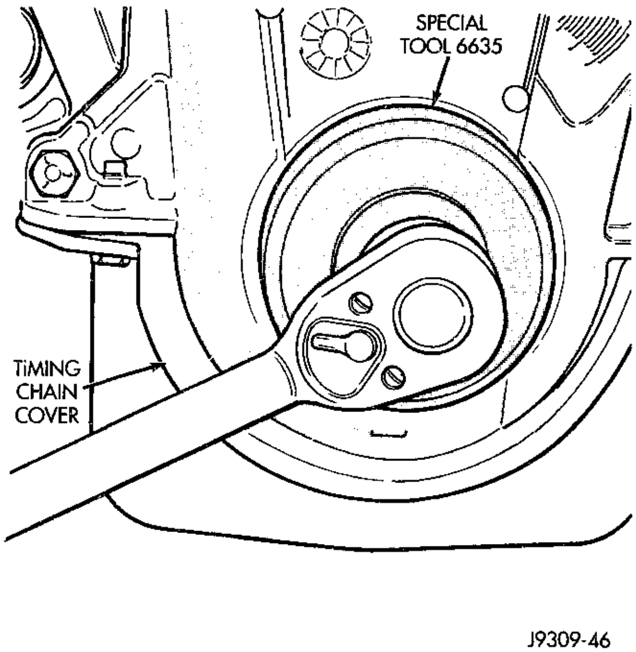

Fig. 44 Installing Oil Seal

INSTALLATION

(1) Clean the cylinder block rear cap mating surface. Be sure the seal groove is free of debris. Check for burrs at the oil hole on the cylinder block mating surface to rear cap.

(2) Lightly oil the new upper seal lips with engine oil.

(3) Install the new upper rear bearing oil seal with the white paint facing toward the rear of the engine.

(4) Position the crankshaft into the cylinder block.

(5) Lightly oil the new lower seal lips with engine oil.

(6) Install the new lower rear bearing oil seal into the bearing cap with the white paint facing towards the rear of the engine.

(7) Apply 5 mm (0.20 in.) drop of Loctite 518, or equivalent, on each side of the rear main bearing cap (Fig. 45). DO NOT over-apply sealant or allow the sealant to contact the rubber seal. Assemble bearing cap to cylinder block immediately after sealant application.

(8) To align the bearing cap, use cap slot, alignment dowel, and cap bolts. DO NOT remove excess material after assembly. DO NOT strike rear cap more than two times for proper engagement.

(9) Clean and oil all cap bolts. Install all main bearing caps. Install all cap bolts and alternately tighten to 115 N·m (85 ft. lbs.) torque.

(10) Install oil pump.

(11) Apply Mopar Silicone Rubber Adhesive Sealant, or equivalent, at bearing cap-to-block joint to provide cap to block and oil pan sealing (Fig. 46). Apply enough sealant so that a small amount is

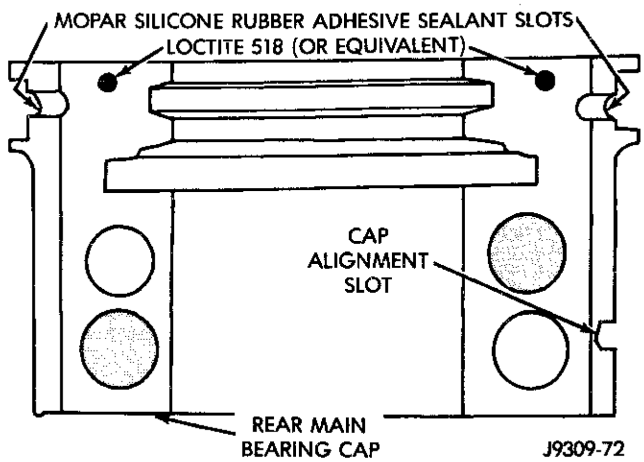

Fig. 45 Sealant Application to Bearing Cap

squeezed out. Withdraw nozzle and wipe excess sealant off the oil pan seal groove.

(12) Install new front crankshaft oil seal.

(13) Immediately install the oil pan.

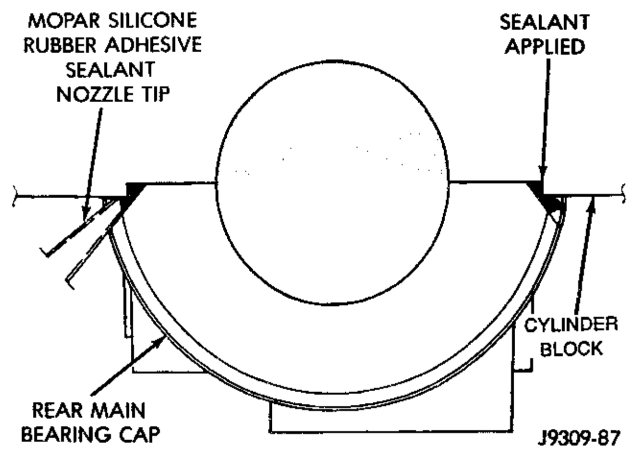

Fig. 46 Apply Sealant to Bearing Cap-to-Block Joint

UPPER SEAL—CRANKSHAFT INSTALLED

REMOVAL

(1) Remove the oil pan.

(2) Remove the oil pump from the rear main bearing cap.

(3) Remove the rear main bearing cap. Remove and discard the old lower oil seal.

(4) Carefully remove and discard the old upper oil seal.

INSTALLATION

(1) Clean the cylinder block mating surfaces before oil seal installation. Check for burrs at the oil hole on the cylinder block mating surface to rear cap.

(2) Lightly oil the new upper seal lips with engine oil. To allow ease of installation of the seal, loosen at

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REMOVAL AND INSTALLATION (Continued)

least the two main bearing caps forward of the rear bearing cap.

(3) Rotate the new upper seal into the cylinder block, being careful not to shave or cut the outer surface of the seal. To ensure proper installation, use the installation tool provided with the kit. Install the new seal with the white paint facing toward the rear of the engine.

(4) Install the new lower rear bearing oil seal into the bearing cap with the white paint facing toward the rear of the engine.

(5) Apply 5 mm (0.20 in.) drop of Loctite 518, or equivalent, on each side of the rear main bearing cap (Fig. 45). DO NOT over-apply sealant or allow the sealant to contact the rubber seal. Assemble bearing cap to cylinder block immediately after sealant application. Be sure the white paint faces toward the rear of the engine.

(6) To align the bearing cap, use cap slot, alignment dowel, and cap bolts. DO NOT remove excess material after assembly. DO NOT strike rear cap more than two times for proper engagement.

(7) Install the rear main bearing cap with cleaned and oiled cap bolts. Alternately tighten ALL cap bolts to 115 N·m (85 ft. lbs.) torque.

(8) Install oil pump.

(9) Apply Mopar Silicone Rubber Adhesive Sealant, or equivalent, at bearing cap-to-block joint to provide cap-to-block and oil pan sealing (Fig. 46). Apply enough sealant until a small amount is squeezed out. Withdraw nozzle and wipe excess sealant off the oil pan seal groove.

(10) Immediately install the oil pan.

LOWER SEAL

REMOVAL

(1) Remove the oil pan.

(2) Remove the oil pump from the rear main bearing cap.

(3) Remove the rear main bearing cap and discard the old lower seal.

INSTALLATION

(1) Clean the rear main cap mating surfaces including the oil pan gasket groove.

(2) Carefully install a new upper seal. Refer to Upper Seal Replacement — Crankshaft Installed proceaure above.

(3) Lightly oil the new lower seal lips with engine oil.

(4) Install a new lower seal in bearing cap with the white paint facing the rear of engine.

(5) Apply 5 mm (0.20 in.) drop of Loctite 518, or equivalent, on each side of the rear main bearing cap (Fig. 45). DO NOT over-apply sealant or allow the sealant to contact the rubber seal. Assemble bearing cap to cylinder block immediately after sealant application.

(6) To align the bearing cap, use cap slot, alignment dowel, and cap bolts. DO NOT remove excess material after assembly. DO NOT strike rear cap more than two times for proper engagement.

(7) Install the rear main bearing cap with cleaned and oiled cap bolts. Alternately tighten the cap bolts to 115 N·m (85 ft. lbs.) torque.

(8) Install oil pump.

(9) Apply Mopar Silicone Rubber Adhesive Sealant, or equivalent, at bearing cap-to-block joint to provide cap to block and oil pan sealing. Apply enough sealant so that a small amount is squeezed out. Withdraw nozzle and wipe excess sealant off the oil pan seal groove.

(10) Immediately install the oil pan.

ENGINE CORE OIL AND CAMSHAFT PLUGS

Engine core plugs have been pressed into the oil galleries behind the camshaft thrust plate (Fig. 47). This will reduce internal leakage and help maintain higher oil pressure at idle.

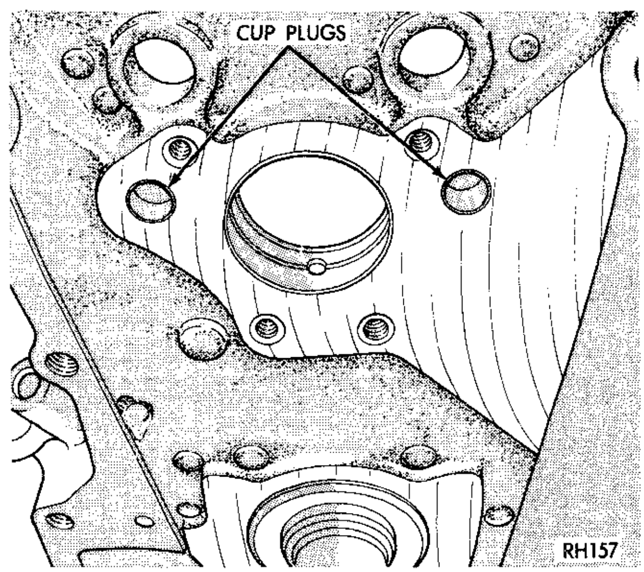

Fig. 47 Location of Cup Plugs in Oil Galleries

REMOVAL

(1) Using a blunt tool such as a drift or a screwdriver and a hammer, strike the bottom edge of the cup plug (Fig. 48).

(2) With the cup plug rotated, grasp firmly with pliers or other suitable tool and remove plug (Fig. 48).

INSTALLATION

Thoroughly clean inside of cup plug hole in cylinder block or head. Be sure to remove old sealer.

Be certain the new plug is cleaned of all oil or grease.

REMOVAL AND INSTALLATION (Continued)

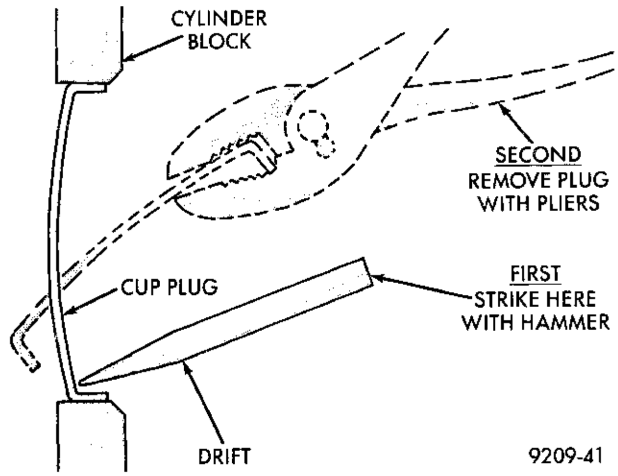

Fig. 48 Core Hole Plug Removal

(1) Coat edges of plug and core hole with Mopar Gasket Maker, or equivalent.

CAUTION: DO NOT drive cup plug into the casting, as restricted coolant flow can result and cause serious engine problems.

(2) Using proper plug drive, drive cup plug into hole. The sharp edge of the plug should be at least 0.50 mm (0.020 in.) inside the lead-in chamfer.

(3) It is not necessary to wait for curing of the sealant. The cooling system can be filled and the vehicle placed in service immediately.

DISASSEMBLY AND ASSEMBLY

HYDRAULIC TAPPETS

CAUTION: The plunger and tappet bodies are not interchangeable. The plunger and valve must always be fitted to the original body. It is advisable to work on one tappet at a time to avoid mixing of parts. Mixed parts are not compatible. DO NOT disassemble a tappet on a dirty work bench.

DISASSEMBLE

(1) Pry out plunger retainer spring clip (Fig. 49).

(2) Clean varnish deposits from inside of tappet body above plunger cap.

(3) Invert tappet body and remove plunger cap, plunger, check valve, check valve spring, check valve retainer, and plunger spring (Fig. 49). Check valve could be flat or ball.

ASSEMBLE

(1) Clean all tappet parts in a solvent that will remove all varnish and carbon.

(2) Replace tappets that are unfit for further service with new assemblies.

(3) If plunger shows signs of scoring or wear, install a new tappet assembly. If valve is pitted, or valve seat on end of plunger is prevented from seating, install a new tappet assembly.

(4) Assemble tappets (Fig. 49).

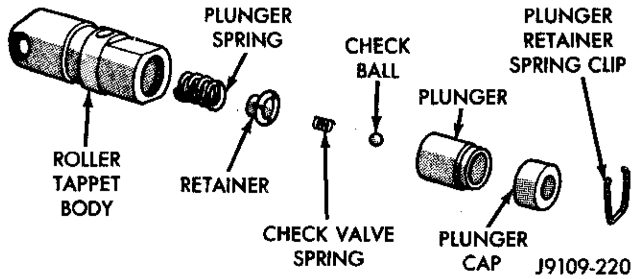

Fig. 49 Hydraulic Tappet Assembly

VALVES, GUIDES AND SPRINGS

VALVE CLEANING

Clean valves thoroughly. Discard burned, warped, or cracked valves.

Remove carbon and varnish deposits from inside of valve guides with a reliable guide cleaner.

VALVE GUIDES

Measure valve stems for wear. If wear exceeds 0.051 mm (0.002 in.), replace the valve.

Measure valve stem guide clearance as follows:

(1) Install Valve Guide Sleeve Tool C-3973 over valve stem and install valve (Fig. 50). The special sleeve places the valve at the correct height for checking with a dial indicator.

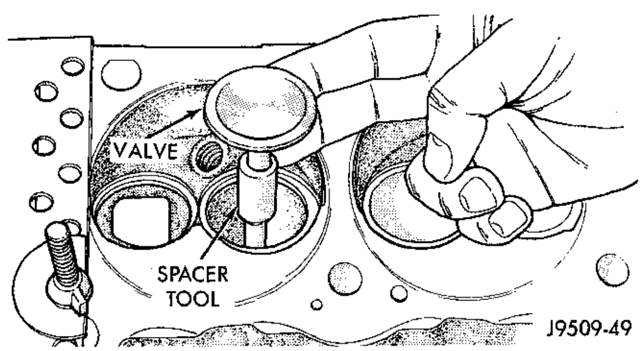

Fig. 50 Positioning Valve with Tool C-3973

(2) Attach dial indicator Tool C-3339 to cylinder head and set it at right angles to valve stem being measured (Fig. 51).

(3) Move valve to and from the indicator. The total dial indicator reading should not exceed 0.432 mm (0.017 in.). Ream the guides for valves with oversize stems if dial indicator reading is excessive or if the stems are scuffed or scored.

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DISASSEMBLY AND ASSEMBLY (Continued)

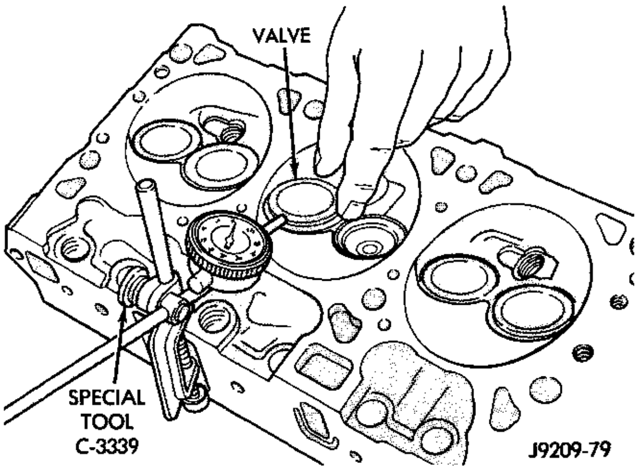

Fig. 51 Measuring Valve Guide Wear

VALVE GUIDES

Service valves with oversize stems are available (Fig. 52).

Reamer O/S	Valve Guide Size
0.076 mm (0.003 in.)	8.026 – 8.052 mm (0.316 – 0.317 in.)
0.381 mm (0.015 in.)	8.331 – 8.357 mm (0.328 – 0.329 in.)

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Fig. 52 Reamer Sizes

(1) Slowly turn reamer by hand and clean guide thoroughly before installing new valve. **Ream the valve guides from standard to 0.381 mm (0.015 in.). Use a two step procedure so the valve guides are reamed true in relation to the valve seat:**

- Step 1—Ream to 0.0763 mm (0.003 inch).
- Step 2—Ream to 0.381 mm (0.015 inch).

REFACING VALVES AND VALVE SEATS

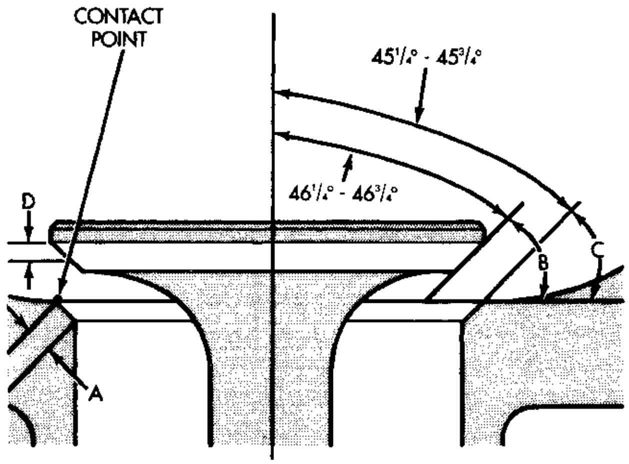
The intake and exhaust valves have a 43-1/4° to 43-3/4° face angle and a 44-1/4° to 44-3/4° seat angle (Fig. 53).

VALVES

Inspect the remaining margin after the valves are refaced (Fig. 54). Valves with less than 1.190 mm (0.047 in.) margin should be discarded.

VALVE SEATS

CAUTION: DO NOT un-shroud valves during valve seat refacing (Fig. 55).



A - SEAT WIDTH – INTAKE 1.016 – 1.524 mm (0.040 – 0.060 in.)
EXHAUST 1.524 – 2.032 mm (0.060 – 0.080 in.)
B - FACE ANGLE (INTAKE & EXHAUST) 43 1/4° – 43 3/4°
C - SEAT ANGLE (INTAKE & EXHAUST) 44 1/4° – 44 3/4°
D - CONTACT SURFACE

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Fig. 53 Valve Face and Seat Angles

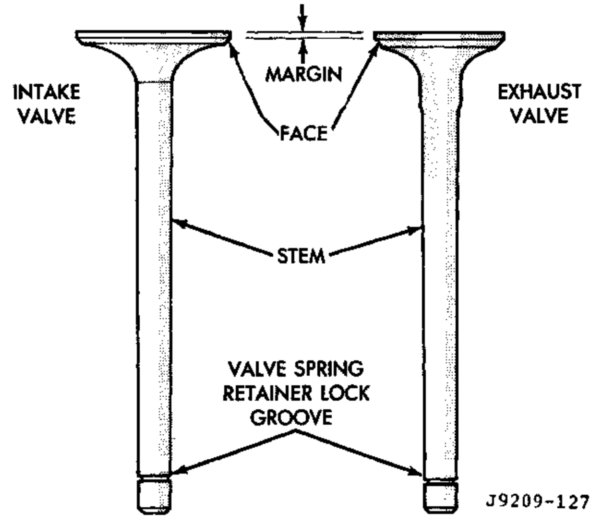

Fig. 54 Intake and Exhaust Valves

(1) When refacing valve seats, it is important that the correct size valve guide pilot be used for reseating stones. A true and complete surface must be obtained.

(2) Measure the concentricity of valve seat using a dial indicator. Total runout should not exceed 0.051 mm (0.002 in.) total indicator reading.

(3) Inspect the valve seat with Prussian blue, to determine where the valve contacts the seat. To do this, coat valve seat LIGHTLY with Prussian blue then set valve in place. Rotate the valve with light pressure. If the blue is transferred to the center of valve face, contact is satisfactory. If the blue is transferred to the top edge of valve face, lower valve seat

DISASSEMBLY AND ASSEMBLY (Continued)

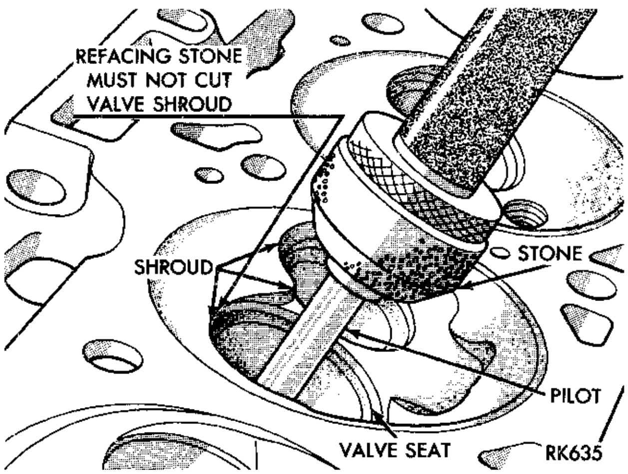

Fig. 55 Refacing Valve Seats

with a 15° stone. If the blue is transferred to bottom edge of valve face raise valve seat with a 60° stone.

(4) When seat is properly positioned the width of intake seats should be 1.016-1.524 mm (0.040-0.060 in.). The width of the exhaust seats should be 1.524-2.032 mm (0.060-0.080 in.).

VALVE SPRINGS

Whenever valves have been removed for inspection, reconditioning or replacement, valve springs should be tested. As an example the compression length of the spring to be tested is 1-5/16 in.. Turn table of Universal Valve Spring Tester Tool until surface is in line with the 1-5/16 in. mark on the threaded stud. Be sure the zero mark is to the front (Fig. 56). Place spring over stud on the table and lift compressing lever to set tone device. Pull on torque wrench until ping is heard. Take reading on torque wrench at this instant. Multiply this reading by 2. This will give the spring load at test length. Fractional measurements are indicated on the table for finer adjustments. Refer to specifications to obtain specified height and allowable tensions. Discard the springs that do not meet specifications.

OIL PUMP

DISASSEMBLE

(1) Remove the relief valve as follows:

(a) Remove cotter pin. Drill a 3.175 mm (1/8 in.) hole into the relief valve retainer cap and insert a self-threading sheet metal screw into cap.

(b) Clamp screw into a vise and while supporting oil pump, remove cap by tapping pump body using a soft hammer. Discard retainer cap and remove spring and relief valve (Fig. 57).

(2) Remove oil pump cover (Fig. 58).

(3) Remove pump outer rotor and inner rotor with shaft (Fig. 58).

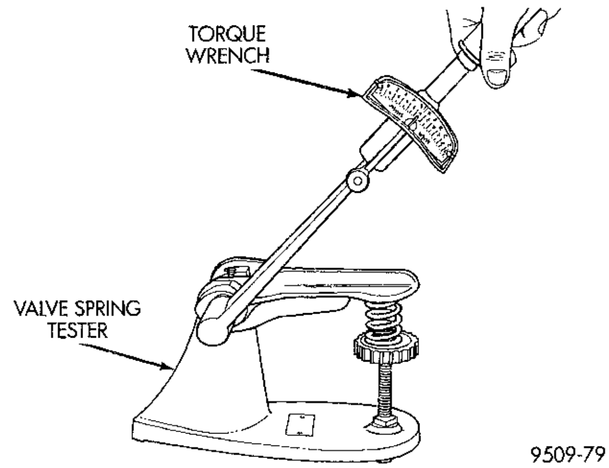

Fig. 56 Testing Valve Spring for Compressed Length

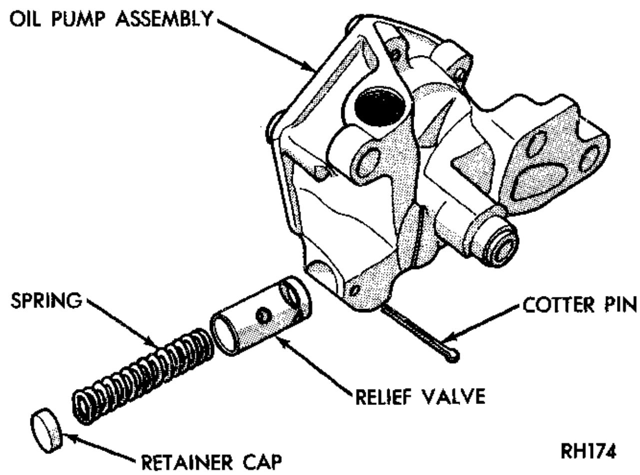

Fig. 57 Oil Pressure Relief Valve

(4) Wash all parts in a suitable solvent and inspect carefully for damage or wear.

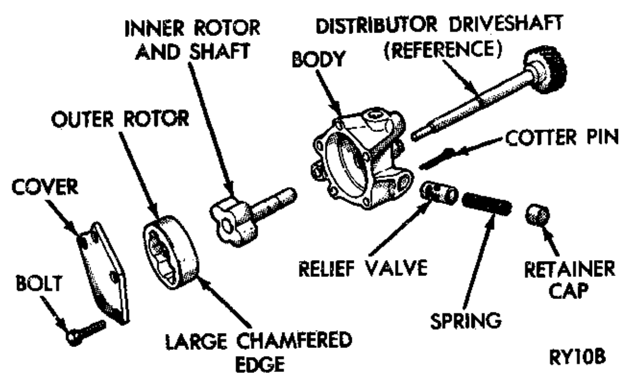

Fig. 58 Oil Pump

ASSEMBLE

(1) Install pump rotors and shaft, using new parts as required.

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DISASSEMBLY AND ASSEMBLY (Continued)

(2) Position the oil pump cover onto the pump body. Tighten cover bolts to 11 N·m (95 in. lbs.) torque.

(3) Install the relief valve and spring. Insert the cotter pin.

(4) Tap on a new retainer cap.

(5) Prime oil pump before installation by filling rotor cavity with engine oil.

CYLINDER BLOCK

DISASSEMBLE

Engine assembly removed from vehicle:

(1) Remove the cylinder head.

(2) Remove the oil pan.

(3) Remove the piston and connecting rod assemblies.

ASSEMBLE

(1) Install the piston and connecting rod assembly.

(2) Install the oil pan.

(3) Install the cylinder head.

(4) Install the engine into the vehicle.

CLEANING AND INSPECTION

CYLINDER HEAD COVER

CLEANING

Clean cylinder head cover gasket surface.

Clean head rail, if necessary.

INSPECTION

Inspect cover for distortion and straighten, if necessary.

Check the gasket for use in head cover installation. If damaged, use a new gasket.

CYLINDER HEAD

CLEANING

Clean all surfaces of cylinder block and cylinder heads.

Clean cylinder block front and rear gasket surfaces using a suitable solvent.

INSPECTION

Inspect all surfaces with a straightedge if there is any reason to suspect leakage. If out-of-flatness exceeds 0.00075 mm/mm (0.00075 in./in.) times the span length in any direction, either replace head or lightly machine the head surface.

FOR EXAMPLE:—A 305 mm (12 in.) span is 0.102 mm (0.004 in.) out-of-flat. The allowable out-of-flat is 305 x 0.00075 (12 x 0.00075) equals 0.23 mm (0.009 in.). This amount of out-of-flat is acceptable.

The cylinder head surface finish should be 1.78-3.00 microns (70-125 microinches).

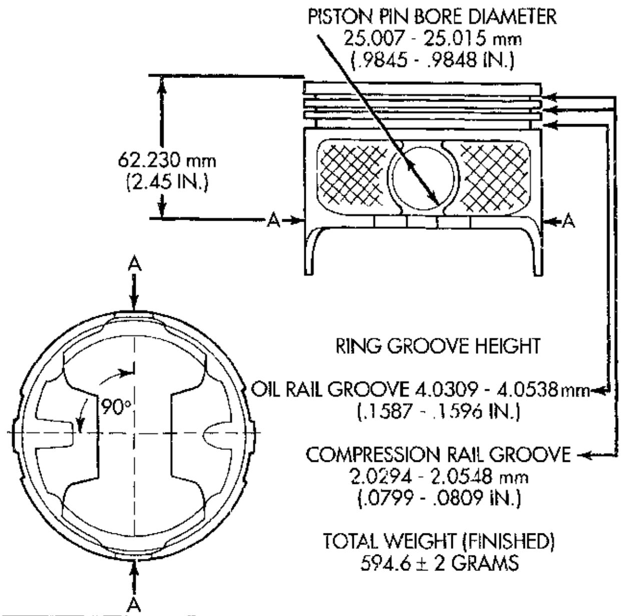
Inspect push rods. Replace worn or bent rods.

PISTON AND CONNECTING ROD INSPECTION

Check the crankshaft connecting rod journal for excessive wear, taper and scoring.

Check the cylinder block bore for out-of-round, taper, scoring and scuffing.

Check the pistons for taper and elliptical shape before they are fitted into the cylinder bore (Fig. 59).



PISTON SIZE	A DIA = PISTON DIAMETER		BORE DIAMETER	
	MIN. mm (IN.)	MAX. mm (IN.)	MIN. mm (IN.)	MAX. mm (IN.)
A	99.280 (3.9087)	99.294 (3.9092)	99.306 (3.9097)	99.319 (3.9102)
B	99.294 (3.9092)	99.306 (3.9097)	99.319 (3.9102)	99.332 (3.9107)
C	99.306 (3.9097)	99.319 (3.9102)	99.332 (3.9107)	99.344 (3.9112)
D	99.319 (3.9102)	99.332 (3.9107)	99.344 (3.9112)	99.357 (3.9117)
E	99.332 (3.9107)	99.344 (3.9112)	99.357 (3.9117)	99.370 (3.9122)

J9509-80

Fig. 59 Piston Measurements

CRANKSHAFT INSPECTION OF JOURNALS

The crankshaft connecting rod and main journals should be checked for excessive wear, taper or scoring. The maximum taper or out-of-round on any crankshaft journal is 0.025 mm (0.001 in.).

Journal grinding should not exceed 0.305 mm (0.012 in.) under the standard journal diameter. DO NOT grind thrust faces of No. 2 main bearing. DO NOT nick crank pin or bearing fillets. After grinding, remove rough edges from crankshaft oil holes and clean out all oil passages.

CAUTION: After any journal grind, it is important that the final paper or cloth polish be in the same direction that the engine rotates.

CLEANING AND INSPECTION (Continued)

OIL PUMP

OIL PUMP PRESSURE

The MINIMUM oil pump pressure is 41.4 kPa (6 psi) at curb idle. The NORMAL oil pump pressure is 207-552 kPa (30-80 psi) at 3,000 RPM or more.

CAUTION: If oil pressure is ZERO at curb idle, DO NOT run engine.

INSPECTION

Mating surface of the oil pump cover should be smooth. Replace pump assembly if cover is scratched or grooved.

Lay a straightedge across the pump cover surface (Fig. 60). If a 0.038 mm (0.0015 in.) feeler gauge can be inserted between cover and straightedge, pump assembly should be replaced.

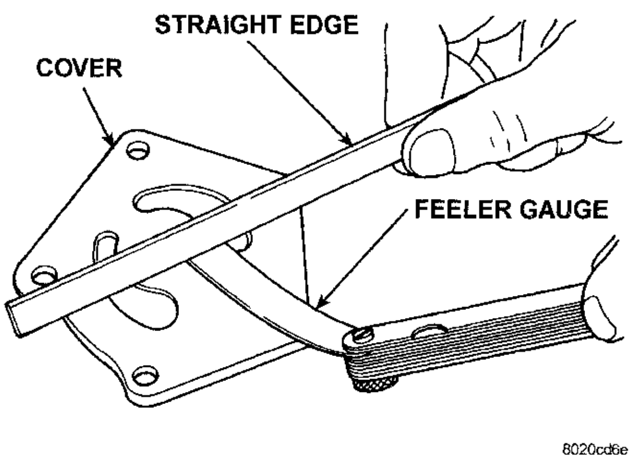


Fig. 60 Checking Oil Pump Cover Flatness

Measure thickness and diameter of outer rotor. If outer rotor thickness measures 20.9 mm (0.825 in.) or less, or if the diameter is 62.7 mm (2.469 in.) or less, replace outer rotor (Fig. 61).

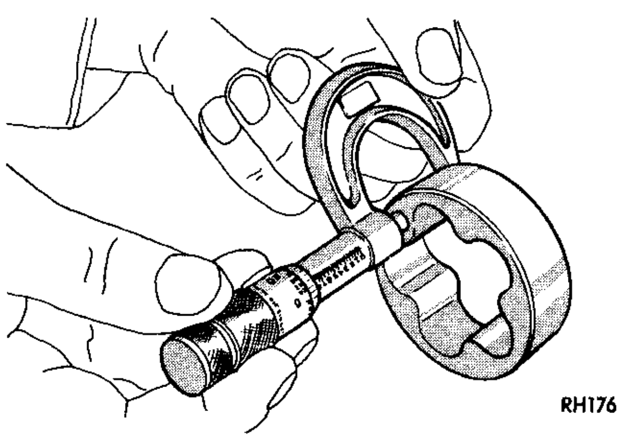


Fig. 61 Measuring Outer Rotor Thickness

If inner rotor measures 20.9 mm (0.825 in.) or less, replace inner rotor and shaft assembly (Fig. 62).

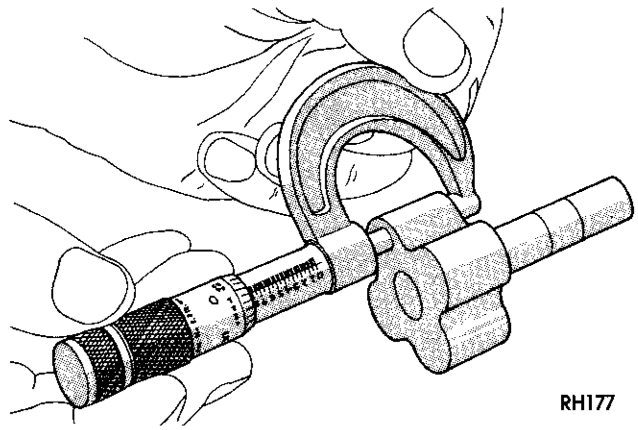


Fig. 62 Measuring Inner Rotor Thickness

Slide outer rotor into pump body. Press rotor to the side with your fingers and measure clearance between rotor and pump body (Fig. 63). If clearance is 0.356 mm (0.014 in.) or more, replace oil pump assembly.

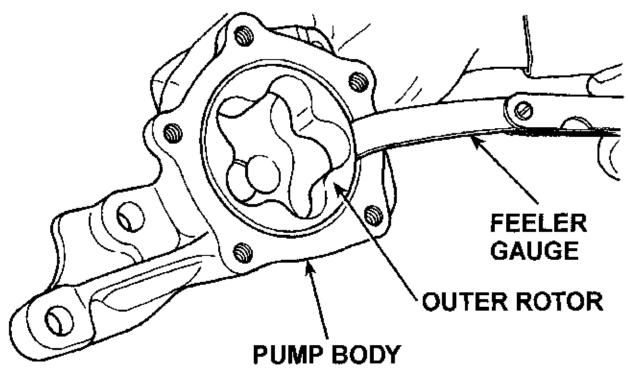


Fig. 63 Measuring Outer Rotor Clearance in Housing

Install inner rotor and shaft into pump body. If clearance between inner and outer rotors is 0.203 mm (0.008 in.) or more, replace shaft and both rotors (Fig. 64).

Place a straightedge across the face of the pump, between bolt holes. If a feeler gauge of 0.102 mm (0.004 in.) or more can be inserted between rotors and the straightedge, replace pump assembly (Fig. 65).

Inspect oil pressure relief valve plunger for scoring and free operation in its bore. Small marks may be removed with 400-grit wet or dry sandpaper.

The relief valve spring has a free length of approximately 49.5 mm (1.95 in.). The spring should test between 19.5 and 20.5 pounds when compressed to

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CLEANING AND INSPECTION (Continued)

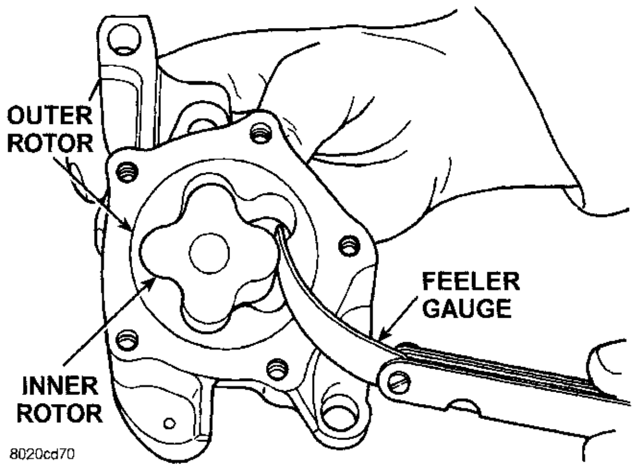

Fig. 64 Measuring Clearance Between Rotors

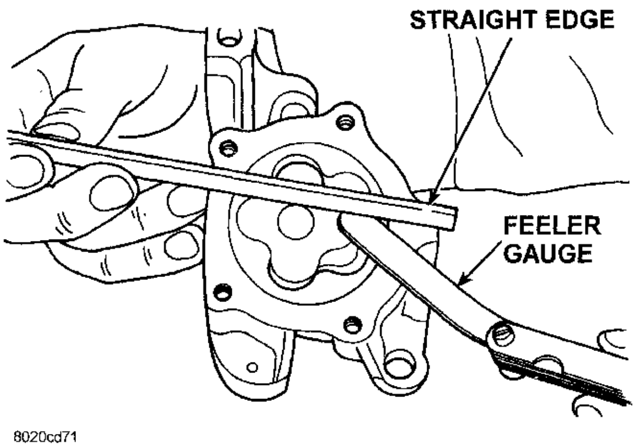

Fig. 65 Measuring Clearance Over Rotors

34 mm (1-11/32 in.). Replace spring that fails to meet these specifications (Fig. 66).

If oil pressure was low and pump is within specifications, inspect for worn engine bearings or other reasons for oil pressure loss.

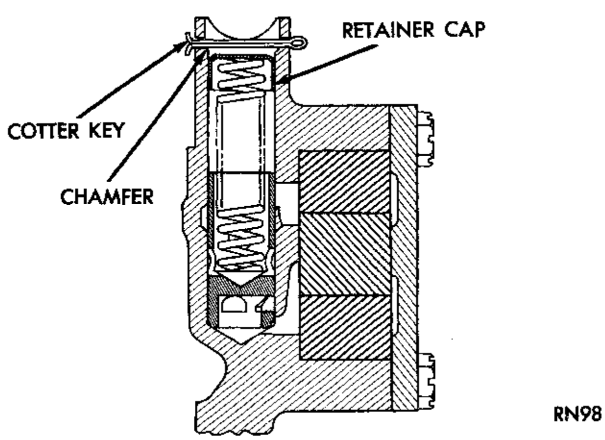

Fig. 66 Proper Installation of Retainer Cap

OIL PAN

CLEANING

Clean the block and pan gasket surfaces.

Trim or remove excess sealant film in the rear main cap oil pan gasket groove. **DO NOT remove the sealant inside the rear main cap slots.**

If present, trim excess sealant from inside the engine.

Clean oil pan in solvent and wipe dry with a clean cloth.

Clean oil screen and pipe thoroughly in clean solvent. Inspect condition of screen.

INSPECTION

Inspect oil drain plug and plug hole for stripped or damaged threads. Repair as necessary.

Inspect oil pan mounting flange for bends or distortion. Straighten flange, if necessary.

CYLINDER BLOCK

CLEANING

Clean cylinder block thoroughly and check all core hole plugs for evidence of leaking.

INSPECTION

Examine block for cracks or fractures.

The cylinder walls should be checked for out-of-round and taper with Cylinder Bore Indicator Tool C-119. The cylinder block should be bored and honed with new pistons and rings fitted if:

- The cylinder bores show more than 0.127 mm (0.005 in.) out-of-round.
- The cylinder bores show a taper of more than 0.254 mm (0.010 in.).
- The cylinder walls are badly scuffed or scored.

Boring and honing operation should be closely coordinated with the fitting of pistons and rings, so that specified clearances can be maintained.

OIL LINE PLUG

The oil line plug is located in the vertical passage at the rear of the block between the oil-to-filter and oil-from-filter passages (Fig. 67). Improper installation or plug missing could cause erratic, low, or no oil pressure.

The oil plug must come out the bottom. Use flat dowel, down the oil pressure sending unit hole from the top, to remove oil plug.

(1) Remove oil pressure sending unit from back of block.

(2) Insert a 3.175 mm (1/8 in.) finish wire, or equivalent, into passage.

(3) Plug should be 190.0 to 195.2 mm (7-1/2 to 7-11/16 in.) from machined surface of block (Fig. 67).

CLEANING AND INSPECTION (Continued)

If plug is too high, use a suitable flat dowel to position properly.

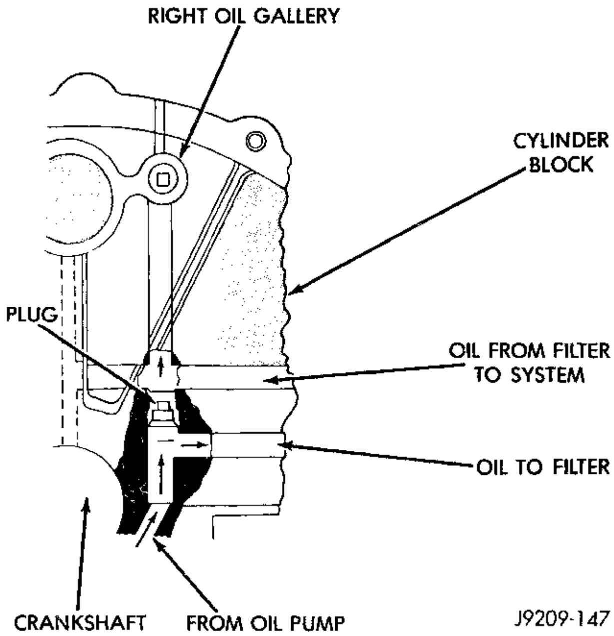

Fig. 67 Oil Line Plug

(4) If plug is too low, remove oil pan and No. 4 main bearing cap. Use suitable flat dowel to position properly. Coat outside diameter of plug with Mopar Stud and Bearing Mount Adhesive, or equivalent. Plug should be 54.0 to 57.7 mm (2-1/8 to 2-5/16 in.) from bottom of the block.

SPECIFICATIONS

3.9L ENGINE SPECIFICATIONS

GENERAL INFORMATION

Engine Type	90° V-6 OHV
Bore and Stroke	99.3 x 84.0 mm (3.91 x 3.31 in.)
Displacement	3.9L (238 c.i.)
Compression Ratio	9.1:1
Firing Order	1–6–5–4–3–2
Lubrication	Pressure Feed - Full Flow Filtration
Cooling System	Liquid Cooled - Forced Circulation
Cylinder Block	Cast Iron
Cylinder Head	Cast Iron
Crankshaft	Nodular Iron
Camshaft	Nodular Cast Iron
Combustion Chambers	"Fast Burn" Design
Pistons	Aluminum Alloy w/strut
Engine Type	90° V-6 OHV
Connecting Rods	Forged Steel
Combustion Pressure (Min.)	689.5 kPa (100 psi)

CAMSHAFT

Bearing Diameter (Inside)	
No. 1	50.800 – 50.825 mm (2.000 – 2.001 in.)
No. 2	50.394 – 50.419 mm (1.984 – 1.985 in.)
No. 3	49.606 – 49.632 mm (1.953 – 1.954 in.)
No. 4	39.688 – 39.713 mm (1.5265 – 1.5635 in.)
Journal Diameter	
No. 1	50.749 – 50.775 mm (1.998 – 1.999 in.)
No. 2	50.343 – 50.368 mm (1.982 – 1.983 in.)
No. 3	49.555 – 49.581 mm (1.951 – 1.952 in.)
No. 4	39.637 – 39.662 mm (1.5605 – 1.5615 in.)
Bearing to Journal Clearance	
Standard	0.0254 – 0.0762 mm (0.001 – 0.003 in.)
Max. Allowable	0.127 mm (0.005 in.)
Camshaft End Play	
End Play	0.051 – 0.254 mm (0.002 – 0.010 in.)

CONNECTING RODS

Piston Pin Bore Diameter	24.940 – 24.978 mm (0.9819 – 0.9834 in.)
Side Clearance (Two Rods)	0.152 – 0.356 mm (0.006 – 0.014 in.)
Total Weight	726 grams (25.61 oz.)

CRANKSHAFT

Rod Journal	
Diameter	53.950 – 53.975 mm (2.124 – 2.125 in.)
Out of Round (Max.)	0.0254 mm (0.001 in.)
Taper (Max.)	0.0254 mm (0.001 in.)
Bearing Clearance	0.013 – 0.056 mm (0.0005 – 0.0022 in.)
Service Limit	0.08 mm (0.003 in.)
Main Journal	
Diameter	63.487 – 63.513 mm (2.4995 – 2.5005 in.)
Out of Round (Max.)	0.0254 mm (0.001 in.)
Taper (Max.)	0.0254 mm (0.001 in.)
Bearing Clearance (#1)	0.013 – 0.038 mm (0.0005 – 0.0015 in.)
Bearing Clearance (#2-4))	0.013 – 0.051 mm (0.0005 – 0.0020 in.)
Service Limit	0.064 mm (0.0025 in.)
Crankshaft End Play	
End Play	0.051 – 0.178 mm (0.002 – 0.007 in.)
Service Limit	0.254 mm (0.010 in.)

Mopar AUTHENTIC RESTORATION PRODUCT

SPECIFICATIONS (Continued)

CYLINDER BLOCK

Cylinder Bore
Diameter. . . . . .99.314 – 99.365 mm (3.910 – 3.912 in.)
Out of Round (Max.) . . . . .0.127 mm (0.005 in.)
Taper (Max.) . . . . .0.254 mm (0.010 in.)
Oversize Limit . . . . .1.016 mm (0.040 in.)

Lifter Bore
Diameter . . . . .22.99 – 23.01 mm (0.9501 – 0.9059 in.)

Distributor Drive Bushing (Press Fit)
Bushing to Bore Interference . . .0.0127 – 0.3556 mm (0.0005 – 0.0140 in.)
Shaft to Bushing Clearance . . . .0.0178 – 0.0686 mm (0.0007 – 0.0027)

CYLINDER HEAD AND VALVES

Valve Seat
Angle . . . . .44.25° – 44.75°
Runout (Max.) . . . . .0.0762 mm (0.003 in.)
Width (Finish) – Intake . . . . .1.016 – 1.542 mm (0.040 – 0.060 in.)
Width (Finish) – Exhaust. . . . . . . .1.524 – 2.032 mm (0.060 – 0.080 in.)

Valve
Face Angle .43.25° – 43.75°
Head Diameter – Intake . . . . .48.666 mm (1.916 in.)
Head Diameter – Exhaust . . . .41.250 mm (1.624 in.)
Length (Overall) – Intake. . . . . .124.28 – 125.92 mm (4.893 – 4.918 in.)
Length (Overall) – Exhaust . . . .124.64 – 125.27 mm (4.907 – 4.932 in.)
Lift (@ zero lash) . . . . .10.973 mm (0.432 in.)
Stem Diameter. . . . . .7.899 – 7.925 mm (0.311 – 0.312 in.)
Guide Bore Diameter . . . . .7.950 – 7.976 mm (0.313 – 0.314 in.)
Stem to Guide Clearance . . . . . .0.0254 – 0.0762 mm (0.001 – 0.003 in.)
Service Limit (Rocking Method). . . . . . .0.4318 mm (0.017 in.)

Valve Spring
Free Length . . . . .49.962 mm (1.967 in.)
Spring Tension (valve closed) . . . .378 N @ 41.66 mm (85 lbs. @ 1.64 in.)
Spring Tension (valve open). . . . . .890 N @30.89 mm (200 lbs. @ 1.212 in.)
Number of Coils. 6.8
Installed Height. . . . . .41.66 mm (1.64 in.)
Wire Diameter . . . . .4.50 mm (0.177 in.)

HYDRAULIC TAPPETS

Body Diameter . . . . .22.949 – 22.962 mm (0.9035 – 0.9040 in.)
Clearance in Block . . . . .0.0279 – 0.0610 mm (0.0011 – 0.0024 in.)
Dry Lash .1.524 – 5.334 mm (0.060 – 0.210 in.)
Push rod Length. . . . . .175.64 – 176.15 mm (6.915 – 6.935 in.)

OIL PRESSURE

@ Curb Idle (Min.)* . . . . .41.4 kPa (6 psi)
@ 3000 rpm . . . . .207 – 552 kPa (30 – 80 psi)
Bypass Valve Setting. . . . . .62 – 103 kPa (9 – 15 psi)
Switch Actuating Pressure. . . . . .34.5 – 48.3 kPa (5 – 7 psi)

CAUTION: If oil pressure is zero at curb idle, DO NOT RUN ENGINE.

OIL PUMP

Clearance over Rotors (Max.) . . . . .0.1016 mm (0.004 in.)
Cover Out of Flat (Max.). . . . . .0.0381 mm (0.0015 in.)
Inner Rotor Thickness (Min.) . . . . .20.955 mm (0.825 in.)
Outer Rotor Clearance (Max.). . . . . .0.3556 mm (0.014 in.)
Outer Rotor Diameter (Min.). . . . . .62.7126 mm (2.469 in.)
Outer Rotor Thickness (Min.) . . . . .20.955 mm (0.825 in.)
Tip Clearance between Rotors (Max.) . . . .0.2032 mm (0.008 in.)

PISTONS

Clearance at Top of Skirt . . . . . .0.0127 – 0.0381 mm (0.0005 – 0.0015 in.)
Land Clearance (Diam.) . . . . .0.635 – 1.016 mm (0.025 – 0.040 in.)
Piston Length . . . . .86.360 mm (3.40 in.)
Ring Groove Depth (#1&2) . . . . . . .4.572 – 4.826 mm (0.180 – 0.190 in.)
Ring Groove Depth (#3) . . . . .3.810 – 4.064 mm (0.150 – 0.160 in.)
Weight . . . . .592.6 – 596.6 grams (20.90 – 21.04 oz.)

SPECIFICATIONS (Continued)

PISTON PINS

Clearance in Piston . . . . .0.0064 – 0.0191 mm (0.00025 – 0.00075 in.)
Clearance in Rod (Interference) . . . . .0.0178 – 0.0356 mm (0.0007 – 0.0014 in.)
Diameter. . . . . .24.996 – 25.001 mm (0.9841 – 0.9843 in.)
End Play . . . . .NONE
Length .75.946 – 76.454 mm (2.990 – 3.010 in.)

PISTON RINGS

Ring Gap
Compression Rings. . . . . .0.254 – 0.508 mm (0.010 – 0.020 in.)
Oil Control (Steel Rails) . . . . .0.254 – 1.270 mm (0.010 – 0.050 in.)

Ring Side Clearance
Compression rings . . . . .0.038 – 0.076 mm (0.0015 – 0.0030 in.)
Oil Control (Steel Rails). . . . . .0.06 – 0.21 mm (0.002 – 0.008 in.)

Ring Width
Compression Rings. . . . . .1.971 – 1.989 mm (0.0776 – 0.0783 in.)
Oil Control (Steel Rails0. . . . . .3.848 – 3.975 mm (0.1515 – 0.1565 in.)

VALVE TIMING

Exhaust Valve
Closes (ATDC). . . . . .16°
Opens (BBDC). . . . . .52°
Duration . . . . .248°
Intake Valve
Closes (ABDC). . . . . .50°
Opens (BTDC). . . . . .10°
Duration . . . . .240°
Valve Overlap . . . . .26°

OVERSIZE AND UNDERSIZE ENGINE COMPONENT MARKINGS

CONDITION	IDENTIFICATION	LOCATION OF IDENTIFICATION
CRANKSHAFT JOURNALS (UNDERSIZE) 0.0254 mm (0.001 in.)	R or M M-2-3 etc. (indicating no. 2 and 3 main bearing journal) and/or R-1-4 etc. (indicating no. 1 and 4 connecting rod journal)	Milled flat on no. 8 crankshaft counterweight.
HYDRAULIC TAPPETS (OVERSIZE) 0.2032 mm (0.008 in.)	♦	Diamond-shaped stamp top pad – front of engine and flat ground on outside surface of each O/S tappet bore.
VALVE STEMS (OVERSIZE) 0.127 mm (0.005 in.)	X	Milled pad adjacent to two tapped holes (3/8 in.) on each end of cylinder head.

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AUTHENTIC RESTORATION

SPECIFICATIONS (Continued)

TORQUE SPECIFICATIONS

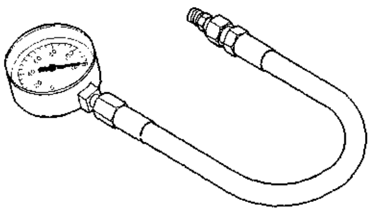
DESCRIPTION	TORQUE
Camshaft	
Bolt	68 N·m (50 ft. lbs.)
Camshaft Thrust Plate	
Bolts	24 N·m (210 in. lbs.)
Chain Case Cover	
Bolts	41 N·m (30 ft. lbs.)
Connecting Rod Cap	
Bolts	61 N·m (45 ft. lbs.)
Crankshaft Main Bearing Cap	
Bolts	115 N·m (85 ft. lbs.)
Crankshaft Pulley	
Bolts	24 N·m (210 in. lbs.)
Cylinder Head	
Bolts (1st Step)	68 N·m (50 ft. lbs.)
Bolts (2nd Step)	143 N·m (105 ft. lbs.)
Cylinder Head Cover	
Bolts	11 N·m (95 in. lbs.)
Engine Support Bracket to Block (4wd)	
Bolts	41 N·m (30 ft. lbs.)
Exhaust Manifold-to-Cylinder Head	
Bolts/Nuts	34 N·m (25 ft. lbs.)
Flywheel	
Bolts	75 N·m (55 ft. lbs.)
Front Insulator (All)	
Through bolt/nut	95 N·m (70 ft. lbs.)
Front Insulator to Support Bracket (4wd)	
Stud nut	41 N·m (30 ft. lbs.)
Through bolt/nut	102 N·m (75 ft. lbs.)
Front Insulator to Block (2wd)	
Bolts	95 N·m (70 ft. lbs.)
Generator	
Mounting Bolt	41 N·m (30 ft. lbs.)
Intake Manifold	
Bolts	Refer to R &I Procedure
Oil Pan	
Bolts	24 N·m (215 in. lbs.)
Oil Pan	
Drain Plug	34 N·m (25 ft. lbs.)

DESCRIPTION	TORQUE
Oil Pump	
Attaching Bolts	41 N·m (30 ft. lbs.)
Oil Pump Cover	
Bolts	11 N·m (95 in. lbs.)
Rear Insulator-to-Bracket (2WD)	
Through-Bolt	68 N·m (50 ft. lbs.)
Rear Insulator-to-Crossmember Support Bracket (2WD)	
Nut	41 N·m (30 ft. lbs.)
Rear Insulator-to-Crossmember (4WD)	
Nuts	68 N·m (50 ft. lbs.)
Rear Insulator-to-Transmission (4WD)	
Bolts	68 N·m (50 ft. lbs.)
Rear Insulator Bracket (4WD Automatic)	
Bolts	68 N·m (50 ft. lbs.)
Rear Support Bracket-to-Crossmember Flange	
Nuts	41 N·m (30 ft. lbs.)
Rear Support Plate-to-Transfer Case	
Bolts	41 N·m (30 ft. lbs.)
Rocker Arm	
Bolts	28 N·m (21 ft. lbs.)
Spark Plugs	
All	41 N·m (30 ft. lbs.)
Starter Motor	
Mounting Bolts	68 N·m (50 ft. lbs.)
Thermostat Housing	
Bolts	25 N·m (225 in. lbs.)
Throttle Body	
Bolts	23 N·m (200 in. lbs.)
Torque Converter Drive Plate	
Bolts	31 N·m (270 in. lbs.)
Transfer Case-to-Insulator Mounting Plate	
Nuts	204 N·m (150 ft. lbs.)
Transmission Support Bracket (2WD)	
Bolts	68 N·m (50 ft. lbs.)
Vibration Damper	
Retainer Bolt	183 N·m (135 ft. lbs.)
Water Pump-to-Chain Case Cover	
Bolt	41 N·m (30 ft. lbs.)

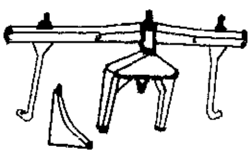
AUTHENTIC RESTORATION PRODUCT

SPECIAL TOOLS

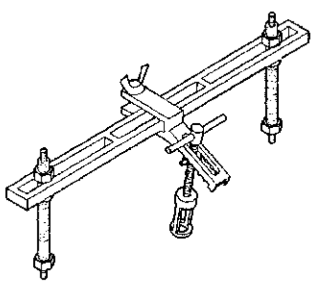
3.9L ENGINE



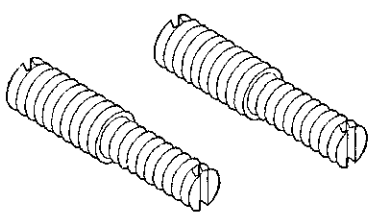
Oil Pressure Gauge C-3292



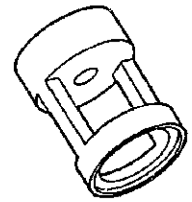
Engine Support Fixture C-3487–A



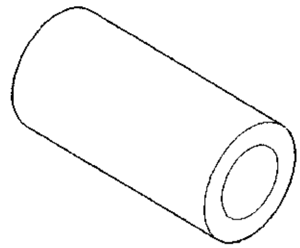
Valve Spring Compressor MD-998772–A



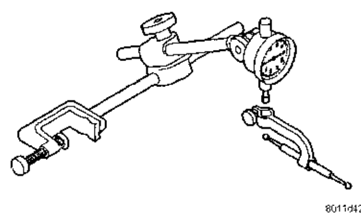
Adapter 6633



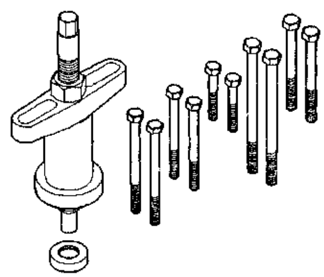
Adapter 6716A



Valve Guide Sleeve C-3973



Dial Indicator C-3339



Puller C-3688

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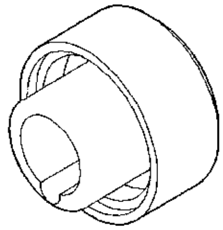
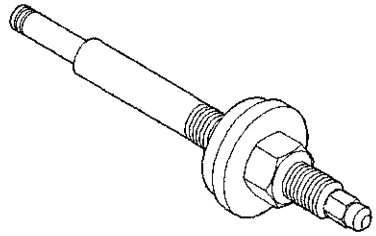
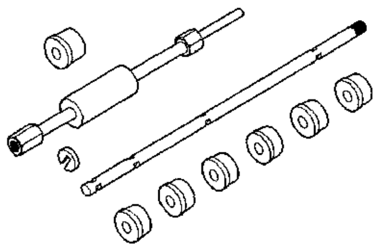
SPECIAL TOOLS (Continued)



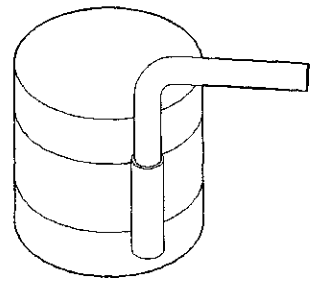
Front Oil Seal Installer 6635



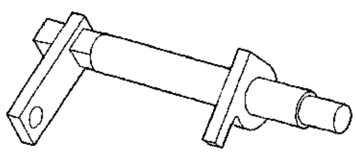
Distributor Bushing Driver/Burnisher C-3053



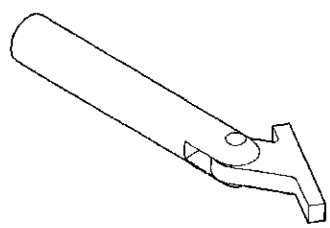
Cam Bearing Remover/Installer C-3132–A



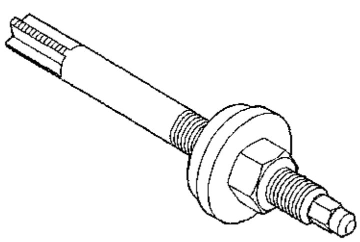
Piston Ring Compressor C-385



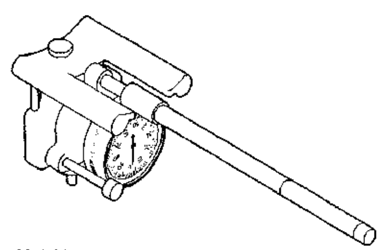
Camshaft Holder C-3509



Crankshaft Main Bearing Remover C-3059



Distributor Bushing Puller C-3052



Cylinder Bore Gauge C-119

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5.2L ENGINE

INDEX

GENERAL INFORMATION

VALVES AND VALVE SPRINGS

The valves are arranged in-line and inclined 18°. The rocker pivot support and the valve guides are cast integral with the heads.

OIL PUMP PRESSURE

The MINIMUM oil pump pressure is 41.4 kPa (6 psi) at curb idle. The NORMAL oil pump pressure is 207-552 kPa (30-80 psi) at 3,000 RPM or more.

CAUTION: If oil pressure is ZERO at curb idle, DO NOT run engine.

PISTON AND CONNECTING ROD ASSEMBLY

The pistons are elliptically turned so that the diameter at the pin boss is less than its diameter across the thrust face. This allows for expansion under normal operating conditions. Under operating temperatures, expansion forces the pin bosses away from each other, causing the piston to assume a more nearly round shape.

All pistons are machined to the same weight, regardless of size, to maintain piston balance.

The piston pin rotates in the piston only and is retained by the press interference fit of the piston pin in the connecting rod.

DESCRIPTION AND OPERATION

ENGINE DESCRIPTION/IDENTIFICATION

The 5.2 Liter (318 CID) eight-cylinder engine is a V-Type lightweight, single cam, overhead valve engine with hydraulic roller tappets. This engine is designed for unleaded fuel.

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DESCRIPTION AND OPERATION (Continued)

Engine lubrication system consists of a rotor type oil pump and a full flow oil filter.

The cylinders are numbered from front to rear; 1, 3, 5, 7 on the left bank and 2, 4, 6, 8 on the right bank. The firing order is 1-8-4-3-6-5-7-2 (Fig. 1).

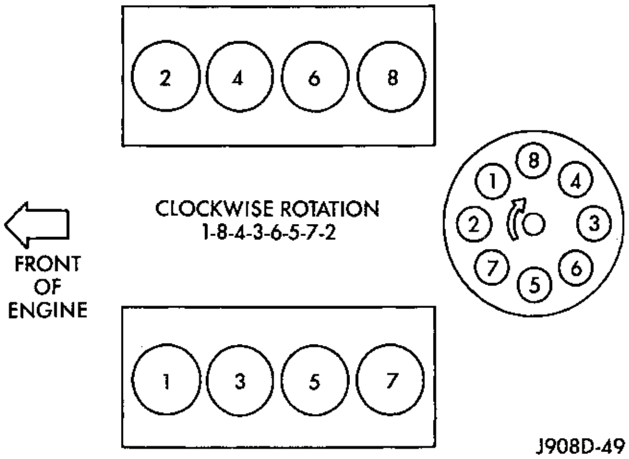

Fig. 1 Firing Order

The engine serial number is stamped into a machined pad located on the left, front corner of the cylinder block. When component part replacement is necessary, use the engine type and serial number for reference (Fig. 2).

X M 5.2L T XXXX XXXXXXXX

X = Last Digit of Model Year
M = Plant - M Mound Road
S Saltillo
T Trenton
K Toluca
5.2L = Engine Displacement
T = Usage - T Truck
XXXX = Month/Day
XXXXXXXX = Serial Code - Last 8 Digits of VIN No.

J9209-73

Fig. 2 Engine Identification Number

LUBRICATION SYSTEM

A gear—type positive displacement pump is mounted at the underside of the rear main bearing cap. The pump draws oil through the screen and inlet tube from the sump at the rear of the oil pan. The oil is driven between the drive and idler gears and pump body, then forced through the outlet to the block. An oil gallery in the block channels the oil to the inlet side of the full flow oil filter. After passing through the filter element, the oil passes from the center outlet of the filter through an oil gallery that channels the oil up to the main gallery which extends the entire length on the right side of the block. The oil then goes down to the No. 1 main bearing, back up to the left side of the block and into the oil gallery on the left side of the engine.

Galleries extend downward from the main oil gallery to the upper shell of each main bearing. The crankshaft is drilled internally to pass oil from the main bearing journals to the connecting rod journals. Each connecting rod bearing has half a hole in it, oil passes through the hole when the rods rotate and the hole lines up, oil is then thrown off as the rod rotates. This oil throw off lubricates the camshaft lobes, distributor drive gear, cylinder walls, and piston pins.

The hydraulic valve tappets receive oil directly from the main oil gallery. The camshaft bearings receive oil from the main bearing galleries. The front camshaft bearing journal passes oil through the camshaft sprocket to the timing chain. Oil drains back to the oil pan under the number one main bearing cap.

The oil supply for the rocker arms and bridged pivot assemblies is provided by the hydraulic valve tappets which pass oil through hollow push rods to a hole in the corresponding rocker arm. Oil from the rocker arm lubricates the valve train components. The oil then passes down through the push rod guide holes, and the oil drain back passages in the cylinder head past the valve tappet area, and returns to the oil pan.

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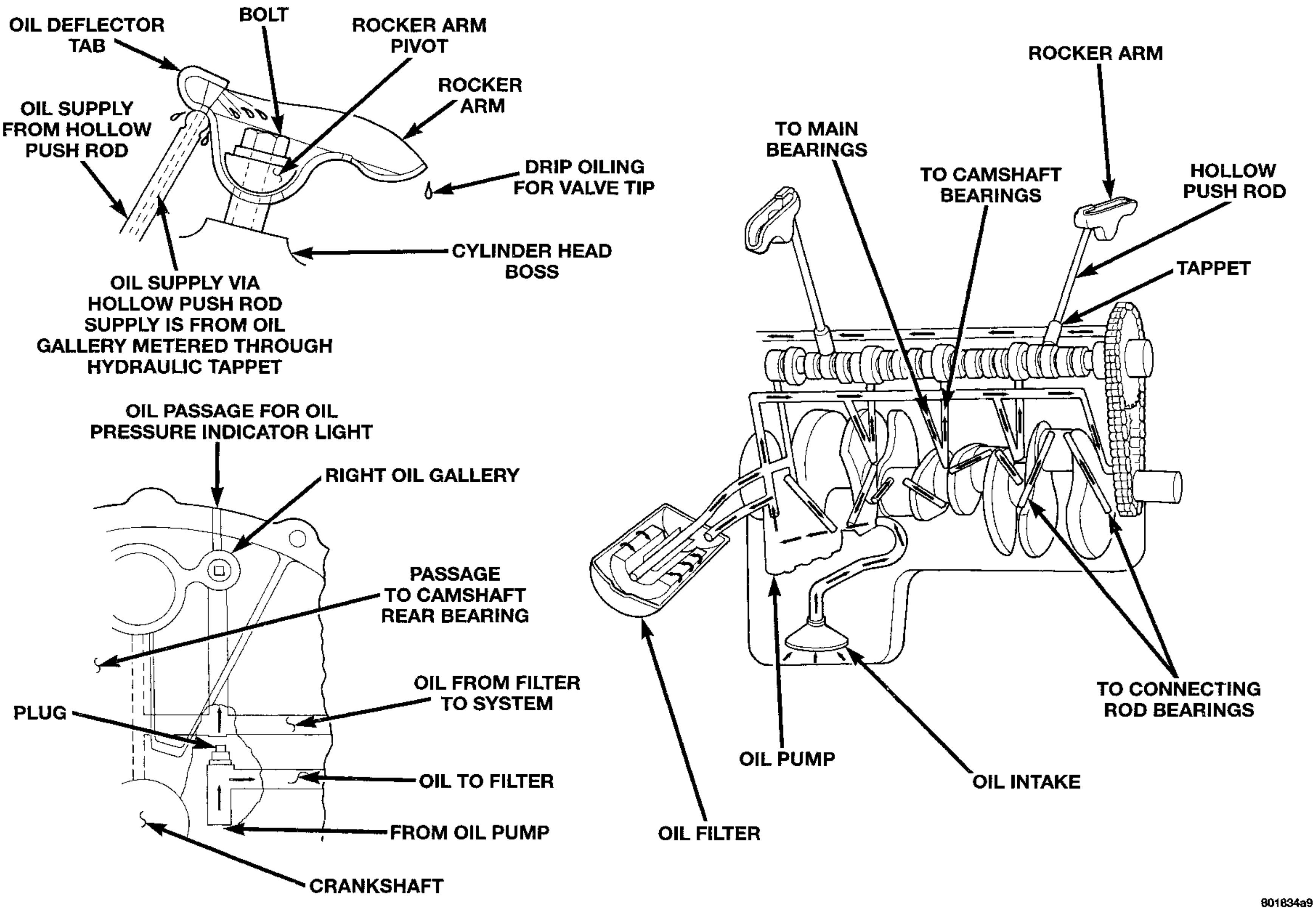

Fig. 3 Oil Lubrication System

DESCRIPTION AND OPERATION (Continued)

ENGINE COMPONENTS

CYLINDER HEAD

The alloy cast iron cylinder heads (Fig. 4) are held in place by 10 bolts. The spark plugs are located in the peak of the wedge between the valves.

The 5.2L cylinder head is identified by the foundry mark NH.

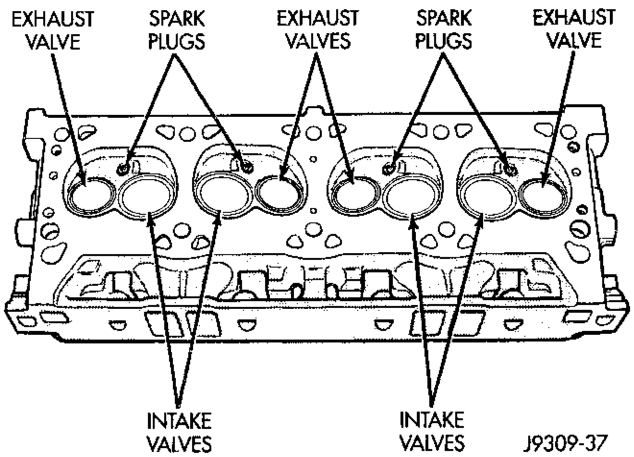

Fig. 4 Cylinder Head Assembly

PISTONS

All pistons are machined to the same weight, regardless of size, to maintain piston balance.

The pistons are elliptically turned so that the diameter at the pin boss is less than its diameter across the thrust face. This allows for expansion under normal operating conditions. Under operating temperatures, expansion forces the pin bosses away from each other, causing the piston to assume a more nearly round shape.

The piston pin rotates in the piston only and is retained by the press interference fit of the piston pin in the connecting rod.

SERVICE PROCEDURES

VALVE TIMING

(1) Turn crankshaft until the No.6 exhaust valve is closing and No.6 intake valve is opening.

(2) Insert a 6.350 mm (1/4 inch) spacer between rocker arm pad and stem tip of No.1 intake valve. Allow spring load to bleed tappet down giving in effect a solid tappet.

(3) Install a dial indicator so plunger contacts valve spring retainer as nearly perpendicular as possible. Zero the indicator.

(4) Rotate the crankshaft clockwise (normal running direction) until the valve has lifted 0.863 mm (0.034 inch). The timing of the crankshaft should now read from 10° before top dead center to 2° after top dead center. Remove spacer.

CAUTION: DO NOT turn crankshaft any further clockwise as valve spring might bottom and result in serious damage.

If reading is not within specified limits:
- Check sprocket index marks.
- Inspect timing chain for wear.
- Check accuracy of DC mark on timing indicator.

MEASURING TIMING CHAIN STRETCH

NOTE: To access timing chain Refer to Timing Chain Cover in Removal and Installation Section.

(1) Place a scale next to the timing chain so that any movement of the chain may be measured.

(2) Place a torque wrench and socket over camshaft sprocket attaching bolt. Apply torque in the direction of crankshaft rotation to take up slack; 41 N·m (30 ft. lbs.) torque with cylinder head installed or 20 N·m (15 ft. lbs.) torque with cylinder head removed. With a torque applied to the camshaft sprocket bolt, crankshaft should not be permitted to move. It may be necessary to block the crankshaft to prevent rotation.

(3) Hold a scale with dimensional reading even with the edge of a chain link. With cylinder heads installed, apply 14 N·m (30 ft. lbs.) torque in the reverse direction. With the cylinder heads removed, apply 20 N·m (15 ft. lbs.) torque in the reverse direction. Note the amount of chain movement (Fig. 5).

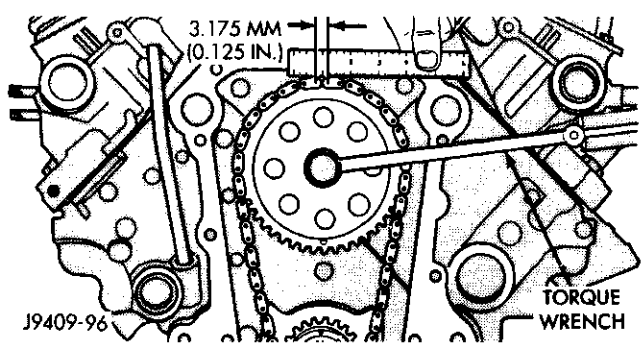

Fig. 5 Measuring Timing Chain Wear and Stretch

(4) Install a new timing chain, if its movement exceeds 3.175 mm (1/8 inch).

(5) If chain is not satisfactory, remove camshaft sprocket attaching bolt and remove timing chain with crankshaft and camshaft sprockets.

(6) Place both camshaft sprocket and crankshaft sprocket on the bench with timing marks on exact imaginary center line through both camshaft and crankshaft bores.

(7) Place timing chain around both sprockets.

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SERVICE PROCEDURES (Continued)

(8) Turn crankshaft and camshaft to line up with keyway location in crankshaft sprocket and in camshaft sprocket.

(9) Lift sprockets and chain (keep sprockets tight against the chain in position as described).

(10) Slide both sprockets evenly over their respective shafts and use a straightedge to check alignment of timing marks (Fig. 6).

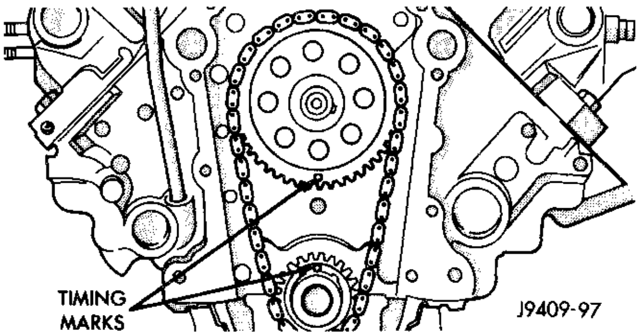


Fig. 6 Alignment of Timing Marks

(11) Install the camshaft bolt. Tighten the bolt to 47 N·m (35 ft. lbs.) torque.

(12) Check camshaft end play. The end play should be 0.051-0.152 mm (0.002-0.006 inch) with a new thrust plate and up to 0.254 mm (0.010 inch) with a used thrust plate. If not within these limits install a new thrust plate.

FITTING PISTONS

Piston and cylinder wall must be clean and dry. Specified clearance between the piston and the cylinder wall is 0.013-0.038 mm (0.0005-0.0015 inch) at 21°C (70°F).

Piston diameter should be measured at the top of skirt, 90° to piston pin axis location A in (Fig. 7). Cylinder bores should be measured halfway down the cylinder bore and transverse to the engine crankshaft center line.

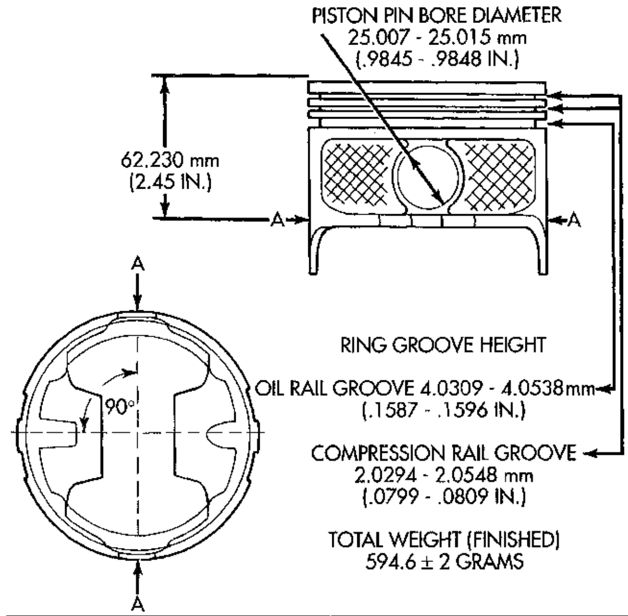
Pistons and cylinder bores should be measured at normal room temperature, 21°C (70°F).

FITTING PISTON RINGS

(1) Measurement of end gaps:

(a) Measure piston ring gap 2 inches from bottom of cylinder bore. An inverted piston can be used to push the rings down to ensure positioning rings squarely in the cylinder bore before measuring.

(b) Insert feeler gauge in the gap. The top compression ring gap should be between 0.254-0.508 mm (0.010-0.020 inch). The second compression ring gap should be between 0.508-0.762 mm (0.020-0.030 inch). The oil ring gap should be 0.254-1.270 mm (0.010-0.050 inch).



PISTON SIZE	A DIA = PISTON DIAMETER		BORE DIAMETER	
	MIN. mm (IN.)	MAX. mm (IN.)	MIN. mm (IN.)	MAX. mm (IN.)
A	99.280 (3.9087)	99.294 (3.9092)	99.306 (3.9097)	99.319 (3.9102)
B	99.294 (3.9092)	99.306 (3.9097)	99.319 (3.9102)	99.332 (3.9107)
C	99.306 (3.9097)	99.319 (3.9102)	99.332 (3.9107)	99.344 (3.9112)
D	99.319 (3.9102)	99.332 (3.9107)	99.344 (3.9112)	99.357 (3.9117)
E	99.332 (3.9107)	99.344 (3.9112)	99.357 (3.9117)	99.370 (3.9122)

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Fig. 7 Piston Measurements

(c) Rings with insufficient end gap may be properly filed to the correct dimension. Rings with excess gaps should not be used.

(2) Install rings and confirm ring side clearance:

(a) Install oil rings being careful not to nick or scratch the piston. Install the oil control rings according to instructions in the package. It is not necessary to use a tool to install the upper and lower rails. Insert oil rail spacer first, then side rails.

(b) Install the second compression rings using Installation Tool C-4184. The compression rings must be installed with the identification mark face up (toward top of piston) and chamfer facing down. An identification mark on the ring is a drill point, a stamped letter "O", an oval depression or the word TOP (Fig. 8) (Fig. 10).

(c) Using a ring installer, install the top compression ring with the chamfer facing up (Fig. 9) (Fig. 10). An identification mark on the ring is a drill point, a stamped letter "O", an oval depression or the word TOP facing up.

(d) Measure side clearance between piston ring and ring land. Clearance should be 0.074-0.097 mm (0.0029-0.0038 inch) for the compression rings. The steel rail oil ring should be free in groove, but

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SERVICE PROCEDURES (Continued)

should not exceed 0.246 mm (0.0097 inch) side clearance.

(e) Pistons with insufficient or excessive side clearance should be replaced.

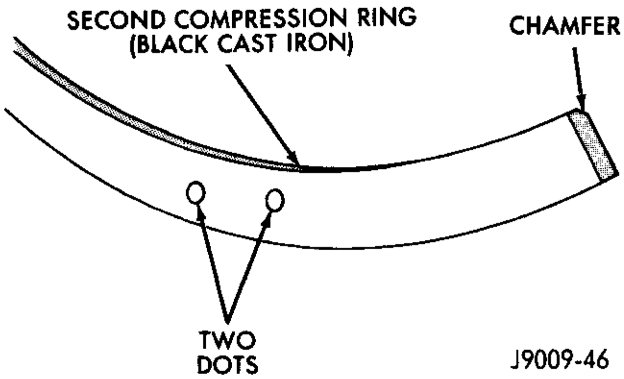

Fig. 8 Second Compression Ring Identification (Typical)

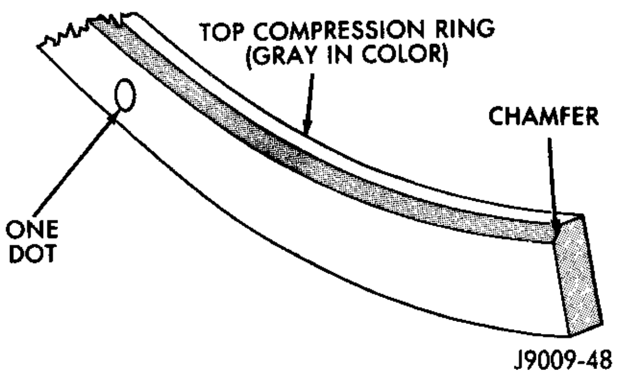

Fig. 9 Top Compression Ring Identification (Typical)

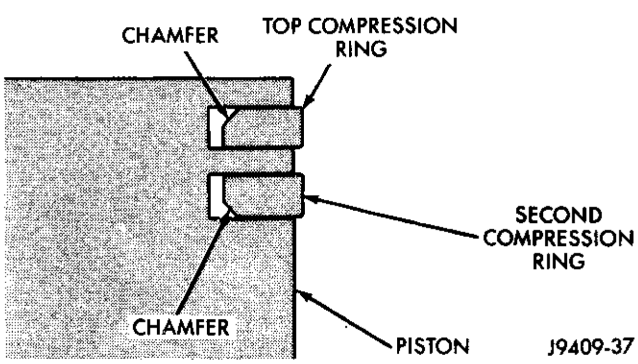

Fig. 10 Compression Ring Chamfer Location (Typical)

FITTING CONNECTING ROD BEARINGS

Fit all rods on a bank until completed. DO NOT alternate from one bank to another, because connecting rods and pistons are not interchangeable from one bank to another.

The bearing caps are not interchangeable and should be marked at removal to ensure correct assembly.

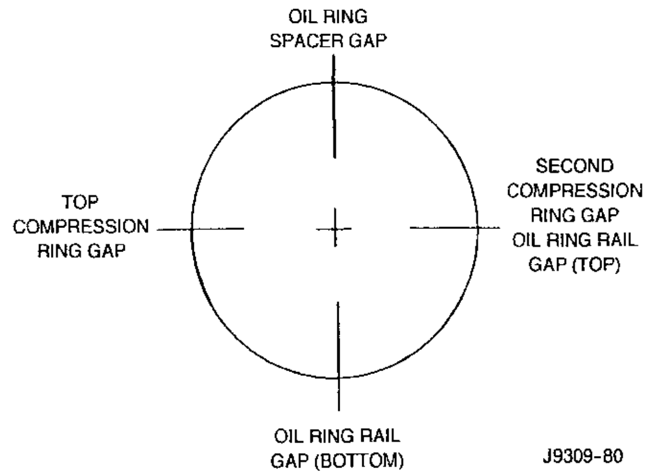

Fig. 11 Proper Ring Installation

Each bearing cap has a small V-groove across the parting face. When installing the lower bearing shell, make certain that the V-groove in the shell is in line with the V-groove in the cap. This provides lubrication of the cylinder wall in the opposite bank.

The bearing shells must be installed so that the tangs are in the machined grooves in the rods and caps.

Limits of taper or out-of-round on any crankshaft journals should be held to 0.025 mm (0.001 inch). Bearings are available in 0.025 mm (0.001 inch), 0.051 mm (0.002 inch), 0.076 mm (0.003 inch), 0.254 mm (0.010 inch) and 0.305 mm (0.012 inch) undersize. **Install the bearings in pairs. DO NOT use a new bearing half with an old bearing half. DO NOT file the rods or bearing caps.**

CRANKSHAFT MAIN BEARINGS

Bearing caps are not interchangeable and should be marked at removal to ensure correct assembly. Upper and lower bearing halves are NOT interchangeable. Lower main bearing halves of No.2 and 4 are interchangeable.

Upper and lower No.3 bearing halves are flanged to carry the crankshaft thrust loads. They are NOT interchangeable with any other bearing halves in the engine (Fig. 12). Bearing shells are available in standard and the following undersizes: 0.25 mm (0.001 inch), 0.051 mm (0.002 inch), 0.076 mm (0.003 inch), 0.254 mm (0.010 inch) and 0.305 mm (0.012 inch). Never install an undersize bearing that will reduce clearance below specifications.

CRANKSHAFT

A crankshaft which has undersize journals will be stamped with 1/4 inch letters on the milled flat on the No.8 crankshaft counterweight (Fig. 13).

FOR EXAMPLE: R2 stamped on the No.8 crankshaft counterweight indicates that the No.2 rod jour-

SERVICE PROCEDURES (Continued)

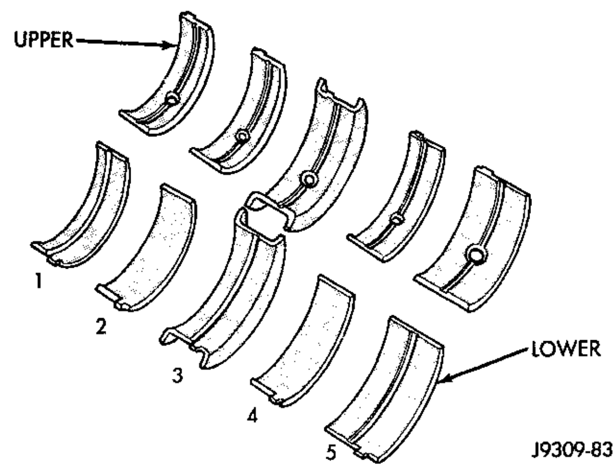

Fig. 12 Main Bearing Identification

nal is 0.025 mm (0.001 in) undersize. M4 indicates that the No.4 main journal is 0.025 mm (0.001 in) undersize. R3 M2 indicates that the No.3 rod journal and the No.2 main journal are 0.025 mm (0.001 in) undersize.

Undersize Journal	Identification Stamp
0.025 mm (0.001 in.) (Rod)	R1-R2-R3 or R4
0.025 mm (0.001 in.) (Main)	M1-M2-M3-M4 or M5

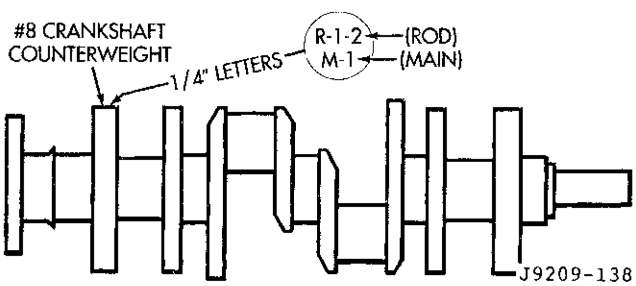

Fig. 13 Location of Crankshaft Identification

When a crankshaft is replaced, all main and connecting rod bearings should be replaced with new bearings. Therefore, selective fitting of the bearings is not required when a crankshaft and bearings are replaced.

REMOVAL AND INSTALLATION

ENGINE MOUNTS—FRONT

REMOVAL

(1) Disconnect the negative cable from the battery.

(2) Position fan to assure clearance for radiator top tank and hose.

CAUTION: DO NOT lift the engine by the intake manifold.

(3) Install engine support/lifting fixture.

(4) Raise vehicle on hoist.

(5) Lift the engine SLIGHTLY and remove the thru-bolt and nut (Fig. 14).

(6) Remove engine support bracket/cushion bolts (Fig. 14). Remove the support bracket/cushion and heat shields.

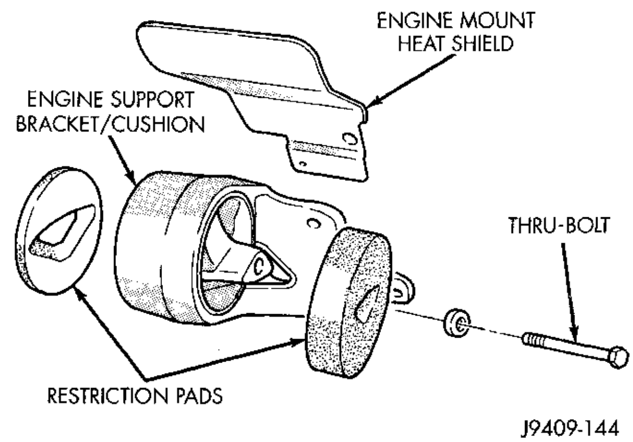

Fig. 14 Engine Front Mounts

INSTALLATION

(1) With engine raised SLIGHTLY, position the engine support bracket/cushion and heat shields to the block. Install new bolts and tighten to 81 N·m (60 ft. lbs.) torque.

(2) Install the thru-bolt into the engine support bracket/cushion.

(3) Lower engine with support/lifting fixture while guiding the engine bracket/cushion and thru-bolt into support cushion brackets (Fig. 15).

(4) Install thru-bolt nuts and tighten the nuts to 68 N·m (50 ft. lbs.) torque.

(5) Lower the vehicle.

(6) Remove lifting fixture.

ENGINE MOUNT—REAR

REMOVAL

(1) Raise the vehicle on a hoist.

(2) Position a transmission jack in place.

(3) Remove support cushion stud nuts (Fig. 16).

(4) Raise rear of transmission and engine SLIGHTLY.

(5) Remove the bolts holding the support cushion to the transmission support bracket. Remove the support cushion.

(6) If necessary, remove the bolts holding the transmission support bracket to the transmission.

REMOVAL AND INSTALLATION (Continued)

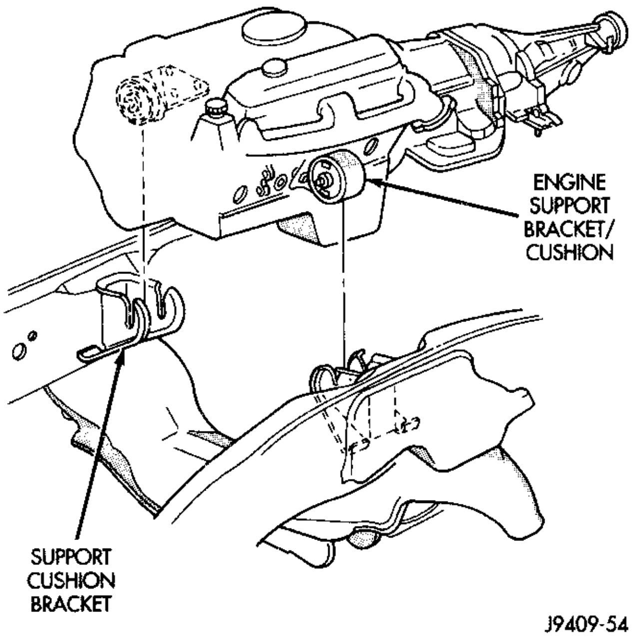

Fig. 15 Positioning Engine Front Mounts

INSTALLATION

(1) If removed, position the transmission support bracket to the transmission. Install new attaching bolts and tighten to 102 N·m (75 ft. lbs.) torque.

(2) Position support cushion to transmission support bracket. Install stud nuts and tighten to 47 N·m (35 ft. lbs.) torque.

(3) Using the transmission jack, lower the transmission and support cushion onto the crossmember (Fig. 16).

(4) Install the support cushion bolts and tighten to 47 N·m (35 ft. lbs.) torque.

(5) Remove the transmission jack.

(6) Lower the vehicle.

ENGINE ASSEMBLY

REMOVAL

(1) Disconnect the battery negative cable.

(2) Drain cooling system. Refer to Group 7, Cooling System for the proper procedure.

(3) Recover refrigerant from a/c system, if equipped. Refer to Group 24, Heating and Air Conditioning for service procedures.

(4) Remove the a/c condenser, if equipped.

(5) Remove the transmission oil cooler. Refer to Group 7, Cooling for the correct procedure.

(6) Remove the washer bottle from the fan shroud.

(7) Remove the viscous fan/drive.

(8) Disconnect the radiator upper hose from the radiator.

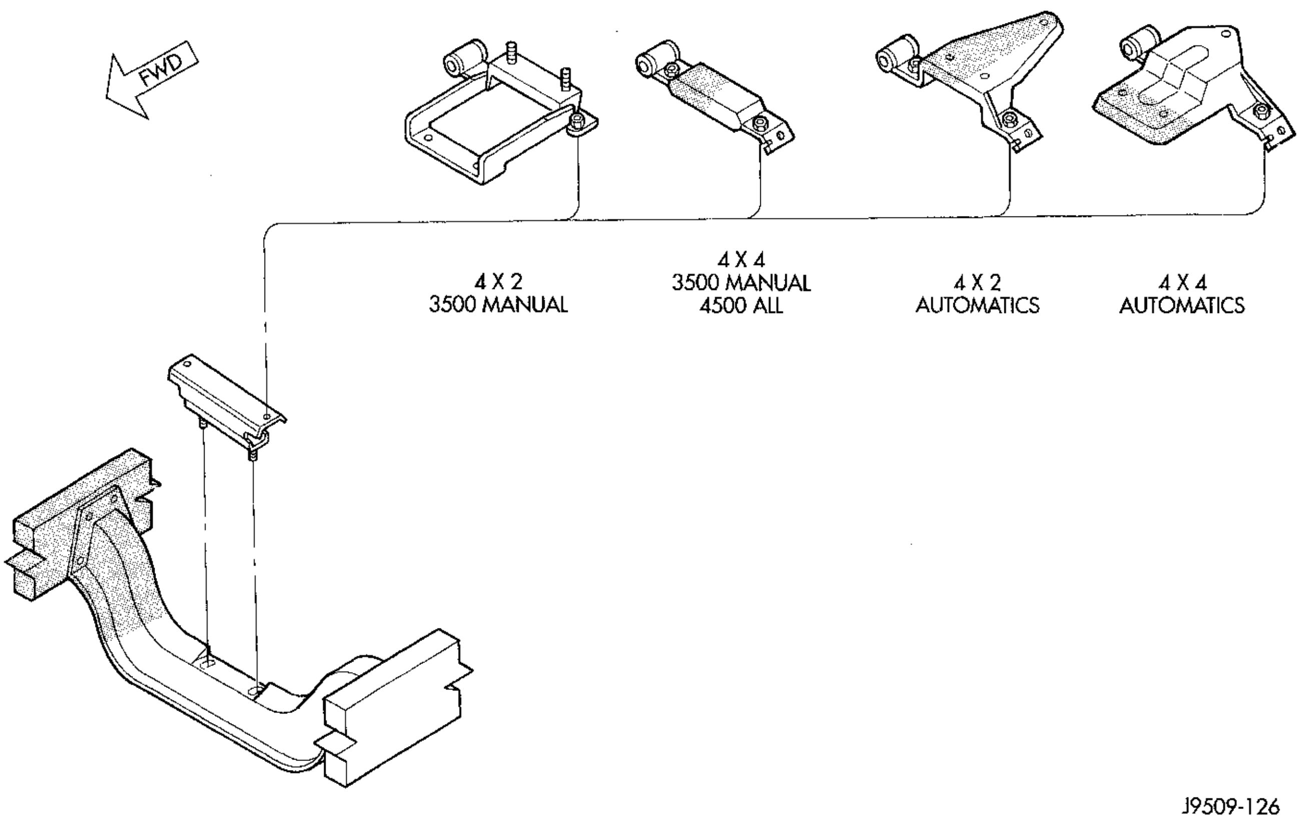

Fig. 16 Engine Rear Support Cushion Assemblies

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REMOVAL AND INSTALLATION (Continued)

(9) Remove the fan shroud.

(10) Disconnect the transmission cooler lines from the radiator.

(11) Disconnect the lower radiator hose at the radiator.

(12) Remove radiator (refer to Group 7, Cooling System).

(13) Remove the upper crossmember and top core support.

(14) Remove the accessory drive belt (refer to Group 7, Cooling System).

(15) Remove the A/C compressor with the lines attached. Secure compressor out of the way.

(16) Remove generator assembly. (refer to Group 8B, Battery/Starter/Generator Service).

(17) Remove the air cleaner resonator and duct work as an assembly.

(18) Disconnect the throttle linkage.

(19) Remove throttle body.

(20) Remove the intake manifold (refer to Group 11, Exhaust System and Intake Manifold).

(21) Remove the distributor cap and wiring.

(22) Disconnect the heater hoses.

(23) Disconnect the power steering hoses, if equipped.

(24) Perform the Fuel System Pressure Release procedure. Refer to Group 14, Fuel System.

(25) Disconnect the fuel supply line. Refer to Group 14, Fuel Systems for the correct procedure..

(26) On Manual Transmission vehicles, remove the shift lever (refer to Group 21, Transmissions).

(27) Raise and support the vehicle on a hoist and drain the engine oil.

(28) Remove engine front mount thru-bolt nuts.

(29) Disconnect the transmission oil cooler lines from their retainers at the oil pan bolts.

(30) Disconnect exhaust pipe at manifolds.

(31) Disconnect the starter wires. Remove starter motor (refer to Group 8B, Battery/Starter/Generator Service).

(32) Remove the dust shield and transmission inspection cover.

(33) Remove drive plate to converter bolts (Automatic transmission equipped vehicles).

(34) Remove transmission bell housing to engine block bolts.

(35) Lower the vehicle.

(36) Install an engine lifting fixture.

(37) Separate engine from transmission, remove engine from vehicle, and install engine assembly on a repair stand.

INSTALLATION

(1) Remove engine from the repair stand and position in the engine compartment. Position the thru-bolt into the support cushion brackets.

(2) Install engine lifting device.

(3) Lower engine into compartment and align engine with transmission:

- Manual Transmission: Align clutch disc assembly (if disturbed). Refer to Group 6, Clutch for the correct procedure. Install transmission input shaft into clutch disc while mating engine and transmission surfaces. Install two transmission to engine block mounting bolts finger tight.
- Automatic Transmission: Mate engine and transmission and install two transmission to engine block mounting bolts finger tight.

(4) Lower engine assembly until engine mount through bolts rest in mount perches.

(5) Install remaining transmission to engine block mounting bolts and tighten.

(6) Tighten engine mount through bolts.

(7) Install drive plate to torque converter bolts. (Automatic transmission models)

(8) Install the dust shield and transmission cover.

(9) Install the starter and connect the starter wires (refer to Group 8B, Battery/Starter/Generator Service).

(10) Install exhaust pipe to manifold.

(11) Install the transmission cooler line brackets to the oil pan.

(12) Install the drain plug and tighten to 34 N·m (25 ft. lbs.) torque.

(13) Lower the vehicle.

(14) Remove engine lifting fixture.

(15) On Manual Transmission vehicles, install the shift lever (refer to Group 21, Transmissions).

(16) Connect the fuel supply line.

(17) Connect the power steering hoses, if equipped.

(18) Connect the heater hoses.

(19) Install the distributor cap and wiring.

(20) Install the intake manifold. Refer to Group 11, Exhaust System and Intake Manifold.

(21) Using a new gasket, install throttle body. Tighten the throttle body bolts to 23 N·m (200 in. lbs.) torque.

(22) Connect the throttle linkage.

(23) Install the air cleaner resonator and duct work..

(24) Install the generator and wire connections (refer to Group 8B, Battery/Starter/Generator Service).

(25) Install a/c compressor and lines.

(26) Install the accessory drive belt (refer to Group 7, Cooling System).

(27) Install upper radiator support crossmember.

(28) Install radiator (refer to Group 7, Cooling System).

(29) Connect the radiator lower hose.

(30) Connect the transmission oil cooler lines to the radiator.

(31) Install the fan shroud.

REMOVAL AND INSTALLATION (Continued)

(32) Install the fan.
(33) Connect the radiator upper hose.
(34) Install the washer bottle.
(35) Install the transmission oil cooler.
(36) Connect the transmission cooler lines.
(37) If equipped, install the condenser.
(38) Evacuate and charge the air conditioning system, if equipped (refer to Group 24, Heating and Air Conditioning for service procedures).
(39) Add engine oil to crankcase. Refer to Group 0, Lubrication and Maintenance for the correct fill capacity.
(40) Add coolant to the cooling system (refer to Group 7, Cooling System for the proper procedure).
(41) Connect battery negative cable.
(42) Start engine and inspect for leaks.
(43) Road test vehicle.

CYLINDER HEAD COVER

NOTE: A steel backed silicon gasket is used with the cylinder head cover (Fig. 17). This gasket can be used again.

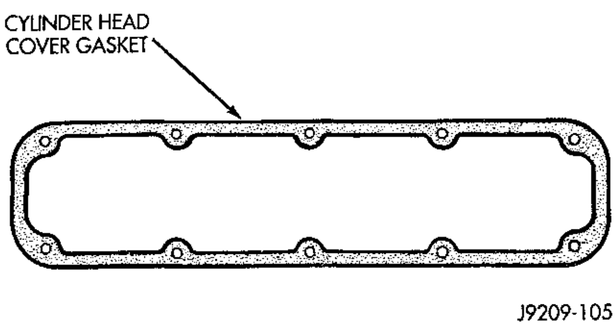

Fig. 17 Cylinder Head Cover Gasket

REMOVAL

(1) Disconnect the negative cable from the battery.
(2) Disconnect closed ventilation system and evaporation control system from cylinder head cover.
(3) Remove cylinder head cover and gasket. The gasket may be used again.

CLEANING

Clean cylinder head cover gasket surface.
Clean head rail, if necessary.

INSPECTION

Inspect cover for distortion and straighten, if necessary.
Check the gasket for use in head cover installation. If damaged, use a new gasket.

INSTALLATION

(1) The cylinder head cover gasket can be used again. Install the gasket onto the head rail.
(2) Position the cylinder head cover onto the gasket. Tighten the bolts to 11 N·m (95 in. lbs.) torque.
(3) Install closed crankcase ventilation system and evaporation control system.
(4) Connect the negative cable to the battery.

ROCKER ARMS AND PUSH RODS

REMOVAL

(1) Disconnect spark plug wires by pulling on the boot straight out in line with plug.
(2) Remove cylinder head cover and gasket.
(3) Remove the rocker arm bolts and pivots (Fig. 18). Place them on a bench in the same order as removed.
(4) Remove the push rods and place them on a bench in the same order as removed.

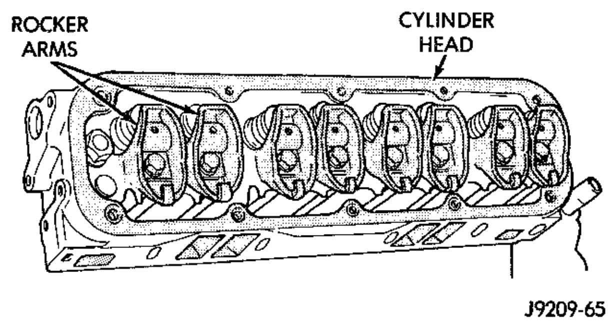

Fig. 18 Rocker Arms

INSTALLATION

(1) Rotate the crankshaft until the "V8" mark lines up with the TDC mark on the timing chain case cover. This mark is located 147° ATDC from the No.1 firing position.
(2) Install the push rods in the same order as removed.
(3) Install rocker arm and pivot assemblies in the same order as removed. Tighten the rocker arm bolts to 28 N·m (21 ft. lbs.) torque.

CAUTION: DO NOT rotate or crank the engine during or immediately after rocker arm installation. Allow the hydraulic roller tappets adequate time to bleed down (about 5 minutes).

(4) Install cylinder head cover.
(5) Connect spark plug wires.

VALVE SPRING AND STEM SEAL REPLACEMENT-IN VEHICLE

(1) Remove the air cleaner.
(2) Remove cylinder head covers and spark plugs.
(3) Remove coil wire from distributor and secure to good ground to prevent engine from starting.

REMOVAL AND INSTALLATION (Continued)

(4) Using suitable socket and flex handle at crankshaft retaining bolt, turn engine so the No.1 piston is at TDC on the compression stroke.

(5) Remove rocker arms.

(6) With air hose attached to an adapter installed in No.1 spark plug hole, apply 620-689 kPa (90-100 psi) air pressure.

(7) Using Valve Spring Compressor Tool MD-998772A with adaptor 6716A, compress valve spring and remove retainer valve locks and valve spring.

(8) Install seals on the exhaust valve stem and position down against valve guides.

(9) The intake valve stem seals should be pushed firmly and squarely over the valve guide using the valve stem as a guide. DO NOT force seal against top of guide. When installing the valve retainer locks, compress the spring only enough to install the locks.

(10) Follow the same procedure on the remaining 7 cylinders using the firing sequence 1-8-4-3-6-5-7-2. Make sure piston in cylinder is at TDC on the valve spring that is being removed.

(11) Remove adapter from the No.1 spark plug hole.

(12) Install rocker arms.

(13) Install covers and coil wire to distributor.

(14) Install air cleaner.

(15) Road test vehicle.

CYLINDER HEADS

REMOVAL

(1) Disconnect the battery negative cable.

(2) Drain cooling system (refer to Group 7, Cooling System for the proper procedures).

(3) Remove the air cleaner resonator and duct work.

(4) Remove the intake manifold-to-generator bracket support rod. Remove the generator.

(5) Remove closed crankcase ventilation system.

(6) Disconnect the evaporation control system.

(7) Perform the Fuel System Pressure Release procedure (refer to Group 14, Fuel System). Disconnect the fuel supply line.

(8) Disconnect accelerator linkage and if so equipped, the speed control and transmission kick-down cables.

(9) Remove distributor cap and wires.

(10) Disconnect the coil wires.

(11) Disconnect heat indicator sending unit wire.

(12) Disconnect heater hoses and bypass hose.

(13) Remove cylinder head covers and gaskets.

(14) Remove intake manifold and throttle body as an assembly. Discard the flange side gaskets and the front and rear cross-over gaskets.

(15) Remove exhaust manifolds.

(16) Remove rocker arm assemblies and push rods. Identify to ensure installation in original locations.

(17) Remove the head bolts from each cylinder head and remove cylinder heads. Discard the cylinder head gasket.

(18) Remove spark plugs.

INSTALLATION

(1) Clean all surfaces of cylinder block and cylinder heads.

(2) Clean cylinder block front and rear gasket surfaces using a suitable solvent.

(3) Position the new cylinder head gaskets onto the cylinder block.

(4) Position the cylinder heads onto head gaskets and cylinder block.

(5) Starting at top center, tighten all cylinder head bolts, in sequence, to 68 N·m (50 ft. lbs.) torque (Fig. 19). Repeat procedure, tighten all cylinder head bolts to 143 N·m (105 ft. lbs.) torque. Repeat procedure to confirm that all bolts are at 143 N·m (105 ft. lbs.) torque.

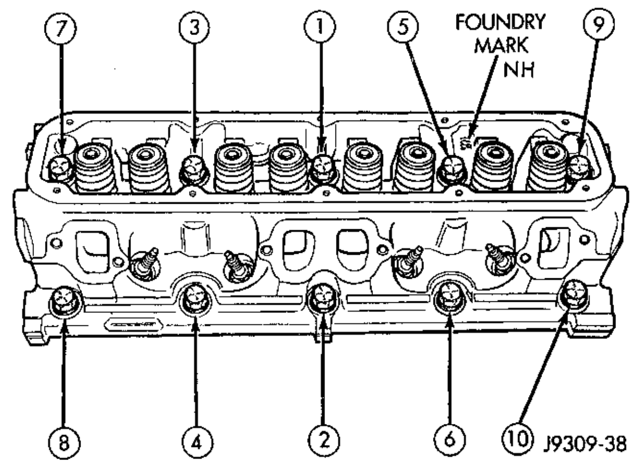

Fig. 19 Cylinder Head Bolt Tightening Sequence

CAUTION: When tightening the rocker arm bolts, make sure the piston in that cylinder is NOT at TDC. Contact between the valves and piston could occur.

(6) Install push rods and rocker arm assemblies in their original position. Tighten the bolts to 28 N·m (21 ft. lbs.) torque.

(7) Install the intake manifold and throttle body assembly (refer to Group 11, Exhaust System and Intake Manifold).

(8) Install exhaust manifolds. Tighten the bolts and nuts to 34 N·m (25 ft. lbs.) torque.

(9) Adjust spark plugs to specifications (refer to Group 8D, Ignition System). Install the plugs and tighten to 41 N·m (30 ft. lbs.) torque.

(10) Install coil wire.

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REMOVAL AND INSTALLATION (Continued)

(11) Connect heat indicator sending unit wire.
(12) Connect the heater hoses and bypass hose.
(13) Install distributor cap and wires.
(14) Connect the accelerator linkage and if so equipped, the speed control and transmission kick-down cables.
(15) Install the fuel supply line.
(16) Install the generator and drive belt. Tighten generator mounting bolt to 41 N·m (30 ft. lbs.) torque. Tighten the adjusting strap bolt to 23 N·m (200 in. lbs.) torque. Refer to Group 7, Cooling System for adjusting the belt tension.
(17) Install the intake manifold-to-generator bracket support rod. Tighten the bolts.
(18) Place the cylinder head cover gaskets in position and install cylinder head covers. Tighten the bolts to 11 N·m (95 in. lbs.) torque.
(19) Install closed crankcase ventilation system.
(20) Connect the evaporation control system.
(21) Install the air cleaner.
(22) Fill cooling system (refer to Group 7, Cooling System for proper procedure).
(23) Connect the negative cable to the battery.

VALVES AND VALVE SPRINGS

REMOVAL

(1) Remove the cylinder head. Refer to procedure in this section.
(2) Compress valve springs using Valve Spring Compressor Tool MD- 998772A and adapter 6716A.
(3) Remove valve retaining locks, valve spring retainers, valve stem seals and valve springs.
(4) Before removing valves, remove any burrs from valve stem lock grooves to prevent damage to the valve guides. Identify valves to ensure installation in original location.

INSTALLATION

(1) Clean valves thoroughly. Discard burned, warped and cracked valves.
(2) Remove carbon and varnish deposits from inside of valve guides with a reliable guide cleaner.
(3) Measure valve stems for wear. If wear exceeds 0.051 mm (0.002 inch), replace the valve.
(4) Coat valve stems with lubrication oil and insert them in cylinder head.
(5) If valves or seats are reground, check valve stem height. If valve is too long, replace cylinder head.
(6) Install new seals on all valve guides. Install valve springs and valve retainers.
(7) Compress valve springs with Valve Spring Compressor Tool MD-998772A and adapter 6716A, install locks and release tool. If valves and/or seats are ground, measure the installed height of springs. Make sure the measurement is taken from bottom of spring seat in cylinder head to the bottom surface of spring retainer. If spacers are installed, measure from the top of spacer. If height is greater than 42.86 mm (1-11/16 inches), install a 1.587 mm (1/16 inch) spacer in head counterbore. This should bring spring height back to normal 41.27 to 42.86 mm (1-5/8 to 1-11/16 inch).

HYDRAULIC TAPPETS

REMOVAL

(1) Remove the air cleaner.
(2) Remove cylinder head cover.
(3) Remove rocker assembly and push rods. Identify push rods to ensure installation in original location.
(4) Remove intake manifold.
(5) Remove yoke retainer and aligning yokes.
(6) Slide Hydraulic Tappet Remover/Installer Tool C-4129-A through opening in cylinder head and seat tool firmly in the head of tappet.
(7) Pull tappet out of bore with a twisting motion. If all tappets are to be removed, identify tappets to ensure installation in original location.
(8) If the tappet or bore in cylinder block is scored, scuffed, or shows signs of sticking, ream the bore to next oversize. Replace with oversize tappet.

INSTALLATION

(1) Lubricate tappets.
(2) Install tappets and push rods in their original positions. Ensure that the oil feed hole in the side of the tappet body faces up (away from the crankshaft).
(3) Install aligning yokes with ARROW toward camshaft.
(4) Install yoke retainer. Tighten the bolts to 23 N·m (200 in. lbs.) torque. Install intake manifold.
(5) Install push rods in original positions.
(6) Install rocker arm.
(7) Install cylinder head cover.
(8) Start and operate engine. Warm up to normal operating temperature.

CAUTION: To prevent damage to valve mechanism, engine must not be run above fast idle until all hydraulic tappets have filled with oil and have become quiet.

VIBRATION DAMPER

REMOVAL

(1) Disconnect the battery negative cable.
(2) Remove the cooling system fan.
(3) Remove the cooling fan shroud.
(4) Remove the accessory drive belt (refer to Group 7, Cooling System).

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REMOVAL AND INSTALLATION (Continued)

(5) Remove the vibration damper pulley.

(6) Remove vibration damper bolt and washer from end of crankshaft.

(7) Install bar and screw from Puller Tool Set C-3688. Install 2 bolts with washers through the puller tool and into the vibration damper (Fig. 20).

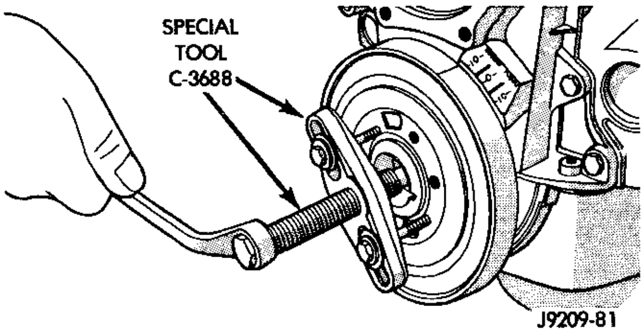

Fig. 20 Vibration Damper Assembly

(8) Pull vibration damper off of the crankshaft.

INSTALLATION

(1) Position the vibration damper onto the crankshaft.

(2) Place installing tool, part of Puller Tool Set C-3688 in position and press the vibration damper onto the crankshaft (Fig. 21).

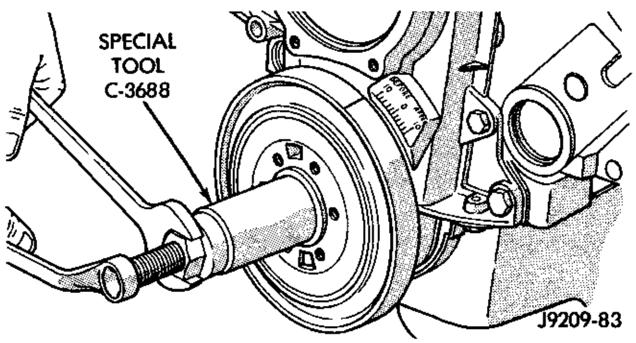

Fig. 21 Installing Vibration Damper

(3) Install the crankshaft bolt and washer. Tighten the bolt to 183 N·m (135 ft. lbs.) torque.

(4) Install the crankshaft pulley. Tighten the pulley bolts to 23 N·m (200 in. lbs.) torque.

(5) Install the accessory drive belt (refer to Group 7, Cooling System).

(6) Position the fan shroud and install the bolts. Tighten the retainer bolts to 11 N·m (95 in. lbs.) torque.

(7) Install the cooling fan

(8) Connect the battery negative cable.

TIMING CHAIN COVER

REMOVAL

(1) Disconnect the negative cable from the battery.

(2) Drain cooling system (refer to Group 7, Cooling System).

(3) Remove the serpentine belt (refer to Group 7, Cooling System).

(4) Remove water pump (refer to Group 7, Cooling System).

(5) Remove power steering pump (refer to Group 19, Steering).

(6) Remove vibration damper.

(7) Loosen oil pan bolts and remove the front bolt at each side.

(8) Remove the cover bolts.

(9) Remove chain case cover and gasket using extreme caution to avoid damaging oil pan gasket.

(10) Place a suitable tool behind the lips of the oil seal to pry the oil seal outward. Be careful not to damage the crankshaft seal surface of cover (Fig. 22).

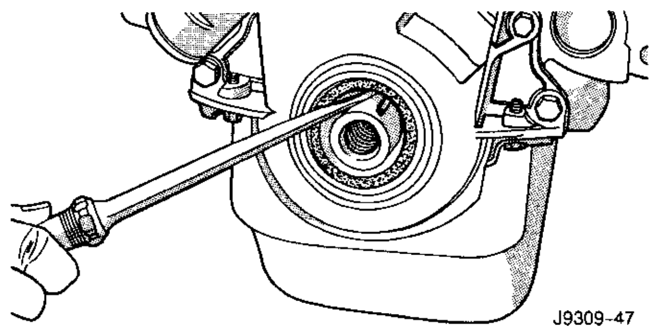

Fig. 22 Removal of Front Crankshaft Oil Seal

INSTALLATION

(1) Be sure mating surfaces of chain case cover and cylinder block are clean and free from burrs.

(2) The water pump mounting surface must be cleaned.

(3) Using a new cover gasket, carefully install chain case cover to avoid damaging oil pan gasket. Use a small amount of Mopar® Silicone Rubber Adhesive Sealant, or equivalent, at the joint between timing chain cover gasket and the oil pan gasket. Finger tighten the timing chain cover bolts at this time.

(4) Place the smaller diameter of the oil seal over Front Oil Seal Installation Tool 6635 (Fig. 23). Seat the oil seal in the groove of the tool.

(5) Position the seal and tool onto the crankshaft (Fig. 24).

(6) Tighten the 4 lower chain case cover bolts to 13N·m (10 ft.lbs.) to prevent the cover from tipping during seal installation.

(7) Using the vibration damper bolt, tighten the bolt to draw the seal into position on the crankshaft (Fig. 25).

REMOVAL AND INSTALLATION (Continued)

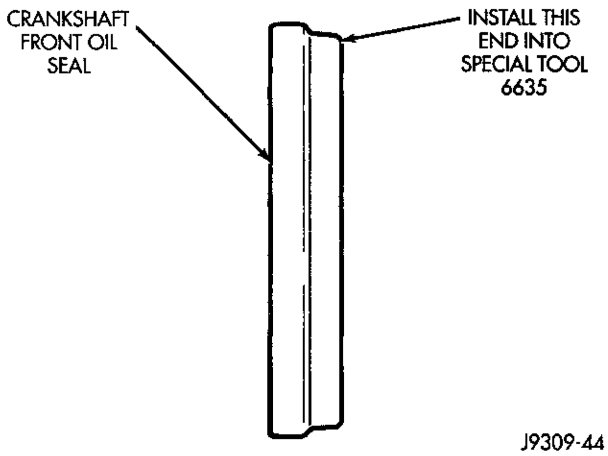

Fig. 23 Placing Oil Seal on Installation Tool 6635

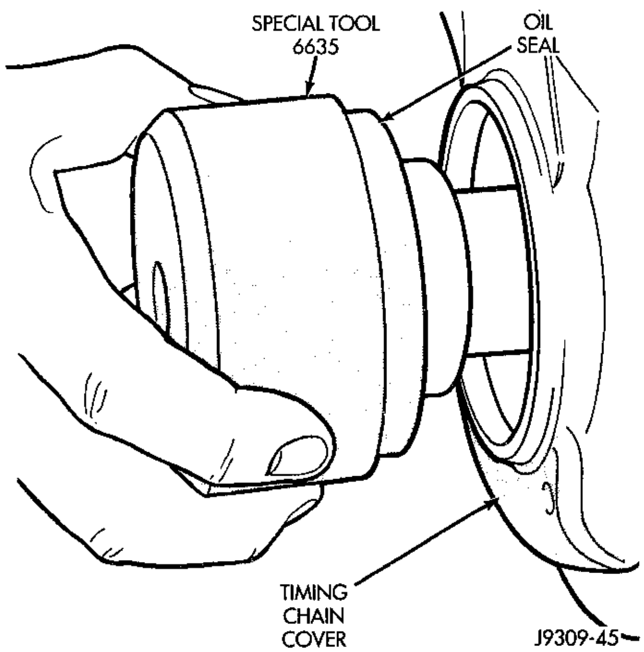

Fig. 24 Position Tool and Seal onto Crankshaft

(8) Loosen the 4 bolts tightened in step 4 to allow realignment of front cover assembly.

(9) Tighten chain case cover bolts to 41 N·m (30 ft.lbs.) torque. Tighten oil pan bolts to 24 N·m (215 in. lbs.) torque.

(10) Remove the vibration damper bolt and seal installation tool.

(11) Inspect the seal flange on the vibration damper.

(12) Install vibration damper.

(13) Install water pump and housing assembly using new gaskets (refer to Group 7, Cooling System). Tighten bolts to 41 N·m (30 ft. lbs.) torque.

(14) Install power steering pump (refer to Group 19, Steering).

(15) Install the serpentine belt (refer to Group 7, Cooling System).

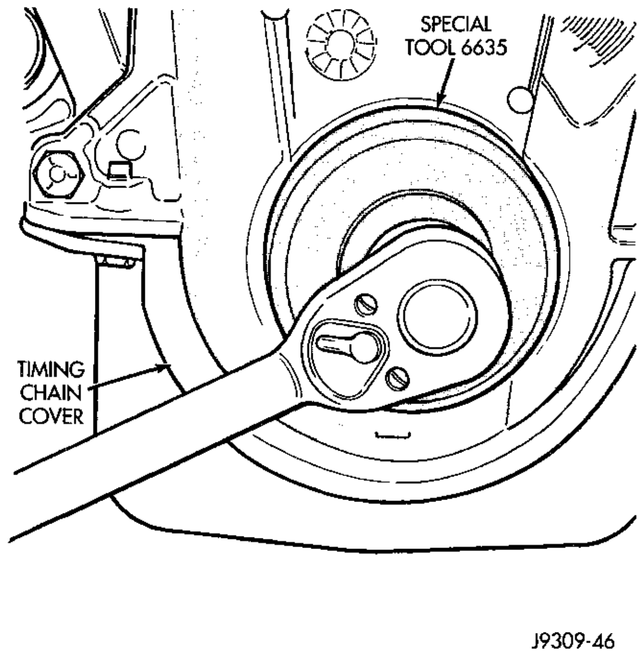

Fig. 25 Installing Oil Seal

(16) Install the cooling system fan. Tighten the bolts to 23 N·m (17 ft. lbs.) torque.

(17) Position the fan shroud and install the bolts. Tighten the bolts to 11 N·m (95 in. lbs.) torque.

(18) Fill cooling system (refer to Group 7, Cooling System for the proper procedure).

(19) Connect the negative cable to the battery.

TIMING CHAIN

REMOVAL

(1) Remove Timing Chain Cover Refer to procedure in this section.

(2) Remove camshaft sprocket attaching bolt and remove timing chain with crankshaft and camshaft sprockets.

INSTALLATION

(1) Place both camshaft sprocket and crankshaft sprocket on the bench with timing marks on exact imaginary center line through both camshaft and crankshaft bores.

(2) Place timing chain around both sprockets.

(3) Turn crankshaft and camshaft to line up with keyway location in crankshaft sprocket and in camshaft sprocket.

(4) Lift sprockets and chain (keep sprockets tight against the chain in position as described).

(5) Slide both sprockets evenly over their respective shafts and use a straightedge to check alignment of timing marks (Fig. 26).

(6) Install the camshaft bolt. Tighten the bolt to 68 N·m (50 ft. lbs.) torque.

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REMOVAL AND INSTALLATION (Continued)

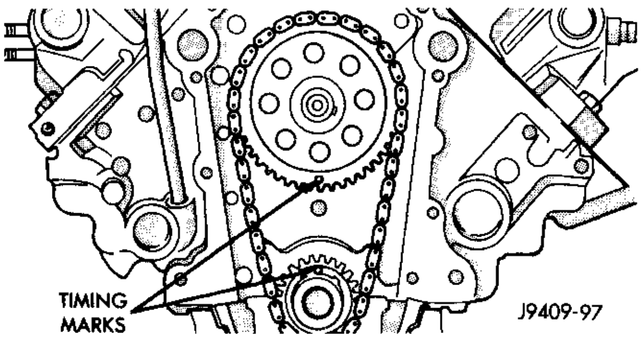

Fig. 26 Alignment of Timing Marks

(7) Check camshaft end play. The end play should be 0.051-0.152 mm (0.002-0.006 inch) with a new thrust plate and up to 0.254 mm (0.010 inch) with a used thrust plate. If not within these limits install a new thrust plate.

CAMSHAFT

NOTE: The camshaft has an integral oil pump and distributor drive gear (Fig. 27).

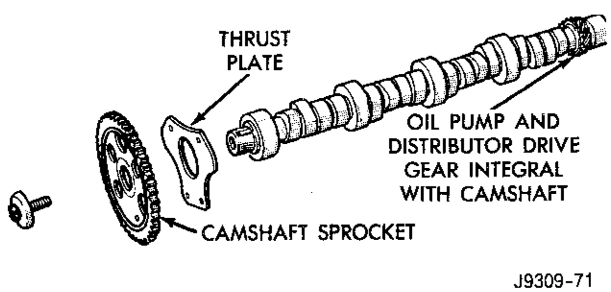

Fig. 27 Camshaft and Sprocket Assembly

REMOVAL

(1) Remove intake manifold.
(2) Remove cylinder head covers.
(3) Remove timing case cover and timing chain.
(4) Remove rocker arms.
(5) Remove push rods and tappets. Identify each part so it can be installed in its original location.
(6) Remove distributor and lift out the oil pump and distributor drive shaft.
(7) Remove camshaft thrust plate, note location of oil tab (Fig. 28).
(8) Install a long bolt into front of camshaft to facilitate removal of the camshaft. Remove camshaft, being careful not to damage cam bearings with the cam lobes.

INSTALLATION

(1) Lubricate camshaft lobes and camshaft bearing journals and insert the camshaft to within 51 mm (2 inches) of its final position in cylinder block.

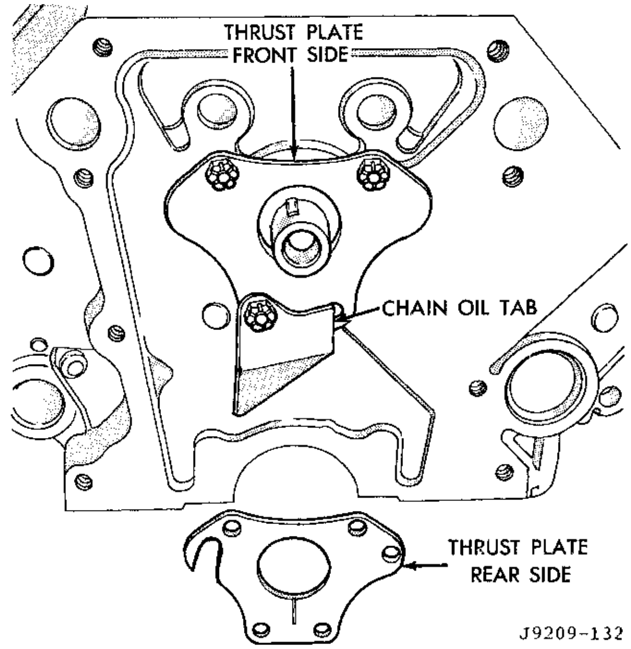

Fig. 28 Timing Chain Oil Tab Installation

NOTE: Whenever an engine has been rebuilt, a new camshaft and/or new tappets installed, add 1 pint of Mopar Crankcase Conditioner, or equivalent. The oil mixture should be left in engine for a minimum of 805 km (500 miles). Drain at the next normal oil change.

(2) Install Camshaft Gear Installer Tool C-3509 with tongue back of distributor drive gear (Fig. 29).

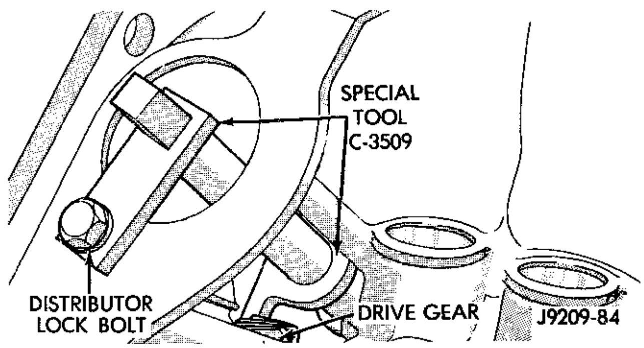

Fig. 29 Camshaft Holding Tool C-3509 (Installed Position)

(3) Hold tool in position with a distributor lock-plate bolt. This tool will restrict camshaft from being pushed in too far and prevent knocking out the welch plug in rear of cylinder block. **Tool should remain installed until the camshaft and crankshaft sprockets and timing chain have been installed.**
(4) Install camshaft thrust plate and chain oil tab. **Make sure tang enters lower right hole in thrust plate.** Tighten bolts to 24 N·m (210 in. lbs.)

REMOVAL AND INSTALLATION (Continued)

torque. Top edge of tab should be flat against thrust plate in order to catch oil for chain lubrication.

(5) Place both camshaft sprocket and crankshaft sprocket on the bench with timing marks on exact imaginary center line through both camshaft and crankshaft bores.

(6) Place timing chain around both sprockets.

(7) Turn crankshaft and camshaft to line up with keyway location in crankshaft sprocket and in camshaft sprocket.

(8) Lift sprockets and chain (keep sprockets tight against the chain in position as described).

(9) Slide both sprockets evenly over their respective shafts and use a straightedge to check alignment of timing marks (Fig. 30).

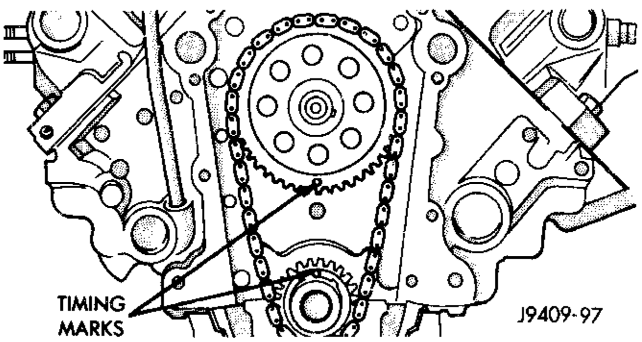

Fig. 30 Alignment of Timing Marks

(10) Install the camshaft bolt/cup washer. Tighten bolt to 68 N·m (50 ft. lbs.) torque.

(11) Measure camshaft end play. Refer to Specifications for proper clearance. If not within limits install a new thrust plate.

(12) Each tappet reused must be installed in the same position from which it was removed. **When camshaft is replaced, all of the tappets must be replaced.**

CAMSHAFT BEARINGS

REMOVAL

NOTE: This procedure requires that the engine is removed from the vehicle.

(1) With engine completely disassembled, drive out rear cam bearing core hole plug.

(2) Install proper size adapters and horseshoe washers (part of Camshaft Bearing Remover/Installer Tool C-3132-A) at back of each bearing shell. Drive out bearing shells (Fig. 31).

INSTALLATION

(1) Install new camshaft bearings with Camshaft Bearing Remover/Installer Tool C-3132-A by sliding the new camshaft bearing shell over proper adapter.

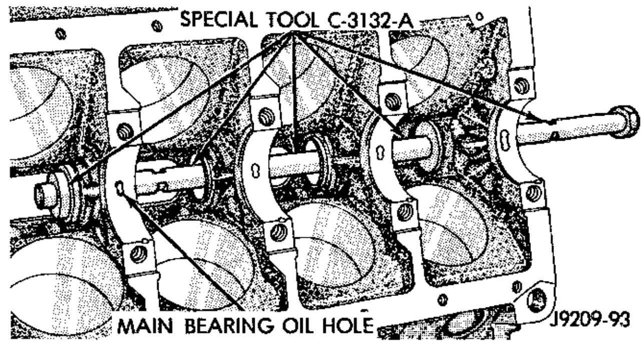

Fig. 31 Camshaft Bearings Removal/Installation with Tool C-3132-A

(2) Position rear bearing in the tool. Install horseshoe lock and by reversing removal procedure, carefully drive bearing shell into place.

(3) Install remaining bearings in the same manner. Bearings must be carefully aligned to bring oil holes into full register with oil passages from the main bearing. If the camshaft bearing shell oil holes are not in exact alignment, remove and install them correctly. Install a new core hole plug at the rear of camshaft. **Be sure this plug does not leak.**

CRANKSHAFT MAIN BEARINGS

REMOVAL

(1) Remove the oil pan.

(2) Remove the oil pump from the rear main bearing cap.

(3) Identify bearing caps before removal. Remove bearing caps one at a time.

(4) Remove upper half of bearing by inserting Crankshaft Main Bearing Remover/Installer Tool C-3059 into the oil hole of crankshaft (Fig. 32).

(5) Slowly rotate crankshaft clockwise, forcing out upper half of bearing shell.

INSTALLATION

Only one main bearing should be selectively fitted while all other main bearing caps are properly tightened. All bearing capbolts removed during service procedures are to be cleaned and oiled before installation.

When installing a new upper bearing shell, slightly chamfer the sharp edges from the plain side.

(1) Start bearing in place, and insert Crankshaft Main Bearing Remover/Installer Tool C-3059 into oil hole of crankshaft (Fig. 32).

(2) Slowly rotate crankshaft counterclockwise sliding the bearing into position. Remove Tool C-3059.

(3) Install the bearing caps. Clean and oil the bolts. Tighten the capbolts to 115 N·m (85 ft. lbs.) torque.

(4) Install the oil pump.

(5) Install the oil pan.

REMOVAL AND INSTALLATION (Continued)

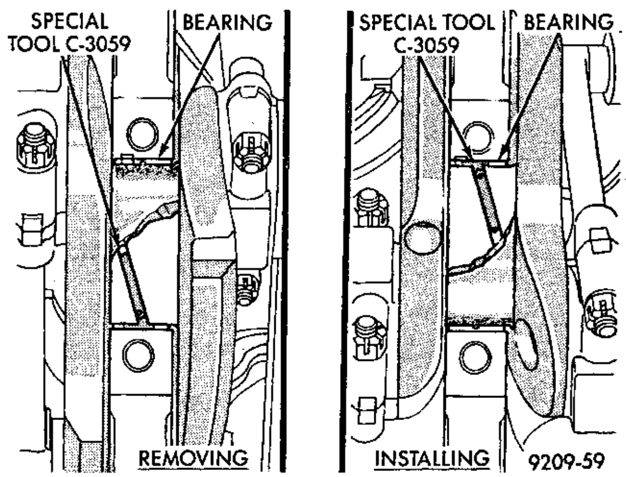

Fig. 32 Upper Main Bearing Removal and Installation with Tool C-3059

DISTRIBUTOR DRIVE SHAFT BUSHING

REMOVAL

(1) Remove distributor, refer to Group 8D, Ignition Systems for the proper procedure.

(2) Remove the intake manifold (refer to Group 11, Exhaust System and Intake Manifold).

(3) Insert Distributor Drive Shaft Bushing Puller Tool C-3052 into old bushing and thread down until a tight fit is obtained (Fig. 33).

(4) Hold puller screw and tighten puller nut until bushing is removed.

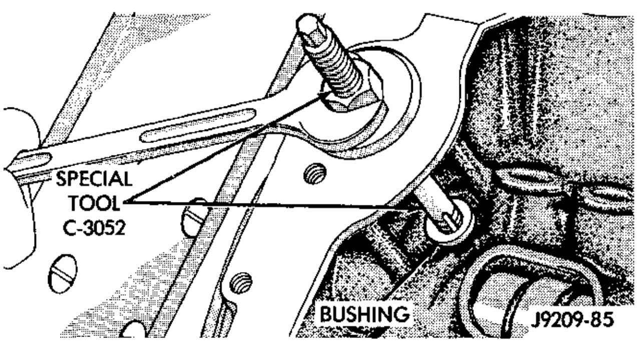

Fig. 33 Distributor Driveshaft Bushing Removal

INSTALLATION

(1) Slide new bushing over burnishing end of Distributor Drive Shaft Bushing Driver/Burnisher Tool C-3053. Insert the tool and bushing into the bore.

(2) Drive bushing and tool into position, using a hammer (Fig. 34).

(3) As the burnisher is pulled through the bushing, the bushing is expanded tight in the block and burnished to correct size (Fig. 35). **DO NOT ream this bushing.**

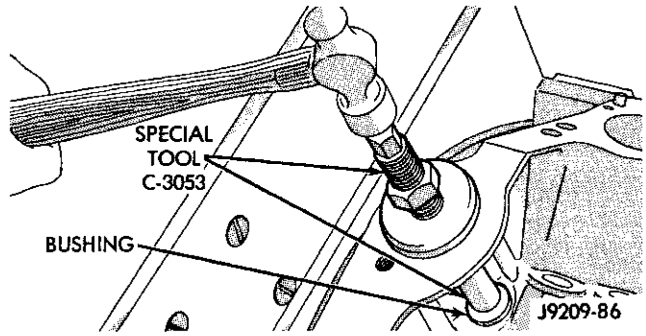

Fig. 34 Distributor Driveshaft Bushing Installation

CAUTION: This procedure MUST be followed when installing a new bushing or seizure to shaft may occur.

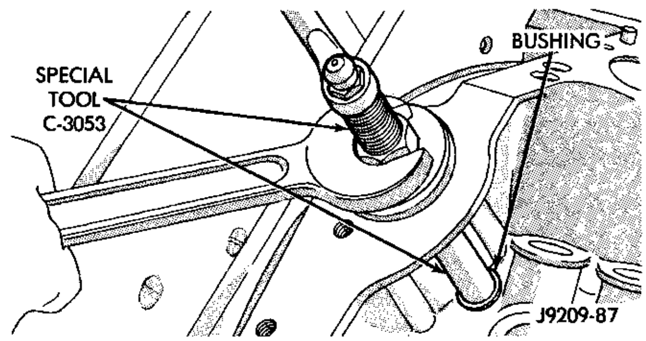

Fig. 35 Burnishing Distributor Driveshaft Bushing

(4) Install the intake manifold (refer to Group 11, Exhaust System and Intake Manifold).

DISTRIBUTOR INSTALLATION

NOTE: Before installing the distributor, the oil pump drive shaft must be aligned to number one cylinder.

(1) Rotate crankshaft until No.1 cylinder is at top dead center on the firing stroke.

(2) When in this position, the timing mark of vibration damper should be under "0" on the timing indicator.

(3) Install the shaft so that after the gear spirals into place, it will index with the oil pump shaft. The slot on top of oil pump shaft should be aligned towards the left front intake manifold attaching bolt hole (Fig. 36).

(4) Install distributor, refer to Group 8D, Ignition Systems for the proper procedure.

After the distributor has been installed, its rotational position must be set using the **SET SYNC** mode of the DRB scan tool. Refer to Checking Distributor Position following the Distributor Installation section in Group 8D, Ignition system.

Do not attempt to adjust ignition timing by rotating the distributor. It has no effect on igni-

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REMOVAL AND INSTALLATION (Continued)

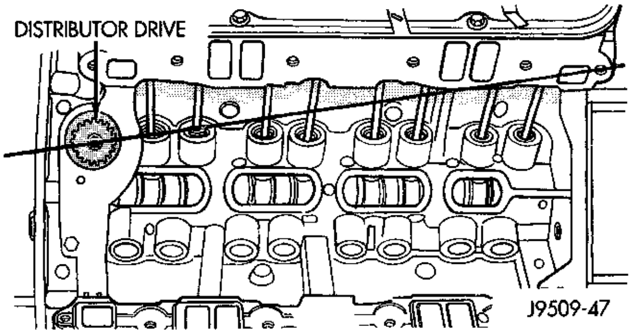


Fig. 36 Position of Oil Pump Shaft Slot

tion timing. Adjusting distributor position will effect fuel synchronization only.

OIL PAN

REMOVAL

(1) Disconnect the negative cable from the battery.
(2) Remove engine oil dipstick.
(3) Raise vehicle.
(4) Drain engine oil.
(5) Remove exhaust pipe.
(6) Remove left engine to transmission strut.
(7) Loosen the right side engine support bracket cushion thru-bolt nut and raise the engine slightly. Remove oil pan by sliding backward and out.
(8) Remove the one-piece gasket.

INSTALLATION

(1) Clean the block and pan gasket surfaces.
(2) Trim or remove excess sealant film in the rear main cap oil pan gasket groove. **DO NOT remove the sealant inside the rear main cap slots.**
(3) If present, trim excess sealant from inside the engine.
(4) Fabricate 4 alignment dowels from 5/16 x 1 1/2 inch bolts. Cut the head off the bolts and cut a slot into the top of the dowel. This will allow easier installation and removal with a screwdriver (Fig. 37).

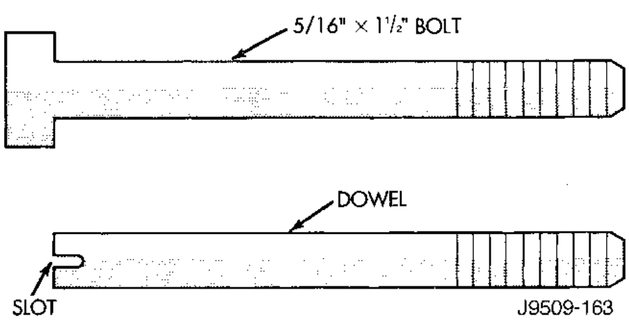


Fig. 37 Fabrication of Alignment Dowels

(5) Install the dowels in the cylinder block (Fig. 38).

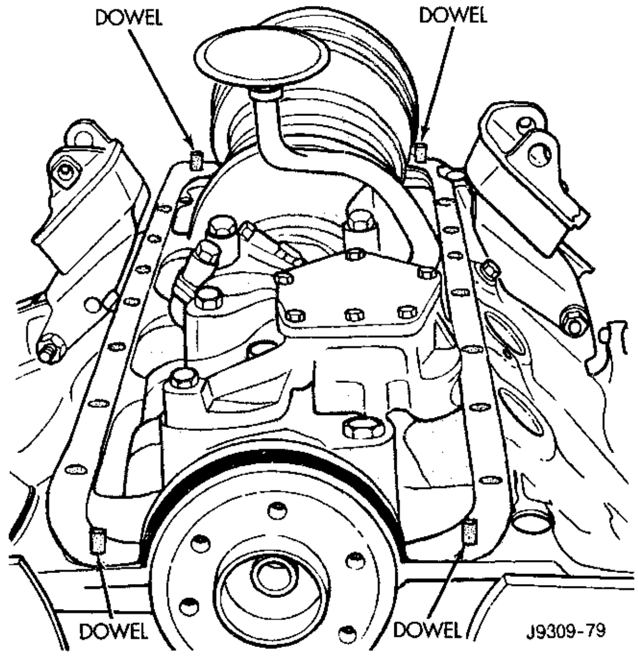


Fig. 38 Position of Dowels in Cylinder Block

(6) Apply small amount of Mopar® Silicone Rubber Adhesive Sealant, or equivalent in the corner of the cap and the cylinder block.
(7) Slide the one-piece gasket over the dowels and onto the block.
(8) Position the oil pan over the dowels and onto the gasket.
(9) Install the oil pan bolts. Tighten the bolts to 24 N·m (215 in. lbs.) torque.
(10) Remove the dowels. Install the remaining oil pan bolts. Tighten these bolts to 24 N·m (215 in. lbs.) torque.
(11) Lower the engine into the support cushion brackets and tighten the thru bolt nut to the proper torque.
(12) Install the drain plug. Tighten drain plug to 34 N·m (25 ft. lbs.) torque.
(13) Install the engine to transmission strut.
(14) Install exhaust pipe.
(15) Lower vehicle.
(16) Install dipstick.
(17) Connect the negative cable to the battery.
(18) Fill crankcase with oil to proper level.

PISTON AND CONNECTING ROD ASSEMBLY

REMOVAL

(1) Remove the engine from the vehicle.
(2) Remove the cylinder head.
(3) Remove the oil pan.
(4) Remove top ridge of cylinder bores with a reliable ridge reamer before removing pistons from cyl-

REMOVAL AND INSTALLATION (Continued)

inder block. Be sure to keep tops of pistons covered during this operation.

(5) Be sure the connecting rod and connecting rod cap are identified with the cylinder number. Remove connecting rod cap. Install connecting rod bolt guide set on connecting rod bolts.

(6) Pistons and connecting rods must be removed from top of cylinder block. When removing piston and connecting rod assemblies, rotate crankshaft to center the connecting rod in the cylinder bore and at BDC. **Be careful not to nick crankshaft journals.**

(7) After removal, install bearing cap on the mating rod.

INSTALLATION

(1) Be sure that compression ring gaps are staggered so that neither is in-line with oil ring rail gap.

(2) Before installing the ring compressor, make sure the oil ring expander ends are butted and the rail gaps located properly (Fig. 39).

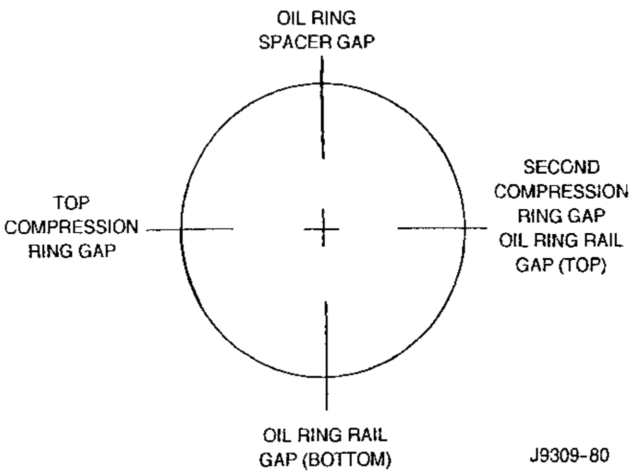


Fig. 39 Proper Ring Installation

(3) Immerse the piston head and rings in clean engine oil. Slide Piston Ring Compressor Tool C-385 over the piston and tighten with the special wrench (part of Tool C-385). **Be sure position of rings does not change during this operation.**

(4) Install connecting rod bolt protectors on rod bolts, the long protector should be installed on the numbered side of the connecting rod.

(5) Rotate crankshaft so that the connecting rod journal is on the center of the cylinder bore. Be sure connecting rod and cylinder bore number are the same. Insert rod and piston into cylinder bore and guide rod over the crankshaft journal.

(6) Tap the piston down in cylinder bore, using a hammer handle. At the same time, guide connecting rod into position on crankshaft journal.

(7) The notch or groove on top of piston must be pointing toward front of engine. The larger chamfer of the connecting rod bore must be installed toward crankshaft journal fillet.

(8) Install rod caps. Be sure connecting rod, connecting rod cap and cylinder bore number are the same. Install nuts on cleaned and oiled rod bolts and tighten nuts to 61 N·m (45 ft. lbs.) torque.

(9) Install the oil pan.

(10) Install the cylinder head.

(11) Install the engine into the vehicle.

CRANKSHAFT

REMOVAL

(1) Remove the oil pan.

(2) Remove the oil pump from the rear main bearing cap.

(3) Remove the vibration damper.

(4) Remove the timing chain cover.

(5) Identify bearing caps before removal. Remove bearing caps and bearings one at a time.

(6) Lift the crankshaft out of the block.

(7) Remove and discard the crankshaft rear oil seals.

(8) Remove and discard the front crankshaft oil seal.

INSTALLATION

(1) Clean Loctite 518 residue and sealant from the cylinder block and rear cap mating surface. Do this before applying the Loctite drop and the installation of rear cap.

(2) Lightly oil the new upper seal lips with engine oil.

(3) Install the new upper rear bearing oil seal with the white paint facing towards the rear of the engine.

(4) Position the crankshaft into the cylinder block.

(5) Lightly oil the new lower seal lips with engine oil.

(6) Install the new lower rear bearing oil seal into the bearing cap with the white paint facing towards the rear of the engine.

(7) Apply 5 mm (0.20 in) drop of Loctite 518, or equivalent, on each side of the rear main bearing cap (Fig. 40). DO NOT over apply sealant or allow the sealant to contact the rubber seal. Assemble bearing cap to cylinder block immediately after sealant application.

(8) To align the bearing cap, use cap slot, alignment dowel and cap bolts. DO NOT remove excess material after assembly. DO NOT strike rear cap more than 2 times for proper engagement.

(9) Clean and oil all cap bolts. Install all main bearing caps. Install all cap bolts and alternately tighten to 115 N·m (85 ft. lbs.) torque.

(10) Install oil pump.

(11) Install the timing chain cover.

(12) Install the vibration damper.

REMOVAL AND INSTALLATION (Continued)

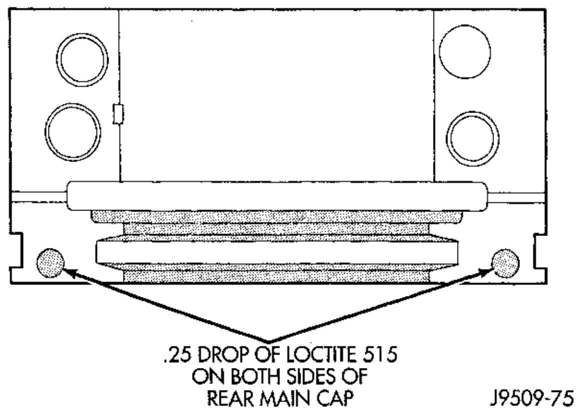


Fig. 40 Sealant Application to Bearing Cap

(13) Apply Mopar® Silicone Rubber Adhesive Sealant, or equivalent, at bearing cap to block joint to provide cap to block and oil pan sealing (Fig. 41). Apply enough sealant until a small amount is squeezed out. Withdraw nozzle and wipe excess sealant off the oil pan seal groove.

(14) Install new front crankshaft oil seal.

(15) Immediately install the oil pan.

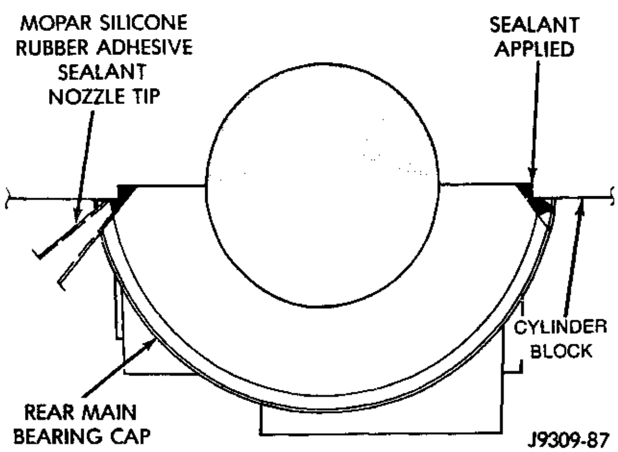


Fig. 41 Apply Sealant to Bearing Cap to Block Joint

OIL PUMP

REMOVAL

(1) Remove the oil pan.

(2) Remove the oil pump from rear main bearing cap.

INSTALLATION

(1) Install oil pump. During installation slowly rotate pump body to ensure driveshaft-to-pump rotor shaft engagement.

(2) Hold the oil pump base flush against mating surface on No.5 main bearing cap. Finger tighten pump attaching bolts. Tighten attaching bolts to 41 N·m (30 ft. lbs.) torque.

(3) Install the oil pan.

FRONT CRANKSHAFT OIL SEAL

The oil seal can be replaced without removing the timing chain cover provided the cover is not misaligned.

(1) Disconnect the negative cable from the battery.

(2) Remove vibration damper.

(3) If front seal is suspected of leaking, check front oil seal alignment to crankshaft. The seal installation/alignment tool 6635, should fit with minimum interference. If tool does not fit, the cover must be removed and installed properly.

(4) Place a suitable tool behind the lips of the oil seal to pry the oil seal outward. Be careful not to damage the crankshaft seal bore of cover.

(5) Place the smaller diameter of the oil seal over Front Oil Seal Installation Tool 6635 (Fig. 42). Seat the oil seal in the groove of the tool.

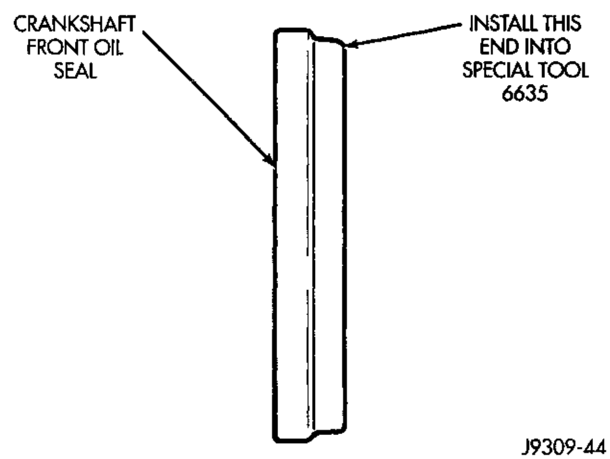


Fig. 42 Placing Oil Seal on Installation Tool 6635

(6) Position the seal and tool onto the crankshaft (Fig. 43).

(7) Using the vibration damper bolt, tighten the bolt to draw the seal into position on the crankshaft (Fig. 44).

(8) Remove the vibration damper bolt and seal installation tool.

(9) Inspect the seal flange on the vibration damper.

(10) Install the vibration damper.

(11) Connect the negative cable to the battery.

CRANKSHAFT REAR OIL SEALS

The service seal is a 2 piece, viton seal. The upper seal half can be installed with crankshaft removed from engine or with crankshaft installed. When a new upper seal is installed, install a new lower seal.

REMOVAL AND INSTALLATION (Continued)

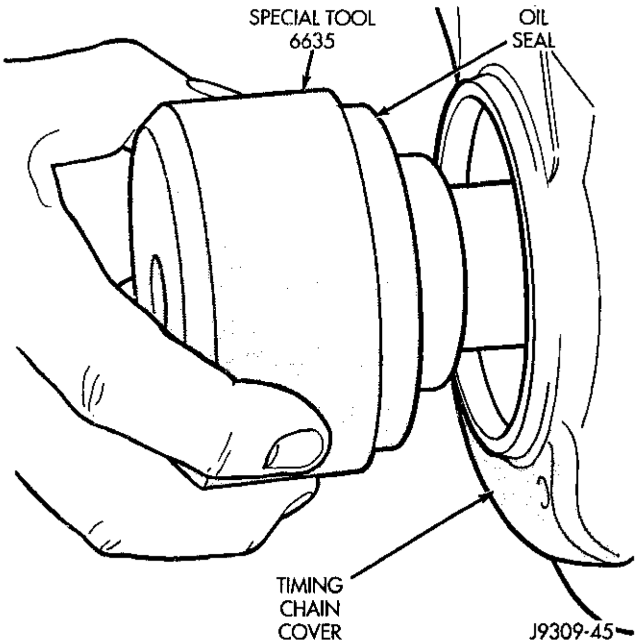


Fig. 43 Position Tool and Seal onto Crankshaft

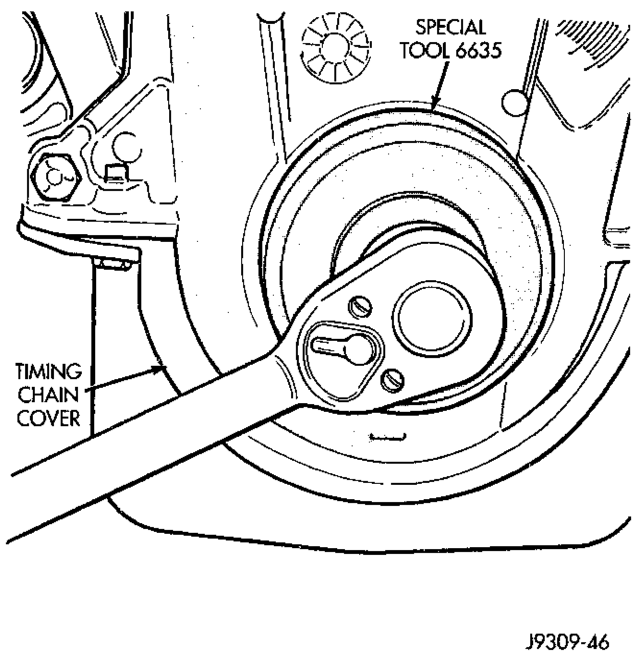


Fig. 44 Installing Oil Seal

The lower seal half can only be installed with the rear main bearing cap removed.

UPPER SEAL —CRANKSHAFT REMOVED

REMOVAL

(1) Remove the crankshaft. Discard the old upper seal.

INSTALLATION

(1) Clean the cylinder block rear cap mating surface. Make sure the seal groove is free of debris.

(2) Lightly oil the new upper seal lips with engine oil.

(3) Install the new upper rear bearing oil seal with the white paint facing towards the rear of the engine.

(4) Position the crankshaft into the cylinder block.

(5) Lightly oil the new lower seal lips with engine oil.

(6) Install the new lower rear bearing oil seal into the bearing cap with the white paint facing towards the rear of the engine.

(7) Apply 5 mm (0.20 in) drop of Loctite 518, or equivalent, on each side of the rear main bearing cap (Fig. 45). DO NOT over apply sealant or allow the sealant to contact the rubber seal. Assemble bearing cap to cylinder block immediately after sealant application.

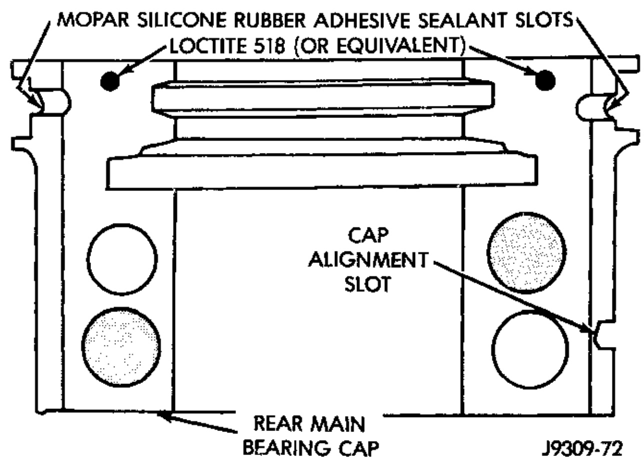


Fig. 45 Sealant Application to Bearing Cap

(8) To align the bearing cap, use cap slot, alignment dowel and cap bolts. DO NOT remove excess material after assembly. DO NOT strike rear cap more than 2 times for proper engagement.

(9) Clean and oil all cap bolts. Install all main bearing caps. Install all cap bolts and alternately tighten to 115 N·m (85 ft. lbs.) torque.

(10) Install oil pump.

(11) Apply Mopar Silicone Rubber Adhesive Sealant, or equivalent, at bearing cap to block joint to provide cap to block and oil pan sealing (Fig. 46). Apply enough sealant until a small amount is squeezed out. Withdraw nozzle and wipe excess sealant off the oil pan seal groove.

(12) Install new front crankshaft oil seal.

(13) Immediately install the oil pan.

REMOVAL AND INSTALLATION (Continued)

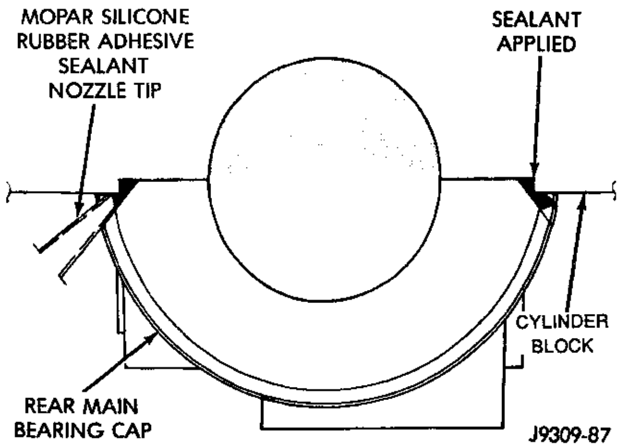


Fig. 46 Apply Sealant to Bearing Cap to Block Joint

UPPER SEAL —CRANKSHAFT INSTALLED

REMOVAL

(1) Remove the oil pan.

(2) Remove the oil pump from the rear main bearing cap.

(3) Remove the rear main bearing cap. Remove and discard the old lower oil seal.

(4) Carefully remove and discard the old upper oil seal.

INSTALLATION

(1) Clean the cylinder block mating surfaces before oil seal installation. Check for burr at the oil hole on the cylinder block mating surface to rear cap.

(2) Lightly oil the new upper seal lips with engine oil. To allow ease of installation of the seal, loosen at least the 2 main bearing caps forward of the rear bearing cap.

(3) Rotate the new upper seal into the cylinder block being careful not to shave or cut the outer surface of the seal. To assure proper installation, use the installation tool provided with the kit. Install the new seal with the white paint facing towards the rear of the engine.

(4) Install the new lower rear bearing oil seal into the bearing cap with the white paint facing towards the rear of the engine.

(5) Apply 5 mm (0.20 in) drop of Loctite 518, or equivalent, on each side of the rear main bearing cap (Fig. 45). DO NOT over apply sealant or allow the sealant to contact the rubber seal. Assemble bearing cap to cylinder block immediately after sealant application. Be sure the white paint faces toward the rear of the engine.

(6) To align the bearing cap, use cap slot, alignment dowel and cap bolts. DO NOT remove excess material after assembly. DO NOT strike rear cap more than 2 times for proper engagement.

(7) Install the rear main bearing cap with cleaned and oiled cap bolts. Alternately tighten ALL cap bolts to 115 N·m (85 ft. lbs.) torque.

(8) Install oil pump.

(9) Apply Mopar Silicone Rubber Adhesive Sealant, or equivalent, at bearing cap to block joint to provide cap to block and oil pan sealing (Fig. 46). Apply enough sealant until a small amount is squeezed out. Withdraw nozzle and wipe excess sealant off the oil pan seal groove.

(10) Immediately install the oil pan.

LOWER SEAL

REMOVAL

(1) Remove the oil pan.

(2) Remove the oil pump from the rear main bearing cap.

(3) Remove the rear main bearing cap and discard the old lower seal.

INSTALLATION

(1) Clean the rear main cap mating surfaces including the oil pan gasket groove.

(2) Carefully install a new upper seal (refer to Upper Seal Replacement - Crankshaft Installed procedure above).

(3) Lightly oil the new lower seal lips with engine oil.

(4) Install a new lower seal in bearing cap with the white paint facing the rear of engine.

(5) Apply 5 mm (0.20 in) drop of Loctite 518, or equivalent, on each side of the rear main bearing cap (Fig. 45). DO NOT over apply sealant or allow the sealant to contact the rubber seal. Assemble bearing cap to cylinder block immediately after sealant application.

(6) To align the bearing cap, use cap slot, alignment dowel and cap bolts. DO NOT remove excess material after assembly. DO NOT strike rear cap more than 2 times for proper engagement.

(7) Install the rear main bearing cap with cleaned and oiled cap bolts. Alternately tighten the cap bolts to 115 N·m (85 ft. lbs.) torque.

(8) Install oil pump.

(9) Apply Mopar Silicone Rubber Adhesive Sealant, or equivalent, at bearing cap to block joint to provide cap to block and oil pan sealing (Fig. 46). Apply enough sealant until a small amount is squeezed out. Withdraw nozzle and wipe excess sealant off the oil pan seal groove.

(10) Immediately install the oil pan.

ENGINE CORE OIL AND CAMSHAFT PLUGS

Engine core plugs have been pressed into the oil galleries behind the camshaft thrust plate (Fig. 47).

REMOVAL AND INSTALLATION (Continued)

This will reduce internal leakage and help maintain higher oil pressure at idle.

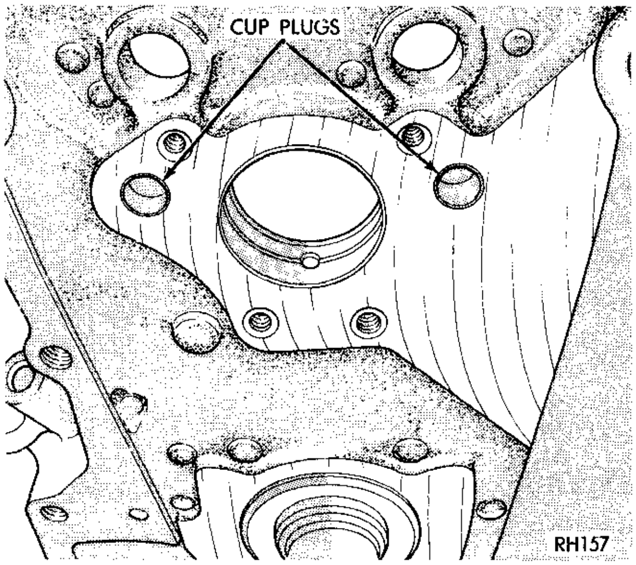


Fig. 47 Location of Cup Plugs in Oil Galleries

REMOVAL

(1) Using a blunt tool such as a drift or a screwdriver and a hammer, strike the bottom edge of the cup plug (Fig. 48).

(2) With the cup plug rotated, grasp firmly with pliers or other suitable tool and remove plug (Fig. 48).

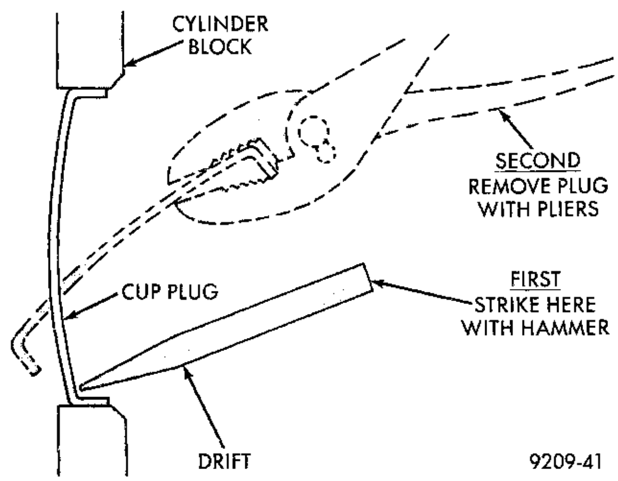


Fig. 48 Core Hole Plug Removal

INSTALLATION

Thoroughly clean inside of cup plug hole in cylinder block or head. Be sure to remove old sealer.

Be certain the new plug is cleaned of all oil or grease.

(1) Coat edges of plug and core hole with Mopar Gasket Maker, or equivalent.

CAUTION: DO NOT drive cup plug into the casting, as restricted coolant flow can result and cause serious engine problems.

(2) Using proper plug drive, drive cup plug into hole. The sharp edge of the plug should be at least 0.50 mm (0.020 in.) inside the lead-in chamfer.

(3) It is not necessary to wait for curing of the sealant. The cooling system can be filled and the vehicle placed in service immediately.

DISASSEMBLY AND ASSEMBLY

HYDRAULIC TAPPETS

CAUTION: The plunger and tappet bodies are not interchangeable. The plunger and valve must always be fitted to the original body. It is advisable to work on one tappet at a time to avoid mixing of parts. Mixed parts are not compatible. DO NOT disassemble a tappet on a dirty work bench.

DISASSEMBLE

(1) Pry out plunger retainer spring clip (Fig. 49).

(2) Clean varnish deposits from inside of tappet body above plunger cap.

(3) Invert tappet body and remove plunger cap, plunger, check valve, check valve spring, check valve retainer and plunger spring (Fig. 49). Check valve could be flat or ball.

ASSEMBLE

(1) Clean all tappet parts in a solvent that will remove all varnish and carbon.

(2) Replace tappets that are unfit for further service with new assemblies.

(3) If plunger shows signs of scoring or wear, install a new tappet assembly. If valve is pitted, or valve seat on end of plunger is prevented from seating, install a new tappet assembly.

(4) Assemble tappets (Fig. 49).

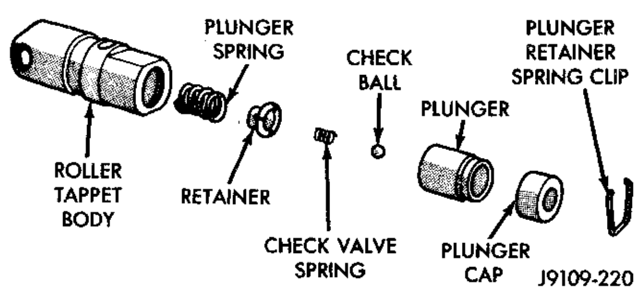


Fig. 49 Hydraulic Tappet Assembly

AUTHENTIC RESTORATION PRODUCTS

DISASSEMBLY AND ASSEMBLY (Continued)

VALVE SERVICE

VALVE GUIDES

Measure valve stem guide clearance as follows:

(1) Install Valve Guide Sleeve Tool C-3973 over valve stem and install valve (Fig. 50). The special sleeve places the valve at the correct height for checking with a dial indicator.

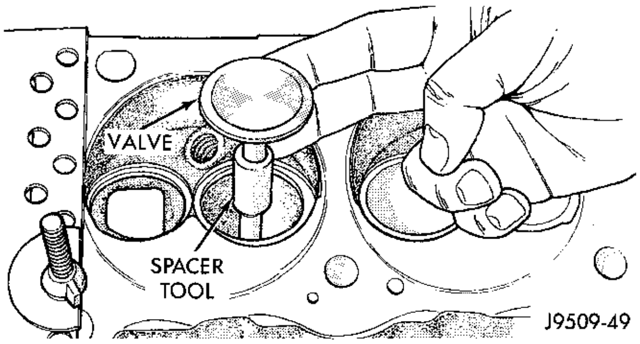


Fig. 50 Positioning Valve with Tool C-3973

(2) Attach Dial Indicator Tool C-3339 to cylinder head and set it at right angle of valve stem being measured (Fig. 51).

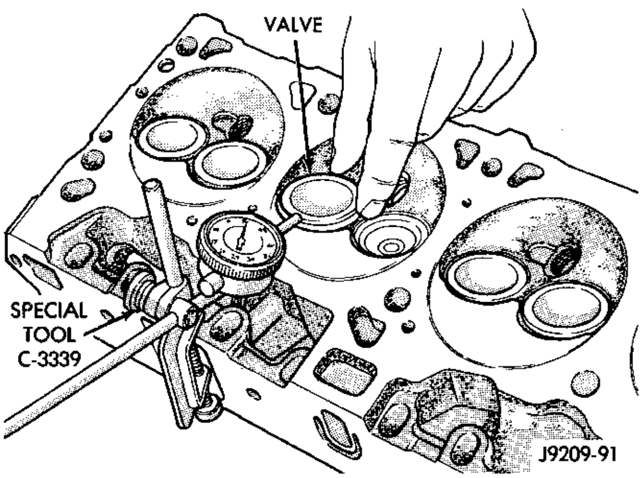


Fig. 51 Measuring Valve Guide Wear

(3) Move valve to and from the indicator. The total dial indicator reading should not exceed 0.432 mm (0.017 inch). Ream the guides for valves with oversize stems if dial indicator reading is excessive or if the stems are scuffed or scored.

(4) Service valves with oversize stems are available (Fig. 52).

(5) Slowly turn reamer by hand and clean guide thoroughly before installing new valve. **Ream the valve guides from standard to 0.381 mm (0.015 inch). Use a 2 step procedure so the valve guides are reamed true in relation to the valve seat:**

- Step 1—Ream to 0.0763 mm (0.003 inch).

Reamer O/S	Valve Guide Size
0.076 mm (0.003 in.)	8.026 – 8.052 mm (0.316 – 0.317 in.)
0.381 mm (0.015 in.)	8.331 – 8.357 mm (0.328 – 0.329 in.)

J9309-30

Fig. 52 Reamer Sizes

- Step 2—Ream to 0.381 mm (0.015 inch).

REFACING VALVES AND VALVE SEATS

The intake and exhaust valves have a 43-1/4° to 43-3/4° face angle and a 44-1/4° to 44-3/4° seat angle (Fig. 53).

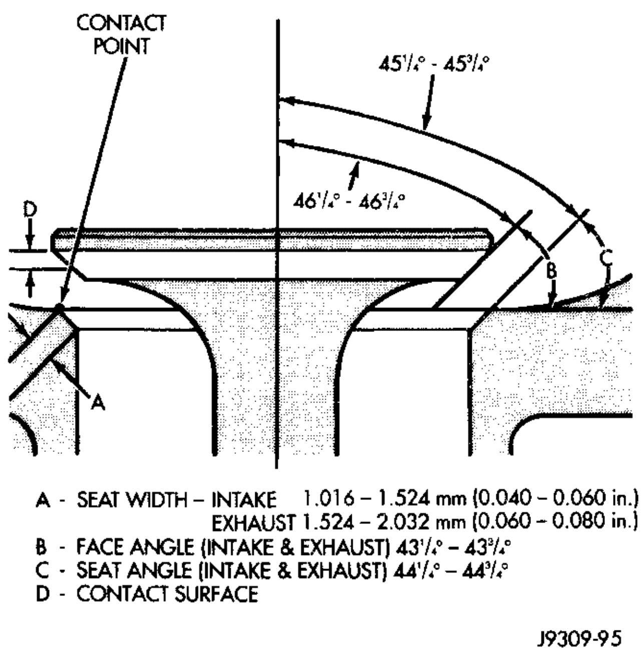


Fig. 53 Valve Face and Seat Angles

VALVES

Inspect the remaining margin after the valves are refaced (Fig. 54). Valves with less than 1.190 mm (0.047 inch) margin should be discarded.

VALVE SEATS

CAUTION: DO NOT un-shroud valves during valve seat refacing (Fig. 55).

(1) When refacing valve seats, it is important that the correct size valve guide pilot be used for reseating stones. A true and complete surface must be obtained.

DISASSEMBLY AND ASSEMBLY (Continued)

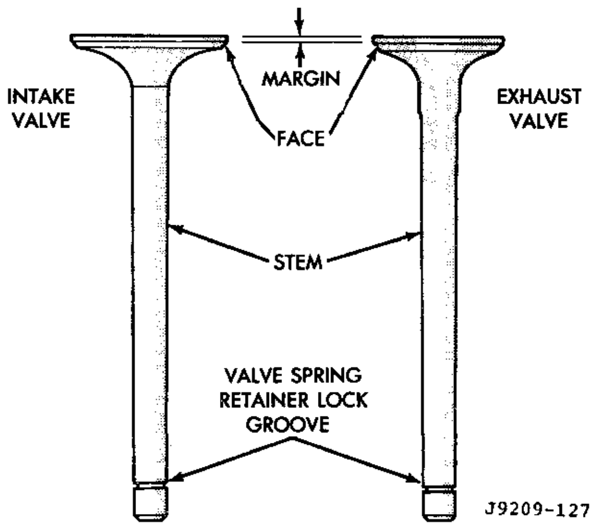


Fig. 54 Intake and Exhaust Valves

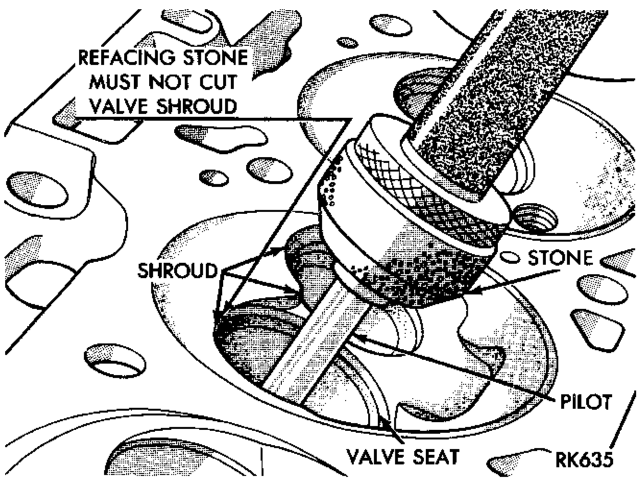


Fig. 55 Refacing Valve Seats

(2) Measure the concentricity of valve seat using a dial indicator. Total runout should not exceed 0.051 mm (0.002 inch) total indicator reading.

(3) Inspect the valve seat with Prussian blue to determine where the valve contacts the seat. To do this, coat valve seat LIGHTLY with Prussian blue then set valve in place. Rotate the valve with light pressure. If the blue is transferred to the center of valve face, contact is satisfactory. If the blue is transferred to the top edge of valve face, lower valve seat with a 15° stone. If the blue is transferred to bottom edge of valve face raise valve seat with a 60° stone.

(4) When seat is properly positioned the width of intake seats should be 1.016-1.524 mm (0.040-0.060 inch). The width of the exhaust seats should be 1.524-2.032 mm (0.060-0.080 inch).

VALVE SPRING INSPECTION

Whenever valves have been removed for inspection, reconditioning or replacement, valve springs should be tested. As an example the compression length of the spring to be tested is 1-5/16 inch. Turn table of Universals Valve Spring Tester Tool until surface is in line with the 1-5/16 inch mark on the threaded stud. Be sure the zero mark is to the front (Fig. 56). Place spring over stud on the table and lift compressing lever to set tone device. Pull on torque wrench until ping is heard. Take reading on torque wrench at this instant. Multiply this reading by 2. This will give the spring load at test length. Fractional measurements are indicated on the table for finer adjustments. Refer to specifications to obtain specified height and allowable tensions. Discard the springs that do not meet specifications.

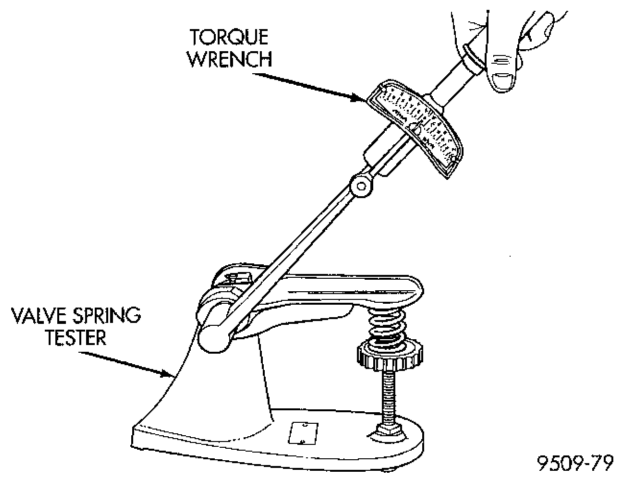


Fig. 56 Testing Valve Spring for Compressed Length

OIL PUMP

DISASSEMBLE

(1) Remove the relief valve as follows:

(a) Remove cotter pin. Drill a 3.175 mm (1/8 inch) hole into the relief valve retainer cap and insert a self-threading sheet metal screw.

(b) Clamp screw into a vise and while supporting oil pump, remove cap by tapping pump body using a soft hammer. Discard retainer cap and remove spring and relief valve (Fig. 57).

(2) Remove oil pump cover (Fig. 58).

(3) Remove pump outer rotor and inner rotor with shaft (Fig. 58).

(4) Wash all parts in a suitable solvent and inspect carefully for damage or wear.

ASSEMBLE

(1) Install pump rotors and shaft, using new parts as required.

(2) Position the oil pump cover onto the pump body. Tighten cover bolts to 11 N·m (95 in. lbs.) torque.

DISASSEMBLY AND ASSEMBLY (Continued)

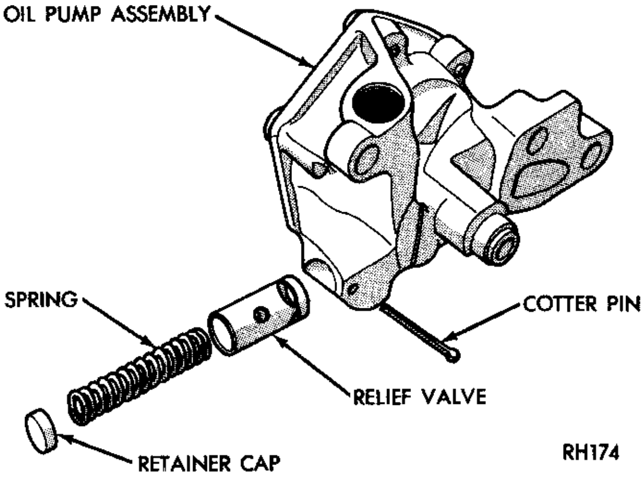


Fig. 57 Oil Pressure Relief Valve

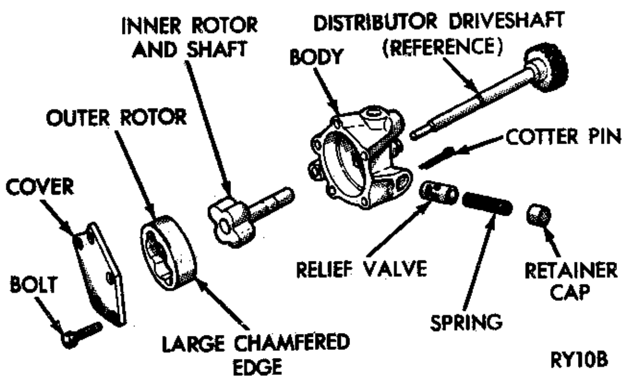


Fig. 58 Oil Pump

(3) Install the relief valve and spring. Insert the cotter pin.

(4) Tap on a new retainer cap.

(5) Prime oil pump before installation by filling rotor cavity with engine oil.

CYLINDER BLOCK

DISASSEMBLE

Engine assembly removed from vehicle:

(1) Remove the cylinder head.

(2) Remove the oil pan.

(3) Remove the piston and connecting rod assemblies.

ASSEMBLE

(1) Install the piston and connecting rod assembly.

(2) Install the oil pan.

(3) Install the cylinder head.

(4) Install the engine into the vehicle.

CLEANING AND INSPECTION

CYLINDER HEADS

CLEANING

Clean all surfaces of cylinder block and cylinder heads.

Clean cylinder block front and rear gasket surfaces using a suitable solvent.

INSPECTION

Inspect all surfaces with a straightedge if there is any reason to suspect leakage. If out-of-flatness exceeds 0.00075 mm/mm (0.00075 inch/inch) times the span length in inches in any direction, either replace head or lightly machine the head surface.

FOR EXAMPLE: A 305 mm (12 inch) span is 0.102 mm (0.004 inch) out-of-flat. The allowable out-of-flat is 305 x 0.00075 (12 x 0.00075) equals 0.23 mm (0.009 inch). This amount of out-of-flat is acceptable.

The cylinder head surface finish should be 1.78-3.00 microns (70-125 micro inches).

Inspect push rods. Replace worn or bent rods.

PISTON AND CONNECTING ROD ASSEMBLY

INSPECTION

Check the crankshaft connecting rod journal for excessive wear, taper and scoring.

Check the cylinder block bore for out-of-round, taper, scoring and scuffing.

Check the pistons for taper and elliptical shape before they are fitted into the cylinder bore (Fig. 59).

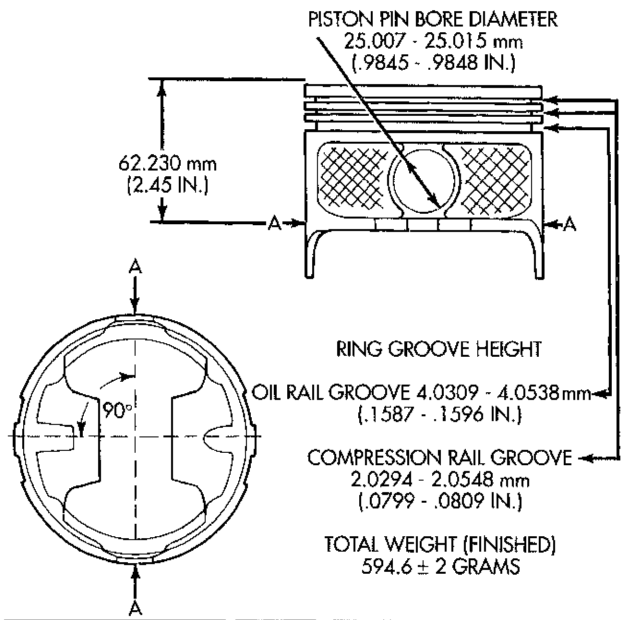
CRANKSHAFT JOURNALS

The crankshaft connecting rod and main journals should be checked for excessive wear, taper and scoring. The maximum taper or out-of-round on any crankshaft journal is 0.025 mm (0.001 inch).

Journal grinding should not exceed 0.305 mm (0.012 inch) under the standard journal diameter. DO NOT grind thrust faces of No.3 main bearing. DO NOT nick crank pin or bearing fillets. After grinding, remove rough edges from crankshaft oil holes and clean out all oil passages.

CAUTION: After any journal grind, it is important that the final paper or cloth polish be in the same direction as the engine rotates.

CLEANING AND INSPECTION (Continued)



PISTON SIZE	A DIA = PISTON DIAMETER		BORE DIAMETER	
	MIN. mm (IN.)	MAX. mm (IN.)	MIN. mm (IN.)	MAX. mm (IN.)
A	99.280 (3.9087)	99.294 (3.9092)	99.306 (3.9097)	99.319 (3.9102)
B	99.294 (3.9092)	99.306 (3.9097)	99.319 (3.9102)	99.332 (3.9107)
C	99.306 (3.9097)	99.319 (3.9102)	99.332 (3.9107)	99.344 (3.9112)
D	99.319 (3.9102)	99.332 (3.9107)	99.344 (3.9112)	99.357 (3.9117)
E	99.332 (3.9107)	99.344 (3.9112)	99.357 (3.9117)	99.370 (3.9122)

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Fig. 59 Piston Measurements

OIL PAN

CLEANING

Clean the block and pan gasket surfaces.

Trim or remove excess sealant film in the rear main cap oil pan gasket groove. **DO NOT remove the sealant inside the rear main cap slots.**

If present, trim excess sealant from inside the engine.

Clean oil pan in solvent and wipe dry with a clean cloth.

Clean oil screen and pipe thoroughly in clean solvent. Inspect condition of screen.

INSPECTION

Inspect oil drain plug and plug hole for stripped or damaged threads. Repair as necessary.

Inspect oil pan mounting flange for bends or distortion. Straighten flange, if necessary.

OIL PUMP

INSPECTION

Mating surface of the oil pump cover should be smooth. Replace pump assembly if cover is scratched or grooved.

Lay a straightedge across the pump cover surface (Fig. 60). If a 0.038 mm (0.0015 inch) feeler gauge can be inserted between cover and straightedge, pump assembly should be replaced.

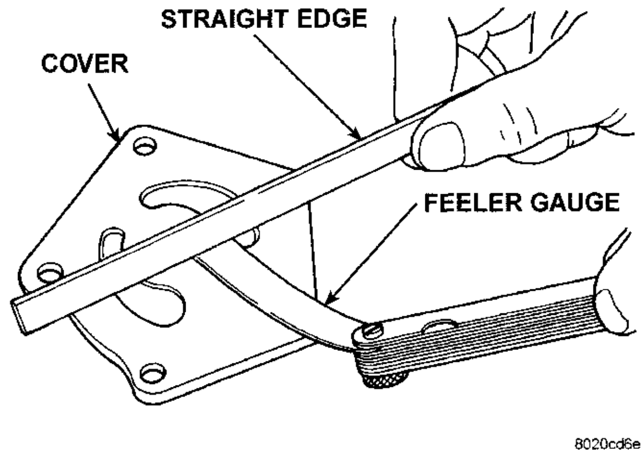

Fig. 60 Checking Oil Pump Cover Flatness

Measure thickness and diameter of OUTER rotor. If outer rotor thickness measures 20.9 mm (0.825 inch) or less or if the diameter is 62.7 mm (2.469 inches) or less, replace outer rotor (Fig. 61).

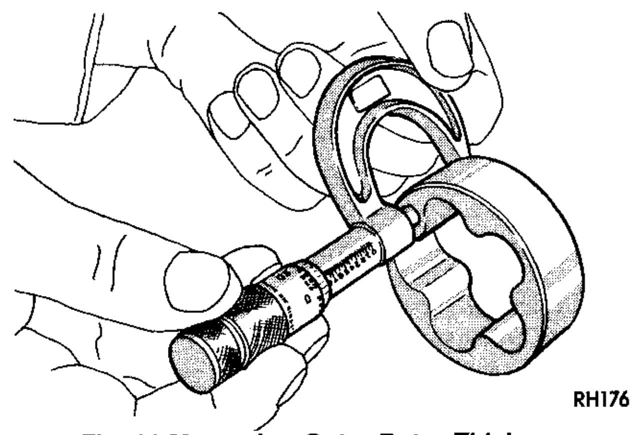

Fig. 61 Measuring Outer Rotor Thickness

If inner rotor measures 20.9 mm (0.825 inch) or less, replace inner rotor and shaft assembly (Fig. 62).

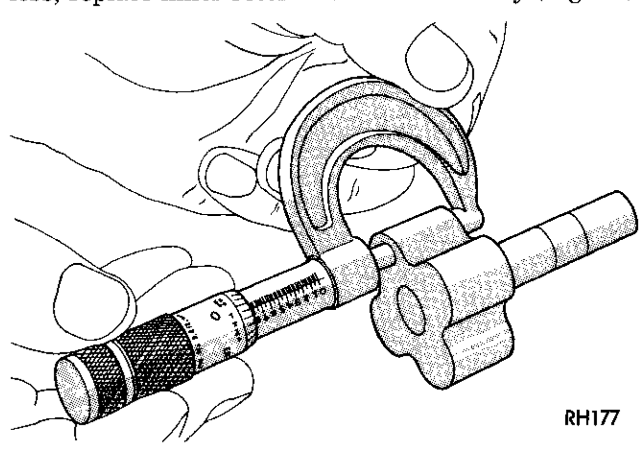

Fig. 62 Measuring Inner Rotor Thickness

AUTHENTIC RESTORATION PRODUCTS

CLEANING AND INSPECTION (Continued)

Slide outer rotor into pump body. Press rotor to the side with your fingers and measure clearance between rotor and pump body (Fig. 63). If clearance is 0.356 mm (0.014 inch) or more, replace oil pump assembly.

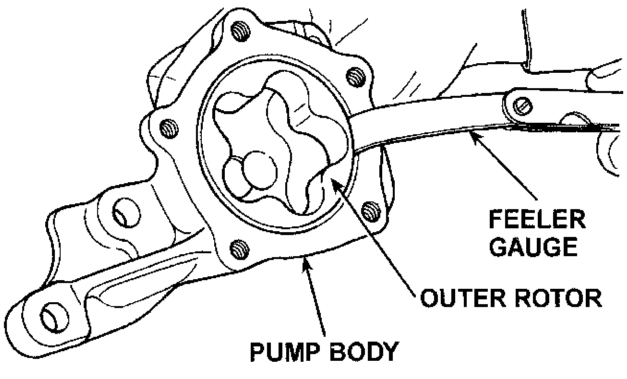

Fig. 63 Measuring Outer Rotor Clearance in Housing

Install inner rotor and shaft into pump body. If clearance between inner and outer rotors is 0.203 mm (0.008 inch) or more, replace shaft and both rotors (Fig. 64).

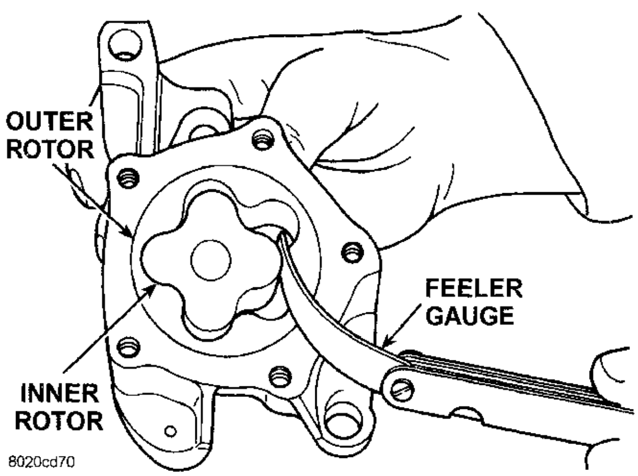

Fig. 64 Measuring Clearance Between Rotors

Place a straightedge across the face of the pump, between bolt holes. If a feeler gauge of 0.102 mm (0.004 inch) or more can be inserted between rotors and the straightedge, replace pump assembly (Fig. 65).

Inspect oil pressure relief valve plunger for scoring and free operation in its bore. Small marks may be removed with 400-grit wet or dry sandpaper.

The relief valve spring has a free length of approximately 49.5 mm (1.95 inches). The spring should test between 19.5 and 20.5 pounds when compressed to 34 mm (1-11/32 inches). Replace spring that fails to meet these specifications (Fig. 66).

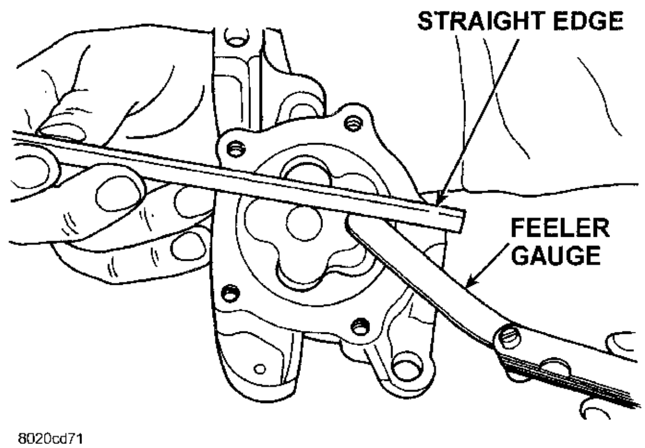

Fig. 65 Measuring Clearance Over Rotors

If oil pressure was low and pump is within specifications, inspect for worn engine bearings or other reasons for oil pressure loss.

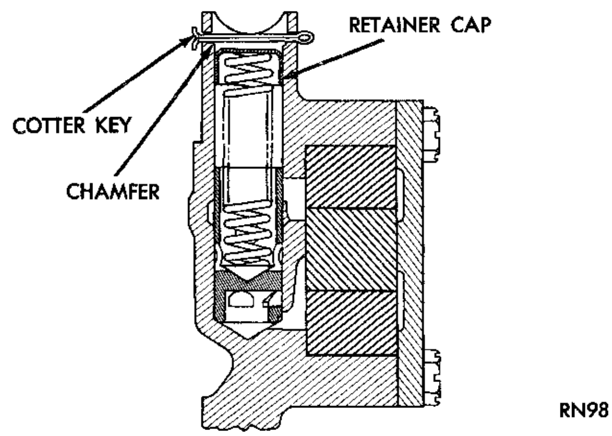

Fig. 66 Proper Installation of Retainer Cap

CYLINDER BLOCK

CLEANING

Clean cylinder block thoroughly and check all core hole plugs for evidence of leaking.

INSPECTION

Examine block for cracks or fractures.

The cylinder walls should be checked for out-of-round and taper with Cylinder Bore Indicator Tool C-119. The cylinder block should be bored and honed with new pistons and rings fitted if:

- The cylinder bores show more than 0.127 mm (0.005 in.) out-of-round.
- The cylinder bores show a taper of more than 0.254 mm (0.010 in.).
- The cylinder walls are badly scuffed or scored.

Boring and honing operation should be closely coordinated with the fitting of pistons and rings, so that specified clearances can be maintained.

CLEANING AND INSPECTION (Continued)

OIL LINE PLUG

The oil line plug is located in the vertical passage at the rear of the block between the oil-to-filter and oil-from-filter passages (Fig. 67). Improper installation or plug missing could cause erratic, low, or no oil pressure.

The oil plug must come out the bottom. Use flat dowel, down the oil pressure sending unit hole from the top, to remove oil plug.

(1) Remove oil pressure sending unit from back of block.

(2) Insert a 3.175 mm (1/8 in.) finish wire, or equivalent, into passage.

(3) Plug should be 190.0 to 195.2 mm (7-1/2 to 7-11/16 in.) from machined surface of block (Fig. 67). If plug is too high, use a suitable flat dowel to position properly.

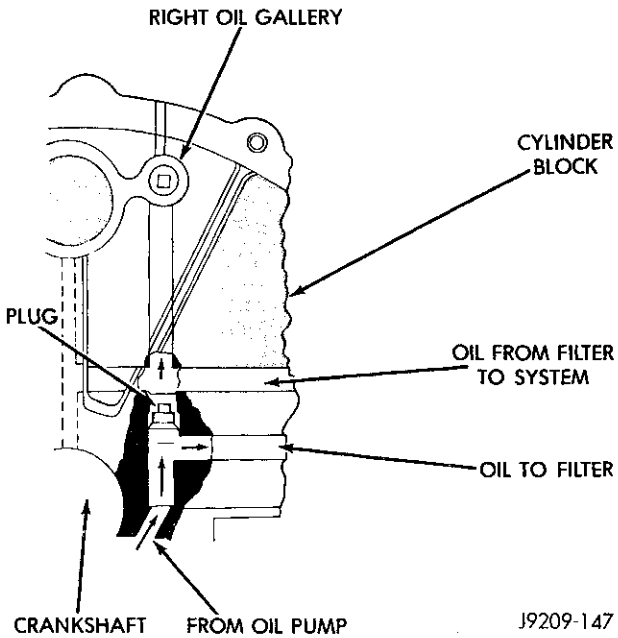

Fig. 67 Oil Line Plug

(4) If plug is too low, remove oil pan and No. 4 main bearing cap. Use suitable flat dowel to position properly. Coat outside diameter of plug with Mopar Stud and Bearing Mount Adhesive, or equivalent. Plug should be 54.0 to 57.7 mm (2-1/8 to 2-5/16 in.) from bottom of the block.

SPECIFICATIONS

5.2L ENGINE SPECIFICATIONS

GENERAL INFORMATION

Engine Type . . . . .90° V-8 OHV
Bore and Stroke . . . . .99.3 x 84.0 mm (3.91 x 3.31 in.)
Engine Type . . . . .90° V-8 OHV
Displacement . . . . .5.2L (318 c.i.)
Compression Ratio 9.1:1
Firing Order 1–8–4–3–6–5–7–2
Lubrication .Pressure Feed—Full Flow Filtration
Cooling System . . . . .Liquid Cooled—Forced Circulation
Cylinder Block . . . . .Cast Iron
Crankshaft . . . . .Nodular Iron
Cylinder Head . . . . .Cast Iron
Combustion Chambers . . . . .Wedge-High Swirl Valve shrouding
Camshaft .Nodular Cast Iron
Pistons . . . . .Aluminum Alloy w/strut
Connecting Rods . . . . .Forged Steel

CAMSHAFT

Bearing Diameter
No. 1 . . . . . . .50.800 – 50.825 mm (2.000 – 2.001 in.)
No. 2 . . . . . . .50.394 – 50.419 mm (1.984 – 1.985 in.)
No. 3 . . . . . . .50.013 – 50.038 mm (1.969 – 1.970 in.)
No. 4 . . . . . . .49.606 – 49.632 mm (1.953 – 1.954 in.)
No. 5 . . . . .39.688 – 39.713 mm (1.5625 – 1.5635 in.)
Bearing Journal Diameter
No. 1 . . . . . . .50.749 – 50.775 mm (1.998 – 1.999 in.)
No. 2 . . . . . . .50.343 – 50.368 mm (1.982 – 1.983 in.)
No. 3 . . . . . . .49.962 – 49.987 mm (1.967 – 1.968 in.)
No. 4 . . . . . . .49.555 – 49.581 mm (1.951 – 1.952 in.)
No. 5 . . . . .39.637 – 39.662 mm (1.5605 – 1.5615 in.)
Bearing to Journal Clearance
Standard . . . . .0.0254 – 0.0762 mm (0.001 – 0.003 in.)
Service Limit . . . . .0.127 mm (0.005 in.)
Camshaft End Play
End Play . . . . .0.051 – 0.254 mm (0.002 – 0.010 in.)

CONNECTING RODS

Piston Pin bore Diameter . . . . . .24.966 – 24.978 mm (0.9829 – 0.9834 in.)
Side Clearance . . . . .0.152 – 0.356 mm (0.006 – 0.014 in.)

CRANKSHAFT

Rod Journal
Diameter . . . . .53.950 – 53.975 mm (2.124 – 2.125 in.)
Out of Round (Max.) . . . . .0.0254 mm (0.001 in.)
Taper (Max.) . . . . .0.0254 mm (0.001 in.)
Bearing Clearance . . . . .0.013 – 0.056 mm (0.0005 – 0.0022 in.)

AUTHENTIC RESTORATION PRODUCTS

SPECIFICATIONS (Continued)

Rod Journal
Service Limit . . . . .0.0762 mm (0.003 in.)
Main Bearing Journal
Diameter. . . . . .63.487 – 63.513 mm (2.4995 – 2.5005in.)
Out of Round (Max.) . . . . .0.127 mm (0.001 in.)
Taper (Max.). . . . . .0.0254 mm (0.001 in.)
Bearing Clearance (#1 Journal) . . .0.013 – 0.038 mm (0.0005 – 0.0015 in.)
Service Limit (#1 Journal). . . . . .0.0381 mm (0.0015 in.)
Bearing Clearance (#2-5 Journals). . . . . .0.013 – 0.051 mm (0.0005 – 0.002 in.)
Service Limit (#2-5 Journals) . . . . .0.064 mm (0.0025 in.)
Crankshaft End Play
End Play . . . . .0.051 – 0.178 mm (0.002 – 0.007 in.)
Service Limit . . . . .0.254 mm (0.010 in.)

CYLINDER BLOCK

Cylinder Bore
Diameter. . . . . .99.314 – 99.365 mm (3.910 – 3.912 in.)
Out of Round (Max.) . . . . .0.127 mm (0.005 in.)
Taper (Max.) . . . . .0.254 mm (0.010 in.)
Oversize Limit . . . . .1.016 mm (0.040 in.)
Lifter Bore
Diameter . . . . .22.99 – 23.01 mm (0.9051 – 0.9059 in.)
Distributor Drive Bushing (Press Fit)
Bushing to Bore Interference . . .0.0127 – 0.3556 mm (0.0005 – 0.0140 in.)
Shaft to Bushing Clearance . . . .0.0178 – 0.0686 mm (0.0007 – 0.0027 in.)

CYLINDER HEAD AND VALVES

Valve Seat
Angle . . . . .44.25° – 44.75°
Runout (Max.) . . . . .0.0762 mm (0.003 in.)
Width (Finish) – Intake . . . . .1.016 – 1.524 mm (0.040 – 0.060 in.)
Width (Finish) – Exhaust. . . . . . . .1.524 – 2.032 mm (0.060 – 0.080 in.)
Valves
Face Angle .43.25° – 43.75°
Head Diameter – Intake . . . . .48.666 mm (1.916 in.)
Head Diameter – Exhaust. . . . . . . .41.250 (1.624 in.)
Length (Overall) – Intake. . . . . .124.28 – 125.92 mm (4.893 – 4.918 in.)
Length (Overall) – Exhaust . . . .124.64 – 125.27 mm (4.907 – 4.932 in.)
Lift (@ zero lash) . . . . .10.973 mm (0.432 in.)
Stem Diameter . . . . .7.899 – 7.925 mm (0.311 – 0.312 in.)
Guide Bore . . . . .7.950 – 7.976 mm (0.313 – 0.314 on.)
Stem to Guide Clearance . . . . . .0.0254 – 0.0762 mm (0.001 – 0.003 in.)
Service Limit (rocking method) . .0.4318 (0.017 in.)
Valve Springs
Free Length . . . . .49.962 mm (1.967 in.)
Spring Tension – (valve closed) . .378 N @ 41.66 mm (85 lbs. @ 1.64 in.)
Spring Tension – (valve open). . . .890 N @ 30.89 mm (200 lbs. @ 1.212 in.)
Number of Coils. 6.5
Installed Height. . . . . .41.66 mm (1.64 in.)
Wire Diameter . . . . .4.50 mm (0.177 in.)

HYDRAULIC TAPPETS

Body Diameter . . . . .22.949 – 22.962 mm (0.9035 – 0.9040 in.)
Clearance (to bore) . . . . .0.0279 – 0.0610 mm (0.0011 – 0.0024 in.)
Dry Lash .1.524 – 5.334 mm (0.060 – 0.210 in.)
Push Rod Length . . . . .175.64 – 176.15 mm (6.915 – 6.935 in.)

OIL PRESSURE

Curb Idle (Min.*). . . . . .41.4 kPa (6 psi)
3000 rpm . . . . .207 – 552 kPa (30 – 80 psi)
Oil Pressure Bypass Valve Setting. . . . .62 – 103 kPa (9 – 15 psi)
Switch Actuating Pressure. . . . . .34.5 – 48.3 kPa (5 – 7 psi)

CAUTION: If oil pressure is zero at curb idle, DO NOT RUN ENGINE.

OIL PUMP

Clearance over Rotors (Max.) . . . . .0.1016 mm (0.004 in.)
Cover Out of Flat (Max.). . . . . .0.0381 mm (0.0015 in.)
Inner Rotor Thickness (Min.) . . . . .20.955 mm (0.825 in.)
Outer Rotor Clearance (Max.). . . . . .0.3556 mm (0.014 in.)
Outer Rotor Diameter (Min.). . . . . .62.7126 mm (2.469 in.)
Outer Rotor Thickness (Min.) . . . . .20.955 mm (0.825 in.)

SPECIFICATIONS (Continued)

Tip Clearance between Rotors (Max.) . . . .0.2032 mm (0.008 in.)

PISTONS

Clearance at Top of Skirt . . . . .0.013 – 0.038 mm (0.0005 – 0.0015 in.)
Land Clearance (Diam.) . . . . .0.635 – 1.016 mm (0.025 – 0.040 in.)
Piston Length . . . . .86.360 mm (3.40 in.)
Piston Ring Groove
Depth – #1&2. . . . . .4.572 – 4.826 mm (0.180 – 0.190 in.)
Piston Ring Groove
Depth – #3 . . . . .3.810 – 4.064 mm (0.150 – 0.160 in.)
Weight .592.6 – 596.6 grams (20.90 – 21.04 oz.)

PISTON PINS

Clearance in Piston. . . . . .0.00635 – 0.01905 mm (0.00025 – 0.00075 in.)
Diameter. . . . . .24.996 – 25.001 mm (0.9841 – 0.9843 in.)
End Play . . . . .NONE
Length .75.946 – 76.454 mm (2.990 – 3.010 in.)

PISTON RINGS

Ring Gap
Compression Rings. . . . . .0.254 – 0.508 mm (0.010 – 0.020 in.)
Oil Control (Steel Rails) . . . . .0.254 – 1.270 mm (0.010 – 0.050 in.)
Ring Side Clearance
Compression Rings. . . . . .0.038 – 0.076 mm (0.0015 – 0.0030 in.)
Oil Ring (Steel Rails) . . . . .0.06 – 0.21 mm (0.002 – 0.008 in.)
Ring Width
Compression rings . . . . .1.971 – 1.989 mm (0.0776 – 0.0783 in.)
Oil Ring (Steel Rails) – Max. . . . . .3.848 – 3.975 mm (0.1515 – 0.1565 in.)

VALVE TIMING

Exhaust Valve
Closes (ATDC). . . . . .21°
Opens (BBDC). . . . . .60°
Duration . . . . .264°
Intake Valve
Closes (ATDC). . . . . .61°
Opens (BBDC). . . . . .10°
Duration . . . . .250°
Valve Overlap . . . . .31°

OVERSIZE AND UNDERSIZE ENGINE COMPONENT MARKINGS

CONDITION	IDENTIFICATION	LOCATION OF IDENTIFICATION
CRANKSHAFT JOURNALS (UNDERSIZE) 0.0254 mm (0.001 in.)	R or M M-2-3 etc. (indicating no. 2 and 3 main bearing journal) and/or R-1-4 etc. (indicating no. 1 and 4 connecting rod journal)	Milled flat on no. 8 crankshaft counterweight.
HYDRAULIC TAPPETS (OVERSIZE) 0.2032 mm (0.008 in.)	♦	Diamond-shaped stamp top pad – front of engine and flat ground on outside surface of each O/S tappet bore.
VALVE STEMS (OVERSIZE) 0.127 mm (0.005 in.)	X	Milled pad adjacent to two tapped holes (3/8 in.) on each end of cylinder head.

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AUTHENTIC RESTORATION

SPECIFICATIONS (Continued)

TORQUE SPECIFICATIONS

5.2L ENGINE

DESCRIPTION	TORQUE
Camshaft	
Bolt	68 N·m (50 ft. lbs.)
Camshaft Thrust Plate	
Bolts	24 N·m (210 in. lbs.)
Chain Case Cover	
Bolts	41 N·m (30 ft. lbs.)
Connecting Rod Cap	
Bolts	61 N·m (45 ft. lbs.)
Crankshaft Main Bearing Cap	
Bolts	115 N·m (85 ft. lbs.)
Crankshaft Pulley	
Bolts	24 N·m (210 in. lbs.)
Cylinder Head	
Bolts (1st Step)	68 N·m (50 ft. lbs.)
Bolts (2nd Step)	143 N·m (105 ft. lbs.)
Cylinder Head Cover	
Bolts	11 N·m (95 in. lbs.)
Engine Support Bracket to Block (4wd)	
Bolts	41 N·m (30 ft. lbs.)
Exhaust Manifold-to-Cylinder Head	
Bolts/Nuts	34 N·m (25 ft. lbs.)
Flywheel	
Bolts	75 N·m (55 ft. lbs.)
Front Insulator (All)	
Through bolt/nut	95 N·m (70 ft. lbs.)
Front Insulator to Support Bracket (4wd)	
Stud nut	41 N·m (30 ft. lbs.)
Through bolt/nut	102 N·m (75 ft. lbs.)
Front Insulator to Block (2wd)	
Bolts	95 N·m (70 ft. lbs.)
Generator	
Mounting Bolt	41 N·m (30 ft. lbs.)
Intake Manifold	
Bolts	Refer to R &I Procedure
Oil Pan	
Bolts	24 N·m (215 in. lbs.)
Oil Pan	
Drain Plug	34 N·m (25 ft. lbs.)
Oil Pump	
Attaching Bolts	41 N·m (30 ft. lbs.)
Oil Pump Cover	
Bolts	11 N·m (95 in. lbs.)
Rear Insulator-to-Bracket (2WD)	
Through-Bolt	68 N·m (50 ft. lbs.)
Rear Insulator-to-Crossmember Support Bracket (2WD)	
Nut	41 N·m (30 ft. lbs.)
Rear Insulator-to-Crossmember (4WD)	
Nuts	68 N·m (50 ft. lbs.)
Rear Insulator-to-Transmission (4WD)	
Bolts	68 N·m (50 ft. lbs.)
Rear Insulator Bracket (4WD Automatic)	
Bolts	68 N·m (50 ft. lbs.)
Rear Support Bracket-to-Crossmember Flange	
Nuts	41 N·m (30 ft. lbs.)
Rear Support Plate-to-Transfer Case	
Bolts	41 N·m (30 ft. lbs.)
Rocker Arm	
Bolts	28 N·m (21 ft. lbs.)
Spark Plugs	
All	41 N·m (30 ft. lbs.)
Starter Motor	
Mounting Bolts	68 N·m (50 ft. lbs.)
Thermostat Housing	
Bolts	25 N·m (225 in. lbs.)
Throttle Body	
Bolts	23 N·m (200 in. lbs.)
Torque Converter Drive Plate	
Bolts	31 N·m (270 in. lbs.)
Transfer Case-to-Insulator Mounting Plate	
Nuts	204 N·m (150 ft. lbs.)
Transmission Support Bracket (2WD)	
Bolts	68 N·m (50 ft. lbs.)
Vibration Damper	
Retainer Bolt	183 N·m (135 ft. lbs.)
Water Pump-to-Chain Case Cover	
Bolt	41 N·m (30 ft. lbs.)

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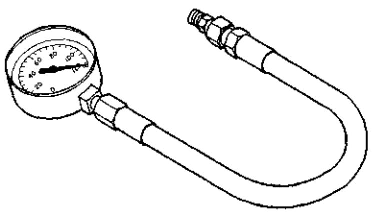
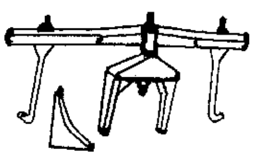
SPECIAL TOOLS

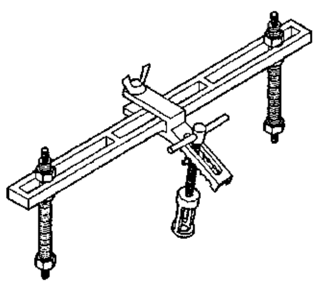
5.2L ENGINE



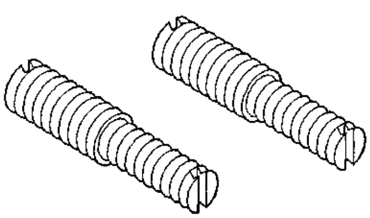
Oil Pressure Gauge C-3292



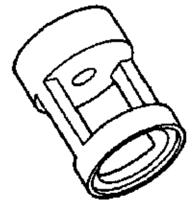
Engine Support Fixture C-3487–A



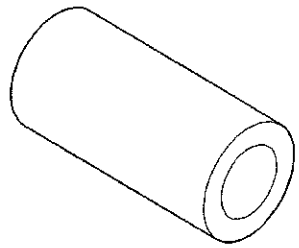
Valve Spring Compressor MD-998772–A



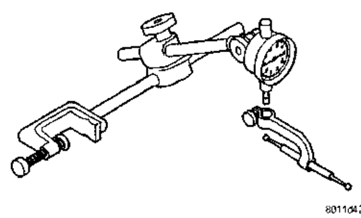
Adapter 6633



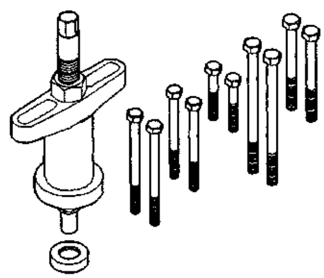
Adapter 6716A



Valve Guide Sleeve C-3973

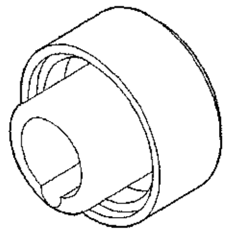


Dial Indicator C-3339

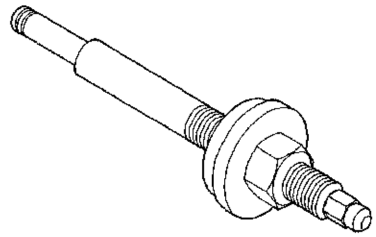


Puller C-3688

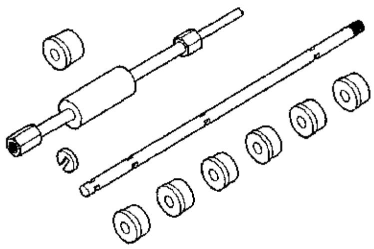
SPECIAL TOOLS (Continued)



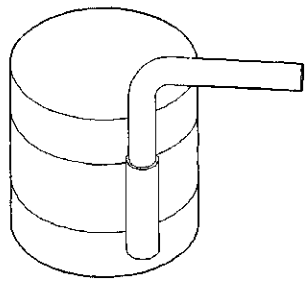
Front Oil Seal Installer 6635



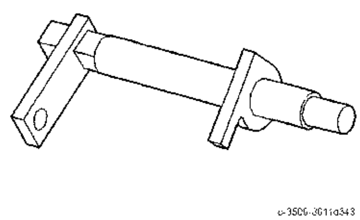
Distributor Bushing Driver/Burnisher C-3053



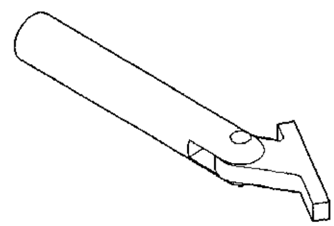
Cam Bearing Remover/Installer C-3132–A



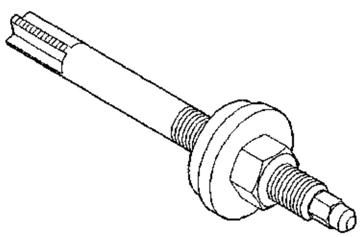
Piston Ring Compressor C-385



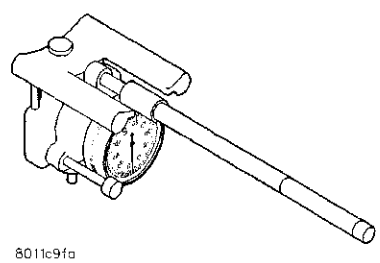
Camshaft Holder C-3509



Crankshaft Main Bearing Remover C-3059



Distributor Bushing Puller C-3052



Cylinder Bore Gauge C-119

5.9L ENGINE

INDEX

GENERAL INFORMATION

OIL PUMP PRESSURE

The MINIMUM oil pump pressure is 41.4 kPa (6 psi) at curb idle. The NORMAL oil pump pressure is 207-552 kPa (30-80 psi) at 3,000 RPM or more.

CAUTION: If oil pressure is ZERO at curb idle, DO NOT run engine.

PISTON AND CONNECTING ROD ASSEMBLY

The pistons are elliptically turned so that the diameter at the pin boss is less than its diameter across the thrust face. This allows for expansion under normal operating conditions. Under operating temperatures, expansion forces the pin bosses away from each other, causing the piston to assume a more nearly round shape.

All pistons are machined to the same weight, regardless of size, to maintain piston balance.

The piston pin rotates in the piston only and is retained by the press interference fit of the piston pin in the connecting rod.

DESCRIPTION AND OPERATION

ENGINE DESCRIPTION/IDENTIFICATION

The 5.9 Liter (360 CID) eight-cylinder engine is a V-Type lightweight, single cam, overhead valve engine with hydraulic roller tappets. This engine is designed for unleaded fuel.

The engine lubrication system consists of a rotor type oil pump and a full flow oil filter.

The cylinders are numbered from front to rear; 1, 3, 5, 7 on the left bank and 2, 4, 6, 8 on the right bank. The firing order is 1-8-4-3-6-5-7-2 (Fig. 1).

AUTHENTIC RESTORATION

DESCRIPTION AND OPERATION (Continued)

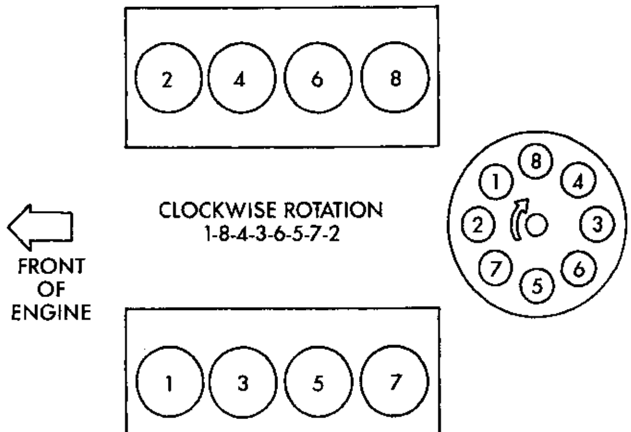


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Fig. 1 Firing Order

The engine serial number is stamped into a machined pad located on the left, front corner of the cylinder block. When component part replacement is necessary, use the engine type and serial number for reference (Fig. 2).

X M 5.9L T XXXX XXXXXXXX

X = Last Digit of Model Year
M = Plant - M Mound Road
S Saltillo
T Trenton
K Toluca
5.9L = Engine Displacement
T = Usage - T Truck
XXXX = Month/Day
XXXXXXXX = Serial Code - Last 8 Digits of VIN No.

J9209-74

Fig. 2 Engine Identification Number

LUBRICATION SYSTEM

A gear—type positive displacement pump is mounted at the underside of the rear main bearing cap. The pump draws oil through the screen and inlet tube from the sump at the rear of the oil pan. The oil is driven between the drive and idler gears and pump body, then forced through the outlet to the block. An oil gallery in the block channels the oil to the inlet side of the full flow oil filter. After passing through the filter element, the oil passes from the center outlet of the filter through an oil gallery that channels the oil up to the main gallery which extends the entire length on the right side of the block. The oil then goes down to the No. 1 main bearing, back up to the left side of the block and into the oil gallery on the left side of the engine.

Galleries extend downward from the main oil gallery to the upper shell of each main bearing. The crankshaft is drilled internally to pass oil from the main bearing journals to the connecting rod journals. Each connecting rod bearing has half a hole in it, oil passes through the hole when the rods rotate and the hole lines up, oil is then thrown off as the rod rotates. This oil throw off lubricates the camshaft lobes, distributor drive gear, cylinder walls, and piston pins.

The hydraulic valve tappets receive oil directly from the main oil gallery. The camshaft bearings receive oil from the main bearing galleries. The front camshaft bearing journal passes oil through the camshaft sprocket to the timing chain. Oil drains back to the oil pan under the number one main bearing cap.

The oil supply for the rocker arms and bridged pivot assemblies is provided by the hydraulic valve tappets which pass oil through hollow push rods to a hole in the corresponding rocker arm. Oil from the rocker arm lubricates the valve train components. The oil then passes down through the push rod guide holes, and the oil drain back passages in the cylinder head past the valve tappet area, and returns to the oil pan.

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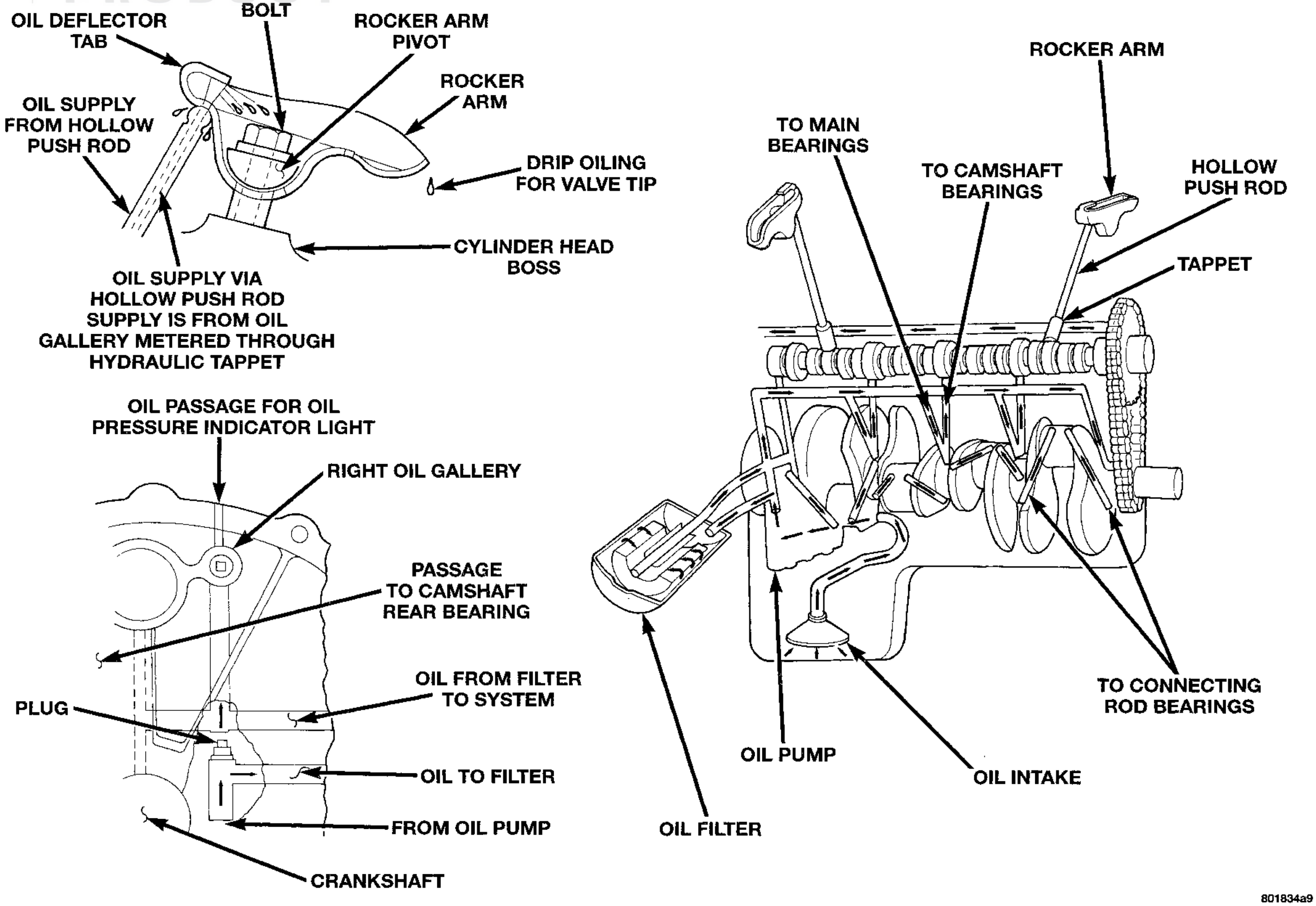

Fig. 3 Oil Lubrication System

AUTHENTIC RESTORATION PRODUCT

DESCRIPTION AND OPERATION (Continued)

ENGINE COMPONENTS

CYLINDER HEADS

The alloy cast iron cylinder heads (Fig. 4) are held in place by 10 bolts. The spark plugs are located in the peak of the wedge between the valves.

The 5.9L cylinder head is identified by the foundry mark CF.

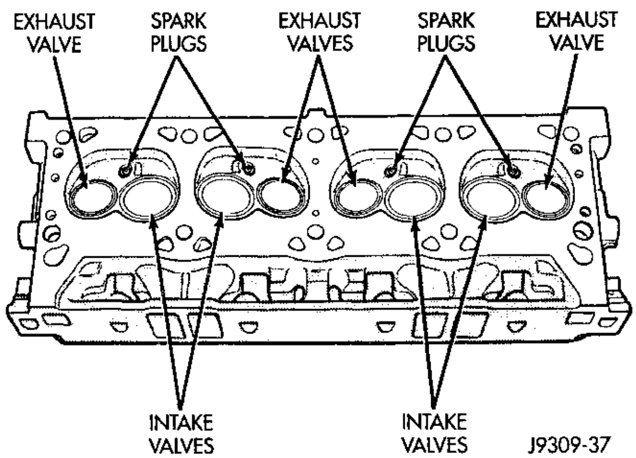

Fig. 4 Cylinder Head Assembly

PISTONS

The pistons are elliptically turned so that the diameter at the pin boss is less than its diameter across the thrust face. This allows for expansion under normal operating conditions. Under operating temperatures, expansion forces the pin bosses away from each other, causing the piston to assume a more nearly round shape.

All pistons are machined to the same weight, regardless of size, to maintain piston balance.

The piston pin rotates in the piston only and is retained by the press interference fit of the piston pin in the connecting rod.

VALVES AND VALVE SPRINGS

The valves are arranged in-line and inclined 18°. The rocker pivot support and the valve guides are cast integral with the heads.

SERVICE PROCEDURES

VALVE TIMING

(1) Turn crankshaft until the No.6 exhaust valve is closing and No.6 intake valve is opening.

(2) Insert a 6.350 mm (1/4 inch) spacer between rocker arm pad and stem tip of No.1 intake valve. Allow spring load to bleed tappet down giving in effect a solid tappet.

(3) Install a dial indicator so plunger contacts valve spring retainer as nearly perpendicular as possible. Zero the indicator.

(4) Rotate the crankshaft clockwise (normal running direction) until the valve has lifted 0.863 mm (0.034 inch). The timing of the crankshaft should now read from 10° before top dead center to 2° after top dead center. Remove spacer.

CAUTION: DO NOT turn crankshaft any further clockwise as valve spring might bottom and result in serious damage.

If reading is not within specified limits:
- Check sprocket index marks.
- Inspect timing chain for wear.
- Check accuracy of DC mark on timing indicator.

MEASURING TIMING CHAIN STRETCH

NOTE: To access timing chain Refer to Timing Chain Cover in Removal and Installation Section.

(1) Place a scale next to the timing chain so that any movement of the chain may be measured.

(2) Place a torque wrench and socket over camshaft sprocket attaching bolt. Apply torque in the direction of crankshaft rotation to take up slack; 41 N·m (30 ft. lbs.) torque with cylinder head installed or 20 N·m (15 ft. lbs.) torque with cylinder head removed. With a torque applied to the camshaft sprocket bolt, crankshaft should not be permitted to move. It may be necessary to block the crankshaft to prevent rotation.

(3) Hold a scale with dimensional reading even with the edge of a chain link. With cylinder heads installed, apply 14 N·m (30 ft. lbs.) torque in the reverse direction. With the cylinder heads removed, apply 20 N·m (15 ft. lbs.) torque in the reverse direction. Note the amount of chain movement (Fig. 5).

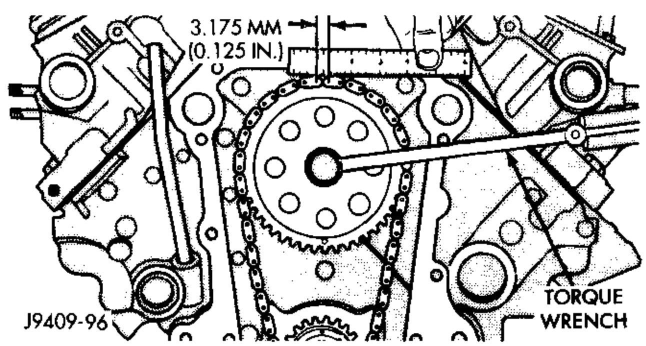

Fig. 5 Measuring Timing Chain Wear and Stretch

(4) Install a new timing chain, if its movement exceeds 3.175 mm (1/8 inch).

(5) If chain is not satisfactory, remove camshaft sprocket attaching bolt and remove timing chain with crankshaft and camshaft sprockets.

(6) Place both camshaft sprocket and crankshaft sprocket on the bench with timing marks on exact

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SERVICE PROCEDURES (Continued)

imaginary center line through both camshaft and crankshaft bores.

(7) Place timing chain around both sprockets.

(8) Turn crankshaft and camshaft to line up with keyway location in crankshaft sprocket and in camshaft sprocket.

(9) Lift sprockets and chain (keep sprockets tight against the chain in position as described).

(10) Slide both sprockets evenly over their respective shafts and use a straightedge to check alignment of timing marks (Fig. 6).

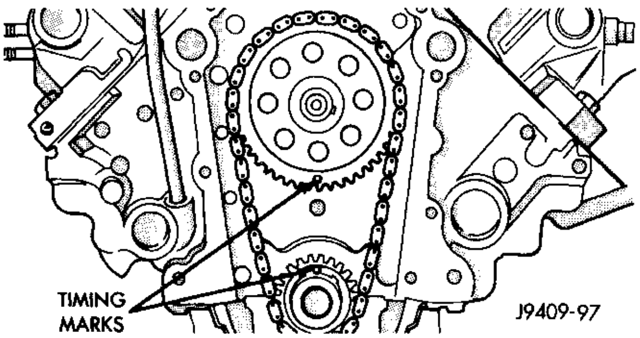


Fig. 6 Alignment of Timing Marks

(11) Install the camshaft bolt. Tighten the bolt to 47 N·m (35 ft. lbs.) torque.

(12) Check camshaft end play. The end play should be 0.051-0.152 mm (0.002-0.006 inch) with a new thrust plate and up to 0.254 mm (0.010 inch) with a used thrust plate. If not within these limits install a new thrust plate.

FITTING PISTONS

Piston and cylinder wall must be clean and dry. Specified clearance between the piston and the cylinder wall is 0.013-0.038 mm (0.0005-0.0015 inch) at 21°C (70°F).

Piston diameter should be measured at the top of skirt, 90° to piston pin axis. Cylinder bores should be measured halfway down the cylinder bore and transverse to the engine crankshaft center line.

Pistons and cylinder bores should be measured at normal room temperature, 21°C (70°F).

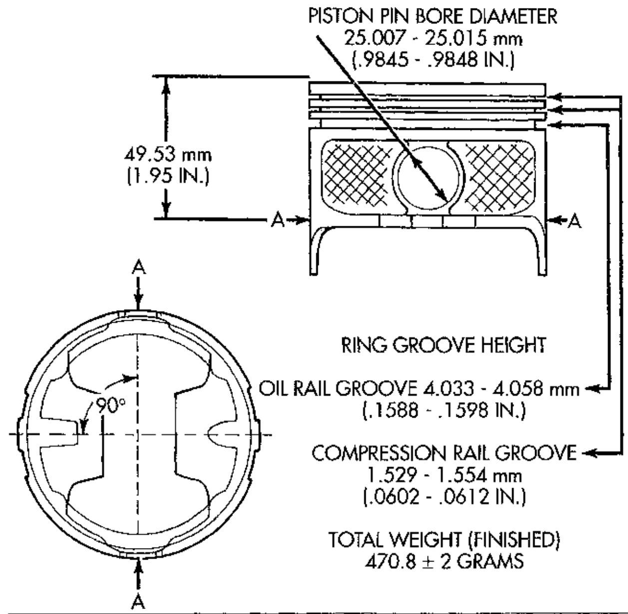
Check the pistons for taper and elliptical shape before they are fitted into the cylinder bore (Fig. 7).

FITTING PISTON RINGS

(1) Measurement of end gaps:

(a) Measure piston ring gap 2 inches from bottom of cylinder bore. An inverted piston can be used to push the rings down to ensure positioning rings squarely in the cylinder bore before measuring.

(b) Insert feeler gauge in the gap. The top compression ring gap should be between 0.254-0.508 mm (0.010-0.020 inch). The second compression ring gap should be between 0.508-0.762 mm (0.020-0.030 inch). The oil ring gap should be 0.254-1.270 mm (0.010-0.050 inch).



PISTON SIZE	A DIA = PISTON DIAMETER		BORE DIAMETER	
	MIN. mm (IN.)	MAX. mm (IN.)	MIN. mm (IN.)	MAX. mm (IN.)
A				
B	101.580 (3.9992)	101.592 (3.9997)	101.605 (4.0002)	101.618 (4.0007)
C	101.592 (3.9997)	101.605 (4.0002)	101.618 (4.0007)	101.630 (4.0012)
D	101.605 (4.0002)	101.618 (4.0007)	101.630 (4.0012)	101.643 (4.0017)
E				

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Fig. 7 Piston Measurements

(c) Rings with insufficient end gap may be properly filed to the correct dimension. Rings with excess gaps should not be used.

(2) Install rings and confirm ring side clearance:

(a) Install oil rings being careful not to nick or scratch the piston. Install the oil control rings according to instructions in the package. It is not necessary to use a tool to install the upper and lower rails. Insert oil rail spacer first, then side rails.

(b) Install the second compression rings using Installation Tool C-4184. The compression rings must be installed with the identification mark face up (toward top of piston) and chamfer facing down. An identification mark on the ring is a drill point, a stamped letter "O", an oval depression or the word TOP (Fig. 8) (Fig. 10).

(c) Using a ring installer, install the top compression ring with the chamfer facing up (Fig. 9) (Fig. 10). An identification mark on the ring is a drill point, a stamped letter "O", an oval depression or the word TOP facing up.

(d) Measure side clearance between piston ring and ring land. Clearance should be 0.074-0.097 mm

SERVICE PROCEDURES (Continued)

(0.0029-0.0038 inch) for the compression rings. The steel rail oil ring should be free in groove, but should not exceed 0.246 mm (0.0097 inch) side clearance.

(e) Pistons with insufficient or excessive side clearance should be replaced.

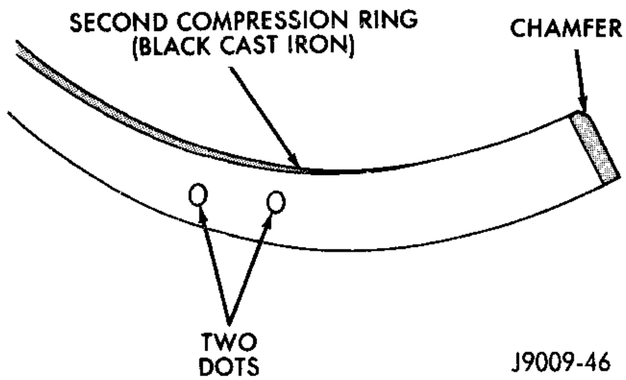

Fig. 8 Second Compression Ring Identification (Typical)

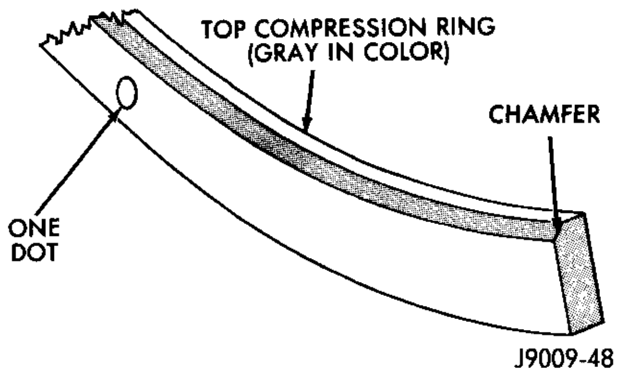

Fig. 9 Top Compression Ring Identification (Typical)

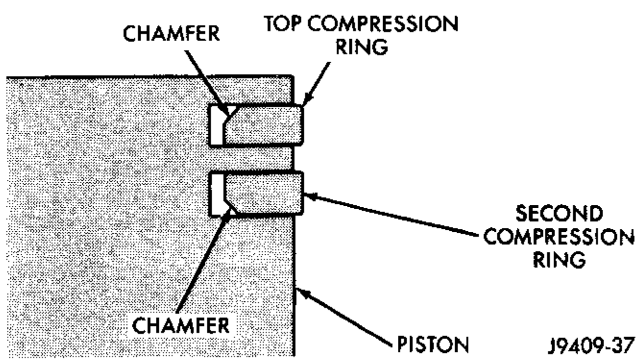

Fig. 10 Compression Ring Chamfer Location (Typical)

FITTING CONNECTING ROD BEARINGS

Fit all rods on a bank until completed. DO NOT alternate from one bank to another, because connecting rods and pistons are not interchangeable from one bank to another.

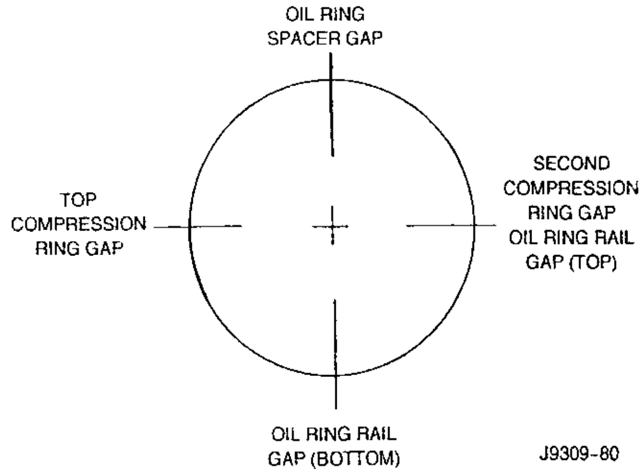

Fig. 11 Proper Ring Installation

The bearing caps are not interchangeable and should be marked at removal to ensure correct assembly.

Each bearing cap has a small V-groove across the parting face. When installing the lower bearing shell, make certain that the V-groove in the shell is in line with the V-groove in the cap. This provides lubrication of the cylinder wall in the opposite bank.

The bearing shells must be installed so that the tangs are in the machined grooves in the rods and caps.

Limits of taper or out-of-round on any crankshaft journals should be held to 0.025 mm (0.001 inch). Bearings are available in 0.025 mm (0.001 inch), 0.051 mm (0.002 inch), 0.076 mm (0.003 inch), 0.254 mm (0.010 inch) and 0.305 mm (0.012 inch) undersize. **Install the bearings in pairs. DO NOT use a new bearing half with an old bearing half. DO NOT file the rods or bearing caps.**

FITTING CRANKSHAFT MAIN BEARINGS

Bearing caps are not interchangeable and should be marked at removal to ensure correct assembly. Upper and lower bearing halves are NOT interchangeable. Lower main bearing halves of No.2 and 4 are interchangeable.

Upper and lower No.3 bearing halves are flanged to carry the crankshaft thrust loads. They are NOT interchangeable with any other bearing halves in the engine (Fig. 12). Bearing shells are available in standard and the following undersizes: 0.25 mm (0.001 inch), 0.051 mm (0.002 inch), 0.076 mm (0.003 inch), 0.254 mm (0.010 inch) and 0.305 mm (0.012 inch). Never install an undersize bearing that will reduce clearance below specifications.

SERVICE PROCEDURES (Continued)

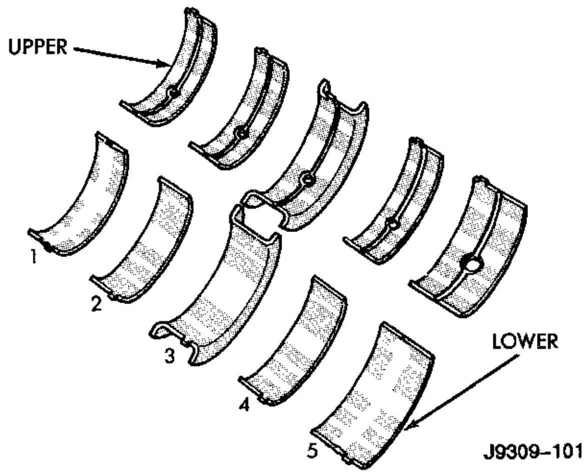

Fig. 12 Main Bearing Identification

CRANKSHAFT SERVICE

A crankshaft which has undersize journals will be stamped with 1/4 inch letters on the milled flat on the No.3 crankshaft counterweight (Fig. 13).

FOR EXAMPLE: R2 stamped on the No.3 crankshaft counterweight indicates that the No.2 rod journal is 0.025 mm (0.001 in) undersize. M4 indicates that the No.4 main journal is 0.025 mm (0.001 in) undersize. R3 M2 indicates that the No.3 rod journal and the No.2 main journal are 0.025 mm (0.001 in) undersize.

Undersize Journal	Identification Stamp
0.025 mm (0.001 inch) (Rod)	R1-R2-R3 or R4
0.025 mm (0.001 inch) (Main)	M1-M2-M3-M4 or M5

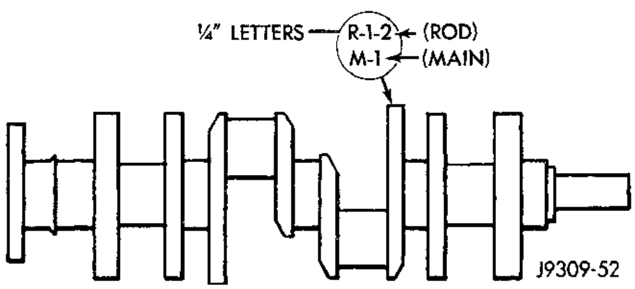

Fig. 13 Location of Crankshaft Identification

When a crankshaft is replaced, all main and connecting rod bearings should be replaced with new bearings. Therefore, selective fitting of the bearings is not required when a crankshaft and bearings are replaced.

INSPECTION OF JOURNALS

The crankshaft connecting rod and main journals should be checked for excessive wear, taper and scoring. The maximum taper or out-of-round on any crankshaft journal is 0.025 mm (0.001 inch).

Journal grinding should not exceed 0.305 mm (0.012 inch) under the standard journal diameter. DO NOT grind thrust faces of No.3 main bearing. DO NOT nick crank pin or bearing fillets. After grinding, remove rough edges from crankshaft oil holes and clean out all oil passages.

CAUTION: After any journal grind, it is important that the final paper or cloth polish be in the same direction as the engine rotates.

REMOVAL AND INSTALLATION

ENGINE MOUNTS—FRONT

REMOVAL

(1) Disconnect the negative cable from the battery.

(2) Position fan to assure clearance for radiator top tank and hose.

CAUTION: DO NOT lift the engine by the intake manifold.

(3) Install engine support/lifting fixture.

(4) Raise vehicle on hoist.

(5) Lift the engine SLIGHTLY and remove the thru-bolt and nut (Fig. 14).

(6) Remove engine support bracket/cushion bolts (Fig. 14). Remove the support bracket/cushion and heat shields.

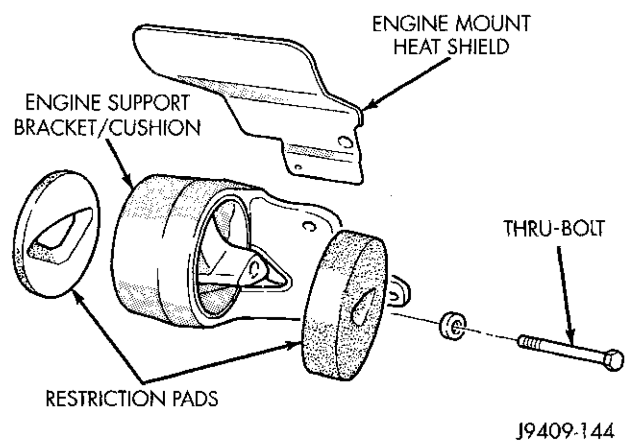

Fig. 14 Engine Front Mounts

INSTALLATION

(1) With engine raised SLIGHTLY, position the engine support bracket/cushion and heat shields to the block. Install new bolts and tighten to 81 N·m (60 ft. lbs.) torque.

REMOVAL AND INSTALLATION (Continued)

(2) Install the thru-bolt into the engine support bracket/cushion.

(3) Lower engine with support/lifting fixture while guiding the engine bracket/cushion and thru-bolt into support cushion brackets (Fig. 15).

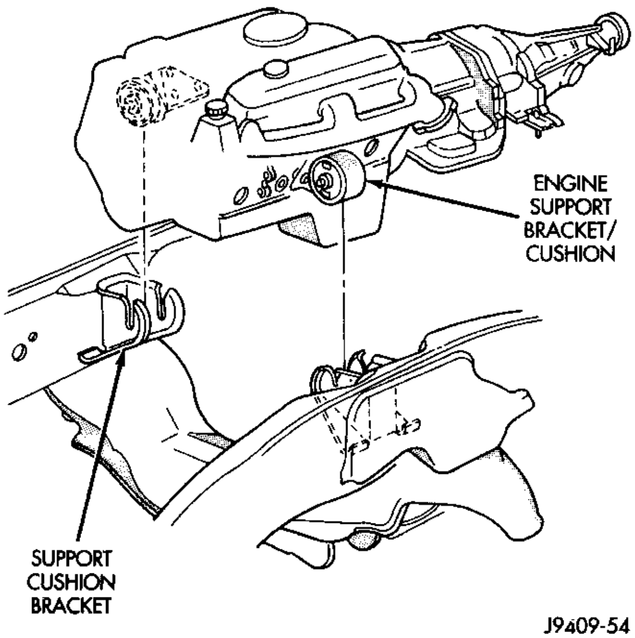

Fig. 15 Positioning Engine Front Mounts

(4) Install thru-bolt nuts and tighten the nuts to 102 N·m (75 ft. lbs.) torque.

(5) Lower the vehicle.

(6) Remove lifting fixture.

ENGINE MOUNT—REAR

REMOVAL

(1) Raise the vehicle on a hoist.

(2) Position a transmission jack in place.

(3) Remove support cushion stud nuts (Fig. 16).

(4) Raise rear of transmission and engine SLIGHTLY.

(5) Remove the bolts holding the support cushion to the transmission support bracket. Remove the support cushion.

(6) If necessary, remove the bolts holding the transmission support bracket to the transmission.

INSTALLATION

(1) If removed, position the transmission support bracket to the transmission. Install new attaching bolts and tighten to 102 N·m (75 ft. lbs.) torque.

(2) Position support cushion to transmission support bracket. Install stud nuts and tighten to 47 N·m (35 ft. lbs.) torque.

(3) Using the transmission jack, lower the transmission and support cushion onto the crossmember (Fig. 16).

(4) Install the support cushion bolts and tighten to 47 N·m (35 ft. lbs.) torque.

(5) Remove the transmission jack.

(6) Lower the vehicle.

ENGINE ASSEMBLY

REMOVAL

(1) Disconnect the battery negative cable.

(2) Drain cooling system. Refer to Group 7, Cooling System for the proper procedure.

(3) Recover refrigerant from a/c system, if equipped. Refer to Group 24, Heating and Air Conditioning for service procedures.

(4) Remove the a/c condenser, if equipped.

(5) Remove the transmission oil cooler. Refer to Group 7, Cooling for the correct procedure.

(6) Remove the washer bottle from the fan shroud.

(7) Remove the viscous fan/drive.

(8) Disconnect the radiator upper hose from the radiator.

(9) Remove the fan shroud.

(10) Disconnect the transmission cooler lines from the radiator.

(11) Disconnect the lower radiator hose at the radiator.

(12) Remove radiator (refer to Group 7, Cooling System).

(13) Remove the upper crossmember and top core support.

(14) Remove the accessory drive belt (refer to Group 7, Cooling System).

(15) Remove the A/C compressor with the lines attached. Secure compressor out of the way.

(16) Remove generator assembly. (refer to Group 8B, Battery/Starter/Generator Service).

(17) Remove the air cleaner resonator and duct work as an assembly.

(18) Disconnect the throttle linkage.

(19) Remove throttle body.

(20) Remove the intake manifold (refer to Group 11, Exhaust System and Intake Manifold).

(21) Remove the distributor cap and wiring.

(22) Disconnect the heater hoses.

(23) Disconnect the power steering hoses, if equipped.

(24) Perform the Fuel System Pressure Release procedure. Refer to Group 14, Fuel System.

(25) Disconnect the fuel supply line. Refer to Group 14, Fuel Systems for the correct procedure..

(26) On Manual Transmission vehicles, remove the shift lever (refer to Group 21, Transmissions).

(27) Raise and support the vehicle on a hoist and drain the engine oil.

REMOVAL AND INSTALLATION (Continued)

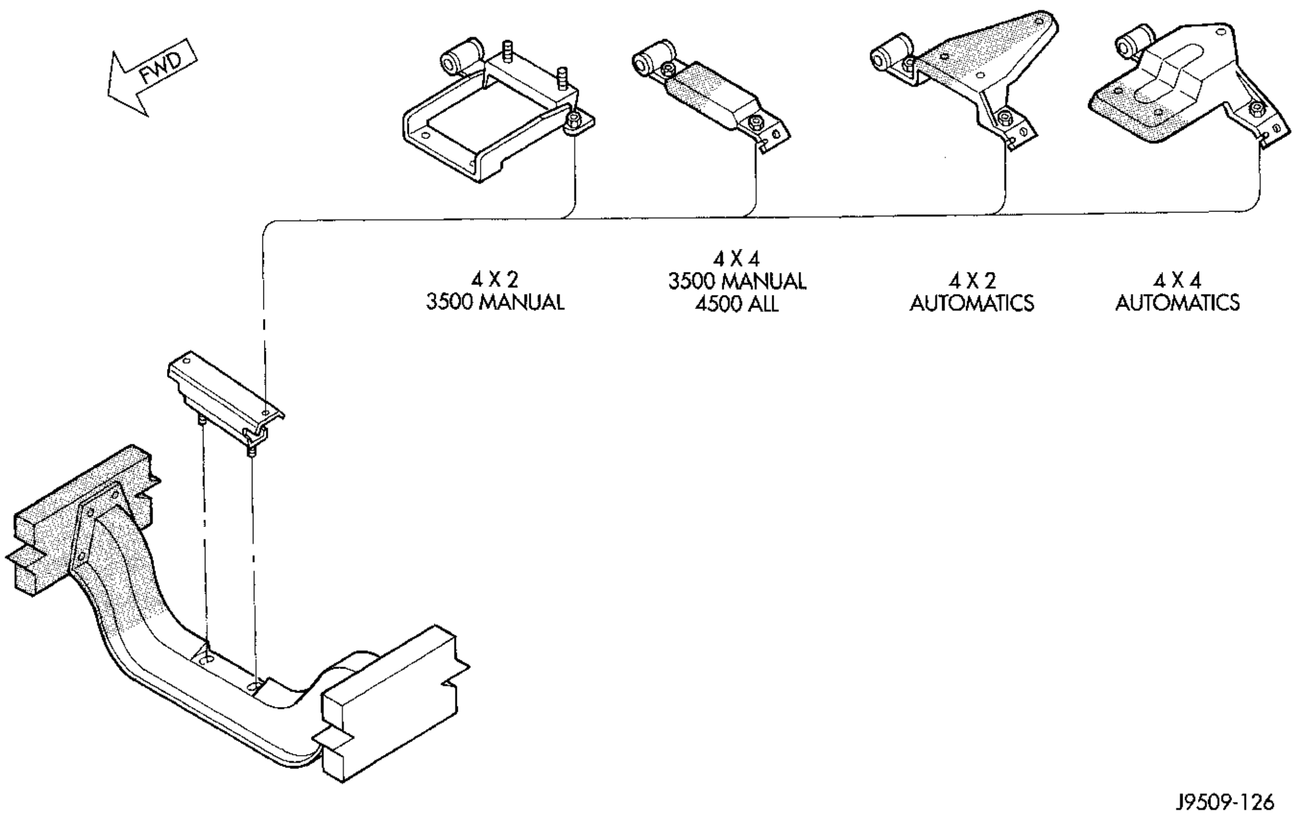

Fig. 16 Engine Rear Support Cushion Assemblies

(28) Remove engine front mount thru-bolt nuts.

(29) Disconnect the transmission oil cooler lines from their retainers at the oil pan bolts.

(30) Disconnect exhaust pipe at manifolds.

(31) Disconnect the starter wires. Remove starter motor (refer to Group 8B, Battery/Starter/Generator Service).

(32) Remove the dust shield and transmission inspection cover.

(33) Remove drive plate to converter bolts (Automatic transmission equipped vehicles).

(34) Remove transmission bell housing to engine block bolts.

(35) Lower the vehicle.

(36) Install an engine lifting fixture.

(37) Separate engine from transmission, remove engine from vehicle, and install engine assembly on a repair stand.

INSTALLATION

(1) Remove engine from the repair stand and position in the engine compartment. Position the thru-bolt into the support cushion brackets.

(2) Install engine lifting device.

(3) Lower engine into compartment and align engine with transmission:

- Manual Transmission: Align clutch disc assembly (if disturbed). Refer to Group 6, Clutch for the correct procedure. Install transmission input shaft into clutch disc while mating engine and transmission surfaces. Install two transmission to engine block mounting bolts finger tight.
- Automatic Transmission: Mate engine and transmission and install two transmission to engine block mounting bolts finger tight.

(4) Lower engine assembly until engine mount through bolts rest in mount perches.

(5) Install remaining transmission to engine block mounting bolts and tighten.

(6) Tighten engine mount through bolts.

(7) Install drive plate to torque converter bolts. (Automatic transmission models)

(8) Install the dust shield and transmission cover.

(9) Install the starter and connect the starter wires (refer to Group 8B, Battery/Starter/Generator Service).

(10) Install exhaust pipe to manifold.

(11) Install the transmission cooler line brackets to the oil pan.

(12) Install the drain plug and tighten to 34 N·m (25 ft. lbs.) torque.

(13) Lower the vehicle.

(14) Remove engine lifting fixture.

(15) On Manual Transmission vehicles, install the shift lever (refer to Group 21, Transmissions).

REMOVAL AND INSTALLATION (Continued)

(16) Connect the fuel supply line.
(17) Connect the power steering hoses, if equipped.
(18) Connect the heater hoses.
(19) Install the distributor cap and wiring.
(20) Install the intake manifold. Refer to Group 11, Exhaust System and Intake Manifold.
(21) Using a new gasket, install throttle body. Tighten the throttle body bolts to 23 N·m (200 in. lbs.) torque.
(22) Connect the throttle linkage.
(23) Install the air cleaner resonator and duct work..
(24) Install the generator and wire connections (refer to Group 8B, Battery/Starter/Generator Service).
(25) Install a/c compressor and lines.
(26) Install the accessory drive belt (refer to Group 7, Cooling System).
(27) Install upper radiator support crossmember.
(28) Install radiator (refer to Group 7, Cooling System).
(29) Connect the radiator lower hose.
(30) Connect the transmission oil cooler lines to the radiator.
(31) Install the fan shroud.
(32) Install the fan.
(33) Connect the radiator upper hose.
(34) Install the washer bottle.
(35) Install the transmission oil cooler.
(36) Connect the transmission cooler lines.
(37) If equipped, install the condenser.
(38) Evacuate and charge the air conditioning system, if equipped (refer to Group 24, Heating and Air Conditioning for service procedures).
(39) Add engine oil to crankcase. Refer to Group 0, Lubrication and Maintenance for the correct fill capacity.
(40) Add coolant to the cooling system (refer to Group 7, Cooling System for the proper procedure).
(41) Connect battery negative cable.
(42) Start engine and inspect for leaks.
(43) Road test vehicle.

CYLINDER HEAD COVER

A steel backed silicon gasket is used with the cylinder head cover (Fig. 17). This gasket can be used again.

REMOVAL

(1) Disconnect the negative cable from the battery.
(2) Disconnect closed ventilation system and evaporation control system from cylinder head cover.
(3) Remove cylinder head cover and gasket. The gasket may be used again.

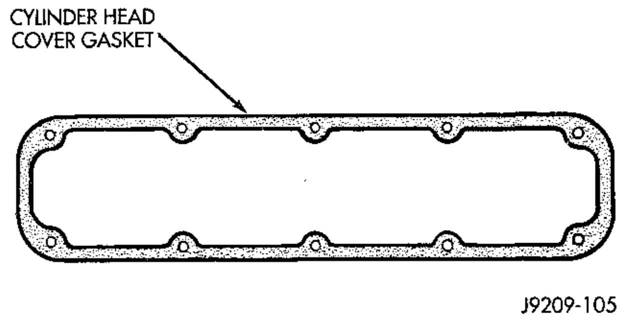

Fig. 17 Cylinder Head Cover Gasket

INSTALLATION

(1) Clean cylinder head cover gasket surface.
(2) Clean head rail, if necessary.
(3) Inspect cover for distortion and straighten, if necessary.
(4) Check the gasket for use in head cover installation. If damaged, use a new gasket.
(5) Position the cylinder head cover onto the gasket. Tighten the bolts to 11 N·m (95 in. lbs.) torque.
(6) Install closed crankcase ventilation system and evaporation control system.
(7) Connect the negative cable to the battery.

ROCKER ARMS AND PUSH RODS

REMOVAL

(1) Disconnect spark plug wires by pulling on the boot straight out in line with plug.
(2) Remove cylinder head cover and gasket.
(3) Remove the rocker arm bolts and pivots (Fig. 18). Place them on a bench in the same order as removed.
(4) Remove the push rods and place them on a bench in the same order as removed.

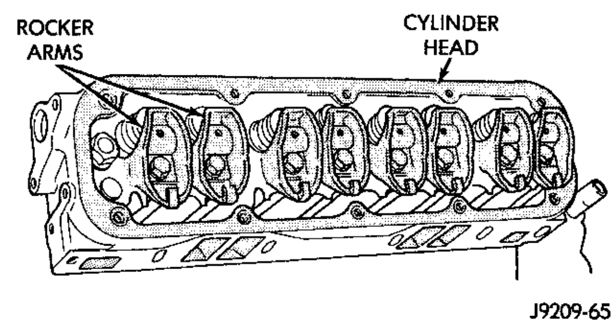

Fig. 18 Rocker Arms

INSTALLATION

(1) Rotate the crankshaft until the "V8" mark lines up with the TDC mark on the timing chain case cover. This mark is located 147° ATDC from the No.1 firing position.
(2) Install the push rods in the same order as removed.

REMOVAL AND INSTALLATION (Continued)

(3) Install rocker arm and pivot assemblies in the same order as removed. Tighten the rocker arm bolts to 28 N·m (21 ft. lbs.) torque.

CAUTION: DO NOT rotate or crank the engine during or immediately after rocker arm installation. Allow the hydraulic roller tappets adequate time to bleed down (about 5 minutes).

(4) Install cylinder head cover.
(5) Connect spark plug wires.

VALVE SPRING AND STEM SEAL REPLACEMENT-IN VEHICLE

(1) Remove the air cleaner.
(2) Remove cylinder head covers and spark plugs.
(3) Remove coil wire from distributor and secure to good ground to prevent engine from starting.
(4) Using suitable socket and flex handle at crankshaft retaining bolt, turn engine so the No.1 piston is at TDC on the compression stroke.
(5) Remove rocker arms.
(6) With air hose attached to an adapter installed in No.1 spark plug hole, apply 620-689 kPa (90-100 psi) air pressure.
(7) Using Valve Spring Compressor Tool MD-998772A with adaptor 6716A, compress valve spring and remove retainer valve locks and valve spring.
(8) Install seals on the exhaust valve stem and position down against valve guides.
(9) The intake valve stem seals should be pushed firmly and squarely over the valve guide using the valve stem as a guide. DO NOT force seal against top of guide. When installing the valve retainer locks, compress the spring only enough to install the locks.
(10) Follow the same procedure on the remaining 7 cylinders using the firing sequence 1-8-4-3-6-5-7-2. Make sure piston in cylinder is at TDC on the valve spring that is being removed.
(11) Remove adapter from the No.1 spark plug hole.
(12) Install rocker arms.
(13) Install covers and coil wire to distributor.
(14) Install air cleaner.
(15) Road test vehicle.

CYLINDER HEADS

REMOVAL

(1) Disconnect the battery negative cable.
(2) Drain cooling system (refer to Group 7, Cooling System for the proper procedures).
(3) Remove the air cleaner resonator and duct work.
(4) Remove the intake manifold-to-generator bracket support rod. Remove the generator.
(5) Remove closed crankcase ventilation system.
(6) Disconnect the evaporation control system.
(7) Perform the Fuel System Pressure Release procedure (refer to Group 14, Fuel System). Disconnect the fuel supply line.
(8) Disconnect accelerator linkage and if so equipped, the speed control and transmission kick-down cables.
(9) Remove distributor cap and wires.
(10) Disconnect the coil wires.
(11) Disconnect heat indicator sending unit wire.
(12) Disconnect heater hoses and bypass hose.
(13) Remove cylinder head covers and gaskets.
(14) Remove intake manifold and throttle body as an assembly. Discard the flange side gaskets and the front and rear cross-over gaskets.
(15) Remove exhaust manifolds.
(16) Remove rocker arm assemblies and push rods. Identify to ensure installation in original locations.
(17) Remove the head bolts from each cylinder head and remove cylinder heads. Discard the cylinder head gasket.
(18) Remove spark plugs.

INSTALLATION

(1) Clean all surfaces of cylinder block and cylinder heads.
(2) Clean cylinder block front and rear gasket surfaces using a suitable solvent.
(3) Position the new cylinder head gaskets onto the cylinder block.
(4) Position the cylinder heads onto head gaskets and cylinder block.
(5) Starting at top center, tighten all cylinder head bolts, in sequence, to 68 N·m (50 ft. lbs.) torque (Fig. 19). Repeat procedure, tighten all cylinder head bolts to 143 N·m (105 ft. lbs.) torque. Repeat procedure to confirm that all bolts are at 143 N·m (105 ft. lbs.) torque.

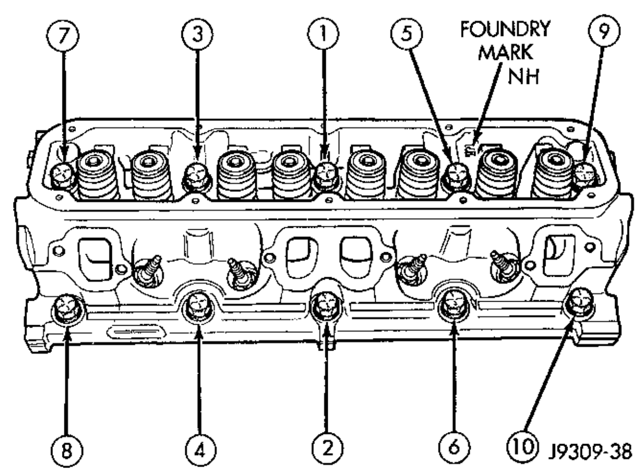

Fig. 19 Cylinder Head Bolt Tightening Sequence

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REMOVAL AND INSTALLATION (Continued)

CAUTION: When tightening the rocker arm bolts, make sure the piston in that cylinder is NOT at TDC. Contact between the valves and piston could occur.

(6) Install push rods and rocker arm assemblies in their original position. Tighten the bolts to 28 N·m (21 ft. lbs.) torque.

(7) Install the intake manifold and throttle body assembly (refer to Group 11, Exhaust System and Intake Manifold).

(8) Install exhaust manifolds. Tighten the bolts and nuts to 34 N·m (25 ft. lbs.) torque.

(9) Adjust spark plugs to specifications (refer to Group 8D, Ignition System). Install the plugs and tighten to 41 N·m (30 ft. lbs.) torque.

(10) Install coil wire.

(11) Connect heat indicator sending unit wire.

(12) Connect the heater hoses and bypass hose.

(13) Install distributor cap and wires.

(14) Connect the accelerator linkage and if so equipped, the speed control and transmission kick-down cables.

(15) Install the fuel supply line.

(16) Install the generator and drive belt. Tighten generator mounting bolt to 41 N·m (30 ft. lbs.) torque. Tighten the adjusting strap bolt to 23 N·m (200 in. lbs.) torque. Refer to Group 7, Cooling System for adjusting the belt tension.

(17) Install the intake manifold-to-generator bracket support rod. Tighten the bolts.

(18) Place the cylinder head cover gaskets in position and install cylinder head covers. Tighten the bolts to 11 N·m (95 in. lbs.) torque.

(19) Install closed crankcase ventilation system.

(20) Connect the evaporation control system.

(21) Install the air cleaner.

(22) Fill cooling system (refer to Group 7, Cooling System for proper procedure).

(23) Connect the negative cable to the battery.

VALVES AND VALVE SPRINGS

REMOVAL

(1) Remove the cylinder head. Refer to procedure in this section.

(2) Compress valve springs using Valve Spring Compressor Tool MD- 998772A and adapter 6716A.

(3) Remove valve retaining locks, valve spring retainers, valve stem seals and valve springs.

(4) Before removing valves, remove any burrs from valve stem lock grooves to prevent damage to the valve guides. Identify valves to ensure installation in original location.

INSTALLATION

(1) Clean valves thoroughly. Discard burned, warped and cracked valves.

(2) Remove carbon and varnish deposits from inside of valve guides with a reliable guide cleaner.

(3) Measure valve stems for wear. If wear exceeds 0.051 mm (0.002 inch), replace the valve.

(4) Coat valve stems with lubrication oil and insert them in cylinder head.

(5) If valves or seats are reground, check valve stem height. If valve is too long, replace cylinder head.

(6) Install new seals on all valve guides. Install valve springs and valve retainers.

(7) Compress valve springs with Valve Spring Compressor Tool MD-998772A and adapter 6716A, install locks and release tool. If valves and/or seats are ground, measure the installed height of springs. Make sure the measurement is taken from bottom of spring seat in cylinder head to the bottom surface of spring retainer. If spacers are installed, measure from the top of spacer. If height is greater than 42.86 mm (1-11/16 inches), install a 1.587 mm (1/16 inch) spacer in head counterbore. This should bring spring height back to normal 41.27 to 42.86 mm (1-5/8 to 1-11/16 inch).

HYDRAULIC TAPPETS

REMOVAL

(1) Remove the air cleaner.

(2) Remove cylinder head cover.

(3) Remove rocker assembly and push rods. Identify push rods to ensure installation in original location.

(4) Remove intake manifold.

(5) Remove yoke retainer and aligning yokes.

(6) Slide Hydraulic Tappet Remover/Installer tool through opening in cylinder head and seat tool firmly in the head of tappet.

(7) Pull tappet out of bore with a twisting motion. If all tappets are to be removed, identify tappets to ensure installation in original location.

(8) If the tappet or bore in cylinder block is scored, scuffed, or shows signs of sticking, ream the bore to next oversize. Replace with oversize tappet.

INSTALLATION

(1) Lubricate tappets.

(2) Install tappets and push rods in their original positions. Ensure that the oil feed hole in the side of the tappet body faces up (away from the crankshaft).

(3) Install aligning yokes with ARROW toward camshaft.

(4) Install yoke retainer. Tighten the bolts to 23 N·m (200 in. lbs.) torque. Install intake manifold.

(5) Install push rods in original positions.

REMOVAL AND INSTALLATION (Continued)

(6) Install rocker arm.

(7) Install cylinder head cover.

(8) Install distributor, start engine and reset timing.

CAUTION: To prevent damage to valve mechanism, engine must not be run above fast idle until all hydraulic tappets have filled with oil and have become quiet.

VIBRATION DAMPER

REMOVAL

(1) Disconnect the battery negative cable.

(2) Remove the cooling system fan.

(3) Remove the cooling fan shroud.

(4) Remove the accessory drive belt (refer to Group 7, Cooling System).

(5) Remove the vibration damper pulley.

(6) Remove vibration damper bolt and washer from end of crankshaft.

(7) Install bar and screw from Puller Tool Set C-3688. Install 2 bolts with washers through the puller tool and into the vibration damper (Fig. 20).

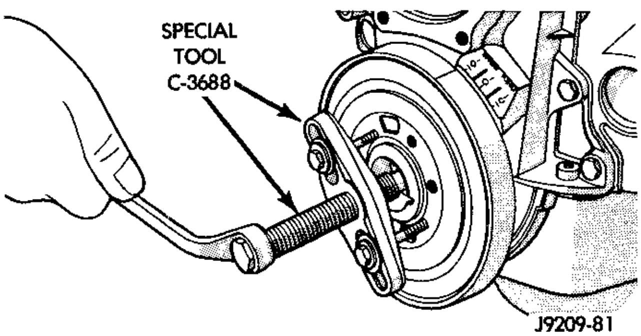

Fig. 20 Vibration Damper Assembly

(8) Pull vibration damper off of the crankshaft.

INSTALLATION

(1) Position the vibration damper onto the crankshaft.

(2) Place installing tool, part of Puller Tool Set C-3688 in position and press the vibration damper onto the crankshaft (Fig. 21).

(3) Install the crankshaft bolt and washer. Tighten the bolt to 183 N·m (135 ft. lbs.) torque.

(4) Install the crankshaft pulley. Tighten the pulley bolts to 23 N·m (200 in. lbs.) torque.

(5) Install the accessory drive belt (refer to Group 7, Cooling System).

(6) Position the fan shroud and install the bolts. Tighten the retainer bolts to 11 N·m (95 in. lbs.) torque.

(7) Install the cooling fan.

(8) Connect the battery negative cable.

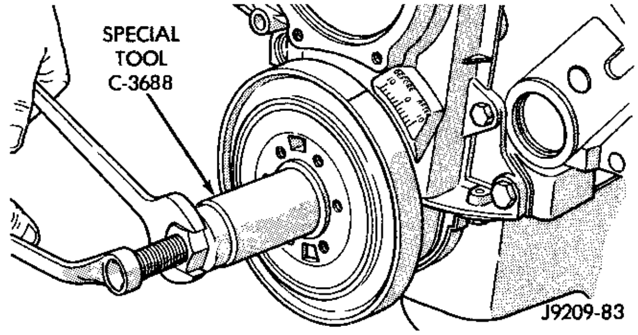

Fig. 21 Installing Vibration Damper

TIMING CHAIN COVER

REMOVAL

(1) Disconnect the negative cable from the battery.

(2) Drain cooling system (refer to Group 7, Cooling System).

(3) Remove the serpentine belt (refer to Group 7, Cooling System).

(4) Remove water pump (refer to Group 7, Cooling System).

(5) Remove power steering pump (refer to Group 19, Steering).

(6) Remove vibration damper.

(7) Loosen oil pan bolts and remove the front bolt at each side.

(8) Remove the cover bolts.

(9) Remove chain case cover and gasket using extreme caution to avoid damaging oil pan gasket.

(10) Place a suitable tool behind the lips of the oil seal to pry the oil seal outward. Be careful not to damage the crankshaft seal surface of cover (Fig. 22).

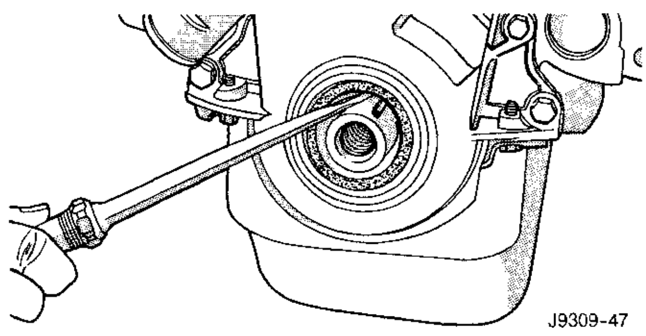

Fig. 22 Removal of Front Crankshaft Oil Seal

INSTALLATION

(1) Be sure mating surfaces of chain case cover and cylinder block are clean and free from burrs.

(2) The water pump mounting surface must be cleaned.

(3) Using a new cover gasket, carefully install chain case cover to avoid damaging oil pan gasket. Use a small amount of Mopar® Silicone Rubber Adhesive Sealant, or equivalent, at the joint between tim-

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REMOVAL AND INSTALLATION (Continued)

ing chain cover gasket and the oil pan gasket. Finger tighten the timing chain cover bolts at this time.

(4) Place the smaller diameter of the oil seal over Front Oil Seal Installation Tool 6635 (Fig. 23). Seat the oil seal in the groove of the tool.

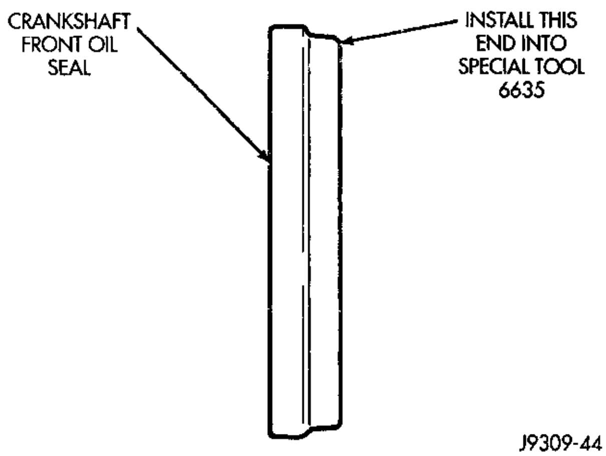

Fig. 23 Placing Oil Seal on Installation Tool 6635

(5) Position the seal and tool onto the crankshaft (Fig. 24).

(6) Tighten the 4 lower chain case cover bolts to 13N·m (10 ft.lbs.) to prevent the cover from tipping during seal installation.

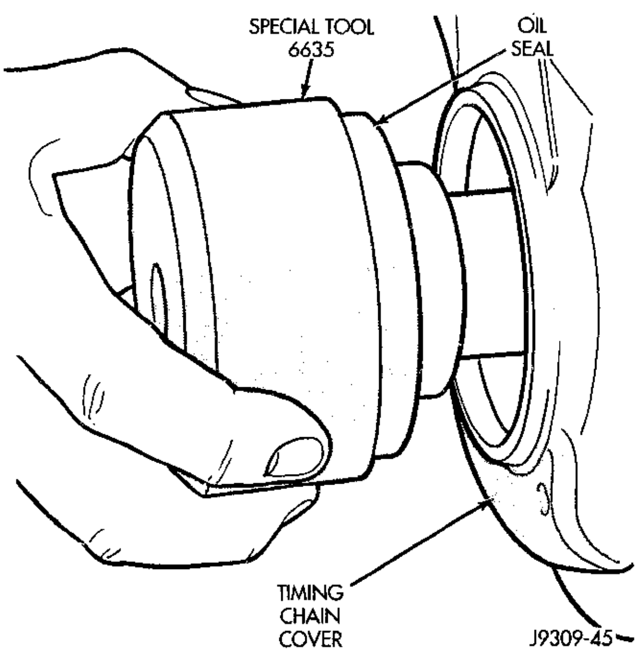

Fig. 24 Position Tool and Seal onto Crankshaft

(7) Using the vibration damper bolt, tighten the bolt to draw the seal into position on the crankshaft (Fig. 25).

(8) Loosen the 4 bolts tightened in step 4 to allow realignment of front cover assembly.

(9) Tighten chain case cover bolts to 41 N·m (30 ft.lbs.) torque. Tighten oil pan bolts to 24 N·m (215 in. lbs.) torque.

(10) Remove the vibration damper bolt and seal installation tool.

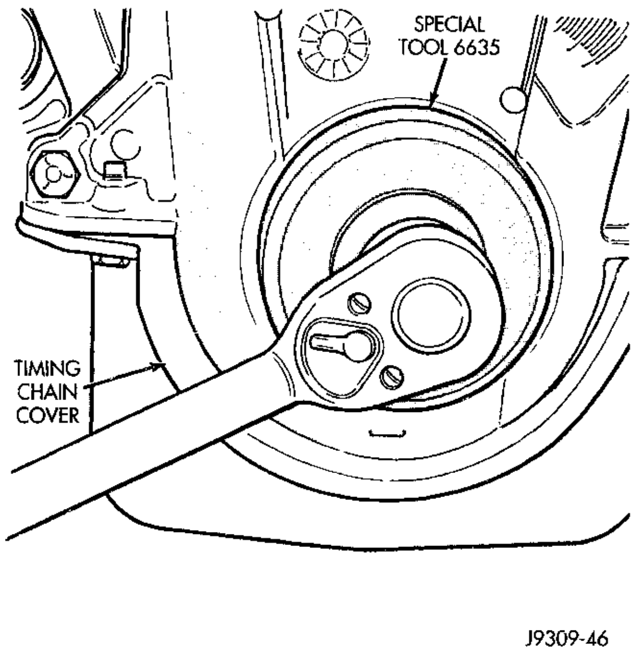

Fig. 25 Installing Oil Seal

(11) Inspect the seal flange on the vibration damper.

(12) Install vibration damper.

(13) Install water pump and housing assembly using new gaskets (refer to Group 7, Cooling System). Tighten bolts to 41 N·m (30 ft. lbs.) torque.

(14) Install power steering pump (refer to Group 19, Steering).

(15) Install the serpentine belt (refer to Group 7, Cooling System).

(16) Install the cooling system fan. Tighten the bolts to 23 N·m (17 ft. lbs.) torque.

(17) Position the fan shroud and install the bolts. Tighten the bolts to 11 N·m (95 in. lbs.) torque.

(18) Fill cooling system (refer to Group 7, Cooling System for the proper procedure).

(19) Connect the negative cable to the battery.

TIMING CHAIN

REMOVAL

(1) Remove Timing Chain Cover Refer to procedure in this section.

(2) Remove camshaft sprocket attaching bolt and remove timing chain with crankshaft and camshaft sprockets.

REMOVAL AND INSTALLATION (Continued)

INSTALLATION

(1) Place both camshaft sprocket and crankshaft sprocket on the bench with timing marks on exact imaginary center line through both camshaft and crankshaft bores.

(2) Place timing chain around both sprockets.

(3) Turn crankshaft and camshaft to line up with keyway location in crankshaft sprocket and in camshaft sprocket.

(4) Lift sprockets and chain (keep sprockets tight against the chain in position as described).

(5) Slide both sprockets evenly over their respective shafts and use a straightedge to check alignment of timing marks (Fig. 26).

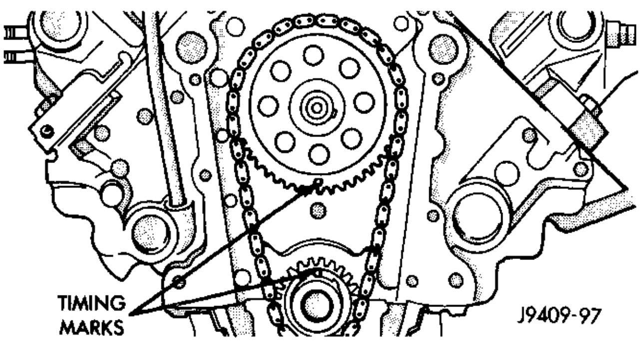

Fig. 26 Alignment of Timing Marks

(6) Install the camshaft bolt. Tighten the bolt to 68 N·m (50 ft. lbs.) torque.

(7) Check camshaft end play. The end play should be 0.051-0.152 mm (0.002-0.006 inch) with a new thrust plate and up to 0.254 mm (0.010 inch) with a used thrust plate. If not within these limits install a new thrust plate.

CAMSHAFT

NOTE: The camshaft has an integral oil pump and distributor drive gear (Fig. 27).

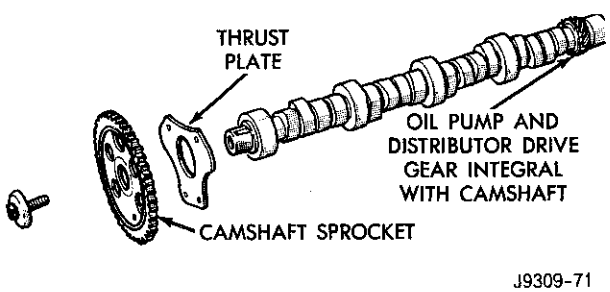

Fig. 27 Camshaft and Sprocket Assembly

REMOVAL

(1) Remove intake manifold.

(2) Remove cylinder head covers.

(3) Remove timing case cover and timing chain.

(4) Remove rocker arms.

(5) Remove push rods and tappets. Identify each part so it can be installed in its original location.

(6) Remove distributor and lift out the oil pump and distributor drive shaft.

(7) Remove camshaft thrust plate, note location of oil tab (Fig. 28).

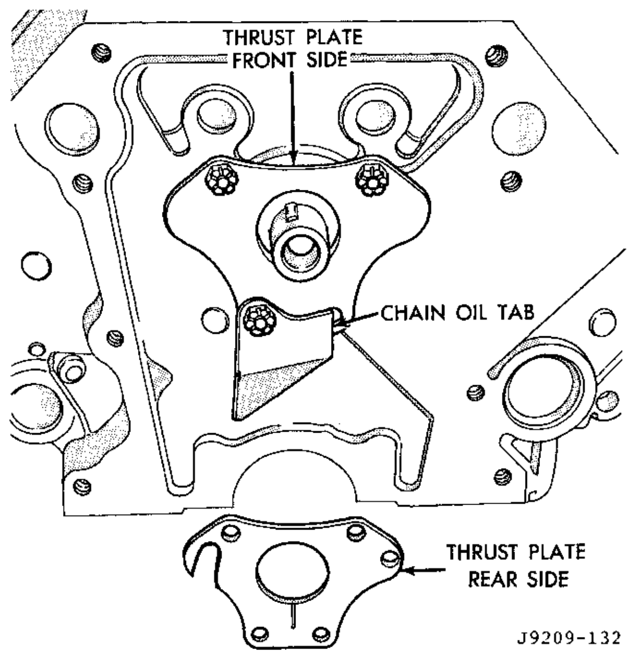

Fig. 28 Timing Chain Oil Tab Installation

(8) Install a long bolt into front of camshaft to facilitate removal of the camshaft. Remove camshaft, being careful not to damage cam bearings with the cam lobes.

INSTALLATION

(1) Lubricate camshaft lobes and camshaft bearing journals and insert the camshaft to within 51 mm (2 inches) of its final position in cylinder block.

NOTE: Whenever an engine has been rebuilt, a new camshaft and/or new tappets installed, add 1 pint of Mopar Crankcase Conditioner, or equivalent. The oil mixture should be left in engine for a minimum of 805 km (500 miles). Drain at the next normal oil change.

(2) Install Camshaft Gear Installer Tool C-3509 with tongue back of distributor drive gear (Fig. 29).

(3) Hold tool in position with a distributor lockplate bolt. This tool will restrict camshaft from being pushed in too far and prevent knocking out the welch plug in rear of cylinder block. **Tool should remain installed until the camshaft and crankshaft sprockets and timing chain have been installed.**

(4) Install camshaft thrust plate and chain oil tab. **Make sure tang enters lower right hole in**

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REMOVAL AND INSTALLATION (Continued)

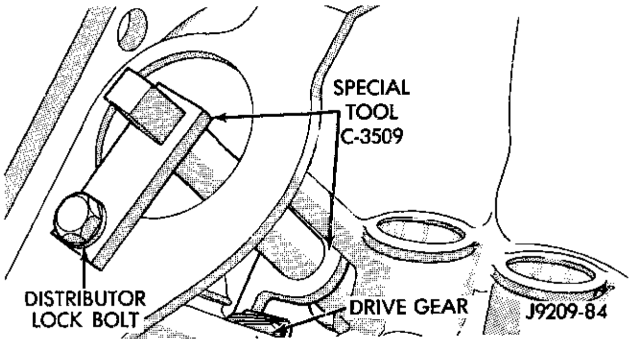

Fig. 29 Camshaft Holding Tool C-3509 (Installed Position)

thrust plate. Tighten bolts to 24 N·m (210 in. lbs.) torque. Top edge of tab should be flat against thrust plate in order to catch oil for chain lubrication.

(5) Place both camshaft sprocket and crankshaft sprocket on the bench with timing marks on exact imaginary center line through both camshaft and crankshaft bores.

(6) Place timing chain around both sprockets.

(7) Turn crankshaft and camshaft to line up with keyway location in crankshaft sprocket and in camshaft sprocket.

(8) Lift sprockets and chain (keep sprockets tight against the chain in position as described).

(9) Slide both sprockets evenly over their respective shafts and use a straightedge to check alignment of timing marks (Fig. 30).

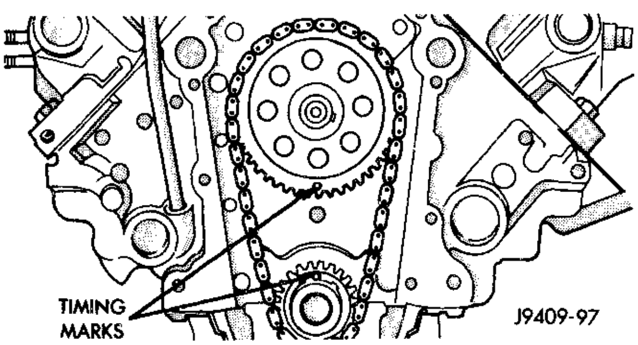

Fig. 30 Alignment of Timing Marks

(10) Install the camshaft bolt/cup washer. Tighten bolt to 68 N·m (50 ft. lbs.) torque.

(11) Measure camshaft end play. Refer to Specifications for proper clearance. If not within limits install a new thrust plate.

(12) Each tappet reused must be installed in the same position from which it was removed. **When camshaft is replaced, all of the tappets must be replaced.**

CAMSHAFT BEARINGS

REMOVAL

NOTE: This procedure requires that the engine is removed from the vehicle.

(1) With engine completely disassembled, drive out rear cam bearing core hole plug.

(2) Install proper size adapters and horseshoe washers (part of Camshaft Bearing Remover/Installer Tool C-3132-A) at back of each bearing shell. Drive out bearing shells (Fig. 31).

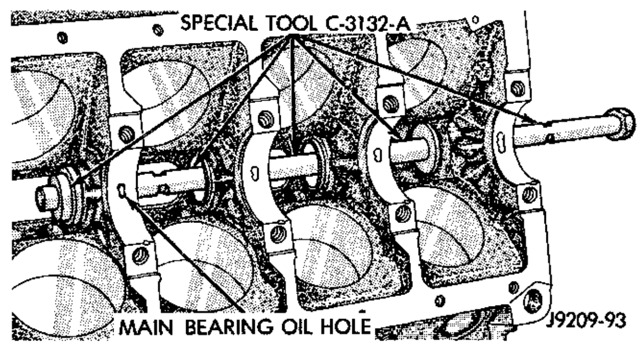

Fig. 31 Camshaft Bearings Removal/Installation with Tool C-3132-A

INSTALLATION

(1) Install new camshaft bearings with Camshaft Bearing Remover/Installer Tool C-3132-A by sliding the new camshaft bearing shell over proper adapter.

(2) Position rear bearing in the tool. Install horseshoe lock and by reversing removal procedure, carefully drive bearing shell into place.

(3) Install remaining bearings in the same manner. Bearings must be carefully aligned to bring oil holes into full register with oil passages from the main bearing. If the camshaft bearing shell oil holes are not in exact alignment, remove and install them correctly. Install a new core hole plug at the rear of camshaft. **Be sure this plug does not leak.**

CAMSHAFT BEARINGS

REMOVAL

NOTE: This procedure requires that the engine is removed from the vehicle.

(1) With engine completely disassembled, drive out rear cam bearing core hole plug.

(2) Install proper size adapters and horseshoe washers (part of Camshaft Bearing Remover/Installer Tool C-3132-A) at back of each bearing shell. Drive out bearing shells (Fig. 32).

REMOVAL AND INSTALLATION (Continued)

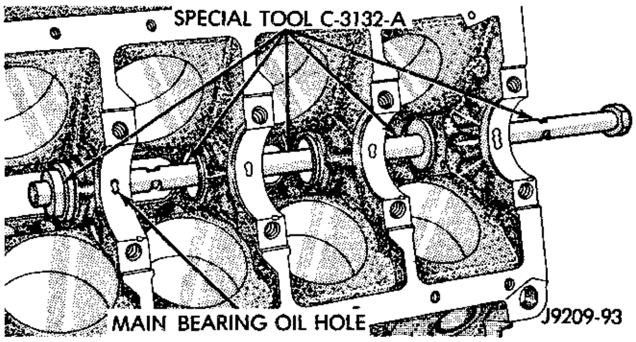

Fig. 32 Camshaft Bearings Removal/Installation with Tool C-3132-A

INSTALLATION

(1) Install new camshaft bearings with Camshaft Bearing Remover/Installer Tool C-3132-A by sliding the new camshaft bearing shell over proper adapter.

(2) Position rear bearing in the tool. Install horseshoe lock and by reversing removal procedure, carefully drive bearing shell into place.

(3) Install remaining bearings in the same manner. Bearings must be carefully aligned to bring oil holes into full register with oil passages from the main bearing. If the camshaft bearing shell oil holes are not in exact alignment, remove and install them correctly. Install a new core hole plug at the rear of camshaft. **Be sure this plug does not leak.**

OIL PAN

REMOVAL

(1) Disconnect the negative cable from the battery.
(2) Remove engine oil dipstick.
(3) Raise vehicle.
(4) Drain engine oil.
(5) Remove exhaust pipe.
(6) Remove left engine to transmission strut.
(7) Loosen the right side engine support bracket cushion thru-bolt nut and raise the engine slightly. Remove oil pan by sliding backward and out.
(8) Remove the one-piece gasket.

INSTALLATION

(1) Clean the block and pan gasket surfaces.

(2) Trim or remove excess sealant film in the rear main cap oil pan gasket groove. **DO NOT remove the sealant inside the rear main cap slots.**

(3) If present, trim excess sealant from inside the engine.

(4) Fabricate 4 alignment dowels from 5/16 x 1 1/2 inch bolts. Cut the head off the bolts and cut a slot into the top of the dowel. This will allow easier installation and removal with a screwdriver (Fig. 33).

(5) Install the dowels in the cylinder block (Fig. 34).

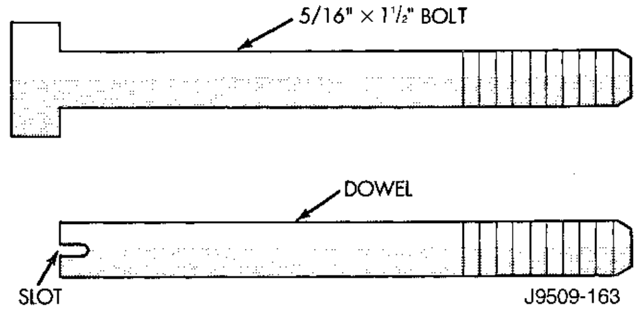

Fig. 33 Fabrication of Alignment Dowels

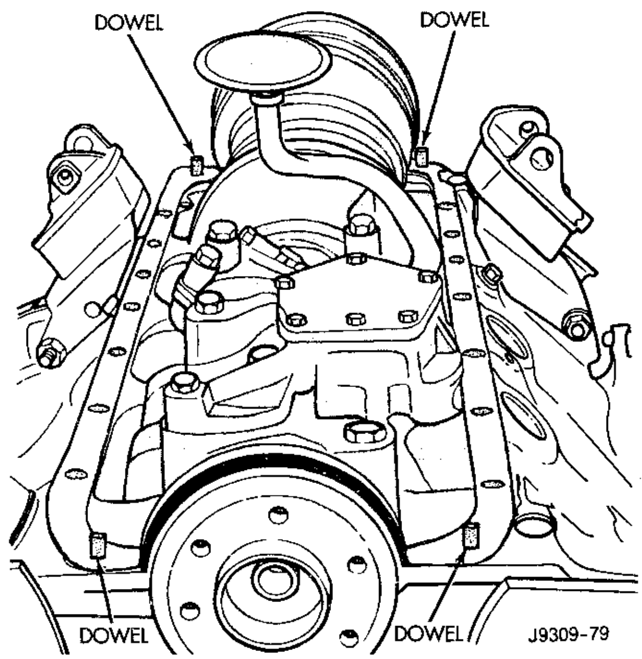

Fig. 34 Position of Dowels in Cylinder Block

(6) Apply small amount of Mopar® Silicone Rubber Adhesive Sealant, or equivalent in the corner of the cap and the cylinder block.

(7) Slide the one-piece gasket over the dowels and onto the block.

(8) Position the oil pan over the dowels and onto the gasket.

(9) Install the oil pan bolts. Tighten the bolts to 24 N·m (215 in. lbs.) torque.

(10) Remove the dowels. Install the remaining oil pan bolts. Tighten these bolts to 24 N·m (215 in. lbs.) torque.

(11) Lower the engine into the support cushion brackets and tighten the thru bolt nut to the proper torque.

(12) Install the drain plug. Tighten drain plug to 34 N·m (25 ft. lbs.) torque.

(13) Install the engine to transmission strut.
(14) Install exhaust pipe.
(15) Lower vehicle.
(16) Install dipstick.

REMOVAL AND INSTALLATION (Continued)

(17) Connect the negative cable to the battery.
(18) Fill crankcase with oil to proper level.

CRANKSHAFT MAIN BEARINGS

REMOVAL

(1) Remove the oil pan.
(2) Remove the oil pump from the rear main bearing cap.
(3) Identify bearing caps before removal. Remove bearing caps one at a time.
(4) Remove upper half of bearing by inserting Crankshaft Main Bearing Remover/Installer Tool C-3059 into the oil hole of crankshaft (Fig. 35).
(5) Slowly rotate crankshaft clockwise, forcing out upper half of bearing shell.

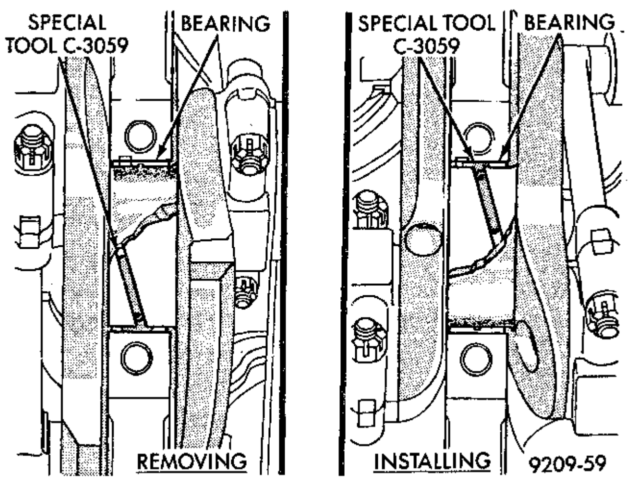

Fig. 35 Upper Main Bearing Removal and Installation with Tool C-3059

INSTALLATION

Only one main bearing should be selectively fitted while all other main bearing caps are properly tightened. All bearing capbolts removed during service procedures are to be cleaned and oiled before installation.

When installing a new upper bearing shell, slightly chamfer the sharp edges from the plain side.

(1) Start bearing in place, and insert Crankshaft Main Bearing Remover/Installer Tool C-3059 into oil hole of crankshaft (Fig. 35).
(2) Slowly rotate crankshaft counterclockwise sliding the bearing into position. Remove Tool C-3059.
(3) Install the bearing cap. Clean and oil the bolts. Tighten the capbolts to 115 N·m (85 ft. lbs.) torque.
(4) Install the oil pump.
(5) Install the oil pan.

PISTON AND CONNECTING ROD ASSEMBLY

REMOVAL

(1) Remove the engine from the vehicle.
(2) Remove the cylinder head.
(3) Remove the oil pan.
(4) Remove top ridge of cylinder bores with a reliable ridge reamer before removing pistons from cylinder block. Be sure to keep tops of pistons covered during this operation.
(5) Be sure the connecting rod and connecting rod cap are identified with the cylinder number. Remove connecting rod cap. Install connecting rod bolt guide set on connecting rod bolts.
(6) Pistons and connecting rods must be removed from top of cylinder block. When removing piston and connecting rod assemblies, rotate crankshaft to center the connecting rod in the cylinder bore and at BDC. **Be careful not to nick crankshaft journals.**
(7) After removal, install bearing cap on the mating rod.

INSTALLATION

(1) Be sure that compression ring gaps are staggered so that neither is in-line with oil ring rail gap.
(2) Before installing the ring compressor, make sure the oil ring expander ends are butted and the rail gaps located properly (Fig. 36).

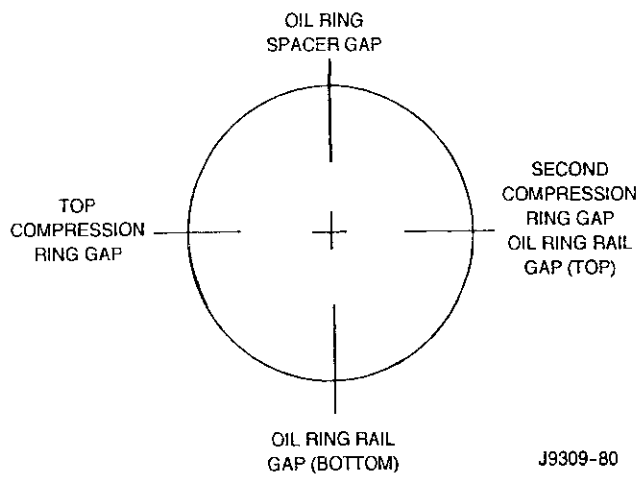

Fig. 36 Proper Ring Installation

(3) Immerse the piston head and rings in clean engine oil. Slide Piston Ring Compressor Tool C-385 over the piston and tighten with the special wrench (part of Tool C-385). **Be sure position of rings does not change during this operation.**
(4) Install connecting rod bolt protectors on rod bolts, the long protector should be installed on the numbered side of the connecting rod.
(5) Rotate crankshaft so that the connecting rod journal is on the center of the cylinder bore. Be sure connecting rod and cylinder bore number are the

REMOVAL AND INSTALLATION (Continued)

same. Insert rod and piston into cylinder bore and guide rod over the crankshaft journal.

(6) Tap the piston down in cylinder bore, using a hammer handle. At the same time, guide connecting rod into position on crankshaft journal.

(7) The notch or groove on top of piston must be pointing toward front of engine. The larger chamfer of the connecting rod bore must be installed toward crankshaft journal fillet.

(8) Install rod caps. Be sure connecting rod, connecting rod cap and cylinder bore number are the same. Install nuts on cleaned and oiled rod bolts and tighten nuts to 61 N·m (45 ft. lbs.) torque.

(9) Install the oil pan.

(10) Install the cylinder head.

(11) Install the engine into the vehicle.

CRANKSHAFT

A crankshaft which has undersize journals will be stamped with 1/4 inch letters on the milled flat on the No.3 crankshaft counterweight (Fig. 37).

FOR EXAMPLE: R2 stamped on the No.3 crankshaft counterweight indicates that the No.2 rod journal is 0.025 mm (0.001 in) undersize. M4 indicates that the No.4 main journal is 0.025 mm (0.001 in) undersize. R3 M2 indicates that the No.3 rod journal and the No.2 main journal are 0.025 mm (0.001 in) undersize.

Undersize Journal	Identification Stamp
0.025 mm (0.001 inch) (Rod)	R1-R2-R3 or R4
0.025 mm (0.001 inch) (Main)	M1-M2-M3-M4 or M5

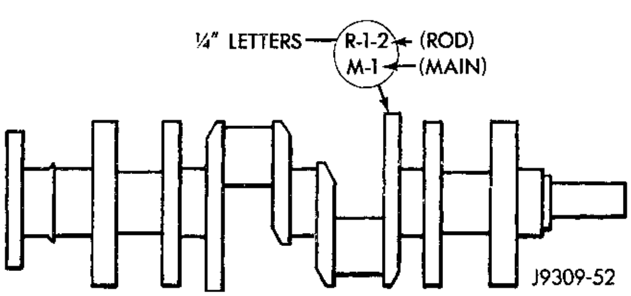

Fig. 37 Location of Crankshaft Identification

When a crankshaft is replaced, all main and connecting rod bearings should be replaced with new bearings. Therefore, selective fitting of the bearings is not required when a crankshaft and bearings are replaced.

REMOVAL

(1) Remove the oil pan.

(2) Remove the oil pump from the rear main bearing cap.

(3) Remove the vibration damper.

(4) Remove the timing chain cover.

(5) Identify bearing caps before removal. Remove bearing caps and bearings one at a time.

(6) Lift the crankshaft out of the block.

(7) Remove and discard the crankshaft rear oil seals.

(8) Remove and discard the front crankshaft oil seal.

INSPECTION OF JOURNALS

The crankshaft connecting rod and main journals should be checked for excessive wear, taper and scoring. The maximum taper or out-of-round on any crankshaft journal is 0.025 mm (0.001 inch).

Journal grinding should not exceed 0.305 mm (0.012 inch) under the standard journal diameter. DO NOT grind thrust faces of No.3 main bearing. DO NOT nick crank pin or bearing fillets. After grinding, remove rough edges from crankshaft oil holes and clean out all oil passages.

CAUTION: After any journal grind, it is important that the final paper or cloth polish be in the same direction as the engine rotates.

CLEANING

Clean Loctite 518 residue and sealant from the cylinder block and rear cap mating surface. Do this before applying the Loctite drop and the installation of rear cap.

INSTALLATION

(1) Lightly oil the new upper seal lips with engine oil.

(2) Install the new upper rear bearing oil seal with the white paint facing towards the rear of the engine.

(3) Position the crankshaft into the cylinder block.

(4) Lightly oil the new lower seal lips with engine oil.

(5) Install the new lower rear bearing oil seal into the bearing cap with the white paint facing towards the rear of the engine.

(6) Apply 5 mm (0.20 in) drop of Loctite 518, or equivalent, on each side of the rear main bearing cap (Fig. 38). DO NOT over apply sealant or allow the sealant to contact the rubber seal. Assemble bearing cap to cylinder block immediately after sealant application.

(7) To align the bearing cap, use cap slot, alignment dowel and cap bolts. DO NOT remove excess material after assembly. DO NOT strike rear cap more than 2 times for proper engagement.

(8) Clean and oil all cap bolts. Install all main bearing caps. Install all cap bolts and alternately tighten to 115 N·m (85 ft. lbs.) torque.

(9) Install oil pump.

AUTHENTIC RESTORATION PRODUCT

REMOVAL AND INSTALLATION (Continued)

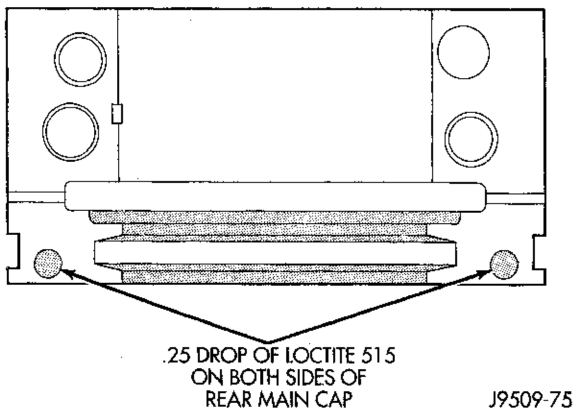

Fig. 38 Sealant Application to Bearing Cap

Apply Mopar® Silicone Rubber Adhesive Sealant, or equivalent, at bearing cap to block joint to provide cap to block and oil pan sealing (Fig. 39). Apply enough sealant until a small amount is squeezed out. Withdraw nozzle and wipe excess sealant off the oil pan seal groove.

(10) Install new front crankshaft oil seal.

(11) Immediately install the oil pan.

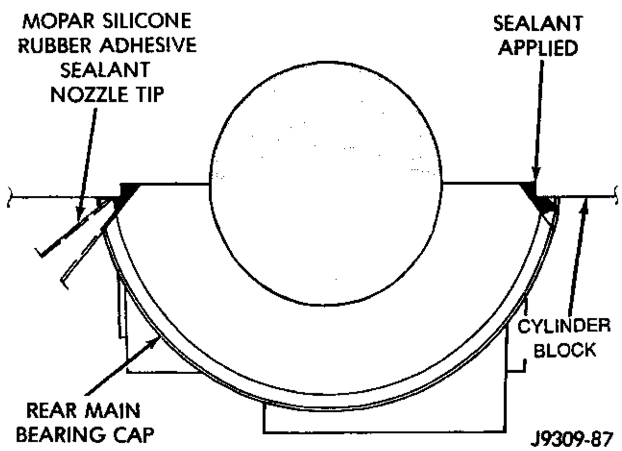

Fig. 39 Apply Sealant to Bearing Cap to Block Joint

OIL PUMP

REMOVAL

(1) Remove the oil pan.

(2) Remove the oil pump from rear main bearing cap.

INSTALLATION

(1) Install oil pump. During installation slowly rotate pump body to ensure driveshaft-to-pump rotor shaft engagement.

(2) Hold the oil pump base flush against mating surface on No.5 main bearing cap. Finger tighten pump attaching bolts. Tighten attaching bolts to 41 N·m (30 ft. lbs.) torque.

(3) Install the oil pan.

FRONT CRANKSHAFT OIL SEAL

The oil seal can be replaced without removing the timing chain cover provided the cover is not misaligned.

(1) Disconnect the negative cable from the battery.

(2) Remove vibration damper.

(3) If front seal is suspected of leaking, check front oil seal alignment to crankshaft. The seal installation/alignment tool 6635, should fit with minimum interference. If tool does not fit, the cover must be removed and installed properly.

(4) Place a suitable tool behind the lips of the oil seal to pry the oil seal outward. Be careful not to damage the crankshaft seal bore of cover.

(5) Place the smaller diameter of the oil seal over Front Oil Seal Installation Tool 6635 (Fig. 40). Seat the oil seal in the groove of the tool.

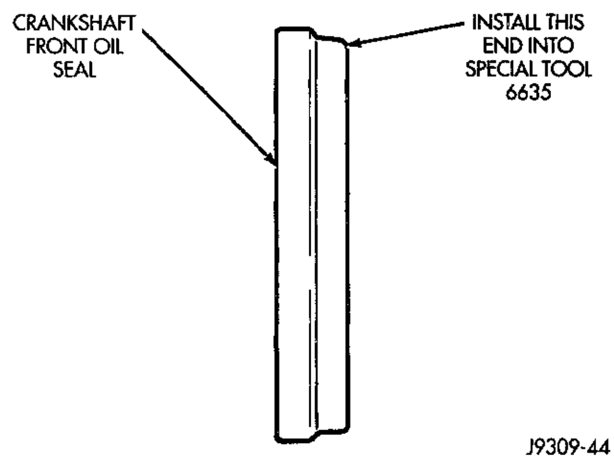

Fig. 40 Placing Oil Seal on Installation Tool 6635

(6) Position the seal and tool onto the crankshaft (Fig. 41).

(7) Using the vibration damper bolt, tighten the bolt to draw the seal into position on the crankshaft (Fig. 42).

(8) Remove the vibration damper bolt and seal installation tool.

(9) Inspect the seal flange on the vibration damper.

(10) Install the vibration damper.

(11) Connect the negative cable to the battery.

CRANKSHAFT REAR OIL SEALS

The service seal is a 2 piece, viton seal. The upper seal half can be installed with crankshaft removed from engine or with crankshaft installed. When a new upper seal is installed, install a new lower seal.

REMOVAL AND INSTALLATION (Continued)

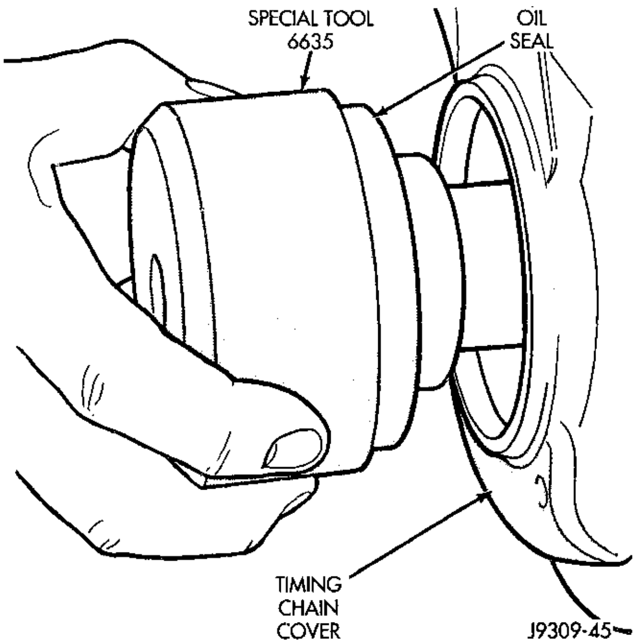

Fig. 41 Position Tool and Seal onto Crankshaft

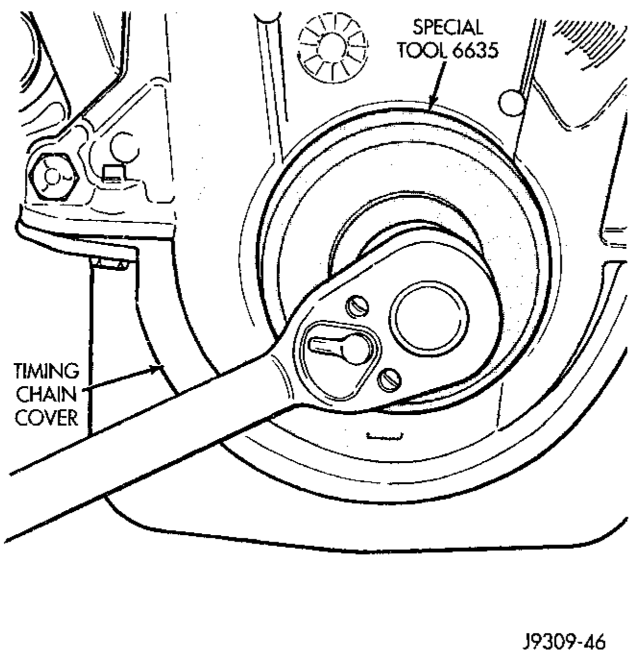

Fig. 42 Installing Oil Seal

The lower seal half can only be installed with the rear main bearing cap removed.

UPPER SEAL REPLACEMENT—CRANKSHAFT REMOVED

(1) Remove the crankshaft. Discard the old upper seal.

(2) Clean the cylinder block rear cap mating surface. Make sure the seal groove is free of debris.

(3) Lightly oil the new upper seal lips with engine oil.

(4) Install the new upper rear bearing oil seal with the white paint facing towards the rear of the engine.

(5) Position the crankshaft into the cylinder block.

(6) Lightly oil the new lower seal lips with engine oil.

(7) Install the new lower rear bearing oil seal into the bearing cap with the white paint facing towards the rear of the engine.

(8) Apply 5 mm (0.20 in) drop of Loctite 518, or equivalent, on each side of the rear main bearing cap (Fig. 43). DO NOT over apply sealant or allow the sealant to contact the rubber seal. Assemble bearing cap to cylinder block immediately after sealant application.

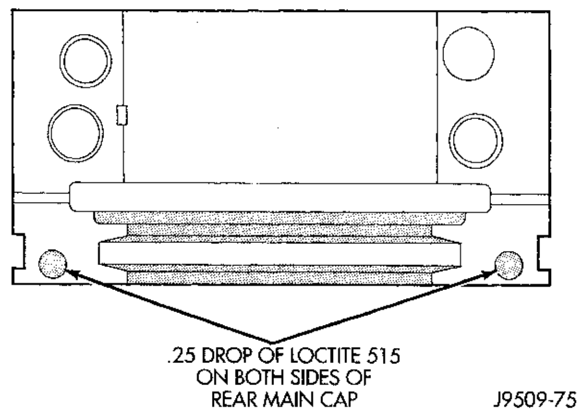

Fig. 43 Sealant Application to Bearing Cap

(9) To align the bearing cap, use cap slot, alignment dowel and cap bolts. DO NOT remove excess material after assembly. DO NOT strike rear cap more than 2 times for proper engagement.

(10) Clean and oil all cap bolts. Install all main bearing caps. Install all cap bolts and alternately tighten to 115 N·m (85 ft. lbs.) torque.

(11) Install oil pump.

(12) Apply Mopar® Silicone Rubber Adhesive Sealant, or equivalent, at bearing cap to block joint to provide cap to block and oil pan sealing (Fig. 44). Apply enough sealant until a small amount is squeezed out. Withdraw nozzle and wipe excess sealant off the oil pan seal groove.

(13) Install new front crankshaft oil seal.

(14) Immediately install the oil pan.

UPPER SEAL REPLACEMENT—CRANKSHAFT INSTALLED

(1) Remove the oil pan.

(2) Remove the oil pump from the rear main bearing cap.

REMOVAL AND INSTALLATION (Continued)

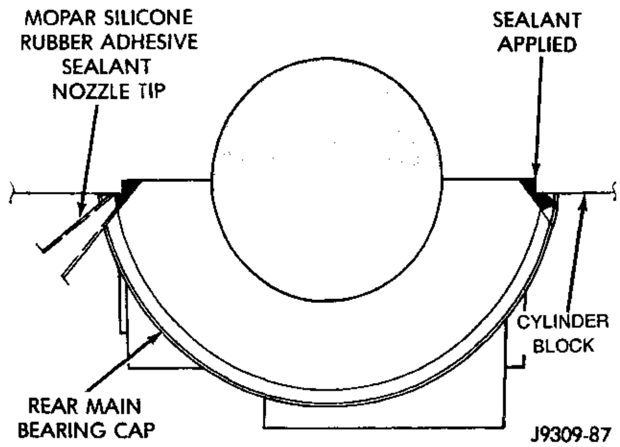

Fig. 44 Apply Sealant to Bearing Cap to Block Joint

(3) Remove the rear main bearing cap. Remove and discard the old lower oil seal.

(4) Carefully remove and discard the old upper oil seal.

(5) Clean the cylinder block mating surfaces before oil seal installation.

(6) Lightly oil the new upper seal lips with engine oil. To allow ease of installation of the seal, loosen at least the 2 main bearing caps forward of the rear bearing cap.

(7) Rotate the new upper seal into the cylinder block being careful not to shave or cut the outer surface of the seal. To assure proper installation, use the installation tool provided with the kit. Install the new seal with the white paint facing towards the rear of the engine.

(8) Install the new lower rear bearing oil seal into the bearing cap with the white paint facing towards the rear of the engine.

(9) Apply 5 mm (0.20 in) drop of Loctite 518, or equivalent, on each side of the rear main bearing cap (Fig. 43). DO NOT over apply sealant or allow the sealant to contact the rubber seal. Assemble bearing cap to cylinder block immediately after sealant application. Be sure the white paint faces toward the rear of the engine.

(10) To align the bearing cap, use cap slot, alignment dowel and cap bolts. DO NOT remove excess material after assembly. DO NOT strike rear cap more than 2 times for proper engagement.

(11) Install the rear main bearing cap with cleaned and oiled cap bolts. Alternately tighten ALL cap bolts to 115 N·m (85 ft. lbs.) torque.

(12) Install oil pump.

(13) Apply Mopar® Silicone Rubber Adhesive Sealant, or equivalent, at bearing cap to block joint to provide cap to block and oil pan sealing (Fig. 44) (Fig. 8). Apply enough sealant until a small amount is squeezed out. Withdraw nozzle and wipe excess sealant off the oil pan seal groove.

(14) Immediately install the oil pan.

LOWER SEAL REPLACEMENT

(1) Remove the oil pan.

(2) Remove the oil pump from the rear main bearing cap.

(3) Remove the rear main bearing cap and discard the old lower seal.

(4) Clean the rear main cap mating surfaces including the oil pan seal grooves.

(5) Carefully install a new upper seal (refer to Upper Seal Replacement - Crankshaft Installed procedure above).

(6) Lightly oil the new lower seal lips with engine oil.

(7) Install a new lower seal in bearing cap with white paint facing the rear of engine.

(8) Apply 5 mm (0.20 in) drop of Loctite 518, or equivalent, on each side of the rear main bearing cap (Fig. 43). DO NOT over apply sealant or allow the sealant to contact the rubber seal. Assemble bearing cap to cylinder block immediately after sealant application.

(9) To align the bearing cap, use cap slot, alignment dowel and cap bolts. DO NOT remove excess material after assembly. DO NOT strike rear cap more than 2 times for proper engagement.

(10) Install the rear main bearing cap with cleaned and oiled cap bolts. Alternately tighten the cap bolts to 115 N·m (85 ft. lbs.) torque.

(11) Install oil pump.

(12) Apply Mopar® Silicone Rubber Adhesive Sealant, or equivalent, at bearing cap to block joint to provide cap to block and oil pan sealing (Fig. 44). Apply enough sealant until a small amount is squeezed out. Withdraw nozzle and wipe excess sealant off the oil pan seal groove.

(13) Immediately install the oil pan.

ENGINE CORE PLUGS

Engine core plugs have been pressed into the oil galleries behind the camshaft thrust plate (Fig. 45). This will reduce internal leakage and help maintain higher oil pressure at idle.

REMOVAL

(1) Using a blunt tool such as a drift or a screwdriver and a hammer, strike the bottom edge of the cup plug (Fig. 46).

(2) With the cup plug rotated, grasp firmly with pliers or other suitable tool and remove plug (Fig. 46).

CLEANING

Thoroughly clean inside of cup plug hole in cylinder block or head. Be sure to remove old sealer.

REMOVAL AND INSTALLATION (Continued)

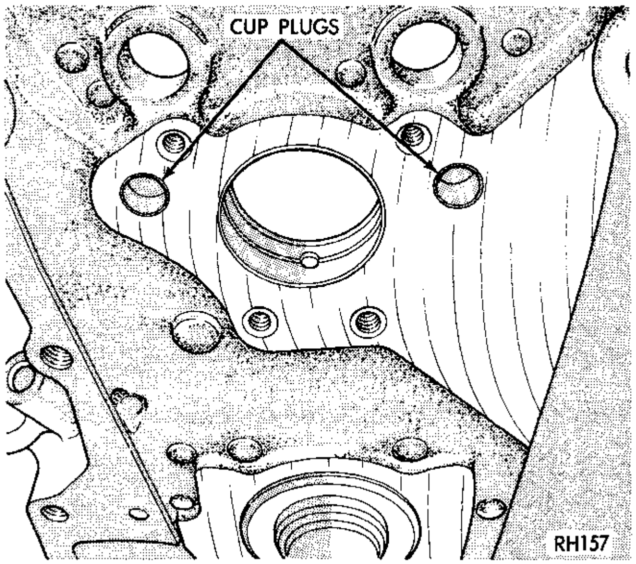

Fig. 45 Location of Cup Plugs in Oil Galleries

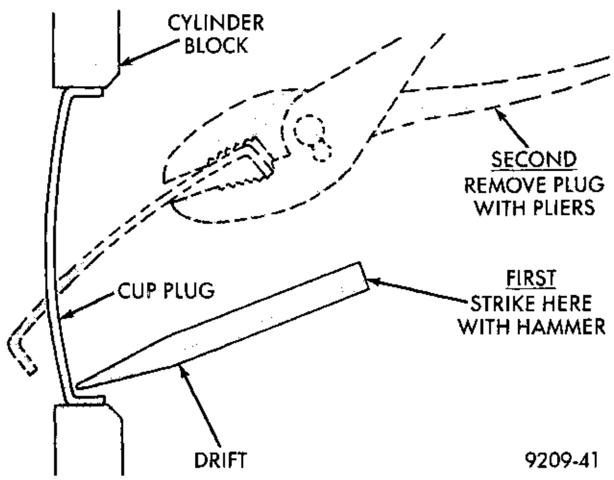

Fig. 46 Core Hole Plug Removal

Make certain the new plug is cleaned of all oil or grease.

INSTALLATION

(1) Coat edges of plug and core hole with Mopar Gasket Maker, or equivalent.

CAUTION: DO NOT drive cup plug into the casting as restricted coolant flow can result and cause serious engine problems.

(2) Using proper plug drive, drive cup plug into hole. The sharp edge of the plug should be at least 0.50 mm (0.020 inch) inside the lead-in chamfer.

(3) It is not necessary to wait for curing of the sealant. The cooling system can be filled and the vehicle placed in service immediately.

DISASSEMBLY AND ASSEMBLY

HYDRAULIC TAPPETS

CAUTION: The plunger and tappet bodies are not interchangeable. The plunger and valve must always be fitted to the original body. It is advisable to work on one tappet at a time to avoid mixing of parts. Mixed parts are not compatible. DO NOT disassemble a tappet on a dirty work bench.

DISASSEMBLE

(1) Pry out plunger retainer spring clip (Fig. 47).

(2) Clean varnish deposits from inside of tappet body above plunger cap.

(3) Invert tappet body and remove plunger cap, plunger, check valve, check valve spring, check valve retainer and plunger spring (Fig. 47). Check valve could be flat or ball.

ASSEMBLE

(1) Clean all tappet parts in a solvent that will remove all varnish and carbon.

(2) Replace tappets that are unfit for further service with new assemblies.

(3) If plunger shows signs of scoring or wear, install a new tappet assembly. If valve is pitted, or valve seat on end of plunger is prevented from seating, install a new tappet assembly.

(4) Assemble tappets (Fig. 47).

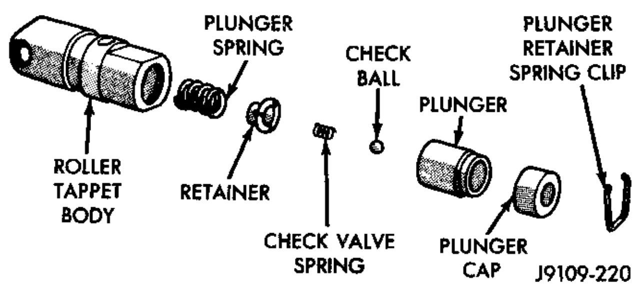

Fig. 47 Hydraulic Tappet Assembly

CYLINDER BLOCK

DISASSEMBLE

(1) Remove the cylinder head.

(2) Remove the oil pan.

(3) Remove the piston/connecting rod assembly.

OIL LINE PLUG

The oil line plug is located in the vertical passage at the rear of the block between the Oil-To-Filter and Oil-From-Filter passages (Fig. 48). Improper installation or plug missing could cause erratic, low or no oil pressure.

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DISASSEMBLY AND ASSEMBLY (Continued)

(1) Remove oil pressure sending unit from back of block.
(2) Insert a 3.175 mm (1/8 inch) finish wire or equivalent into passage.
(3) Plug should be 190.0 to 195.2 mm (7-1/2 to 7-11/16 inches) from machined surface of block (Fig. 48). If plug is too high, use a suitable flat dowel drift to position properly.

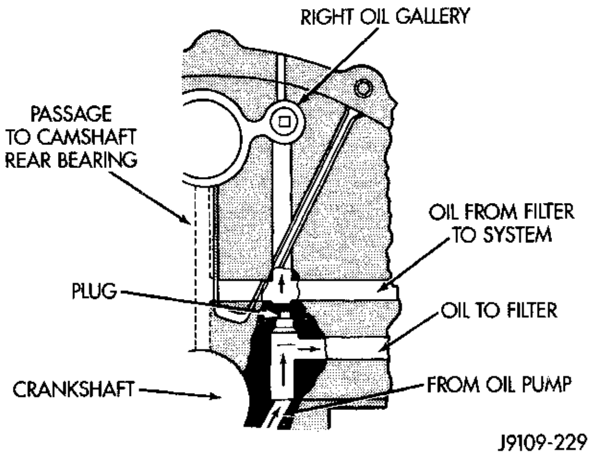

Fig. 48 Oil Line Plug

(4) If plug is too low, remove oil pan and rear main bearing cap. Use suitable flat dowel to properly postion. Coat outside diameter of plug with Mopar® (stud and bearing mount adhesive), or equivalent. Plug should be 54.0 to 57.7 mm (2-1/8 to 2-5/16 inches) from bottom of the block.
(5) Assemble engine and check oil pressure.

ASSEMBLE

(1) Install the piston/connecting rod assembly.
(2) Install the oil pan.
(3) Install the cylinder head.
(4) Install the engine into the vehicle.

VALVE SERVICE

VALVE CLEANING

Clean valves thoroughly. Discard burned, warped and cracked valves.

Remove carbon and varnish deposits from inside of valve guides with a reliable guide cleaner.

VALVE INSPECTION

Measure valve stems for wear. If wear exceeds 0.051 mm (0.002 inch), replace the valve.

VALVE GUIDES

Measure valve stem guide clearance as follows:
(1) Install Valve Guide Sleeve Tool C-3973 over valve stem and install valve (Fig. 49). The special sleeve places the valve at the correct height for checking with a dial indicator.

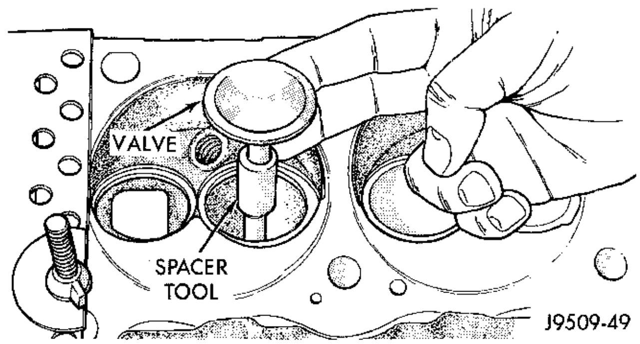

Fig. 49 Positioning Valve with Tool C-3973

(2) Attach Dial Indicator Tool C-3339 to cylinder head and set it at right angle of valve stem being measured (Fig. 50).

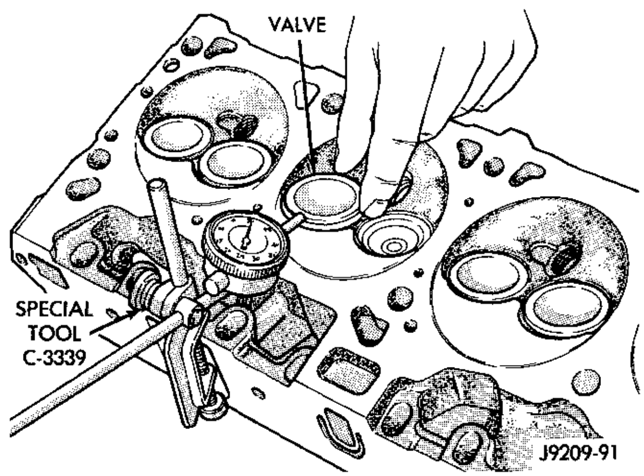

Fig. 50 Measuring Valve Guide Wear

(3) Move valve to and from the indicator. The total dial indicator reading should not exceed 0.432 mm (0.017 inch). Ream the guides for valves with oversize stems if dial indicator reading is excessive or if the stems are scuffed or scored.

Service valves with oversize stems are available (Fig. 51).

Reamer O/S	Valve Guide Size
0.076 mm (0.003 in.)	8.026 – 8.052 mm (0.316 – 0.317 in.)
0.381 mm (0.015 in.)	8.331 – 8.357 mm (0.328 – 0.329 in.)

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Fig. 51 Reamer Sizes

DISASSEMBLY AND ASSEMBLY (Continued)

Slowly turn reamer by hand and clean guide thoroughly before installing new valve. **Ream the valve guides from standard to 0.381 mm (0.015 inch). Use a 2 step procedure so the valve guides are reamed true in relation to the valve seat:**

- Step 1—Ream to 0.0763 mm (0.003 inch).
- Step 2—Ream to 0.381 mm (0.015 inch).

REFACING VALVES AND VALVE SEATS

The intake and exhaust valves have a 43-1/4° to 43-3/4° face angle and a 44-1/4° to 44-3/4° seat angle (Fig. 52).

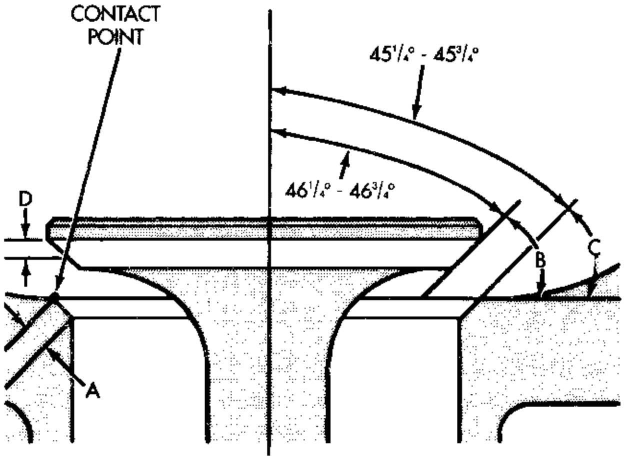


Fig. 52 Valve Face and Seat Angles

VALVES

Inspect the remaining margin after the valves are refaced (Fig. 53). Valves with less than 1.190 mm (0.047 inch) margin should be discarded.

VALVE SEATS

CAUTION: DO NOT un-shroud valves during valve seat refacing (Fig. 54).

(1) When refacing valve seats, it is important that the correct size valve guide pilot be used for reseating stones. A true and complete surface must be obtained.

(2) Measure the concentricity of valve seat using a dial indicator. Total runout should not exceed 0.051 mm (0.002 inch) total indicator reading.

(3) Inspect the valve seat with Prussian blue to determine where the valve contacts the seat. To do this, coat valve seat **LIGHTLY**with Prussian blue then set valve in place. Rotate the valve with light pressure. If the blue is transferred to the center of valve face, contact is satisfactory. If the blue is transferred to the top edge of valve face, lower valve seat with a 15° stone. If the blue is transferred to bottom edge of valve face raise valve seat with a 60° stone.

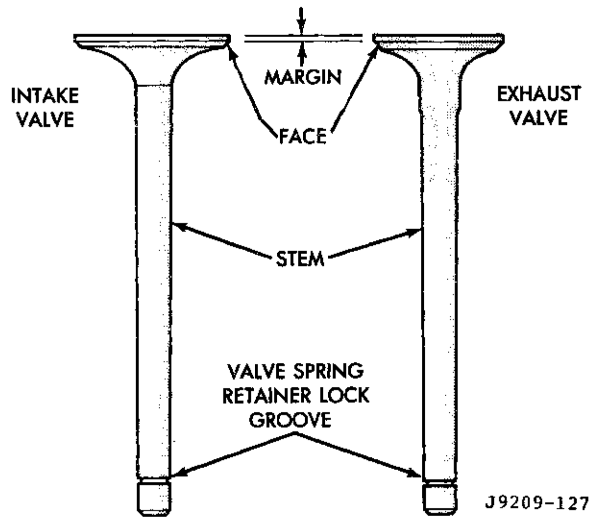


Fig. 53 Intake and Exhaust Valves

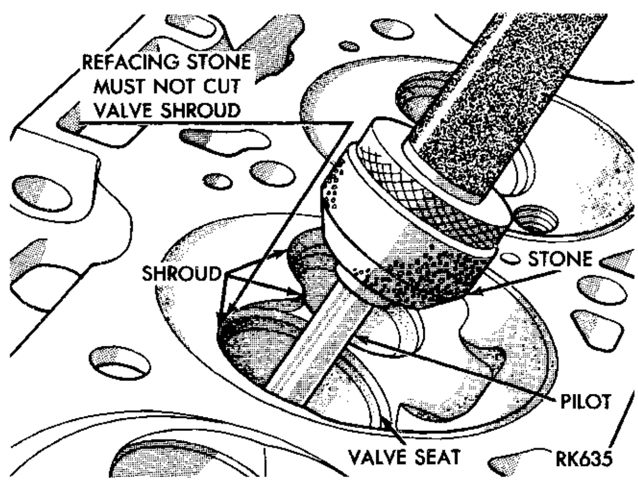


Fig. 54 Refacing Valve Seats

(4) When seat is properly positioned the width of intake seats should be 1.016-1.524 mm (0.040-0.060 inch). The width of the exhaust seats should be 1.524-2.032 mm (0.060-0.080 inch).

VALVE SPRING INSPECTION

Whenever valves have been removed for inspection, reconditioning or replacement, valve springs should be tested. As an example the compression length of the spring to be tested is 1-5/16 inch. Turn table of Universal Valve Spring Tester Tool until surface is in line with the 1-5/16 inch mark on the threaded stud. Be sure the zero mark is to the front (Fig. 55). Place spring over stud on the table and lift compressing lever to set tone device. Pull on torque wrench until ping is heard. Take reading on torque wrench at this

DISASSEMBLY AND ASSEMBLY (Continued)

instant. Multiply this reading by 2. This will give the spring load at test length. Fractional measurements are indicated on the table for finer adjustments. Refer to specifications to obtain specified height and allowable tensions. Discard the springs that do not meet specifications.

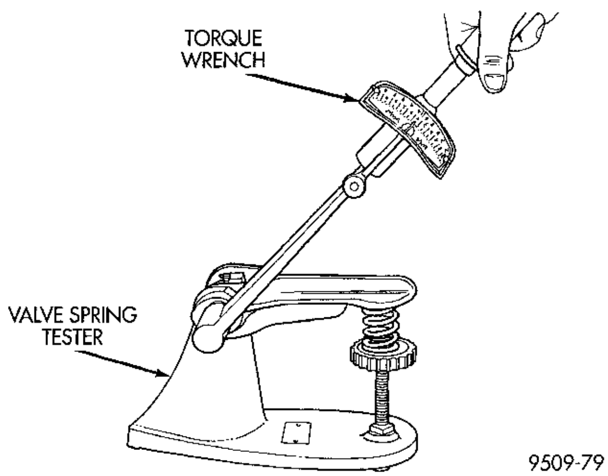


Fig. 55 Testing Valve Spring for Compressed Length

OIL PUMP

DISASSEMBLE

(1) Remove the relief valve as follows:

(a) Remove cotter pin. Drill a 3.175 mm (1/8 inch) hole into the relief valve retainer cap and insert a self-threading sheet metal screw.

(b) Clamp screw into a vise and while supporting oil pump, remove cap by tapping pump body using a soft hammer. Discard retainer cap and remove spring and relief valve (Fig. 56).

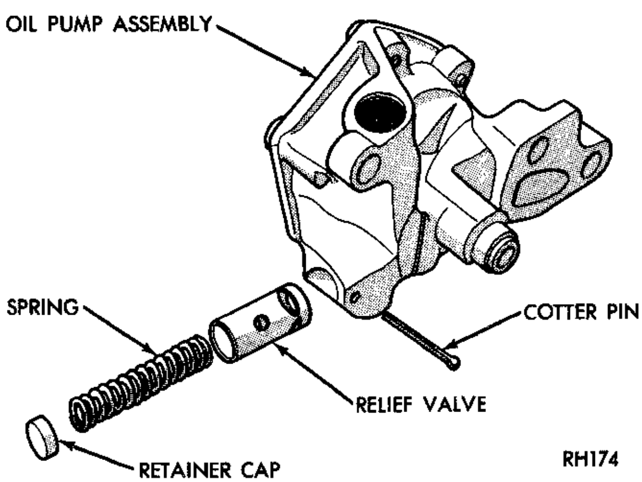


Fig. 56 Oil Pressure Relief Valve

(2) Remove oil pump cover (Fig. 57).

(3) Remove pump outer rotor and inner rotor with shaft (Fig. 57).

(4) Wash all parts in a suitable solvent and inspect carefully for damage or wear.

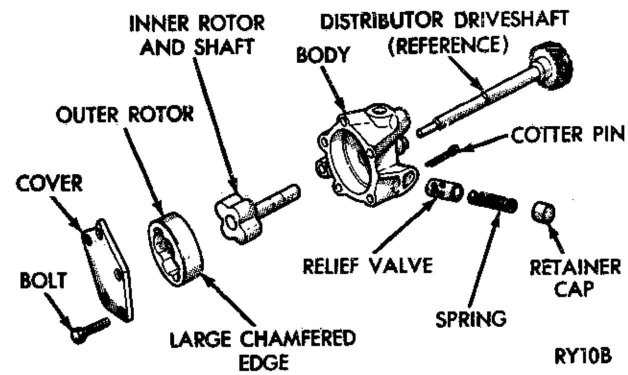


Fig. 57 Oil Pump

ASSEMBLE

(1) Install pump rotors and shaft, using new parts as required.

(2) Position the oil pump cover onto the pump body. Tighten cover bolts to 11 N·m (95 in. lbs.) torque.

(3) Install the relief valve and spring. Insert the cotter pin.

(4) Tap on a new retainer cap.

(5) Prime oil pump before installation by filling rotor cavity with engine oil.

CLEANING AND INSPECTION

CYLINDER HEAD ASSEMBLY

CLEANING

Clean all surfaces of cylinder block and cylinder heads.

Clean cylinder block front and rear gasket surfaces using a suitable solvent.

INSPECTION

Inspect all surfaces with a straightedge if there is any reason to suspect leakage. If out-of-flatness exceeds 0.00075 mm/mm (0.00075 inch/inch) times the span length in inches in any direction, either replace head or lightly machine the head surface.

FOR EXAMPLE: A 305 mm (12 inch) span is 0.102 mm (0.004 inch) out-of-flat. The allowable out-of-flat is 305 X 0.00075 (12 X 0.00075) equals 0.23 mm (0.009 inch). This amount of out-of-flat is acceptable.

The cylinder head surface finish should be 1.78-3.00 microns (70-125 microinches).

CLEANING AND INSPECTION (Continued)

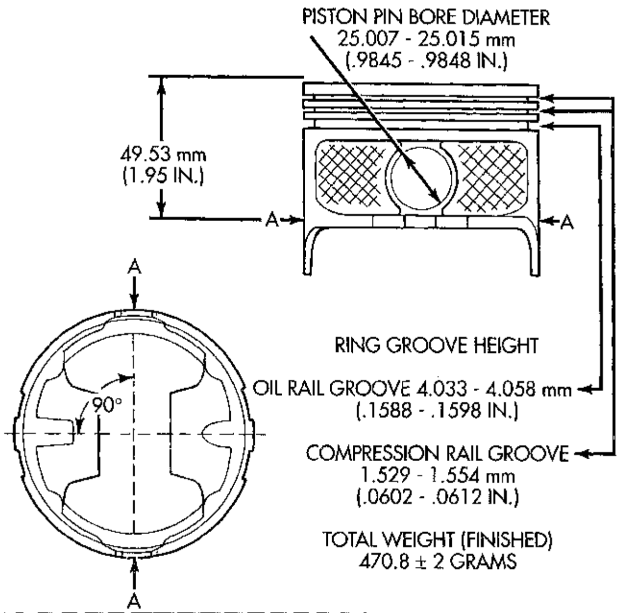
PISTON AND CONNECTING ROD ASSEMBLY

INSPECTION

Check the crankshaft connecting rod journal for excessive wear, taper and scoring.

Check the cylinder block bore for out-of-round, taper, scoring and scuffing.

Check the pistons for taper and elliptical shape before they are fitted into the cylinder bore (Fig. 58).



PISTON SIZE	A DIA = PISTON DIAMETER		BORE DIAMETER	
	MIN. mm (IN.)	MAX. mm (IN.)	MIN. mm (IN.)	MAX. mm (IN.)
A				
B	101.580 (3.9992)	101.592 (3.9997)	101.605 (4.0002)	101.618 (4.0007)
C	101.592 (3.9997)	101.605 (4.0002)	101.618 (4.0007)	101.630 (4.0012)
D	101.605 (4.0002)	101.618 (4.0007)	101.630 (4.0012)	101.643 (4.0017)
E				

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Fig. 58 Piston Measurements

OIL PAN

CLEANING

Clean the block and pan gasket surfaces.

Trim or remove excess sealant film in the rear main cap oil pan gasket groove. **DO NOT remove the sealant inside the rear main cap slots.**

If present, trim excess sealant from inside the engine.

Clean oil pan in solvent and wipe dry with a clean cloth.

Clean oil screen and pipe thoroughly in clean solvent. Inspect condition of screen.

INSPECTION

Inspect oil drain plug and plug hole for stripped or damaged threads. Repair as necessary.

Inspect oil pan mounting flange for bends or distortion. Straighten flange, if necessary.

OIL PUMP

INSPECTION

Mating surface of the oil pump cover should be smooth. Replace pump assembly if cover is scratched or grooved.

Lay a straightedge across the pump cover surface (Fig. 59). If a 0.038 mm (0.0015 inch) feeler gauge can be inserted between cover and straightedge, pump assembly should be replaced.

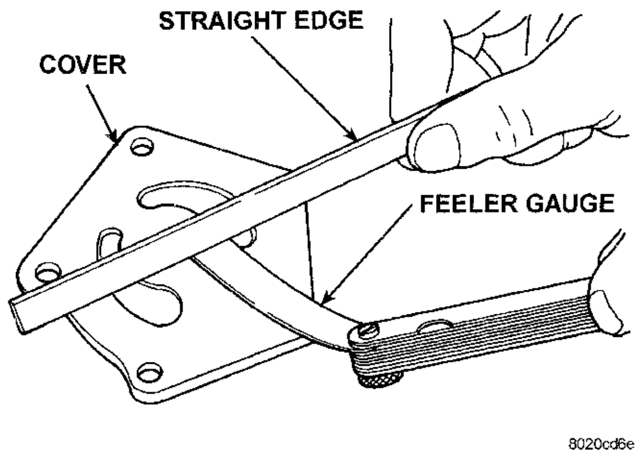


Fig. 59 Checking Oil Pump Cover Flatness

Measure thickness and diameter of OUTER rotor. If outer rotor thickness measures 20.9 mm (0.825 inch) or less or if the diameter is 62.7 mm (2.469 inches) or less, replace outer rotor (Fig. 60).

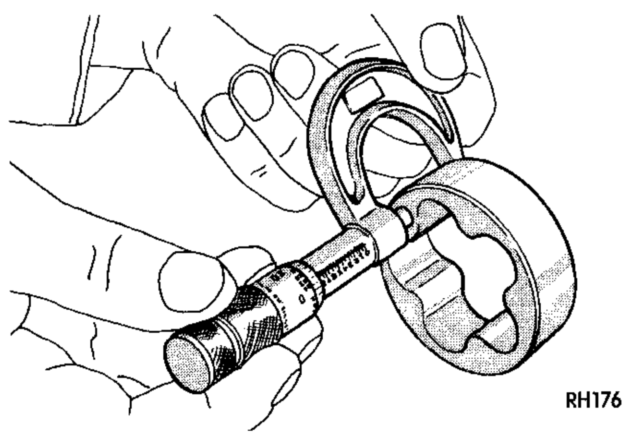


Fig. 60 Measuring Outer Rotor Thickness

If inner rotor measures 20.9 mm (0.825 inch) or less, replace inner rotor and shaft assembly (Fig. 61).

Slide outer rotor into pump body. Press rotor to the side with your fingers and measure clearance between rotor and pump body (Fig. 62). If clearance

CLEANING AND INSPECTION (Continued)

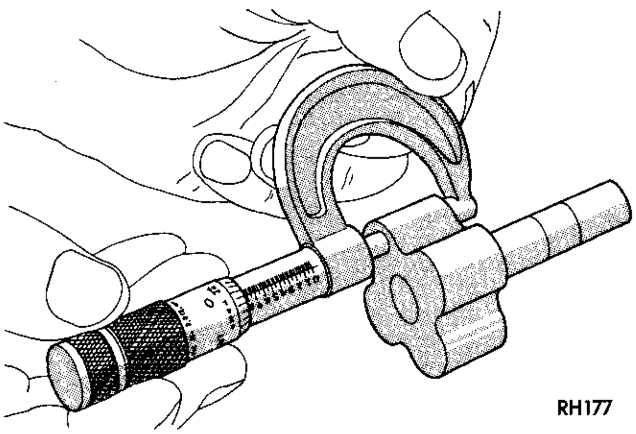


Fig. 61 Measuring Inner Rotor Thickness

is 0.356 mm (0.014 inch) or more, replace oil pump assembly.

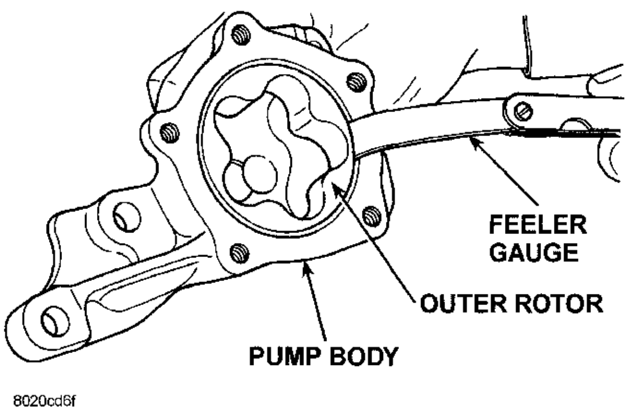


Fig. 62 Measuring Outer Rotor Clearance in Housing

Install inner rotor and shaft into pump body. If clearance between inner and outer rotors is 0.203 mm (0.008 inch) or more, replace shaft and both rotors (Fig. 63).

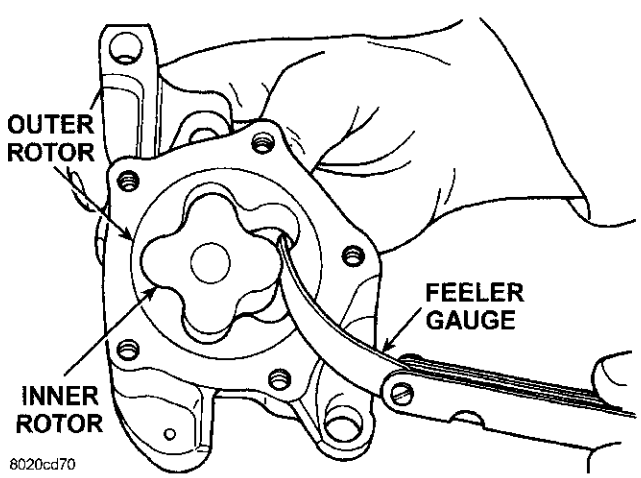


Fig. 63 Measuring Clearance Between Rotors

Place a straightedge across the face of the pump, between bolt holes. If a feeler gauge of 0.102 mm (0.004 inch) or more can be inserted between rotors and the straightedge, replace pump assembly (Fig. 64).

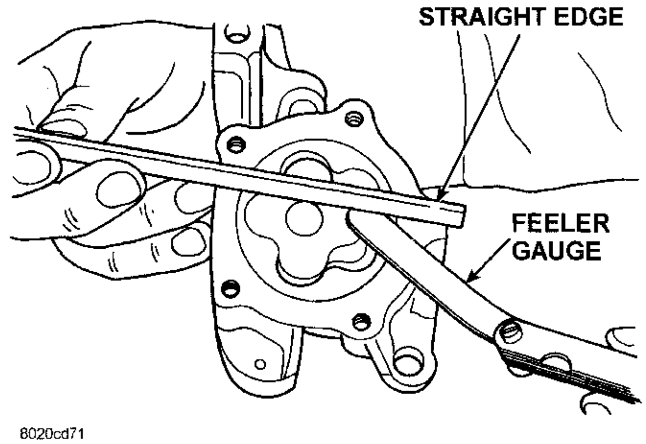


Fig. 64 Measuring Clearance Over Rotors

Inspect oil pressure relief valve plunger for scoring and free operation in its bore. Small marks may be removed with 400-grit wet or dry sandpaper.

The relief valve spring has a free length of approximately 49.5 mm (1.95 inches). The spring should test between 19.5 and 20.5 pounds when compressed to 34 mm (1-11/32 inches). Replace spring that fails to meet these specifications (Fig. 65).

If oil pressure was low and pump is within specifications, inspect for worn engine bearings or other reasons for oil pressure loss.

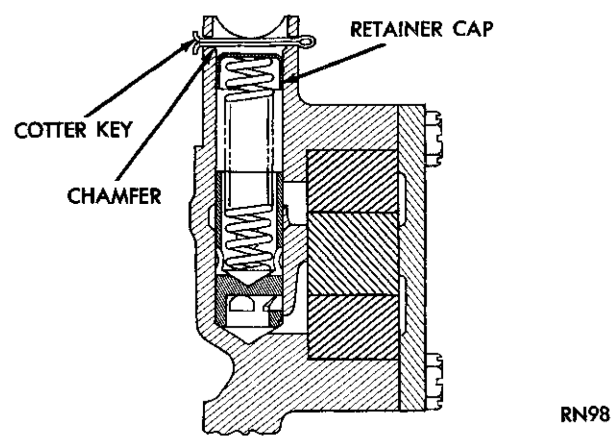


Fig. 65 Proper Installation of Retainer Cap

CYLINDER BLOCK

CLEANING

Clean cylinder block thoroughly and check all core hole plugs for evidence of leaking.

CLEANING AND INSPECTION (Continued)

INSPECTION

Examine block for cracks or fractures.

The cylinder walls should be checked for out-of-round and taper with Cylinder Bore Indicator Tool C-119. The cylinder block should be bored and honed with new pistons and rings fitted if:

• The cylinder bores show more than 0.127 mm (0.005 inch) out-of-round.

• The cylinder bores show a taper of more than 0.254 mm (0.010 inch).

• The cylinder walls are badly scuffed or scored.

Boring and honing operation should be closely coordinated with the fitting of pistons and rings so specified clearances may be maintained.

Refer to Standard Service Procedures in the beginning of this Group for the proper honing of cylinder bores.

SPECIFICATIONS

5.9L ENGINE SPECIFICATIONS

GENERAL INFORMATION

Engine Type. . . . . .90° V-8 OHV
Bore and Stroke . . .101.6 x 90.9 mm (4.00 x 3.58 in.)
Displacement .5.9L (360 c.i.)
Compression Ratio 9.1:1
Firing Order. 1–8–4–3–6–5–7–2
Lubrication . . . .Pressure Feed – Full Flow Filtration
Cooling System . .Liquid Cooled – Forced Circulation
Cylinder Block. . . . . .Cast Iron
Cylinder Head . . . . .Cast Iron
Crankshaft. . . . . .Nodular Iron
Camshaft. . . . . .Nodular Cast Iron
Combustion Chambers . . . .Wedge - High Swirl Valve Shrouding
Pistons . . . . .Aluminum Alloy w/strut
Connecting Rods. . . . . .Forged Steel
Compression Pressure . . . .689.5 kPa (100 psi) (Min.)

CAMSHAFT

Bearing Diameter
No. 1 . . . . . . .50.800 – 50.825 mm (2.000 – 2.001 in.)
No. 2 . . . . . . .50.394 – 50.419 mm (1.984 – 1.985 in.)
No. 3 . . . . . . .50.013 – 50.038 mm (1.969 – 1.970 in.)
No. 4 . . . . . . .49.606 – 49.632 mm (1.953 – 1.954 in.)
No. 5 . . . . .39.688 – 39.713 mm (1.5625 – 1.5635 in.)
Bearing Journal Diameter
No. 1 . . . . . . .50.749 – 50.775 mm (1.998 – 1.999 in.)
No. 2 . . . . . . .50.343 – 50.368 mm (1.982 – 1.983 in.)
No. 3 . . . . . . .49.962 – 49.987 mm (1.967 – 1.968 in.)
No. 4 . . . . . . .49.555 – 49.581 mm (1.951 – 1.952 in.)
No. 5 . . . . .39.637 – 39.662 mm (1.5605 – 1.5615 in.)
Bearing Diameter
Bearing to Journal Clearance
Standard . . . .0.0254 – 0.0762 mm (0.001 – 0.003 in.)
Service Limit . . . . .0.127 mm (0.005 in.)
Camshaft End Play
End Play . . . . . .0.051 – 0.254 mm (0.002 – 0.010 in.)

CONNECTING RODS

Piston Pin bore Diameter . . . . . .24.966 – 24.978 mm (0.9829 – 0.9834 in.)
Side Clearance . . . . .0.152 – 0.356 mm (0.006 – 0.014 in.)

CRANKSHAFT

Rod Journal
Diameter. . . . . .53.950 – 53.975 mm (2.124 – 2.125 in.)
Out of Round (Max.). . . . . .0.0254 mm (0.001 in.)
Taper (Max.). . . . . .0.0254 mm (0.001 in.)
Bearing Clearance . . . . .0.013 – 0.056 mm (0.0005 – 0.0022 in.)
Service Limit . . . . .0.0762 mm (0.003 in.)
Main Bearing Journal
Diameter. . . . . .71.361 – 71.387 mm (2.8095 – 2.8105 in.)
Out of Round (Max.) . . . . .0.127 mm (0.001 in.)
Taper (Max.). . . . . .0.0254 mm (0.001 in.)
Bearing Clearance (#1 Journal) . . .0.013 – 0.038 mm (0.0005 – 0.0015 in.)
Service Limit (#1 Journal). . . . . .0.0381 mm (0.0015 in.)
Bearing Clearance (#2-5 Journals) . . . . .0.013 – 0.051 mm (0.0005 – 0.002 in.)
Service Limit (#2-5 Journals). . . . . .0.064 mm (0.0025 in.)
Crankshaft End Play
End Play . . . . . .0.051 – 0.178 mm (0.002 – 0.007 in.)
Service Limit . . . . .0.254 mm (0.010 in.)

CYLINDER BLOCK

Cylinder Bore
Diameter . . . .101.60 – 101.65 mm (4.000 – 4.002 in.)
Out of Round (Max.) . . . . .0.127 mm (0.005 in.)
Taper (Max.) . . . . .0.254 mm (0.010 in.)
Lifter Bore
Diameter . . . .22.99 – 23.01 mm (0.9051 – 0.9059 in.)
Distributor Drive Bushing (Press Fit)
Bushing to Bore Interference . . .0.0127 – 0.3556 mm (0.0005 – 0.0140 in.)
Shaft to Bushing Clearance . . . .0.0178 – 0.0686 mm (0.0007 – 0.0027 in.)

AUTHENTIC RESTORATION PRODUCTS

SPECIFICATIONS (Continued)

CYLINDER HEAD AND VALVES

Valve Seat
Angle . . . . .44.25° – 44.75°
Runout (Max.) . . . . .0.0762 mm (0.003 in.)
Width (Finish) –
Intake . . . . . .1.016 – 1.524 mm (0.040 – 0.060 in.)
Width (Finish) –
Exhaust. . . . .1.524 – 2.032 mm (0.060 – 0.080 in.)
Valves
Face Angle .43.25° – 43.75°
Head Diameter – Intake . . . . . .47.752 mm (1.88 in.)
Head Diameter – Exhaust. . . . . . . .41.072 (1.617 in.)
Length (Overall) –
Intake . . . .126.21 – 126.85 mm (4.969 – 4.994 in.)
Length (Overall) –
Exhaust. . .126.44 – 127.30 mm (4.978 – 5.012 in.)
Lift (@ zero lash) – Intake . . . .10.414 mm (0.410 in.)
Lift (@ zero lash) – Exhaust. . .10.592 mm (0.417 in.)
Stem Diameter –
Intake . . . . . .9.449 – 9.474 mm (0.372 – 0.373 in.)
Stem Diameter –
Exhaust. . . . .9.423 – 9.449 mm (0.371 – 0.372 in.)
Guide Bore . . . .9.500 – 9.525 mm (0.374 – 0.375 on.)
Stem to Guide Clearance –
Intake. . . .0.0254 – 0.0762 mm (0.001 – 0..003 in.)
Stem to Guide Clearance –
Exhaust. . .0.0508 – 0.1016 mm (0.002 – 0.004 in.)
Service Limit . . . . .0.4318 (0.017 in.)
Valve Springs
Free Length . . . . .49.962 mm (1.967 in.)
Spring Tension – (valve closed) . .378 N @ 41.66 mm (85 lbs. @ 1.64 in.)
Spring Tension – (valve open). . . .890 N @ 30.89 mm (200 lbs. @ 1.212 in.)
Number of Coils. 6.8
Installed Height. . . . . .41.66 mm (1.64 in.)
Wire Diameter . . . . .4.50 mm (0.177 in.)

HYDRAULIC TAPPETS

Body Diameter . . . . .22.949 – 22.962 mm (0.9035 – 0.9040 in.)
Clearance (to bore) . . . . .0.0279 – 0.0610 mm (0.0011 – 0.0024 in.)
Dry Lash. . . . . .1.524 – 5.334 mm (0.060 – 0.210 in.)
Push Rod Length . . . . .175.64 – 176.15 mm (6.915 – 6.935 in.)

OIL PRESSURE

Curb Idle (Min.*). . . . . .41.4 kPa (6 psi)
3000 rpm. . . . . .207 – 552 kPa (30 – 80 psi)
Oil Pressure Bypass Valve
Setting . . . . .62 – 103 kPa (9 – 15 psi)
Curb Idle (Min.*). . . . . .41.4 kPa (6 psi)
Switch Actuating
Pressure . . . . .34.5 – 48.3 kPa (5 – 7 psi)

CAUTION: If oil pressure is zero at curb idle, DO NOT RUN ENGINE.

OIL PUMP

Clearance over Rotors
(Max.). . . . . .0.1016 mm (0.004 in.)
Cover Out of Flat
(Max.). . . . . .0.0381 mm (0.0015 in.)
Inner Rotor Thickness
(Min.). . . . . .20.955 mm (0.825 in.)
Outer Rotor Clearance
(Max.). . . . . .0.3556 mm (0.014 in.)
Outer Rotor Diameter
(Min.) . . . . .62.7126 mm (2.469 in.)
Outer Rotor Thickness
(Min.). . . . . .20.955 mm (0.825 in.)
Tip Clearance between Rotors
(Max.). . . . . .0.2032 mm (0.008 in.)

PISTONS

Clearance at Top of Skirt . . . . .0.013 – 0.038 mm (0.0005 – 0.0015 in.)
Land Clearance (Diam.) . . . . .0.508 – 0.660 mm (0.020 – 0.026 in.)
Piston Length . . . . .81.03 mm (3.19 in.)
Piston Ring Groove Depth –
#1&2 . . . . . . .4.761 – 4.912 mm (0.187 – 0.193 in.)
Piston Ring Groove Depth –
#3 . . . . .3.996 – 4.177 mm (0.157 – 0.164 in.)
Weight . . . . .582 – 586 grams (20.53 – 20.67 oz.)

PISTON PINS

Clearance in Piston . . . . .0.006 – 0.019 mm (0.00023 – 0.00074 in.)
Diameter. . . . . .25.007 – 25.015 mm (0.9845 – 0.9848 in.)
End Play . . . . .NONE
Length . . . . .67.8 – 68.3 mm (2.67 – 2.69 in.)

PISTON RINGS

Ring Gap
Compression Ring (Top) . . . . .0.30 – 0.55 mm (0.012 – 0.022 in.)
Compression Ring (2nd). . . . . .0.55 – 0.80 mm (0.022 – 0.031 in.)
Oil Control (Steel Rails) . . . . .0.381 – 1.397 mm (0.015 – 0.055 in.)

mopar AUTHENTIC RESTORATION

SPECIFICATIONS (Continued)

Ring Gap
Ring Side Clearance
Compression Rings . . . . .0.040 – 0.085 mm (0.0016 – 0.0033 in.)
Oil Ring (Steel Rails) . . . . .0.05 – 0.21 mm (0.002 – 0.008 in.)
Ring Width
Compression rings . . . . .1.530 – 1.555 mm (0.060 – 0.061 in.)
Oil Ring (Steel Rails) – Max. . . . . . .0.447 –0.473 mm (0.018 – 0.019 in.)

VALVE TIMING

Exhaust Valve
Closes (ATDC) . . . . .33°
Opens (BBDC) . . . . .56°
Duration . . . . .269°
Intake Valve
Closes (ATDC) . . . . .62°
Opens (BBDC) . . . . .7°
Duration . . . . .249°
Valve Overlap . . . . .41°

OVERSIZE AND UNDERSIZE ENGINE COMPONENT MARKINGS

CONDITION	IDENTIFICATION	LOCATION OF IDENTIFICATION
0.025 mm (0.001 inch) U/S Crankshaft	R or M M-2-3 etc. (Indicating No. 2 & 3 main bearing journal) and/or R-1-4 etc. (Indicating No. 1 & 4 connecting rod journal)	Milled flat on number three crankshaft counterweight
0.508 mm (0.020 inch) O/S Cylinder Bores	A	Following engine serial number.
0.203 mm (0.008 inch) O/S Tappets	◆	3/8″ diamond-shaped stamp Top pad — Front of engine and flat ground on outside surface of each O/S tappet bore.
0.127 mm (0.005 inch) O/S Valve Stems	X	Milled pad adjacent to two 3/8″ tapped holes on each end of cylinder head.

J9209-120

TORQUE SPECIFICATIONS

5.9L ENGINE

DESCRIPTION **TORQUE**
Camshaft
Bolt . . . . .68 N·m (50 ft. lbs.)
Camshaft Thrust Plate
Bolts .24 N·m (210 in. lbs.)
Chain Case Cover
Bolts . . . . .41 N·m (30 ft. lbs.)
Connecting Rod Cap
Bolts . . . . .61 N·m (45 ft. lbs.)
Crankshaft Main Bearing Cap
Bolts . . . . .115 N·m (85 ft. lbs.)
Crankshaft Pulley
Bolts .24 N·m (210 in. lbs.)
Cylinder Head
Bolts (1st Step) . . . . .68 N·m (50 ft. lbs.)

DESCRIPTION **TORQUE**
Bolts (2nd Step) . . . . .143 N·m (105 ft. lbs.)
Cylinder Head Cover
Bolts . . . . .11 N·m (95 in. lbs.)
Engine Support Bracket to Block (4wd)
Bolts . . . . .41 N·m (30 ft. lbs.)
Exhaust Manifold-to-Cylinder Head
Bolts/Nuts . . . . .34 N·m (25 ft. lbs.)
Flywheel
Bolts . . . . .75 N·m (55 ft. lbs.)
Front Insulator (All)
Through bolt/nut . . . . .95 N·m (70 ft. lbs.)
Front Insulator to Support Bracket (4wd)
Stud nut . . . . .41 N·m (30 ft. lbs.)
Through bolt/nut . . . . .102 N·m (75 ft. lbs.)
Front Insulator to Block (2wd)
Bolts . . . . .95 N·m (70 ft. lbs.)
Generator
Mounting Bolt . . . . .41 N·m (30 ft. lbs.)

AUTHENTIC RESTORATION PRODUCT

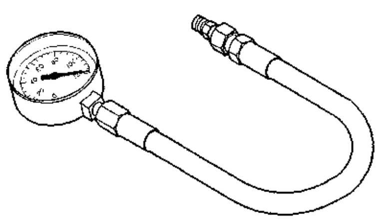
SPECIFICATIONS (Continued)

DESCRIPTION	TORQUE
Intake Manifold	
Bolts	Refer to R &I Procedure
Oil Pan	
Bolts	24 N·m (215 in. lbs.)
Oil Pan	
Drain Plug	34 N·m (25 ft. lbs.)
Oil Pump	
Attaching Bolts	41 N·m (30 ft. lbs.)
Oil Pump Cover	
Bolts	11 N·m (95 in. lbs.)
Rear Insulator-to-Bracket (2WD)	
Through-Bolt	68 N·m (50 ft. lbs.)
Rear Insulator-to-Crossmember Support Bracket (2WD)	
Nut	41 N·m (30 ft. lbs.)
Rear Insulator-to-Crossmember (4WD)	
Nuts	68 N·m (50 ft. lbs.)
Rear Insulator-to-Transmission (4WD)	
Bolts	68 N·m (50 ft. lbs.)
Rear Insulator Bracket (4WD Automatic)	
Bolts	68 N·m (50 ft. lbs.)
Rear Support Bracket-to-Crossmember Flange	
Nuts	41 N·m (30 ft. lbs.)

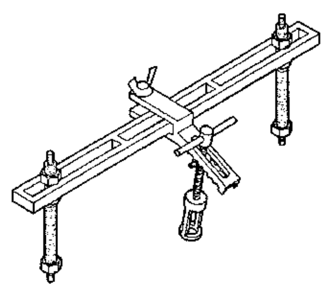
DESCRIPTION	TORQUE
Rear Support Plate-to-Transfer Case	
Bolts	41 N·m (30 ft. lbs.)
Rocker Arm	
Bolts	28 N·m (21 ft. lbs.)
Spark Plugs	
All	41 N·m (30 ft. lbs.)
Starter Motor	
Mounting Bolts	68 N·m (50 ft. lbs.)
Thermostat Housing	
Bolts	25 N·m (225 in. lbs.)
Throttle Body	
Bolts	23 N·m (200 in. lbs.)
Torque Converter Drive Plate	
Bolts	31 N·m (270 in. lbs.)
Transfer Case-to-Insulator Mounting Plate	
Nuts	204 N·m (150 ft. lbs.)
Transmission Support Bracket (2WD)	
Bolts	68 N·m (50 ft. lbs.)
Vibration Damper	
Retainer Bolt	183 N·m (135 ft. lbs.)
Water Pump-to-Chain Case Cover	
Bolt	41 N·m (30 ft. lbs.)

SPECIAL TOOLS

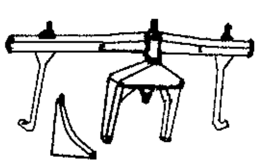
5.9L ENGINE



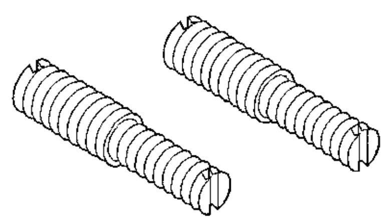
Oil Pressure Gauge C-3292



Valve Spring Compressor MD-998772–A

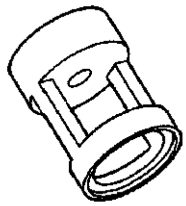


Engine Support Fixture C-3487–A

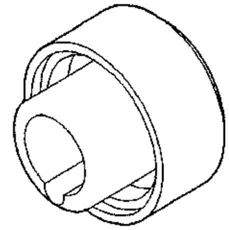


Adaptor 6633

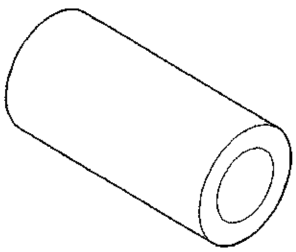
SPECIAL TOOLS (Continued)



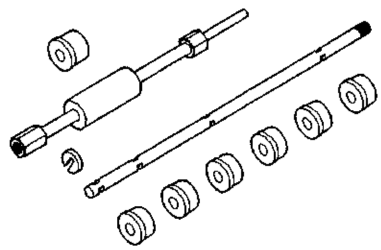
Adaptor 6716A



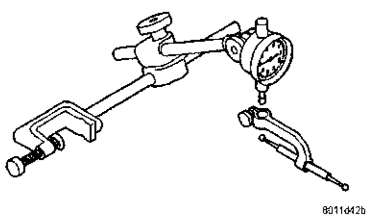
Front Oil Seal Installer 6635



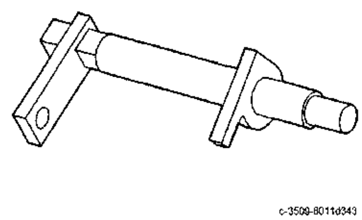
Valve Guide Sleeve C-3973



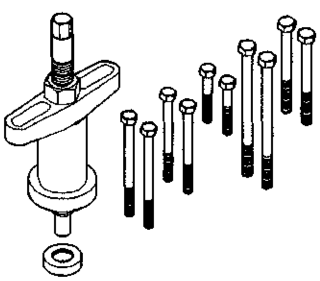
Cam Bearing Remover/Installer C-3132–A



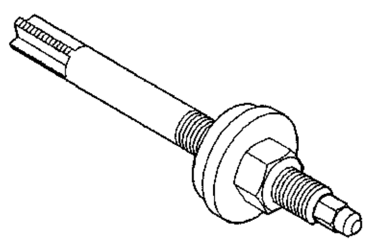
Dial Indicator C-3339



Camshaft Holder C-3509

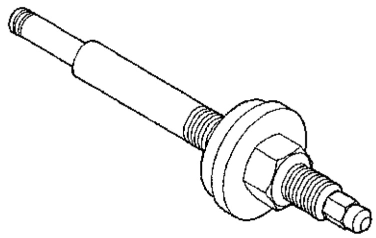


Puller C-3688

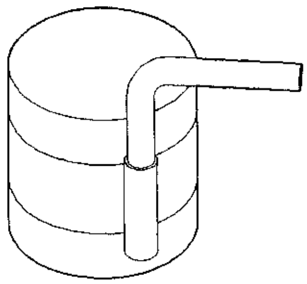


Distributor Bushing Puller C-3052

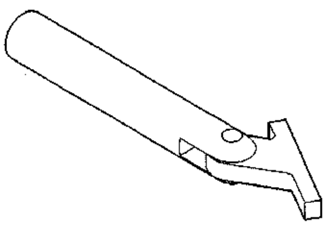
SPECIAL TOOLS (Continued)



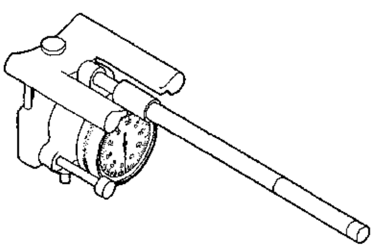
Distributor Bushing Driver/Burnisher C-3053



Piston Ring Compressor C-385



Crankshaft Main Bearing Remover C-3059



8011c9fa

Cylinder Bore Gauge C-119

mopar AUTHENTIC RESTORATION PRODUCT

8.0L ENGINE

INDEX

DESCRIPTION AND OPERATION

ENGINE DESCRIPTION/IDENTIFICATION

The 8.0 Liter (488 CID) ten-cylinder engine is a V-Type lightweight, single cam, overhead valve engine with hydraulic roller tappets. This engine is designed for unleaded fuel.

Engine lubrication system consists of a gerotor type oil pump mounted in the timing chain cover and driven by the crankshaft. The V-10 uses a full flow oil filter.

The cylinders are numbered from front to rear; 1, 3, 5, 7, 9 on the left bank and 2, 4, 6, 8, 10 on the right bank. The firing order is 1-10-9-4-3-6-5-8-7-2 (Fig. 1).

AUTHENTIC RESTORATION PRODUCT

DESCRIPTION AND OPERATION (Continued)

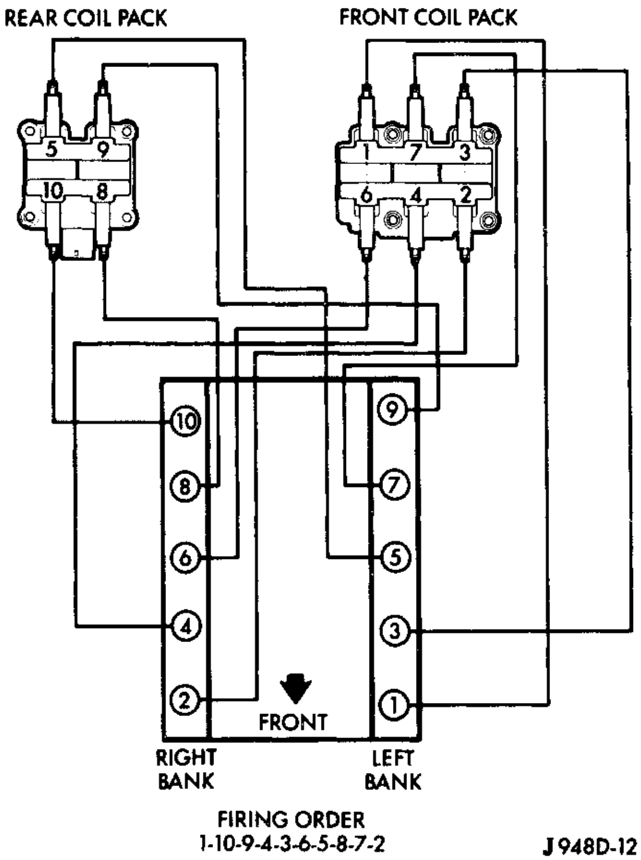


Fig. 1 Firing Order

The engine serial number is located on the lower left front of the cylinder block in front of the engine mount (Fig. 2). When component part replacement is necessary, use the engine type and serial number for reference.

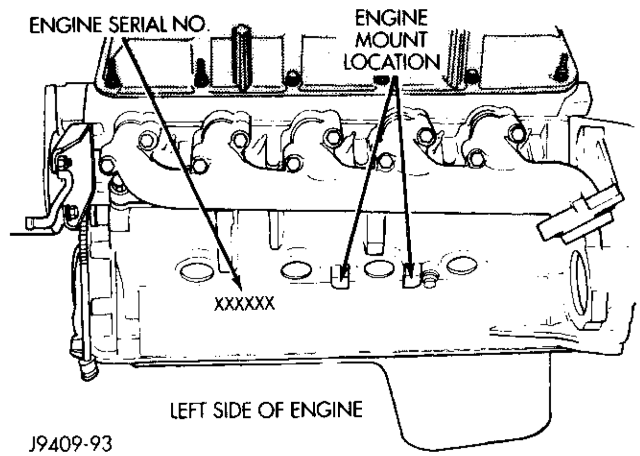


Fig. 2 Engine Identification

LUBRICATION SYSTEM

The lubrication system is a full flow filtration pressure feed type. Oil stored in the oil pan is taken in and discharged by an internal gear pump directly coupled to the crankshaft. Its pressure is regulated by the relief valve located in the chain case cover. The oil is pump through an oil filter and feeds three main oil gallery. This oil gallery feeds oil under pressure to the main and rod bearings and camshaft bearings. Passages in the cylinder block feed oil to the hydraulic lifters through hollow push rods which feeds the rocker arm sockets.

Mopar
AUTHENTIC RESTORATION PRODUCT

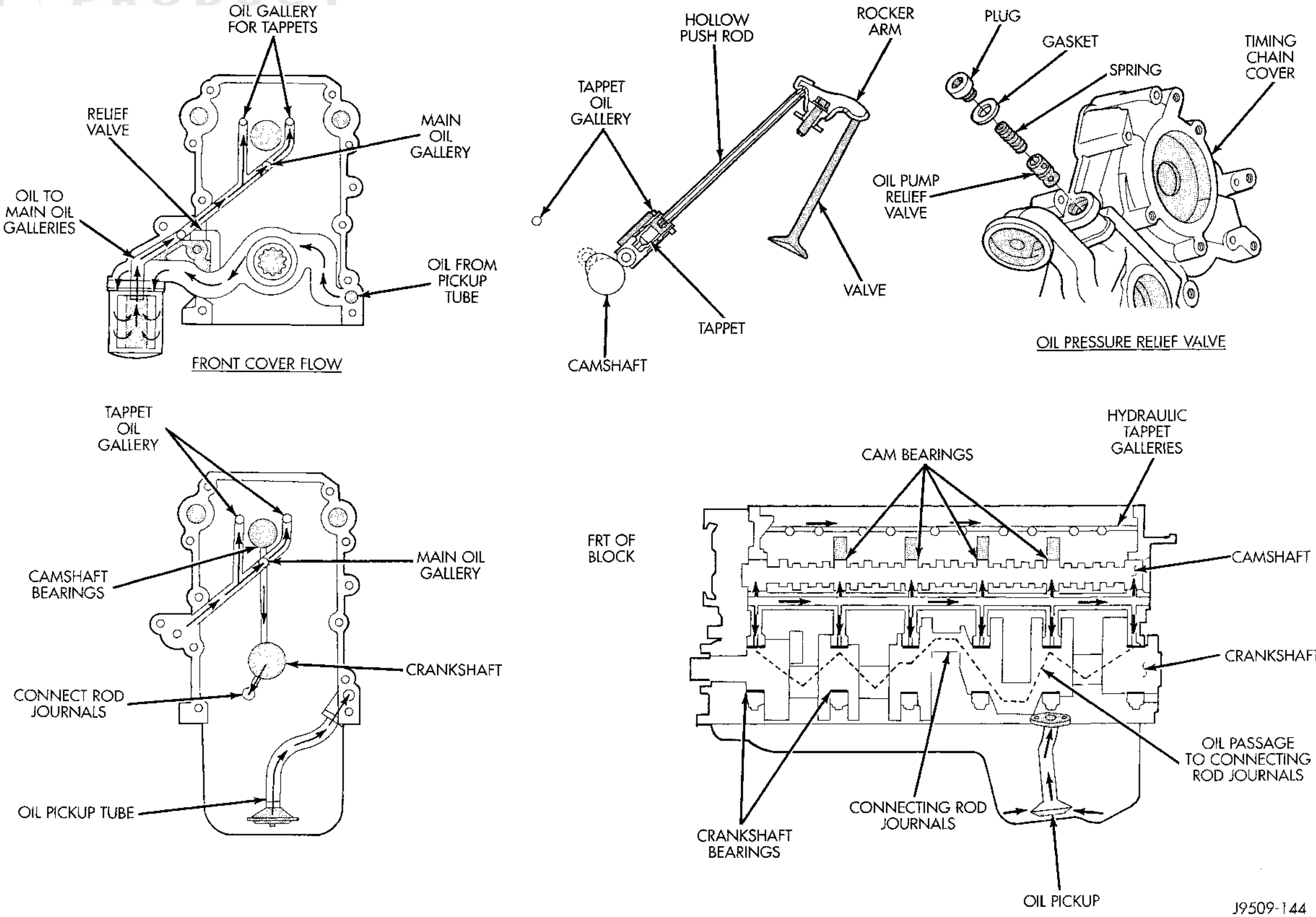


Fig. 3 Engine Lubrication System

Mopar AUTHENTIC RESTORATION PRODUCT

DESCRIPTION AND OPERATION (Continued)

ENGINE COMPONENTS

CYLINDER HEAD COVER

Die-cast magnesium cylinder head covers reduce noise and provide a good sealing surface. A steel backed silicon gasket is used with the cylinder head cover. This gasket can be used again.

CYLINDER HEADS

The alloy cast iron cylinder heads (Fig. 4) are held in place by 12 bolts. The spark plugs are located in the peak of the wedge between the valves.

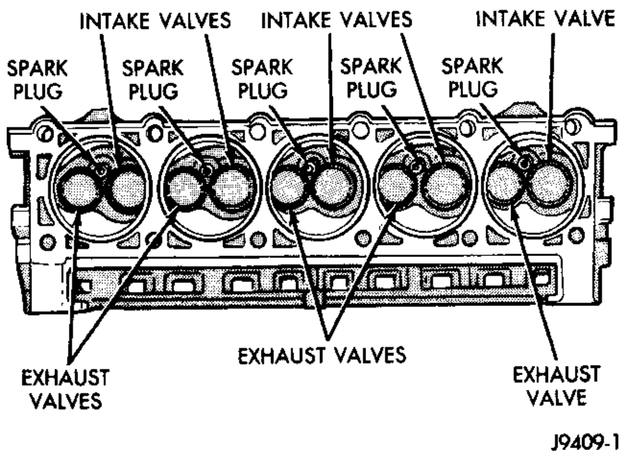


Fig. 4 Cylinder Head Assembly

VALVES AND VALVE SPRINGS

The valves are arranged in-line and inclined 18°. The rocker pivot support and the valve guides are cast integral with the heads.

PISTON AND CONNECTING ROD ASSEMBLY

The pistons are elliptically turned so that the diameter at the pin boss is less than its diameter across the thrust face. This allows for expansion under normal operating conditions. Under operating temperatures, expansion forces the pin bosses away from each other, causing the piston to assume a more nearly round shape.

All pistons are machined to the same weight, regardless of size, to maintain piston balance.

The piston pin rotates in the piston only and is retained by the press interference fit of the piston pin in the connecting rod.

The pistons have a unique dry-film lubricant coating baked onto the skirts to reduce friction. The lubricant is particularly effective during engine break-in, but with time, the material becomes embedded into cylinder bore walls and continues to reduce friction.

SERVICE PROCEDURES

VALVE TIMING

(1) Turn crankshaft until the No.6 exhaust valve is closing and No.6 intake valve is opening.

(2) Insert a 6.350 mm (1/4 inch) spacer between rocker arm pad and stem tip of No.1 intake valve. Allow spring load to bleed tappet down giving in effect a solid tappet.

(3) Install a dial indicator so plunger contacts valve spring retainer as nearly perpendicular as possible. Zero the indicator.

(4) Rotate the crankshaft clockwise (normal running direction) until the valve has lifted 0.863 mm (0.034 inch). The timing of the crankshaft should now read from 10° before top dead center to 2° after top dead center. Use a protractor as there are no timing marks on the engine.

CAUTION: DO NOT turn crankshaft any further clockwise as valve spring might bottom and result in serious damage.

(5) If reading is not within specified limits:
- (a) Check sprocket index marks.
- (b) Inspect timing chain for wear.
- (c) Check accuracy of TDC mark on timing indicator.

MEASURING TIMING CHAIN STRETCH

(1) Place a scale next to the timing chain so that any movement of the chain may be measured.

(2) Place a torque wrench and socket over camshaft sprocket attaching bolt. Apply torque in the direction of crankshaft rotation to take up slack; 41 N·m (30 ft. lbs.) torque with cylinder head installed or 20 N·m (15 ft. lbs.) torque with cylinder head removed. With a torque applied to the camshaft sprocket bolt, crankshaft should not be permitted to move. It may be necessary to block the crankshaft to prevent rotation.

(3) Hold a scale with dimensional reading even with the edge of a chain link. With cylinder heads installed, apply 14 N·m (30 ft. lbs.) torque in the reverse direction. With the cylinder heads removed, apply 20 N·m (15 ft. lbs.) torque in the reverse direction. Note the amount of chain movement (Fig. 5).

(4) Install a new timing chain, if its movement exceeds 3.175 mm (1/8 inch).

FITTING PISTONS

Piston and cylinder wall must be clean and dry. Specified clearance between the piston and the cylinder wall is 0.013-0.038 mm (0.0005-0.0015 inch). The max. allowable clearance is 0.0762 mm (0.003 in.).

Piston diameter should be measured at the top of skirt, 90° to piston pin axis. Cylinder bores should be

SERVICE PROCEDURES (Continued)

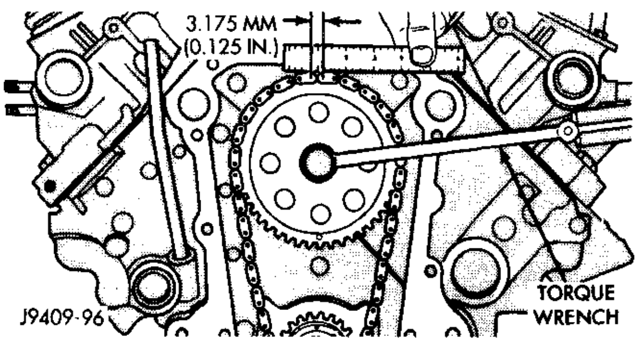


Fig. 5 Measuring Timing Chain Wear and Stretch

measured halfway down the cylinder bore and transverse to the engine crankshaft center line.

Pistons and cylinder bores should be measured at normal room temperature, 21°C (70°F).

(1) To correctly select the proper size piston, a cylinder bore gauge, capable of reading in .0001″ INCREMENTS is required (Fig. 6). If a bore gauge is not available, do not use an inside micrometer.

(2) The coating material is applied to the piston after the final piston machining process. Measuring the outside diameter of a coated piston will not provide accurate results. Therefore measuring the inside diameter of the cylinder bore with a dial Bore Gauge is **MANDATORY.**. To correctly select the proper size piston, a cylinder bore gauge capable of reading in .0001″ increments is required.

(3) Piston installation into the cylinder bore require slightly more pressure than that required for non-coated pistons. The bonded coating on the piston will give the appearance of a line-to-line fit with the cylinder bore.

FITTING RINGS

(1) Measurement of end gaps:

(a) Measure piston ring gap 2 inches from bottom of cylinder bore. An inverted piston can be used to push the rings down to ensure positioning rings squarely in the cylinder bore before measuring.

(b) Insert feeler stock in the gap. Gap for compression rings should be between 0.254-0.508 mm (0.010-0.020 inch). The oil ring gap should be 0.381- 1.397 mm (0.015-0.055 inch).

(c) Rings with insufficient end gap may be properly filed to the correct dimension. Ends should be stoned smooth after filing with Arkansas White Stone. Rings with excess gaps should not be used.

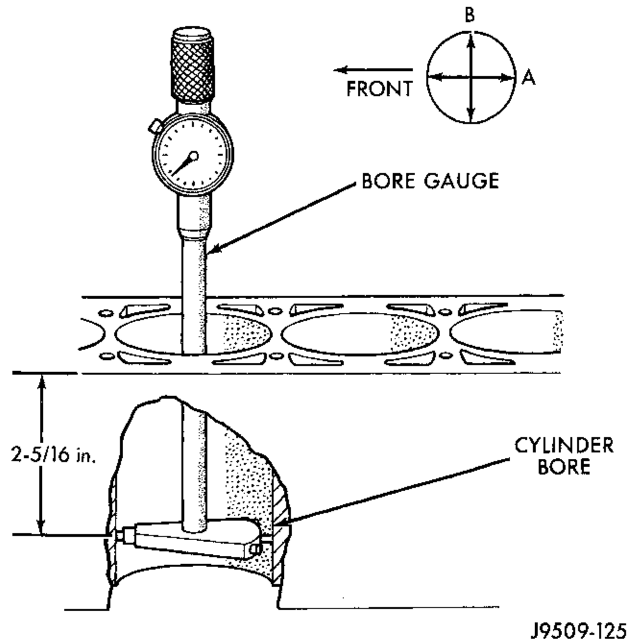


Fig. 6 Bore Gauge

(2) Install rings and confirm ring side clearance:

(a) Install oil rings being careful not to nick or scratch the piston. Install the oil control rings according to instructions in the package. It is not necessary to use a tool to install the upper and lower rails. Insert oil rail spacer first, then side rails.

(b) Install the second compression rings using Installation Tool C-4184. The compression rings must be installed with the identification mark face up (toward top of piston) and chamfer facing down. An identification mark on the ring is a drill point, a stamped letter O, an oval depression or the word TOP (Fig. 7) (Fig. 9).

(c) Using a ring installer, install the top compression ring with the chamfer facing up (Fig. 9). An identification mark on the ring is a drill point, a stamped letter O, an oval depression or the word TOP facing up.

(d) Measure side clearance between piston ring and ring land. Clearance should be 0.074-0.097 mm (0.0029-0.0038 inch) for the compression rings. The steel rail oil ring should be free in groove, but should not exceed 0.246 mm (0.0097 inch) side clearance.

(e) Pistons with insufficient or excessive side clearance should be replaced.

(3) Arrange ring gaps 180° apart as shown in (Fig. 10).

SERVICE PROCEDURES (Continued)

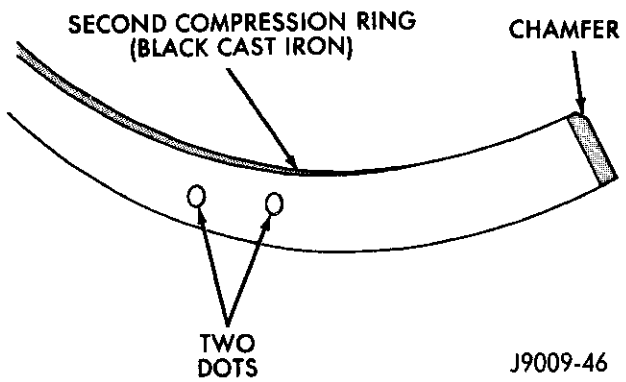


Fig. 7 Second Compression Ring Identification—Typical

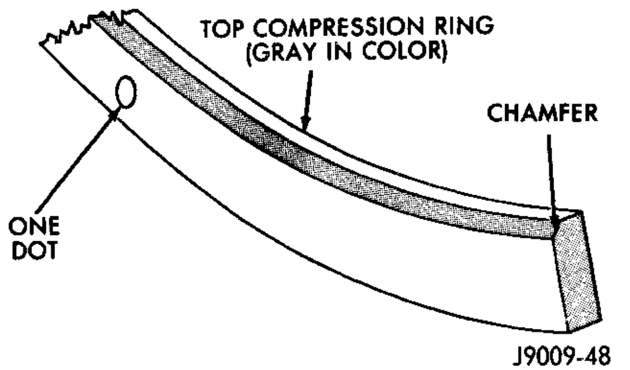


Fig. 8 Top Compression Ring Identification—Typical

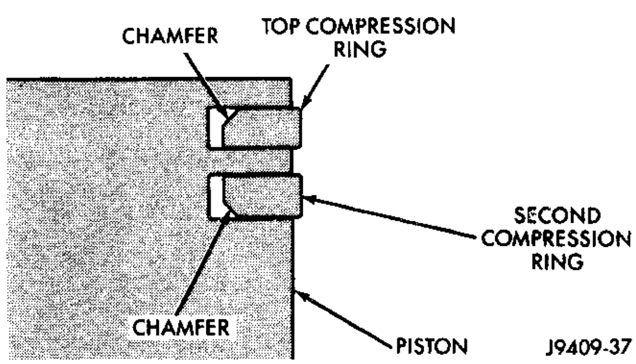


Fig. 9 Compression Ring Chamfer Location—Typical

FITTING CONNECTING ROD BEARINGS

Fit all rods on a bank until completed. DO NOT alternate from one bank to another, because connecting rods and pistons are not interchangeable from one bank to another.

The bearing caps are not interchangeable and should be marked at removal to ensure correct assembly.

Each bearing cap has a small V-groove across the parting face. When installing the lower bearing shell, make certain that the V-groove in the shell is in line with the V-groove in the cap. This provides lubrication of the cylinder wall in the opposite bank.

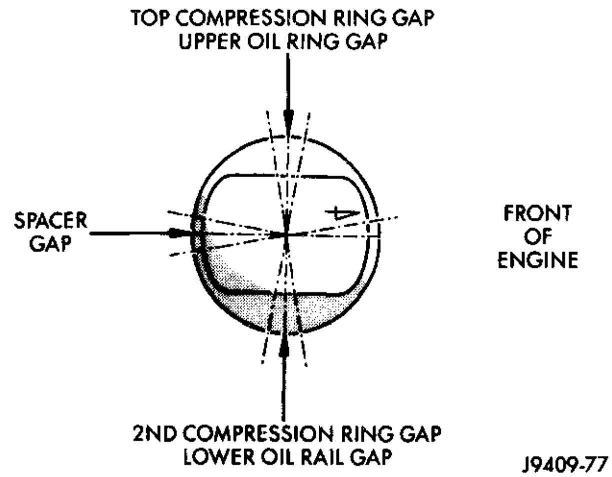


Fig. 10 Proper Ring Installation

The bearing shells must be installed so that the tangs are in the machined grooves in the rods and caps.

Limits of taper or out-of-round on any crankshaft journals should be held to 0.025 mm (0.001 inch). Bearings are available in 0.025 mm (0.001 inch), 0.051 mm (0.002 inch), 0.076 mm (0.003 inch), 0.254 mm (0.010 inch) and 0.305 mm (0.012 inch) undersize. **Install the bearings in pairs. DO NOT use a new bearing half with an old bearing half. DO NOT file the rods or bearing caps.**

FITTING CRANKSHAFT MAIN BEARINGS

Bearing caps are not interchangeable and should be marked at removal to ensure correct assembly. Upper and lower bearing halves are NOT interchangeable. All lower main bearing halves are interchangeable. Upper main bearing halves of No. 2, 4, and 5 are interchangeable. Upper main bearing halves of No. 1 and 6 are interchangeable, this also applies to the lower bearing halves.

The No.3 main bearing is flanged to carry the crankshaft thrust loads. This bearing is NOT interchangeable with any other bearing halves in the engine. Bearing shells are available in standard and the following undersizes: 0.25 mm (0.001 inch), 0.051 mm (0.002 inch), 0.076 mm (0.003 inch), 0.254 mm (0.010 inch) and 0.305 mm (0.012 inch). Never install an undersize bearing that will reduce clearance below specifications.

CRANKSHAFT SERVICE

The crankshaft connecting rod and main journals should be checked for excessive wear, taper and scoring. The maximum taper or out-of-round on any crankshaft journal is 0.025 mm (0.001 inch).

SERVICE PROCEDURES (Continued)

Journal grinding should not exceed 0.305 mm (0.012 inch) under the standard journal diameter. DO NOT grind thrust faces of No.3 main bearing. DO NOT nick crank pin or bearing fillets. After grinding, remove rough edges from crankshaft oil holes and clean out all oil passages.

CAUTION: After any journal grind, it is important that the final paper or cloth polish be in the same direction as the engine rotates.

REMOVAL AND INSTALLATION

ENGINE MOUNTS—FRONT

REMOVAL

(1) Disconnect the negative cable from the battery.

(2) Position fan to assure clearance for radiator top tank and hose.

CAUTION: DO NOT lift the engine by the intake manifold.

(3) Install engine support/lifting fixture.

(4) Raise vehicle on hoist.

(5) Lift the engine SLIGHTLY and remove the thru-bolt and nut and rubber engine restrictors. (Fig. 11).

(6) Remove engine support bracket/cushion bolts (Fig. 11). Remove the support bracket/cushion and heat shields.

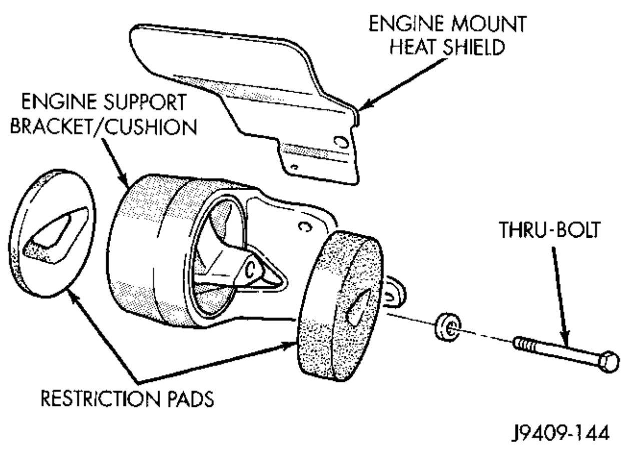


Fig. 11 Engine Mounts—Front

INSTALLATION

(1) With engine raised SLIGHTLY, position the engine support bracket/cushion and heat shields to the block. Install new bolts and tighten to 81 N·m (60 ft. lbs.) torque.

(2) Install the thru-bolt and 2 piece rubber engine rubber restrictors onto the engine support bracket/cushion.

(3) Lower engine with support/lifting fixture while guiding the engine bracket/cushion and thru-bolt into support cushion brackets (Fig. 12).

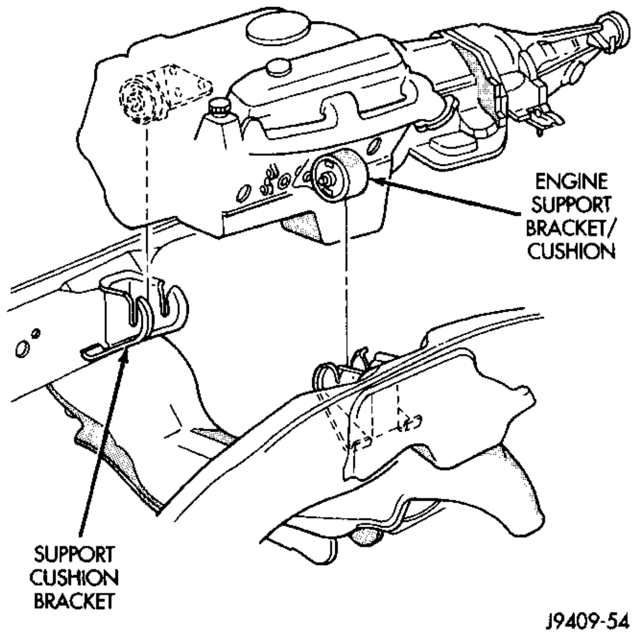


Fig. 12 Positioning Engine Mounts—Front

(4) Install thru-bolt nuts and tighten the nuts to 68 N·m (50 ft. lbs.) torque.

(5) Lower the vehicle.

(6) Remove lifting fixture.

ENGINE MOUNT—REAR

REMOVAL

(1) Raise the vehicle on a hoist.

(2) Position a transmission jack in place.

(3) Remove support cushion stud nuts (Fig. 13).

(4) Raise rear of transmission and engine SLIGHTLY.

(5) Remove the bolts holding the support cushion to the transmission support bracket. Remove the support cushion.

(6) If necessary, remove the bolts holding the transmission support bracket to the transmission.

INSTALLATION

(1) If removed, position the transmission support bracket to the transmission. Install new attaching bolts and tighten to 102 N·m (75 ft. lbs.) torque.

(2) Position support cushion to transmission support bracket. Install stud nuts and tighten to 47 N·m (35 ft. lbs.) torque.

REMOVAL AND INSTALLATION (Continued)

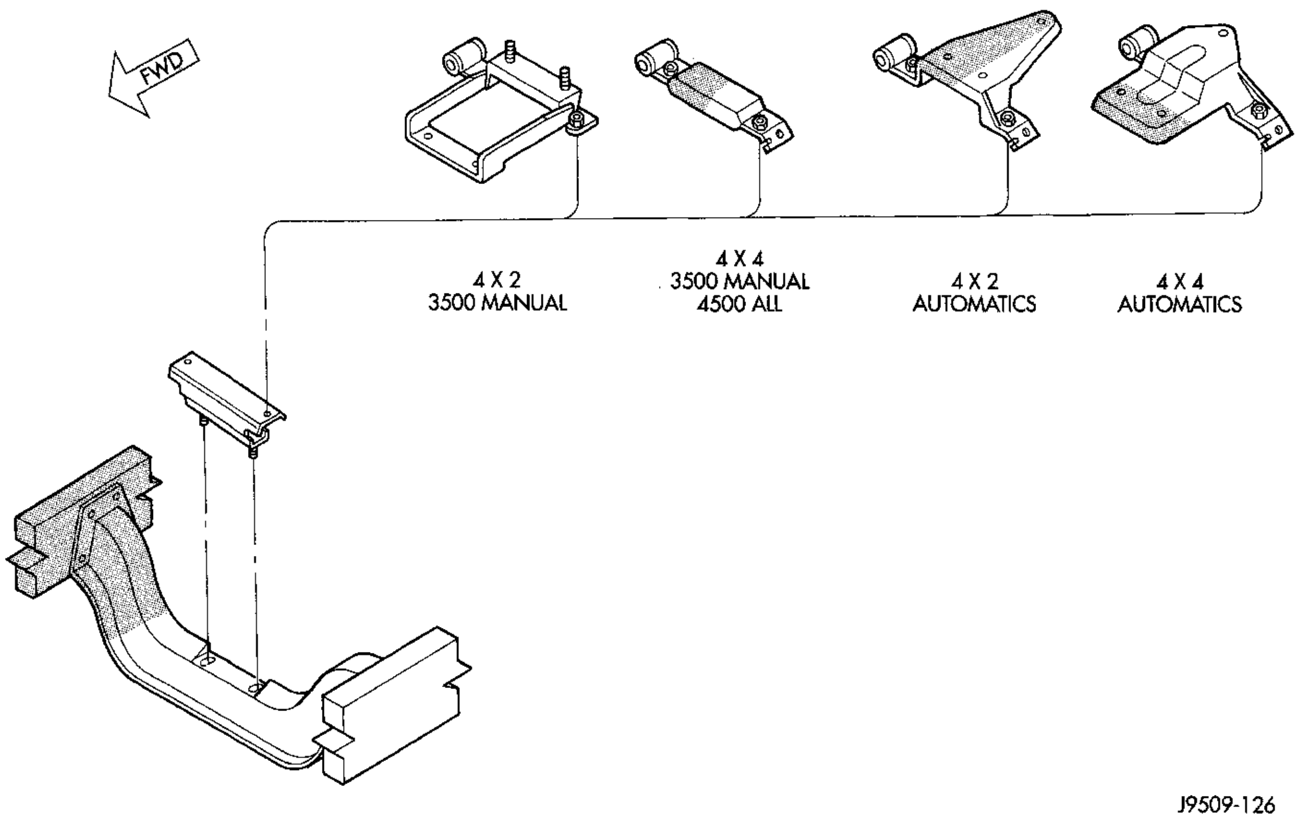


Fig. 13 Engine Rear Support Cushion Assembly

(3) Using the transmission jack, lower the transmission and support cushion onto the crossmember (Fig. 13).

(4) Install the support cushion bolts and tighten to 47 N·m (35 ft. lbs.) torque.

(5) Remove the transmission jack.

(6) Lower the vehicle.

ENGINE ASSEMBLY

REMOVAL

(1) Remove the battery.

(2) Drain cooling system (refer to Group 7, Cooling System for the proper procedure).

(3) Discharge the air conditioning system, if equipped (refer to Group 24, Heating and Air Conditioning for service procedures).

(4) Remove the upper crossmember.

(5) Remove the transmission oil cooler.

(6) Remove the serpentine belt (refer to Group 7, Cooling System).

(7) Remove the A/C compressor with the lines attached. Set aside.

(8) If equipped, remove the condenser.

(9) Remove the washer bottle.

(10) Disconnect the top radiator hose.

(11) Remove the fan.

(12) Remove the fan shroud.

(13) Disconnect the lower radiator hose.

(14) Disconnect the transmission cooler lines.

(15) Remove radiator (refer to Group 7, Cooling System).

(16) Remove the generator with the wire connections (refer to Group 8B, Battery/Starter/Generator Service).

(17) Remove the air cleaner.

(18) Disconnect the throttle linkage.

(19) Remove throttle body.

(20) Remove the upper intake manifold (refer to Group 11, Exhaust System and Intake Manifold).

(21) Remove the coil assemblies with the ignition cables.

(22) Disconnect the heater hoses.

(23) Disconnect the power steering hoses, if equipped.

(24) Perform the Fuel System Pressure release procedure (refer to Group 14, Fuel System). Disconnect the fuel line.

(25) On Manual Transmission vehicles, remove the shift lever (refer to Group 21, Transmissions).

(26) Raise and support the vehicle on a hoist.

(27) Remove the drain plug and drain the engine oil.

(28) Loosen front engine mount thru-bolt nuts.

REMOVAL AND INSTALLATION (Continued)

(29) Remove the transmission cooler line brackets from oil pan.

(30) Disconnect exhaust pipe at manifold (refer to Group 11, Exhaust System and Intake Manifold).

(31) Disconnect the starter wires. Remove starter motor (refer to Group 8B, Battery/Starter/Generator Service).

(32) Refer to Group 21, Transmissions for transmission removal.

(33) Lower vehicle.

CAUTION: DO NOT lift the engine by the intake manifold.

(34) Install an engine lifting fixture.

(35) Remove engine from vehicle and install engine assembly on a repair stand.

INSTALLATION

(1) Remove engine from the repair stand and position in the engine compartment. Position the thru-bolt into the support cushion brackets.

(2) Install an engine support fixture.

(3) Raise and support the vehicle on a hoist.

(4) Refer to Group 21, Transmissions for transmission installation.

(5) Install the prop shaft (refer to Group 16, Propeller Shaft).

(6) Install the starter and connect the starter wires (refer to Group 8B, Battery/Starter/Generator Service).

(7) Install exhaust pipe to manifold (refer to Group 11, Exhaust System and Intake Manifold).

(8) Install the transmission cooler line brackets from oil pan.

(9) Tighten the Front mount thru-bolts and nuts to 102N·m (75 ft. lbs.).

(10) Install the drain plug and tighten to 34 N·m (25 ft. lbs.) torque.

(11) Prime oil pump by squirting oil in the oil filter mounting hole and filling the J-trap of the front timing cover. When oil is running out, install oil filter that has been filled with oil.

(12) Lower the vehicle.

(13) Remove engine lifting fixture.

(14) On Manual Transmission vehicles, install the shift lever (refer to Group 21, Transmissions).

(15) Connect the fuel lines.

(16) Connect the heater hoses.

(17) Install the upper intake manifold (refer to Group 11, Exhaust System and Intake Manifold).

(18) Install the coil assemblies with the ignition cables.

(19) Using a new gasket, install throttle body. Tighten the throttle body nuts to 23 N·m (200 in. lbs.) torque.

(20) Connect the throttle linkage.

(21) Install the air cleaner box.

(22) Install the generator and wire connections (refer to Group 8B, Battery/Starter/Generator Service).

(23) Install the upper crossmember.

(24) Install radiator (refer to Group 7, Cooling System).

(25) Connect the lower radiator hose.

(26) Install the transmission oil cooler.

(27) Connect the transmission cooler lines.

(28) Connect the power steering hoses, if equipped.

(29) Install the fan shroud.

(30) Install the fan.

(31) Connect the top radiator hose.

(32) Install the washer bottle.

(33) If equipped, install the condenser.

(34) Install the A/C compressor with the lines attached.

(35) Install the serpentine belt (refer to Group 7, Cooling System).

(36) Evacuate and charge the air conditioning system, if equipped (refer to Group 24, Heating and Air Conditioning for service procedures).

(37) Add coolant to the cooling system (refer to Group 7, Cooling System for the proper procedure).

(38) Install the battery.

(39) Warm engine and adjust.

(40) Road test vehicle.

CYLINDER HEAD COVER

Die-cast magnesium cylinder head covers (Fig. 14) reduce noise and provide a good sealing surface. A steel backed silicon gasket is used with the cylinder head cover (Fig. 15).

REMOVAL

(1) Disconnect the negative cable from the battery.

(2) Disconnect closed ventilation system and evaporation control system from cylinder head cover. Identify each system for installation.

(3) Remove the upper intake manifold to remove the right side head cover (refer to Group 11, Exhaust System and Intake Manifold).

(4) Remove cylinder head cover bolts and stud bolts. Remove the covers and gaskets. The gasket may be used again.

INSTALLATION

(1) Clean cylinder head cover gasket surface.

(2) Clean head rail, if necessary.

(3) Check the gasket for use in head cover installation. If damaged, use a new gasket.

(4) Install the gasket onto the head rail. **For the left side the number tab is at the front of engine with the number up. For the right side the number tab is at the rear of engine with the number up.**

REMOVAL AND INSTALLATION (Continued)

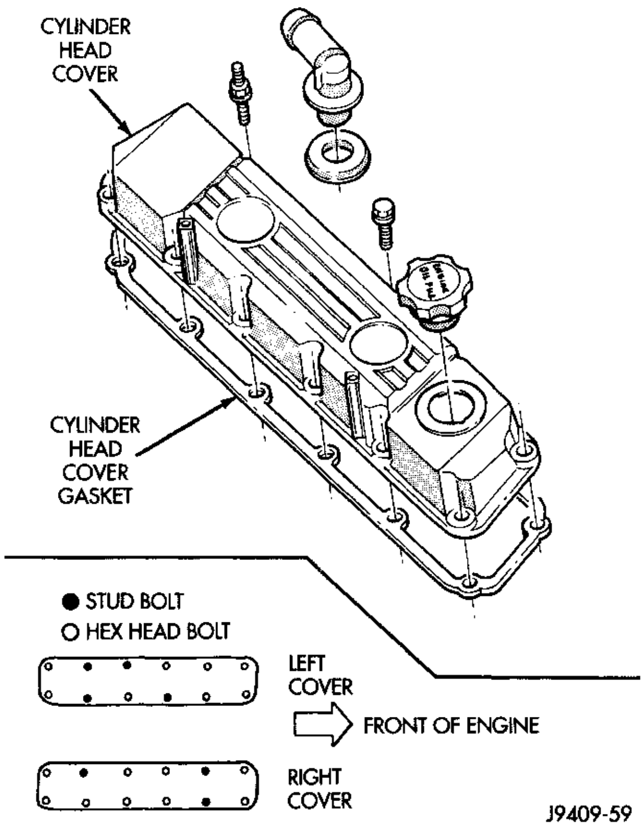


Fig. 14 Cylinder Head Covers

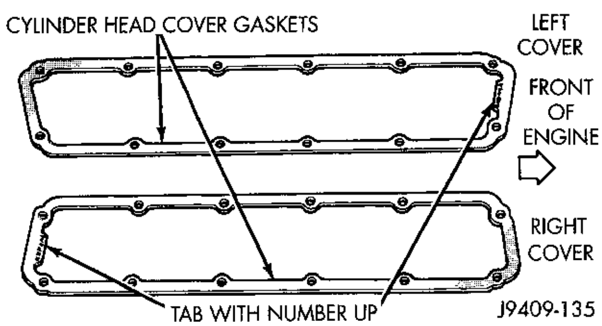


Fig. 15 Cylinder Head Cover Gaskets

CAUTION: The cylinder head cover fasteners have a special plating. DO NOT use alternative fasteners.

(5) Position the cylinder head cover onto the gasket. Install the stud bolts and hex head bolts in the proper positions (Fig. 14). Tighten the stud bolts and the bolts to 16 N·m (144 in. lbs.) torque.

(6) If removed, install the upper intake manifold (refer to Group 11, Exhaust System and Intake Manifold).

(7) Install closed crankcase ventilation system and evaporation control system onto the proper head cover. DO NOT switch the systems.

(8) Connect the negative cable to the battery.

ROCKER ARMS AND PUSH RODS

REMOVAL

(1) Disconnect spark plug wires by pulling the boot straight out in line with plug.

(2) Remove cylinder head cover and gasket.

(3) Remove the rocker arm bolts and the rocker arm assembly (Fig. 16). Place rocker arm assemblies on a bench in the same order as removed.

(4) Remove the push rods and place them on a bench in the same order as removed.

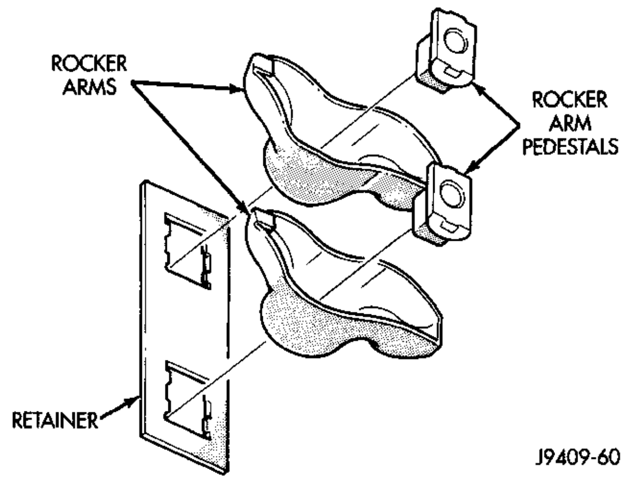


Fig. 16 Rocker Arm Assembly

INSTALLATION

CAUTION: DO NOT rotate or crank the engine during or immediately after rocker arm installation. Allow the hydraulic roller tappets adequate time to bleed down (about 5 minutes).

(1) Install the push rods in the same order as removed.

(2) Install rocker arm assemblies in the same order as removed. Tighten the rocker arm bolts to 28 N·m (21 ft. lbs.) torque.

(3) Install cylinder head cover and gasket. DO NOT use alternative fasteners.

(4) Connect spark plug wires.

VALVE STEM SEAL AND SPRING REPLACEMENT

This procedure is done with the cylinder head installed.

(1) Disconnect the negative cable from the battery.

(2) Set engine basic timing to Top Dead Center (TDC) and remove air cleaner.

(3) Remove cylinder head covers and spark plugs.

(4) Using suitable socket and flex handle at crankshaft retaining bolt, turn engine so the No.1 piston is at TDC on the compression stroke.

(5) Remove rocker arms.

REMOVAL AND INSTALLATION (Continued)

(6) With air hose attached to an adapter installed in No.1 spark plug hole, apply 620-689 kPa (90-100 psi) air pressure.

(7) Using Valve Spring Compressor Tool MD-998772A with adapter 6716A, compress valve spring and remove retainer valve locks and valve spring.

(8) Install seals on the exhaust valve stem and position down against valve guides. The exhaust valve stem seal is brown.

(9) The black intake valve stem seals should be pushed firmly and squarely over the valve guide using the valve stem as a guide. DO NOT force seal against top of guide. When installing the valve retainer locks, compress the spring only enough to install the locks.

(10) Follow the same procedure on the remaining 9 cylinders using the firing sequence 1-10-9-4-3-6-5-8-7-2. Make sure piston in cylinder is at TDC on the valve spring that is being removed.

(11) Remove adapter from the No.1 spark plug hole.

(12) Install rocker arms.

(13) The cylinder head cover gasket can be used again. Install the gasket onto the head rail. **For the left side the number tab is at the front of engine with the number up. For the right side the number tab is at the rear of engine with the number up.**

CAUTION: The cylinder head cover fasteners have a special plating. DO NOT use alternative fasteners.

(14) Position the cylinder head cover onto the gasket. Install the stud bolts and hex head bolts in the proper positions (Fig. 17). Tighten the stud bolts and the bolts to 16 N·m (144 in. lbs.) torque.

(15) Install closed crankcase ventilation system.

(16) Connect the evaporation control system.

(17) Install air cleaner.

(18) Connect the negative cable to the battery.

(19) Road test vehicle and check for leaks.

CYLINDER HEADS

REMOVAL

(1) Disconnect the negative cable from the battery.

(2) Drain cooling system (refer to Group 7, Cooling System for the proper procedures).

(3) Remove the heat shields (Fig. 18).

(4) Remove the intake manifold-to-generator bracket support rod. Remove the generator.

(5) Remove closed crankcase ventilation system.

(6) Disconnect the evaporation control system.

(7) Remove the air cleaner.

(8) Perform the Fuel System Pressure release procedure (refer to Group 14, Fuel System). Disconnect the fuel line.

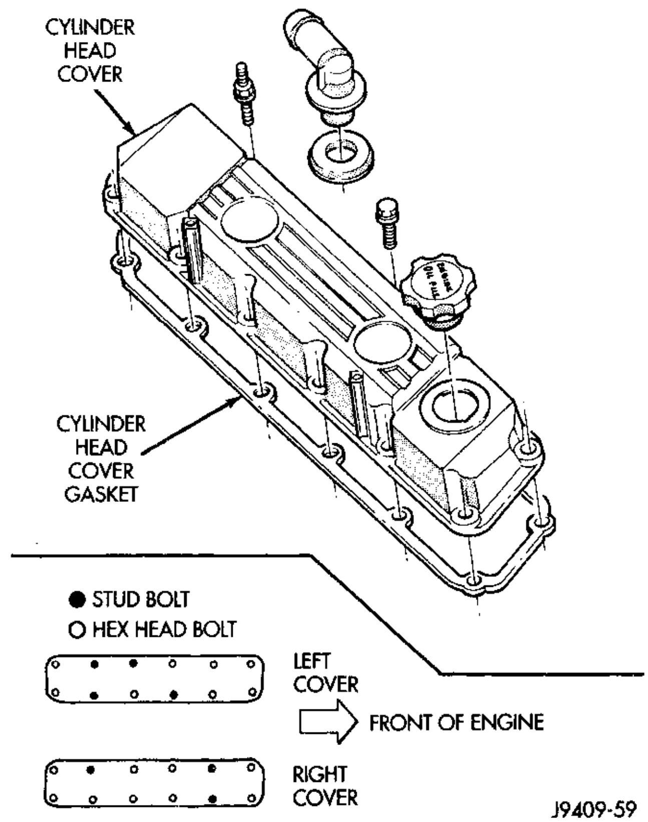


Fig. 17 Cylinder Head Covers

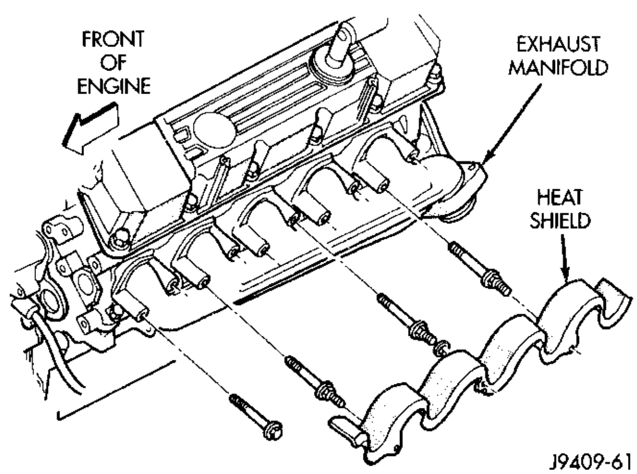


Fig. 18 Spark Plug Wire Heat Shields (Left Side Shown)

(9) Disconnect accelerator linkage and if so equipped, the speed control and transmission kick-down cables.

(10) Remove coil pack and bracket (Fig. 19).

(11) Disconnect the coil wires.

(12) Disconnect heat indicator sending unit wire.

(13) Disconnect heater hoses and bypass hose.

AUTHENTIC RESTORATION PRODUCT

REMOVAL AND INSTALLATION (Continued)

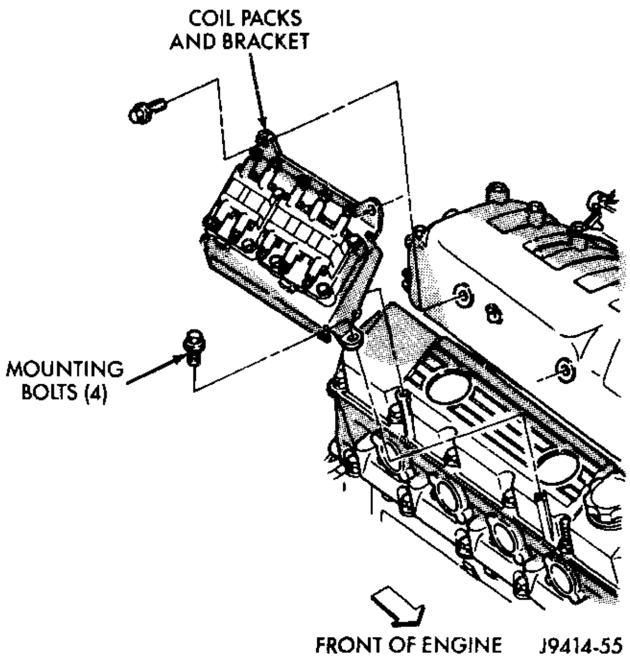


Fig. 19 Coil Pack and Bracket

(14) Remove upper intake manifold and throttle body as an assembly.

(15) Remove cylinder head covers and gaskets.

(16) Remove the EGR tube. Discard the gasket, for right side only.

(17) Remove lower intake manifold. Discard the flange side gaskets and the front and rear cross-over gaskets.

(18) Disconnect exhaust pipe from exhaust manifold (refer to Group 11, Exhaust System and Intake Manifold).

(19) Remove exhaust manifolds and gaskets (refer to Group 11, Exhaust System and Intake Manifold).

(20) Remove rocker arm assemblies and push rods. Identify to ensure installation in original locations.

(21) Remove the head bolts from each cylinder head and remove cylinder heads. Discard the cylinder head gasket.

(22) Remove spark plugs.

INSTALLATION

(1) Position the new cylinder head gaskets onto the cylinder block.

(2) Position the cylinder heads onto head gaskets and cylinder block.

(3) Tighten the cylinder head bolts in two steps (Fig. 20):

• Step 1—Tighten all cylinder head bolts, in sequence, to 58 N·m (43 ft. lbs.) torque.

• Step 2—Tighten all cylinder head bolts, in sequence, to 143 N·m (105 ft. lbs.) torque.

CAUTION: When tightening the rocker arm bolts, make sure the piston in that cylinder is NOT at TDC. Contact between the valves and piston could occur.

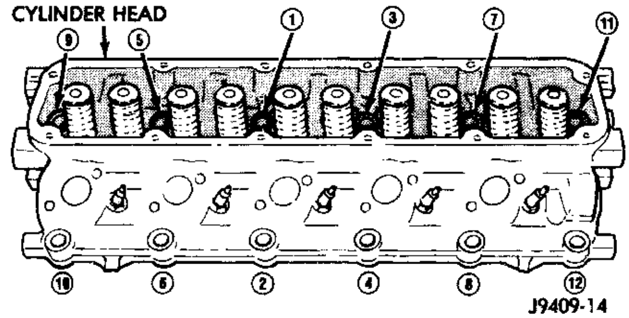


Fig. 20 Cylinder Head Bolt Tightening Sequence

(4) Install push rods and rocker arm assemblies in their original position. Tighten the bolts to 28 N·m (21 ft. lbs.) torque.

(5) Install the side intake manifold gaskets. Be sure that the locator dowels are positioned in the head (Fig. 21).

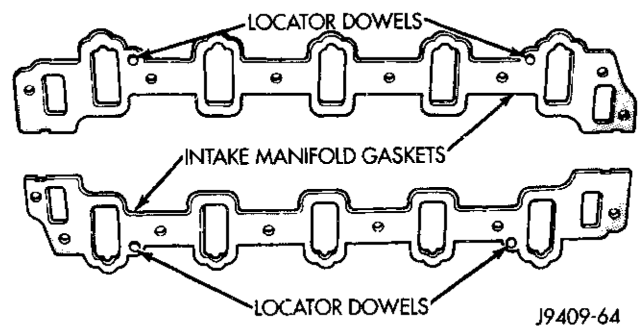


Fig. 21 Intake Manifold Flange Gasket Alignment

(6) Peel off the protective paper (blue - rear and brown - front) and press firmly onto the block (Fig. 22). **BE SURE THE BLOCK IS OIL FREE.** Aligning slots in end seals with notches in intake manifold gaskets.

(7) Insert Mopar® Silicone Rubber Adhesive Sealant, or equivalent, into the four corner pockets (Fig. 23). **Fill the pocket, but DO NOT overfill.**

(8) The lower intake manifold MUST be installed within 3 minutes of sealant application. Carefully lower intake manifold into position on the cylinder block and cylinder heads. After intake manifold is in place, inspect to make sure seals and gaskets are in place.

(9) Finger start all bolts, alternate one side to the other.

(10) Tighten the lower intake manifold bolts to 54 N·m (40 ft. lbs.) torque.

(11) Using a new gasket, position the upper intake manifold onto the lower intake manifold.

REMOVAL AND INSTALLATION (Continued)

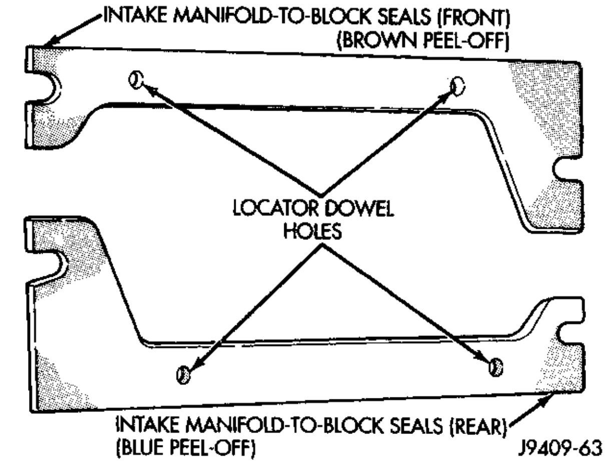


Fig. 22 Intake Manifold-to-Block Seals

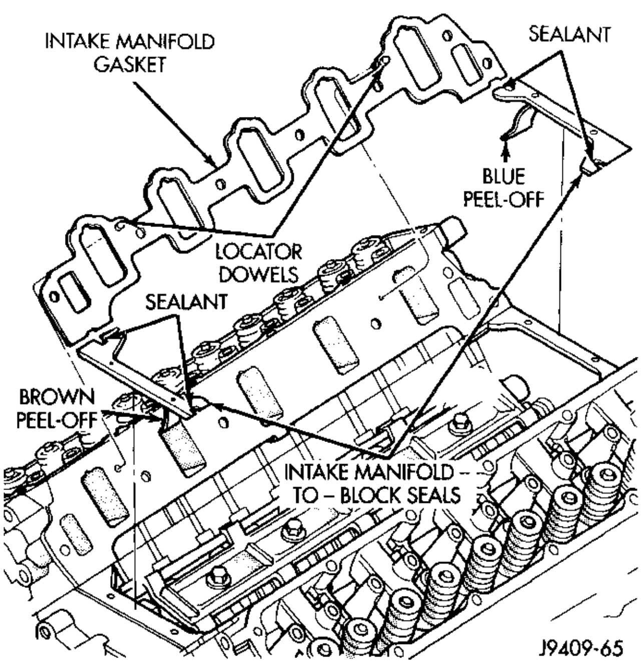


Fig. 23 Mopar® Silicone Rubber Adhesive Sealant Application Locations

(12) Tighten upper intake manifold bolts to 22 N·m (16 ft. lbs.) torque.

(13) Install the exhaust manifolds and new gaskets. Tighten the bolts and stud bolts to 22 N·m (16 ft. lbs.) torque.

(14) Install exhaust pipe to the exhaust manifold. Tighten the bolts to 34 n·m (25 ft. lbs.) torque.

(15) Using a new gasket, position the EGR tube to the intake manifold and the exhaust manifold. Tighten the EGR tube nut to 34 N·m (25 ft. lbs.) torque. Tighten the bolts to 20 N·m (174 in. lbs.) torque.

(16) Install the heat shields and the washers. **Make sure that heat shields tabs hook over the exhaust gasket.** Tighten the nuts to 15 N·m (132 in. lbs.) torque.

(17) Adjust spark plugs to specifications (refer to Group 8D, Ignition System). Install the plugs and tighten to 41 N·m (30 ft. lbs.) torque.

(18) Install coil packs and bracket. Tighten the bracket bolts to 21 N·m (190 in. lbs.) torque. Connect the coil wires.

(19) Connect heat indicator sending unit wire.

(20) Connect the heater hoses and bypass hose.

(21) Connect the accelerator linkage and if so equipped, the speed control and transmission kick-down cables.

(22) Install the fuel line.

(23) Install the generator and drive belt. Tighten generator mounting bolt to 41 N·m (30 ft. lbs.) torque. Tighten the adjusting strap bolt to 23 N·m (200 in. lbs.) torque. Refer to Group 7, Cooling System for adjusting the belt tension.

(24) Install the intake manifold-to-generator bracket support rod. Tighten the bolts to 41 N·m (30 ft. lbs.) torque.

(25) The cylinder head cover gasket can be used again. Install the gasket onto the head rail. **For the left side the number tab is at the front of engine with the number up. For the right side the number tab is at the rear of engine with the number up.**

CAUTION: The cylinder head cover fasteners have a special plating. DO NOT use alternative fasteners.

(26) Position the cylinder head cover onto the gasket. Install the stud bolts and hex head bolts in the proper positions (Fig. 1). Tighten the stud bolts and the bolts to 16 N·m (144 in. lbs.) torque.

(27) Install closed crankcase ventilation system.

(28) Connect the evaporation control system.

(29) Install the air cleaner.

(30) Fill cooling system (refer to Group 7, Cooling System for proper procedure).

(31) Connect the negative cable to the battery.

(32) Check for leaks (fuel, oil, antifreeze, etc.).

VALVES AND VALVE SPRINGS

REMOVAL

(1) Remove the cylinder head.

(2) Special studs must be used to adapt the Valve Spring Compressor Tool to the V-10 cylinder head (Fig. 24). Install the metric end into the Special Tool MD998772A and the 5/16 end into the cylinder head.

(3) Compress valve springs using Valve Spring Compressor Tool MD-998772A with Adapter 6716A and Screw 6765 (Fig. 25). Tap the retainer using a brass drift and ball peen hammer to loosen locks away from retainer.

REMOVAL AND INSTALLATION (Continued)

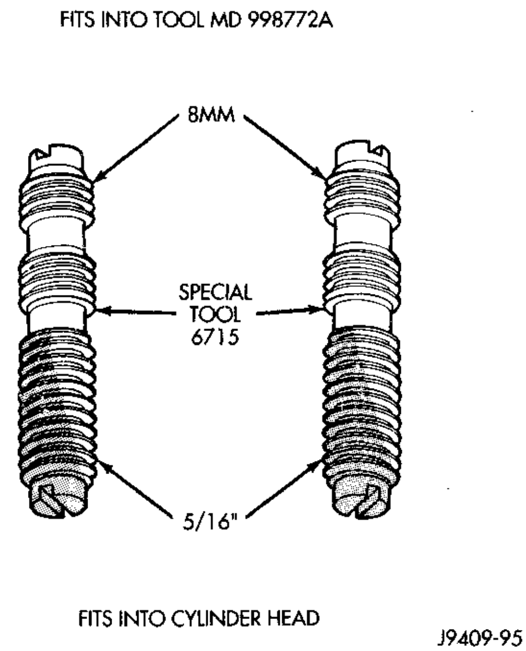


Fig. 24 Special Studs 6715 for V-10 Engine

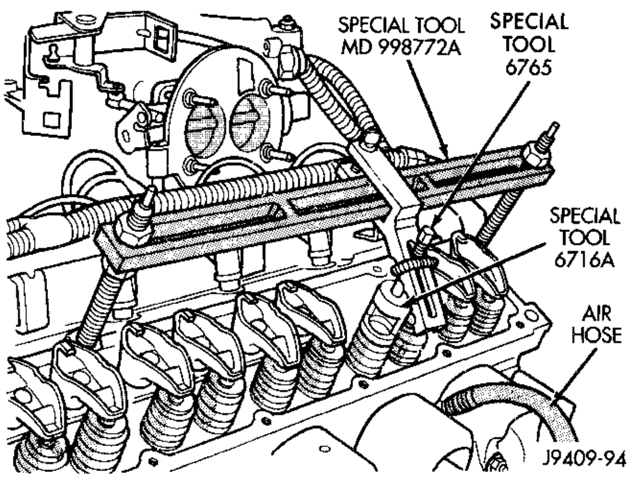


Fig. 25 Valve Spring Compressor MD-998772A with Adaptor 6716-A and Screw 6765

(4) Remove valve retaining locks, valve spring retainers and valve springs. Check for abnormal wear, replace as required.

(5) Remove the valve stem seals.

(6) Before removing valves, remove any burrs from valve stem lock grooves to prevent damage to the valve guides. Identify valves to ensure installation in original location.

INSTALLATION

(1) Clean valves thoroughly. Discard burned, warped and cracked valves.

(2) Remove carbon and varnish deposits from inside of valve guides with a reliable guide cleaner.

(3) Measure valve stems for wear. If wear exceeds 0.051 mm (0.002 inch), replace the valve.

(4) Make sure there are no burrs on valve stems.

(5) Coat valve stems with lubrication oil. Insert valves into valve guides in cylinder head.

(6) Install new seals on all valve guides **(BLACK on intake and BROWN on exhaust)**. Install valve springs and valve retainers.

(7) Compress valve springs with Valve Spring Compressor Tool MD-998772A and adapter 6716A, install locks and release tool. Tap the retainer with a brass or heavy plastic hammer to ensure locks have been seated.

(8) If valves and/or seats were ground, measure the installed height of springs. Make sure the measurement is taken from bottom of spring seat in cylinder head to the bottom surface of spring retainer. If spacers are installed, measure from the top of spacer. If height is greater than 42.86 mm (1-11/16 inches), install a 1.587 mm (1/16 inch) spacer in head counterbore. Ensure this brings spring height back to normal, 41.27 to 42.86 mm (1-5/8 to 1-11/16 inch).

HYDRAULIC TAPPETS

REMOVAL

(1) Disconnect the negative cable from the battery.

(2) Remove the air cleaner.

(3) Remove cylinder head cover.

(4) Remove rocker arm assembly and push rods. Identify push rods to ensure installation in original location.

(5) Remove upper and lower intake manifold.

(6) Cut the cylinder head gasket for accessibility if the end tappets are to be removed.

(7) Remove yoke retainer spider and tappet aligning yokes (Fig. 26).

(8) Pull tappet out of bore with a twisting motion. If all tappets are to be removed, identify tappets to ensure installation in original location.

(9) If the tappet or bore in cylinder block is scored, scuffed, or shows signs of sticking, ream the bore to next oversize. Replace with oversize tappet.

(10) Check camshaft lobes for abnormal wear.

INSTALLATION

(1) Lubricate tappets.

(2) Install tappets in their original positions. **Ensure that the oil bleed hole (if so equipped) faces forward.**

(3) Install tappet aligning yokes. Position the yoke retainer spider over the tappet aligning yokes (Fig. 26) Install the yoke retaining spider bolts and tighten to 22 N·m (16 ft. lbs.) torque.

(4) Install the push rods in their original location.

REMOVAL AND INSTALLATION (Continued)

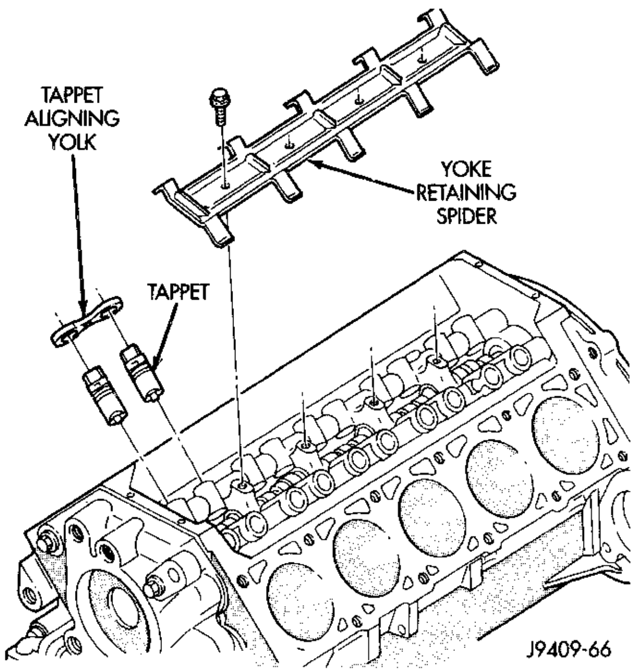


Fig. 26 Tappets, Aligning Yoke and Yoke Retaining Spider

(5) Position the rocker arm assembly on the pedestal and align to the push rods. Install the bolts and tighten to 28 N·m (21 ft. lbs.) torque.

(6) Install lower and upper intake manifold.

(7) The cylinder head cover gasket can be used again. Install the gasket onto the head rail. **For the left side the number tab is at the front of engine with the number up. For the right side the number tab is at the rear of engine with the number up.**

(8) Position the cylinder head cover onto the gasket. Install the stud bolts and hex head bolts in the proper positions (Fig. 26). Tighten the stud bolts and the bolts to 16 N·m (144 in. lbs.) torque.

(9) Install the air cleaner.

CAUTION: To prevent damage to valve mechanism, engine must not be run above fast idle until all hydraulic tappets have filled with oil and have become quiet.

(10) Connect the negative cable to the battery.

(11) Road test vehicle and check for leaks.

VIBRATION DAMPER

REMOVAL

(1) Disconnect the negative cable from the battery.

(2) Remove fan shroud retainer bolts and set shroud back over engine.

(3) Remove the cooling system fan.

(4) Remove the serpentine belt (refer to Group 7, Cooling System).

(5) Remove crankshaft pulley/damper bolt and washer from end of crankshaft (Fig. 27).

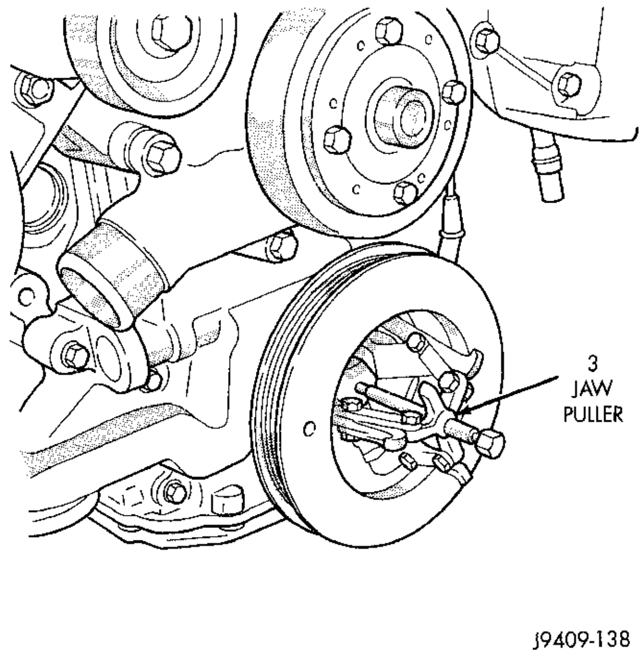


Fig. 27 Crankshaft Pulley—Damper

(6) Using a 3-prong puller tool, pull pulley—damper off of the crankshaft.

(7) Inspect crankshaft oil seal (Fig. 28).

INSTALLATION

(1) Position the crankshaft pulley/damper onto the crankshaft.

(2) Use tool C-3688 to press the pulley/damper onto the crankshaft. Install crankshaft bolt and washer and tighten to 183 N·m (135 ft. lbs.) torque (Fig. 28).

(3) Install the serpentine belt (refer to Group 7, Cooling System).

(4) Install the cooling system fan. Tighten the bolts to 23 N·m (17 ft. lbs.) torque.

(5) Position the fan shroud and install the bolts. Tighten the bolts to 11 N·m (95 in. lbs.) torque.

(6) Connect the negative cable to the battery.

TIMING CHAIN COVER

REMOVAL

(1) Disconnect the negative cable from the battery.

(2) Drain cooling system (refer to Group 7, Cooling System).

(3) Remove the serpentine belt (refer to Group 7, Cooling System).

(4) Remove fan shroud.

(5) Remove fan.

REMOVAL AND INSTALLATION (Continued)

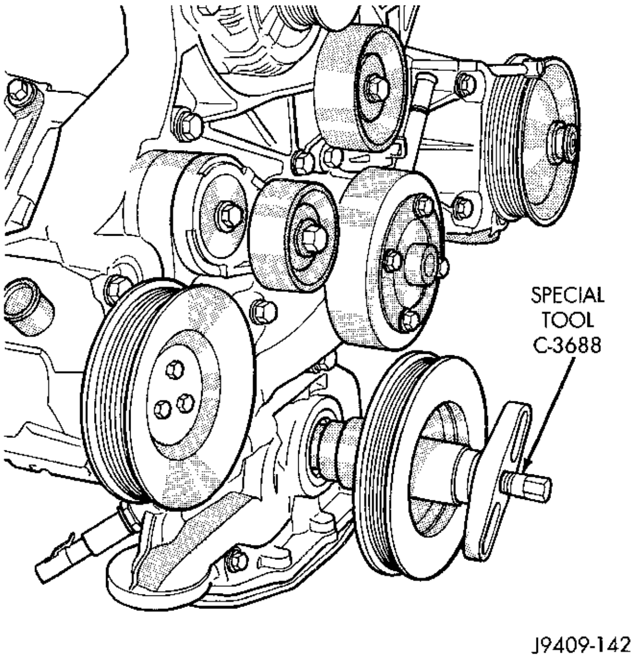


Fig. 28 Installing Crankshaft Pulley—Damper

(6) Unbolt A/C compressor and set on top of engine.
(7) Remove generator, air pump, and bracket assembly.
(8) Remove water pump (refer to Group 7, Cooling System).
(9) Using a 3-prong puller to remove pulley/damper from the crankshaft. (Fig. 29)

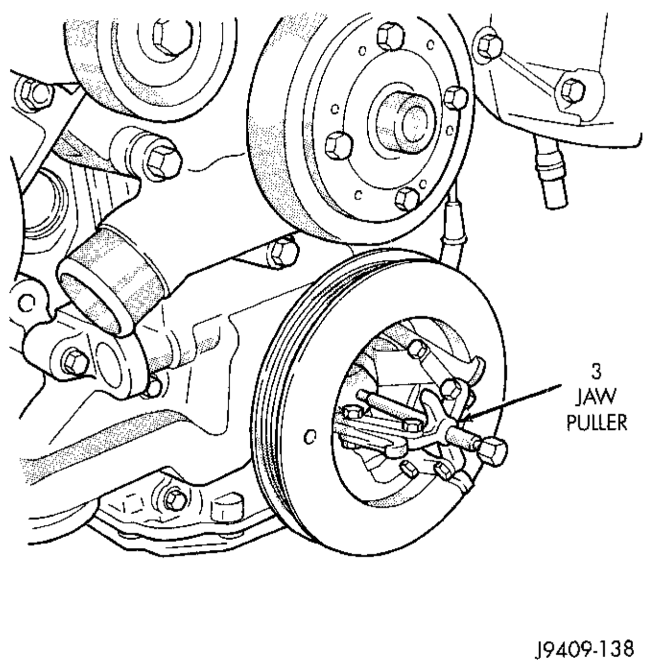


Fig. 29 Pulley—Damper Removal

(10) Loosen oil pan bolts and remove the front oil pan bolts that mount the pan to the timing chain cover.
(11) Remove the cover bolts.
(12) Remove timing chain cover and gasket using extreme caution to avoid damaging oil pan gasket.
(13) Inspect surface of cover. Remove any burrs or high spots.

INSTALLATION

(1) Be sure mating surfaces of timing chain cover and cylinder block are clean and free from burrs.
(2) Lubricate the pump rotors using petroleum jelly or lubriplate and install in the timing chain cover (Fig. 30).

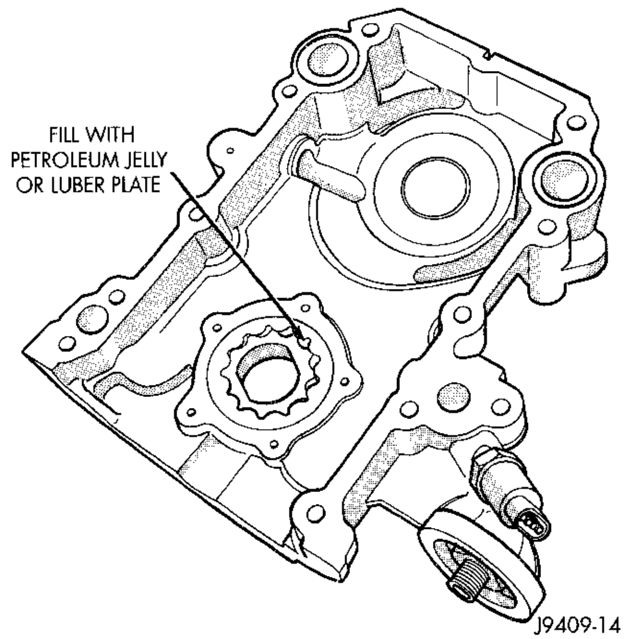


Fig. 30 Priming Oil Pump.

(3) Using a new cover gasket, carefully install timing chain cover to avoid damaging oil pan gasket. Use a small amount of Mopar® Silicone Rubber Adhesive Sealant, or equivalent, at the joint between timing chain cover gasket and the oil pan gasket. Finger tighten the timing chain cover bolts at this time.
(4) Tighten timing chain cover bolts to 47 N·m (35 ft. lbs.) torque. Tighten oil pan bolts to 24 N·m (215 in. lbs.) torque.
(5) Install pulley/vibration damper use tool C-3688 (Fig. 31)
(6) Prime oil pump by squirt oil in the oil filter mounting hole and filling the J-trap of the front timing cover. When oil is running out, install oil filter that has been filled with oil.
(7) Install water pump and housing assembly using o-ring (refer to Group 7, Cooling System). Tighten bolts to 41 N·m (30 ft. lbs.) torque.

REMOVAL AND INSTALLATION (Continued)

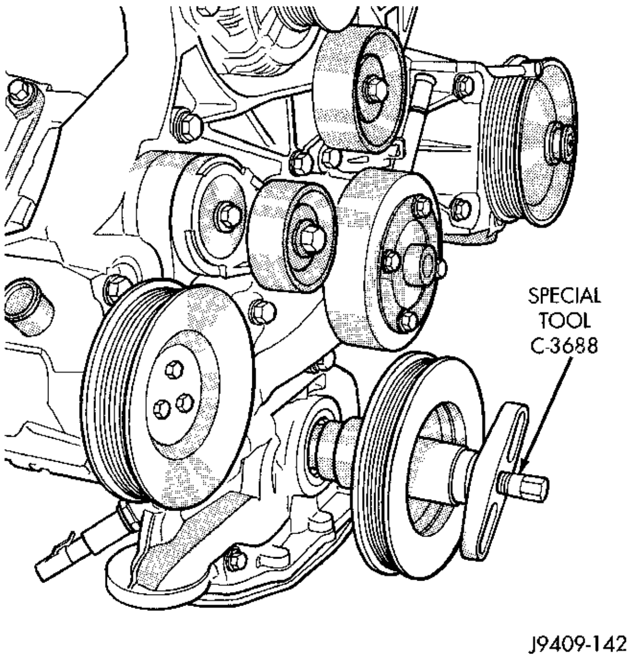


Fig. 31 Installing Crankshaft Pulley/Damper

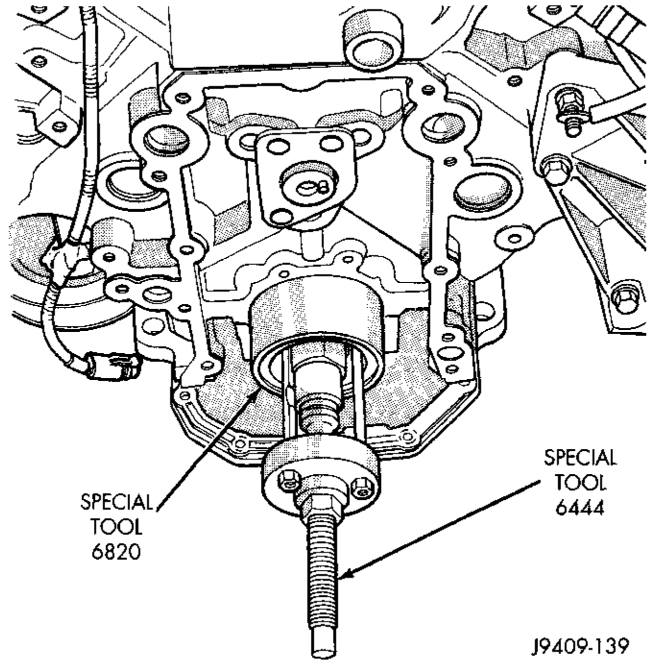


Fig. 32 Crankshaft Sprocket Removal.

(8) Install generator, air pump, and bracket assembly.
(9) Install A/C compressor.
(10) (10) Install the cooling system fan. Tighten the bolts to 23 N·m (17 ft. lbs.) torque.
(11) Position the fan shroud and install the bolts. Tighten the bolts to 11 N·m (95 in. lbs.) torque.
(12) Install the serpentine belt (refer to Group 7, Cooling System).
(13) Fill cooling system (refer to Group 7, Cooling System for the proper procedure).
(14) Connect the negative cable to the battery.
(15) Road test vehicle and check for leaks.

TIMING CHAIN

REMOVAL

(1) Remove timing chain cover and gasket using extreme caution to avoid damaging oil pan gasket.
(2) Aline camshaft and crankshaft centerline. Remove camshaft sprocket attaching bolt and remove timing chain and camshaft sprockets.
(3) Use puller 6444 and jaws 6820 to remove crankshaft sprocket (Fig. 32).

INSTALLATION

(1) Line up key in crankshaft with keyway in sprocket, press on crankshaft timing sprocket, use tools C-3688, C-3718 and MB-990799, seat sprocket against crankshaft shoulder (Fig. 33).
(2) Turn crankshaft to line up the timing mark with the crankshaft and camshaft centerline.
(3) Put chain on camshaft sprocket.

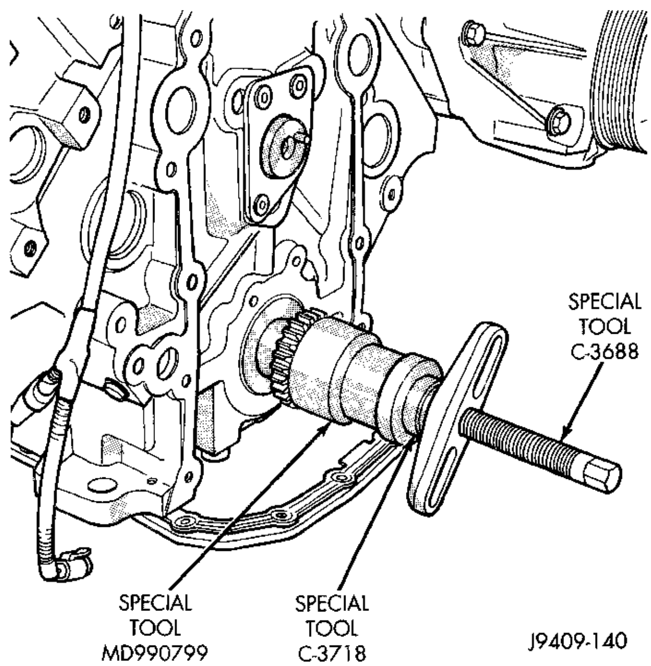


Fig. 33 Crankshaft Sprocket Installation

(4) Take chain and camshaft sprocket, align timing marks and install chain and cam sprocket onto crankshaft sprocket. Check to see that timing marks are on the centerline of the crankshaft and camshaft centerline (Fig. 34).
(5) Install the camshaft bolt. Tighten the bolt to 61 N·m (45 ft. lbs.) torque.
(6) Check camshaft end play. The end play should be 0.051-0.152 mm (0.002-0.006 inch) with a new

REMOVAL AND INSTALLATION (Continued)

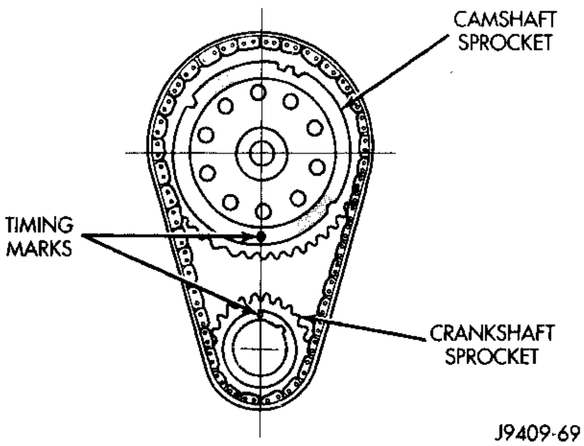


Fig. 34 Alignment of Timing Marks

thrust plate and up to 0.254 mm (0.010 inch) with a used thrust plate. If not within these limits install a new thrust plate.

(7) Install timing chain cover.

TIMING CHAIN COVER OIL SEAL (COVER NOT REMOVED)

REMOVAL

(1) Disconnect the negative cable from the battery.

(2) Remove the cooling fan and shroud.

(3) Remove the serpentine belt (refer to Group 7, Cooling Systems).

(4) Using a 3-jaw puller tool, pull pulley/damper off of the crankshaft.

(5) Place a suitable tool behind the lips of the oil seal to pry the oil seal outward. Be careful not to damage the crankshaft seal surface of the cover (Fig. 35).

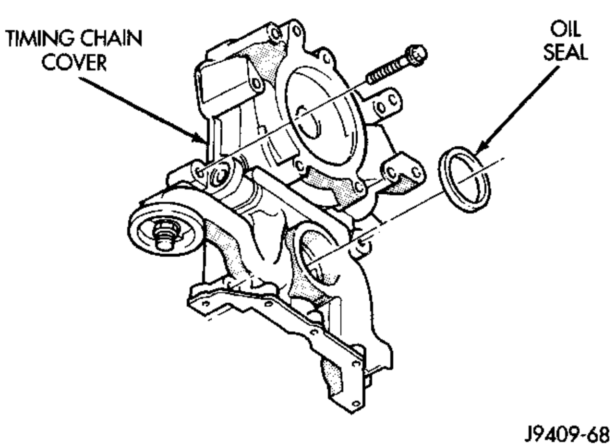


Fig. 35 Timing Chain Cover and Oil Seal

INSTALLATION

(1) Position the crankshaft front oil seal onto seal installer special tool 6806 and C-3688 (Fig. 36). Install seal.

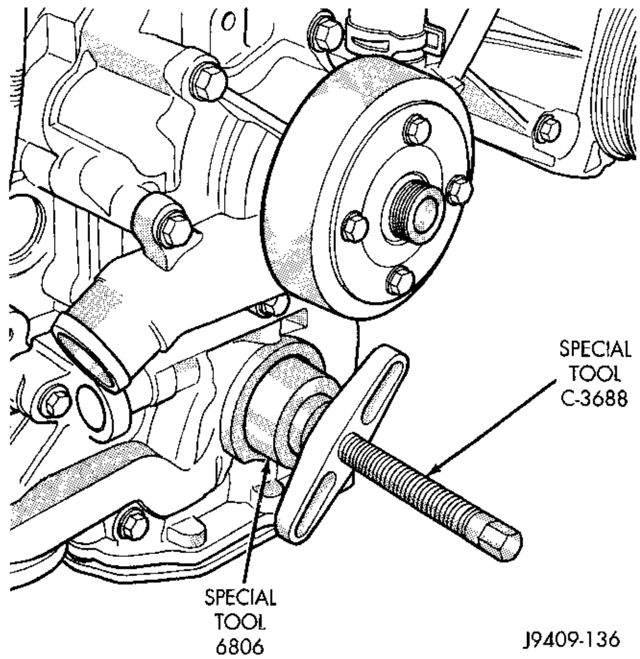


Fig. 36 Timing Chain Cover and Oil Seal

(2) Install crankshaft pulley/damper using tool C-3688.

(3) Install serpentine belt (refer to Group 7, Cooling System).

(4) Install cooling fan and shroud.

(5) Connect negative cable to the battery.

TIMING CHAIN COVER OIL SEAL (COVER REMOVED)

REMOVAL

(1) With timing cover removed from engine place a suitable tool behind the lips of the oil seal to pry the oil seal outward. Be careful not to damage the crankshaft seal surface of the cover.

INSTALLATION

(1) Position the crankshaft front oil seal onto seal installer special tool 6806.

(2) Use tool 6761 to support timing chain cover when installing oil seal with tool 6806 (Fig. 37), install seal.

REMOVAL AND INSTALLATION (Continued)

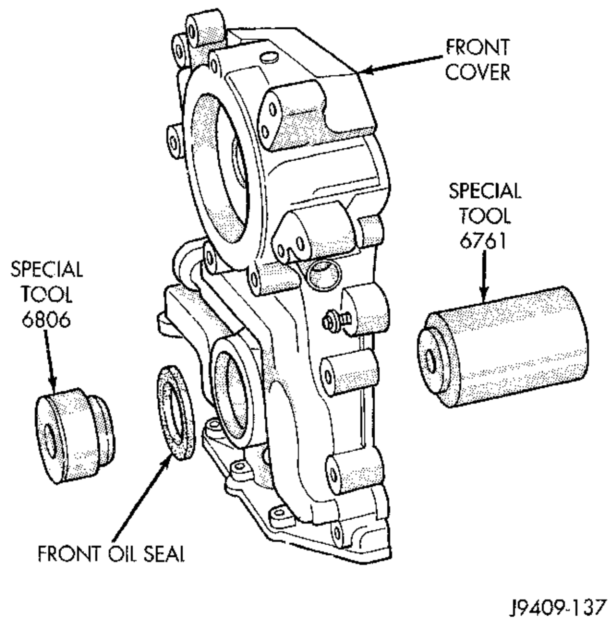


Fig. 37 Oil Seal, Tools—6806 and 6761

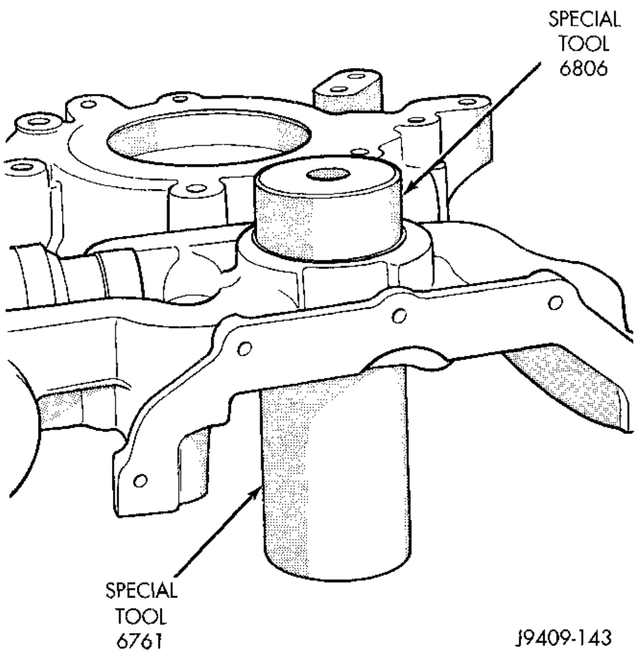


Fig. 38 Oil Seal Installed

CAMSHAFT

The camshaft has an integral oil pump and distributor drive gear (Fig. 39).

REMOVAL

(1) Remove cylinder head covers.

(2) Remove rocker arm assemblies, identify each part so it can be installed in its original location..

(3) Remove push rods and tappets. Identify each part so it can be installed in its original location.

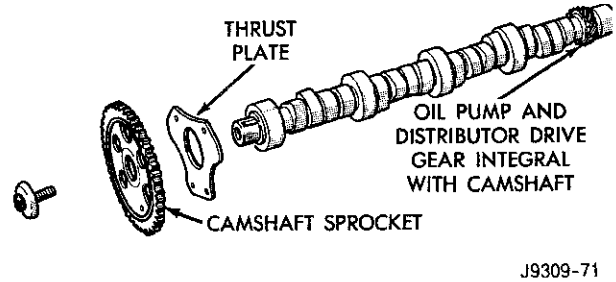


Fig. 39 Camshaft and Sprocket Assembly

(4) The 4 corner tappets can not be removed without removing the cylinder heads and gaskets. They can be lifted and retained for camshaft removal.

(5) Remove upper and lower intake manifold (refer to Group 11 Intake and Exhaust Systems).

(6) Remove timing chain cover and timing chain.

(7) Remove camshaft thrust plate (Fig. 40).

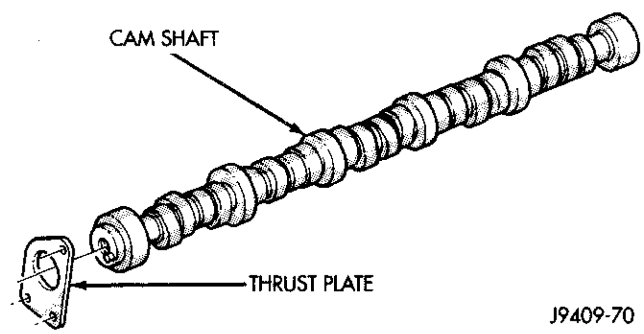


Fig. 40 Camshaft

(8) Install a long bolt into front of camshaft to facilitate removal of the camshaft. Remove camshaft, being careful not to damage cam bearings with the cam lobes.

INSTALLATION

(1) Lubricate camshaft lobes and camshaft bearing journals. Using a long bolt, insert the camshaft into the cylinder block.

NOTE: Whenever an engine has been rebuilt, a new camshaft and/or new tappets installed, add 1 pint of Mopar® Crankcase Conditioner, or equivalent. The oil mixture should be left in engine for a minimum of 805 km (500 miles). Drain at the next normal oil change.

(2) Install camshaft thrust plate. Tighten the torx bolts to 22 N·m (16 ft. lbs.) torque.

(3) Check camshaft end play. The end play should be 0.051-0.152 mm (0.002-0.006 inch) with a new thrust plate and up to 0.254 mm (0.010 inch) with a used thrust plate. If not within these limits install a new thrust plate.

REMOVAL AND INSTALLATION (Continued)

(4) Line up key with keyway in sprocket, press on crankshaft timing sprocket, use tools C-3688, C-3718 and MB990799, to seat sprocket against crankshaft shoulder (Fig. 41).

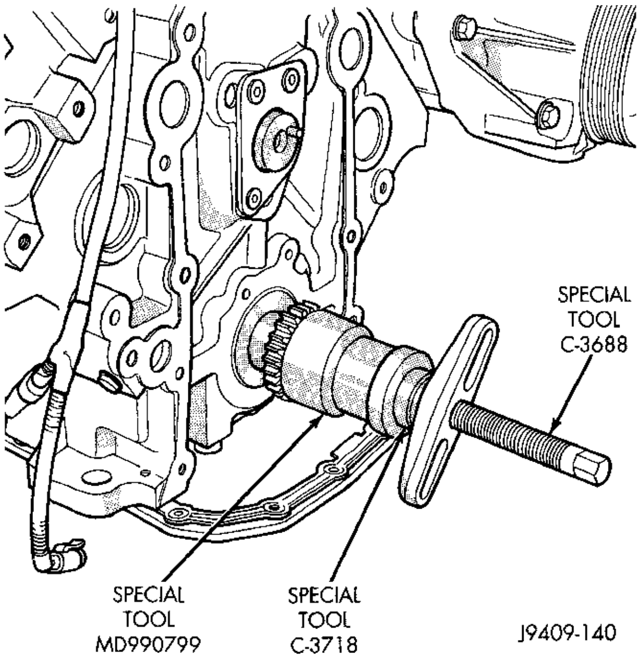


Fig. 41 Crankshaft Sprocket Installation

(5) Align timing mark on crankshaft sprocket with center line of crankshaft and camshaft.

(6) Put chain on camshaft sprocket.

(7) Take chain and camshaft sprocket and align mark with centerline of crankshaft and camshaft install camshaft sprocket and chain to camshaft.

(8) Install the camshaft bolt. Tighten bolt to 75 N·m (55 ft. lbs.) torque.

(9) Install the timing chain cover.

(10) Install the crankshaft pulley/damper use tool C-3688.

(11) Prime oil pump by squirt oil in the oil filter mounting hole and filling the J-trap of the front timing cover. When oil is running out, install oil filter that has been filled with oil.

(12) Each tappet reused must be installed in the same position from which it was removed. **When camshaft is replaced, all of the tappets must be replaced.**

(13) Install tappets and push rods in their original location.

(14) Install the rocker arms.

(15) The cylinder head cover gasket can be used again. Install the gasket onto the head rail. **For the left side the number tab is at the front of engine with the number up. For the right side the number tab is at the rear of engine with the number up.**

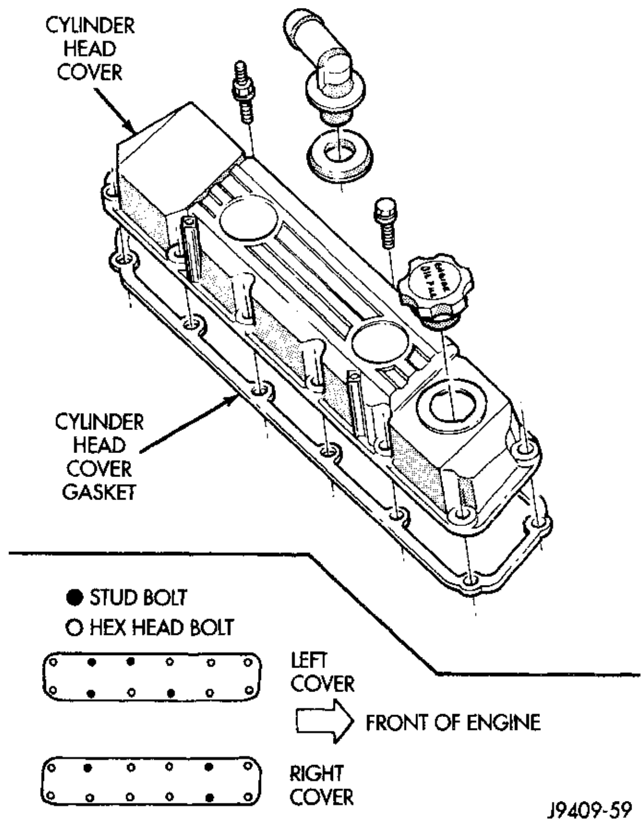


Fig. 42 Cylinder Head Cover

CAUTION: The cylinder head cover fasteners have a special plating. DO NOT use alternative fasteners.

(16) Position the cylinder head cover onto the gasket. Install the stud bolts and hex head bolts in the proper positions (Fig. 42). Tighten the stud bolts and the bolts to 16 N·m (144 in. lbs.) torque.

(17) Install the intake manifolds, (refer to Group 11 Intake and Exhaust Systems).

CAMSHAFT BEARING

REMOVAL

This procedure requires that the engine is removed from the vehicle.

(1) With engine completely disassembled, drive out rear cam bearing core hole plug.

(2) Install proper size adapters and horseshoe washers (part of Camshaft Bearing Remover/Installer Tool C-3132-A) at back of each bearing shell. Drive out bearing shells (Fig. 43).

INSTALLATION

(1) Install new camshaft bearings with Camshaft Bearing Remover/Installer Tool C-3132-A by sliding the new camshaft bearing shell over proper adapter.

REMOVAL AND INSTALLATION (Continued)

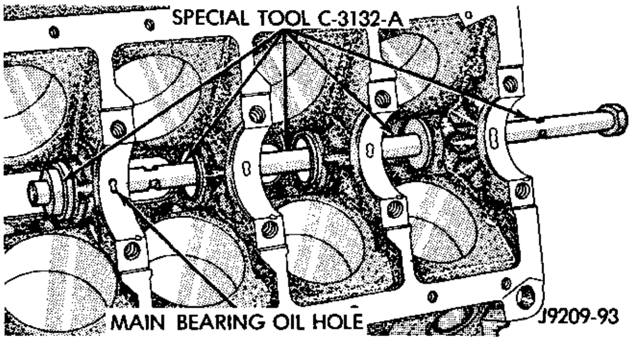


Fig. 43 Camshaft Bearings Removal and Installation with Tool C-3132-A

(2) Position rear bearing in the tool. Install horseshoe lock and by reversing removal procedure, carefully drive bearing shell into place.

(3) Install remaining bearings in the same manner. Bearings must be carefully aligned to bring oil holes into full register with oil passages from the main bearing. If the camshaft bearing shell oil holes are not in exact alignment, remove and install them correctly. Install a new core hole plug at the rear of camshaft. **Be sure this plug does not leak.**

OIL PAN

REMOVAL

(1) Disconnect the negative cable from the battery.

(2) Raise vehicle.

(3) Drain engine oil.

(4) Remove left engine to transmission strut.

(5) Remove oil pan and one-piece gasket. The engine may have to be raised slightly on 2WD vehicles.

(6) Remove the oil pick-up tube assembly (Fig. 44). Discard the gasket.

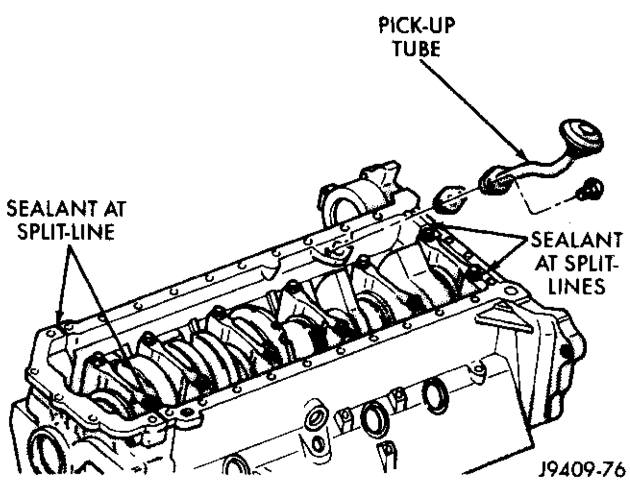


Fig. 44 Oil Pick-Up Tube

INSTALLATION

(1) Fabricate 4 alignment dowels from 5/16 x 1 1/2 inch bolts. Cut the head off the bolts and cut a slot into the top of the dowel. This will allow easier installation and removal with a screwdriver (Fig. 45).

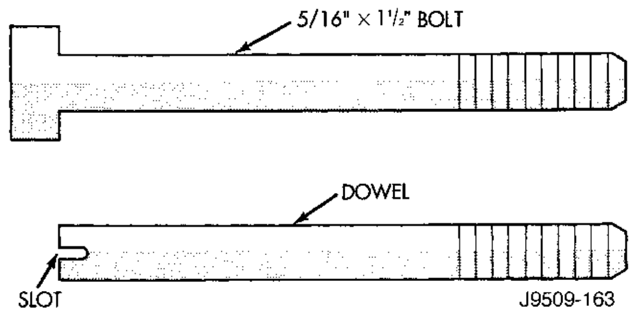


Fig. 45 Fabrication of Alignment Dowels

(2) Install the dowels in the cylinder block at the four corners.

(3) Apply small amount of Mopar® Silicone Rubber Adhesive Sealant, or equivalent at the split lines. The split lines are between the cylinder block, the timing chain cover and the rear crankshaft seal assembly (Fig. 44). **After the sealant is applied you have 3 minutes to install the gasket and oil pan.**

(4) Slide the one-piece gasket over the dowels and onto the block.

(5) Position the oil pan over the dowels and onto the gasket. The engine may have to be slightly raised on 2WD vehicles.

(6) Install the oil pan bolts (Fig. 46). Tighten the 1/4 inch bolts to 11 N·m (96 in. lbs.) torque. Tighten the stud bolts to 16 N·m (144 in. lbs.) torque. Tighten the 5/16 inch bolts to 16 N·m (144 in. lbs.) torque.

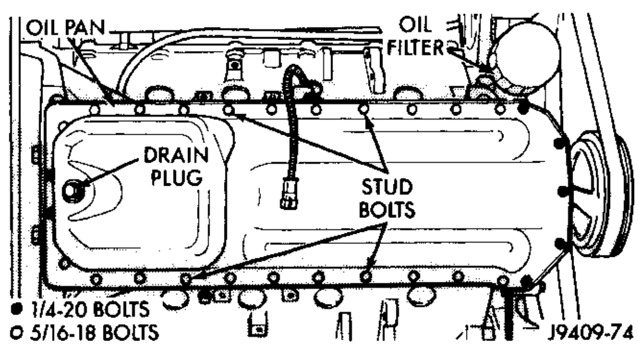


Fig. 46 Oil Pan Bolt Location

(7) Remove the dowels. Install the remaining 5/16 inch oil pan bolts. Tighten these bolts to 16 N·m (144 in. lbs.) torque.

(8) Install the drain plug. Tighten drain plug to 34 N·m (25 ft. lbs.) torque.

(9) Install the engine to transmission strut.

(10) Lower vehicle.

REMOVAL AND INSTALLATION (Continued)

(11) Connect the negative cable to the battery.
(12) Fill crankcase with oil to proper level.

PISTON AND CONNECTING ROD ASSEMBLY

REMOVAL

(1) Remove the engine from the vehicle (refer to Engine Removal of this manual).

(2) Remove the valve cover, rocker arms, push rods and cylinder head. Mark parts as removed.

(3) Remove the oil pan and oil pump pick-up tube.

(4) Remove top ridge of cylinder bores with a reliable ridge reamer before removing pistons from cylinder block. Be sure to keep tops of pistons covered during this operation.

(5) Be sure the connecting rod and connecting rod cap are identified with the cylinder number. Remove connecting rod cap. Install connecting rod bolt guide set on connecting rod bolts.

(6) Pistons and connecting rods must be removed from top of cylinder block. When removing piston and connecting rod assemblies, rotate crankshaft center the connecting rod in the cylinder bore and at BDC. **Be careful not to nick crankshaft journals. DO NOT try to remove black coating on skirt. This is the dry film lubricant.**

(7) After removal, install bearing cap on the mating rod.

INSTALLATION

(1) Check the crankshaft connecting rod journal for excessive wear, taper and scoring.

(2) Check the cylinder block bore for out-of-round, taper, scoring and scuffing.

(3) Be sure that compression ring gaps are staggered so that neither is in line with oil ring rail gap.

(4) Before installing the ring compressor, make sure the oil ring expander ends are butted and the rail gaps located properly (Fig. 47).

(5) Immerse the piston head and rings in clean engine oil. Slide Piston Ring Compressor Tool C-385 over the piston and tighten with the special wrench (part of Tool C-385). **Be sure position of rings does not change during this operation.**

(6) Install connecting rod bolt protectors on rod bolts, a long protector should be installed on the numbered side of the connecting rod.

(7) Rotate crankshaft so that the connecting rod journal is on the center of the cylinder bore in the bottom dead center position. Be sure connecting rod and cylinder bore number are the same. Insert rod and piston into cylinder bore. Be sure the piston and rod assemblies are installed in the proper orientation (Fig. 48).

(8) The notch, groove or arrow on top of piston must be pointing toward front of engine. The larger chamfer of the connecting rod bore must be installed toward crankshaft journal fillet.

(9) While tapping the piston down in cylinder bore with the handle of a hammer, guide the connecting rod over the crankshaft journal.

(10) Install rod caps. Install nuts on cleaned and oiled rod bolts and tighten nuts to 61 N·m (45 ft. lbs.) torque.

(11) Install the oil pump pick-up tube and oil pan.

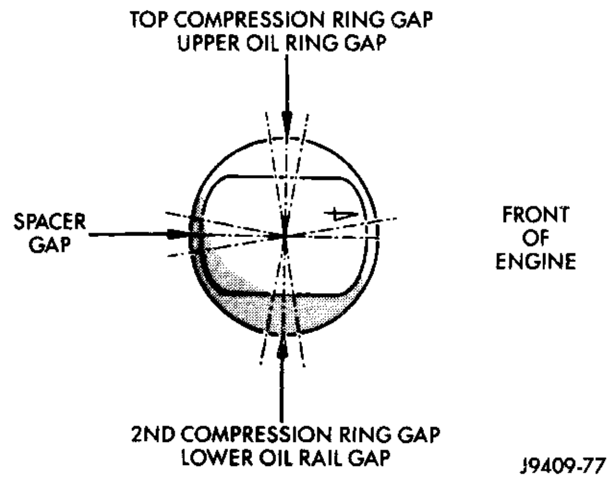


Fig. 47 Proper Ring Installation

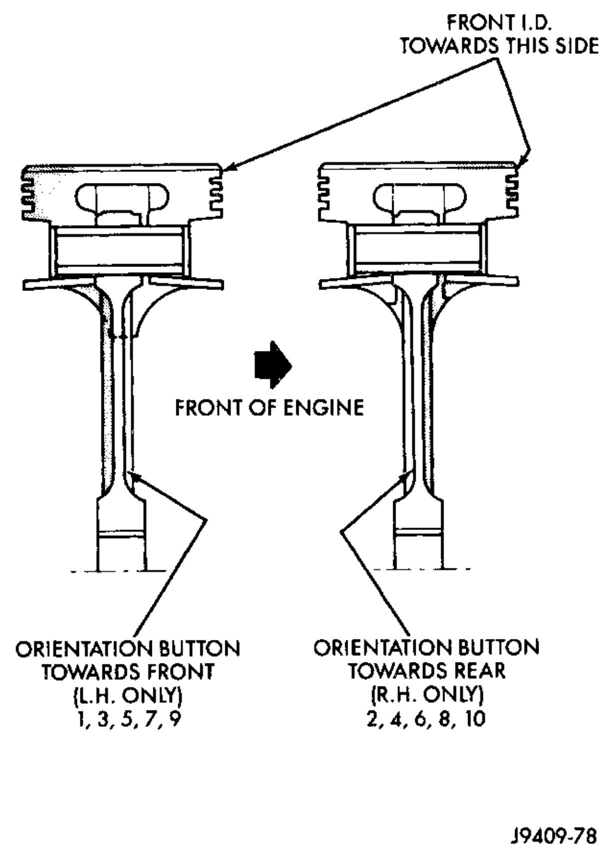


Fig. 48 Piston and Rod Orientation

REMOVAL AND INSTALLATION (Continued)

(12) Install the cylinder head, push rods, rocker arms and valve cover.

(13) Install lower intake manifold.

(14) Install the engine into the vehicle.(refer to Engine Installation of this manual).

CRANKSHAFT MAIN BEARINGS

REMOVAL

(1) Remove the oil pan and oil pump pick-up tube.

(2) Identify bearing caps before removal. Remove bearing caps one at a time.

(3) Remove upper half of bearing by inserting Crankshaft Main Bearing Remover/Installer Tool C-3059 into the oil hole of crankshaft (Fig. 49).

(4) Slowly rotate crankshaft clockwise, forcing out upper half of bearing shell.

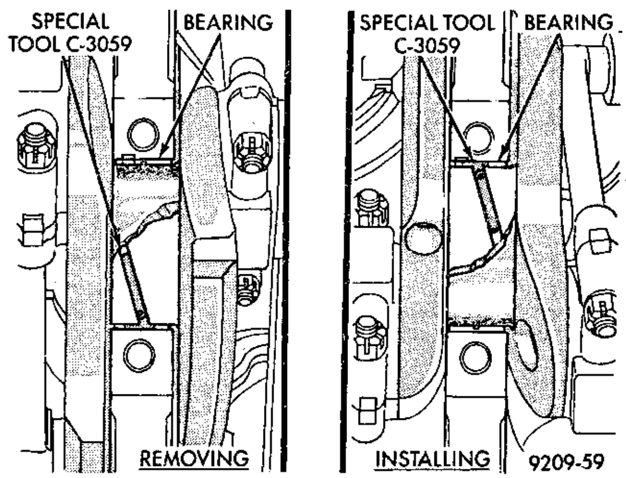


Fig. 49 Upper Main Bearing Removal and Installation with Tool C-3059

INSTALLATION

Only one main bearing should be selectively fitted while all other main bearing caps are properly tightened. All bearing capbolts removed during service procedures are to be cleaned and oiled before installation.

When installing a new upper bearing shell, slightly chamfer the sharp edges from the plain side.

(1) Start bearing in place, and insert Crankshaft Main Bearing Remover/Installer Tool C-3059 into oil hole of crankshaft (Fig. 49).

(2) Slowly rotate crankshaft counterclockwise sliding the bearing into position. Remove Tool C-3059.

(3) Lubricate the main journals with clean engine oil. Install main bearing caps and bolts. Follow the 2 step tightening sequence.

- Step 1—Starting with bearing cap No.1, tighten the bolts to 27 N·m (20 ft. lbs.) torque.
- Step 2—Starting with bearing cap No.1, tighten the bolts to 115 N·m (85 ft. lbs.) torque.

(4) Apply a rearward axial load of 667 N (150 lbs-f) on crankshaft centerline, driving No.3 main cap and thrust bearing against No.3 bulkhead. Repeat procedure, driving crankshaft forward to align rear flange of thrust bearings in a common plane. Front face of No.1 main cap must not extend forward in front of face of No.1 bulkhead.

(5) Install the oil pump pick-up tube and oil pan.

CRANKSHAFT

When a crankshaft is replaced, all main and connecting rod bearings should be replaced with new bearings. Therefore, selective fitting of the bearings is not required when a crankshaft and bearings are replaced.

REMOVAL

(1) Remove the oil pan.

(2) Remove the oil pickup tube.

(3) Remove the timing chain cover and gasket. Remove and discard the front crankshaft oil seal and cover gasket.

(4) Remove Transmission (refer to Group 21, Transmission).

(5) Remove the rear seal retainer. Remove and discard the crankshaft rear oil seal and retainer gasket.

(6) Identify main bearing caps before removal (Fig. 50). Remove bearing caps and bearings one at a time.

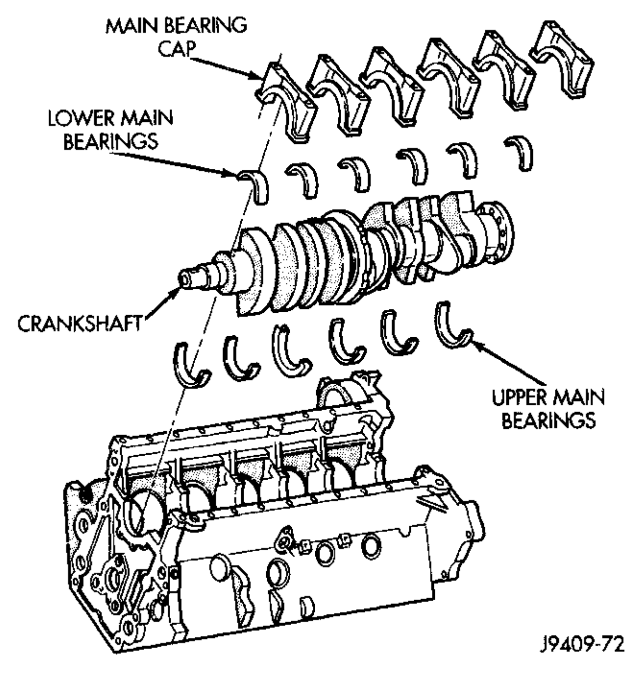


Fig. 50 Main Bearing Identification

(7) Remove the connecting rod bearing caps.

(8) Lift the crankshaft straight out of the block.

REMOVAL AND INSTALLATION (Continued)

INSTALLATION

(1) Lubricate crankshaft main bearings with clean engine oil.

(2) Install the crankshaft into the cylinder block.

(3) Lubricate the main journals with clean engine oil. Install main bearing caps and bolts. Follow the 2 step tightening sequence.

- Step 1—Starting with bearing cap No.1, tighten the bolts to 27 N·m (20 ft. lbs.) torque.
- Step 2—Starting with bearing cap No.1, tighten the bolts to 115 N·m (85 ft. lbs.) torque.

(4) Lubricate the connecting rod bearings and journals with clean engine oil. Carefully install connecting rods to the crankshaft.

(5) Install the rear seal retainer with a new gasket and oil seal. Use seal installer 6687 when installing the oil seal.

(6) Install the timing chain cover with a new gasket and oil seal.

(7) Prime oil pump by squirt oil in the oil filter mounting hole and filling the J-trap of the front timing cover. When oil is running out, install oil filter that has been filled with oil.

(8) Apply a rearward axial load of 667 N (150 lbs-f) on crankshaft centerline, driving No.3 main cap and thrust bearing against No.3 bulkhead. Repeat procedure, driving crankshaft forward to align rear flange of thrust bearings in a common plane. Front face of No.1 main cap must not extend forward in front of face of No.1 bulkhead.

(9) Install the oil pickup tube. Tighten the bolts to 16 N·m (144 in. lbs.) torque.

(10) Install the oil pan.

OIL PUMP

REMOVAL

(1) Remove the timing chain cover.

(2) Remove the relief valve plug, gasket, spring and valve (Fig. 51). Discard the gasket.

(3) Remove oil pump cover (Fig. 52).

(4) Remove pump rotors (Fig. 52).

INSTALLATION

(1) Lubricate the pump rotors using petroleum jelly or lubriplate and install in the timing chain cover. Use new parts as required (Fig. 53).

(2) Position the oil pump cover onto the timing chain cover. Tighten cover bolts to 14 N·m (125 in. lbs.) torque.

(3) Make sure that inner ring moves freely after cover is installed.

(4) Install the timing chain cover.

(5) Squirt oil into relief valve hole until oil runs out.

(6) Install the relief valve and spring.

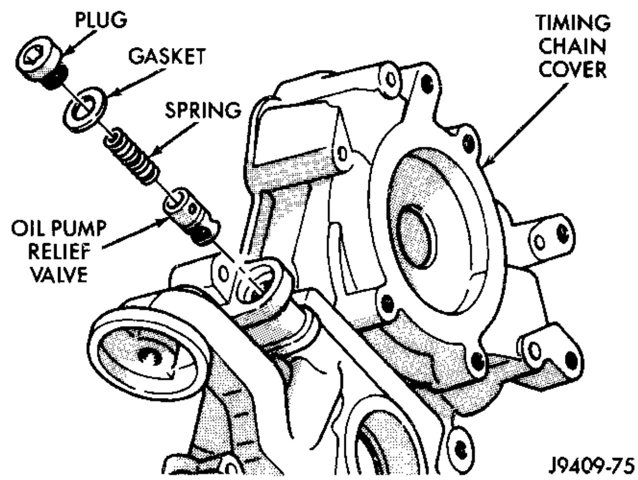


Fig. 51 Oil Pressure Relief Valve

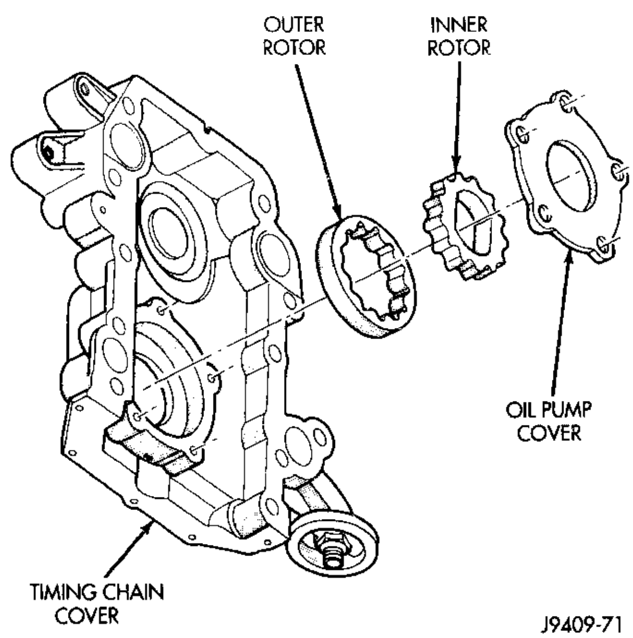


Fig. 52 Oil Pump

(7) Using a new pressure relief valve gasket, install the relief valve plug. Tighten the plug to 20 N·m (15 ft. lbs.) torque.

(8) Install oil filter that has been filled with oil.

CRANKSHAFT REAR SEAL/ RETAINER

REMOVAL

(1) Remove the transmission (refer to Group 21, Transmissions).

(2) Remove the oil pan.

(3) Remove the rear seal retainer. Discard the oil seal and the gasket (Fig. 54).

REMOVAL AND INSTALLATION (Continued)

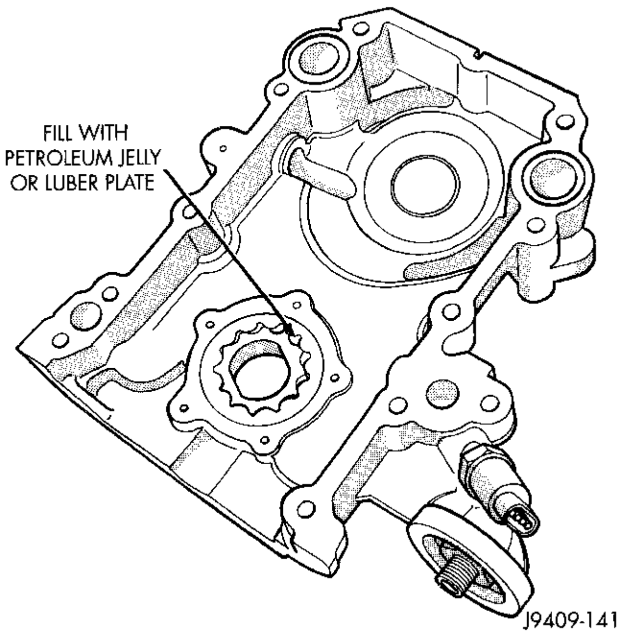


Fig. 53 Priming Oil Pump.

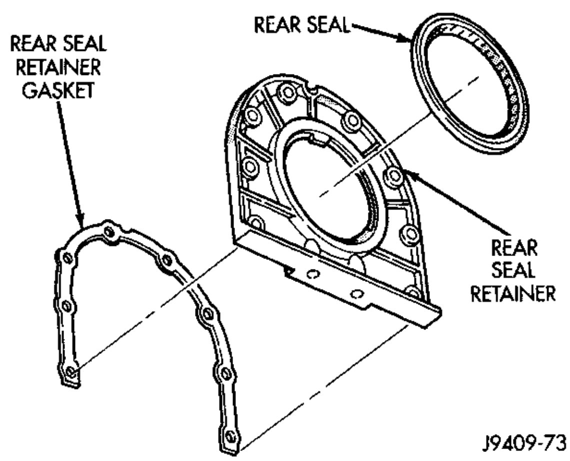


Fig. 54 Crankshaft Rear Seal Retainer

INSTALLATION

(1) Wash all parts in a suitable solvent and inspect carefully for damage or wear.

(2) Position the rear seal in the retainer.

(3) Using Special Tool 6687, position the retainer and oil seal over the crankshaft. Install the bolts and tighten to 22 N·m (16 ft. lbs.) torque.

(4) The seal face surface must be within 0.508 mm (0.020 in) full indicator movement relative to rear face of crankshaft. If out of limits, gently tap the high side into the retainer.

(5) Add a small amount of Mopar® Silicone Rubber Adhesive Sealant at split-line.

(6) Install the oil pan.

(7) Install the transmission (refer to group 21, Transmissions).

ENGINE CORE OIL—CAMSHAFT PLUGS

Engine core plugs have been pressed into the oil galleries behind the camshaft thrust plate. This will reduce internal leakage and help maintain higher oil pressure at idle.

REMOVAL

(1) Using a blunt tool such as a drift or a screwdriver and a hammer, strike the bottom edge of the cup plug (Fig. 55).

(2) With the cup plug rotated, grasp firmly with pliers or other suitable tool and remove plug (Fig. 55).

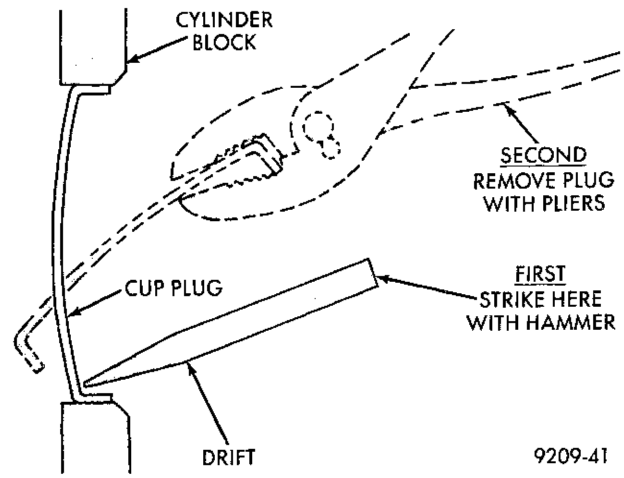


Fig. 55 Core Hole Plug Removal

INSTALLATION

(1) Thoroughly clean inside of cup plug hole in cylinder block or head. Be sure to remove old sealer.

(2) Make certain the new plug is cleaned of all oil or grease.

(3) Coat edges of plug and core hole with Mopar® Gasket Maker, or equivalent.

CAUTION: DO NOT drive cup plug into the casting as restricted coolant flow can result and cause serious engine problems.

(4) Using proper drive plug, drive plug into hole. The sharp edge of the plug should be at least 0.50 mm (0.020 inch) inside the lead-in chamfer.

It is not necessary to wait for curing of the sealant. The cooling system can be filled and the vehicle placed in service immediately.

DISASSEMBLY AND ASSEMBLY

VALVE SERVICE

VALVE GUIDES

Measure valve stem guide clearance as follows:

(1) Install Black Valve Guide Sleeve Tool C-6819 over valve stem for the **INTAKE** valve and install valve (Fig. 56). The special sleeve places the valve at the correct height for checking with a dial indicator.

(2) Install Silver Valve Guide Sleeve Tool C-6818 over valve stem for the **EXHAUST** valve and install valve. The special sleeve places the valve at the correct height for checking with a dial indicator.

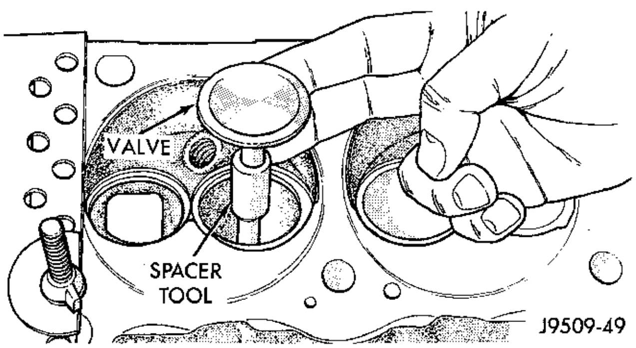


Fig. 56 Positioning Valve Spacer Tool (Typical)

(3) Attach Dial Indicator Tool C-3339 to cylinder head and set it at right angle of valve stem being measured (Fig. 57).

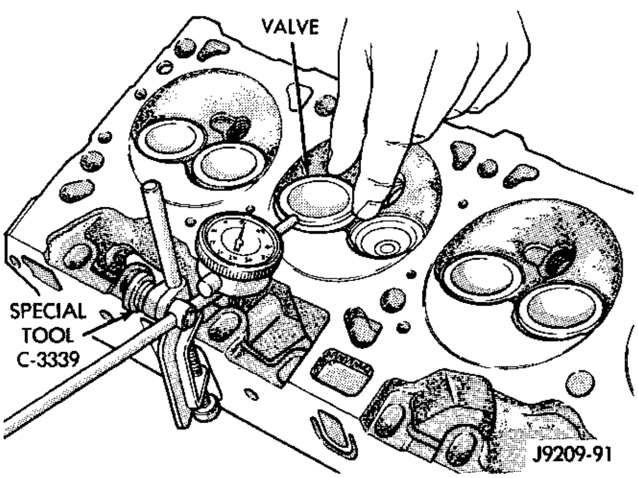


Fig. 57 Measuring Valve Guide Wear

(4) Move valve to and from the indicator. The total dial indicator reading should not exceed 0.432 mm (0.017 inch). Ream the guides for valves with oversize stems if dial indicator reading is excessive or if the stems are scuffed or scored.

Service valves with oversize stems are available (Fig. 58).

Reamer O/S	Valve Guide Size
0.076 mm (0.003 in.)	8.026 – 8.052 mm (0.316 – 0.317 in.)
0.381 mm (0.015 in.)	8.331 – 8.357 mm (0.328 – 0.329 in.)

J9309-30

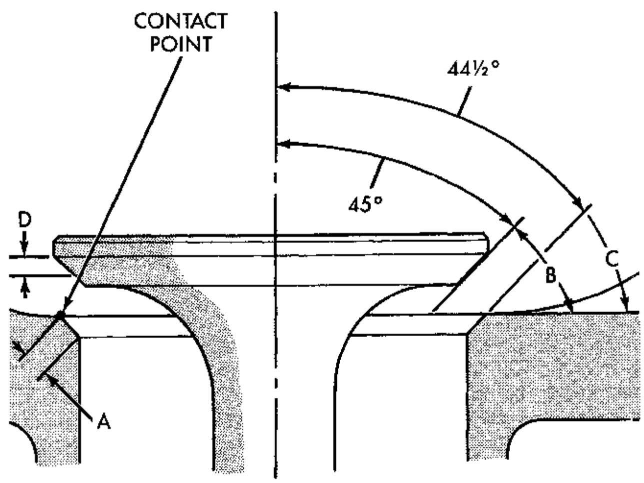
Fig. 58 Reamer Sizes

(5) Slowly turn reamer by hand and clean guide thoroughly before installing new valve. **Ream the valve guides from standard to 0.381 mm (0.015 inch). Use a 2 step procedure so the valve guides are reamed true in relation to the valve seat:**

- Step 1—Ream to 0.0763 mm (0.003 inch).
- Step 2—Ream to 0.381 mm (0.015 inch).

REFACING VALVES AND VALVE SEATS

The intake and exhaust valves have a 45° face angle and a 45° to 44 1/2° seat angle (Fig. 59).



A - SEAT WIDTH — INTAKE 1.016–1.524 mm (0.040–0.060 in.)
EXHAUST 1.016–1.524 mm (0.040–0.060 in.)
B - FACE ANGLE (INTAKE & EXHAUST)
C - SEAT ANGLE (INTAKE & EXHAUST)
D - CONTACT SURFACE

J9409-133

Fig. 59 Valve Face and Seat Angles

VALVES

Inspect the remaining margin after the valves are refaced (Fig. 17). Valves with less than 1.190 mm (0.047 inch) margin should be discarded.

VALVE SEATS

(1) When refacing valve seats, it is important that the correct size valve guide pilot be used for reseat-

DISASSEMBLY AND ASSEMBLY (Continued)

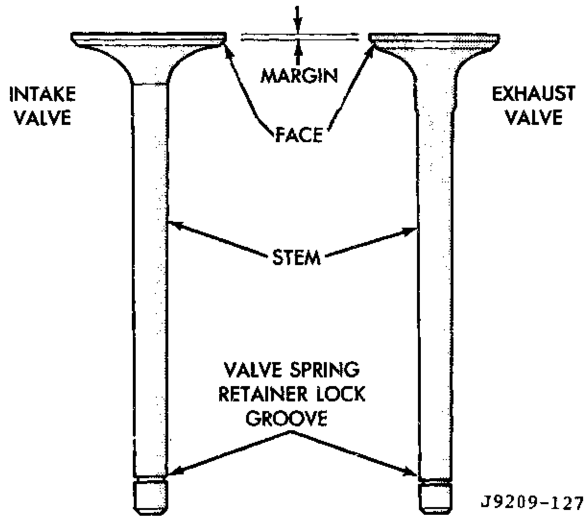


Fig. 60 Intake and Exhaust Valves

ing stones. A true and complete surface must be obtained.

(2) Measure the concentricity of valve seat using a dial indicator. Total runout should not exceed 0.038 mm (0.0015 inch) total indicator reading.

(3) Inspect the valve seat with Prussian blue to determine where the valve contacts the seat. To do this, coat valve seat LIGHTLY with Prussian blue then set valve in place. Rotate the valve with light pressure. If the blue is transferred to the center of valve face, contact is satisfactory. If the blue is transferred to the top edge of valve face, lower valve seat with a 15° stone. If the blue is transferred to bottom edge of valve face raise valve seat with a 60° stone.

(4) When seat is properly positioned the width of valve seats should be 1.016-1.524 mm (0.040-0.060 inch).

VALVE SPRING INSPECTION

Whenever valves have been removed for inspection, reconditioning or replacement, valve springs should be tested. As an example the compression length of the spring to be tested is 1-5/16 inch. Turn table of Universal Valve Spring Tester Tool until surface is in line with the 1-5/16 inch mark on the threaded stud. Be sure the zero mark is to the front (Fig. 61). Place spring over stud on the table and lift compressing lever to set tone device. Pull on torque wrench until ping is heard. Take reading on torque wrench at this instant. Multiply this reading by 2. This will give the spring load at test length. Fractional measurements are indicated on the table for finer adjustments. Refer to specifications to obtain specified height and allowable tensions. Discard the springs that do not meet specifications.

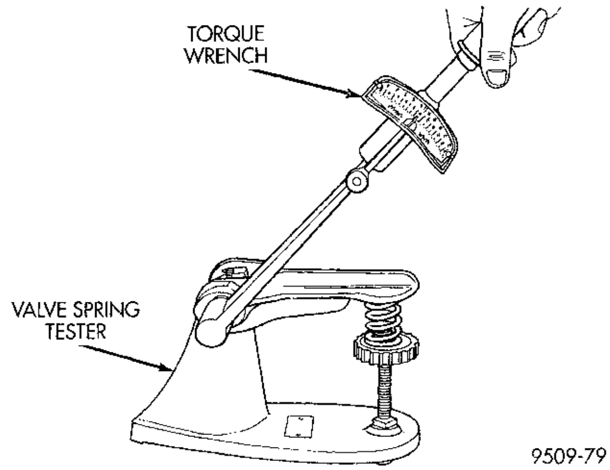


Fig. 61 Testing Valve Spring for Compressed Length

CYLINDER BLOCK

Remove the engine assembly from the vehicle.

DISASSEMBLE

(1) Remove the cylinder head and valve train.
(2) Remove the intake system.
(3) Remove the timing cover and timing chain with sprockets.
(4) Remove the oil pan.
(5) Remove the piston-connecting rod assemblies.
(6) Remove the crankshaft and bearings.

ASSEMBLE

(1) Install crankshaft and bearings.
(2) Install the piston/connecting rod assembly.
(3) Install the oil pan.
(4) Install timing cover, timing chain and sprockets.
(5) Install the cylinder head and valve train.
(6) Install the engine into the vehicle.
(7) Install intake system.

CLEANING AND INSPECTION

CYLINDER HEADS

CLEANING

Clean all surfaces of cylinder block and cylinder heads. Be sure material does not fall into the lifters and surrounding valley.

Clean cylinder block front and rear gasket surfaces using a suitable solvent.

Clean the exhaust manifold to cylinder head mating areas.

INSPECTION

Inspect all surfaces with a straightedge if there is any reason to suspect leakage. The out-of-flatness

CLEANING AND INSPECTION (Continued)

specifications are 0.0007 mm/mm (0.0004 inch/inch), 0.127 mm/152 mm (0.005 inch/6 inches) any direction or 0.254 mm (0.010 inch) overall across head. If exceeded, either replace head or lightly machine the head surface.

The cylinder head surface finish should be 1.78-4.57 microns (15-80 microinches).

Inspect push rods. Replace worn or bent rods.

Inspect rocker arms. Replace if worn or scored.

OIL PAN

CLEANING

Clean the block and pan gasket surfaces.

If present, trim excess sealant from inside the engine.

Clean oil pan in solvent and wipe dry with a clean cloth.

Clean oil screen and pipe thoroughly in clean solvent. Inspect condition of screen.

INSPECTION

Inspect oil drain plug and plug hole for stripped or damaged threads. Repair as necessary.

Inspect oil pan mounting flange for bends or distortion. Straighten flange, if necessary.

OIL PUMP

CLEANING

Wash all parts in a suitable solvent and inspect carefully for damage or wear.

INSPECTION

Mating surface of the oil pump cover should be smooth. Replace pump cover if scratched or grooved.

Lay a straightedge across the pump cover surface (Fig. 62). If a 0.076 mm (0.003 inch) feeler gauge can be inserted between cover and straightedge, cover should be replaced.

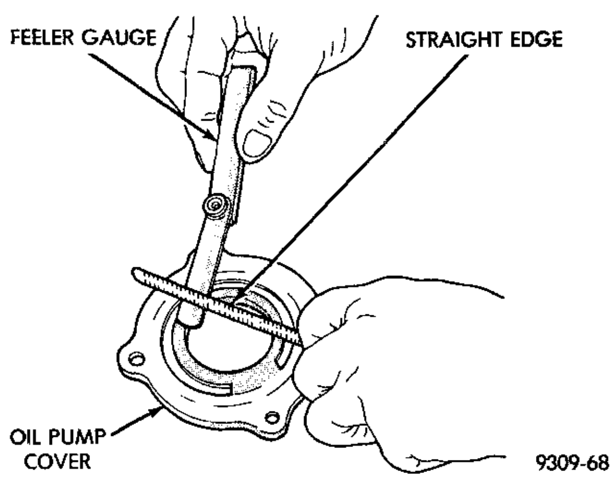


Fig. 62 Checking Oil Pump Cover Flatness

Measure thickness (Fig. 63) (Fig. 64)and diameter of rotors. If either rotor thickness measures 14.956 mm (0.5876 inch) or less, or if the diameter is 82.45 mm (3.246 inches) or less, replace rotor set.

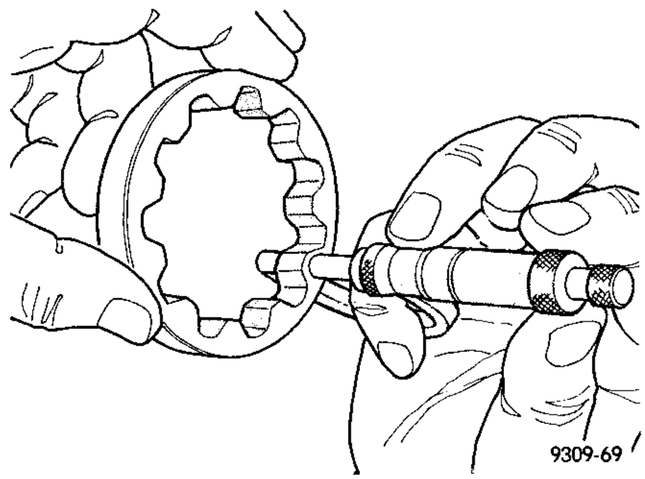


Fig. 63 Measuring Outer Rotor Thickness

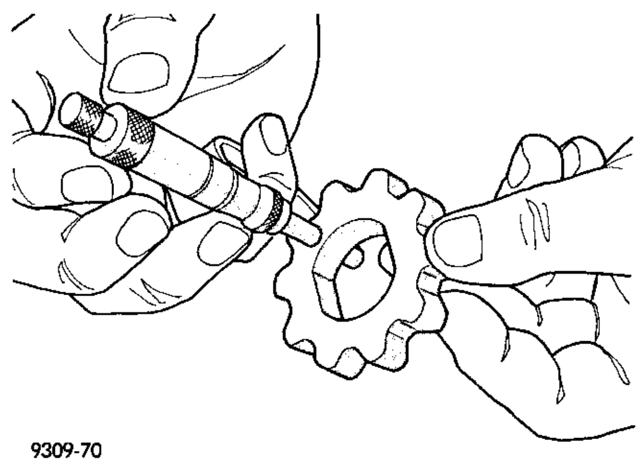


Fig. 64 Measuring Inner Rotor Thickness

Slide outer rotor into timing chain cover pump body. Press rotor to the side with your fingers and measure clearance between rotor and pump body (Fig. 65). If clearance is 0.19 mm (0.007 inch) or more, and outer rotor is within specifications, replace timing chain cover.

Install inner rotor into timing chain cover pump body (Fig. 66). Inner rotor should be positioned with chamfer up or toward engine when cover is installed. This allows easy installation over crankshaft. If clearance between inner and outer rotors is 0.150 mm (0.006 inch) or more, replace both rotors.

Place a straightedge across the face of the timing chain cover pump body, between bolt holes (Fig. 67). If a feeler gauge of 0.077 mm (0.003 inch) or more can be inserted between rotors and the straightedge,

CLEANING AND INSPECTION (Continued)

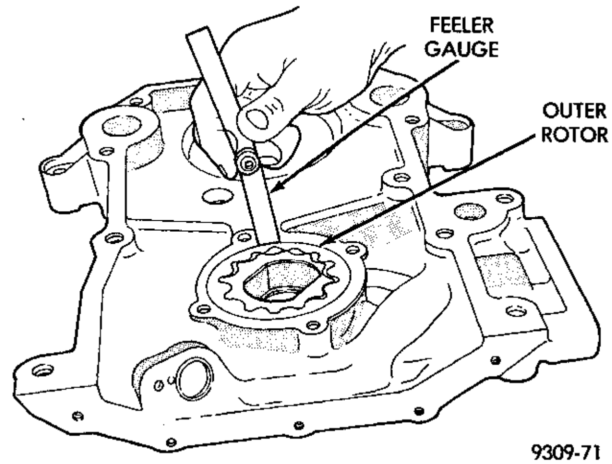


Fig. 65 Measuring Outer Rotor Clearance in Cover

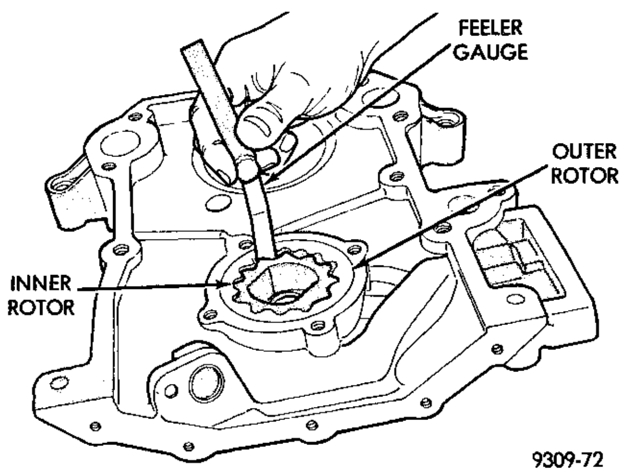


Fig. 66 Measuring Inner Rotor Clearance in Cover

and the rotors are within specifications, replace timing chain cover.

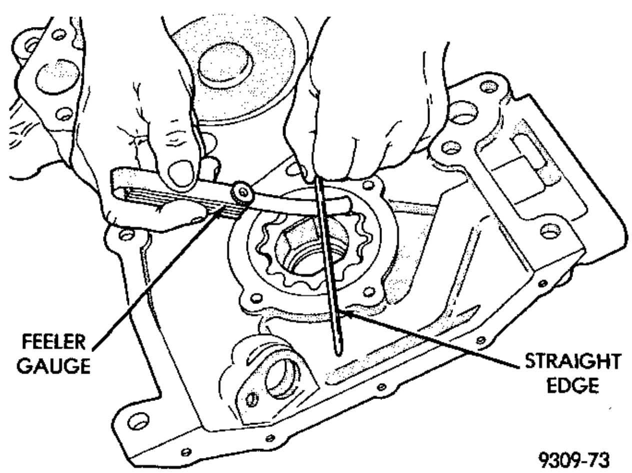


Fig. 67 Measuring Clearance Over Rotors

Inspect oil pressure relief valve plunger for scoring and free operation in its bore. Small marks may be removed with 400-grit wet or dry sandpaper.

The relief valve spring has a free length of approximately 49.5 mm (1.95 inches). The spring should test between 100 and 109 N (22.5 and 24.5 pounds) when compressed to 34 mm (1-11/32 inches). Replace spring that fails to meet these specifications.

If oil pressure was low and pump is within specifications, inspect for worn engine bearings or other reasons for oil pressure loss.

CYLINDER BLOCK

CLEANING

Clean cylinder block thoroughly and check all core hole plugs for evidence of leaking.

INSPECTION

Examine block for cracks or fractures.

The cylinder walls should be checked for out-of-round and taper with Cylinder Bore Indicator Tool, Special tool 6879 or equivalent. The cylinder block should be bored and honed with new pistons and rings fitted if:

- The cylinder bores show more than 0.127 mm (0.005 inch) out-of-round.
- The cylinder bores show a taper of more than 0.254 mm (0.010 inch).
- The cylinder walls are badly scuffed or scored.

Boring and honing operation should be closely coordinated with the fitting of pistons and rings so specified clearances may be maintained.

SPECIFICATIONS

8.0L ENGINE SPECIFICATIONS

GENERAL INFORMATION

Engine Type . . . . .90° V-10 OHV
Bore and Stroke . . .101.6 x 98.6 mm (4.00 x 3.88 in.)
Displacement .8.0L (488 c.i.)
Compression Ratio 8.4:1
Firing Order 1–10–9–4–3–6–5–8–7–2
Lubrication . . . .Pressure Feed – Full Flow Filtration
Cooling System . .Liquid Cooled – Forced Circulation
Cylinder Block. . . . . .Cast Iron
Cylinder Head . . . . .Cast Iron
Crankshaft. . . . . .Nodular Iron
Camshaft. . . . . .Nodular Cast Iron
Combustion Chambers . . . .Wedge - High Swirl Valve Shrouding
Pistons . . . . .Aluminum Alloy
Connecting Rods. . . . . .Forged Steel
Compression Pressure . . . .689.5 kPa (100 psi) (Min.)

AUTHENTIC RESTORATION PRODUCT

SPECIFICATIONS (Continued)

CAMSHAFT

Bearing Diameter
No. 1 . . . . .53.16 – 53.19 mm (2.093 – 2.094 in.)
No. 2 . . . . .52.76 – 52.78 mm (2.077 – 2.078 in.)
No. 3 . . . . .52.35 – 52.37 mm (2.061 – 2.062 in.)
No. 4 . . . . .51.94 – 51.97 mm (2.045 – 2.046 in.)
No. 5 . . . . .51.54 – 51.56 mm (2.029 – 2.030 in.)
No. 6 . . . . .48.74 – 48.77 mm (1.919 – 1.920 in.)
Bearing Journal Diameter
No. 1 . . . . .53.11 – 53.14 mm (2.091 – 2.092 in.)
No. 2 . . . . . . .52.69 – 52.72 mm (2.0745 – 2.0755 in.)
No. 3 . . . . .52.30 – 52.32 mm (2.059 – 2.060 in.)
No. 4 . . . . .51.89 – 51.92 mm (2.043 – 2.044 in.)
No. 5 . . . . .51.49 – 51.51 mm (2.027 – 2.028 in.)
No. 6 . . . . .48.69 – 48.72 mm (1.917 – 1.918 in.)
Bearing to Journal Clearance
No. 1,3,4,5,6. .0.0254 – 0.0762 mm (0.001 – 0.003 in.)
No. 2 . . . . .0.0381 – 0.0889 mm (0.0005 – 0.0035 in.)
Service Limit . . . . .0.127 mm (0.005 in.)
Camshaft End Play
End Play . . . . . .0.127 – 0.381 mm (0.005 – 0.015 in.)

CONNECTING RODS

Piston Pin bore Diameter . . . . . .24.940 – 24.978 mm (0.9819 – 0.9834 in.)
Side Clearance . . . . .0.25 – 0.46 mm (0.010 – 0.018 in.)
Total Weight (Less Bearing) . . . .744 gms. (26.24 oz.)

CRANKSHAFT

Rod Journal
Diameter. . . . . .53.950 – 53.975 mm (2.124 – 2.125 in.)
Out of Round (Max.). . . . . .0.0254 mm (0.001 in.)
Taper (Max.). . . . . .0.0254 mm (0.001 in.)
Bearing Clearance . . . . .0.005 – 0.074 mm (0.0002 – 0.0029 in.)
Service Limit . . . . .0.0762 mm (0.003 in.)
Main Bearing Journal
Diameter. . . . . .76.187 – 76.213 mm (2.8995 – 3.0005 in.)
Out of Round (Max.). . . . . .0.0254 mm (0.001 in.)
Taper (Max.). . . . . .0.0254 mm (0.001 in.)
Bearing Clearance . . . . .0.0051 – 0.058 mm (0.0002 – 0.0023 in.)
Service Limit . . . . .0.071 mm (0.0028 in.)
Crankshaft End Play
End Play . . . . . .0.076 – 0.305 mm (0.003 – 0.012 in.)
Service Limit . . . . .0.381 mm (0.015 in.)

CYLINDER BLOCK

Cylinder Bore
Diameter. . . . . .101.60 – 101.65 mm (4.0003 – 4.0008 in.)
Out of Round (Max.). . . . . .0.0762 mm (0.003 in.)
Taper (Max.) . . . . .0.127 mm (0.005 in.)
Lifter Bore
Diameter. . . . . .22.982 – 23.010 mm (0.9048 – 0.9059 in.)

CYLINDER HEAD AND VALVES

Valve Seat
Angle . . . . .44.5°
Runout (Max.) . . . . .0.0762 mm (0.003 in.)
Width (Finish) –
Intake . . . . . .1.016 – 1.524 mm (0.040 – 0.060 in.)
Valves
Face Angle . . . . .45°
Head Diameter –
Intake . . . .48.640 – 48.900 mm (1.915 – 1.925 in.)
Head Diameter –
Exhaust . . . . . .41.123 – 41.377 (1.619 – 1.629 in.)
Length (Overall) –
Intake . . . .145.19 – 145.82 mm (5.716 – 5.741 in.)
Length (Overall) –
Exhaust. . .145.54 – 146.18 mm (5.730 – 5.755 in.)
Lift (@ zero lash) – Intake . . . . . .9.91 mm (0.390 in.)
Lift (@ zero lash) – Exhaust. . . .10.34 mm (0.407 in.)
Stem Diameter . . . . .7.900 – 7.920 mm (0.311 – 0.312 in.)
Guide Bore . . . . .9.500 – 9.525 mm (0.374 – 0.375 on.)
Stem to Guide Clearance . . . . .0.025 – 0.076 mm (0.001 – 0..003 in.)
Service Limit . . . . .0.4318 (0.017 in.)
Valve Springs
Free Length . . . . .49.962 mm (1.967 in.)
Spring Tension –
(valve closed) . . . . .378 N @ 41.66 mm (85 lbs. @ 1.64 in.)
Spring Tension –
(valve open) . . . . .890 N @ 30.89 mm (200 lbs. @ 1.212 in.)
Number of Coils. 6.8
Installed Height. . . . . .41.66 mm (1.64 in.)
Wire Diameter . . . . .4.50 mm (0.177 in.)

mopar AUTHENTIC RESTORATION

SPECIFICATIONS (Continued)

HYDRAULIC TAPPETS

Body Diameter . . . . .22.949 – 22.962 mm (0.9035 – 0.9040 in.)
Clearance (to bore) . . . . .0.0203 – 0.0610 mm (0.0008 – 0.0024 in.)
Dry Lash .1.524 – 5.334 mm (0.060 – 0.210 in.)
Push Rod Length . . . . .195.52 – 196.02 mm (7.698 – 7.717 in.)

OIL PRESSURE

Curb Idle (Min.*) . . . . .83 kPa (12 psi)
3000 rpm. . . . . .345 – 414 kPa (50 – 60 psi)

CAUTION: If oil pressure is zero at curb idle, DO NOT RUN ENGINE.

OIL PUMP

Clearance over Rotors
(Max.). . . . . .0.1906 mm (0.0075 in.)
Cover Out of Flat (Max.) . . . . . .0.051 mm (0.002 in.)
Inner Rotor Thickness
(Min.). . .14.925 – 14.950 mm (0.5876 – 0.5886 in.)
Outer Rotor Clearance
(Max.). . . . . .0.1626 mm (0.006 in.)
Outer Rotor Diameter
(Min.) . . . . .82.461 mm (3.246 in.)
Outer Rotor Thickness
(Min.) . . . . .14.925 mm (0.5876 in.)
Tip Clearance between Rotors
(Max.). . . . . .0.584 mm (0.0230 in.)

PISTONS

Clearance at Top of Skirt . . . . .0.013 – 0.038 mm (0.0005 – 0.0015 in.)
Piston Length . . . . .82.5 mm (3.25 in.)
Piston Ring Groove Depth –
#1&2 . . . . . . .91.30 – 91.55 mm (3.594 – 3.604 in.)
Piston Ring Groove Depth –
#3 . . . . .92.90 – 93.15 mm (3.657 – 3.667 in.)
Weight . . . . .463 – 473 grams (16.33 – 16.68 oz.)
Piston to Bore Clearance . . . . .0.013 – 0.038 mm (0.0005 – 0.0015 in.)
Service Limit . . . . .0.0762 mm (0.003 in.)

PISTON PINS

Clearance in Piston . . . . .0.010 – 0.020 mm (0.0004 – 0.0008 in.)
Diameter. . . . . .24.996 – 25.001 mm (0.9841 – 0.9843 in.)
End Play . . . . .NONE
Length . . . . .67.8 – 68.3 mm (2.67 – 2.69 in.)

PISTON RINGS

Ring Gap
Compression Rings. . . . . .0.254 – 0.508 mm (0.010 – 0.020 in.)
Oil Control (Steel Rails) . . . . .0.381 – 1.397 mm (0.015 – 0.055 in.)
Ring Side Clearance
Compression Rings. . . . . .0.074 – 0.097 mm (0.0029 – 0.0038 in.)
Oil Ring (Steel Rails) . . . . .0.185 – 0.246 mm (0.0073 – 0.0097 in.)
Ring Width
Compression rings . . . . .4.115 – 4.369 mm (0.162 – 0.172 in.)
Oil Ring (Steel Rails) . . . . .2.591 – 2.743 mm (0.102 – 0.108 in.)

VALVE TIMING

Exhaust Valve
Closes (ATDC). . . . . .25°
Opens (BBDC). . . . . .60°
Duration . . . . .265°
Intake Valve
Closes (ATDC). . . . . .61°
Opens (BBDC) . . . . .6°
Duration . . . . .246°
Valve Overlap . . . . .31°

AUTHENTIC RESTORATION

SPECIFICATIONS (Continued)

CONDITION	IDENTIFICATION	LOCATION OF IDENTIFICATION
CRANKSHAFT JOURNALS (UNDERSIZE) 0.0254 mm (0.001 in.)	R or M M-2-3 etc. (indicating no. 2 and 3 main bearing journal) and/or R-1-4 etc. (indicating no. 1 and 4 connecting rod journal)	Milled flat on no. 8 crankshaft counterweight.
CYLINDER BORES (OVERSIZE) 0.508 mm (0.020 in.)	A	Following engine serial number.
HYDRAULIC TAPPETS (OVERSIZE) 0.2032 mm (0.008 in.)	♦	Diamond-shaped stamp top pad – front of engine and flat ground on outside surface of each O/S tappet bore.
VALVE STEMS (OVERSIZE) 0.127 mm (0.005 in.)	X	Milled pad adjacent to two tapped holes (3/8 in.) on each end of cylinder head.

J9209-142

TORQUE SPECIFICATIONS

8.0L ENGINE

DESCRIPTION **TORQUE**

Camshaft Sprocket
Bolt. . . . . .75 N·m (55 ft. lbs.)
Camshaft Thrust Plate
Bolts . . . . .22 N·m (16 ft. lbs.)
Coil Pack Bracket
Bolts. . . . . .21 N·m (190 in. lbs.)
Connecting Rod Cap
Bolts . . . . .61 N·m (45 ft. lbs.)
Crankshaft Main Bearing Bolts
Step 1 – Initial . . . . .27 N·m (20 ft. lbs.)
Step 2 – Final . . . . .115 N·m (85 ft. lbs.)
Crankshaft Pulley/Damper
Bolt. . . . . .183 N·m (135 ft. lbs.)
Crankshaft Rear Seal Retainer
Bolts . . . . .22 N·m (16 ft. lbs.)
Cylinder Head Bolts
Step 1 – Initial . . . . .58 N·m (43 ft. lbs.)
Step 2 – Final. . . . . .143 N·m (105 ft. lbs.)
Cylinder Head Cover
Bolts/Studs. . . . . .16 N·m (144 in. lbs.)
Drive Plate to Crankshaft
Bolts . . . . .75 N·m (55 ft. lbs.)
Drive Plate to Torque Converter
Bolts . . . . .47 N·m (35 ft. lbs.)
EGR Tube
Nut. . . . . .34 N·m (25 ft. lbs.)

ENGINE SPECIFICATIONS—CONT.

DESCRIPTION **TORQUE**

EGR Valve
Bolts. . . . . .20 N·m (174 in. lbs.)
Engine Support Bracket/Insulator
Through Bolt . . . . .68 N·m (50 ft. lbs.)
Engine Support Bracket/Insulator to Block
Bolts . . . . .47 N·m (35 ft. lbs.)
Exhaust Manifold to Cylinder Head
Bolts . . . . .22 N·m (16 ft. lbs.)
Generator Mounting
Bolt. . . . . .41 N·m (30 ft. lbs.)
Generator to Intake Manifold Bracket
Bolts . . . . .41 N·m (30 ft. lbs.)
Heat Shield
Nuts. . . . . .20 N·m (175 in. lbs.)
Hydraulic Tappet Yoke Retaining Spider
Bolts . . . . .22 N·m (16 ft. lbs.)
Intake Manifold (Lower)
Bolts . . . . .54 N·m (40 ft. lbs.)
Intake Manifold (Upper)
Bolts . . . . .22 N·m (16 ft. lbs.)
Oil Filter
Filter . . . . .9 N·m (80 in. lbs.) + 45°
Oil Filter Connector
. . . . .46 N·m (34 ft. lbs.)
Oil Pan
1/4 – 20 Bolts . . . . .11 N·m (96 in. lbs.)
5/16 – 18 Bolts . . . . .16 N·m (144 in. lbs.)
Stud Bolts . . . . .16 N·m (144 in. lbs.)
Drain Plug . . . . .34 N·m (25 ft. lbs.)

SPECIFICATIONS (Continued)

DESCRIPTION	TORQUE
Oil Pan Pick Up Tube	
Bolts	16 N·m (144 in. lbs.)
Oil Pump Attaching	
Bolts	41 N·m (30 ft. lbs.)
Oil Pump Cover	
Bolts	14 N·m (125 in. lbs.)
Oil Pump Pressure Relief Plug	
Plug	20 N·m (15 ft. lbs.)
Rocker Arm	
Bolts	28 N·m (21 ft. lbs.)
Spark Plugs	
Plugs	41 N·m (30 ft. lbs.)
Starter Mounting	
Bolts	68 N·m (50 ft. lbs.)
Timing Chain Cover	
Bolts	47 N·m (35 ft. lbs.)
Thermostat Housing	
Bolts	25 N·m (220 in. lbs.)
Throttle Body	
Nuts	11 N·m (96 in. lbs.)
Transfer Case to Insulator Mounting Plate	
Nuts	204 N·m (150 ft. lbs.)
Transmission Support Bracket	
Bolts	102 N·m (75 ft. lbs.)
Transmission Support Cushion	
Bolts	47 N·m (35 ft. lbs.)
Transmission Support Cushion Stud	
Nuts	47 N·m (35 ft. lbs.)
Water Pump to Chain Case Cover	
Bolts	41 N·m (30 ft. lbs.)
Water Pump Pulley	
Bolts	22 N·m (16 ft. lbs.)

SPECIAL TOOLS

8.0L ENGINE

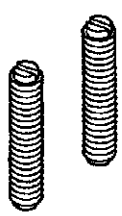


Fig. 68 Valve Compressor Adapting Stud Tool 6715

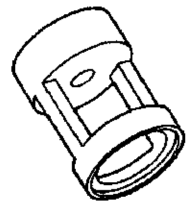


Fig. 69 Valve Spring Compressor Adapter Tool 6716A

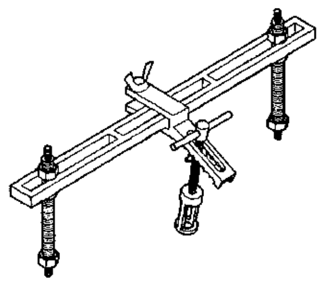


Fig. 70 Valve Spring Compressor Tool MD-998772A

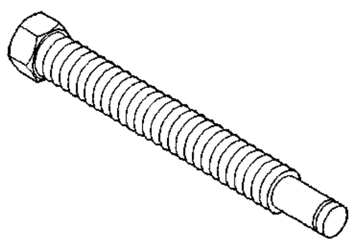


Fig. 71 Valve Spring Compressor Screw Tool 6756

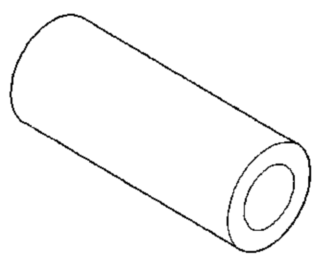


Fig. 72 Black Valve Guide Sleeve Tool C6819

SPECIAL TOOLS (Continued)

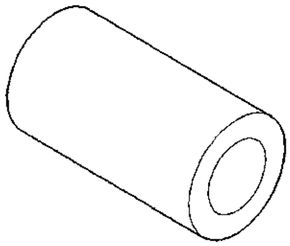


Fig. 73 Silver Valve Guide Sleeve Tool C6818

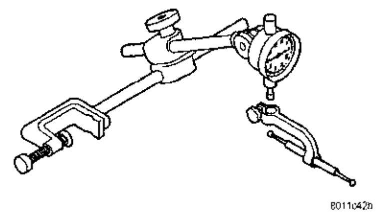


Fig. 74 Dial Indicator Tool C3339

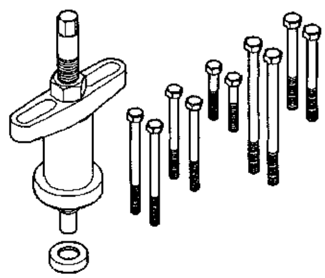


Fig. 75 Crankshaft Pulley/Damper Installer Tool C3688

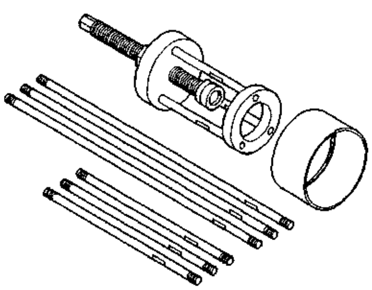


Fig. 76 Crankshaft Sprocket Puller Tool 6444

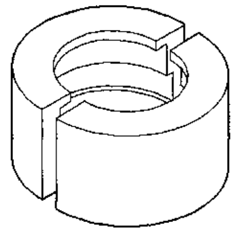


Fig. 77 Crankshaft Sprocket Puller Jaws Tool 6820

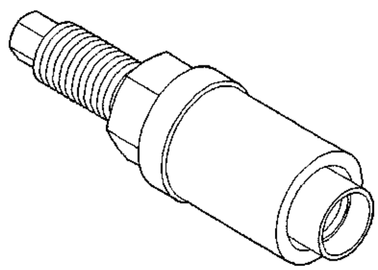


Fig. 78 Crankshaft Sprocket Installer Tool 3718

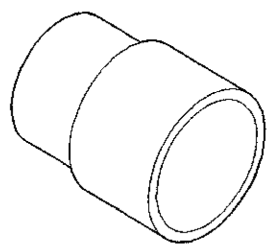


Fig. 79 Crankshaft Sprocket Installer Tool MD990799

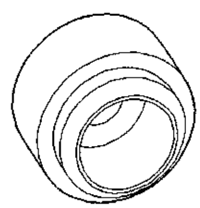


Fig. 80 Front Oil Seal Installer Tool 6806

SPECIAL TOOLS (Continued)

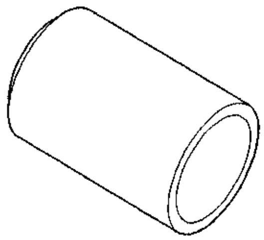


Fig. 81 Front Oil Seal Installer Tool 6761

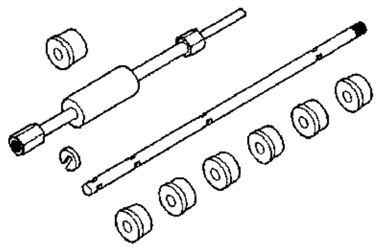


Fig. 82 Camshaft Bearing Installer Tool C3132A

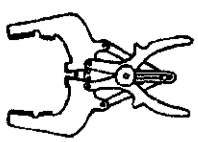


Fig. 83 Compression Ring Installer Tool C4184

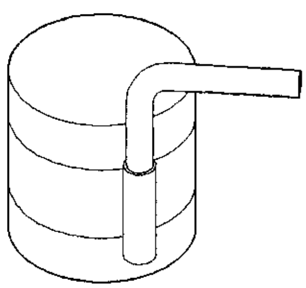


Fig. 84 Piston Ring Compressor Tool C385

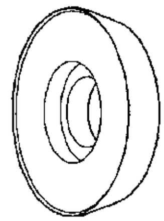


Fig. 85 Seal Installer Tool 6687

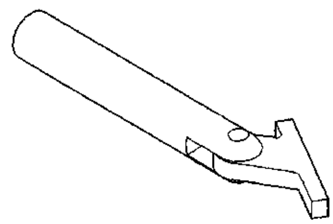


Fig. 86 Crankshaft Main Bearing Remover/Installer Tool C3059

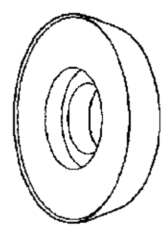


Fig. 87 Seal Installer Tool 6687

5.9L DIESEL ENGINE

INDEX

GENERAL INFORMATION

PISTON GRADING

When rebuilding an engine with the original cylinder block, crankshaft and pistons, make sure the pistons are installed in the original cylinder.

If replacing the piston(s), make sure the replacement piston(s) are the same grade as the original piston.

If a new cylinder block or crankshaft is used, the piston grading procedure MUST be performed to determine the proper piston grade for each cylinder.

OIL FILTER

When replacing the oil filter, use replacement filter specified in your Operator's Manual.

CAUTION: The internal filtering medium of some filters has been known to disintegrate. Debris from failed filters may plug the piston oil cooling nozzles, resulting in scuffed pistons and eventual engine failure.

mopar AUTHENTIC RESTORATION PRODUCT

DESCRIPTION AND OPERATION

ENGINE DESCRIPTION

The 5.9 Liter (359 CID) six-cylinder diesel engine is an In-line valve in head type.

Engine type	In line 6 (Diesel Turbo)
Bore and Stroke	102.0 x 120.0 (4.02 x 4.72 in.)
Displacement	5.9L (359 cu. in.)
Compression Ratio	17.5:1
Horsepower (automatic)	180 @ 2500 rpm
Horsepower (manual)	215 @ 2600 rpm
Torque (automatic)	569 N·m (420 ft. lbs) @ 1500 rpm
Torque (manual)	596 N·m (440 ft. lbs.) @ 1600 rpm
Firing Order	1–5–3–6–2–4
Lubrication	Pressure Feed-Full Flow Filtration w/Bypass Valve
Engine Oil Capacity	10.4 L (11.0 Qts.) w/filter
Cooling System	Liquid Cooled – Forced Circulation
Cooling Capacity	23L (24 Qts.)
Cylinder Block	Cast Iron
Crankshaft	Induction Hardened Forged Steel
Cylinder Head	Cast Iron
Combustion Chambers	High Swirl Bowl
Camshaft	Chilled Ductile Iron
Pistons	Cast Aluminum
Connecting Rods	Forged Steel

This engine is designed for No.2 Diesel Fuel. Only use No.1 Diesel Fuel where extended arctic conditions exist (below -23°C or -10°F).

Engine lubrication system consists of a gerotor type oil pump and a full flow oil filter with a bypass valve.

The cylinders are numbered from front to rear; 1 to 6. The firing order is 1-5-3-6-2-4 (Fig. 1).

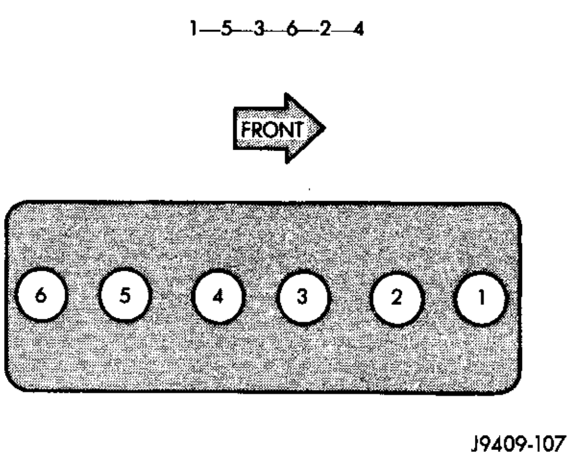


Fig. 1 Firing Order

The engine data plate is located on the driver side of the engine forward of the fuel injection pump.

LUBRICATION SYSTEM

The engine uses a gerotor type lubricating pump. The machined cavity in the block is the same for all engines. The pressure regulating valve is designed to keep the lubricating oil pressure from exceeding 449 kPa (65 PSI). When the lubricating oil pressure from the pump is greater the 499 kPa (65 PSI), The valve opens uncovering the dump port so part of the lubricating oil is routed to the oil pan. Because of manufacturing tolerances of the components and the oil passages, the lubricating oil pressure can differ as much as 69 kPa (10 PSI) between engines.

The engines use full flow, plate type oil coolers. The oil flows through a cast passage in the cooler cover and through the element where it is cooled by the engine coolant flowing past the plates of the elements. After the oil is cooled, it flows through the full flow oil filter.

The lubricating oil cooler cover contains a bypass valve the will let the lubricating oil flow bypass a plugged filter. The valve is designed to open when the pressure drop across the filter is more than 172 kPa (25 PSI), as with a plugged filter and lets the lubricating oil continue on through the engine. When a filter becomes plugged, an oil pressure decrease of 60 kPa (10 PSI) or less from normal operating pressure can be observed on the vehicle lubricating oil pressure gauge. This allows unfiltered oil into the engine. This condition should be avoided by changing the filter at each oil change.

The turbocharger receives filtered, cooled and pressurized lubricating oil through a supply line from the filter head. A drain line connected to the bottom of the turbocharger housing returns the lubricating oil to the lubricating oil pan through a fitting in the cylinder block.

The main bearings and the valve train are lubricated by pressurized oil directly from the main oil gallery. the other power components, connecting rods, pistons, and camshaft receive pressurized oil directly from the main oil gallery. Passages in the crankshaft supply oil to the connecting rods bearings. The oil is supplied to the camshaft journals through passages in the main bearings saddles. Smaller passages in the main bearings saddles supply oil to the pistons cooling nozzles. The spray from the nozzles also provides lubrication for the piston pins.

Lubrication for the valve train is supplied through separate passages in the cylinder block. Oil flows through the passages and across the oil transfer slot in the cylinder head gasket. From the transfer slot, the oil flows around the outside diameter at the cylinder capscrew, across a slot in the bottom of the rocker lever support, and up the vertical passage in the support. From these passages, oil flows through passages in the rocker lever shaft to lubricate the rocker levers. The oil from the channel lubricates the valves stems, push rods, and tappets.

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DESCRIPTION AND OPERATION (Continued)

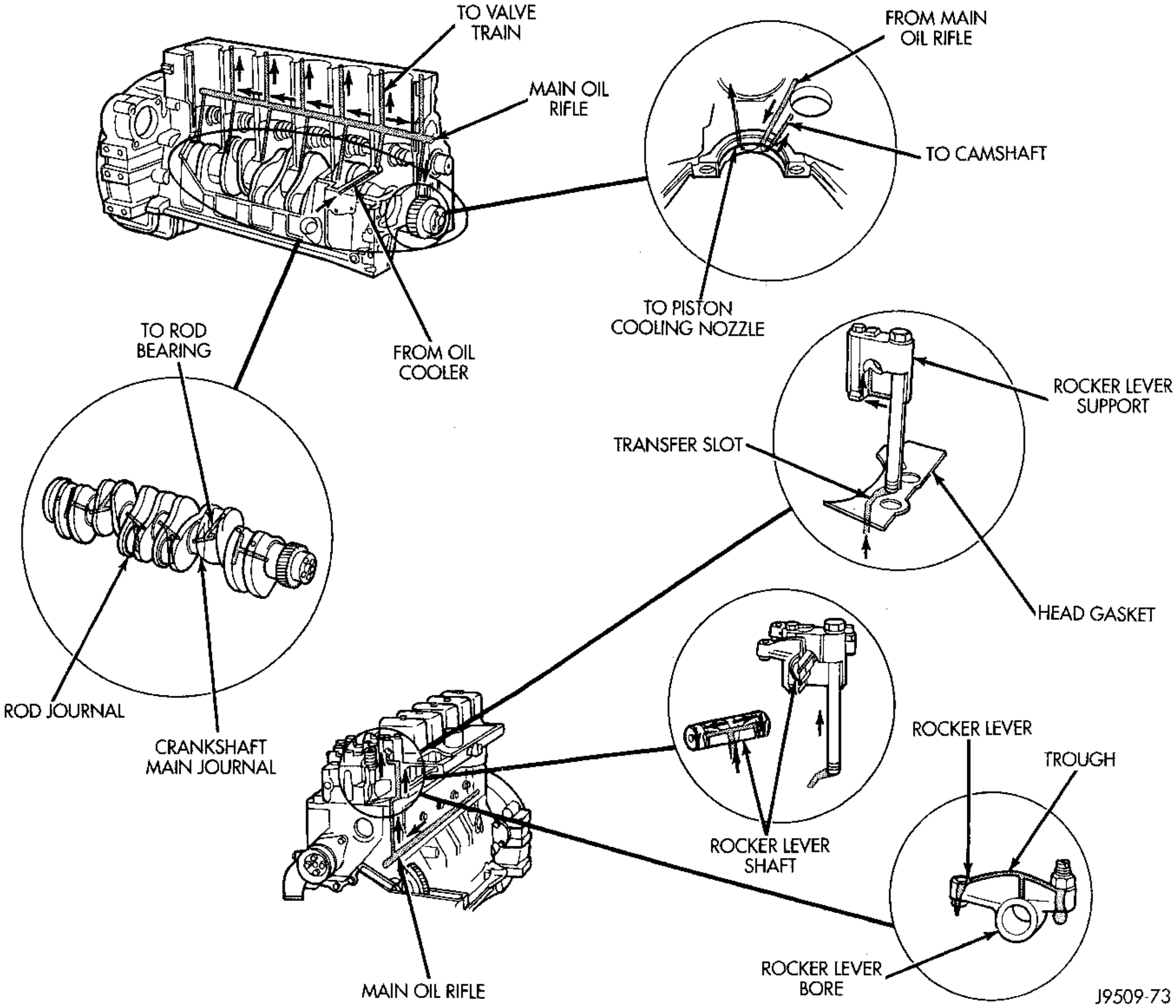


Fig. 2 Lubricating System Components

DESCRIPTION AND OPERATION (Continued)

OIL PRESSURE REGULATOR VALVE

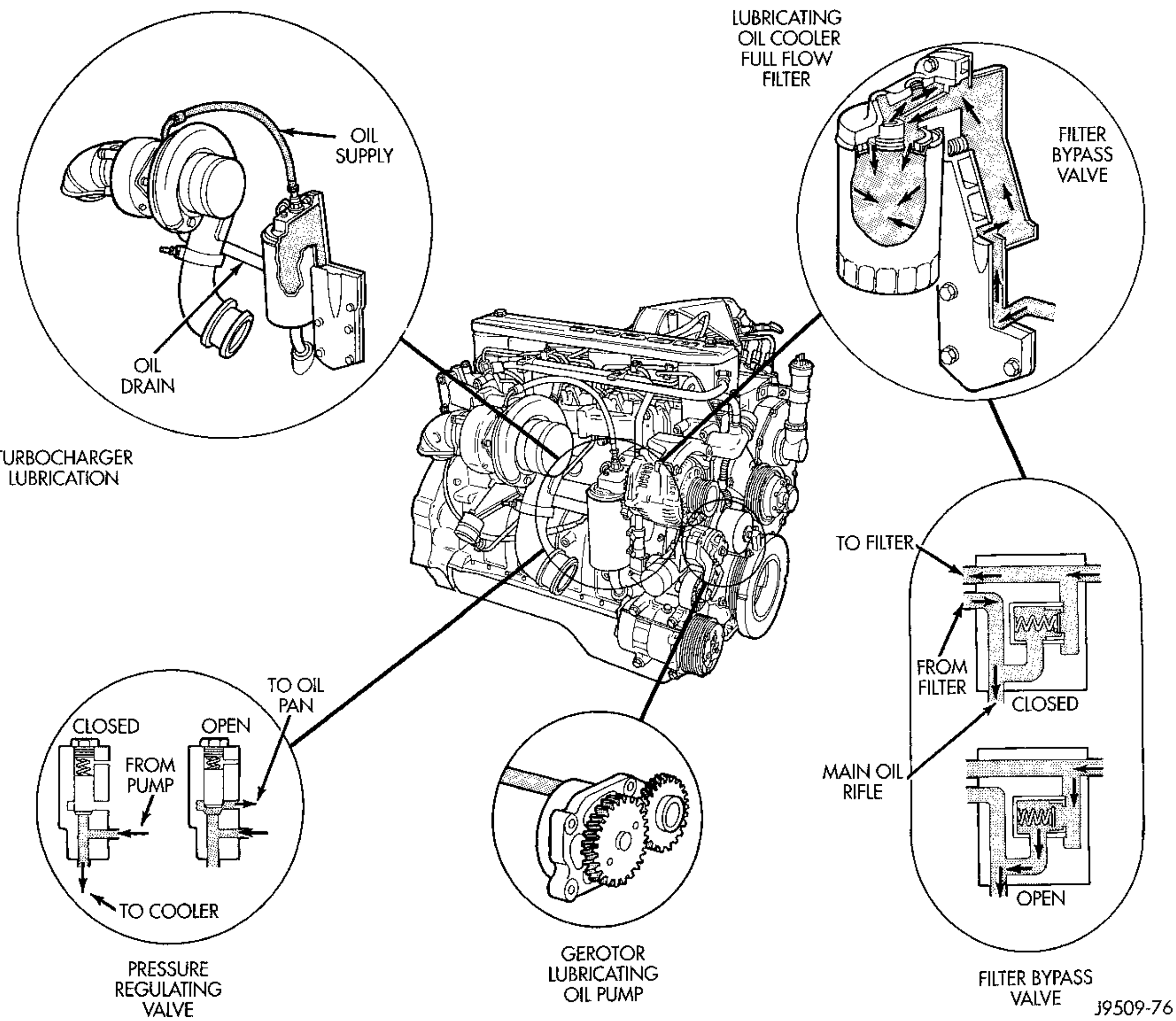


Fig. 3 Lubricating System Passages

When oil pressure from the oil pump exceeds 448 kPa (65 psi), the regulator valve opens to allow oil to drain back into the pan.

TIMING PIN

The timing pin is used for three different procedures:
- Valve adjustment
- Top Dead Center (TDC) location
- Fuel injector pump timing procedure

VACUUM PUMP

The vacuum pump and the power steering pump are combined into a single assembly on diesel engine models (Fig. 4). Both pumps are operated by a drive gear attached to the vacuum pump shaft. The shaft gear is driven by the camshaft gear.

The vacuum pump is a constant displacement, vane-type pump. Vacuum is generated by four vanes mounted in the pump rotor. The rotor is located in the pump housing and is pressed onto the pump shaft.

The vacuum and steering pumps are operated by a single drive gear pressed onto the vacuum pump shaft. The drive gear is operated by the engine camshaft gear.

The vacuum and power steering pump shafts are connected by a coupling. Each pump shaft has an adapter with drive lugs that engage in the coupling.

The vacuum pump rotating components are lubricated by engine oil. Lubricating oil is supplied to the pump through an oil line at the underside of the pump housing.

The complete assembly must be removed in order to service either pump. However, the power steering

AUTHENTIC RESTORATION PRODUCT

DESCRIPTION AND OPERATION (Continued)

pump can be removed and serviced separately when necessary.

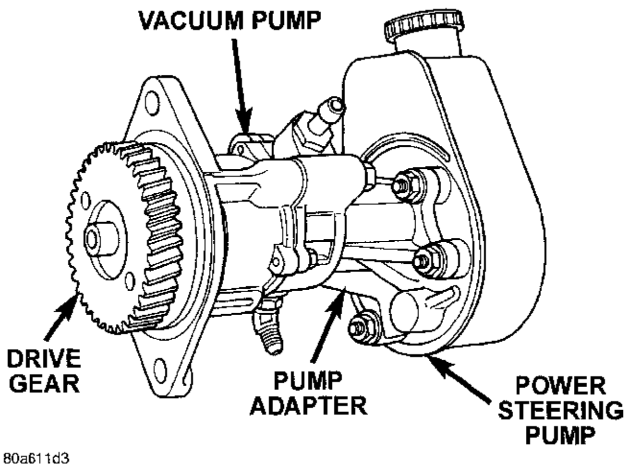


Fig. 4 Diesel Vacuum & Power Steering Pump Assembly

The vacuum pump is not a serviceable component. If diagnosis indicates a pump malfunction, the pump must be replaced as an assembly. Do not disassemble or attempt to repair the pump.

The combined vacuum and steering pump assembly must be removed for access to either pump. However, the vacuum pump can be removed without having to disassemble the power steering pump.

If the power steering pump requires service, simply remove the assembly and separate the two pumps. Refer to the pump removal and installation procedures in this section.

VACUUM PUMP OPERATION

Vacuum pump output is transmitted to the HEVAC, speed control, and EGR systems through a supply hose. The hose is connected to an outlet port on the pump housing and uses an in-line check valve to retain system vacuum when vehicle is not running.

Pump output ranges from a minimum of 8.5 to 25 inches vacuum.

The pump rotor and vanes are rotated by the pump drive gear. The drive gear is operated by the camshaft gear.

SERVICE PROCEDURES

ENGINE OIL SERVICE

When replacing the oil filter, use replacement filter specified in your Operator's Manual.

CAUTION: The internal filtering medium of some filters has been known to disintegrate. Debris from failed filters may plug the piston oil cooling nozzles, resulting in scuffed pistons and eventual engine failure.

REMOVAL

WARNING: HOT OIL CAN CAUSE PERSONAL INJURY.

(1) Operate the engine until the water temperature reaches 60°C (140°F). Shut the engine off.

(2) Use a container that can hold at least 14 liters (15 quarts) to hold the used oil. Remove the oil drain plug and drain the used engine oil into the container.

(3) Always check the condition of the used oil. This can give you an indication of some engine problems that might exist.

- Thin, black oil indicates fuel dilution.
- Milky discoloration indicates coolant dilution.

(4) Clean the area around the lubricating oil filter head. Remove the filter using a 90-95 mm filter wrench.

(5) Clean the gasket surface of the filter head. The filter canister O-Ring seal can stick on the filter head. Make sure it is removed.

INSTALLATION

(1) Fill the oil filter element with clean oil before installation. Use the same type oil that will be used in the engine.

(2) Apply a light film of lubricating oil to the sealing surface before installing the filter.

CAUTION: Mechanical over-tightening may distort the threads or damage the filter element seal.

(3) Install the filter as specified by the filter manufacturer.

(4) Clean the drain plug and the sealing surface of the pan. Check the condition of the threads and sealing surface on the oil pan and drain plug.

(5) Install the drain plug. Tighten the plug to 60 N·m (44 ft. lbs.) torque.

(6) Use only High-Quality Multi-Viscosity lubricating oil in the Cummins Turbo Diesel engine. Choose the correct oil for the operating conditions outlined in Group 0, Lubrication and Maintenance.

(7) Fill the engine with the correct grade of new oil. Refer to Group 0, Lubrication and Maintenance for the correct oil fill capacity.

(8) Start the engine and operate it at idle for several minutes. Check for leaks at the filter and drain plug.

(9) Stop engine. Wait several minutes to allow the oil to drain back to the pan and check the level again.

SERVICE PROCEDURES (Continued)

VALVE SERVICE

VALVE GUIDE INSTALLATION

THIN WALL—SERVICE GUIDES

Machine the cylinder head valve guide bores to 11.125 ±0.013 mm (0.4380 ±0.0005 inch) in diameter (Fig. 5).

Service valve guides must be centered with valve seats within 0.35 mm (0.01378 inch) diameter. They must also be square with the combustion face within 0.10 mm (0.004 inch) at 50.0 mm (1.9685 inch) radius.

Lubricate the valve guides with oil and press the guides flush to the bottom of the bosses.

Trim off the top of the valve guides flush to top of guide bosses, if necessary.

Machine the valve guide bores to 8.029 ±0.010 mm (0.3161 ±0.0004 inch) - (Fig. 5).

The valve guide bore must be centered with the valve seat within 0.35 mm (0.0138 inch) diameter. It also must be square with the combustion face within 0.010 mm (0.0004 inch) at 50.0 mm (2.0 inch) radius.

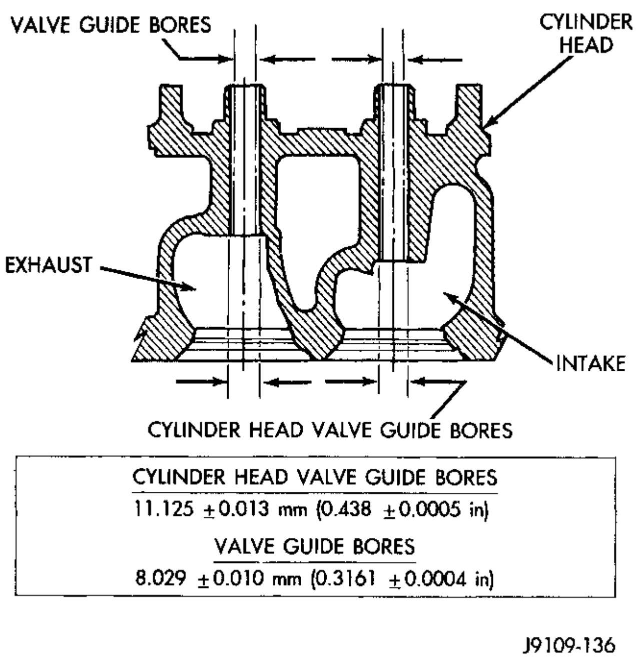


Fig. 5 Service Valve Guides—Thin Wall

THICK WALL—SERVICE GUIDES

Machine the cylinder head valve guide bores to 14.000 ±0.013 mm (0.5512 ±0.0005 inch) diameter (Fig. 6).

Valve guides must be centered with valve seats within 0.35 mm (0.01378 inch) diameter. Valve guides must also be square with the combustion face within 0.10 mm (0.004 inch) at 50.0 mm (2.0 inch) radius.

Lubricate the valve guides with oil and press in the guides to 12.25 ±0.50 mm (0.4823 ±0.020 inch) protrusion above the cylinder head.

Ream the bores to 8.029 ±0.010 mm (0.3161 ±0.0004 inch) - (Fig. 6).

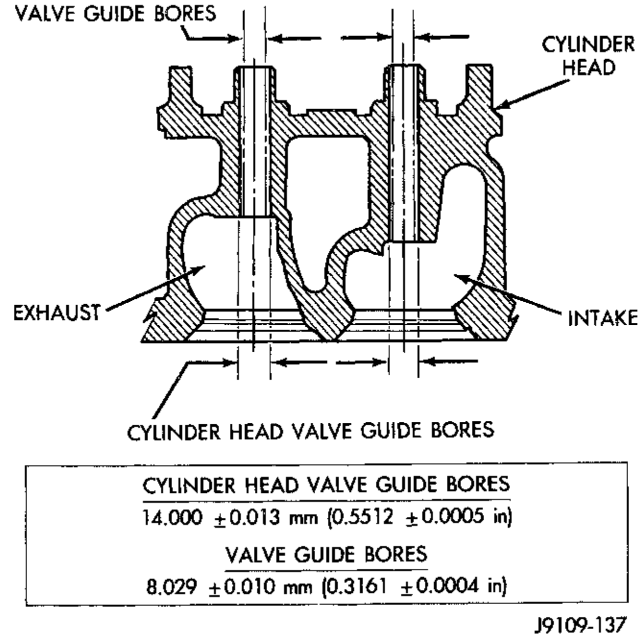


Fig. 6 Service Valve Guides—Thick Wall

VALVE SEATS

INTEGRAL VALVE SEAT GRINDING

After resurfacing the valves and determining that all valves meet specifications, install the valves in their designated locations and measure valve depth (Fig. 7). The valve depth is the distance from the valve face to the head deck. Record the depth of each valve.

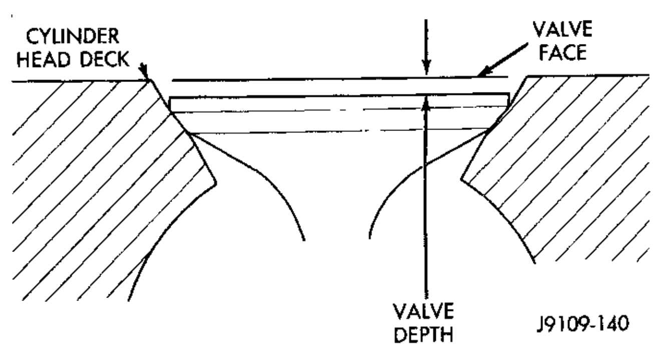


Fig. 7 Valve Depth

Grind the valve seats to remove scores, scratches and burns. The seat angle should be—Intake 30° and Exhaust 45°.

SERVICE PROCEDURES (Continued)

Install the valves in their respective bores and measure the depth again (Fig. 7). Record the depth of each valve.

The grinding depth is the difference between the measurement before grinding and the measurement after grinding. The grinding depth maximum limit (integral seats only) is 0.254 mm (0.010 inch). Service valve seats are available for over limit integral valve seats.

Identify ground valve seats by stamping the cylinder head.

Install the valves in their designated locations and measure the depth of each. The valve depth limit (Integral and Inserted Seats) is 0.99 mm to 1.52 mm (0.039 inch to 0.060 inch). Replace the valve if the depth is over this limit.

Apply a light coat of valve lapping compound to each valve and lap each valve to its mating seat.

Remove the valves and clean lapping compound from the valves and seats.

Measure the valve seat width indicated by the lapping surface. The valve seat width limit is 1.50-2.00 mm (0.060-0.080 inch).

If required, grind the areas with a 60° stone and a 15° stone to center the seat on the valve face. Maintain the valve seat width limits (Fig. 8).

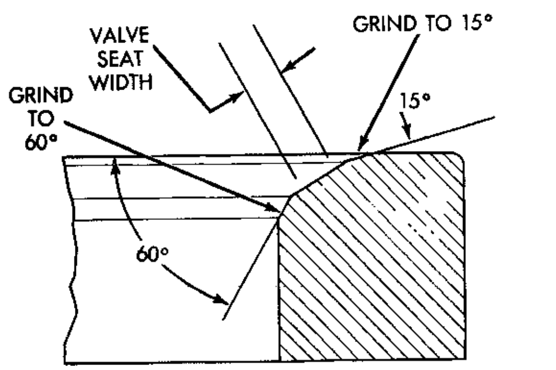


Fig. 8 Grind Valve Seat

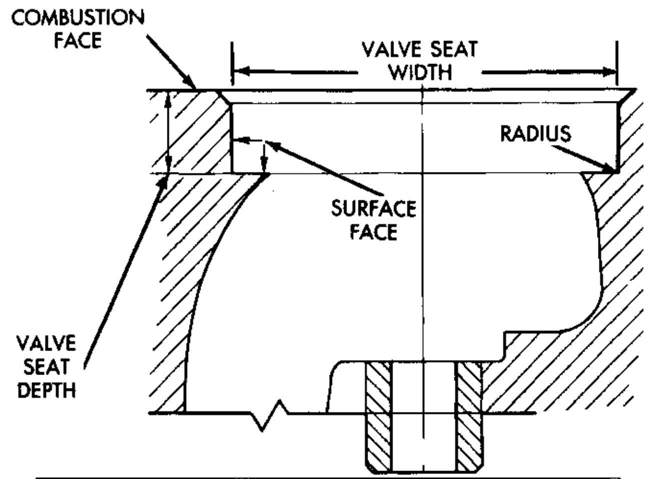
SERVICE VALVE SEAT INSTALLATION

Inspect the valve guide bores as described in the Cleaning and Inspection section of this group. If it is necessary to install valve guides, install the guides before installing the service seats.

Replacement valve seat inserts must be installed if the valve seats have been ground previously. The illustrated marks indicate valve seats have been ground previously.

Machine the cylinder head to install the service valve seats (Fig. 9) (Fig. 10).

Press service seats into the machined pockets. Stake the valve seats into the pockets.



VALVE SEAT DEPTH
10.40 ±0.10 mm (0.4094 ±0.004 inch)
VALVE SEAT WIDTH
47.0 ±0.013 mm (1.8504 ±0.0005 in)
MAXIMUM RADIUS
0.40 mm (0.0157 inch) MAX.
SURFACE FINISH
3.2 micrometers (128.0 microinch)

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Fig. 9 Machining for Service Valve Seats—Intake Valve

SERVICE VALVE SEAT GRINDING

Install the valves in their designated location and measure the valve depth. The valve depth is the distance from the valve face to the head deck.

Record the depth of each valve (Fig. 11). The depth is 0.99-1.52 mm (0.039-0.060 inch).

Grind the valve seats to remove scores, scratches and burns. The valve seat angle is 30° (Intake) and 45° (Exhaust).

Install the valves in their respective bores and measure the depth again (Fig. 11). The valve depth limit is 0.99-1.52 mm (0.039-0.060 inch). Replace the valve if the depth is over the limit.

Apply a light coat of valve lapping compound to each valve and lap each valve to its companion seat. Remove the valves and clean the lapping compound from the valve and seats.

Measure the valve seat width indicated by the lapped surface (Fig. 12). The width limits are 1.5-2.0 mm (0.060-0.080 inch). If required, grind lower area with 60° stone and upper area with 15° stone (Fig. 12). Be sure to center the seat on the valve face. Maintain the valve seat within limits.

SERVICE PROCEDURES (Continued)

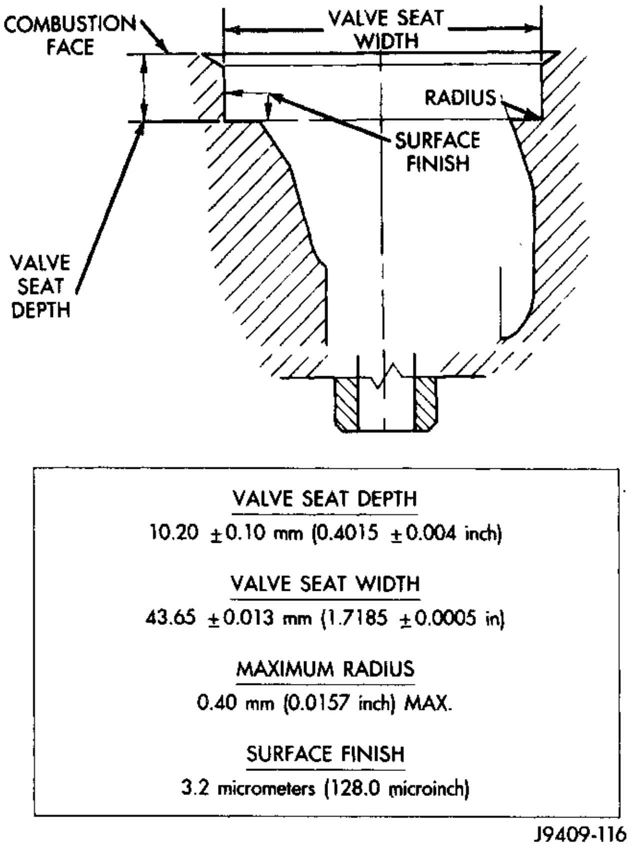

Fig. 10 Machining for Service Valve Seats—Exhaust Valve

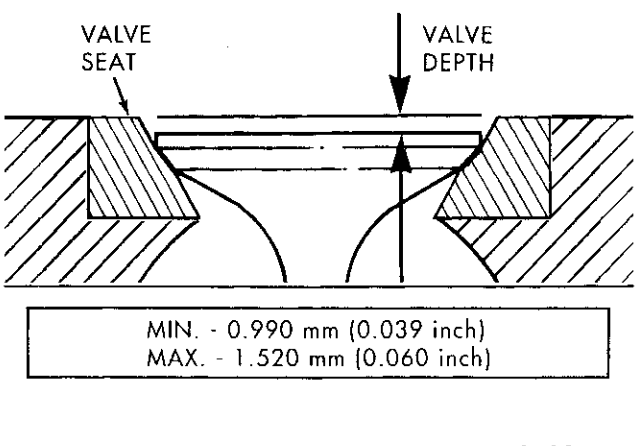

Fig. 11 Valve Depth with Seat Insert

SERVICE VALVE SEAT REPLACEMENT

To replace service seat inserts, machine the insert in the same manner as if machining out the internal seat. Hold the same tolerances and follow the same installation procedures.

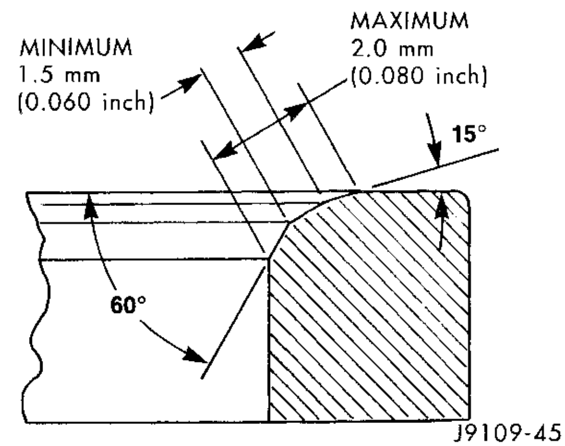

Fig. 12 Valve Seat Width

CYLINDER BORES—DE-GLAZE

(1) New piston rings may not seat in glazed cylinder bores.

(2) De-glazing gives the bore the correct surface finish required to seat the rings. The size of the bore is not changed by proper de-glazing.

(3) Cover the lube holes in the top of the block with waterproof tape.

(4) A correctly honed surface will have a crosshatch appearance with the lines at 15° to 25° angles (Fig. 13). For the rough hone, use 80 grit honing stones. To finish hone, use 280 grit honing stones.

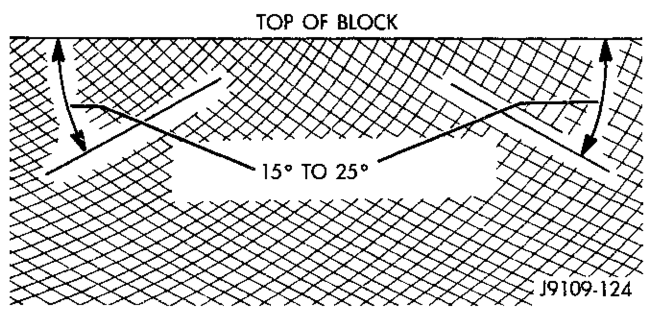

Fig. 13 Cylinder Bore Crosshatch Pattern

(5) Use a drill, a fine grit Flex-hone and a mixture of equal parts of mineral spirits and SAE 30W engine oil to de-glaze the bores.

(6) The crosshatch angle is a function of drill speed and how fast the hone is moved vertically (Fig. 14).

(7) Vertical strokes MUST be smooth continuous passes along the full length of the bore (Fig. 14).

(8) Inspect the bore after 10 strokes.

(9) Use a strong solution of hot water and laundry detergent to clean the bores. Clean the cylinder bores immediately after de-glazing.

(10) Rinse the bores until the detergent is removed and blow the block dry with compressed air.

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SERVICE PROCEDURES (Continued)

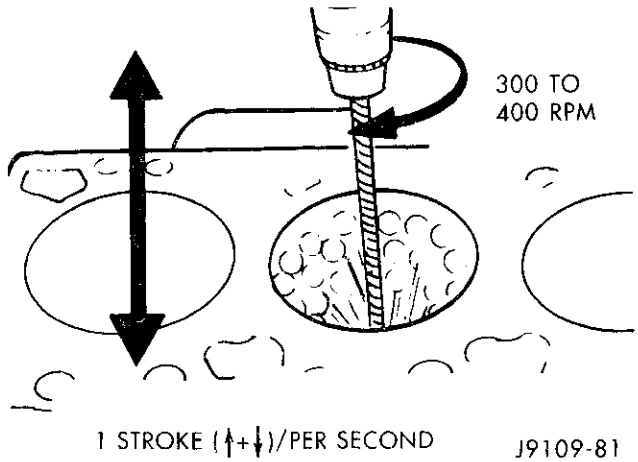


Fig. 14 De-Glazing Drill Speed and Vertical Speed

(11) Check the bore cleanliness by wiping with a white, lint free, lightly oiled cloth. If grit residue is still present, repeat the cleaning process until all residue is removed. Wash the bores and the complete block assembly with solvent and dry with compressed air.

(12) Be sure to remove the tape covering the lube holes after the cleaning process is complete.

CYLINDER BLOCK REFACING

(1) The combustion deck can be refaced twice. The first reface should be 0.25 mm (0.0098 inch). If additional refacing is required, an additional 0.25 mm (0.0098 inch) can be removed. Total allowed refacing is 0.50 mm (0.0197 inch) - (Fig. 15).

CYLINDER BLOCK REFACING DIMENSIONS

DIMENSION "A"		
1st Reface	0.25mm	(0.0098 in.)
2nd Reface	0.25mm	(0.0098 in.)
Dim (A) Total	0.50 mm	(0.0197 in.)
DIMENSION "B"		
Dim. "B" (STD.)	323.00 mm ± 0.10 mm	(12.7165 in. ± 0.0039 in.)
1st Reface	322.75 mm ± 0.10 mm	(12.7067 in. ± 0.0039 in.)
2nd Reface	322.50 mm ± 0.10 mm	(12.6968 in. ± 0.0039 in.)

(2) The upper right corner of the rear face of the block must be stamped with a X when the block is refaced to 0.25 mm (0.0098 inch). A second X must be stamped beside the first when the block is refaced to 0.50 mm (0.0197 inch) - (Fig. 16).

(3) Consult the parts catalog for the proper head gaskets which must be used with refaced blocks to ensure proper piston-to-valve clearance.

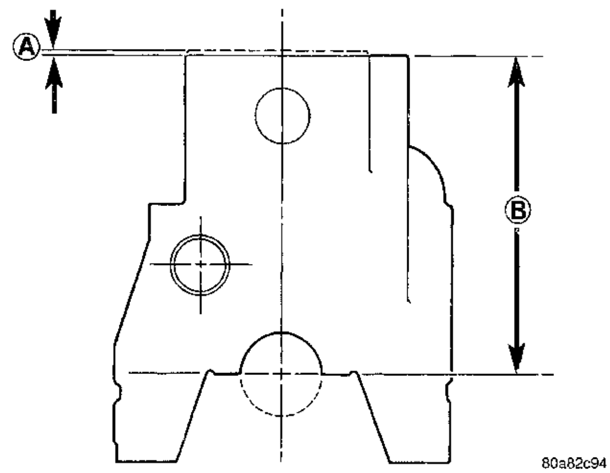


Fig. 15 Refacing Dimensions of the Cylinder Block

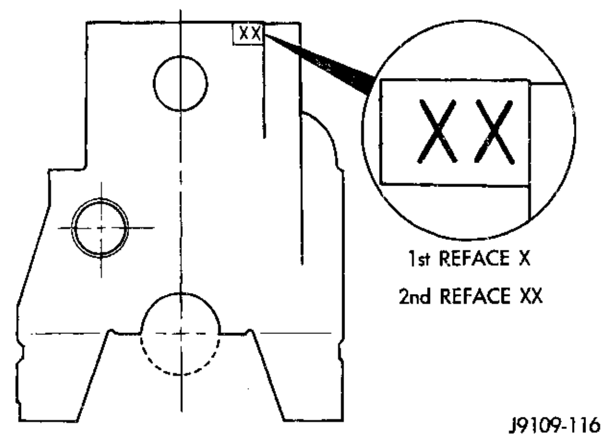


Fig. 16 Stamp Block after Reface

CYLINDER BORE REPAIR

Cylinder bore(s) can be repaired by one of two methods:

- Method 1:—Over boring and using oversize pistons and rings.
- Method 2:—Boring and installing a repair sleeve to return the bore to standard dimensions.

METHOD 1—OVERSIZE BORE

Oversize pistons and rings are available in two sizes - 0.50 mm (0.0197 inch) and 1.00 mm (0.0393 inch).

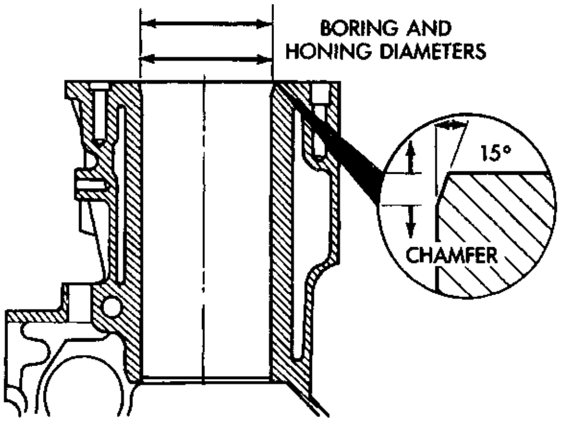
Any combination of standard, 0.50 mm (0.0197 inch) or 1.00 mm (0.0393 inch) overbore may be used in the same engine.

If more than 1.00 mm (0.0393 inch) overbore is needed, a repair sleeve can be installed (refer to Method 2—Repair Sleeve).

Cylinder block bores may be bored twice before use of a repair sleeve is required (Fig. 17). The first bore is 0.50 mm (0.0197 inch) oversize. The second bore is 1.00 mm (0.0393 inch) oversize.

SERVICE PROCEDURES (Continued)

After boring to size, use a honing stone to chamfer the edge of the bore (Fig. 17).



BORING DIAMETER DIMENSION

1st REBORE – 102.469 mm
(4.0342 inch)
2nd REBORE – 102.969 mm
(4.0539 inch)

HONING DIAMETER DIMENSIONS

STANDARD 102.020 ±0.020 mm
(4.0165 ±0.0008 inch)
1st REBORE 102.520 ±0.020 mm
(4.0362 ±0.0008 inch)
2nd REBORE 103.020 ±0.020 mm
(4.0559 ±0.0008 inch)

CHAMFER DIMENSIONS

Approx. 1.25 mm (0.049 inch)
by 15°

J9109-119

Fig. 17 Cylinder Bore Dimensions

A correctly honed surface will have a crosshatch appearance with the lines at 15° to 25° angles with the top of the cylinder block (Fig. 18). For the rough hone, use 80 grit honing stones. To finish hone, use 280 grit honing stones.

A maximum of 1.2 micrometer (48 microinch) surface finish must be obtained.

After finish honing is complete, immediately clean the cylinder bores with a strong solution of laundry detergent and hot water.

After rinsing, blow the block dry.

Check the bore cleanliness by wiping with a white, lint-free, lightly- oiled cloth. There should be no grit residue present.

If the block is not to be used right away, coat it with a rust- preventing compound.

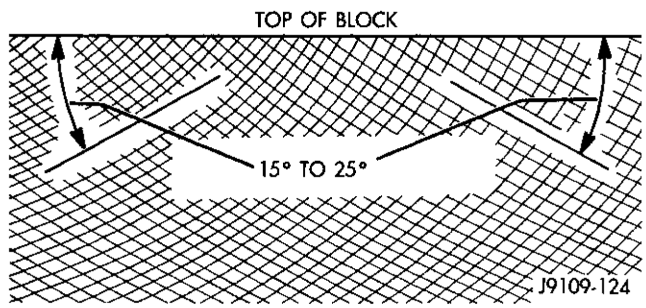


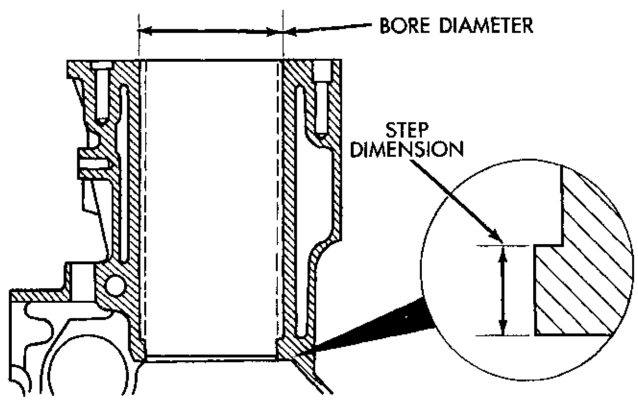
Fig. 18 Crosshatch Pattern of Repaired Sleeve(s)

METHOD 2—REPAIR SLEEVE

If more than a 1.00 mm (0.03937 inch) diameter oversize bore is required, the block must be bored and a repair sleeve installed.

Bore the block cylinder bore to 104.500-104.515 mm (4.1142-4.1148 inch) - (Fig. 19).

Repair sleeves can be replaced by using a boring bar to bore out the old sleeve. DO NOT cut the cylinder bore beyond the oversize limit.



BLOCK REBORE FOR REPAIR SLEEVE

BORE DIA. – 104.500 +0.015 mm
(4.1142 +0.0006 inch)
STEP DIM. – 6.35 mm (0.25 inch)

J9109-120

Fig. 19 Block Bore for Repair Sleeve Dimensions

After machining the block for the new repair sleeve, thoroughly clean the bore of all metal chips, debris and oil residue before installing the sleeve.

Cool the repair sleeve(s) to a temperature of -12°C (10°F) or below for a minimum of one hour. Be ready to install the sleeve immediately after removing it from the freezer.

Apply a coat of Loctite 620, or equivalent to the bore that is to be sleeved.

Wear protective gloves to push the cold sleeve into the bore as far as possible.

SERVICE PROCEDURES (Continued)

Using a sleeve driver, drive the sleeve downward until it contacts the step at the bottom of the bore (Fig. 20).

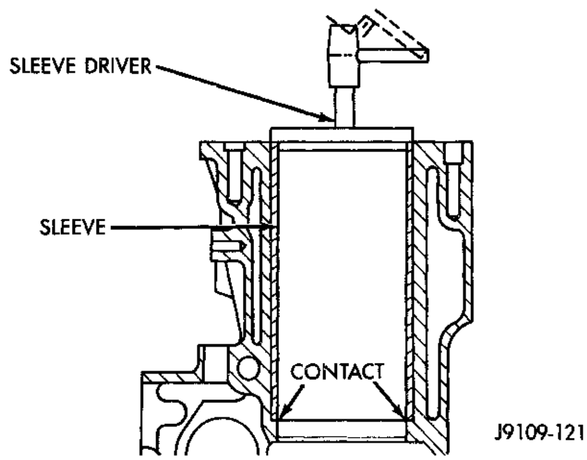


Fig. 20 Sleeve Installation

A sleeve driver can be constructed as follows (Fig. 21).

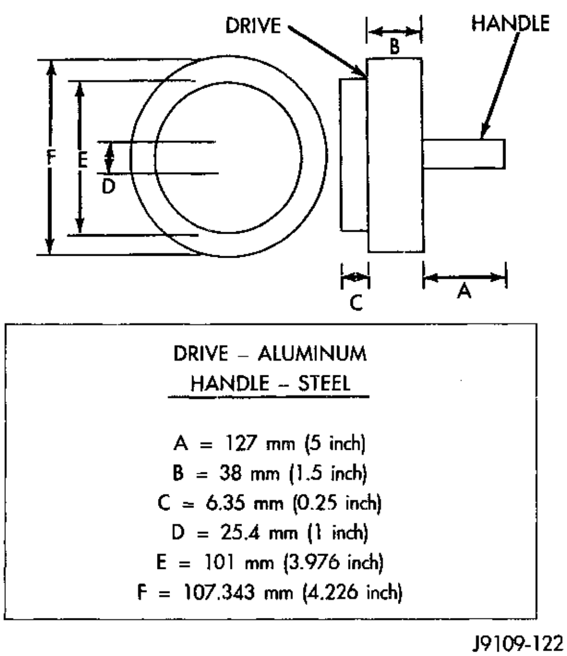


Fig. 21 Sleeve Driver Construction

Set up a boring bar and machine the sleeve to 101.956 mm (4.014 inch) - (Fig. 22).

After removing the boring bar, use a honing stone to chamfer the corner of the repair sleeve(s) - (Fig. 22).

A correctly honed surface will have a crosshatch appearance with the lines at 15° to 25° angles with the top of the cylinder block. For the rough hone, use 80 grit honing stones. To finish hone, use 280 grit honing stones.

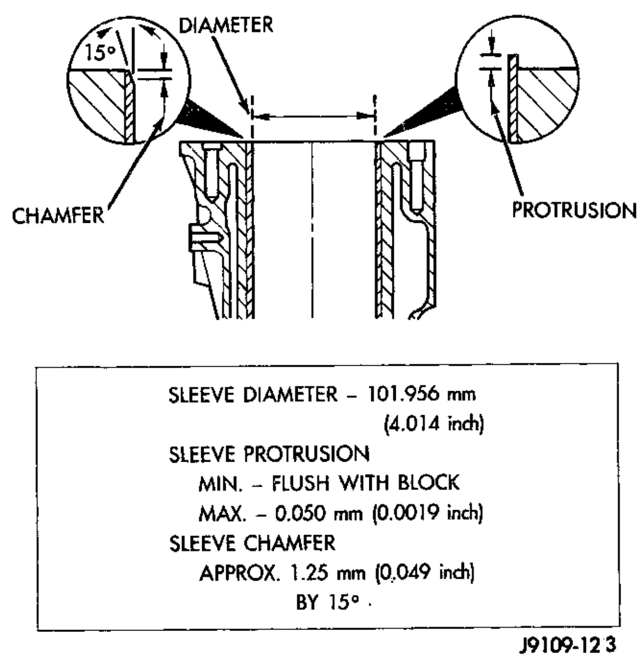


Fig. 22 Sleeve Machining Dimensions

Finished bore inside dimension is 102.020 ±0.020 mm (4.0165 ±0.0008 inch).

A maximum of 1.2 micrometer (48 microinch) surface finish must be obtained.

After finish honing is complete, immediately clean the cylinder bores with a strong solution of laundry detergent and hot water.

After rinsing, blow the block dry with compressed air.

Wipe the bore with a white, lint-free, lightly oiled cloth. Make sure there is no grit residue present.

Apply a rust-preventing compound if the block will not be used immediately.

A standard diameter piston and a piston ring set must be used with a sleeved cylinder bore.

CAM BORE REPAIR

The front cam bushing bore can be bored to 59.235 Mm ±0.013 mm (2.332 inch ±0.0006 inch) oversize. DO NOT bore the intermediate or rear cam bore to the front cam bore oversize dimensions. Intermediate and rear cam bores may be bored to 57.235 mm ±0.013 mm (2.253 inch ±0.0006 inch) oversize.

A surface finish of 2.3 micrometers (92 microinch) must be maintained. Not more than 20% of an area of any one bore may be 3.2 micrometers (126 microinch).

Camshaft bores can be repaired individually. It is not necessary to repair undamaged cam bores in order to repair individually damaged cam bores. The standard front bushing cannot be used to repair intermediate or rear bores.

SERVICE PROCEDURES (Continued)

Install all cam bushings flush or below the front cam bore surface. The oil hole must align to allow a 3.2 mm (0.125 inch) rod to pass through freely (Fig. 23).

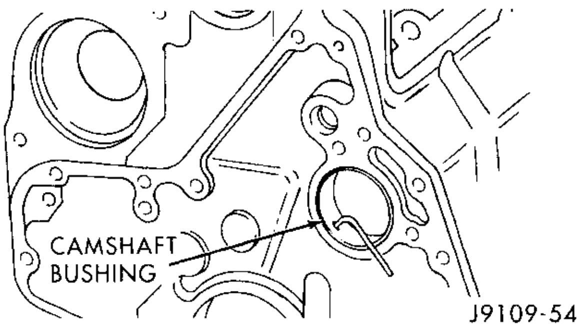


Fig. 23 Oil Hole Alignment

CYLINDER BLOCK CUP PLUG REPLACEMENT

(1) Remove the cup plugs from the oil passages (Fig. 24).

(2) Apply a bead of Loctite 277 around the outside diameter of the oil passage cup plugs.

(3) Drive the cup plugs in until they bottom in the bore (Fig. 24).

(4) Fill the engine with oil. Run the engine and check for leaks.

(5) Stop the engine and check the oil level with the dipstick.

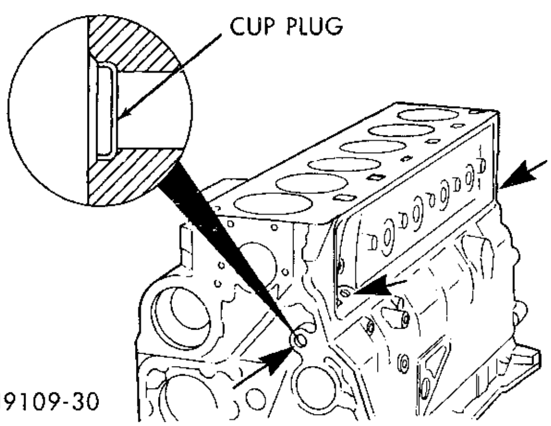


Fig. 24 Cup Plug Locations in Cylinder Block

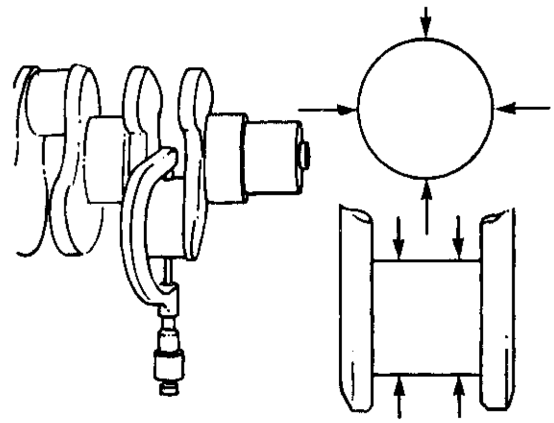
CONNECTING ROD BEARING AND CRANKSHAFT JOURNAL CLEARANCE

Measure the connecting rod bore with the bearings installed and the bolts tightened to 100 N·m (73 ft. lbs.) torque.

Record the smaller diameter.

Measure the diameter of the rod journal at the location shown (Fig. 25). Calculate the average diameter for each side of the journal.

The clearance is the difference between the connecting rod bore (smallest diameter) and the average diameter for each side of the crankshaft journal.



MIN.	68.962 mm	(2.715 inch)
MAX.	69.013 mm	(2.717 inch)

Out-of-Round - Max.
0.050 mm (0.002 inch)

Taper - Max.
0.013 mm (0.0005 inch)

Bearing Clearance - Max.
0.089 mm (0.0035 inch)

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Fig. 25 Connecting Rod Journal Diameter Limits

If the crankshaft is within limits, replace the bearing. If the crankshaft is out of limits, grind the crankshaft to the next smaller size and use oversize rod bearings.

PISTON GRADING PROCEDURE

- When rebuilding an engine with the original cylinder block, crankshaft and pistons, make sure the pistons are installed in their original cylinder.
- If replacing the piston(s), make sure the replacement piston(s) are the same grade as the one being replaced.
- If a new cylinder block and/or crankshaft is used, the piston grading procedure **MUST** be performed to determine the proper piston grade for each cylinder.

(1) Install any of the original connecting rod and piston assemblies into the No.1 cylinder. DO NOT install the piston rings.

(2) Install the upper bearing shell in the connecting rod with the tang of the bearing in the slot of the connecting rod. The connecting rod bearing shell must be installed in the original connecting rod and

AUTHENTIC RESTORATION PRODUCT

SERVICE PROCEDURES (Continued)

cap. Use clean lubricating oil to coat the inside diameter of the connecting rod bearing shell.

(3) Install the bearing shell in the connecting rod cap with the tang of the bearing in the slot to the cap. Use clean lubricating oil to coat the inside diameter of the bearing shell.

(4) The four digit number stamped on the connecting rod and cap at the parting line must match and be installed on the oil cooler side of the engine. Install the connecting rod cap and capscrews. Tighten the capscrews to 35 N·m (26 ft. lbs.) torque.

(5) Use a fine grit stone to remove any burrs from the cylinder block head deck. Zero the dial indicator to the cylinder block head deck.

(6) Move the dial indicator directly over the piston pin to eliminate any side-to-side movement.

(7) Rotate the crankshaft to top dead center (TDC). Rotate the crankshaft clockwise and counterclockwise to find the highest dial indicator reading. Record the reading.

(8) Remove the piston and connecting rod assembly from the No.1 cylinder and install the assembly into the No.2 cylinder. Repeat the procedure for every cylinder using the same piston and connecting rod assembly.

(9) Determine the grade of the piston being used by referring to the Piston Protrusion Chart below. Four digits on top of the piston can be cross referenced to a Chrysler part number for replacement (Fig. 26). If the number on the piston cannot be seen, measure from the top of the piston to the top of the piston pin to see what grade piston is used (Fig. 27).

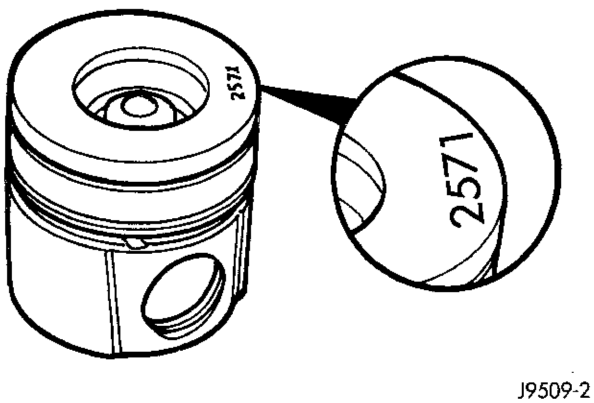

Fig. 26 Piston Grading Number Location

NOTE: Use the table below when piston grading numbers are missing or not legible.

PISTON PROTRUSION CHART

IF MEASURING PISTON IS GRADING NUMBER:		AND PROTRUSION IS:	USE GRADE:
180 H.P. (A/T)	215H.P. (M/T)		
2571	6631	0.609-0.711 mm (0.024-0.028 in.)	A
2571	6631	0.508-0.609mm (0.020-0.024 in.)	B
2571	6631	0.406-0.508 mm (0.016-0.020 in.)	C
2572	6632	0.711-0.813 mm (0.028-0.032 in.)	A
2572	6632	0.609-0.711 mm (0.024-0.028 in.)	B
2572	6632	0.508-0.609 mm (0.020-0.024 in.)	C
2573	6633	0.813-0.914 mm (0.032-0.036 in.)	A
2573	6633	0.711-0.813 mm (0.028-0.032 in.)	B
2573	6633	0.609-0.711 mm (0.024-0.028 in.)	C

ALTERNATIVE GRADE IDENTIFICATION METHOD

DIMENSION "A"	REF. NUMBER	GRADE
51.554-51.607 mm (2.029-2.031 in.)	2571/6631	A
51.654-51.707 mm (2.033-2.035 in.)	2572/6632	B
51.754-51.807 mm (2.037-2.039 in.)	2573/6633	C

CRANKSHAFT REWORK

Crankshaft main and rod journals may be ground in increments of 0.25 mm (0.0098 inch) up to a total of 1.00 mm (0.0394 inch).

The only exception is the main journal thrust width surface. This journal must be ground in increments of 0.50 mm (0.0197 inch) up to a total of 1.00 mm (0.0394 inch). The thrust surface is located on the No.6 main bearing. When the thrust surface

SERVICE PROCEDURES (Continued)

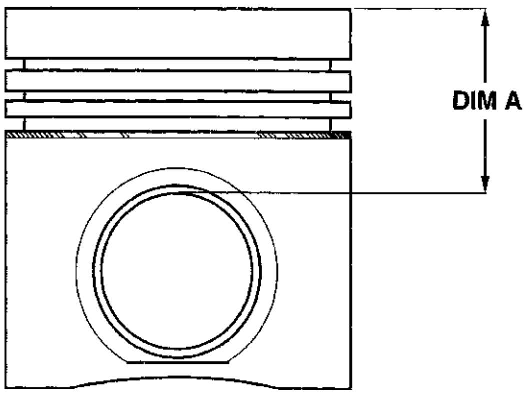

Fig. 27 Piston Grading Measurement

requires grinding, the main journal must be ground to the same undersize dimension.

CAUTION: Welding of the crankshaft is not allowed. Failure of the crankshaft will result.

MAIN JOURNAL

All main journals are to be ground in the opposite direction of engine rotation (clockwise as viewed from the front of crankshaft). Polish the journals in the same direction as engine rotation.

The main bearing grinding specifications are shown in (Fig. 28).

STANDARD MAIN JOURNAL DIAMETER	
83.000 ±0.013 mm (3.2677 ±0.0005 inch)	
WORN MAIN JOURNAL DIAMETER LIMIT	
82.962 (3.2662 inch)	
UNDERSIZES	REGRIND TO
0.25 mm (0.0098 inch)	82.750 ±0.013 mm (3.2579 ±0.0005 inch)
0.50 mm (0.0197 inch)	82.500 ±0.013 mm (3.2480 ±0.0005 inch)
0.75 mm (0.0295 inch)	82.250 ±0.013 mm (3.2381 ±0.0005 inch)
1.00 mm (0.0394 inch)	82.000 ±0.013 mm (3.2283 ±0.0005 inch)
OUT-OF ROUND & TAPER (MAX.)	
0.005 mm (0.0002 inch)	
ALL MAIN JOURNALS ARE TO BE PARALLEL TO THE FRONT AND REAR MAINS WITHIN: 0.030 mm (0.001 inch)	

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Fig. 28 Crankshaft Main Journal Dimensions

Thrust journals can be ground in the same increments and using the same specifications as all other main journals. The main journal radius may be ground using either the preferred or the alternative procedure providing the thrust surface width is not being ground. The preferred procedure must be used when the main bearing thrust width surface is ground. When the thrust surface width requires grinding, the main journal must be ground to the same undersize dimension (Fig. 29).

THRUST JOURNAL WIDTH	
37.500 ±0.025 mm (1.4764 ±0.001 inch)	
UNDERSIZES	REGRIND WIDTH TO
0.50 mm (0.0197 inch)	38.000 ±0.025 mm (1.4961 ±0.001 inch
1.00 mm (0.0394 inch)	38.500 ±0.025 mm (1.5158 ±0.001 inch)

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Fig. 29 Crankshaft Thrust Journal Width Dimensions

The thrust surface is to be ground on center within 0.10 mm (0.004 inch). It also must be perpendicular to the front and rear mains within 0.0015 mm (0.00006 inch) per radial inch on the thrust area (Fig. 30). The surface finish requirement is 0.04 micrometer (16.0 microinch).

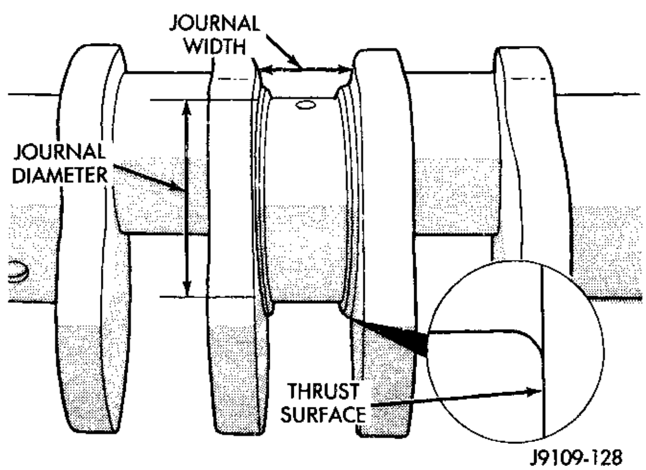

Fig. 30 Crankshaft Thrust Surface

PREFERRED PROCEDURE:

Smoothly blend a 4.20 ±0.020 mm (0.1654 ±0.0008 inch) radius to the ground diameters (Fig. 31).

CAUTION: DO NOT use the Alternative Procedure when the thrust surface width is ground.

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SERVICE PROCEDURES (Continued)

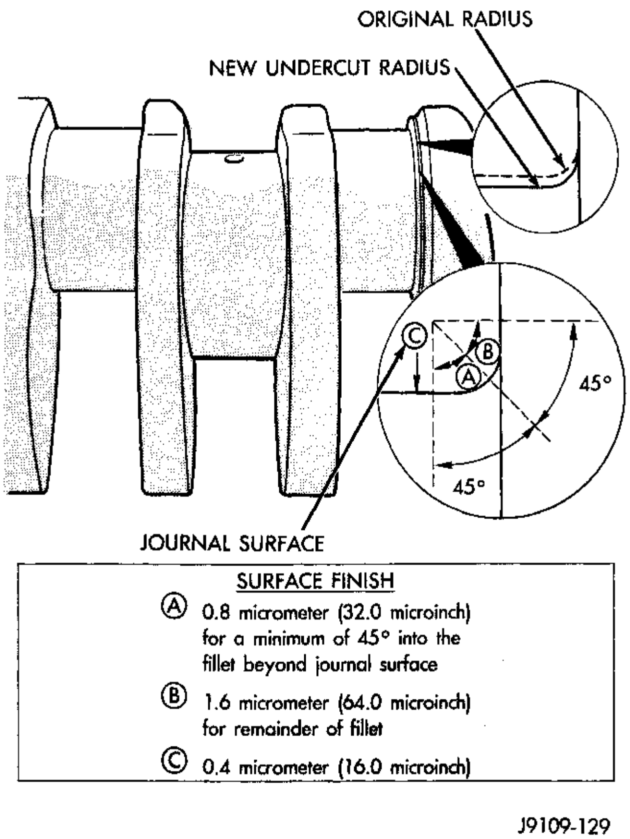

Fig. 31 Grind Crankshaft Main Journal—Preferred Method

ALTERNATIVE PROCEDURE:

Smoothly blend a 1.25 ±0.020 mm (0.0492 ±0.0008 inch) radius to the ground diameters (Fig. 32).

ROD JOURNAL

All rod journals are to be ground in the opposite direction of engine rotation (clockwise as viewed from the front of crankshaft). Polish the journals in the same direction as engine rotation.

The rod bearing grinding specifications are shown in (Fig. 33).

PREFERRED PROCEDURE:

Smoothly blend a 4.00 ±0.020 (0.1575 ±0.0008 inch) radius to the ground diameters and side faces (Fig. 34).

ALTERNATIVE PROCEDURE:

Smoothly blend a 1.25 ±0.020 mm (0.0492 ±0.0008 inch) radius to the ground journals (Fig. 35).

MAIN BEARING CLEARANCE

Inspect the main bearing bores for damage or abnormal wear.

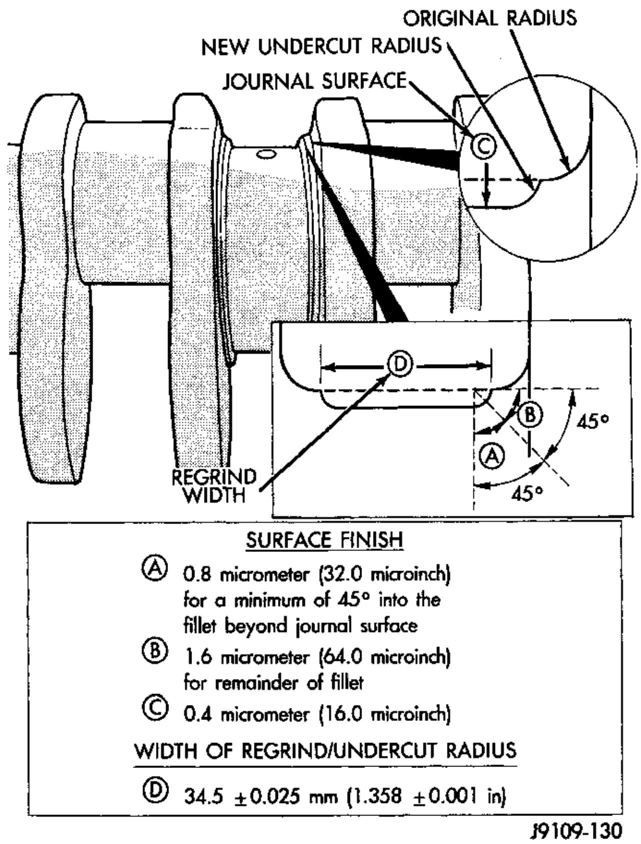

Fig. 32 Grind Crankshaft Main Journal—Alternative Method

STANDARD ROD JOURNAL DIAMETER	
69.000 ±0.013 mm (2.7165 ±0.0005 inch)	
WORN ROD JOURNAL DIAMETER LIMIT	
68.962 (2.7150 inch)	
UNDERSIZES	REGRIND TO
0.25 mm (0.0098 inch)	68.750 ±0.013 mm (2.7067 ±0.0005 inch)
0.50 mm (0.0197 inch)	68.500 ±0.013 mm (2.6969 ±0.0005 inch)
0.75 mm (0.0295 inch)	68.250 ±0.013 mm (2.6870 ±0.0005 inch)
1.00 mm (0.0394 inch)	68.000 ±0.013 mm (2.6772 ±0.0005 inch)
OUT-OF ROUND & TAPER (MAX.)	
0.005 mm (0.0002 inch)	
ALL MAIN JOURNALS ARE TO BE PARALLEL TO THE FRONT AND REAR MAINS WITHIN: 0.030 mm (0.001 inch)	

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Fig. 33 Crankshaft Rod Journal Dimensions

SERVICE PROCEDURES (Continued)

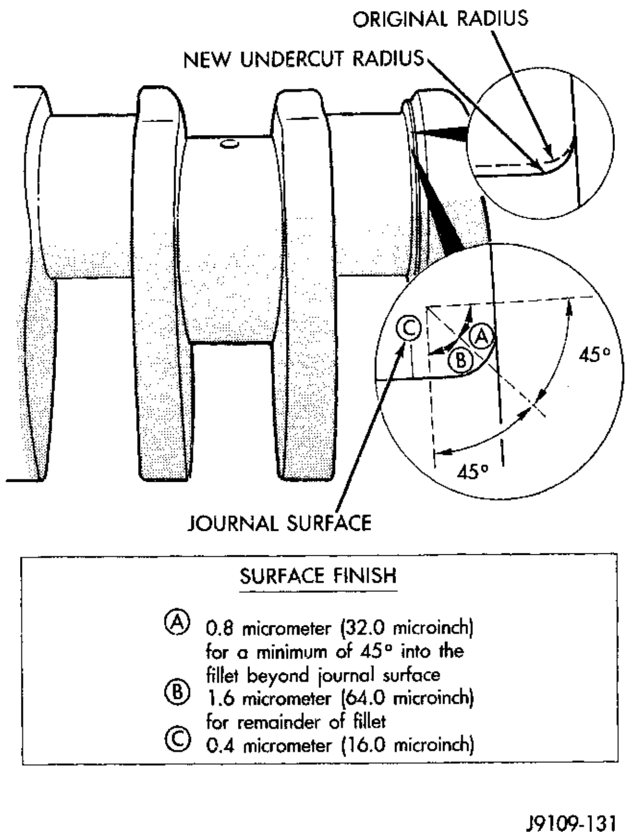

Fig. 34 Crankshaft Rod Journal Grind—Preferred Method

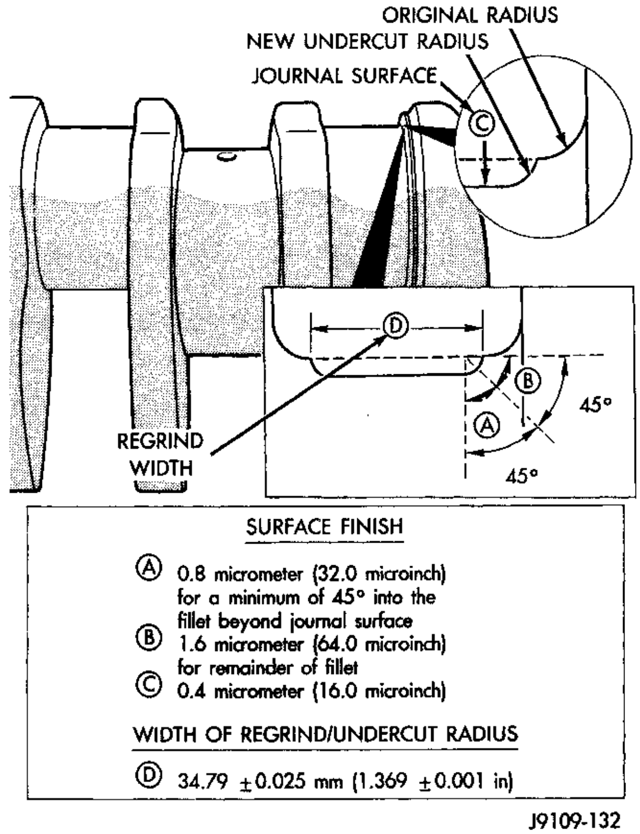

Fig. 35 Grind Crankshaft Rod Journal—Alternative Method

Install the crankshaft main bearings and measure main bearing bore diameter with the main bolts tightened to 176 N·m (130 ft. lbs.) torque (Fig. 36).

Measure the diameter of the main journal at the locations shown (Fig. 37). Calculate the average diameter for each side of the journal.

Calculate the main bearing journal to bearing clearance. the clearance specifications are 0.119 mm (0.00475 inch). If the crankshaft journal is within limits, replace the main bearings. If not within specifications, grind the crankshaft to next size and use oversize bearings.

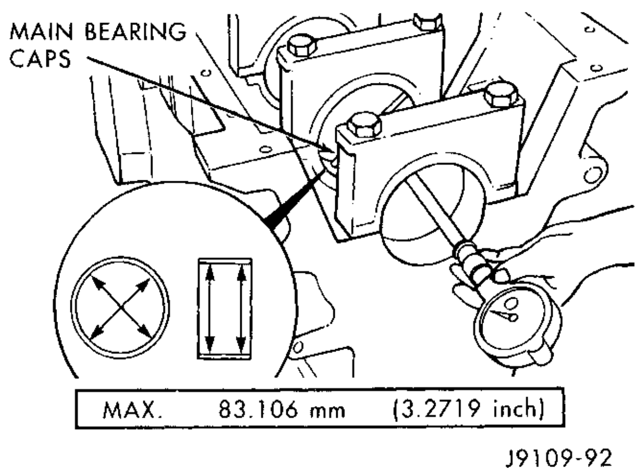

Fig. 36 Crankshaft Main Bearing Bore Diameter

REMOVAL AND INSTALLATION

ENGINE FRONT MOUNTS

REMOVAL

(1) Disconnect the negative cable from the battery.

(2) Position fan to assure clearance for radiator top tank and hose.

(3) Install engine support/lifting fixture.

(4) Raise vehicle on hoist.

(5) Lift the engine SLIGHTLY and remove the thru-bolt and nut (Fig. 38).

(6) Remove engine support bracket/cushion bolts (Fig. 38). Remove the support bracket/cushion.

INSTALLATION

(1) With engine raised SLIGHTLY, position the engine support bracket/cushion to the block. Install new bolts and tighten to 189 N·m (140 ft. lbs.) torque.

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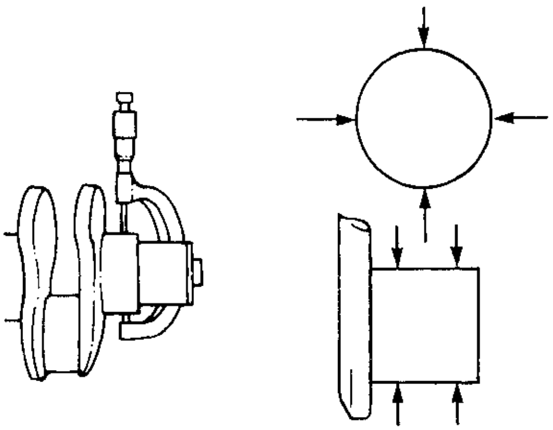
REMOVAL AND INSTALLATION (Continued)



MIN.	82.962 mm	(3.2662 inch)
MAX.	83.103 mm	(3.2682 inch)

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Fig. 37 Crankshaft Main Journal Diameter

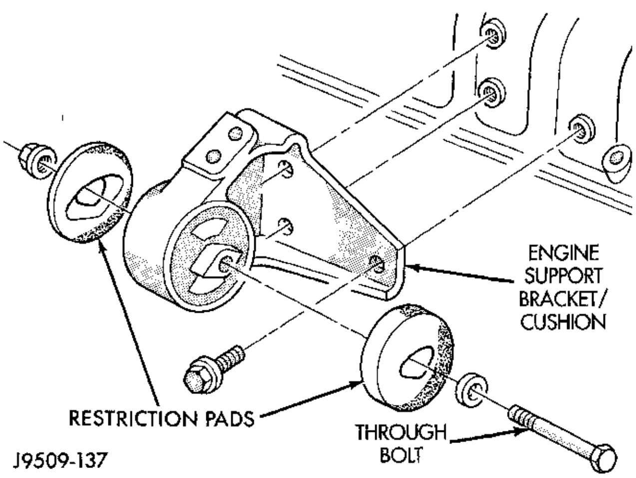

Fig. 38 Front Engine Mounts

(2) Install the thru-bolt into the engine support bracket/cushion.

(3) Lower engine with support/lifting fixture while guiding the engine bracket/cushion and thru-bolt into support cushion brackets (Fig. 39).

(4) Install thru-bolt nuts and tighten the nuts to 68 N·m (50 ft. lbs.) torque.

(5) Lower the vehicle.

(6) Remove lifting fixture.

ENGINE REAR MOUNT

REMOVAL

(1) Raise the vehicle on a hoist.

(2) Position a transmission jack in place.

(3) Remove support cushion stud nuts (Fig. 40).

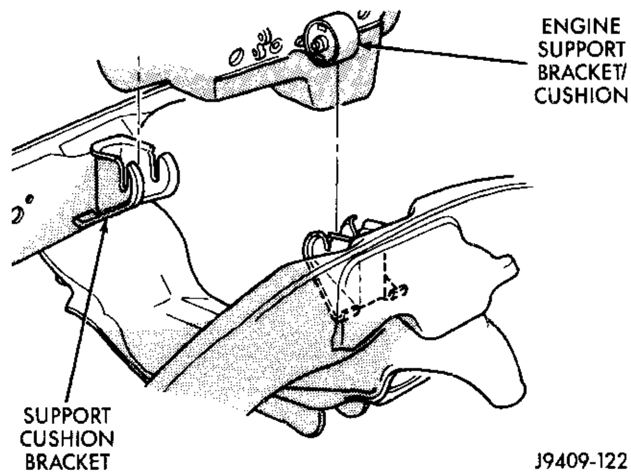

Fig. 39 Positioning Engine Front Mounts

(4) Raise rear of transmission and engine SLIGHTLY.

(5) Remove the bolts holding the support cushion to the transmission support bracket. Remove the support cushion.

(6) If necessary, remove the bolts holding the transmission support bracket to the transmission.

INSTALLATION

(1) If removed, position the transmission support bracket to the transmission. Install new attaching bolts and tighten to 102 N·m (75 ft. lbs.) torque.

(2) Position support cushion to transmission support bracket. Install stud nuts and tighten to 47 N·m (35 ft. lbs.) torque.

(3) Using the transmission jack, lower the transmission and support cushion onto the crossmember (Fig. 40).

(4) Install the support cushion bolts and tighten to 47 N·m (35 ft. lbs.) torque.

(5) Remove the transmission jack.

(6) Lower the vehicle.

ENGINE ASSEMBLY

REMOVAL

(1) Remove the battery.

(2) Drain cooling system (refer to Group 7, Cooling System for the proper procedure).

(3) Remove the upper crossmember and top core support.

(4) Remove the transmission oil cooler.

(5) Discharge the air conditioning system, if equipped (refer to Group 24, Heating and Air Conditioning for service procedures).

(6) Remove the serpentine belt (refer to Group 7, Cooling System).

(7) Remove the A/C compressor with the lines attached. Set aside.

REMOVAL AND INSTALLATION (Continued)

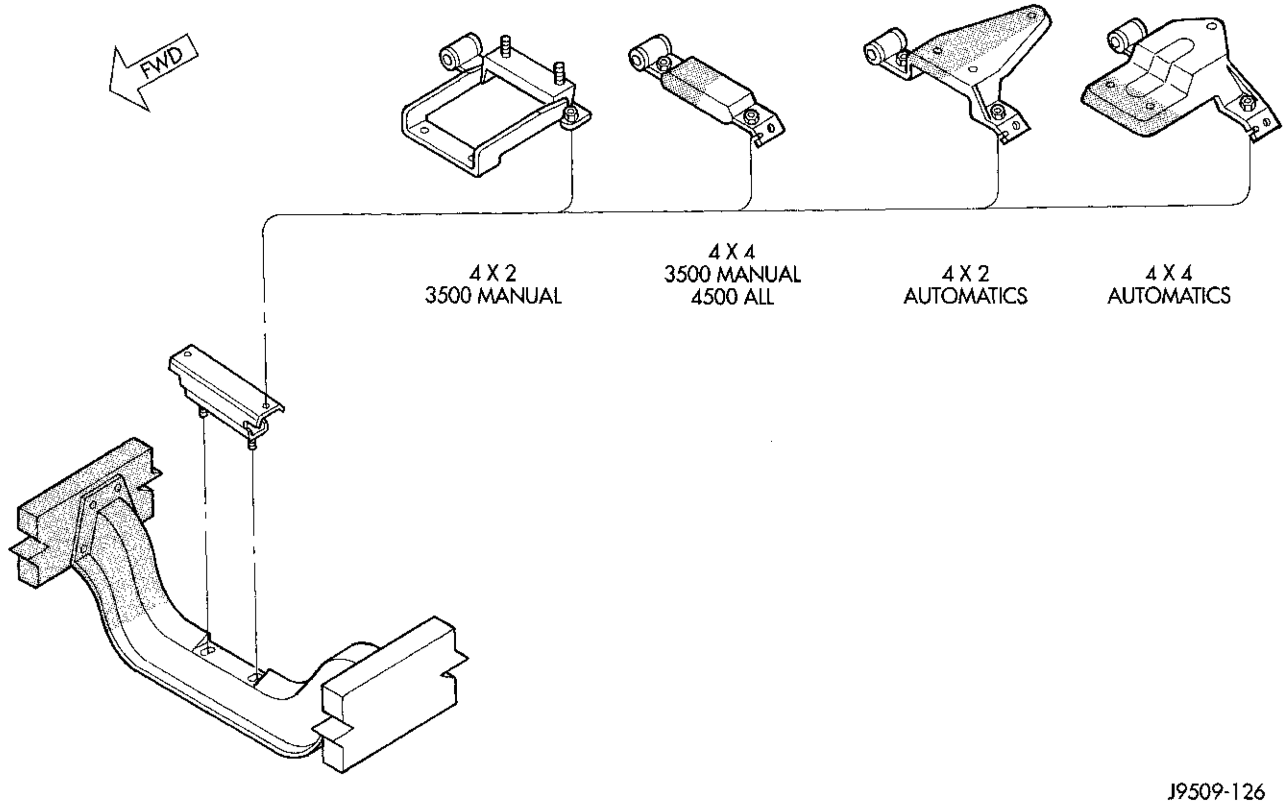

Fig. 40 Engine Rear Support Cushion Assemblies

(8) If equipped, remove the condenser.

(9) Remove the washer bottle.

(10) Remove the radiator overflow bottle.

(11) Disconnect the top radiator hose.

(12) Remove the fan.

(13) Remove the fan shroud.

(14) Disconnect the lower radiator hose.

(15) Remove radiator (refer to Group 7, Cooling System).

(16) Remove the generator (Fig. 41) with the wire connections (refer to Group 8B, Battery/Starter/Generator Service).

(17) Disconnect the heater hoses at the dash panel and at the water valve (Fig. 42).

(18) Disconnect the air inlet tube from the turbocharger (Fig. 43) and the air intake housing. Remove the tube.

(19) Remove the exhaust pipe from the turbocharger outlet flange (Fig. 43).

(20) Disconnect the intercooler inlet duct from the turbocharger and the intercooler. Remove the inlet duct.

(21) Disconnect the intercooler outlet duct from the air inlet housing and the intercooler. Remove the outlet duct.

(22) Disconnect the accelerator linkage, the speed control linkage and the throttle valve linkage.

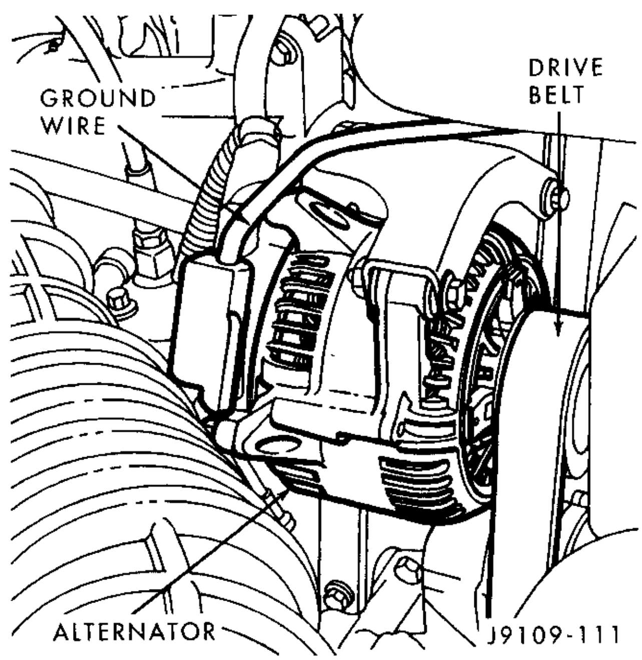

Fig. 41 Generator Removal

(23) Disconnect the power steering hoses, if equipped.

(24) Disconnect the transmission cooler lines.

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REMOVAL AND INSTALLATION (Continued)

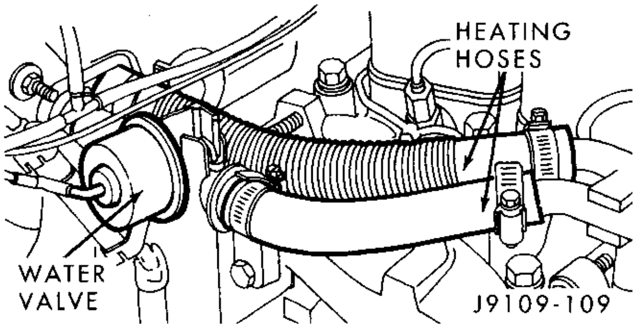


Fig. 42 Heater Hoses

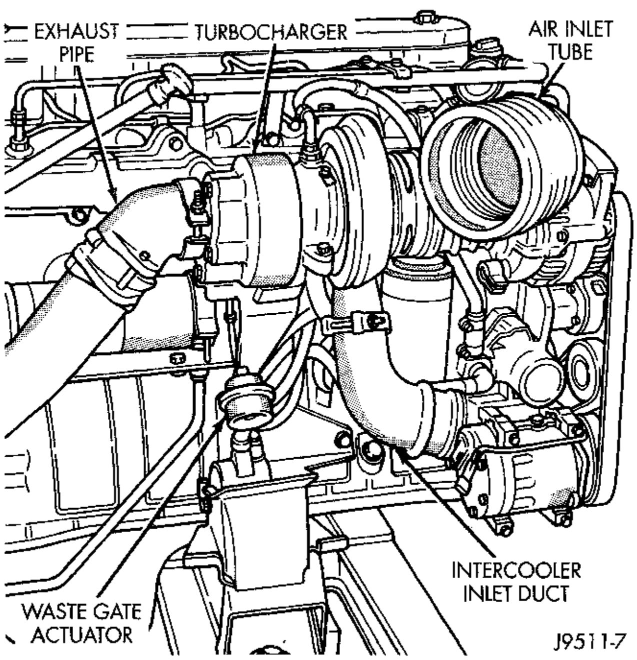


Fig. 43 Air Inlet Tube and Exhaust Pipe Connection

(25) Disconnect all electrical connections from the engine. Put tags on the connections to identify their locations.

(26) Disconnect the fuel lines to the lift pump and fuel return. Use tags to identify the lines.

(27) On Manual Transmission vehicles, remove the shift lever (refer to Group 21, Transmissions).

(28) Raise and support the vehicle on a hoist.

(29) Drain the engine lubricating oil. Dispose of the oil according to all applicable regulations.

(30) Remove the oil pan.

(31) Remove engine front mount thru-bolt nuts.

(32) Remove the transmission cooler line brackets from oil pan.

(33) Disconnect exhaust pipe at manifold.

(34) Disconnect the starter wires. Remove starter motor (refer to Group 8B, Battery/Starter/Generator Service).

(35) Remove the dust shield and transmission cover.

(36) Refer to Group 21, Transmissions for transmission removal.

(37) Lower the vehicle.

(38) Put a cover or tape over all engine openings.

(39) Lift the engine out of the vehicle.

(40) Install the engine on a suitable stand.

(41) Remove all accessories and brackets not previously removed for use with the replacement engine.

INSTALLATION

(1) Check the data plate to verify that the replacement engine is the same model and rating as the engine that was removed.

(2) Install all accessories and brackets that had been removed from the previous engine.

(3) Use the lifting brackets to lift the engine off of the stand.

(4) Position the engine in the chassis with the thru-bolt installed.

(5) Remove the covers or tape covering the engine openings.

(6) Raise and support the vehicle.

(7) Refer to Group 21, Transmissions for transmission installation.

(8) Install the dust shield and transmission cover.

(9) Install the prop shaft (refer to Group 16, Propeller Shaft).

(10) Install the starter motor (refer to Group 8B, Battery/Starter/Generator Service). Connect the starter wires.

(11) Install the transmission cooler line brackets to oil pan.

(12) Install and tighten engine front mount thru-bolt nuts.

(13) Install the oil pan. Install the drain plug.

(14) Lower the vehicle.

(15) On Manual Transmission vehicles, install the shift lever (refer to Group 21, Transmissions).

(16) Connect the fuel lines to the lift pump and fuel return. Use tags to identify the lines.

(17) Connect all electrical connections to the engine. Use tags to identify their locations.

(18) Connect the transmission cooler lines.

(19) Connect the power steering hoses, if equipped.

(20) Connect the accelerator linkage, the speed control linkage and the throttle valve linkage.

(21) Install the outlet duct. Connect the intercooler outlet duct to the air inlet housing and the intercooler.

(22) Install the inlet duct. Connect the intercooler inlet duct to the turbocharger and the intercooler.

(23) Install the exhaust pipe to the turbocharger outlet flange.

(24) Install the air inlet tube. Connect the air inlet tube to the turbocharger and the air intake housing.

(25) Connect the heater hoses at the dash panel and at the water valve.

REMOVAL AND INSTALLATION (Continued)

(26) Install the generator and wire connections (refer to Group 8B, Battery/Starter/Generator Service).

(27) Install the radiator (refer to Group 7, Cooling System).

(28) Connect the lower radiator hose.

(29) Install the fan shroud.

(30) Install the fan.

(31) Connect the top radiator hose.

(32) Install the radiator overflow bottle.

(33) Install the washer bottle.

(34) If equipped, install the condenser.

(35) Install the A/C compressor with the lines attached.

(36) Evacuate and charge the air conditioning system, if equipped (refer to Group 24, Heating and Air Conditioning for service procedures).

(37) Install the transmission oil cooler.

(38) Install the upper crossmember and top core support.

(39) Install the serpentine belt (refer to Group 7, Cooling System).

(40) Fill the cooling system with a mixture of 50% water and 50% ethylene-glycol base antifreeze (refer Group 7, Cooling System for the proper procedure).

(41) Fill the engine with the required amount of clean engine lubricating oil (refer to Group 0, Lubrication and Maintenance).

(42) Install the battery and connect the battery cables.

(43) Check the oil level after the engine has run for 2 or 3 minutes. Oil held in the oil filter and oil passages will cause the oil level in the pan to be lower than normal for a short period of time.

(44) Operate the engine at idle for 5 to 10 minutes and check for leaks and loose parts.

ROCKER LEVERS AND PUSH RODS

REMOVAL

(1) Remove the EGR tube and gaskets.

(2) Remove the valve covers.

(3) Loosen the adjusting screw locknuts. Loosen the adjusting screws until they stop (Fig. 44).

(4) Remove the bolts from the rocker lever pedestals. Remove the pedestals and rocker lever assemblies (Fig. 44).

(5) Remove the push rods. The rear two push rods must be raised through holes in cab overhang.

INSTALLATION

(1) Make sure the dowel rings in the pedestals are installed into the dowel bores in the cylinder head.

(2) If the push rod is holding pedestal off head, bar the engine until the pedestal will set on the head surface without interference.

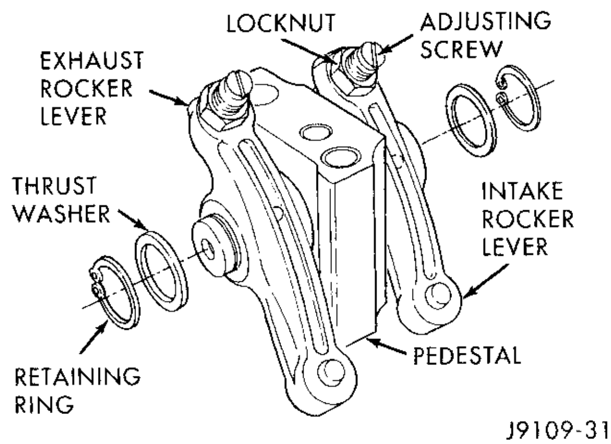


Fig. 44 Location of Rocker Lever Components

(3) Use clean engine oil to lubricate the cylinder head bolt threads and under the bolt heads.

(4) Install the long bolts (12 mm) into the rocker lever pedestals. Tighten the bolts as follows:

• Step 1—Tighten the bolts, in sequence (Fig. 45), to 90 N·m (66 ft. lbs.) torque. Check the torque. If lower than 90 N·m (66 ft. lbs.), tighten to this torque.

• Step 2—Tighten the bolts, in sequence (Fig. 45), to 120 N·m (89 ft. lbs.) torque. Check the torque. If lower than 120 N·m (89 ft. lbs.), tighten to this torque.

• Step 3—Tighten the bolts, in sequence (Fig. 45), an additional 90°.

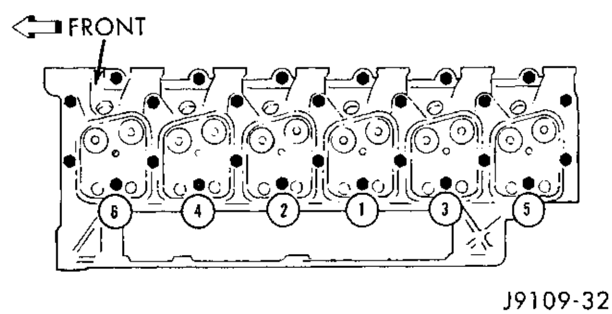


Fig. 45 Rocker Lever (Head Bolts) Tightening Sequence

(5) Tighten the 8 mm bolts to 24 N·m (18 ft. lbs.) torque.

(6) Install the valve cover. Tighten the valve cover bolt to 24 N·m (18 ft. lbs.) torque.

(7) Install the EGR tube and start fasteners by hand.

(8) Tighten all bolts/nuts to 24 N·m (212 in. lbs.) torque. **When tightening bolts at EGR valve end of tube, alternate between the upper and lower bolt to allow face of EGR valve to remain square to tube mounting flange on EGR tube.**

REMOVAL AND INSTALLATION (Continued)

CYLINDER HEAD

These cylinder heads can only be used on engines with an intercooler. DO NOT interchange with earlier models.

REMOVAL

(1) Drain the coolant. DO NOT waste reusable coolant. If the solution is clean, drain the coolant into a clean container for reuse.

(2) Drain the engine oil. Dispose of the used oil properly.

(3) Disconnect the radiator and heater hoses (refer to Group 7, Cooling System).

(4) Remove the turbocharger.

(5) Remove the EGR tube and gaskets.

(6) Remove the exhaust manifold (Fig. 46).

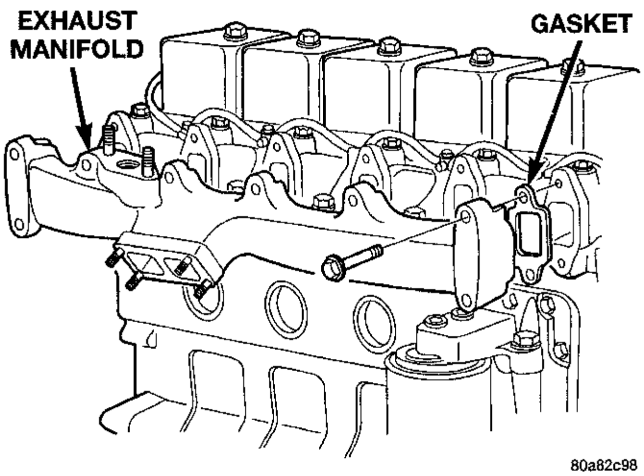


Fig. 46 Exhaust Manifold

(7) Remove the fuel lines and injector nozzles as an assembly (refer to Group 14, Fuel System).

(8) Remove the valve covers.

(9) Remove the rocker levers and push rods.

(10) Remove the fuel filter/water separator (Fig. 47). Refer to Group 14, Fuel System, for the proper procedures. Remove the remote fuel filter/water separator head.

(11) If the engine is hot, remove the cylinder head bolts in the sequence shown in (Fig. 48). The removal sequence is not important if the engine is cold. There are 3 sizes of head bolts. Note the position of each bolt for future installation.

(12) Remove the cylinder head and gasket from the cylinder block.

INSTALLATION

(1) The cylinder block and head must be clean and dry.

(2) Position the gasket onto the dowels (Fig. 49). Make sure the gasket is correctly aligned with the holes in the cylinder block.

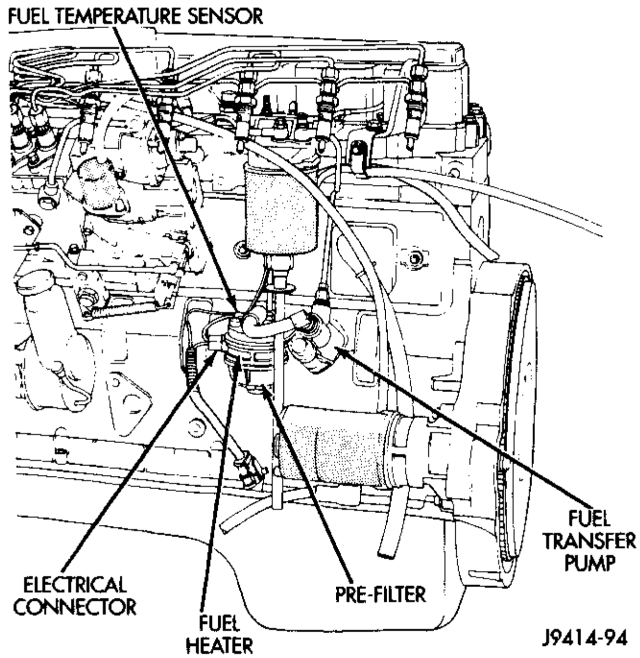


Fig. 47 Fuel/Water Separator Filter

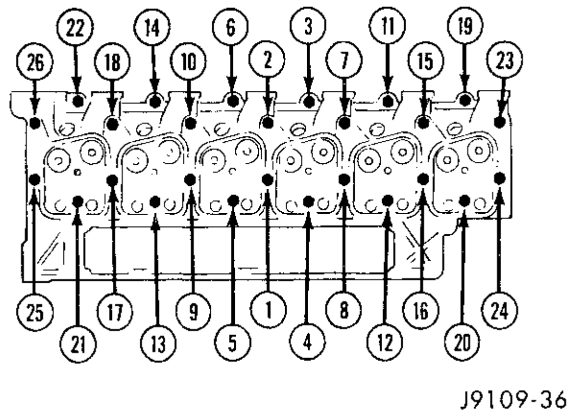


Fig. 48 Cylinder Head Bolt Removal Sequence—Cylinder Head Hot

(3) Carefully put the cylinder head onto the gasket and cylinder block. Make sure the cylinder head is installed onto the dowels in the cylinder block (Fig. 49).

(4) Install the push rods and rocker levers.

(5) Use clean engine oil to lubricate the cylinder head bolt threads and under the bolt heads.

(6) The cylinder head bolts are 3 different sizes. Install the bolts in the proper hole. Tighten the bolts as follows:

- Step 1—Tighten all bolts, in sequence (Fig. 10), to 90 N·m (66 ft. lbs.) torque. Check the torque. If lower than 90 N·m (66 ft. lbs.), tighten to this torque.
- Step 2—Tighten all long 12 mm bolts (Nos. 4, 5, 12, 13, 20 and 21), in sequence (Fig. 50), to 120 N·m

REMOVAL AND INSTALLATION (Continued)

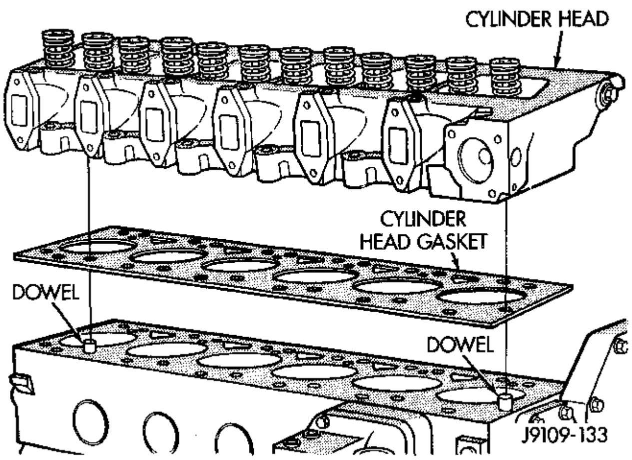


Fig. 49 Cylinder Head/Gasket Alignment

(89 ft. lbs.) torque. Check the torque. If lower than 120 N·m (89 ft. lbs.), tighten to this torque.

• Step 3—Tighten all bolts, in sequence (Fig. 50), an additional 90°.

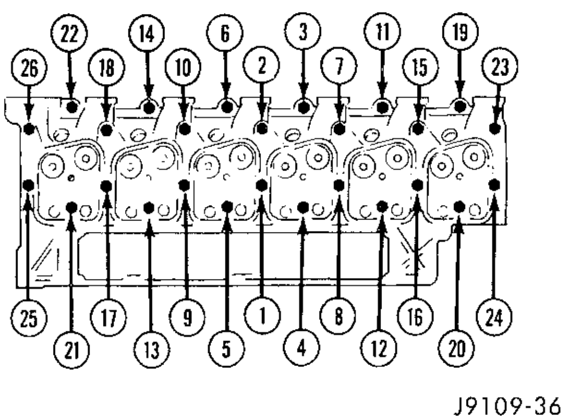


Fig. 50 Cylinder Head Tightening Sequence

(7) Be sure to lubricate the push rod sockets with clean engine oil. Be sure push rod is seated properly in the tappet.

(8) Install the rocker lever pedestal bolts and tighten to 24 N·m (18 ft. lbs.) torque.

(9) Adjust the valve clearance.

(10) Install the valve covers. Tighten the bolts to 24 N·m (18 ft. lbs.) torque.

(11) Install the injector nozzles and fuel lines (refer to Group 14, Fuel System).

(12) Install the remote fuel filter/water separator head. Install the fuel filter/water separator (refer to Group 14, Fuel System for the proper procedures).

(13) Install the exhaust manifold (refer to Group 11, Exhaust System and Intake Manifold).

(14) Install the EGR tube and start fasteners by hand.

(15) Tighten all bolts/nuts to 24 N·m (212 in. lbs.) torque. **When tightening bolts at EGR valve end of tube, alternate between the upper and lower bolt to allow face of EGR valve to remain square to tube mounting flange on EGR tube.**

(16) Install the turbocharger.

(17) Connect the radiator and heater hoses.

(18) Fill the engine with new coolant or the clean drained coolant (refer to Group 7, Cooling System for the proper procedure).

(19) Fill the engine with clean lubricating oil (refer to Group 0, Lubrication and Maintenance).

VALVES AND VALVE SPRINGS

REMOVAL

(1) Remove the cylinder head (Refer to Cylinder Head Removal and Installation in this section).

(2) Mark the valves to identify their position.

(3) Compress the valve spring and remove the valve stem collets (Fig. 51).

(4) Release valve spring and remove the retainer and spring (Fig. 51).

(5) Remove the remaining collets, retainers, springs and valves. Keep the valves in a labeled rack.

(6) Remove the valve stem seals (Fig. 51).

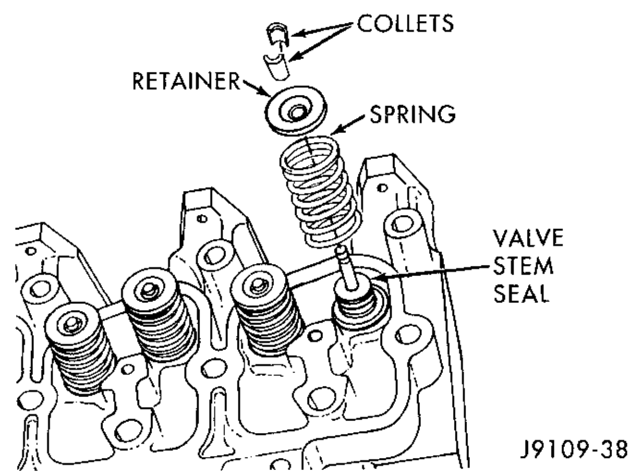


Fig. 51 Valve Removal

INSTALLATION

(1) Clean all cylinder head components before assembling.

(2) Install the valve stem seals (Fig. 52). The intake and exhaust valve seals are the same.

(3) Lubricate the stems with SAE 90W oil before installing the valves. Install the valves in the same positions as removed.

(4) Compress the valve spring after installing the spring and retainer (Fig. 53).

(5) Install new valve collets and release the spring tension (Fig. 53).

REMOVAL AND INSTALLATION (Continued)

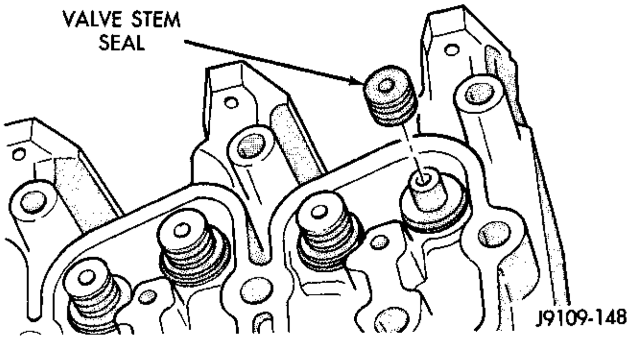


Fig. 52 Valve Stem Seal Installation

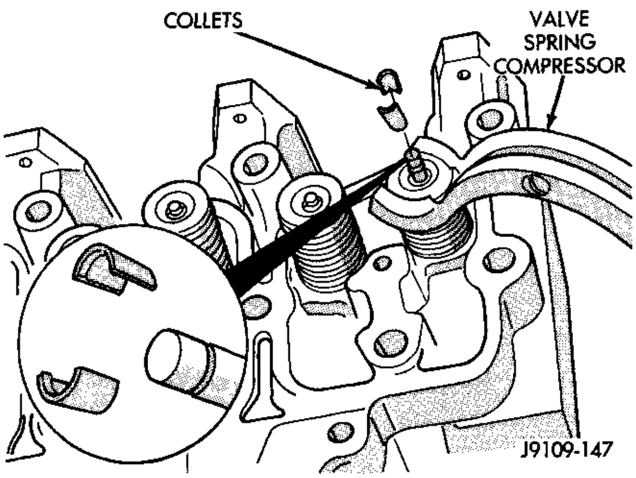


Fig. 53 Valve, Valve Spring and Collet Installation

WARNING: WEAR PROTECTIVE EQUIPMENT AND DO NOT STAND IN LINE WITH THE VALVE STEM WHEN TAPPING THE VALVES.

(6) Tap the ends of the valve stems with a mallet to verify the collets are seated.

(7) Install the cylinder head (Refer to Cylinder Head Removal and Installation in this section).

(8) Check the valve clearance adjustment.

GEAR HOUSING COVER

REMOVAL

(1) Remove fan drive assembly.

(2) Remove the fan belt (Fig. 54).

(3) Remove belt tensioner (Fig. 54).

(4) Remove oil fill tube and adaptor (Fig. 55).

(5) Remove vibration damper.

(6) Remove the bolts that hold the gear cover to the gear housing.

(7) Gently pry the cover away from the housing, taking care not to mar the gasket surfaces (Fig. 56).

(8) Clean the old gasket residue from the back of the gear cover and front of the gear housing.

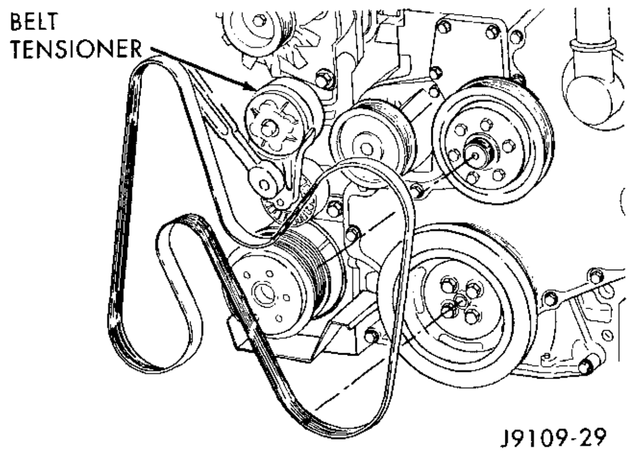


Fig. 54 Drive Belt Installation

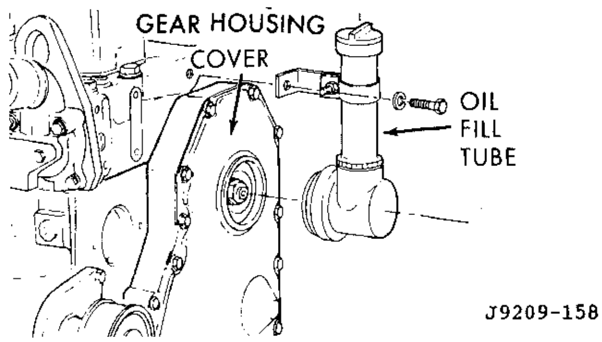


Fig. 55 Oil Fill Tube

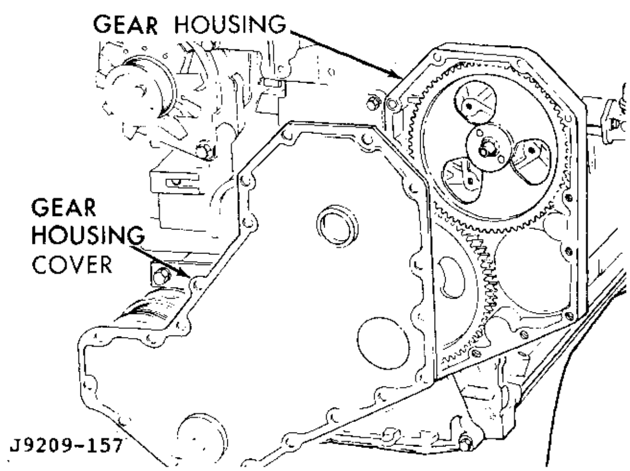


Fig. 56 Gear Housing and Cover

INSTALLATION

(1) Lubricate the front gear train with clean engine oil.

(2) Thoroughly clean the front seal area of the crankshaft. The seal lip and the sealing surface on the crankshaft must be free from all oil residue to prevent seal leaks.

(3) Apply a bead of Loctite 277 to the outside diameter of the seal.

REMOVAL AND INSTALLATION (Continued)

(4) Install the seal into the rear of the cover using a plastic hammer and the alignment/installation tool provided in the seal kit to prevent damage to the seal carrier, hit the alignment/installation tool alternately at the 12, 3, 6 and 9 o'clock positions.

(5) Install the pilot from the seal kit onto the crankshaft.

(6) Using the pilot as an alignment tool, install the cover and a new gasket.

(7) Install the cover bolts and tighten to 24 N·m (18 ft. lbs.) torque. Remove pilot tool.

(8) Install the oil fill tube and mounting bolts. Tighten the bolts to 43 N·m (32 ft. lbs.) torque.

(9) Install the vibration damper. DO NOT tighten the bolts to the correct torque value at this time.

(10) Install the belt tensioner. Tighten the mounting bolts to 43 N·m (32 ft. lbs.) torque.

(11) Raise the belt tensioner to install the belt.

(12) Tighten the vibration damper bolts to 125 N·m (92 ft. lbs.) torque. Use an engine barring tool to keep the engine from rotating during tightening operation.

(13) Install the fan drive assembly.

GEAR HOUSING

REMOVAL

(1) Remove the engine assembly from the vehicle.

(2) Remove the front end components and the gear housing cover (refer to Gear Housing Cover Removal for the proper procedures).

(3) Remove the following:

- Camshaft
- Gear driven accessories
- Fuel injection pump (refer to Group 14, Fuel System)
- Fan hub assembly (refer to Group 7, Cooling System)

(4) Remove the gear housing and gasket (Fig. 57).

(5) Clean the gasket material from the cylinder block.

INSTALLATION

(1) Install a new gasket and the gear housing. Tighten the bolts to 24 N·m (18 ft. lbs.) torque.

(2) Install the camshaft. Make sure the alignment marks on the camshaft and crankshaft gears are aligned (Fig. 58).

(3) If a new housing is installed, the timing pin assembly must be accurately located.

(4) Install the following:

- Fan hub assembly (refer to Group 7, Cooling System)
- Fuel injection pump (refer to Group 14, Fuel System)
- Gear driven accessories

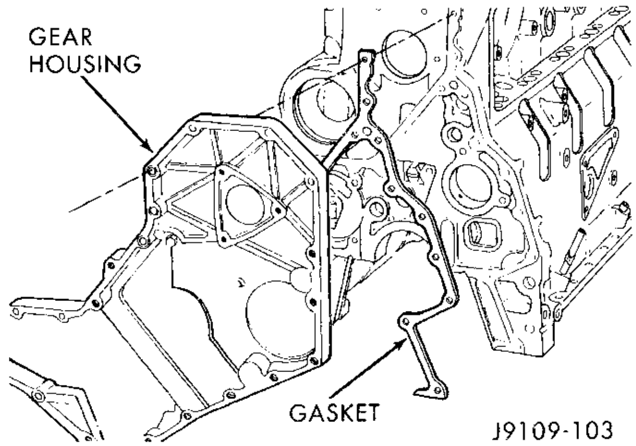


Fig. 57 Gear Housing/Gasket

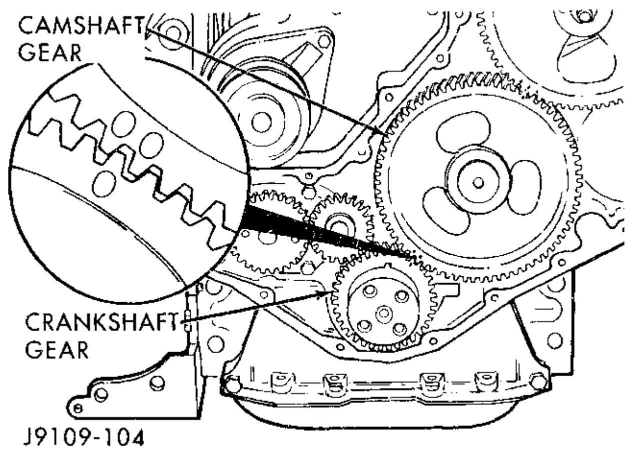


Fig. 58 Camshaft/Crankshaft Gear Alignment

(5) Install the gear housing cover (refer to Gear Housing Cover Installation for the proper procedures).

(6) Install the front end components.

(7) Install the engine assembly into the vehicle.

TIMING PIN

The timing pin can be replaced without removing the assembly from the gear housing.

REMOVAL

(1) Remove the timing pin by prying the retaining ring out with a small screwdriver. Replace the retaining ring if it is damaged during removal.

INSTALLATION

(1) If timing pin assembly is removed from gear housing, it must be precisely reset to obtain exact TDC.

(2) Install a new O-Ring, lubricate the pin and position in the housing (Fig. 59). Install the new retaining ring to 1.5 mm (0.059 inch).

REMOVAL AND INSTALLATION (Continued)

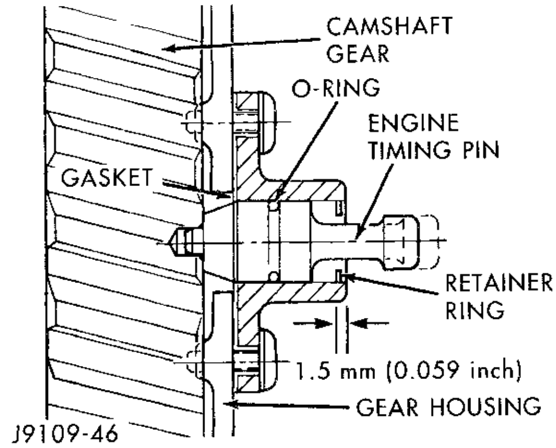


Fig. 59 Engine Timing Pin Location

TIMING PIN HOUSING ASSEMBLY

REMOVAL

(1) Locate TDC for cylinder No.1.

(2) Remove the timing pin housing assembly and gasket.

(3) Clean any gasket material from the gear housing and from the timing pin housing assembly.

INSTALLATION—CYLINDER HEAD ON

The location of the timing pin assembly on the gear housing is critical for correct engine adjustment. Follow this procedure to install the assembly so that it corresponds to TDC for cylinder No.1.

(1) Look through the hole in the gear housing and rotate the engine until the hole in the cam gear can be seen.

(2) Remove the injector nozzles from all of the cylinders. This step is important to vent the cylinders so the crankshaft can be rotated smoothly to locate TDC for cylinder No.1.

(3) Temporarily install the vibration damper.

(4) Fabricate and install a wire pointer (Fig. 60). This can be done by forming a piece of wire that can be tighten under one of the gear housing capscrews. The wire should extend from the gear cover to a place on the crankshaft vibration damper that is easily seen.

(5) Rotate the crankshaft one-quarter rotation in the direction of engine rotation.

(6) Tighten the adjusting screw for the No.1 intake valve to zero lash plus 5 turns.

CAUTION: Use extreme care when rotating the crankshaft. Use of too much force could damage the valve or push rod (Fig. 61).

(7) Rotate the crankshaft slowly in the opposite direction of normal engine rotation until the piston touches the intake valve (Fig. 61).

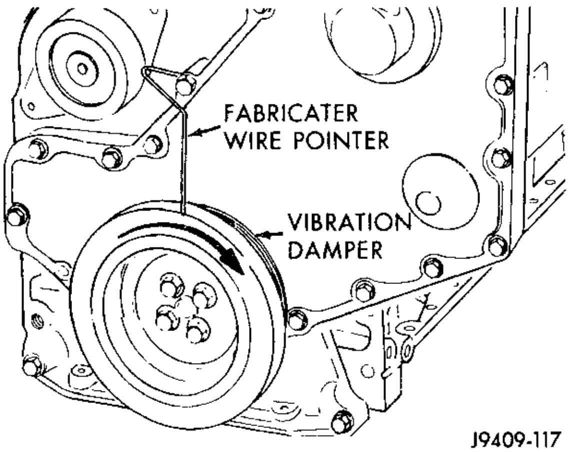


Fig. 60 Fabricated Wire Pointer

(8) Mark the vibration damper at the wire pointer (Fig. 61).

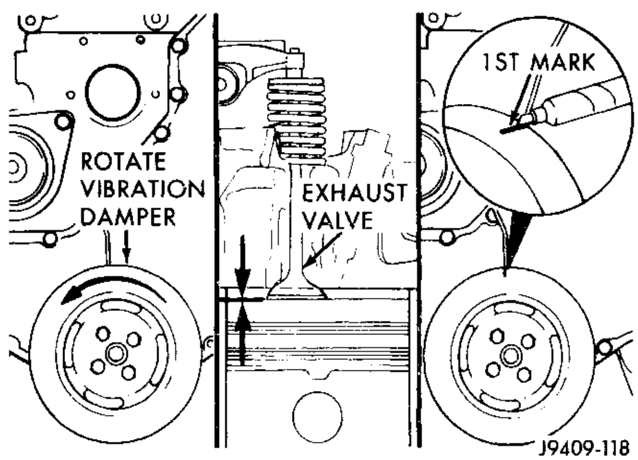


Fig. 61 Locate and Mark Vibration Damper—First Mark

(9) Rotate the crankshaft in the direction of normal engine rotation until the piston touches the intake valve (Fig. 62). **Make sure that the piston touches the intake valve with approximately the same amount of force as in the previous step (Fig. 62).**

(10) Mark the vibration damper at the wire pointer (Fig. 62).

(11) Measure the distance and mark the vibration damper at one-half that distance between the two marks. This mark is the TDC mark (Fig. 63).

(12) Completely loosen the intake valve adjusting screw. If not done, damage to the intake valve or push rod could occur when the crankshaft is rotated.

(13) Rotate the crankshaft in the direction of normal engine rotation until the pointer is aligned with the TDC mark. Rotate crankshaft one additional turn.

REMOVAL AND INSTALLATION (Continued)

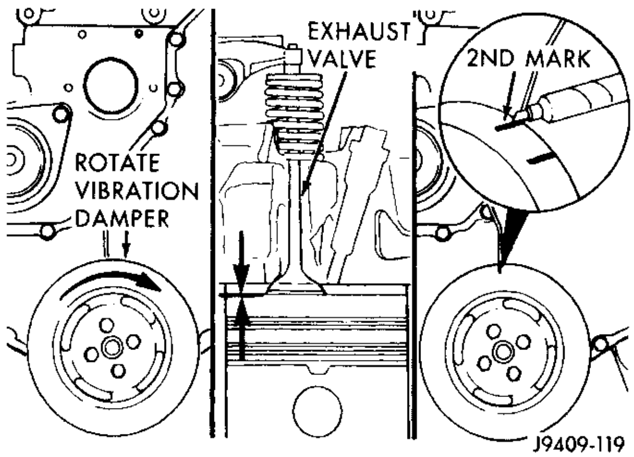


Fig. 62 Mark Vibration Damper—Second Mark

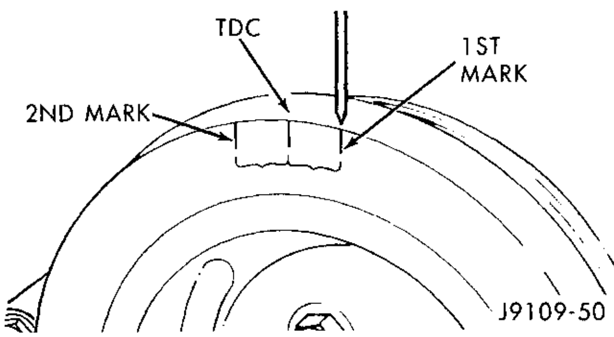


Fig. 63 Location of Top Dead Center (TDC)

(14) The timing pin hole in the cam gear should be visible or felt through the back side of the gear housing. If not, the crankshaft must be rotated one revolution in the direction of engine rotation.

(15) Apply a coat of Loctite® 59241 (Liquid Teflon), or equivalent to the threads of the Torx head bolts. Install the timing pin assembly and new O-ring.

(16) Hold the timing pin in the hole to align the housing and install the Torx head bolts. Tighten the Torx bolts to 5 N·m (44 in. lbs.) torque.

(17) Install the remaining rocker lever pedestal assemblies. Tighten the rocker lever pedestal mounting capscrews.

(18) Adjust the valves.

(19) Install the injectors and bleed the fuel system (refer to Group 14, Fuel System).

(20) Install the fuel pump (refer to Group 14, Fuel System).

(21) Install the gear cover.

(22) Remove the pointer. Install the crankshaft vibration damper.

INSTALLATION—CYLINDER HEAD REMOVED

The timing pin assembly is precisely located on the gear housing to correspond to TDC for Cylinder No.1. The timing pin assembly must be relocated if the gear housing is interchanged.

(1) Temporarily install the vibration damper and a fabricated wire pointer (Fig. 64). Put a flat washer between the pointer and gear housing to prevent damage to the gear housing.

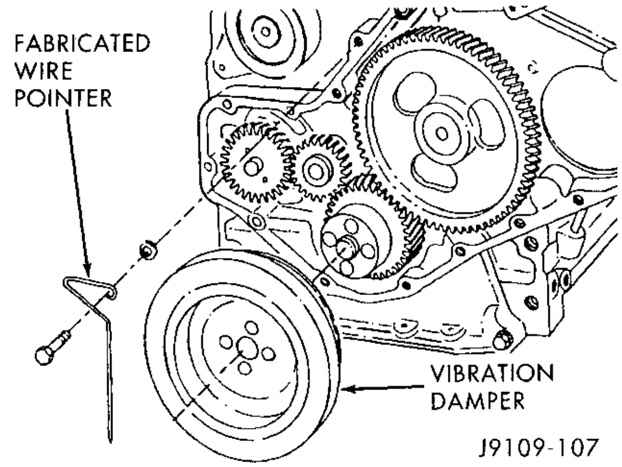


Fig. 64 Fabricated Wire Pointer

(2) Fabricate a steel plate (Fig. 65).

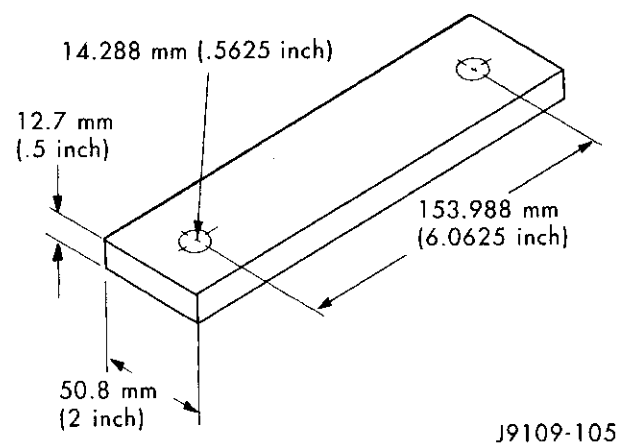


Fig. 65 Fabricated Steel Plate

(3) Use two flywheel housing bolts to assemble the plate over No.1 cylinder (Fig. 66).

(4) Rotate the crankshaft in the direction of rotation until the piston contacts the plate.

(5) Mark the vibration damper (Fig. 63).

(6) Rotate the engine in the opposite direction until the piston contacts the plate.

(7) Mark the vibration damper (Fig. 63).

(8) Mark the vibration damper for TDC. TDC will be one-half the distance between the first two marks (Fig. 63).

(9) Remove the plate and rotate the engine in the direction of rotation until the pointer aligns with the TDC mark.

REMOVAL AND INSTALLATION (Continued)

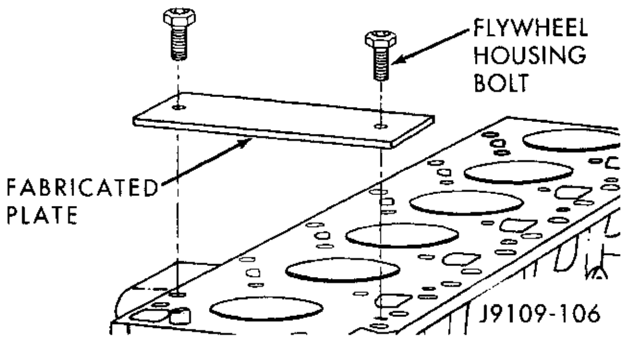


Fig. 66 Fabricated Plate Location on No.1 Cylinder

(10) Look for the timing pin hole in the camshaft gear. If it is not visible, rotate the crankshaft one complete rotation. Align the pointer with the TDC mark.

(11) Install the timing pin housing assembly with a new gasket.

(12) Apply a coat of Loctite 59241 liquid teflon, or equivalent to the threads of the torx head bolts.

(13) Push the pin into the hole in the cam gear to align the timing pin housing.

(14) Hold the pin in while tightening the torx head bolts to 5 N·m (44 in. lbs.) torque. Be sure timing pin is disengaged before rotating the engine.

(15) Remove the vibration damper and wire pointer.

CAMSHAFT

REMOVAL

(1) Disconnect battery negative cable.

(2) Drain cooling system.

(3) Remove the following parts:
- Fan Shroud
- Radiator
- A/C Condenser (if equipped)
- Intercooler
- Auxiliary Transmission Cooler
- Upper Radiator Support
- EGR Tube
- Name Plate
- Valve covers
- Rocker lever assemblies
- Push rods
- Drive belt
- Fan hub assembly
- Vibration damper
- Gear housing cover
- Lift pump

(4) Insert the dowels through the push tube holes and into the top of each tappet. When properly installed, the dowels can be used to pull the tappets up (Fig. 67).

(5) Pull the tappets up and wrap a rubber band around the top of the dowel rods (Fig. 67). This will prevent the tappets from dropping down.

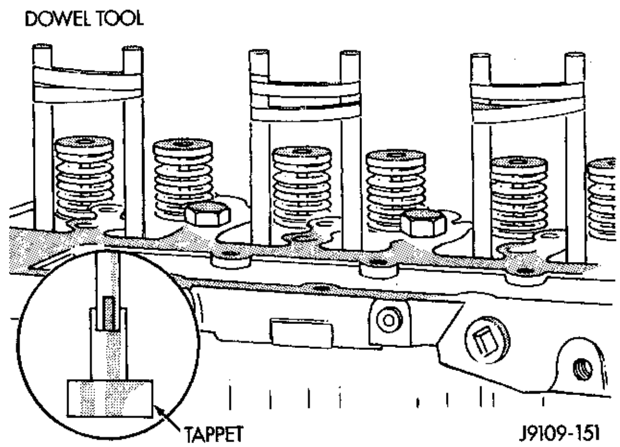


Fig. 67 Holding Tappets in Place

(6) Rotate the crankshaft to align the crankshaft to camshaft timing marks. (Fig. 68)

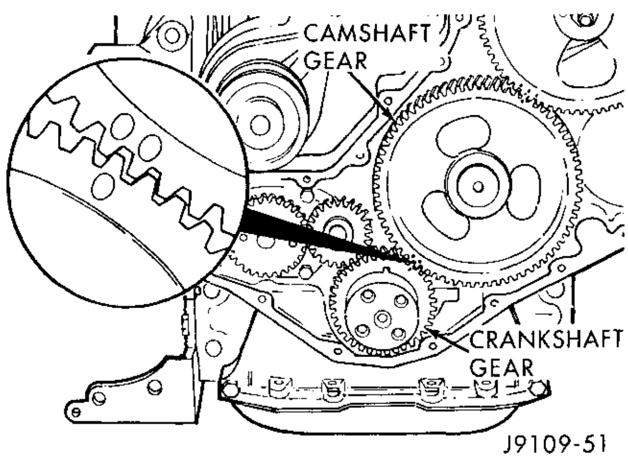


Fig. 68 Align Crankshaft to Camshaft

(7) Remove the bolts from the thrust plate (Fig. 69).

(8) Remove the camshaft, gear and thrust plate.

BUSHING REPLACEMENT

(1) Measure the diameter of each bore. (The limit for the bushing in the No.1 bore is the same as for the other bores without bushings). The limit of the inside diameter is 54.133 mm (2.1312 inch). If the camshaft bore for the first cam bushing is worn beyond the limit, install a new service bushing. Inspect the rest of the camshaft bores for damage or excessive wear.

(2) If the bores without a bushing are worn beyond the limit, the engine must be removed for machining and installation of service bushings. If badly worn, replace the cylinder block.

REMOVAL AND INSTALLATION (Continued)

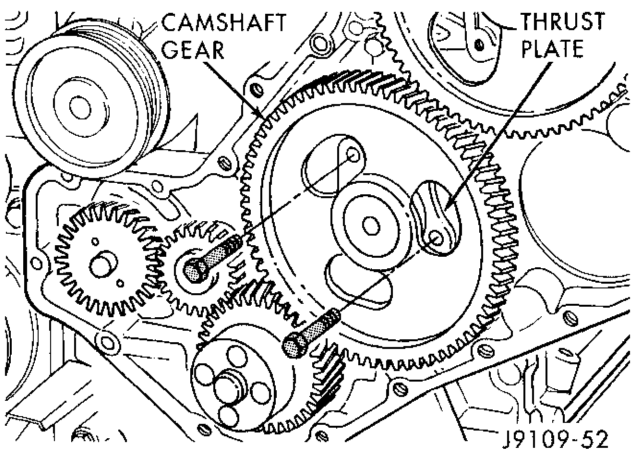


Fig. 69 Thrust Plate Bolt Location

(3) Remove the bushing from the No.1 bore, using a universal cam bushing tool.

(4) Mark the cylinder block so you can align the oil hole in the cylinder block with the oil hole in the bushing.

Apply a coating of Loctite® 609 to the backside of the new bushing. Avoid getting Loctite® in the oil hole.

(5) Use a universal cam bushing installation tool and install the bushing so that it is even with the front face of the cylinder block. The oil hole must be aligned. A 3.2 mm (0.128 inch) diameter rod must be able to pass through the hole (Fig. 70).

(6) Measure the installed bushing. The limit of the inside diameter is 54.133 mm (2.1312 inch).

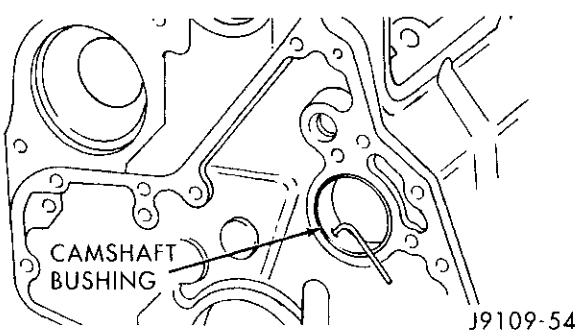


Fig. 70 Oil Hole Alignment

GEAR REPLACEMENT

(1) Press the camshaft out of the gear.

(2) Remove all burrs and smooth any rough surfaces caused by removing the gear.

(3) Install the camshaft key.

(4) Lubricate the camshaft surface with Lubriplate 105, or equivalent.

CAUTION: The camshaft gear will be permanently distorted if overheated. The oven temperature should never exceed 177°C (350°F).

(5) Heat the gear in an oven at 177°C (350°F) for 45 minutes.

WARNING: WEAR PROTECTIVE GLOVES TO HANDLE THE HOT GEAR.

(6) Install the gear with the timing marks visible. Be sure the gear is seated against the camshaft shoulder.

(7) If the camshaft is not to be used immediately, lubricate the lobes and journals to prevent rust.

INSTALLATION

(1) Apply a coat of Lubriplate 105 to the camshaft bores.

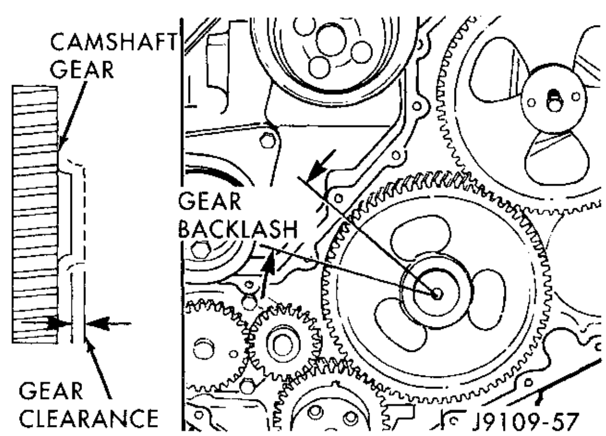
(2) Lubricate the camshaft lobes, journals and thrust washer with Lubriplate 105, or equivalent.

CAUTION: When installing the camshaft, DO NOT push it in farther than it will go with the thrust washer in place. Pushing it too far can dislodge the plug in the rear of the camshaft bore and cause an oil leak.

(3) Install the camshaft/thrust washer. Align the timing marks as illustrated (Fig. 68).

(4) Install the thrust washer bolts and tighten to 24 N·m (18 ft. lbs.) torque.

(5) Verify the camshaft has the correct amount of backlash and end clearance (Fig. 71).



BACKLASH - 0.080-0.330 mm (0.003-0.013 inch)
CLEARANCE - 0.152-0.254 mm (0.006-0.010 inch)

Fig. 71 Camshaft Backlash and End Clearance

(6) Install the following parts:
- Lift pump
- Gear housing cover
- Vibration damper
- Fan hub assembly
- Drive belt

REMOVAL AND INSTALLATION (Continued)

- Push rods
- Rocker lever assemblies
- Valve covers
- Name Plate
- Upper Radiator Support
- A/C Condenser (if equipped)
- Auxiliary Transmission Cooler
- Intercooler
- Radiator
- Fan Shroud

(7) Install the EGR tube and start fasteners by hand.

(8) Tighten all bolts/nuts to 24 N·m (212 in. lbs.) torque. **When tightening bolts at EGR valve end of tube, alternate between the upper and lower bolt to allow face of EGR valve to remain square to tube mounting flange on EGR tube.**

(9) Refill cooling system.

(10) Operate the engine at idle for five to ten minutes and check for leaks and loose parts.

TAPPET

REMOVAL

(1) Remove the camshaft.

(2) Insert a trough the full length of the cam bore (Fig. 72). Cummins Tappet Changing Tool 3822513 is available for this job.

(3) Make sure the trough is positioned so it will catch the tappet when the wooden dowel is removed.

(4) Identify the location of each tappet as it is removed. The tappets must be installed in their original locations.

(5) Only remove one tappet at a time. Remove the rubber band from the two companion tappets, securing the tappet not to be removed with the rubber band.

(6) Pull the wooden dowel from the tappet bore allowing the tappet to fall into the trough (Fig. 72).

(7) Normally the tappet will fall over when it drops into the trough. Use a flashlight to determine this. If the tappet does not fall over, shake the trough gently to get it to do so.

(8) Special care should be taken, when removing the No.6 cylinder tappets. DO NOT knock or shake the tappet over the end barrier of the trough.

(9) Carefully pull the trough and tappet from the cam bore and remove the tappet. Repeat the process until all tappets are removed.

INSTALLATION

(1) Insert the trough the full length of the cam bore.

(2) Feed the installation tool down the tappet bore and into the trough (Fig. 73).

(3) Feed the installation tool cord through the cam bores. Carefully pull the trough and installation tool out the front. The barrier at the rear of the trough will assure the tool will be pulled out with it.

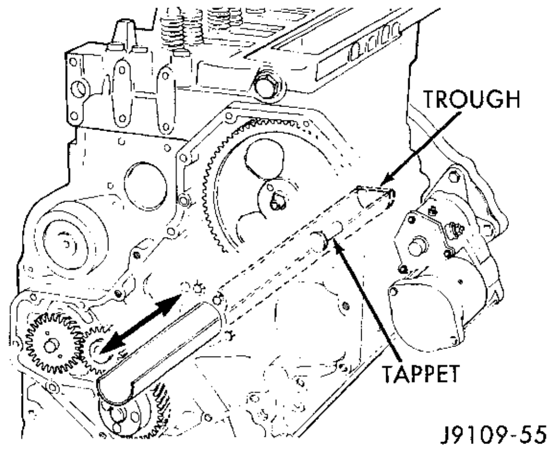


Fig. 72 Tappet Removal using a Trough

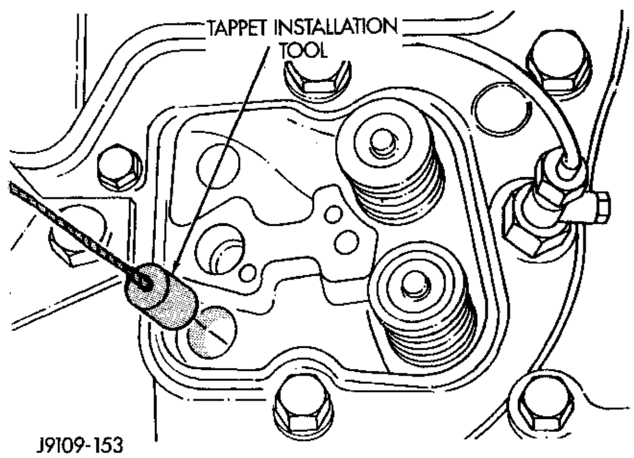


Fig. 73 Tappet Installation Tool

(4) Lubricate the tappets with Lubriplate 105, or equivalent.

(5) Insert the installation tool into the tappet (Fig. 74). To aid in removing the installation tool after the tappets is installed, work the tool in and out of the tappet several times before installing the tappets.

(6) Place the tappet and tool in the trough and slide the trough back into the cam bore (Fig. 74).

(7) Pull the tool/tappet through the cam bore and up into the tappet bore (Fig. 75).

(8) Difficulty could be experienced in getting the tappet to make the bend from the trough up to the tappet bore (due to the webbing of the block). If this occurs, pull the trough out enough to allow the tappet to drop down and align itself. Now pull the tappet up into the bore carefully.

(9) After the tappet has been pulled up into position, slide the trough back into the cam bore and rotate it 1/2 turn. This will position the round side of the trough up, which will hold the tappet in place.

REMOVAL AND INSTALLATION (Continued)

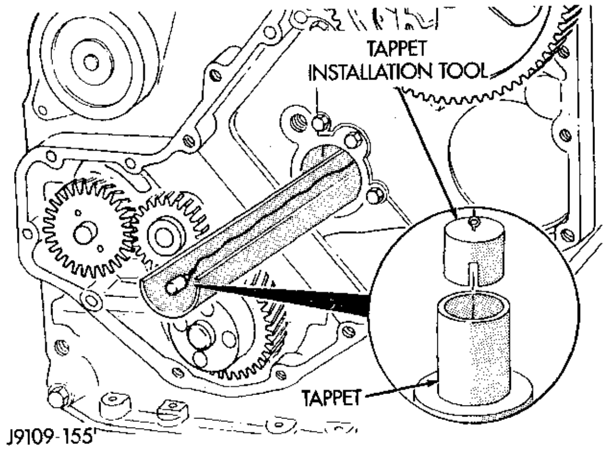


Fig. 74 Insert Installation Tool into Tappet

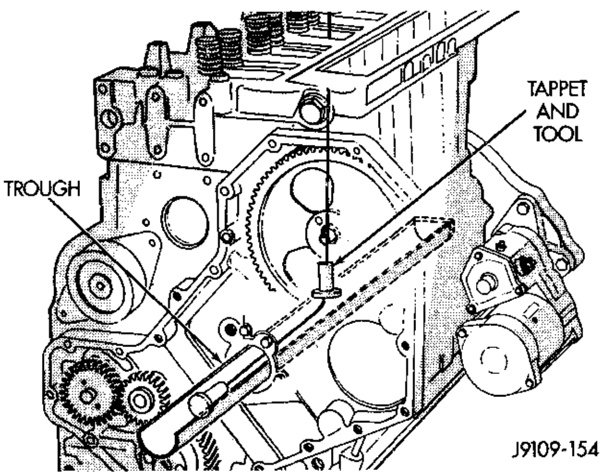


Fig. 75 Pull Tappet/Tool into Position

(10) Remove the installation tool from the tappet.

(11) Install a wooden dowel into the top of the tappet and secure it with a rubber band.

(12) Repeat this process until all tappets have been installed.

(13) Install the camshaft.

OIL PAN AND SUCTION TUBE

REMOVAL

(1) Disconnect the negative cable from the battery.

(2) Remove transmission from vehicle, refer to Group 21 Transmission and Transfer Case.

(3) Remove flywheel ring gear assembly.

(4) Disconnect starter cables from starter motor.

(5) Remove transmission oil cooler bolts.

(6) Remove starter motor and spacer plate assembly.

WARNING: HOT OIL CAN CAUSE PERSONAL INJURY.

(7) Drain the used engine oil. Dispose of the used oil properly.

(8) Remove oil pan bolts, lower pan slightly and remove oil suction tube.

(9) Remove oil pan.

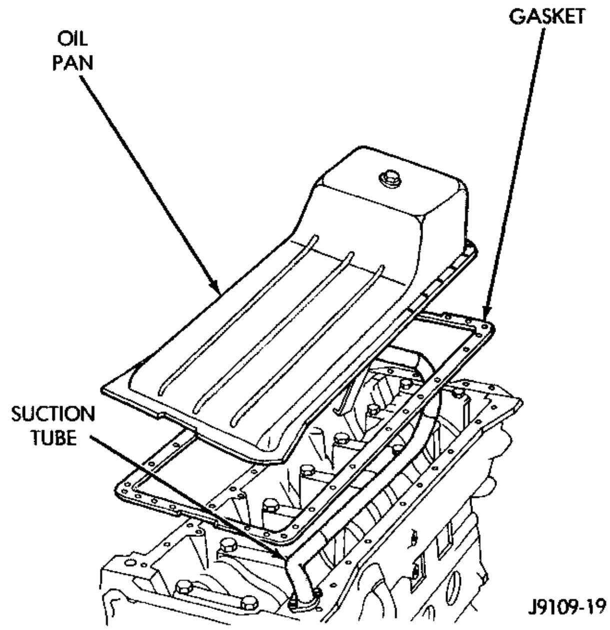


Fig. 76 Oil Pan, Suction Tube and Gasket

INSTALLATION

(1) Clean the oil pan and engine block sealing surfaces.

(2) Install the suction tube and gasket. Tighten the bolts to 24 N·m (18 ft. lbs.) torque.

(3) Fill the joint between the pan rail/gear housing and pan rail/rear cover with sealant. Use Three Bond 1207-C, or equivalent.

(4) Install the pan and gasket (Fig. 76). Tighten the bolts to 24 N·m (18 ft. lbs.) torque.

(5) Install the drain plug with a new sealing washer and tighten to 60 N·m (44 ft. lbs.) torque.

(6) Install the spacer plate assembly with the starter motor attached.

(7) Install transmission oil cooler tank bolts. Tighten bolts to 35 N·m (25 ft. lbs.) torque.

(8) Install transmission assy. and transfer case (if equipped). Refer to Group 21 Transmission and Transfer Case.

(9) Install battery negative cable.

(10) Fill the engine with clean lubrication oil. Run the engine and check for leaks.

(11) Stop the engine for five minutes. Check the oil level, and add oil if needed.

PISTON AND CONNECTING ROD ASSEMBLY

The turbocharged intercooler piston has a Ni-Resist insert with a keystone profile for the top com-

AUTHENTIC RESTORATION PRODUCT

REMOVAL AND INSTALLATION (Continued)

pression ring. The new piston has a new design bowl and a 7 mm longer piston pin. These pistons can not be interchanged with earlier models.

REMOVAL

(1) Remove the engine assembly from the vehicle (Refer to Engine Remove and Install procedure in this section).

(2) Remove the cylinder head from the block.

(3) Remove the oil pan and suction tube.

(4) If the cylinder bores have ridges, use a ridge reamer to cut the ridge from the top of the cylinder bore before removing the piston. Make sure the ridge reamer does not make a deep cut into the bore. DO NOT remove more metal than is necessary to remove the ridge.

(5) If cylinders have ridges, the cylinders are oversize and will need boring.

(6) Use a hammer and a steel stamp to mark the cylinder number onto each connecting rod cap. Mark the cylinder number onto the top of each piston.

(7) Remove the connecting rod bolts and rod caps. Use care so the cylinder bores and connecting rods are not damaged.

(8) Use a hammer handle or similar object to push the piston and connecting rod through the cylinder bore.

(9) Store the piston/rod assemblies in a rack.

(10) If a piston must be replaced, replace with the same part number (grading) that was removed.

INSTALLATION

(1) Lubricate the cylinder bore with clean engine oil.

(2) Generously lubricate the rings and piston skirts with clean engine oil.

(3) Compress the rings using a piston ring compressor tool (Fig. 77). If using a strap-type ring compressor, make sure the inside end of the strap does not hook on a ring gap and break the ring.

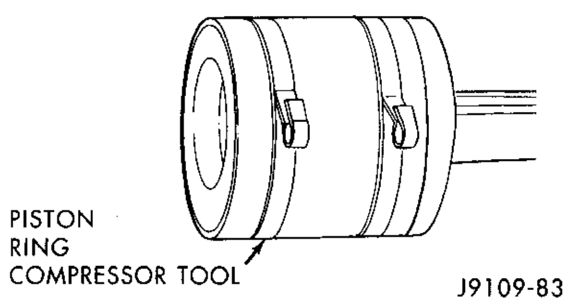


Fig. 77 Piston Ring Compressor Tool

(4) Bar the crankshaft so the rod journal for the piston to be installed is at BDC (Bottom Dead Center) - (Fig. 78).

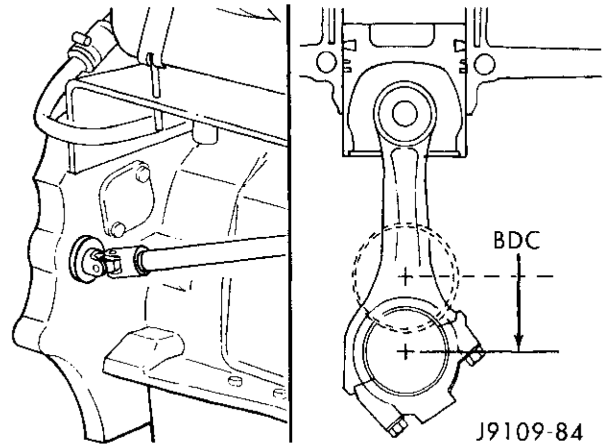


Fig. 78 Piston/Rod Assembly at BDC

(5) Be sure the FRONT marking on the piston and the numbers on the rod and cap are oriented as illustrated.

(6) Position the piston and rod assembly into the cylinder bore with the word FRONT on the piston towards the front of the cylinder block. Use care when you install the piston and connecting rod so the cylinder bore is not damaged.

(7) Push the piston into the bore until the top of the piston is approximately 50 mm (2 inch) below the top of the block. Carefully pull the connecting rod onto the crankshaft journal.

(8) Use clean engine oil to lubricate the threads and under the heads of the connecting rod bolts.

(9) The 4 digit number stamped on the rod cap at the parting line must match and be installed towards the oil cooler side of the engine (Fig. 79).

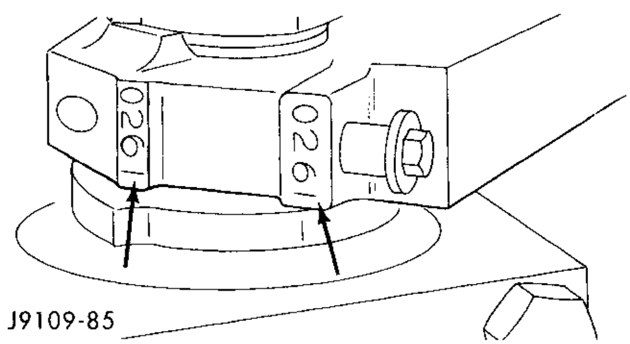


Fig. 79 Correct Rod Cap Installation

(10) Install the rod cap and bolts to the connecting rod. Tighten the connecting rod and bolt evenly in 3 steps.

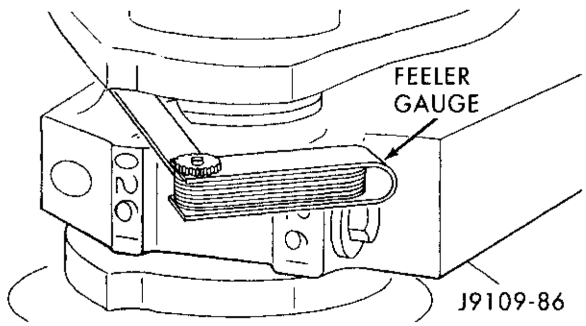
- Tighten the bolts to 35 N·m (26 ft. lbs.) torque.
- Tighten the bolts to 70 N·m (51 ft. lbs.) torque.
- Tighten the bolts to 100 N·m (73 ft. lbs.) torque.

(11) The crankshaft must rotate freely. Check for freedom of rotation as the caps are installed. If the

REMOVAL AND INSTALLATION (Continued)

crankshaft does not rotate freely, check the installation of the rod bearing and the bearing size.

(12) Measure the side clearance between the connecting rod and the crankshaft (Fig. 80). DO NOT measure the clearance between the cap and crankshaft.



SIDE CLEARANCE LIMITS		
MIN.	0.100 mm	(0.004 inch)
MAX.	0.300 mm	(0.012 inch)

Fig. 80 Side Clearance between Connecting Rod/Crankshaft

(13) Install the suction tube and oil pan.
(14) Install the cylinder head onto the block.
(15) Install the engine assembly into the vehicle.

CRANKSHAFT

REMOVAL

(1) Remove the rear crankshaft seal housing.
(2) Remove the gear housing.
(3) Rotate the engine to a horizontal position and remove the main bearing bolts.
(4) The main bearing caps should be numbered. If they are not, be sure to mark them, beginning with number one at the front and ending with number seven at the rear (Fig. 81).

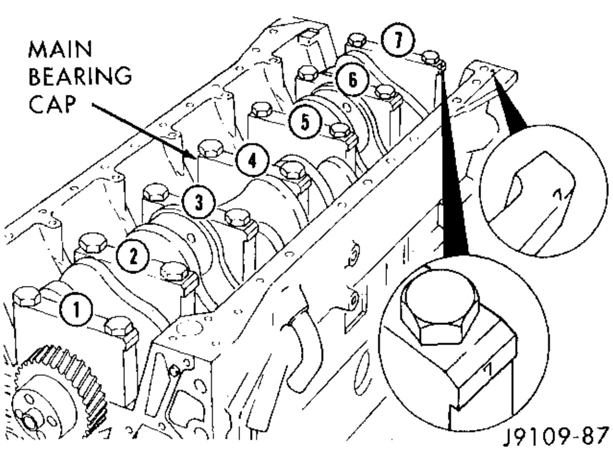


Fig. 81 Numbering Main Bearing Caps

CAUTION: DO NOT pry on the main caps to free them from the cylinder block.

(5) Use two of the main bearing cap bolts to wiggle the main cap loose, being careful not to damage the bolt threads (Fig. 82). Remove the caps.

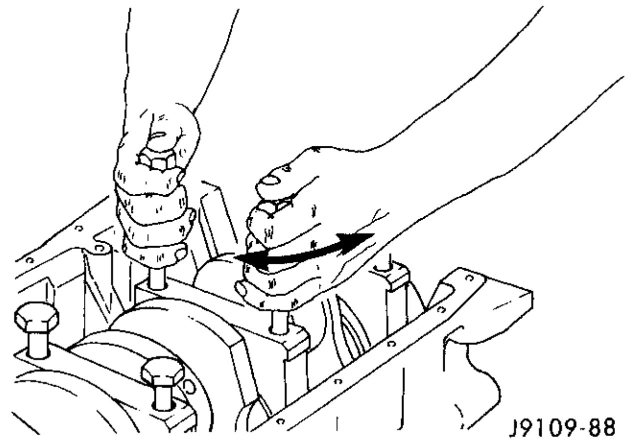


Fig. 82 Main Bearing Cap Removal

WARNING: USE A HOIST TO AVOID INJURY.

(6) Lift the crankshaft and gear from the cylinder block (Fig. 83).

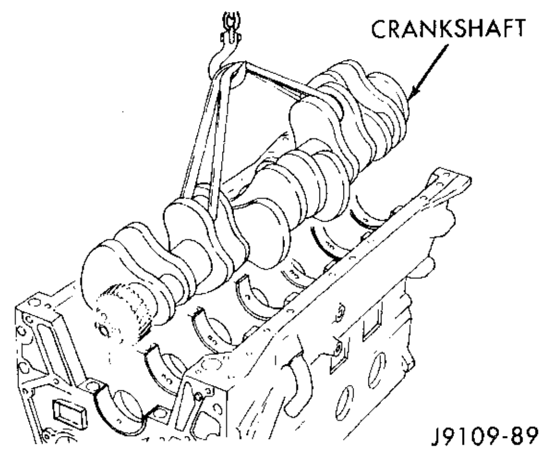


Fig. 83 Lifting Crankshaft out of Cylinder Block

(7) Remove the main bearings from the block and the main caps.
(8) Remove the piston cooling nozzles by using a 3/16 inch pin punch to push them out (Fig. 84).

INSTALLATION

CAUTION: Use only hand force to push the nozzle in place. If driven with a hammer, the nozzle will be damaged.

AUTHENTIC RESTORATION PRODUCT

REMOVAL AND INSTALLATION (Continued)

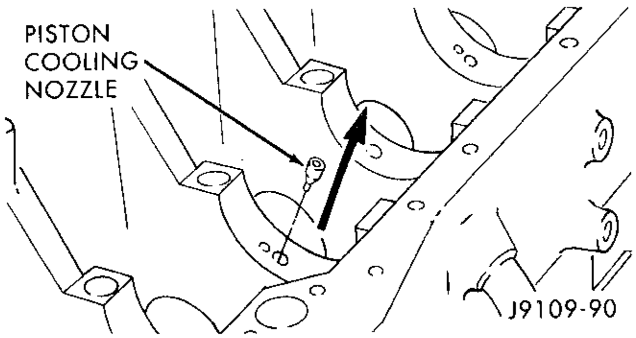


Fig. 84 Piston Cooling Nozzles

(1) Use a center punch to push the piston cooling nozzle into place. Install nozzles so they are even with or slightly below the saddle surface.

(2) Make sure the saddle surface is clean and dry. Install the upper main bearings.

(3) Install the combination thrust/main bearing in the number six main bearing location.

(4) Lubricate the bearings with Lubriplate 105, or equivalent.

WARNING: TO AVOID INJURY, USE A HOIST TO INSTALL THE CRANKSHAFT.

(5) Install the crankshaft.

CAUTION: Crankshaft must be lowered onto the bearings straight to prevent damage to thrust bearings.

(6) Install the ring dowels in the main bearing caps (Fig. 85).

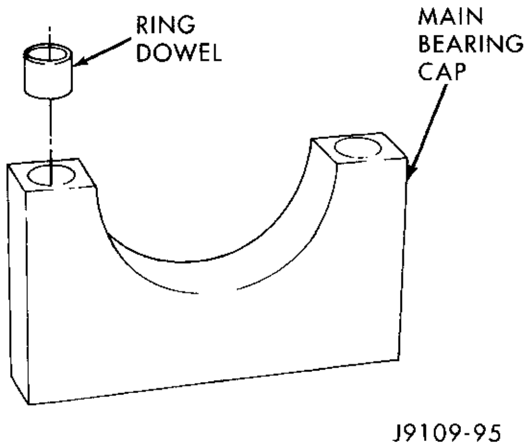


Fig. 85 Install Ring Dowels

(7) Install the lower main bearings in the caps.

(8) Lubricate the bearings with Lubriplate, or equivalent.

(9) Numbers on the main bearings caps face the oil cooler side of the engine with number one at the front of the engine.

(10) Place the caps in their respective positions.

(11) Lubricate the main bearing bolt threads and underside of the bolt head with clean engine oil.

(12) Tighten the bolts evenly in the sequence shown using the following torque steps (Fig. 86).

- STEP 1—Tighten all bolts in sequence to 60 N·m (44 ft. lbs.) torque.
- STEP 2—Tighten all bolts in sequence to 90 N·m (60 ft. lbs.) torque.
- STEP 3—Tighten all bolts in sequence an additional 90°.

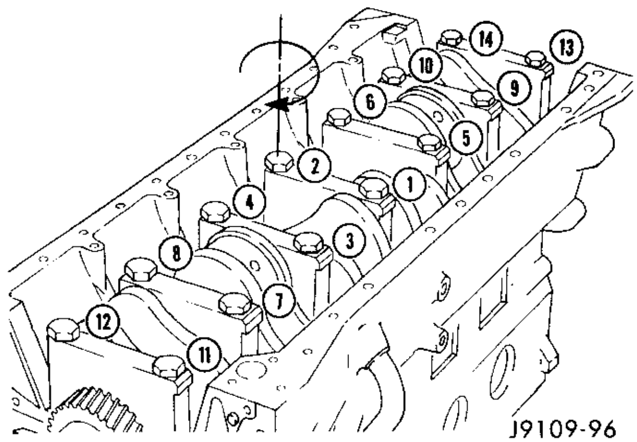


Fig. 86 Main Bearing Bolt Tightening Sequence

(13) Turn the crankshaft to determine that it will rotate freely all 360°. Check the main bearing cap installations and/or the bearing sizes if the shaft does not turn easily.

(14) Push the crankshaft towards one end of its thrust and place a dial indicator as shown (Fig. 87).

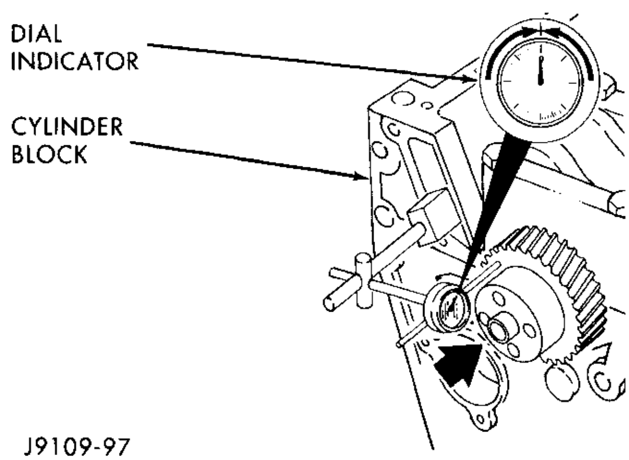
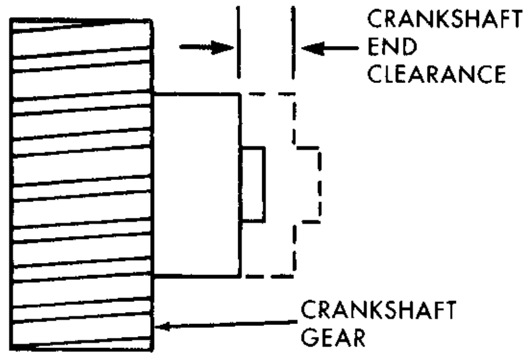


Fig. 87 Position of Dial Indicator

(15) Zero the indicator needle and push the crankshaft towards the other end of its thrust and record the crankshaft end clearance (Fig. 88).

REMOVAL AND INSTALLATION (Continued)



MIN.	0.100 mm	(0.004 inch)
MAX.	0.430 mm	(0.017 inch)

J9409-120

Fig. 88 Crankshaft End Clearance

CRANKSHAFT FRONT SEAL

REMOVAL

(1) Remove fan drive assembly.
(2) Remove the fan belt (Fig. 89).
(3) Remove belt tensioner (Fig. 89).

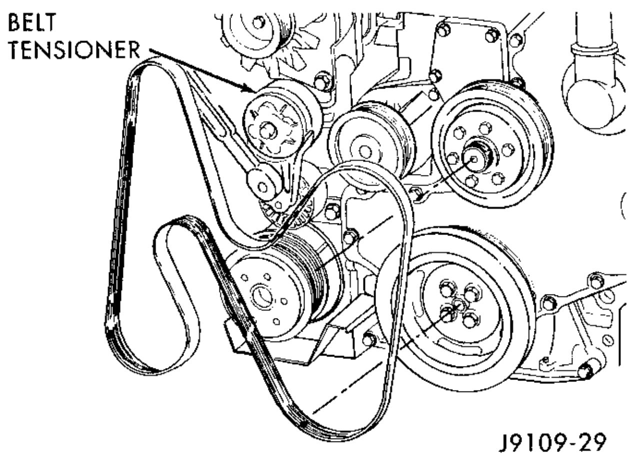


Fig. 89 Drive Belt Installation

(4) Remove oil fill tube and adaptor (Fig. 90).

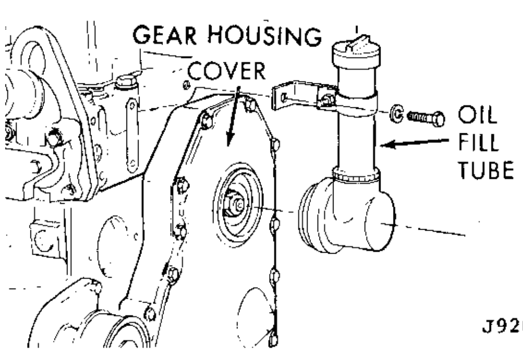


Fig. 90 Oil Fill Tube

(5) Remove vibration damper.

(6) Remove the bolts that hold the gear cover to the gear housing.

(7) Gently pry the cover away from the housing, taking care not to mar the gasket surfaces (Fig. 91).

(8) Clean the old gasket residue from the back of the gear cover and front of the gear housing.

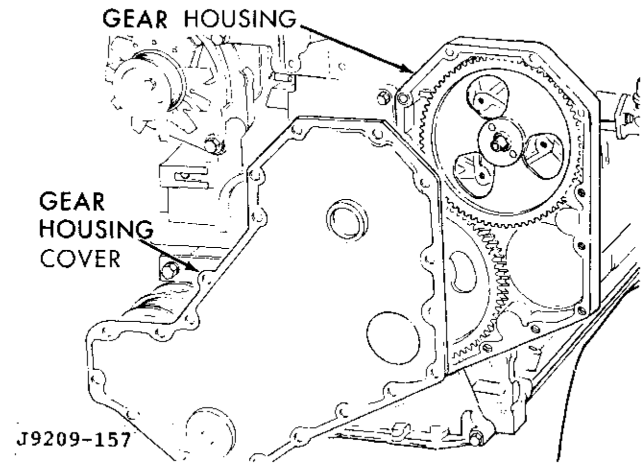


Fig. 91 Gear Housing and Cover

INSTALLATION

(1) Lubricate the front gear train with clean engine oil.

(2) Thoroughly clean the front seal area of the crankshaft. The seal lip and the sealing surface on the crankshaft must be free from all oil residue to prevent seal leaks.

(3) Apply a bead of Loctite 277 to the outside diameter of the seal.

(4) Install the seal into the rear of the cover using a plastic hammer and the alignment/installation tool provided in the seal kit to prevent damage to the seal carrier, hit the alignment/installation tool alternately at the 12, 3, 6 and 9 o'clock positions.

(5) Install the pilot from the seal kit onto the crankshaft.

(6) Using the pilot as an alignment tool, install the cover and a new gasket.

(7) Install the cover bolts and tighten to 24 N·m (18 ft. lbs.) torque. Remove pilot tool.

(8) Install the oil fill tube and mounting bolts. Tighten the bolts to 43 N·m (32 ft. lbs.) torque.

(9) Install the vibration damper. DO NOT tighten the bolts to the correct torque value at this time.

(10) Install the belt tensioner. Tighten the mounting bolts to 43 N·m (32 ft. lbs.) torque.

(11) Raise the belt tensioner to install the belt.

(12) Tighten the vibration damper bolts to 125 N·m (92 ft. lbs.) torque. Use an engine barring tool to keep the engine from rotating during tightening operation.

(13) Install the fan drive assembly.

REMOVAL AND INSTALLATION (Continued)

CRANKSHAFT REAR SEAL

REMOVAL

(1) Remove the transmission (refer to Group 21, Transmission for the proper procedure).
(2) Remove the clutch cover.
(3) Remove the clutch plate.
(4) Remove the flywheel.
(5) Drill holes 180° apart into the seal. Be careful not to get the drill against the crankshaft.
(6) Install #10 sheet metal screws in the drilled holes and remove the rear seal with a slide hammer (Fig. 92).

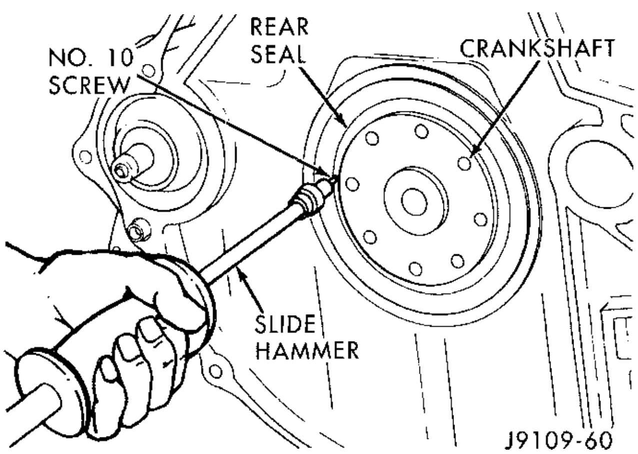


Fig. 92 Crankshaft Rear Seal Removal

INSTALLATION

CAUTION: The seal lip and the sealing surface on the crankshaft must be free from all oil residue to prevent seal leaks.

The crankshaft and seal must be dry when the seal is installed.
(1) Install the seal pilot, provided in the replacement kit, on the crankshaft. Push the seal on the pilot and crankshaft.
(2) Remove the seal pilot.
(3) Use the alignment tool to install the seal to the correct depth in the housing. Use a hammer to drive the seal into the housing until the alignment tool stops against the housing (Fig. 93).
(4) Hit the tool at the 12, 3, 6 and 9 o'clock positions to drive the seal evenly and prevent bending the seal housing.

CRANKSHAFT REAR SEAL HOUSING

REMOVAL

(1) Remove the rear seal housing and gasket (Fig. 94).

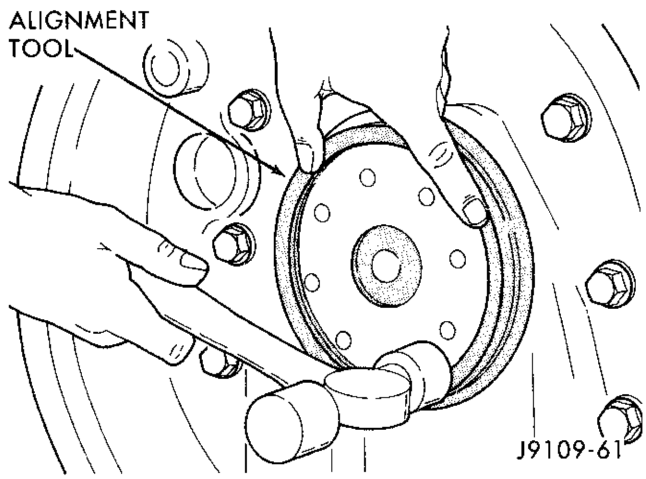


Fig. 93 Seal Installation using Alignment Tool

(2) Support the seal area of the rear seal housing and press/drive out the seal using a hammer and a pin pinch.
(3) Clean the rear seal housing.

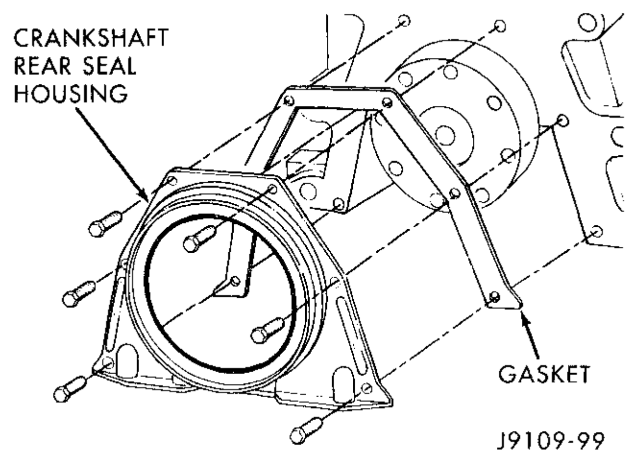


Fig. 94 Crankshaft Rear Seal Housing/Gasket

INSTALLATION

(1) Clean and dry the rear crankshaft sealing surface. The seal lip and the sealing surface on the crankshaft must be free from all oil residue to prevent seal leaks.
(2) Assemble the rear seal housing and gasket to the cylinder block with the bolts.
(3) Align the seal housing to the crankshaft with the alignment tool provided in the seal kit (Fig. 14). Make sure the seal housing is level with both sides of the block oil pan rail. Tighten the bolts to 9 N·m (7 ft. lbs.) torque.
(4) Remove the alignment tool and trim the gasket even with the oil pan mounting surface (Fig. 95).
(5) Install the seal pilot (provided with the replacement kit) onto the crankshaft. Push the seal onto the crankshaft (Fig. 96).
(6) Remove the seal pilot.

REMOVAL AND INSTALLATION (Continued)

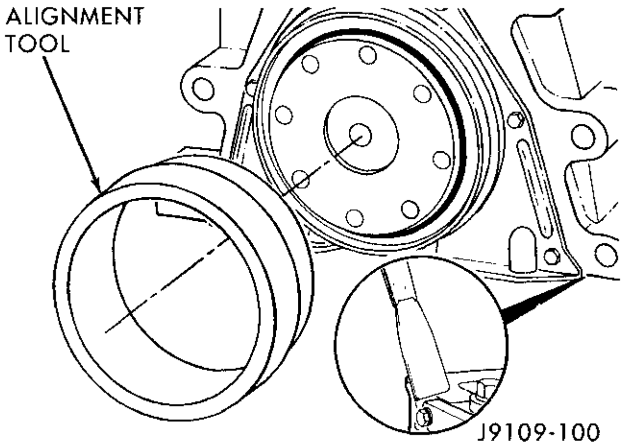


Fig. 95 Crankshaft Rear Seal Housing Alignment Tool

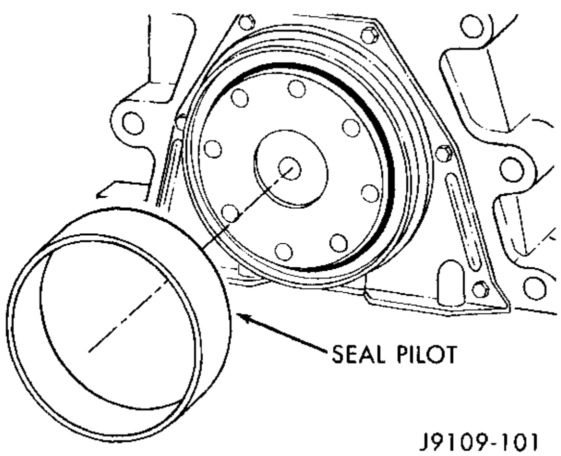


Fig. 96 Crankshaft Rear Seal Pilot

(7) Use alignment and installation tool packaged in the seal kit (Fig. 97). Alternately, drive the seal at the 12, 3, 6 and 9 o'clock positions to prevent bending the seal carrier during installation.

FLYWHEEL RING GEAR

REMOVAL

(1) Remove the transmission.
(2) Remove the clutch cover.
(3) Remove the clutch plate.
(4) Remove the flywheel.
(5) Use a drift pin to drive the ring gear from the flywheel (Fig. 19). Strike the gear at several points around the wheel until it is off.
(6) Heat the new ring for 20 minutes in an oven preheated to 127°C (250°F).
(7) Install the gear. The gear must be installed so the bevel on the teeth is towards the crankshaft side of the flywheel (Fig. 98).

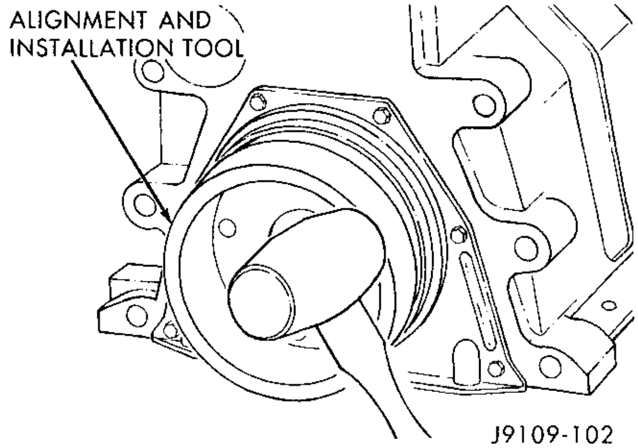


Fig. 97 Crankshaft Rear Seal Alignment/Installation Tool

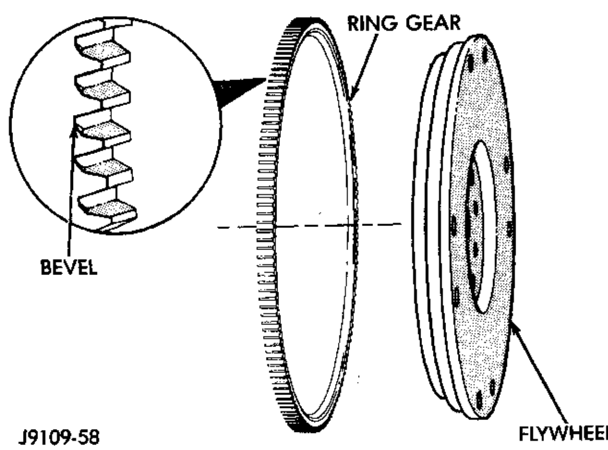


Fig. 98 Flywheel/Ring Gear Position

INSTALLATION

CAUTION: Never use the timing pin to hold the crankshaft in position.

(1) Use the engine barring tool to hold the crankshaft when the flywheel bolts are being tightened.
(2) Tighten the bolts in a criss-cross pattern to 137 N·m (101 ft. lbs.) torque.

CRANKSHAFT GEAR

REMOVAL

Remove the crankshaft gear using a heavy duty puller.

INSTALLATION

Remove all burrs and make sure the gear surface on the end of the crankshaft is smooth.

If removed, install a new alignment pin. Drive the pin in using a ball- peen hammer, leaving it protrud-

REMOVAL AND INSTALLATION (Continued)

ing 1.60 mm (0.063 inch) to 2.39 mm (0.094 inch) above the crankshaft (Fig. 99).

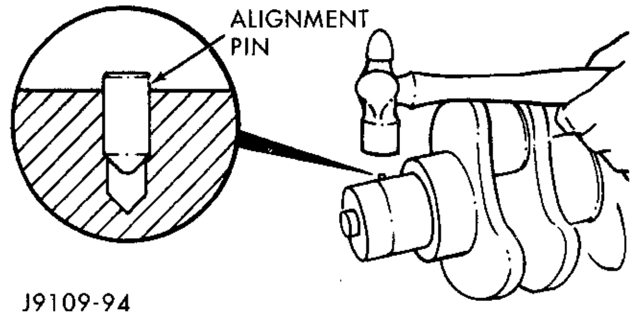


Fig. 99 Installing Alignment Pin

Heat the crankshaft gear for 45 minutes at a temperature of 121°C (250°F).

CAUTION: DO NOT heat the gear longer than 45 minutes.

WARNING: WEAR PROTECTIVE GLOVES TO PREVENT INJURY.

Position the gear with the timing mark out and install it on the crankshaft using the alignment pin. Make sure the gear contacts the shoulder.

OIL PUMP

The non-intercooled turbocharged engine oil pumps can not be used on intercooled engines.

REMOVAL

(1) Remove the radiator (refer to Group 7, Cooling System for the proper procedure).

(2) Loosen the crankshaft vibration damper and remove the drive belt.

(3) Remove the fan clutch assembly.

(4) Remove the fan hub.

(5) Remove the oil fill tube.

(6) Remove the crankshaft vibration damper.

(7) Remove the gear housing cover.

(8) Remove the four mounting bolts and pull the pump from the bore in the cylinder block (Fig. 100).

INSTALLATION

(1) Lubricate the pump with clean engine oil. Filling the pump with clean engine oil during installation will help to prime the pump at engine start up.

Make sure the idler gear pin is installed in the locating bore in the cylinder block.

(2) Install the pump. Tighten the oil pump mounting bolts in two steps and in the sequence shown (Fig. 100).

- Step 1—Tighten to 5 N·m (44 in. lbs.) torque.
- Step 2—Tighten to 24 N·m (18 ft. lbs.) torque.

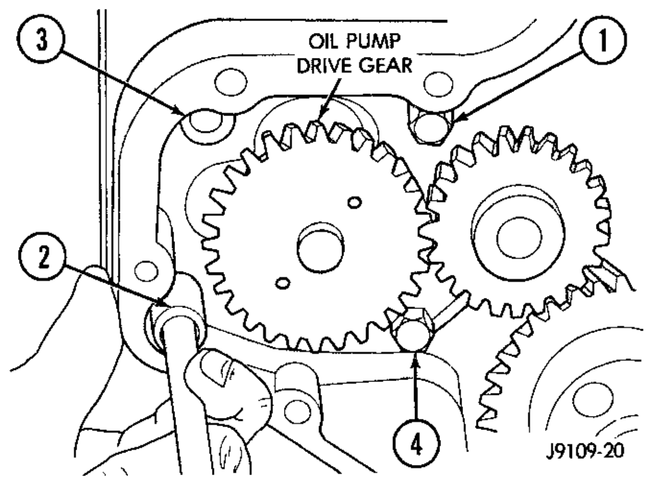


Fig. 100 Oil Pump Removal

(3) The back plate on the pump seats against the bottom of the bore in the cylinder block. When the pump is correctly installed, the flange on the pump will not touch the cylinder block.

(4) Measure the idler gear to pump drive gear backlash and the idler gear to crankshaft gear backlash (Fig. 101). The backlash should be 0.080- 0.330 mm (0.003-0.013 inch). If the backlash is out of limits, replace the oil pump drive gear and the idler gear.

(5) If the adjoining gear moves when you measure the backlash, the reading will be incorrect.

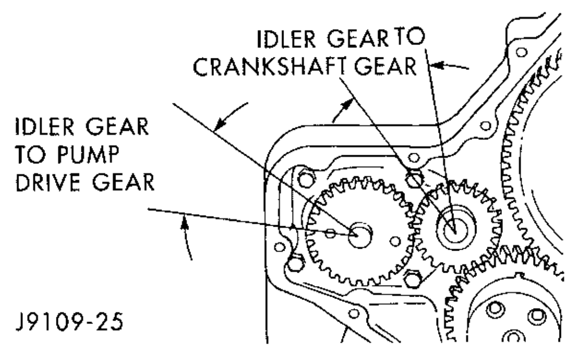


Fig. 101 Idler Gear to Pump Drive Gear and Crankshaft Gear Backlash

OIL FILTER BYPASS VALVE

REMOVAL

(1) Remove the oil cooler cover (Fig. 102).

(2) Remove the valve from the cooler cover (Fig. 102).

INSTALLATION

(1) Drive the new valve in until it bottoms against the step in the bypass valve bore (Fig. 103).

(2) Install the oil cooler cover.

REMOVAL AND INSTALLATION (Continued)

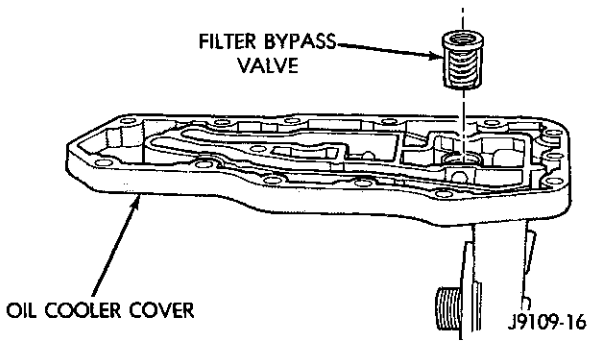


Fig. 102 Removing Filter Bypass Valve

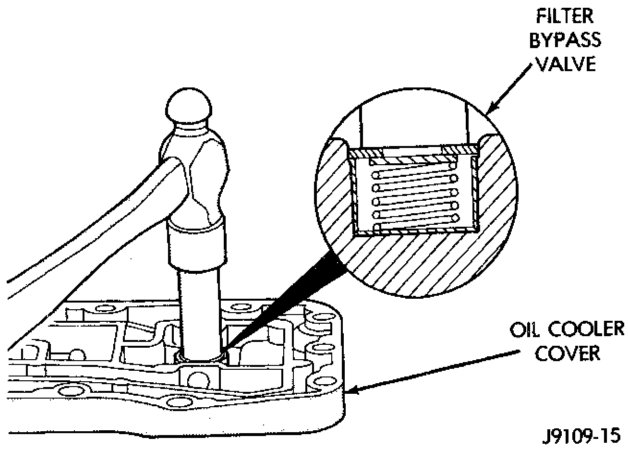


Fig. 103 Installing New Filter Bypass Valve

OIL PRESSURE REGULATOR VALVE AND SPRING

REMOVAL

(1) Remove the threaded plug, gasket, spring and valve (Fig. 104).

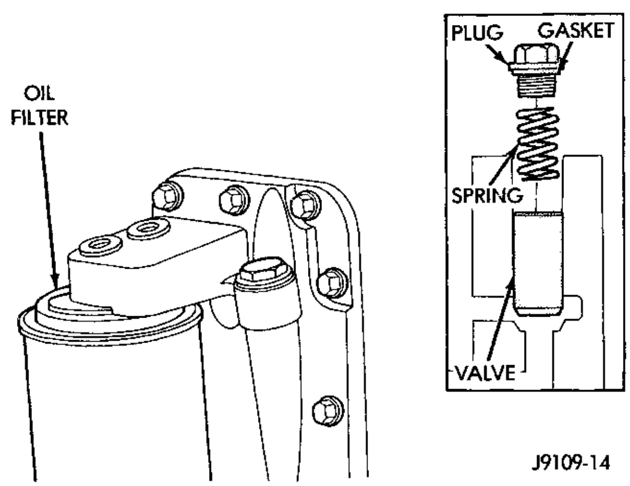


Fig. 104 Oil Pressure Regulator

(2) Check the spring for height and load limitations (Fig. 105). Replace the spring if out of limits.

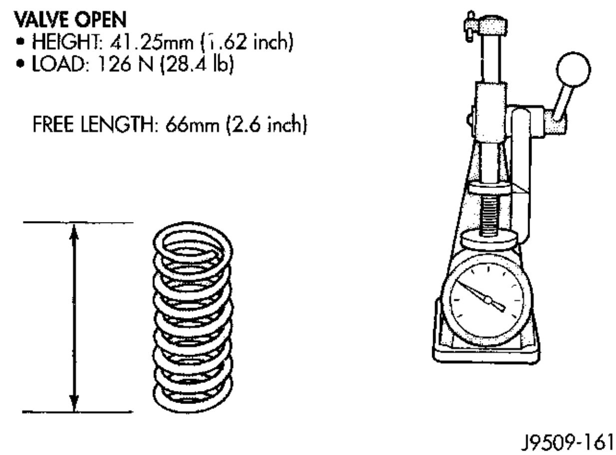


Fig. 105 Oil Pressure Regulator Spring Check

INSTALLATION

(1) Clean and inspect the plunger, bore and seat before assembly. The plunger must move freely in the valve bore.

(2) Install the valve, spring, gasket and plug. Tighten the plug to 80 N·m (60 ft. lbs.) torque.

VACUUM PUMP

REMOVAL

(1) Disconnect battery negative cable.

(2) Position drain pan under power steering pump.

(3) Disconnect vacuum and steering pump hoses.

(4) Disconnect oil pressure sender wires and remove sending unit (Fig. 106).

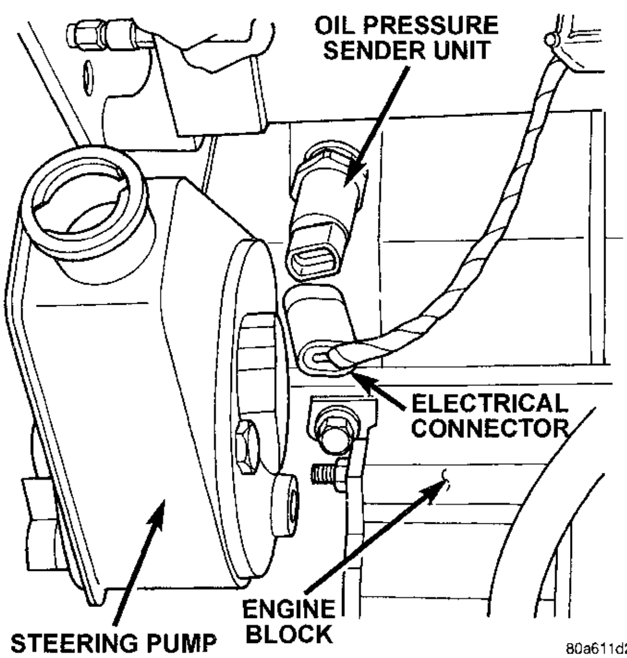


Fig. 106 Oil Pressure Sender Unit

REMOVAL AND INSTALLATION (Continued)

(5) Disconnect lubricating oil feed line from fitting at underside of vacuum pump (Fig. 107).

(6) Remove lower bolt that attaches pump assembly to engine block (Fig. 108).

(7) Remove bottom, inboard nut that attaches adapter to steering pump. This nut secures a small bracket to engine block. Nut and bracket must be removed before pump assembly can be removed from block.

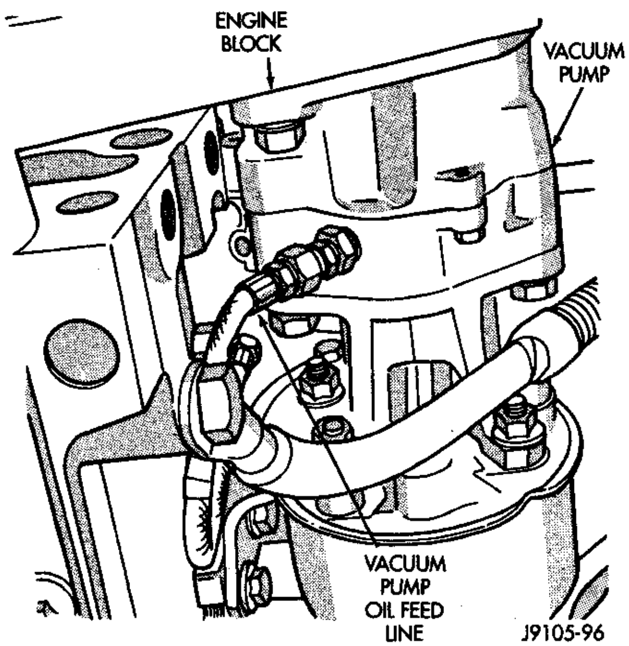


Fig. 107 Vacuum Pump Oil Feed Line

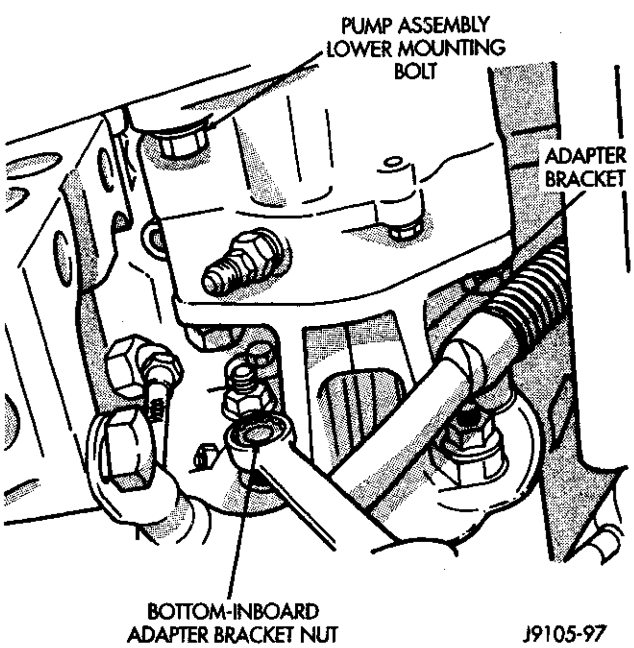


Fig. 108 Vacuum Pump Mounting

(8) Remove upper bolt that attaches pump assembly to engine block (Fig. 109).

(9) Remove pump assembly from vehicle.

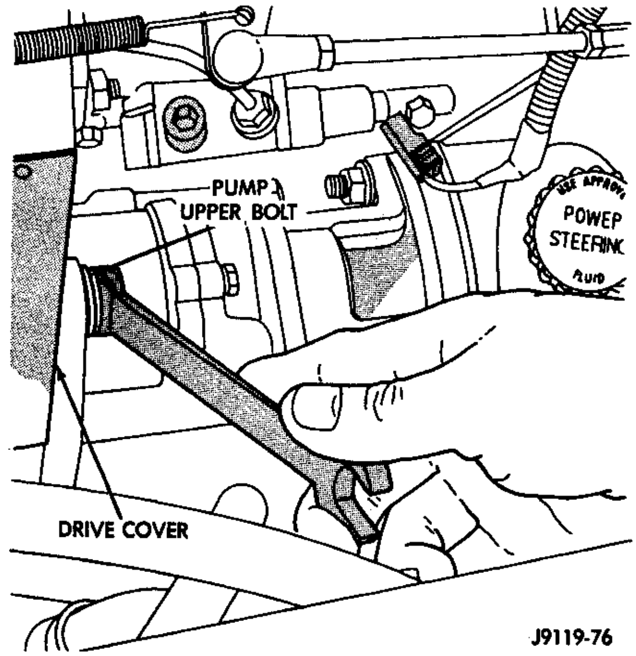


Fig. 109 Pump Assembly Upper Mounting Bolt

(10) Remove nuts attaching vacuum pump to adapter (Fig. 110).

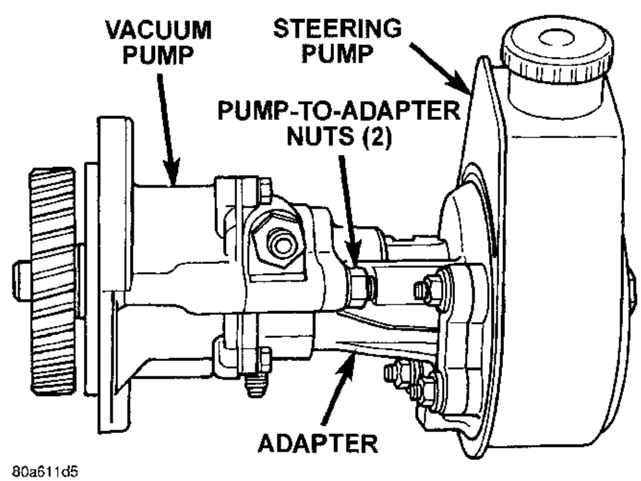


Fig. 110 Pump Assembly

(11) Remove vacuum pump from adapter (Fig. 111). Turn pump gear back and forth to disengage pump shaft from coupling.

(12) Remove coupling from adapter (Fig. 112).

(13) Remove remaining adapter attaching nuts and remove adapter from steering pump (Fig. 113). If steering pump will be serviced, remove spacer from each inboard mounting stud on pump.

REMOVAL AND INSTALLATION (Continued)

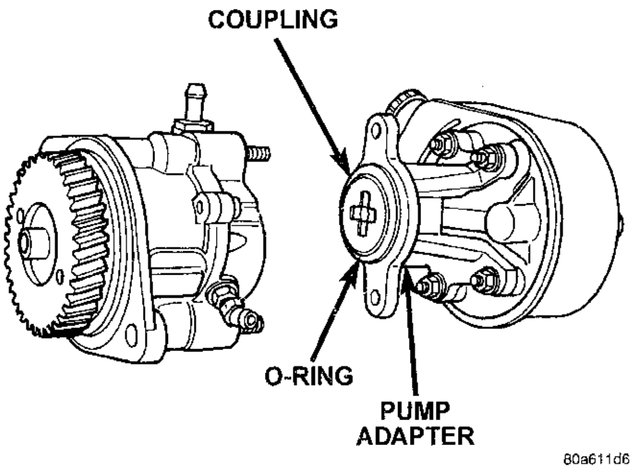


Fig. 111 Vacuum Pump Adapter

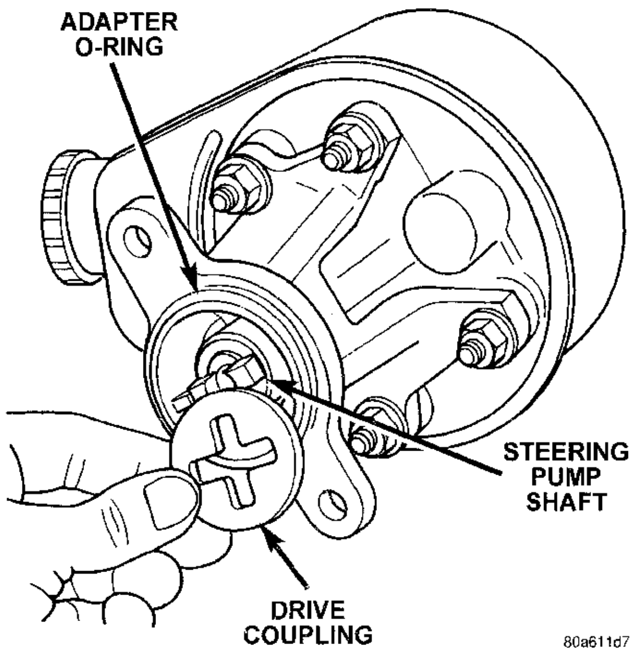


Fig. 112 Pump Drive Coupling

INSTALLATION

(1) Clean and lubricate pump shaft with engine oil.

(2) Install spacers on steering pump studs.

(3) Install O-ring on adapter.

(4) Position adapter on pump studs.

(5) Install attaching nuts on outboard stud and on the two upper pump studs. Do **not** install nut on lower, inboard stud at this time. Tighten nuts to 24 N·m (18 ft. lbs.).

(6) Install coupling on pump shaft. Be sure coupling is securely engaged in shaft drive tangs.

(7) Install vacuum pump on adapter. Rotate drive gear until tangs on pump shaft engage in coupling.

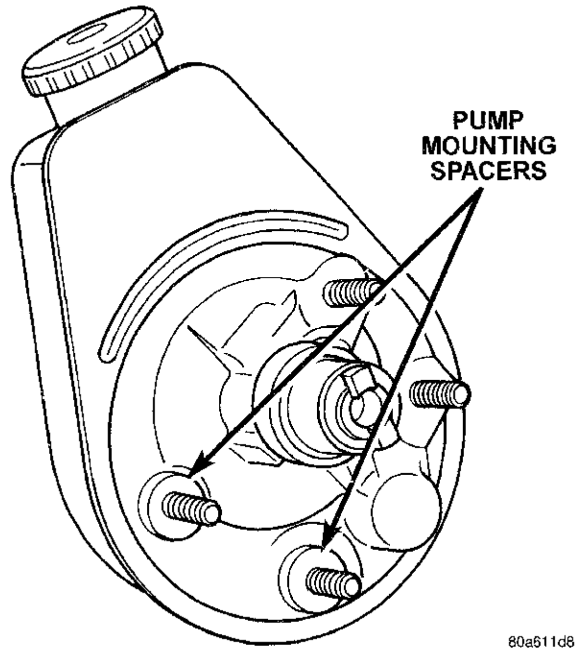


Fig. 113 Steering Pump Mounting Stud Spacers

Verify that pump is seated before installing attaching nuts.

(8) Install and tighten vacuum pump attaching nuts.

(9) Inspect adapter O-ring and replace O-ring if cut or torn.

(10) Lubricate adapter O-ring with engine oil.

(11) Note position of drive slots in coupling (Fig. 114). Then rotate drive gear to align tangs on vacuum pump shaft with coupling.

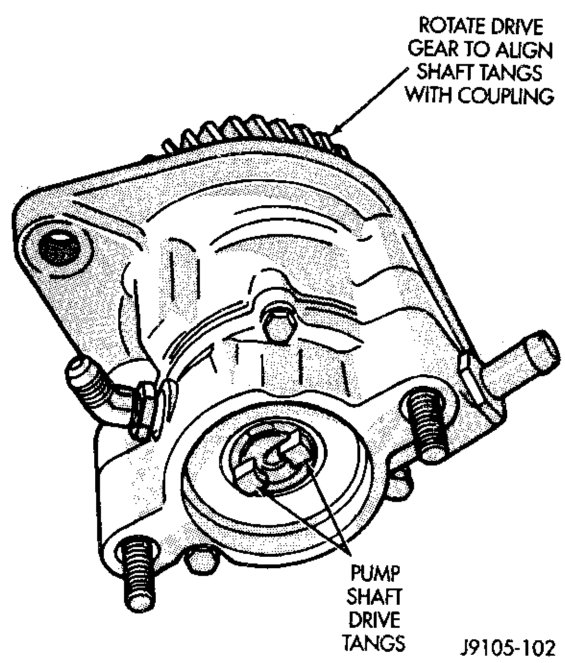


Fig. 114 Pump Shaft Drive Tangs

REMOVAL AND INSTALLATION (Continued)

(12) Verify that pump is seated in adapter and coupling.

(13) Install and tighten pump attaching nuts and washers.

(14) Position new gasket on vacuum pump mounting flange (Fig. 115). Use Mopar Perfect Seal, or silicone adhesive/sealer to hold gasket in place.

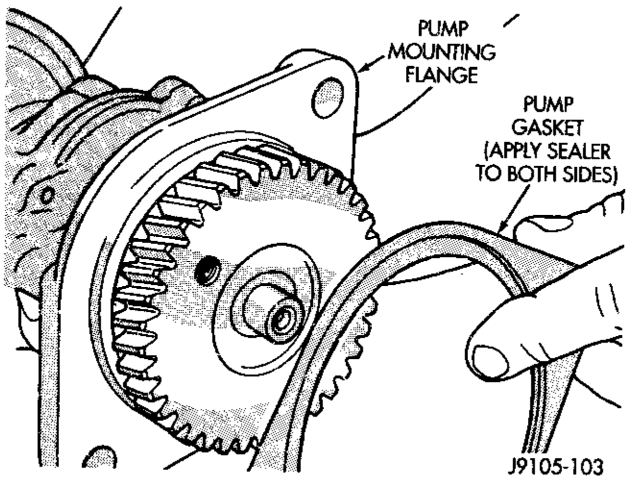


Fig. 115 Pump Mounting Flange Gasket

(15) Insert pump assembly upper attaching bolt in mounting flange and gasket. Use sealer or grease to hold bolt in place if necessary.

(16) Position pump assembly on engine and install upper bolt (Fig. 116). Tighten upper bolt only enough to hold assembly in place at this time.

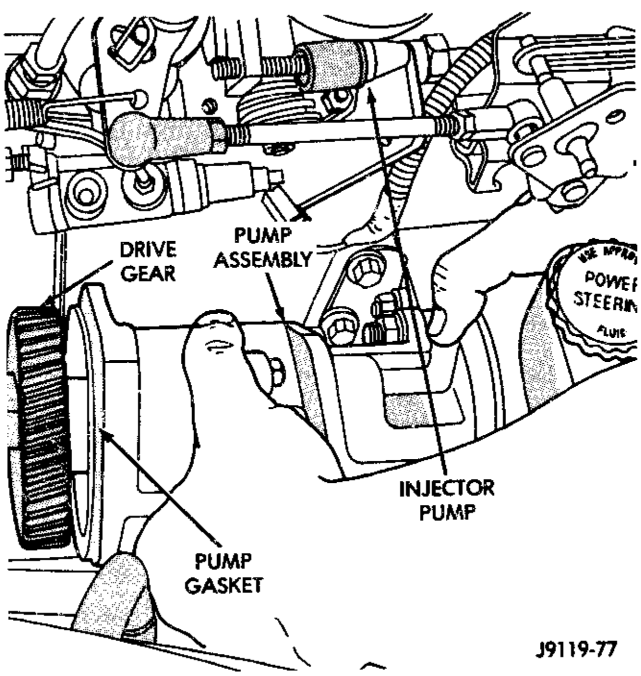


Fig. 116 Installing Pump Assembly On Engine

(17) Working from under vehicle, install pump assembly lower attaching bolt. Then tighten upper and lower bolt to 77 N·m (57 ft. lbs.).

(18) Position bracket on steering pump inboard stud. Then install remaining adapter attaching nut on stud. Tighten nut to 24 N·m (18 ft. lbs.).

(19) Connect oil feed line to vacuum pump connector and tighten line fitting.

(20) Install oil pressure sender and connect sender wires.

(21) Connect steering pump pressure and return lines to pump. Tighten pressure line fitting to 30 N·m (22 ft. lbs.).

(22) Connect vacuum hose to vacuum pump.

(23) Connect battery cables, if removed.

(24) Fill power steering pump reservoir.

(25) Purge air from steering pump lines. Start engine and slowly turn steering wheel left and right to circulate fluid and purge air from system.

(26) Stop engine and top off power steering reservoir fluid level.

(27) Start engine and verify that steering action is correct. Do this before moving vehicle.

DISASSEMBLY AND ASSEMBLY

ROCKER LEVERS

DISASSEMBLE

(1) Remove the retaining rings and thrust washers (Fig. 117).

(2) Remove the rocker levers (Fig. 117). DO NOT disassemble the rocker lever shaft and pedestal. The pedestal and shaft must be replaced as an assembly.

(3) Remove the locknut and adjusting screw (Fig. 117).

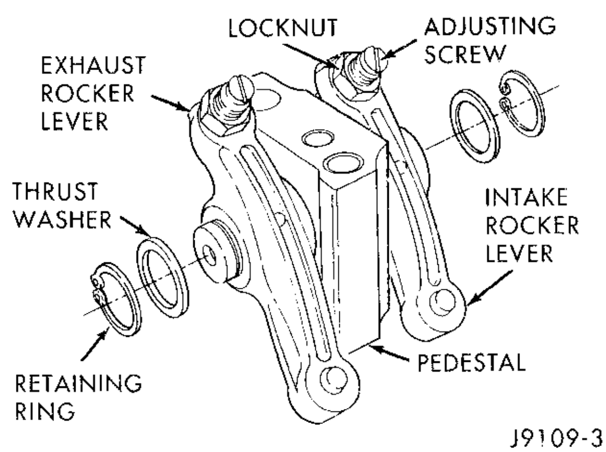


Fig. 117 Rocker Lever Components

(4) Clean all parts in a strong solution of laundry detergent in hot water.

DISASSEMBLY AND ASSEMBLY (Continued)

(5) Use compressed air to dry the parts after rinsing in clean hot water. The pedestals are made from powdered metal and may continue to show wetness after they have been cleaned and dried.

(6) Inspect for excessive wear in the bore and the contact surface for the valve stem.

(7) Measure the rocker lever bore diameter. The maximum diameter is 19.05 mm (0.75 inch). Replace if out of limits.

(8) Inspect the pedestal and shaft.

(9) Measure the shaft diameter. The minimum diameter is 18.94 mm (0.746 inch). Replace if out of limits.

ASSEMBLE

(1) Install the adjusting screw and locknut.

(2) Lubricate the shaft with clean engine oil. Be sure to assemble the intake and exhaust rocker levers in the correct location.

(3) Position the levers on the rocker shaft. Install the thrust washers.

(4) Clean the push rods in the hot soapy water.

(5) Inspect the push rod ball and socket for signs of scoring or cracks where the ball and the socket are pressed into the tube.

(6) Check the push rods for roundness and straightness.

(7) Install the push rods into the sockets of the valve tappets. Lubricate the push rod sockets with clean engine oil.

(8) Make sure the rocker lever adjusting screws are completely backed out.

PISTON AND CONNECTING ROD ASSEMBLY

DISASSEMBLE

(1) Remove the retainer rings from the piston (Fig. 118).

(2) Remove the piston pin. Heating the piston is not required.

(3) Remove the piston rings (Fig. 118).

ASSEMBLE

(1) Be sure the FRONT marking on the piston and the numbers on the rod and cap are oriented (Fig. 119). Install the retaining ring into the pin groove on the FRONT side of the piston.

(2) Lubricate the pin and bore with engine oil.

(3) Install the piston pin in the opposite side of the installed retaining pin. Pistons do not require heating to install the pin, however, the piston does need to be at room temperature or above.

(4) Determine the piston diameter and obtain the appropriate ring set. The piston rings can be identified as shown in (Fig. 120).

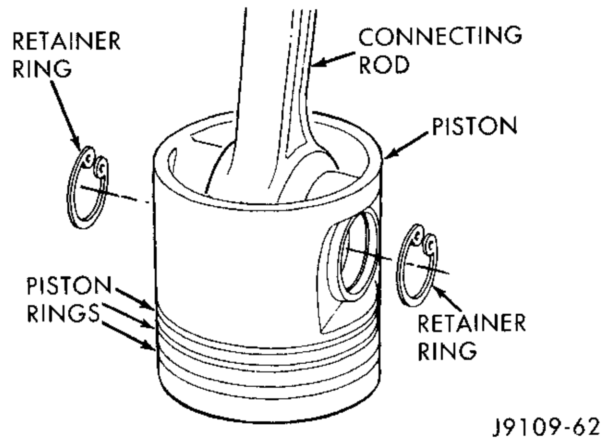


Fig. 118 Retainer Rings

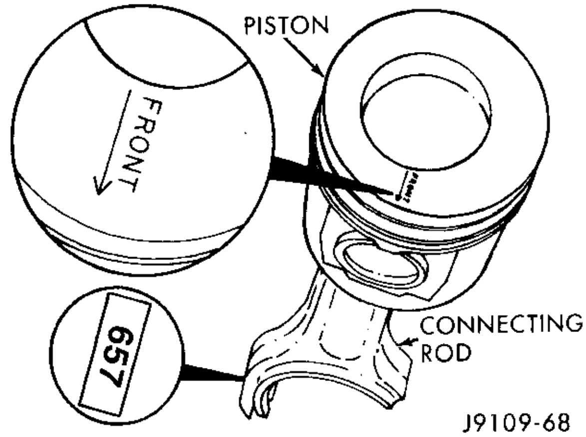


Fig. 119 Proper Markings on the Piston and Connecting Rod

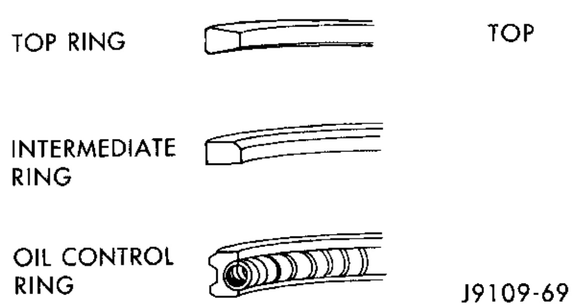


Fig. 120 Piston Ring Identification

(5) Position each ring in the cylinder and use a piston to square it with the bore at a depth of 89.0 mm (3.5 inch) - (Fig. 121).

(6) Use a feeler gauge to measure the piston ring gap (Fig. 122).

(7) The top surface of all of the rings are identified with the word TOP or the supplier's MARK. Assemble the rings with the word TOP or the supplier's MARK up.

DISASSEMBLY AND ASSEMBLY (Continued)

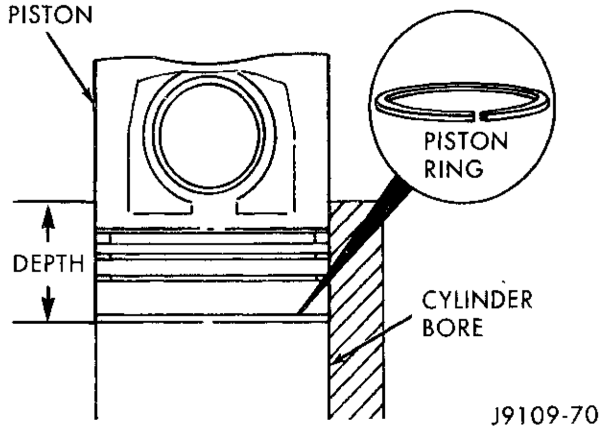
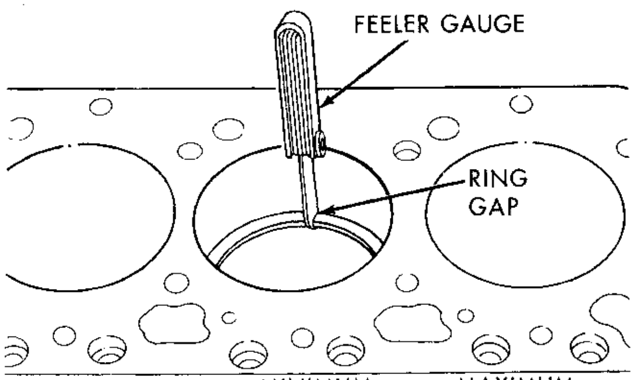


Fig. 121 Position of Ring in Cylinder Bore



	MINIMUM	MAXIMUM
TOP	0.400 mm (0.0160 inch)	0.700 mm (0.0275 inch)
INTERMEDIATE	0.250 mm (0.0100 inch)	0.550 mm (0.0215 inch)
OIL CONTROL	0.250 mm (0.0100 inch)	0.550 mm (0.0215 inch)

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Fig. 122 Piston Ring Gap

(8) Position the oil ring expander in the oil control ring groove (bottom groove).

(9) Install the oil control ring with the end gap OPPOSITE the ends on the expander (Fig. 123).

(10) Install the intermediate piston ring in the second groove (Fig. 121).

(11) Install the top piston ring in the top groove (Fig. 124).

(12) Position the rings as shown in (Fig. 125).

(13) Install the original bearings as removed or install new bearings. If new bearings are used, be sure to obtain the proper bearing clearance (Fig. 126).

(14) DO NOT lubricate the side of the bearing that is against the connecting rod or cap. Apply a coat of Lubriplate 105, or equivalent to the new upper and lower connecting rod bearings.

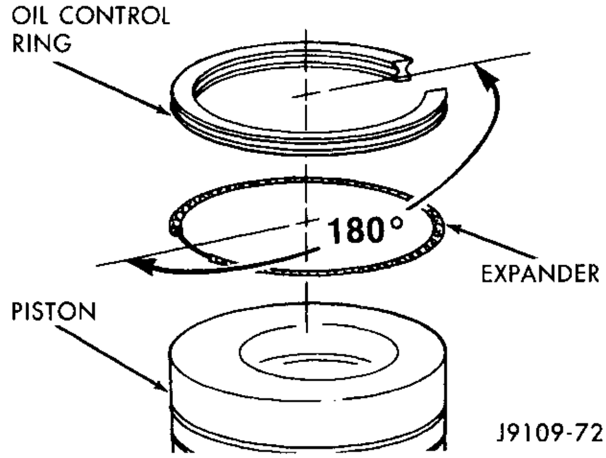

Fig. 123 Oil Control Ring/Expander Location in Groove

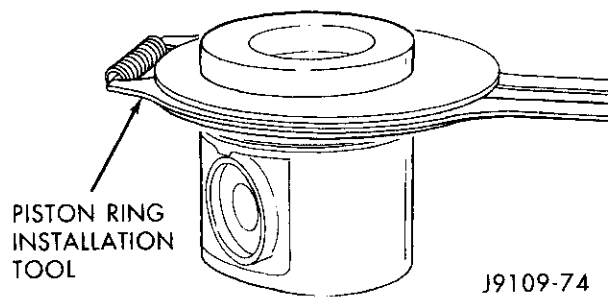

Fig. 124 Piston Ring Installation Tool

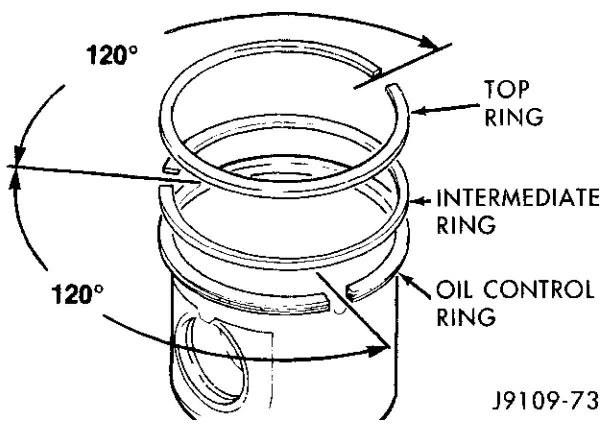

Fig. 125 Piston Ring Positioning

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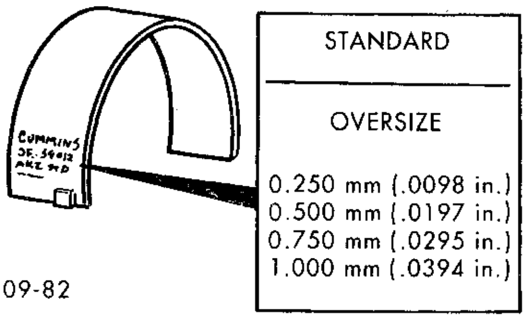


Fig. 126 Connecting Rod Bearing Size Location

CLEANING AND INSPECTION

OIL COOLER ELEMENT AND GASKET

CLEANING AND INSPECTION

Clean the sealing surfaces.

Apply 483 kPa (70 psi) air pressure to the element to check for leaks. If the element leaks, replace the element.

CYLINDER HEAD

INSPECTION

Remove the cup plugs and inspect the coolant passages. A large build up of rust and lime will require removal of the cylinder block for cleaning in a hot tank.

Inspect the cylinder bores for damage or excessive wear. Rotate the crankshaft so the piston is at Bottom Dead Center (BDC) to inspect the bores.

Measure the cylinder bores (Fig. 127). DO NOT proceed with in-chassis repair if the bores are damaged or worn beyond the limits (refer to Cylinder Bore Repair - Cylinder Block).

Check the top surface for damage caused by the cylinder head gasket leaking between cylinders.

Inspect the block and head surface for nicks, erosion, etc.

Check the head distortion (Fig. 128). The distortion of the combustion deck face is not to exceed 0.010 mm (0.0004 inch) in any 50.8 mm (2.00 inch) diameter. Overall variation end to end or side to side 0.30 mm (0.012 inch).

DO NOT proceed with the in-chassis overhaul if the cylinder head or block surface is damaged or not flat (within specifications).

REFACING HEAD SURFACE

The cylinder head combustion deck may be refaced in whatever increments necessary to clean up the surface and maintain the surface finish and flatness tolerances. The combined total of stock removed must not exceed 1.00 mm (0.03937 inch). The amount of stock removed each time must be steel stamped above combustion deck edge, on the lower right hand corner of the rear face (Fig. 129). Check valve protrusion after head surface refacing.

Surface finish requirements are 1.5-3.2 micrometers (60-126 microinch).

CLEANING

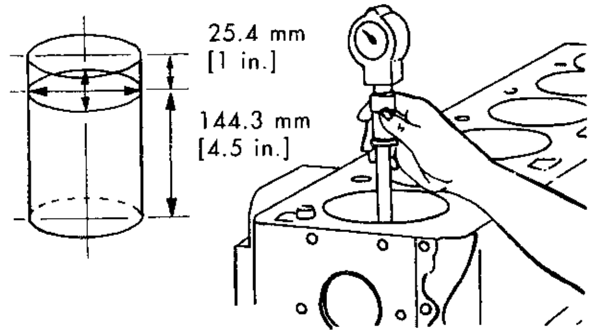
Clean the carbon from the injector nozzle seat with a nylon or brass brush.

Scrape the gasket residue from all gasket surfaces.

Wash the cylinder head in hot soapy water solution (88°C or 140°F).

After rinsing, use compressed air to dry the cylinder head.

Polish the gasket surface with 400 grid paper. Use an orbital sander or sanding block to maintain a flat surface.



MIN.	102.0 mm	(4.0157 inch)
MAX.	102.116 mm	(4.0203 inch)
Out-of-Round	0.038 mm	(0.0015 inch)
Taper	0.76 mm	(0.003 inch)
Oversize pistons and rings are available for bored cylinder blocks.		

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Fig. 127 Cylinder Bore Diameter

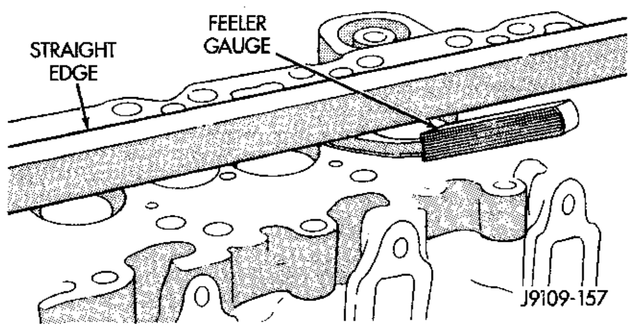

Fig. 128 Cylinder Head Combustion Deck Face Measurement

CLEANING AND INSPECTION (Continued)

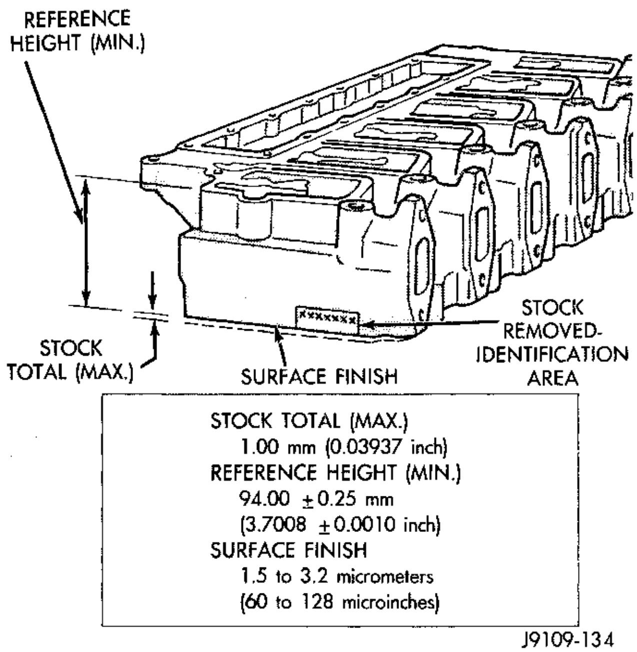

Fig. 129 Cylinder Head Stock Removal

VALVES AND VALVE SPRINGS

VALVES

CLEANING AND INSPECTION

Before cleaning, note the valve number. Clean the valve heads with a soft wire wheel. Mark the valve with the number noted above.

Polish the valve stems with crocus cloth.

Inspect for abnormal wear on the valve heads and stems. Replace badly worn valves.

Check for bent valves. Replace bent valves.

Measure the valve stem diameter (Fig. 130). The valve stem diameter should be 7.935-7.960 mm (0.3126-0.3134 inch). If out of limits, replace the valve. Mark the new valves with the replacement location.

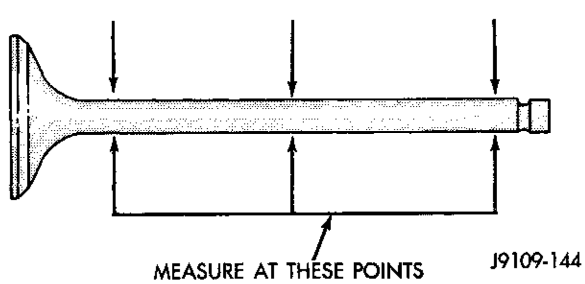

Fig. 130 Measure Valve Stem Diameter

Inspect the end of the valve stem for flatness. If required, resurface the valve end.

VALVE GRINDING

The valve seat angle should be 30° (Intake Valve) and 45° (Exhaust Valve) - (Fig. 131).

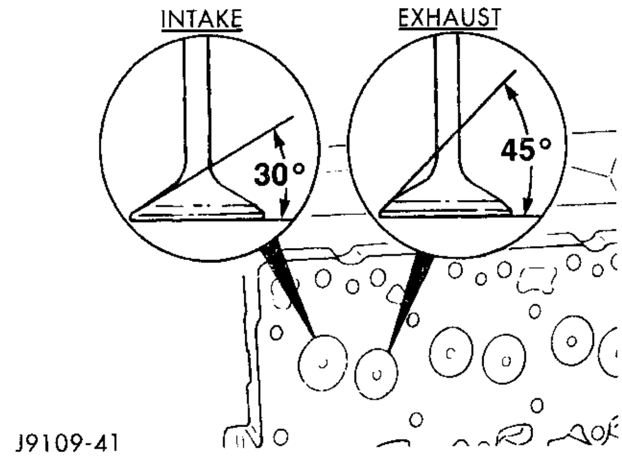

Fig. 131 Valve Seat Angle

Measure the rim thickness (Fig. 132). The minimum valve rim thickness is 0.79 mm (0.031 inch).

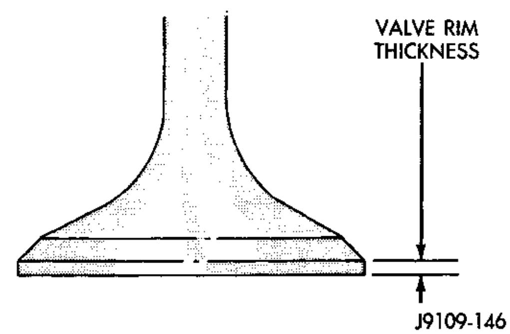

Fig. 132 Valve Rim Thickness

Grind the face of valves to be reused.

Check the valve stem tip for flatness. If required, re-surface the tip.

VALVE GUIDES

INSPECTION

Inspect the valve guides for scuffing or scoring.

Measure the valve guide bore (Fig. 133). The bore diameter should be 8.019-8.089 mm (0.3157-0.3185 inch).

If the valve guide bores are larger than the worn limit, the cylinder head must be machined for service valve guides. New valve guides must be reamed to size after they are installed.

If the cylinder head needs service valve guides and valve seat inserts, the valve guides should be installed first.

CLEANING AND INSPECTION (Continued)

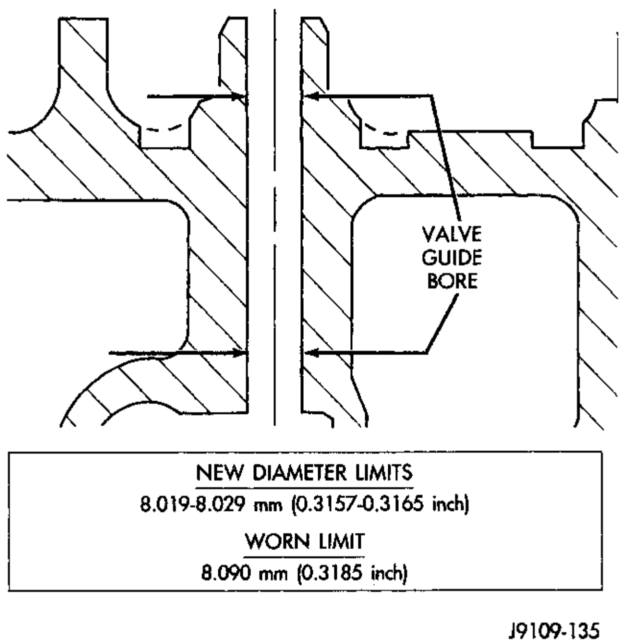

Fig. 133 Valve Guide Bore

VALVE SPRINGS

INSPECTION

Measure the valve spring length. The approximate free length is 60 mm (2.36 inch) with the maximum inclination of 1.0 mm (0.039 inch).

Measure the valve spring force. 359 N (81 lbs.) is the minimum acceptable load required to compress the spring to a height of 49.25 mm (1.94 inch).

If the valve spring does not meet the limits above, replace the spring.

VALVE SEATS

INSPECTION

Cylinder head with integral valve seats can be ground only once. Previously ground integral seats must be replaced with service seats.

One X stamped into the head casting identify seats that have been ground previously (Fig. 134).

Two X's stamped on the head indicate service seats have been installed (Fig. 134). Service seats can be ground.

On the integral seat head, if 0.254 mm (0.010 inch) or more has been removed from the head combustion surface, service seats must be installed.

To determine if the head has been previously resurfaced, before calculating valve depth, process as follows:

(1) Check the rear lower right corner of the head for a stamping that would indicate previous resurfacing (.003).

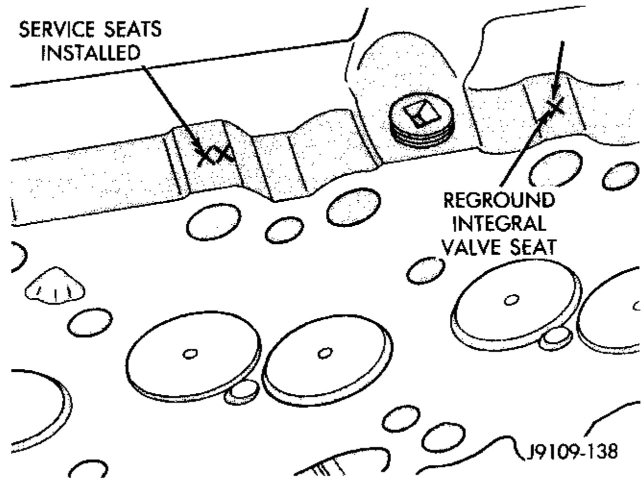

Fig. 134 Reworked Cylinder Head Seats—Stamped Identification

(2) To verify the information, or if no amount is indicated, measure the head height (Fig. 135).

(3) If the head height is 94.75 mm (3.730 inch) or greater, the valve seats may be ground, if they have not been ground previously.

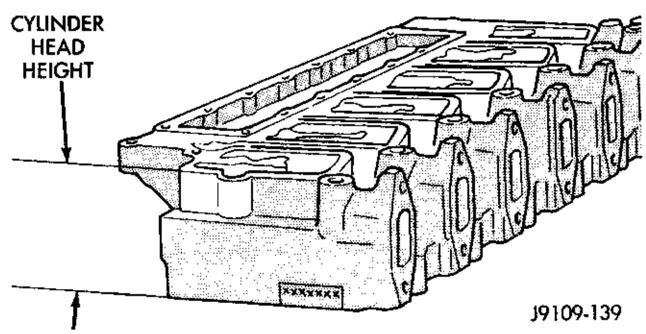

Fig. 135 Cylinder Head Height

TAPPET

INSPECTION

Inspect the tappet socket, stem and face for excessive wear, cracks and other damage (Fig. 136).

The minimum tappet stem diameter is 15.925 mm (0.627 inch) - (Fig. 136). If the tappet is out of limits, replace the tappet.

CAMSHAFT

INSPECTION

Inspect the lift pump lobe, valve lobes and bearing journals for wear, cracking, pitting and other damage.

Clean the camshaft and gear with solvent and a lint free cloth.

Inspect the gear teeth for wear and damage. Look for cracks at the root of the teeth.

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CLEANING AND INSPECTION (Continued)

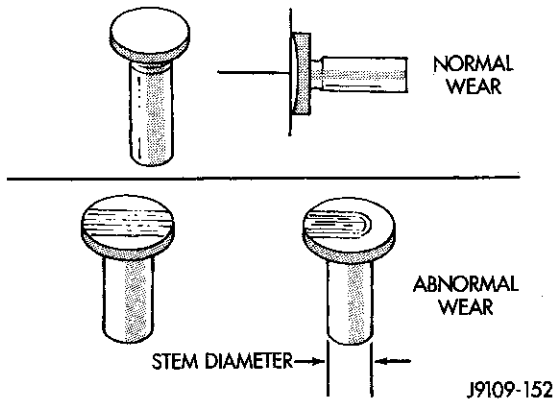


Fig. 136 Tappet Inspection

Measure the bearing journals, lift pump lobe and valve lobes (Fig. 137).

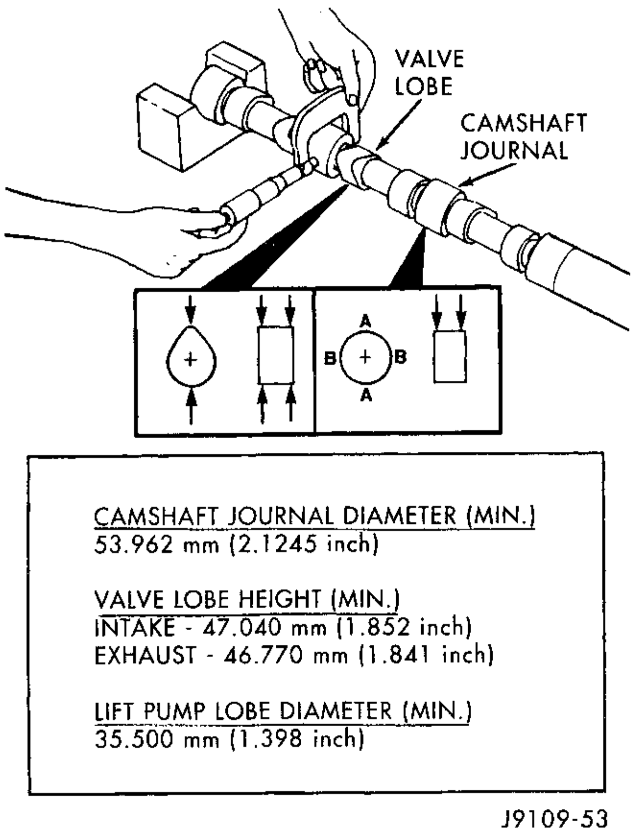


Fig. 137 Bearing Journal/Valve Lobe Measurements

OIL PUMP

CLEAN AND INSPECT

Visually inspect the lube pump gears for chips, cracks or excessive wear.

Remove the back plate (Fig. 138).

Mark TOP on the gerotor planetary using a felt tip pen (Fig. 138).

Remove the gerotor planetary (Fig. 138).

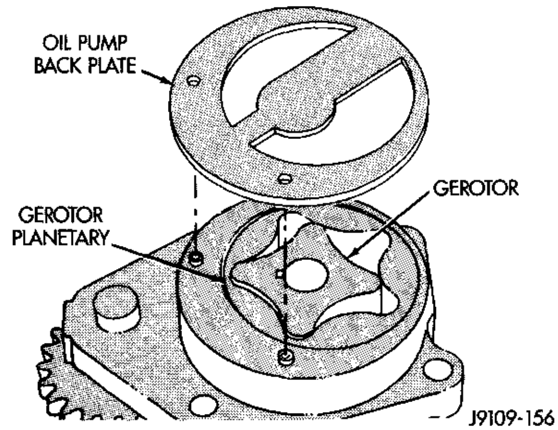


Fig. 138 Gerotor Planetary and Gerotor

Inspect for excessive wear or damage.

Clean all parts in solvent and dry with compressed air.

Inspect the pump housing and gerotor drive for damaged and excessive wear.

Install the gerotor planetary in the original position. The chamfer must be on the O.D. and down.

Measure the tip clearance (Fig. 139). Maximum clearance is 0.1778 mm (0.007 inch). If the oil pump is out of limits, replace the pump.

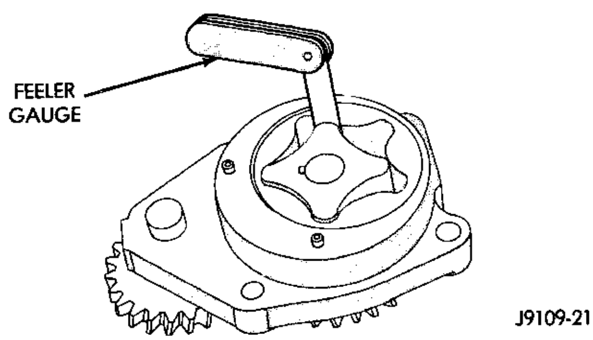


Fig. 139 Tip Clearance

Measure the clearance of the gerotor drive/gerotor planetary to port plate (Fig. 140). Maximum clearance is 0.127 mm (0.005 inch). If the oil pump is out of limits, replace the pump.

Measure the clearance of the gerotor planetary to the body bore (Fig. 141). Maximum clearance is 0.381 mm (0.015 inch). If the oil pump is out of limits, replace the pump.

Measure the gears backlash (Fig. 142). The limits of a used pump is 0.080- 0.380 mm (0.003-0.015 inch). If the backlash is out of limits, replace the oil pump.

Install the back plate.

CLEANING AND INSPECTION (Continued)

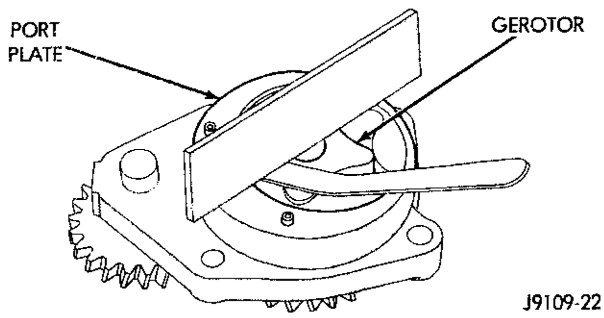


Fig. 140 Gerotor to Port Plate Clearance

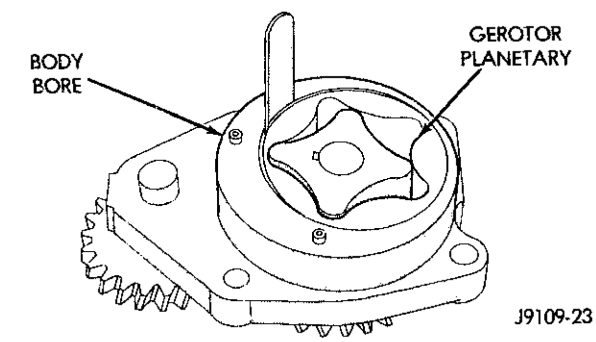


Fig. 141 Gerotor Planetary to Body Bore Clearance

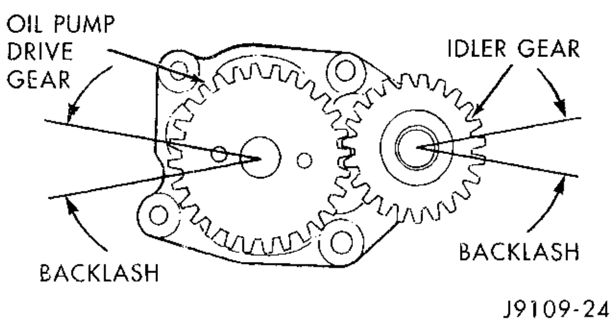


Fig. 142 Measure Gear Backlash

CYLINDER BLOCK

(1) Remove the engine assembly from the vehicle.
(2) Remove the cylinder head from the block.
(3) Remove the camshaft.
(4) Remove the piston/connecting rod assemblies.

INSPECTION

Measure the combustion deck face using a straight edge and a feeler gauge (Fig. 143). The distortion of the combustion deck face is not to exceed 0.010 mm (0.0004 inch) in any 50.00 mm (2.0 inch) diameter. Overall variation end to end or side to side is 0.075 mm (0.003 inch).

If the surface exceeds the limit, refer to Cylinder Block Refacing.

Inspect the cylinder bores for damage or excessive wear.

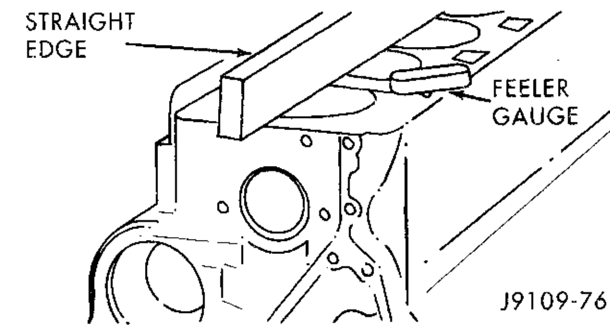
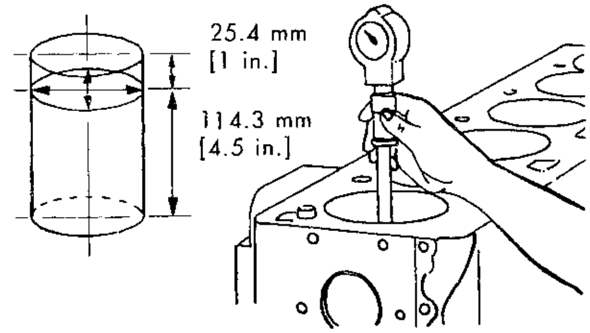


Fig. 143 Combustion Deck Face Measurement

Measure the cylinder bores (Fig. 144). If the cylinder bores exceeds the limit, refer to Cylinder Bore Repair.



MIN.	102.0 mm	(4.0157 inch)
MAX.	102.116 mm	(4.0203 inch)
Out-of-Round	0.038 mm	(0.0015 inch)
Taper	0.076 mm	(0.003 inch)
Oversize pistons and rings are available for bored cylinder blocks.		

J9209-167

Fig. 144 Cylinder Bore Diameter

Inspect the camshaft bores for scoring or excessive wear.

Measure the camshaft bores. Refer to engine specifications at the rear of this section. Limit for the No.1 bore applies to the ID of the bushing.

If a bore exceeds the limit, refer to Camshaft Bore Repair.

Inspect the tappet bores for scoring or excessive wear (Fig. 145). If out of limits, replace the cylinder block.

PISTON AND CONNECTING ROD ASSEMBLY

CLEANING

CAUTION: DO NOT use bead blast to clean the pistons. DO NOT clean the pistons and rods in an acid tank.

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CLEANING AND INSPECTION (Continued)

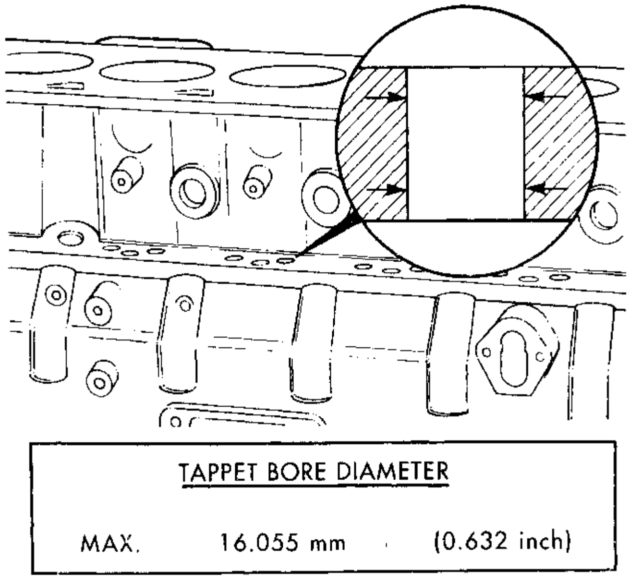

Fig. 145 Tappet Bore Diameter

Soak the pistons in cold parts cleaner. Soaking the pistons overnight will usually loosen the carbon deposits.

Wash the pistons and rods in a strong solution of laundry detergent and hot water.

Clean the remaining deposits from the ring grooves with the square end of a broken ring. DO NOT use a ring groove cleaner and be sure not to scratch the ring sealing surface in the piston groove.

Wash the pistons again in a detergent solution or solvent.

Rinse the pistons. Use compressed air to dry.

INSPECTION

Inspect the rod journals for deep scratches, indication of overheating and other damage.

Inspect the pistons for damage and excessive wear. Check top of the piston, ring grooves, skirt and pin bore.

Measure the piston skirt diameter (Fig. 146). If the piston is out of limits, replace the piston.

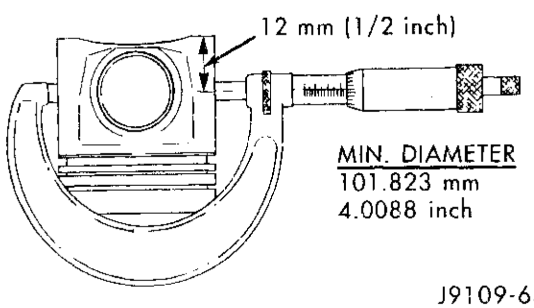

Fig. 146 Piston Skirt Diameter

The upper groove only needs to be inspected for damage.

Use a new piston ring to measure the clearance in the intermediate ring groove (Fig. 147). If the clearance of the intermediate ring exceeds 0.152 mm (0.006 inch), replace the piston.

Use a new oil ring to measure the clearance in the oil groove (Fig. 147). If the clearance exceeds 0.127 mm (0.005 inch), replace the piston.

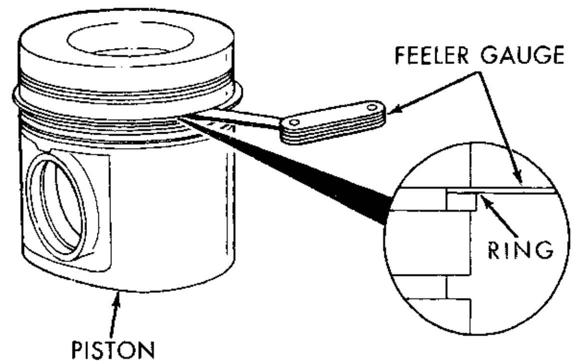

Fig. 147 Intermediate and Oil Ring Clearances

Measure the pin bore (Fig. 148). The maximum diameter is 40.025 mm (1.5758 inch). If the bore is over limits, replace the piston.

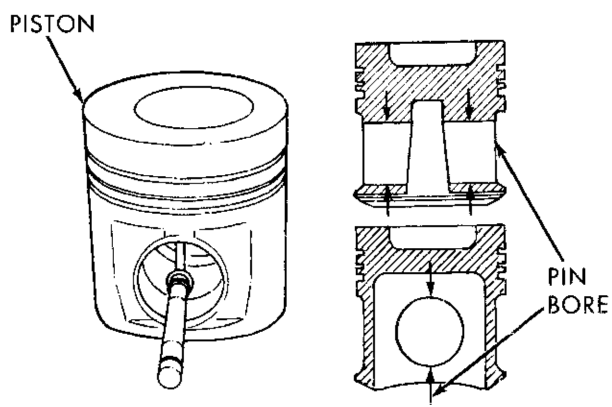

Fig. 148 Piston Pin Bore

Inspect the piston pin for nicks, gouges and excessive wear.

Measure the pin diameter (Fig. 149). The minimum diameter is 39.990 mm (1.5744 inch). If the diameter is out of limits, replace the pin.

Inspect the rod for damage and wear. The I-Beam section of the connecting rod cannot have dents or other damage. Damage to this part can cause stress risers which will progress to breakage.

Measure the connecting rod pin bore (Fig. 150). The maximum diameter is 40.042 mm (1.5764 inch). If out of limits, replace the connecting rod.

CLEANING AND INSPECTION (Continued)

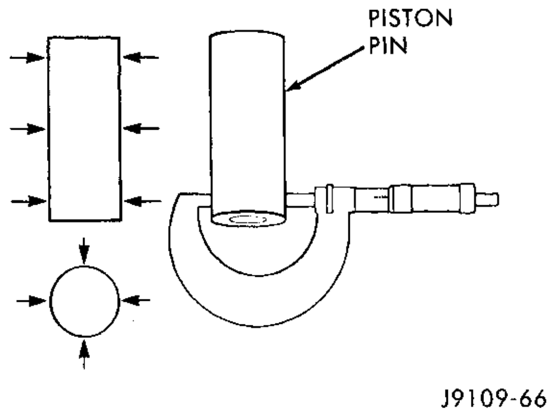

Fig. 149 Piston Pin Diameter

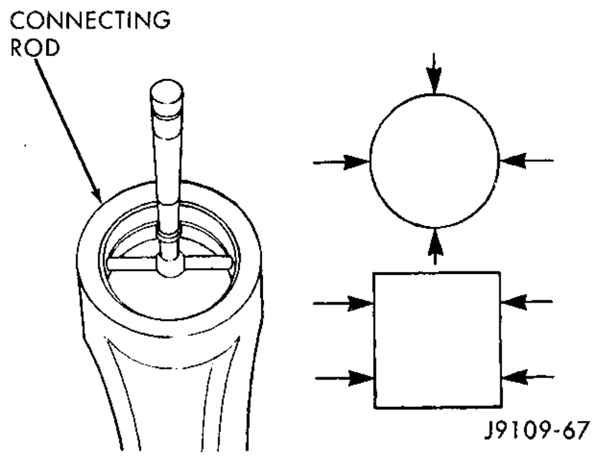

Fig. 150 Connecting Rod Pin Bore

CRANKSHAFT

CLEANING AND INSPECTION

Clean the crankshaft oil galley holes with a nylon brush.

Rinse in clean solvent and dry with compressed air.

Inspect the front and rear seal contact areas of the crankshaft for scratches or grooving.

The service seal kit will position the seal slightly deeper into the seal bore so it will contact the crankshaft at a different location. If this has already been done and the crankshaft has two worn areas, install a wear sleeve to provide a new contact surface for the seal.

Inspect the rod and main journal for deep scores, signs of overheating and other abnormal marks.

ADJUSTMENTS

VALVE CLEARANCE ADJUSTMENT

Use the timing pin to locate Top Dead Center (TDC) for cylinder No.1 (Fig. 151). The timing pin is located at the back of the gear housing and below the injection pump. **Be sure to disengage the timing pin after locating top dead center. Refer to TIMING PIN for more information.**

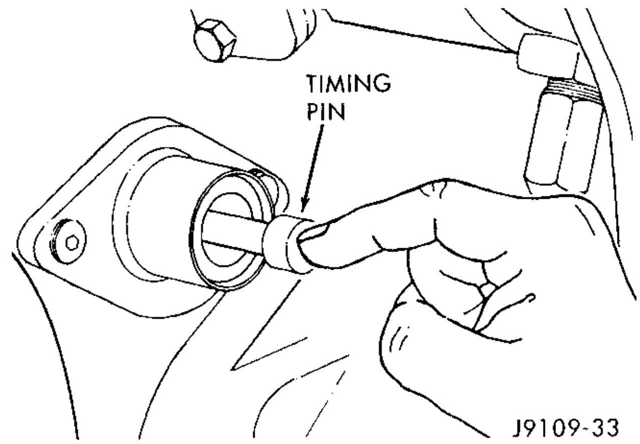

Fig. 151 Locating TDC using Timing Pin

Adjust the valves when the engine is cold, below 60°C (140°F).

STEP 1

Adjust the clearance for the valves shown in (Fig. 152). The valve lash adjustment is 0.254 mm (0.010 inch) for the intake valve. The valve lash adjustment is 0.508 mm (0.020 inch) for the exhaust valve.

Tighten the valve adjusting nuts to 24 N·m (18 ft. lbs.) torque. **Be sure timing pin is disengaged before rotating the crankshaft.** Mark the pulley and rotate the crankshaft 360°.

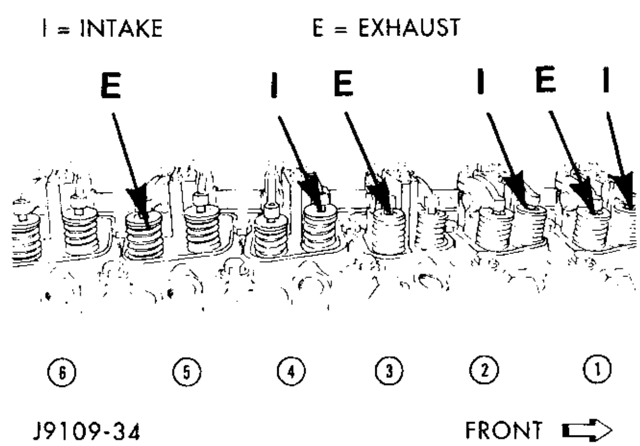

Fig. 152 Adjust Valve Clearance—Step 1

STEP 2

Adjust the clearance for the valves shown in (Fig. 153). The valve lash adjustment is 0.254 mm (0.010 inch) for the intake valve. The valve lash adjustment is 0.508 mm (0.020 inch) for the exhaust valve.

Tighten the bolts to 24 N·m (18 ft. lbs.) torque.

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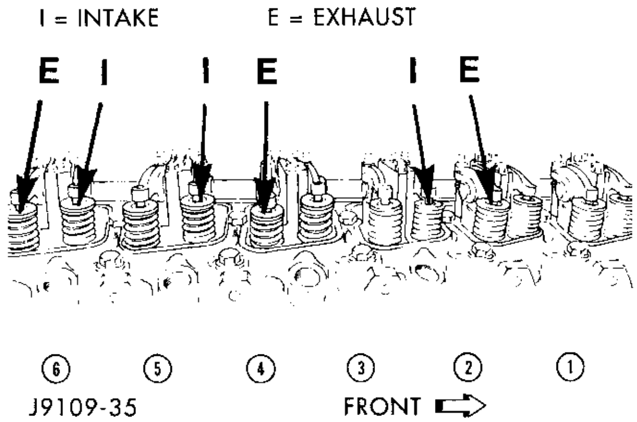

Fig. 153 Adjust Valve Clearance—Step 2

SPECIFICATIONS

5.9L DIESEL ENGINE SPECIFICATIONS

Camshaft

Journal Diameter (Min.). . . . .53.962 mm (2.1245 in.)
Intake Lobe
(Min. dia. @ peak) . . . . .47.040 mm (1.852 in.)
Exhaust Lobe
(Min. dia. @ peak) . . . . .46.770 mm (1.841 in.)
Lift Pump Lobe
(Min. dia. @ peak) . . . . .35.500 mm (1.398 in.)
End Clearance . . . . .0.152 – 0.254 mm (0.006 – 0.010 in.)
Gear Backlash . . . . .0.080 – 0.330 mm (0.003 – 0.013 in.)

Connecting Rods

Pin Bore Diameter (Max.) . . . 40.042 mm (1.5764 in.)
Side Clearance . . . . .0.100 – 0.300 mm (0.004 – 0.012 in.)

Crankshaft

Main Bearing Journal Diameter (Std.) . . .82.962 mm (3.2662 in.)
Main Journal Out of Round
(Max.) . . . . .0.050 mm (0.002 in.)
Main Journal Taper (Max.) . . .0.013 mm (0.0005 in.)
Main Journal Oil Clearance
(Max.). . . . . .0.119 mm (0.0047 in.)
Rod Bearing Journal Diameter
(Std.) . . . . .68.962 mm (2.7150 in.)
Rod Journal Out of Round
(Max.) . . . . .0.050 mm (0.002 in.)

Camshaft

Rod Journal Taper (Max.) . . . .0.013 mm (0.0005 in.)
Rod Journal Oil Clearance
(Max.). . . . . .0.089 mm (0.0035 in.)
End Play .0.100 – 0.430 mm (0.004 – 0.017 in.)
Gear Backlash . . . . .0.080 – 0.330 mm (0.003 – 0.030 in.)

Cylinder Block

Cylinder Bore Diameter . . . .102.116 mm (4.0203 in.)
Cylinder Bore Out of Round
(Max.). . . . . .0.038 mm (0.0015 in.)
Cylinder Bore Taper (Max.) . . . .0.076 mm (0.003 in.)
Tappet Bore Diameter . . . . . . .16.055 mm (0.632 in.)
Deck Surface Flatness
(Max. Overall) . . . . .0.075 mm (0.003 in.)
First Reface . . . . .0.250 mm (0.0098 in.)
Second Reface. . . . . .0.250 mm (0.0098 in.)
Total Reface . . . . .0.500 mm (0.197 in.)
Surface Finish . . . . .1.50 – 3.20 micrometers (60–126 microinches)
Main bearing Bore Dia.
(Bearing Installed) . . . . . . .83.106 mm (3.2719 in.)
Cam Bore Dia. (Max.)
#1 w/o bushing . . . . .59.248 mm (2.3326 in.)
Cam Bore Dia. (Max.)
#1–7 w/bushing . . . . .54.139 mm (2.1314 in.)

Cylinder Head

Overall Flatness (Max.) . . . . . . .0.030 mm (0.012 in.)
Intake Valve Seat Angle . . . . .30°
Exhaust Valve Seat Angle. . . . . .45°
Valve Seat Width (Min.). . . . . . . .1.52 mm (0.060 in.)
Valve Seat Width (Max.) . . . . . . .2.03 mm (0.080 in.)

Tappets

Stem Diameter. . . . . .15.925 mm (0.627 in.)

Oil Pump

Tip Clearance (Max.) . . . . .0.1778 mm (0.007 in.)
Gerotor Drive/Planetary to Port Plate
Clearance (Max.) . . . . .0.127 mm (0.005 in.)
Gerotor Planetary to Body
Clearance (Max.) . . . . .0.381 mm (0.015 in.)
Gear Backlash (Used Pump) . . . . .0.080 – 0.380 mm (0.003 – 0.015 in.)

Oil Pressure (Min.)

At Idle Speed* . . . . .69 kPa (10 psi)
At 2,500 rpm*. . . . . .207 kPa (30 psi)
Regulating Valve Opening
Pressure . . . . .448 kPa (65 psi)

SPECIFICATIONS (Continued)

CAUTION: If oil pressure is ZERO at curb idle, DO NOT run engine.

Oil Filter
Diff. Pressure to Open
Filter Bypass . . . . .172.3 kPa (25 psi)
Pistons
Skirt Diameter . . . . .101.880 – 101.823 mm (4.0110 – 4.0088 in.)
Ring Groove Depth (Intermediate) . . . . . . .0.150 mm (0.006 in.)
Ring Groove Depth
(Oil Control). . . . . .0.130 mm (0.005 in.)
Piston Pins
Diameter (Min.) . . . . .39.990 mm (1.5744 in.)
Bore Diameter (Max.). . . . . . .40.025 mm (1.5758 in.)
Piston Rings
End Gap (Top) . . . . .0.400 – 0.700 mm (0.016 – 0.0275 in.)
End Gap (Intermediate) . . . . .0.250 – 0.550 mm (0.010 – 0.0215 in.)
End Gap (Oil Control) . . . . .0.250 – 0.550 mm (0.010 – 0.0215 in.)
Valves
Clearance (Intake) . . . . .0.25 mm (0.010 in.)
Clearance (Exhaust) . . . . .0.51 mm (0.020 in.)
Guide Diameter . . . . .8.019 – 8.089 mm (0.3157 – 0.3185 in.)
Stem Diameter . . . . .7.935 – 7.960 mm (0.3126 – 0.3134 in.)
Depth (Installed) . . . . .0.99 – 1.52 mm (0.039 – 0.060 in.)
Valve Springs
Free Length . . . . .60 mm (2.36 in.)
Inclination (Max.) . . . . .1.00 mm (0.039 in.)
Minimum Load . . . .@49.25 mm — 359 N (@1.94 in. — 81 lbs.)

TORQUE SPECIFICATIONS

5.9L DIESEL ENGINE

Description	Torque
Air Fuel Control	
Fitting	8 N·m (72 in. lbs)
Battery Cable (Negative) to Block	
Bolt	77 N·m (57 ft. lbs.)
Belt Tensioner Mounting	
Bolt	43 N·m (32 ft. lbs.)
Block Heater Mounting	
Bolt	12 N·m (108 in. lbs.)
Cab Heater Hose Clamp	
Screw	4 N·m (35 in. lbs.)
Cab Heater Tubing Bracket	
Bolt	9 N·m (84 in. lbs.)
Camshaft Thrust Plate	
Bolts	24 N·m (18 ft. lbs.)
Clutch Cover to Flywheel	
Bolts	23 N·m (17 ft. lbs.)
Connecting Rod Nuts	
Step 1– Preliminary	35 N·m (26 ft. lbs.)
Step 2 – Secondary	70 N·m (51 ft. lbs.)
Step 3 – Final	100 N·m (73 ft. lbs.)
Cooling Fan to Fan Clutch	
Bolts	20 N·m (15 ft. lbs.)
Crankshaft Main Bearing Bolts	
Step 1 – Preliminary	60 N·m (45 ft. lbs.)
Step 2 – Secondary	90 N·m (60 ft. lbs.)
Step 3 – Final	Additional 90°
Cylinder Head Bolts	
Step 1 – (All Bolts)	90 N·m (66 ft. lbs.)
Step 2 – (Re-check All Bolts)	90 N·m (66 ft. lbs.)
Step 3 – (Long Bolts)	120 N·m (90 ft. lbs.)
Step 4 – (Re-check Long Bolts)	120 N·m (90 ft. lbs.)
Step 5 – (Rotate All)	Additional ¼ Turn (90°)
Exhaust Manifold	
Bolts	43 N·m (32 ft. lbs.)
Fan Clutch Mounting to Fan Hub	
Left Hand Thread	57 N·m (42 ft. lbs.)
Fan Hub Bracket	
Bolts	24 N·m (18 ft. lbs.)
Fan Hub Bearing	
Bolt	77 N·m (57 ft. lbs.)
Fan Pulley to Fan Hub	
Bolts	9 N·m (84 in. lbs.)
Fan Shroud Mounting	
Bolts	11 N·m (95 in. lbs.)
Flywheel	
Bolts	137 N·m (101 ft. lbs.)
Flywheel Housing Adaptor	
Bolts	77 N·m (57 ft. lbs.)
Generator Mounting	
Bolts	41 N·m (30 ft. lbs.)
Generator Pulley	
Nut	80 N·m (59 ft. lbs.)
Generator Support	
Bolt	24 N·m (18 ft. lbs.)
Gear Cover	
Bolts	24 N·m (18 ft. lbs.)
Gear Cover Housing	
Bolts	24 N·m (18 ft. lbs.)
Intake Manifold Cover	
Bolts	24 N·m (18 ft. lbs.)
Intercooler Attaching	
Bolts	2 N·m (17 in. lbs.)
Intercooler Duct Clamp	
Nuts	8 N·m (72 in. lbs.)

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SPECIFICATIONS (Continued)

Description	Torque
Lift Bracket (Rear)	
Bolts	77 N·m (57 ft. lbs.)
Oil Cooler Assembly	
Bolts	24 N·m (18 ft. lbs.)
Oil Fill Tube Bracket	
Bolt	43 N·m (32 ft. lbs.)
Oil Filter	
Gasket	¾ Turn After Gasket Contact
Oil Pan	
Bolts	24 N·m (18 ft. lbs.)
Oil Pan Drain Plug	
Plug	80 N·m (60 ft. lbs.)
Oil Pressure Regulator	
Plug	80 N·m (60 ft. lbs.)
Oil Pressure Sender/Switch	
Sender/Switch	16 (144 ft. lbs.)
Oil Pump Mounting	
Bolts	24 N·m (18 ft. lbs.)
Oil Suction Tube (Flange)	
Bolts	24 N·m (18 ft. lbs.)
Oil Suction Tube (Brace)	
Bolt	24 N·m (18 ft. lbs.)
Oil Supply to Vacuum Pump	
Fitting	10 N·m (89 in. lbs.)
Rear Mount – Support Cushion to Crossmember	
Nut	47 N·m (35 ft. lbs.)
Rear Mount – Support Cushion to Support Bracket	
Nuts	47 N·m (35 ft. lbs.)
Rear Mount – Support Bracket to Transmission	
Bolts	102 N·m (75 ft. lbs.)

Description	Torque
Rear Support Plate to Transfer Case	
Bolts	41 N·m (30 ft. lbs.)
Rocker Arm	
Bolts	24 N·m (18 ft. lbs.)
Starter Mounting	
Bolts	68 N·m (50 ft. lbs.)
Torque Converter Drive Plate	
Bolts	47 N·m (35 ft. lbs.)
Transfer Case to Insulator Mounting Plate	
Nuts	204 N·m (150 ft. lbs.)
Transmission Support Bracket – (2wd)	
Bolts	68 N·m (50 ft. lbs.)
Transmission Support Spacer – (4wd)	
Bolts	68 N·m (50 ft. lbs.)
Transmission Support Spacer to Insulator Mounting Plate – (4wd)	
Bolts	204 N·m (150 ft. lbs.)
Vacuum Pump to Adaptor	
Nuts	24 N·m (18 ft. lbs.)
Vacuum Pump Adaptor to P/S Pump	
Nuts	24 N·m (18 ft. lbs.)
Vacuum Pump Assy. to Gear Cover	
Bolts	77 N·m (57 ft. lbs.)
Vacuum Pump Oil Supply Line	
Fitting	10 N·m (89 in. lbs.)
Vibration Damper	
Bolts	125 N·m (92 ft. lbs.)
Water Pump	
Bolts	24 N·m (18 ft. lbs.)

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EXHAUST SYSTEM AND INTAKE MANIFOLD

CONTENTS

GENERAL INFORMATION

EXHAUST SYSTEM

The gasoline engine exhaust system consists of engine exhaust manifolds, exhaust pipes, catalytic converter(s), extension pipe (if needed), exhaust heat shields, muffler and exhaust tailpipe (Fig. 1).

The diesel engine exhaust system consists of an engine exhaust manifold, turbocharger, exhaust pipe, catalytic converter, extension pipe (if needed), muffler and exhaust tailpipe (Fig. 2).

The engine exhaust manifolds on gasoline engines are equipped with ball flange outlets to assure a tight seal and strain free connections.

The exhaust system must be properly aligned to prevent stress, leakage and body contact. If the system contacts any body panel, it may amplify objectionable noises from the engine or body.

When inspecting an exhaust system, critically inspect for cracked or loose joints, stripped screw or bolt threads, corrosion damage and worn, cracked or broken hangers. Replace all components that are badly corroded or damaged. DO NOT attempt to repair.

When replacement is required, use original equipment parts (or their equivalent). This will assure proper alignment and provide acceptable exhaust noise levels.

CAUTION: Avoid application of rust prevention compounds or undercoating materials to exhaust system floor pan exhaust heat shields. Light overspray near the edges is permitted. Application of coating will result in excessive floor pan temperatures and objectionable fumes.

CATALYTIC CONVERTER

There is no regularly scheduled maintenance on any Mopar® stainless steel catalytic converter body. Excessive heat can result in bulging or other distortion, but excessive heat will not be the fault of the

GENERAL INFORMATION (Continued)

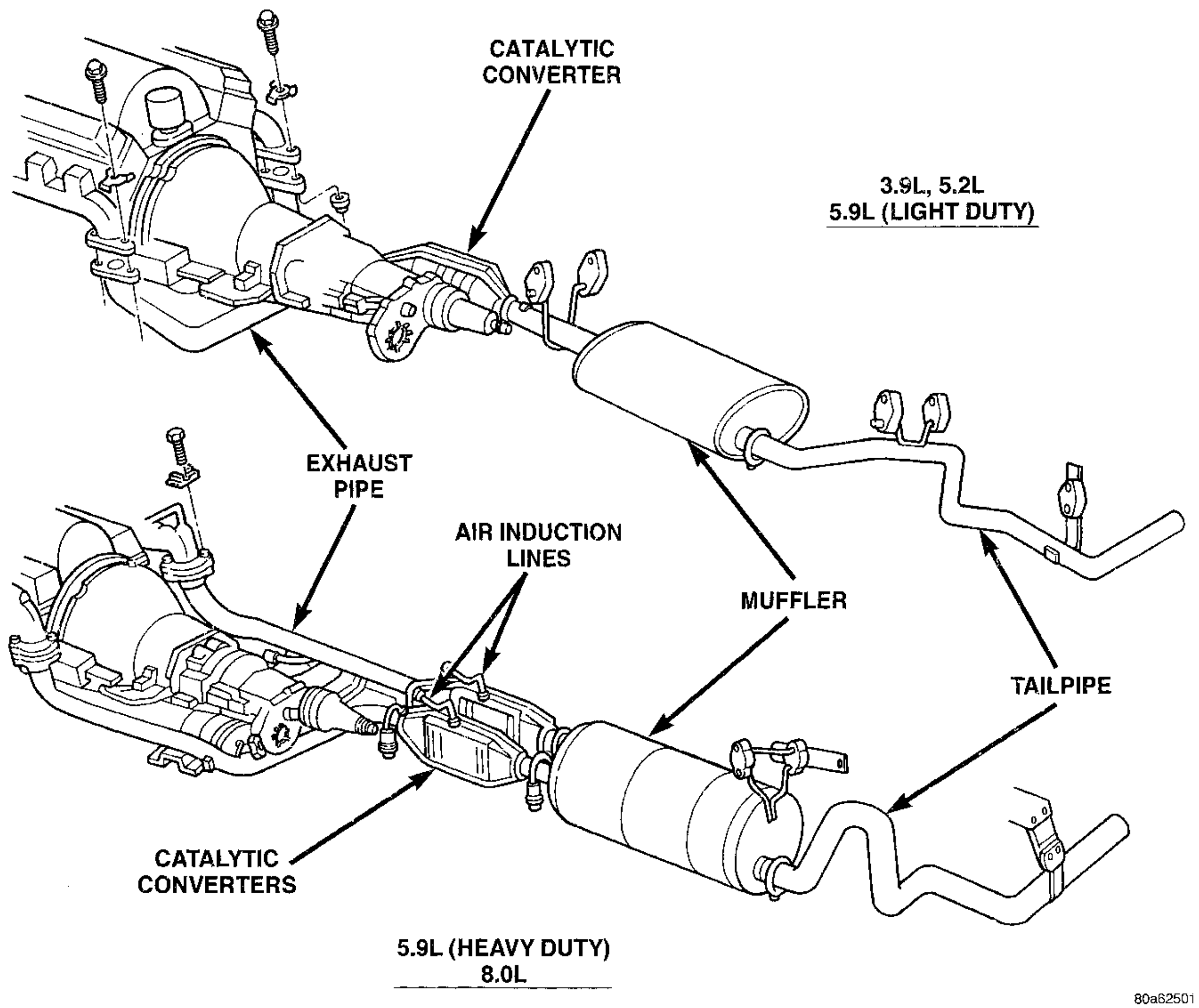

Fig. 1 Exhaust System—Gasoline Engines (Typical)

converter. If unburned fuel enters the converter, overheating may occur. If a converter is heat-damaged, correct the cause of the damage at the same time the converter is replaced. Also, inspect all other components of the exhaust system for heat damage.

Unleaded gasoline must be used in gas engines to avoid contaminating the catalyst core.

EXHAUST HEAT SHIELDS

Exhaust heat shields are needed to protect both the vehicle and the environment from the high temperatures developed by the catalytic converter. The combustion reaction facilitated by the catalyst releases additional heat in the exhaust system. Under severe operating conditions, the temperature increases in the area of the reactor. Such conditions can exist when the engine misfires or otherwise does not operate at peak efficiency. DO NOT remove spark plug wires from plugs or by any other means short out cylinders. Failure of the catalytic converter can occur due to a temperature increase caused by unburned fuel passing through the converter.

DO NOT allow the engine to operate at fast idle for extended periods (over 5 minutes). This condition may result in excessive temperatures in the exhaust system and on the floor pan.

AUTHENTIC RESTORATION PRODUCT

GENERAL INFORMATION (Continued)

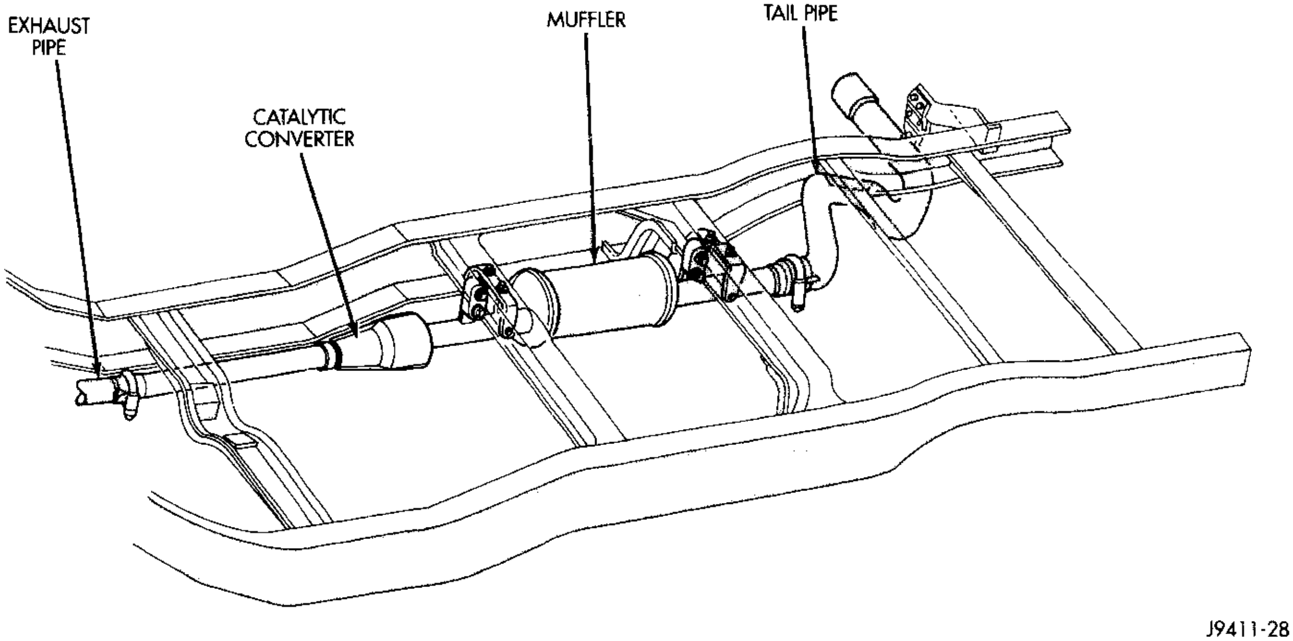

Fig. 2 Exhaust System—Diesel Engines (Typical)

DESCRIPTION AND OPERATION

TURBOCHARGER—5.9L DIESEL ENGINE

A turbocharger is used to force more air into the engine cylinders. Exhaust gas energy is used to turn the turbine wheel and shaft. At the other end of the shaft is the compressor wheel. The compressor wheel draws air in and forces it into the engine cylinders through the intake manifold.

NOTE: Supplying increased air flow to the engine provides:

- Improved engine performance
- Lower exhaust smoke density
- Improved operating economy
- Altitude compensation
- Noise reduction.

INTERCOOLER—CHARGE AIR COOLER

Intake air is drawn through the air cleaner and into the turbocharger compressor housing. Pressurized air from the turbocharger then flows forward through the charge air cooler (intercooler) located in front of the radiator. From the charge air cooler (Intercooler) the air flows back into the intake manifold.

The charge air cooler (Intercooler) is a heat exchanger that uses air flow to dissipate heat from the intake air. As the turbocharger increases air pressure, the air temperature increases. Lowering the intake air temperature increases engine efficiency and power.

INTAKE MANIFOLD—V-6 and V-8 ENGINES

The aluminum intake manifold is a single plane design with equal length runners. The manifold is sealed by flange side gaskets with front and rear cross-over gaskets.

INTAKE MANIFOLD—V-10 ENGINE

The aluminum intake manifold has two plenum chambers an upper and lower which supply air to five runners each. Passages across the longitudinal center of the manifold feed air from the throttle body to the plenum chambers.

ENGINE EXHAUST MANIFOLD—V-6 and V-8 ENGINES

Engine exhaust manifolds are LOG type with porting for air injection into the LOG.

EXHAUST MANIFOLD—V-10 ENGINE

Engine exhaust manifolds are made of high molybdenum ductile cast iron. A special ribbed design helps control permanent dimensional changes during heat cycles.

DIAGNOSIS AND TESTING

INTAKE MANIFOLD DIAGNOSIS

An intake manifold leak is characterized by lower than normal manifold vacuum. Also, one or more cylinder may not be fuctioning.

DIAGNOSIS AND TESTING (Continued)

EXHAUST SYSTEM DIAGNOSIS CHART

CONDITION	POSSIBLE CAUSE	CORRECTION
EXCESSIVE EXHAUST NOISE OR LEAKING EXHAUST GASES	1. Leaks at pipe joints.	1. Tighten clamps/bolts at leaking joints.
	2. Rusted or blown out muffler.	2. Replace muffler. Inspect exhaust system.
	3. Broken or rusted out exhaust pipe.	3. Replace exhaust pipe.
	4. Exhaust pipe leaking at manifold flange.	4. Tighten/replace flange attaching nuts/bolts.
	5. Exhaust manifold cracked or broken.	5. Replace exhaust manifold.
	6. Leak between exhaust manifold and cylinder head.	6. Tighten exhaust manifold to cylinder head bolts.
	7. Catalytic converter rusted or blown out.	7. Replace catalytic converter assy.
	8. Restriction in exhaust system.	8. Remove restriction, if possible. Replace restricted part if necessary.

CAUTION: When servicing and replacing exhaust system components, disconnect the oxygen sensor connector(s). Allowing the exhaust to hang by the oxygen sensor wires will damage the harness and/or sensor.

WARNING: USE EXTREME CAUTION WHEN THE ENGINE IS OPERATING. DO NOT PUT YOUR HANDS NEAR THE PULLEYS, BELTS OR THE FAN. DO NOT WEAR LOOSE CLOTHING.

(1) Start the engine allowing it to warm up.
(2) Inspect for disconected vacuum hoses or hardened or cracked vacuum lines.
(3) With a spray bottle, spray a small stream of water on the suspect area.
(4) If there is a change in RPM'S, the suspected leak has been found.
(5) Repair as required.

REMOVAL AND INSTALLATION

EXHAUST PIPE

REMOVAL

(1) Raise and support the vehicle.
(2) Saturate the bolts and nuts with heat valve lubricant. Allow 5 minutes for penetration.
(3) Remove exhaust pipe to manifold bolts, retainers and nuts (Fig. 3) (Fig. 4).
(4) Remove the clamp nuts (Fig. 5).
(5) Disconnect the exhaust pipe from the support hangers on the 5.9L (Heavy Duty) and the 8.0L engines (Fig. 4).
(6) Remove the exhaust pipe.

INSTALLATION

(1) Connect the exhaust pipe support hangers on the 5.9L (Heavy Duty) and the 8.0L engine (Fig. 4).

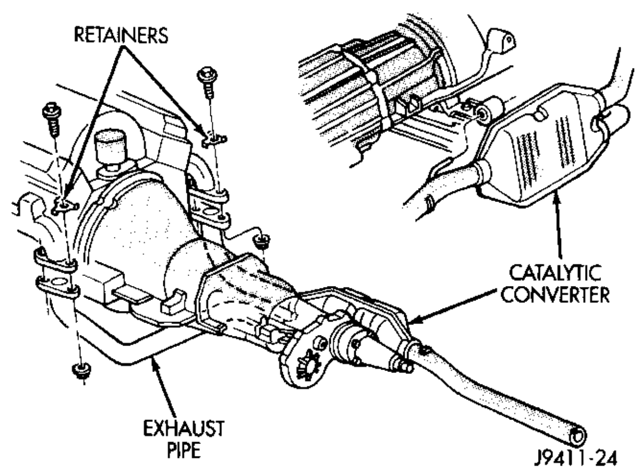

Fig. 3 Exhaust Pipe—3.9/5.2/5.9L (Light Duty)

(2) Position the exhaust pipe for proper clearance with underbody parts.
(3) Position the exhaust pipe to manifold. Install the bolts, retainers and nuts. Tighten the nuts to 34 N·m (25 ft. lbs.) torque.
(4) Tighten the clamp nuts to 54 N·m (40 ft. lbs.) torque.
(5) Lower the vehicle.
(6) Start the engine and inspect for exhaust leaks and exhaust system contact with the body panels. Adjust the alignment, if needed.

REMOVAL AND INSTALLATION (Continued)

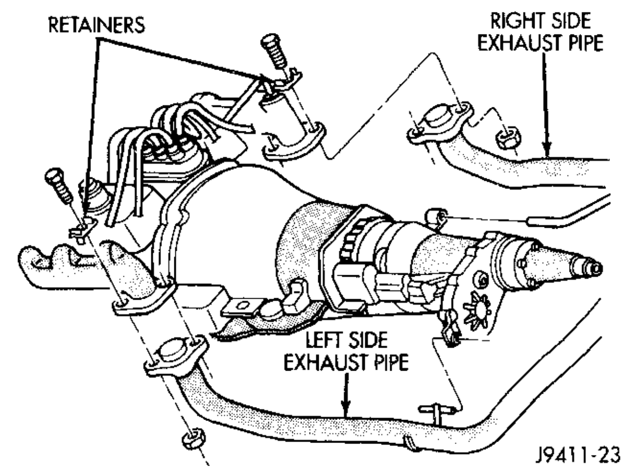

Fig. 4 Exhaust Pipe—5.9L Heavy Duty and 8.0L—Typical

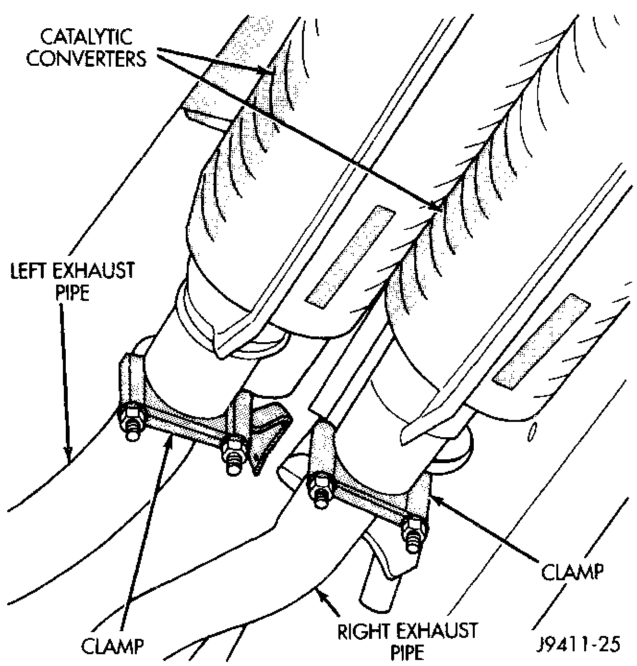

Fig. 5 Exhaust Pipe Clamp Location for 5.9L—Heavy Duty and 8.0L

CATALYTIC CONVERTERS

REMOVAL

(1) Raise and support vehicle.

(2) Saturate the bolts and nuts with heat valve lubricant. Allow 5 minutes for penetration.

(3) Remove clamps and nuts (Fig. 5) (Fig. 6).

(4) Disconnect the catalytic converter from the support hanger on the 3.9L, 5.2L and 5.9L—Light Duty engines (Fig. 3).

(5) Remove the catalytic converter.

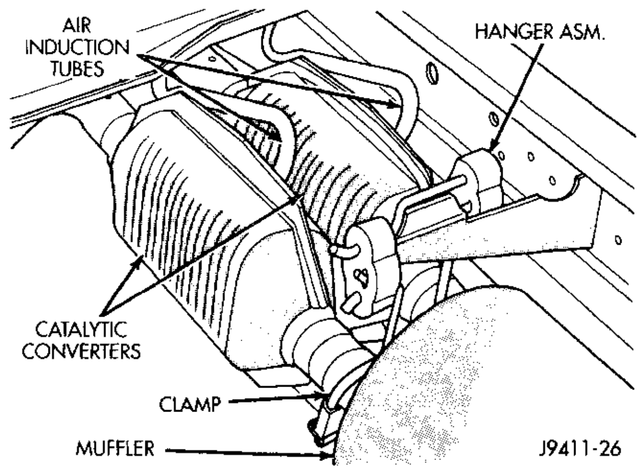

Fig. 6 Catalytic Converter Clamp Location for 5.9L—Heavy Duty and 8.0L

INSTALLATION

(1) Connect the support hanger on the 3.9L, 5.2L and 5.9L—Light Duty engines (Fig. 3).

(2) Assemble converter and clamps loosely to permit proper clearance with exhaust heat shields and underbody parts.

(3) Tighten all clamp nuts to 54 N·m (40 ft. lbs.) torque.

(4) Lower the vehicle.

(5) Start the engine and inspect for exhaust leaks and exhaust system contact with the body panels. Adjust the alignment, if needed.

MUFFLERS

REMOVAL

(1) Raise and support the vehicle.

(2) Saturate the clamp nuts with heat valve lubricant. Allow 5 minutes for penetration.

(3) Disconnect the muffler hanger (Fig. 6) (Fig. 7).

(4) Remove clamps and nuts (Fig. 6) (Fig. 7).

(5) Remove the muffler.

INSTALLATION

(1) Assemble muffler and clamps loosely to permit proper alignment of all parts.

(2) Connect the muffler hanger.

(3) Tighten the clamp nuts to 54 N·m (40 ft. lbs.) torque.

(4) Lower the vehicle.

(5) Start the engine and inspect for exhaust leaks and exhaust system contact with the body panels. Adjust the alignment, if needed.

AUTHENTIC RESTORATION

REMOVAL AND INSTALLATION (Continued)

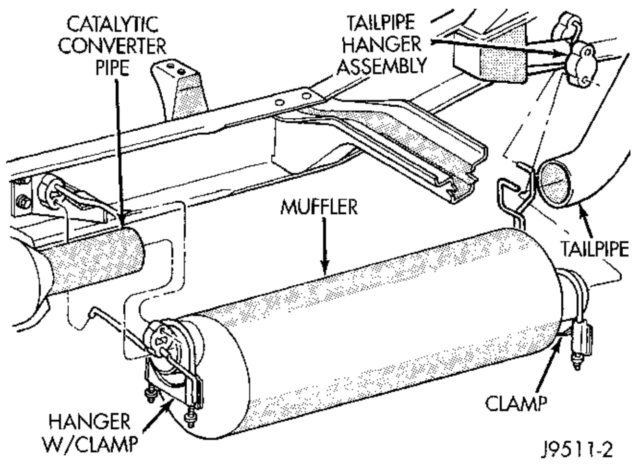

Fig. 7 Muffler for 3.9L, 5.2L and 5.9L-Light Duty Engines

EXHAUST TAILPIPE

REMOVAL

(1) Raise and support the vehicle.

(2) Saturate the clamp nuts with heat valve lubricant. Allow 5 minutes for penetration.

(3) Disconnect the exhaust tailpipe support hanger.

(4) Remove clamps and nuts.

(5) Remove the exhaust tailpipe.

INSTALLATION

(1) Loosely assemble exhaust tailpipe to permit proper alignment of all parts.

(2) Connect the support hangers.

(3) Position the exhaust tailpipe for proper clearance with the underbody parts.

(4) Tighten all clamp nuts to 54 N·m (40 ft. lbs.) torque.

(5) Lower the vehicle.

(6) Start the engine and inspect for exhaust leaks and exhaust system contact with the body panels. Adjust the alignment, if needed.

EXHAUST HEAT SHIELDS

REMOVAL

(1) Raise and support the vehicle.

(2) Remove the nuts or bolts holding the exhaust heat shield to the floor pan, crossmember or bracket.

(3) Slide the shield out around the exhaust system.

INSTALLATION

(1) Position the exhaust heat shield to the floor pan, crossmember or bracket and install the nuts or bolts.

(2) Tighten the nuts and bolts.

(3) Lower the vehicle.

INTAKE MANIFOLD—V-6 and V-8 ENGINES

REMOVAL

(1) Disconnect the negative cable from the battery.

(2) Drain the cooling system (refer to Group 7, Cooling System for the proper procedures).

(3) Remove the generator.

(4) Remove the air cleaner.

(5) Perform the Fuel System Pressure release procedure (refer to Group 14, Fuel System). Disconnect the fuel lines.

(6) Disconnect the accelerator linkage and if so equipped, the speed control and transmission kickdown cables.

(7) Remove the return spring.

(8) Remove the distributor cap and wires.

(9) Disconnect the coil wires.

(10) Disconnect the heat indicator sending unit wire.

(11) Disconnect the heater hoses and bypass hose.

(12) Remove the closed crankcase ventilation and evaporation control systems.

(13) Remove intake manifold bolts.

(14) Lift the intake manifold and throttle body out of the engine compartment as an assembly.

(15) Remove and discard the flange side gaskets and the front and rear cross-over gaskets.

(16) Remove the throttle body bolts and lift the throttle body off the intake manifold (Fig. 8). Discard the gasket.

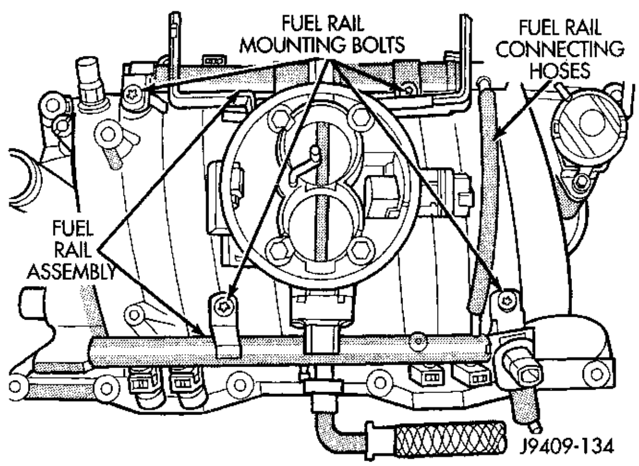

Fig. 8 Throttle Body Assembly

(17) Remove the plenum pan as follows:

(a) Turn the intake manifold upside down. Support the manifold.

(b) Remove the bolts and lift the pan off the manifold. Discard the gasket.

INSTALLATION

(1) Install the plenum pan, if removed, as follows:

AUTHENTIC RESTORATION PRODUCT

REMOVAL AND INSTALLATION (Continued)

(a) Turn the intake manifold upside down. Support the manifold.

(b) Place a new plenum pan gasket onto the seal rail of the intake manifold. Position the pan over the gasket. Align all the gasket and pan holes with the intake manifold.

(c) Hand start all bolts.

(d) Tighten the bolts, in sequence (Fig. 9), as follows:

- Step 1—Tighten bolts to 2.7 N·m (24 in. lbs.) torque.
- Step 2—Tighten bolts to 5.4 N·m (48 in. lbs.) torque.
- Step 3—Tighten bolts to 9.5 N·m (84 in. lbs.) torque.
- Step 4—Check that all bolts are tighten to 9.5 N·m (84 in. lbs.) torque.

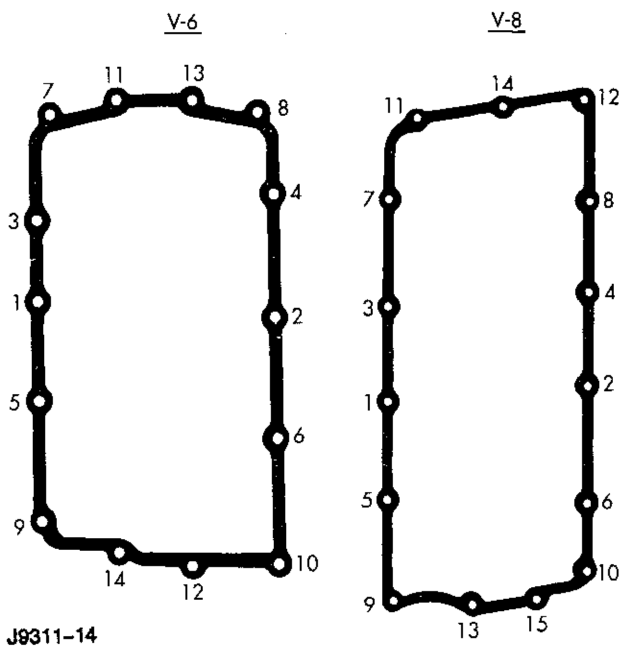

Fig. 9 Plenum Pan Bolt Tightening Sequence

(2) Using a new gasket, install the throttle body onto the intake manifold. Tighten the bolts to 23 N·m (200 in. lbs.) torque.

(3) Place the 4 plastic locator dowels into the holes in the block (Fig. 10).

(4) Apply Mopar® Silicone Rubber Adhesive Sealant, or equivalent, to the four corner joints. An excessive amount of sealant is not required to ensure a leak proof seal. However, an excessive amount of sealant may reduce the effectiveness of the flange gasket. The sealant should be slightly higher than the cross-over gaskets, approximately 5 mm (0.2 in).

(5) Install the front and rear cross-over gaskets onto the dowels (Fig. 10).

(6) Install the flange gaskets. Ensure that the vertical port alignment tab is resting on the deck face of the block. Also the horizontal alignment tabs must be in position with the mating cylinder head gasket tabs (Fig. 11). The words MANIFOLD SIDE should be visible on the center of each flange gasket.

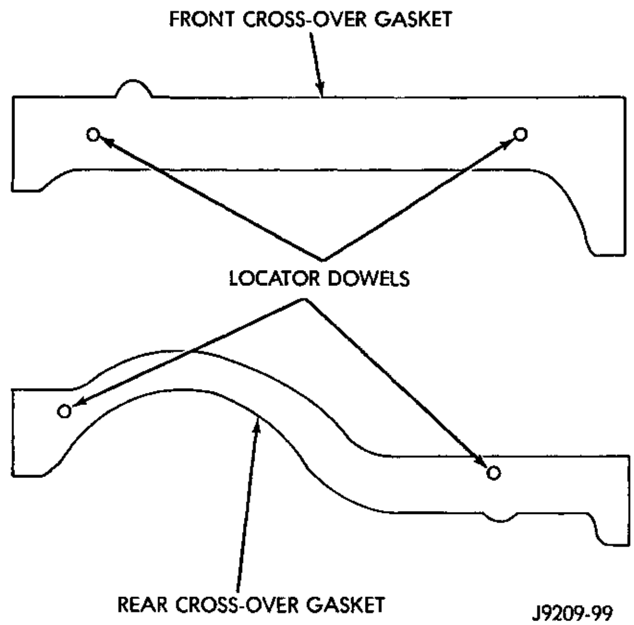

Fig. 10 Cross-Over Gaskets and Locator Dowels

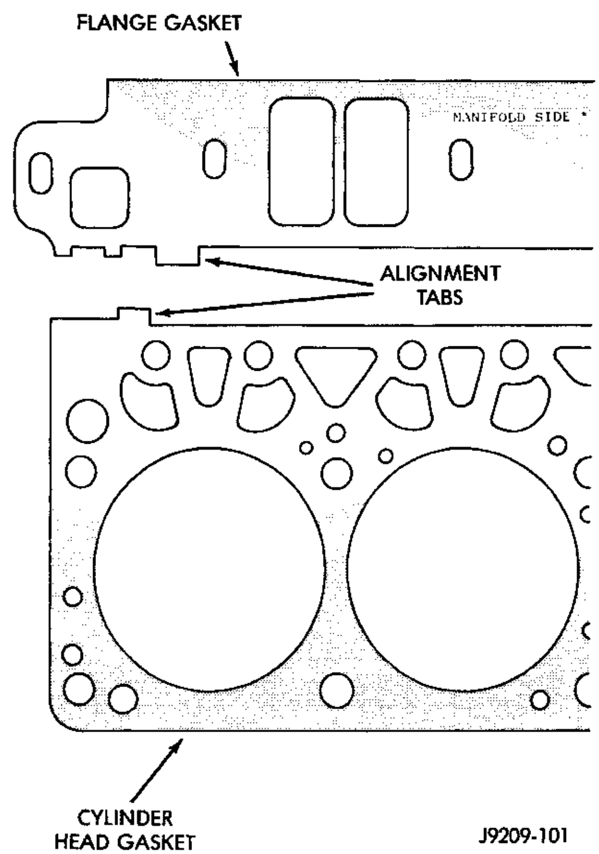

Fig. 11 Intake Manifold Flange Gasket Alignment

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REMOVAL AND INSTALLATION (Continued)

(7) Carefully lower intake manifold into position on the cylinder block and cylinder heads. Use the alignment dowels in the cross-over gaskets to position the intake manifold. After intake manifold is in place, inspect to make sure seals are in place.

(8) Install the intake manifold bolts and tighten as follows:

(a) V-6 ENGINE— (Fig. 12)

- Step 1—Tighten bolts 1 and 2 to 8 N·m (72 in. lbs.) torque. Tighten in alternating steps 1.4 N·m (12 in. lbs.) torque at a time.
- Step 2—Tighten bolts 3 through 12, in sequence, to 8 N·m (72 in. lbs.) torque.
- Step 3—Check that all bolts are tighten to 8 N·m (72 in. lbs.) torque.
- Step 4—Tighten all bolts, in sequence, to 16 N·m (12 ft. lbs.) torque.
- Step 5—Check that all bolts are tighten to 16 N·m (12 ft. lbs.) torque.

(b) V-8 ENGINE— (Fig. 13)

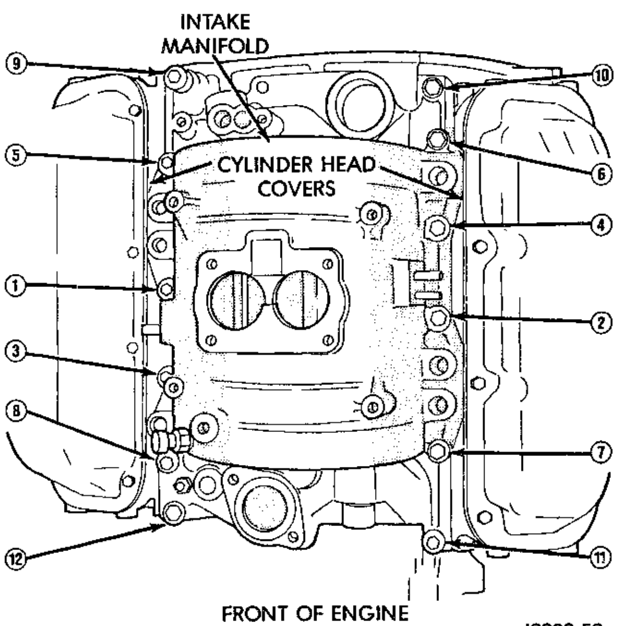

Fig. 12 Intake Manifold Bolt Tightening Sequence—V-6

- Step 1—Tighten bolts 1 through 4, in sequence, to 8 N·m (72 in. lbs.) torque. Tighten in alternating steps 1.4 N·m (12 in. lbs.) torque at a time.
- Step 2—Tighten bolts 5 through 12, in sequence, to 8 N·m (72 in. lbs.) torque.
- Step 3—Check that all bolts are tighten to 8 N·m (72 in. lbs.) torque.
- Step 4—Tighten all bolts, in sequence, to 16 N·m (12 ft. lbs.) torque.
- Step 5—Check that all bolts are tighten to 16 N·m (12 ft. lbs.) torque.

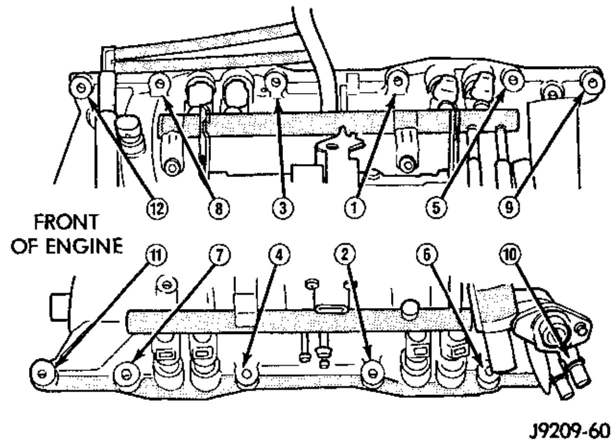

Fig. 13 Intake Manifold Bolt Tightening Sequence—V-8

(9) Install closed crankcase ventilation and evaporation control systems.

(10) Connect the coil wires.

(11) Connect the heat indicator sending unit wire.

(12) Connect the heater hoses and bypass hose.

(13) Install distributor cap and wires.

(14) Hook up the return spring.

(15) Connect the accelerator linkage and if so equipped, the speed control and transmission kick-down cables.

(16) Install the fuel lines.

(17) Install the generator and drive belt. Tighten generator mounting bolt to 41 N·m (30 ft. lbs.) torque.

(18) Install the air cleaner.

(19) Fill cooling system (refer to Group 7, Cooling System for the proper procedure).

(20) Connect the negative cable to the battery.

INTAKE MANIFOLD V-10

REMOVAL

(1) Disconnect the negative cable from the battery.

(2) Drain the cooling system (refer to Group 7, Cooling System for the proper procedures).

(3) Remove the accessory drive belt (refer to Group 7, Cooling System for the proper procedures).

(4) Remove the generator brace and generator (Fig. 14).

(5) Remove the A/C compressor brace (Fig. 14). Remove the compressor and set aside.

(6) Remove the air cleaner cover and filter. Remove the air cleaner housing (Fig. 15). Discard the gasket.

(7) Perform the Fuel System Pressure release procedure (refer to Group 14, Fuel System). Disconnect the fuel lines.

REMOVAL AND INSTALLATION (Continued)

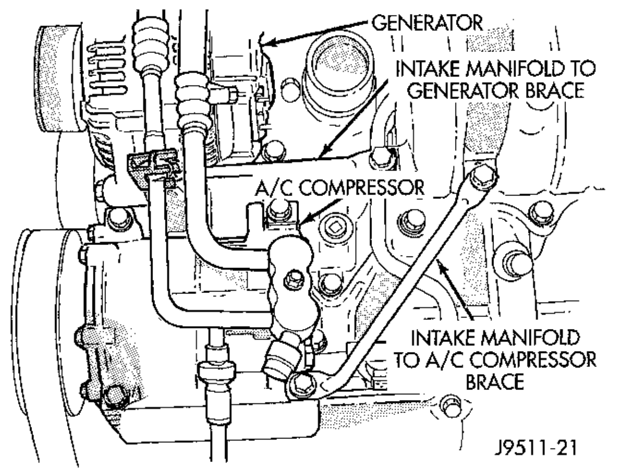

Fig. 14 Generator and A/C Compressor Braces

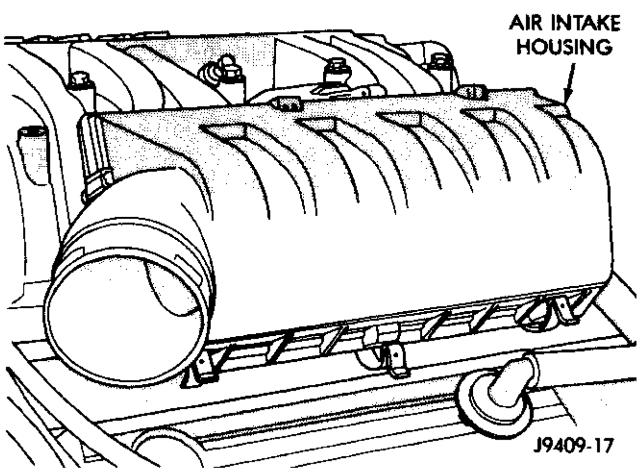

Fig. 15 Air Intake Housing

(8) Disconnect the accelerator linkage and if so equipped, the speed control and transmission kick-down cables.

(9) Remove the coil assemblies with the ignition cables.

(10) Disconnect the vacuum lines.

(11) Disconnect the heater hoses and bypass hose.

(12) Remove the closed crankcase ventilation and evaporation control systems.

(13) Remove the throttle body bolts and lift the throttle body off the upper intake manifold (Fig. 16). Discard the gasket.

(14) Remove upper intake manifold bolts.

(15) Lift the upper intake manifold out of the engine compartment (Fig. 16). Discard the gasket.

(16) Remove the lower intake manifold bolts and remove the manifold (Fig. 17).

(17) Discard the lower intake manifold gaskets (Fig. 18).

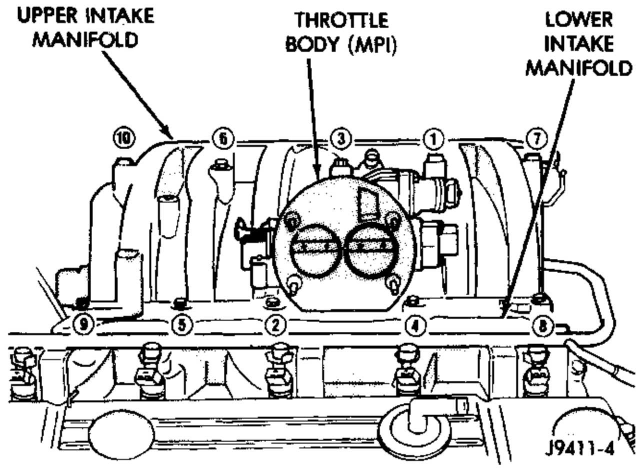

Fig. 16 Upper Intake Manifold and Throttle Body

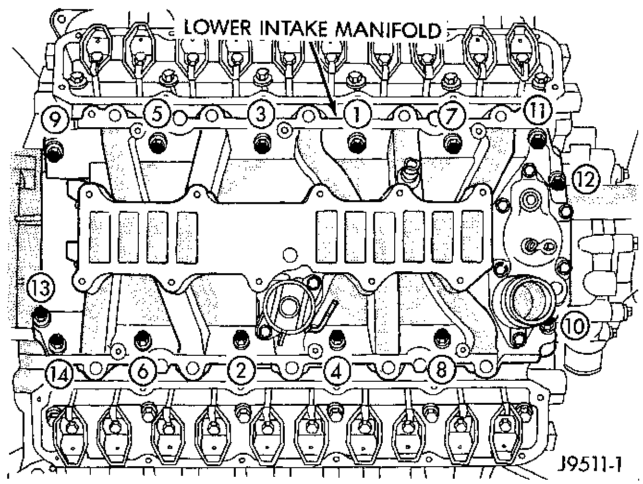

Fig. 17 Lower Intake Manifold

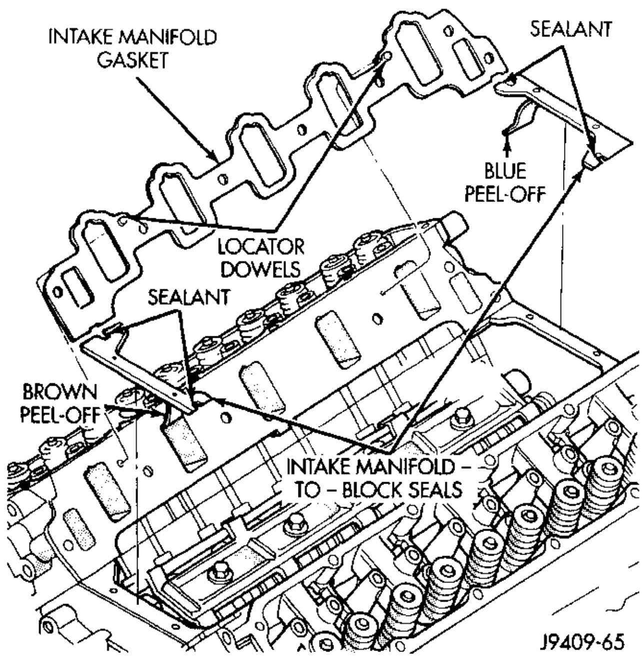

Fig. 18 Lower Intake Manifold Gaskets

REMOVAL AND INSTALLATION (Continued)

INSTALLATION

(1) Install the intake manifold side gaskets. Be sure that the locator dowels are positioned in the head (Fig. 19).

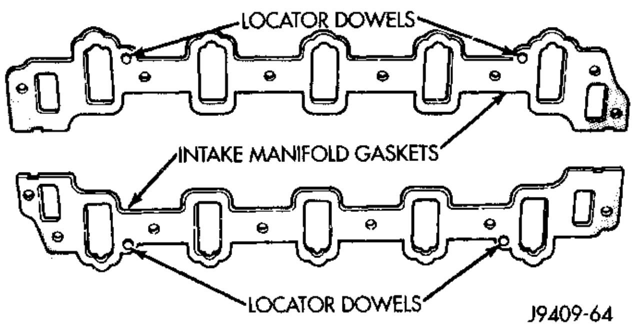

Fig. 19 Intake Manifold Flange Gasket Alignment

(2) Peel off the protective paper (blue - rear and brown - front) and press firmly onto the block (Fig. 18). **BE SURE THE BLOCK IS OIL FREE.**. Aligning slots in end seals with notches in intake manifold gaskets.

(3) Insert Mopar® Silicone Rubber Adhesive Sealant, or equivalent, into the four corner pockets (Fig. 18). **Fill the pocket, but DO NOT overfill.**

(4) The lower intake manifold MUST be installed within 3 minutes of sealant application. Carefully lower intake manifold into position on the cylinder block and heads. After intake manifold is in place, inspect to make sure seals and gaskets are in place. Finger start all the lower intake bolts.

(5) Tighten the lower intake manifold bolts in sequence to 54 N·m (40 ft. lbs.) torque (Fig. 17).

(6) Using a new gasket, position the upper intake manifold onto the lower intake manifold.

(7) Finger start all bolts, alternate one side to the other.

(8) Tighten upper intake manifold bolts in sequence to 22 N·m (16 ft. lbs.) torque (Fig. 16).

(9) Using a new gasket, install the throttle body onto the upper intake manifold. Tighten the bolts to 23 N·m (200 in. lbs.) torque.

(10) Install closed crankcase ventilation and evaporation control systems.

(11) Connect the heater hoses and bypass hose.

(12) Connect the vacuum lines.

(13) Install the coil assemblies and the ignition cables.

(14) Connect the accelerator linkage and if so equipped, the speed control and transmission kickdown cables.

(15) Install the fuel lines.

(16) Using a new gasket, install the air cleaner housing. Tighten the nuts to 11 N·m (96 in. lbs.) torque. Install the air cleaner filter and cover.

(17) Install the A/C compressor. Position the compressor brace and install the bolts. Tighten the brace bolts to 41 N·m (30 ft. lbs.) torque.

(18) Install the generator. Position the generator brace and install the bolts. Tighten the brace bolts to 41 N·m (30 ft. lbs.) torque.

(19) Install the accessory drive belt (refer to Group 7, Cooling System).

(20) Fill cooling system (refer to Group 7, Cooling System for the proper procedure).

(21) Connect the negative cable to the battery.

ENGINE EXHAUST MANIFOLD—V-6 and V-8 ENGINES

REMOVAL

(1) Disconnect the negative cable from the battery.

(2) Raise and support the vehicle.

(3) Remove the bolts and nuts attaching the exhaust pipe to the engine exhaust manifold.

(4) Lower the vehicle.

(5) Remove the exhaust heat shields.

(6) Remove bolts, nuts and washers attaching manifold to cylinder head.

(7) Remove manifold from the cylinder head.

INSTALLATION

CAUTION: If the studs came out with the nuts when removing the engine exhaust manifold, install new studs. Apply sealer on the coarse thread ends. Water leaks may develop at the studs if this precaution is not taken.

(1) Position the engine exhaust manifolds on the two studs located on the cylinder head. Install conical washers and nuts on these studs (Fig. 20) (Fig. 21).

(2) Install two bolts and conical washers at the inner ends of the engine exhaust manifold outboard arms. Install two bolts WITHOUT washers on the center arm of engine exhaust manifold (Fig. 20) (Fig. 21). Starting at the center arm and working outward, tighten the bolts and nuts to 34 N·m (25 ft. lbs.) torque.

(3) Install the exhaust heat shields.

(4) Raise and support the vehicle.

(5) Assemble exhaust pipe to manifold and secure with bolts, nuts and retainers. Tighten the bolts and nuts to 34 N·m (25 ft. lbs.) torque.

(6) Lower the vehicle.

(7) Connect the negative cable to the battery.

REMOVAL AND INSTALLATION (Continued)

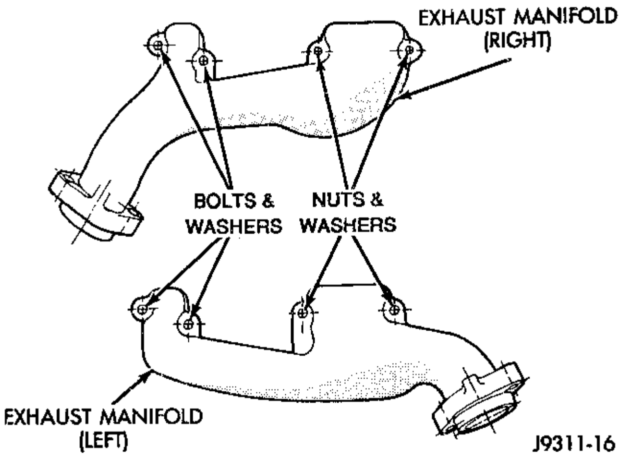

Fig. 20 Engine Exhaust Manifold Installation—3.9L Engine

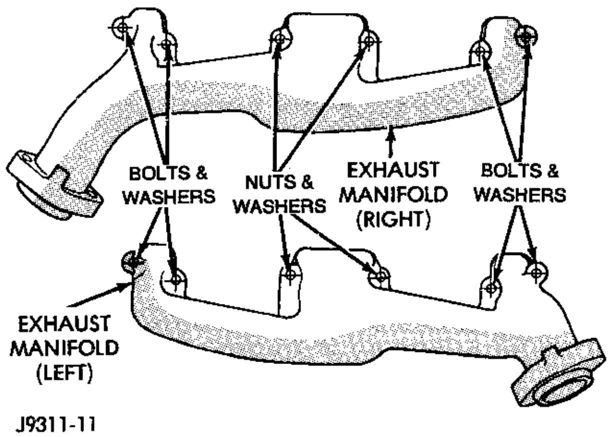

Fig. 21 Engine Exhaust Manifold Installation—5.2L/5.9L Engines

EXHAUST MANIFOLD V-10

REMOVAL

(1) Disconnect the negative cable from the battery.
(2) Raise and support the vehicle.
(3) Remove the bolts and nuts attaching the exhaust pipe to the engine exhaust manifold.
(4) Lower the vehicle.
(5) Remove the exhaust heat shields (Fig. 22).
(6) Right exhaust manifold and discard the gasket.
(7) Right exhaust manifold—Remove the dipstick bracket from the manifold.
(8) Remove bolts attaching manifold to cylinder head.
(9) Remove manifold from the cylinder head. Discard the gasket.

INSTALLATION

(1) Using a new gasket position the engine exhaust manifold onto the cylinder head. Install bolts

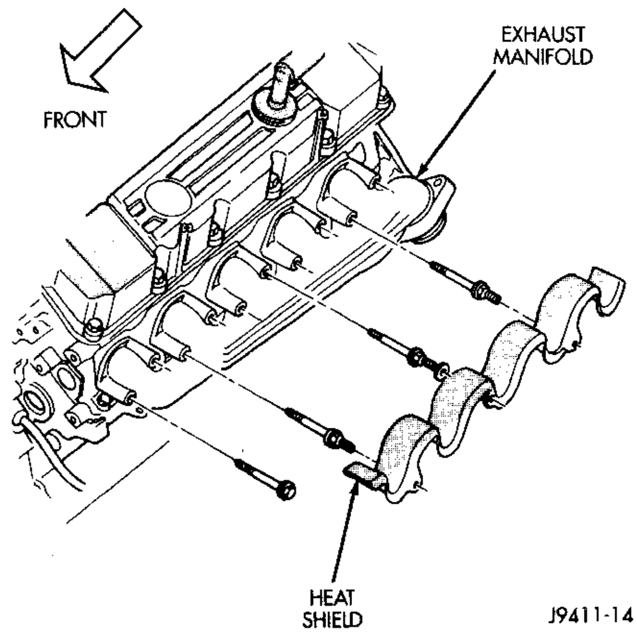

Fig. 22 8.0L Engine Exhaust Manifold—Typical

and stud bolts in the proper position. (Fig. 22) Tighten the bolts to 22 N·m (16 ft. lbs.) torque.
(2) Right exhaust manifold—Install the dipstick bracket to the manifold.
(3) Position washers and exhaust heat shields onto the manifold stud bolts (Fig. 22). Be sure the tabs on the heat shields are hooked over the top of the exhaust gasket. Install the nuts and tighten to 20 N·m (175 in. lbs.) torque.
(4) Raise and support the vehicle.
(5) Assemble exhaust pipe to manifold and secure with bolts. Tighten the bolts to 34 N·m (25 ft. lbs.) torque.
(6) Lower the vehicle.
(7) Connect the negative cable to the battery.

EXHAUST PIPE—DIESEL

REMOVAL

(1) Raise and support the vehicle on a hoist.
(2) Saturate the bolts and nuts with heat valve lubricant. Allow 5 minutes for penetration.
(3) Remove the bolts and nuts from the exhaust pipe to turbocharger exhaust pipe (Fig. 23).
(4) Remove the clamp nuts.
(5) Disconnect the exhaust pipe support hanger.

INSTALLATION

(1) Connect the exhaust pipe support hangers.
(2) Align the exhaust pipe with the turbocharger exhaust pipe and the catalytic converter. Install the bolts and nuts. Tighten the nuts to 34 N·m (25 ft. lbs.) torque.

REMOVAL AND INSTALLATION (Continued)

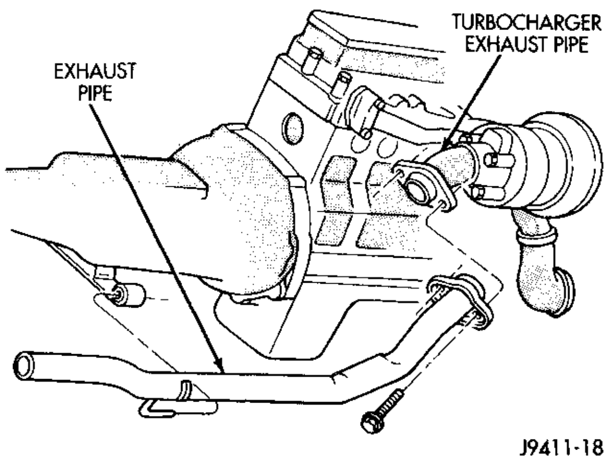

Fig. 23 Exhaust Pipe Mounting

(3) Tighten the clamp nuts to 54 N·m (40 ft. lbs.) torque.

(4) Install the exhaust pipe support clamps and nuts. Tighten the nuts to 54 N·m (40 ft. lbs.) torque.

(5) Lower the vehicle.

(6) Start the engine and inspect for exhaust leaks and exhaust system contact with the body panels. Adjust the alignment, if needed.

CATALYTIC CONVERTER—DIESEL

REMOVAL

(1) Raise and support vehicle.

(2) Saturate the bolts and nuts with heat valve lubricant. Allow 5 minutes for penetration.

(3) Remove clamps and nuts (Fig. 24).

(4) Remove the catalytic converter.

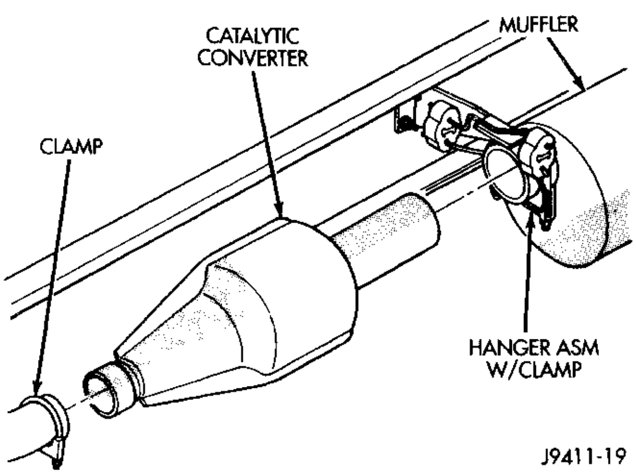

Fig. 24 Catalytic Converter

INSTALLATION

(1) Assemble converter and clamps loosely to permit proper clearance with exhaust heat shields and underbody parts.

(2) Tighten all clamp nuts to 43 N·m (32 ft. lbs.) torque.

(3) Lower the vehicle.

(4) Start the engine and inspect for exhaust leaks and exhaust system contact with the body panels. Adjust the alignment, if needed.

MUFFLER—DIESEL

REMOVAL

(1) Raise and support the vehicle.

(2) Remove the clamps and nuts.

(3) Disconnect the support hanger (Fig. 25).

(4) Remove the muffler.

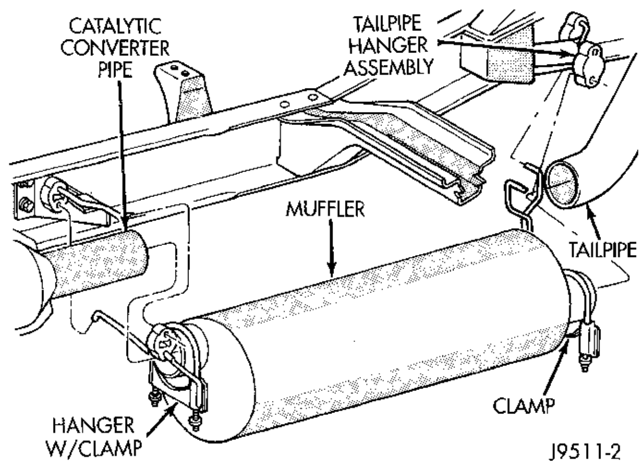

Fig. 25 Muffler

INSTALLATION

(1) Connect the support hanger.

(2) Install the clamps and nuts. Tighten the nuts to 43 N·m (32 ft. lbs.) torque.

(3) Lower the vehicle.

(4) Start the engine and inspect for exhaust leaks and exhaust system contact with the body panels. Adjust the alignment, if needed.

EXHAUST TAILPIPE—DIESEL

REMOVAL

(1) Raise and support the vehicle.

(2) Saturate the clamp nuts with heat valve lubricant. Allow 5 minutes for penetration.

(3) Disconnect the exhaust tailpipe support hanger (Fig. 26). If used, disconnect the extension pipe support hanger (Fig. 25).

(4) Remove clamps and nuts (Fig. 26).

(5) Remove the exhaust tailpipe and extension pipe, if used.

REMOVAL AND INSTALLATION (Continued)

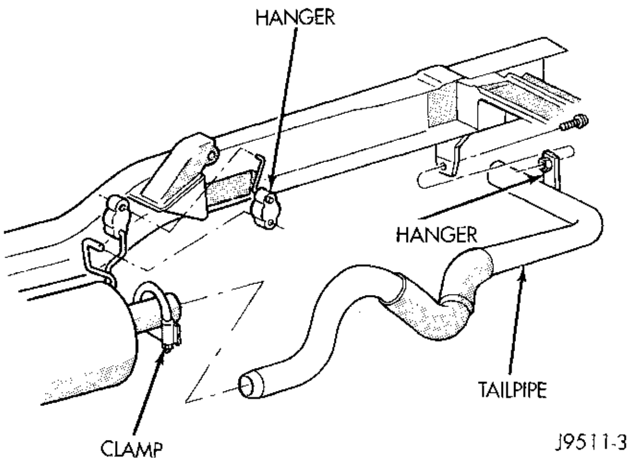

Fig. 26 Exhaust Tailpipe HD

INSTALLATION

(1) Loosely assemble exhaust tailpipe and extension pipe, if used, to permit proper alignment of all parts.
(2) Connect the support hangers.
(3) Position the exhaust tailpipe and extension pipe, if used, for proper clearance with the underbody parts.
(4) Tighten all clamp nuts to 43 N·m (32 ft. lbs.) torque.
(5) Lower the vehicle.
(6) Start the engine and inspect for exhaust leaks and exhaust system contact with the body panels. Adjust the alignment, if needed.

HEAT SHIELDS—DIESEL

REMOVAL

(1) Raise and support the vehicle.
(2) Remove the nuts or bolts holding the exhaust heat shield to the floor pan, crossmember or bracket.
(3) Slide the shield out around the exhaust system.

INSTALLATION

(1) Position the exhaust heat shield to the floor pan, crossmember or bracket and install the nuts or bolts.
(2) Tighten the nuts and bolts.
(3) Lower the vehicle.

EXHAUST MANIFOLD—DIESEL

REMOVAL

(1) Disconnect the air intake and exhaust pipes (Fig. 27).
(2) Disconnect the turbocharger oil supply line and the oil drain tube from the turbocharger (Fig. 28).
(3) Disconnect the charge air cooler (Intercooler) inlet duct from the turbocharger (Fig. 28).
(4) Remove the turbocharger and gasket.

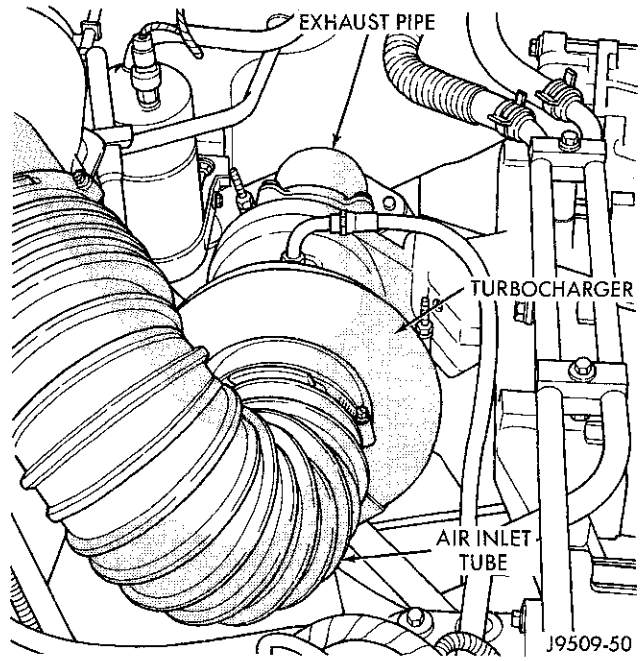

Fig. 27 Air Intake Pipe, Exhaust Pipe and Turbocharger

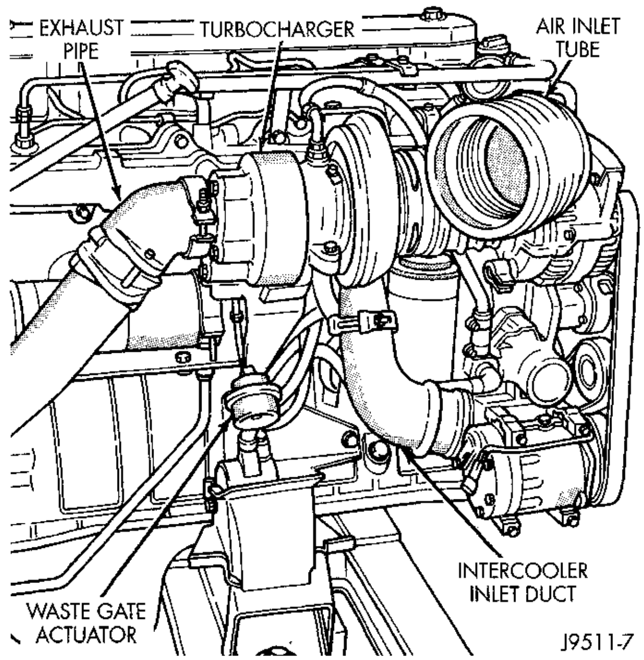

Fig. 28 Oil Supply Line and Charge Air Cooler (Intercooler) Inlet Duct

(5) Remove EGR tube (Fig. 29).
(6) Remove the cab heater supply and return lines.
(7) Remove the engine exhaust manifold and gaskets (Fig. 30).
(8) Clean the sealing surfaces.

REMOVAL AND INSTALLATION (Continued)

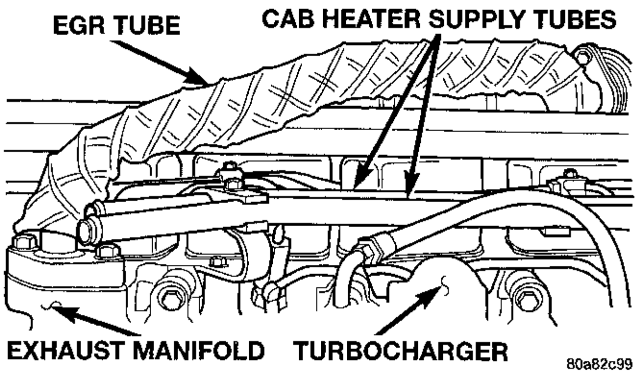

Fig. 29 EGR TUBE

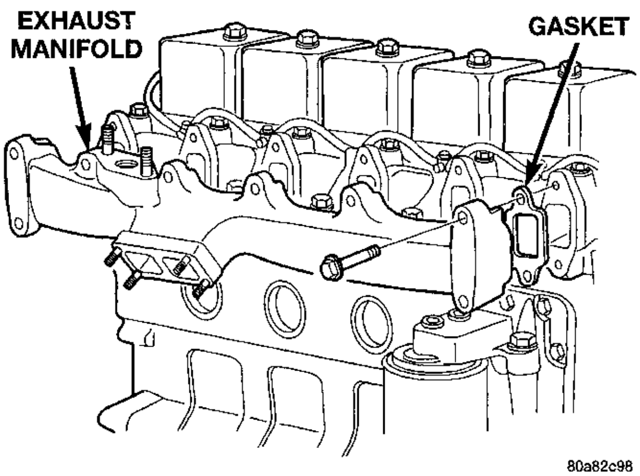

Fig. 30 Engine Exhaust Manifold and Gaskets

INSTALLATION

(1) Install the engine exhaust manifold and gaskets use anti-seize on capscrews. Tighten the exhaust manifold bolts in sequence to 43 N·m (32 ft. lbs.) torque (Fig. 31).

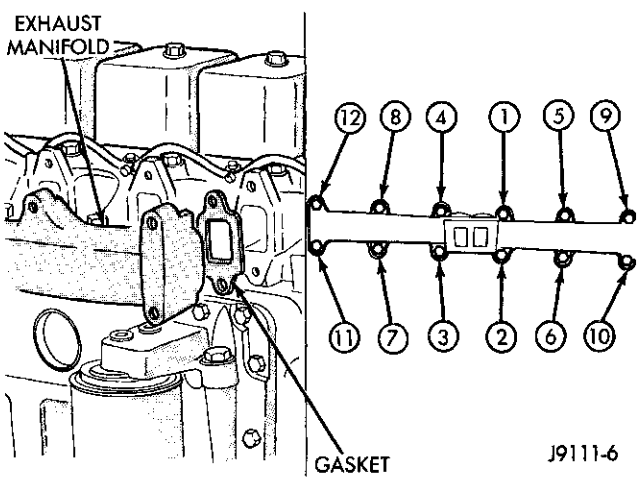

Fig. 31 Engine Exhaust Manifold Bolt Tightening Sequence

(2) Install the turbocharger. Apply anti-seize to the studs and then tighten the turbocharger mounting nuts to 32 N·m (24 ft. lbs.) torque.

(3) Position the charge air cooler (intercooler) inlet duct to the turbocharger. With the clamp in position, tighten the clamp nut to 8 N·m (72 in. lbs.) torque.

(4) Position the air intake pipe and the exhaust pipe onto the turbocharger. Tighten the clamps to 8 N·m (74 in. lbs.) torque.

(5) Install the oil drain tube and oil supply line to the turbocharger. Tighten the drain tube bolts to 24 N·m (18 ft. lbs.) torque. Tighten the oil supply line fitting nut to 15 N·m (11 ft. lbs.) torque.

(6) Connect the cab heater supply and return lines. Tighten the line nuts to 24 N·m (18 ft. lbs.) torque.

(7) Install the EGR tube and start fasteners by hand.

(8) Tighten all bolts/nuts to 24 N·m (212 in. lbs.) torque. **When tightening bolts at EGR valve end of tube, alternate between the upper and lower bolt to allow face of EGR valve to remain square to tube mounting flange on EGR tube (Fig. 32).**

(9) Operate the engine to check for leaks.

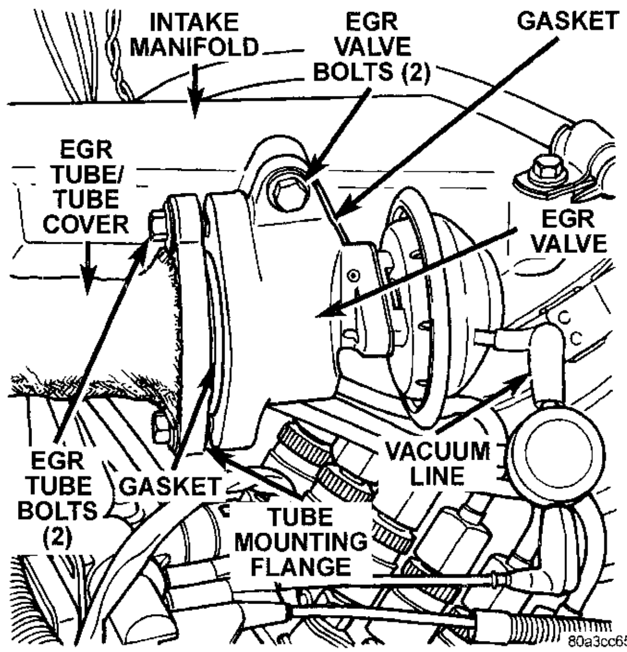

Fig. 32 EGR Tube Connection at Valve

INTAKE MANIFOLD COVER—AIR INTAKE HEATER (DIESEL)

REMOVAL

(1) Disconnect both negative battery cables.

(2) Remove the charge air cooler (intercooler) outlet duct from the air inlet housing (Fig. 33).

REMOVAL AND INSTALLATION (Continued)

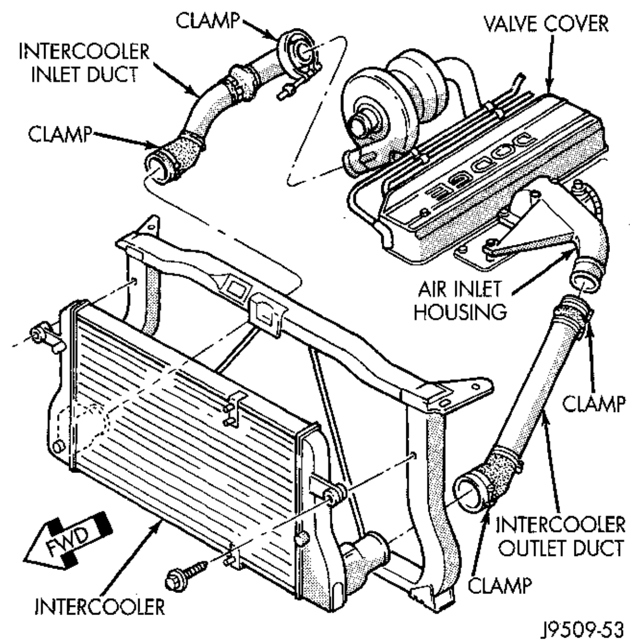

Fig. 33 Intercooler Outlet Duct

(3) Remove the valve cover name plate.

(4) Remove air inlet housing.

(5) Remove the EGR tube (Refer to Group 25, Emission Control Systems for proper procedures).

(6) Remove the high pressure fuel lines as an assembly (refer to Group 14, Fuel System for proper procedures).

(7) Disconnect the air intake heater power supply lines (Fig. 34).

(8) Disconnect the charge air temperature sensor connector.

(9) Remove the manifold intake cover and gasket (Fig. 35). Keep the gasket material and any other material out of the air intake.

(10) Clean the sealing surface.

INSTALLATION

(1) Using a new gasket, install the intake manifold cover.

(2) Some of the intake manifold bolt holes are drilled through and must be sealed. Apply liquid teflon sealant to the bolts. Install the intake manifold cover bolts. Tighten the bolts to 24 N·m (18 ft. lbs.) torque.

(3) Connect the charge air temperature connector to the sensor.

(4) Install a new gasket on top of the air intake heater.

(5) Install the air inlet housing. Tighten the air inlet housing bolts to 24 N·m (18 ft. lbs.) torque.

(6) Install and tighten the air intake heater power supply nuts to 14 N·m (10 ft. lbs.) torque.

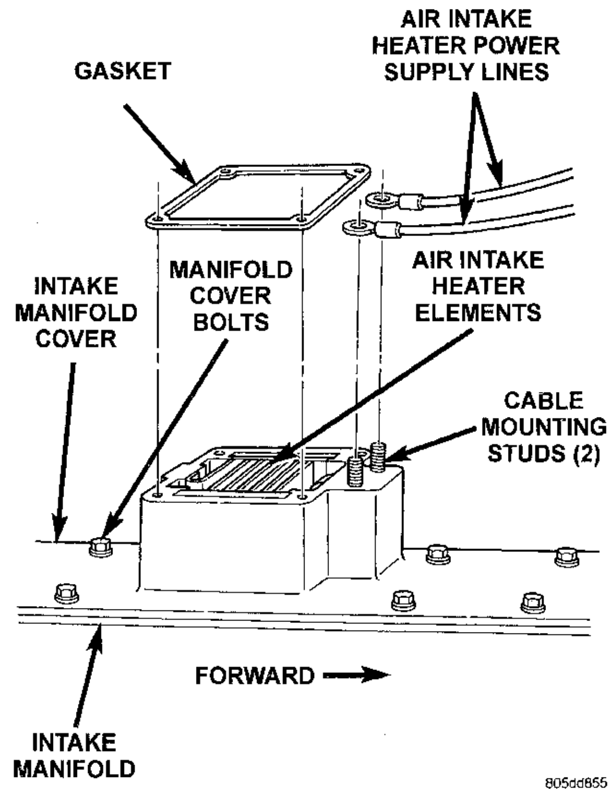

Fig. 34 Air Intake Heater

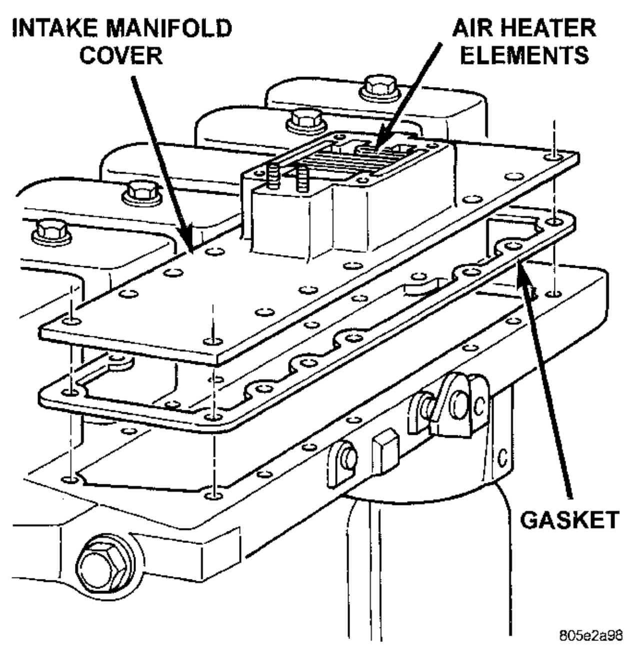

Fig. 35 Manifold Intake Cover

(7) Position the charge air cooler (intercooler) outlet duct onto the air inlet housing. Tighten the charge air cooler (intercooler) outlet duct clamps to 8 N·m (74 in. lbs.) torque.

(8) Install and bleed the high pressure fuel lines (Refer to Group 14, Fuel System for proper proce-

REMOVAL AND INSTALLATION (Continued)

dures). Tighten the high pressure fuel line nuts to 24 N·m (18 ft. lbs.) torque.

(9) Install the valve cover name plate.

(10) Install the EGR tube. Tighten all bolts/nuts to 24 N·m (212 in. lbs.) torque. **When tightening bolts at EGR valve end of tube, alternate between the upper and lower bolt to allow face of EGR valve to remain square to the mounting flange on the EGR tube.**

(11) Connect both negative battery cables.

TURBOCHARGER

REMOVAL

(1) Disconnect the negative cable from the battery.

(2) Disconnect the air intake pipe and exhaust pipe (Fig. 36).

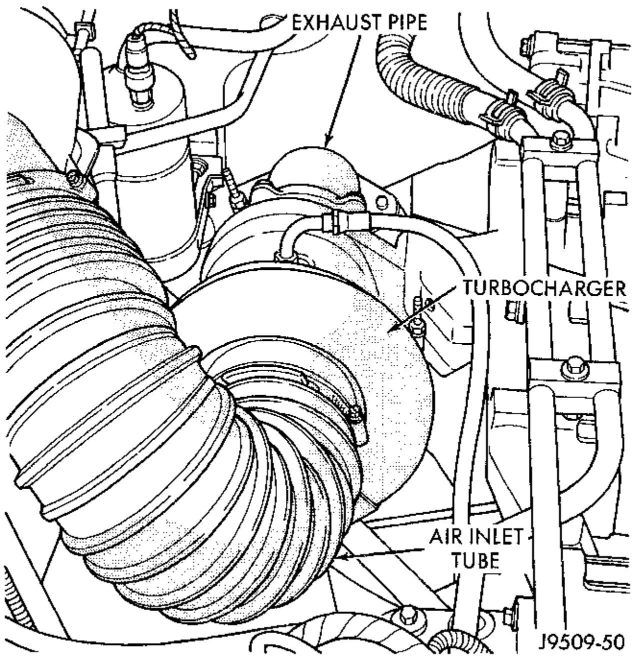

Fig. 36 Air Intake Pipe, Exhaust Pipe and Turbocharger

(3) Remove the oil drain tube bolts.

(4) Remove the oil supply line.

(5) Disconnect the charge air cooler (intercooler) inlet duct from the turbocharger (Fig. 37).

(6) Remove the turbocharger mounting nuts and the turbocharger.

(7) If the turbocharger is not to be installed immediately, cover the opening to prevent material from entering into the manifold.

(8) Clean and inspect the sealing surface.

CAUTION: The turbocharger is a precision piece of equipment and should only be repaired by an authorized facility. Disassembly is not recommended, as engine/turbo failure could result.

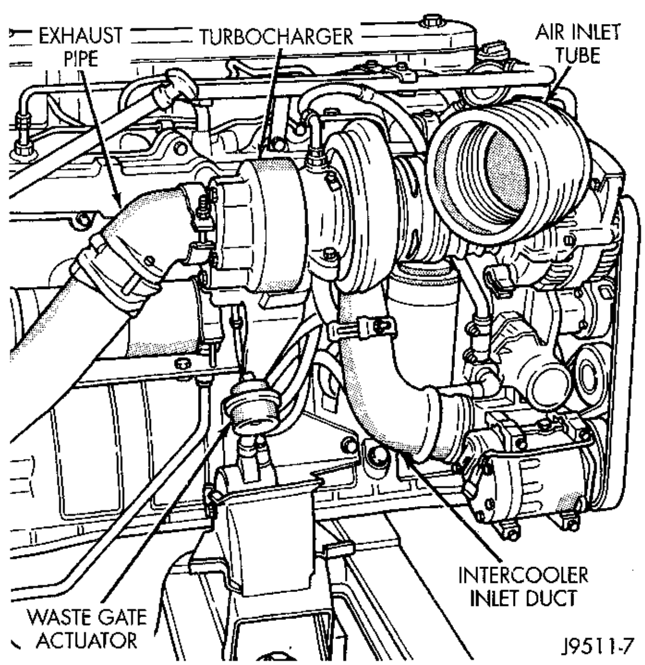

Fig. 37 Air Cooler (Intercooler) Inlet Duct

INSTALLATION

(1) Install a new gasket and apply anti-seize compound to the mounting studs.

(2) Install the turbocharger. Tighten the turbocharger mounting nuts to 32 N·m (24 ft. lbs.) torque.

(3) Use a new gasket and connect the drain line. Tighten the drain line connection bolts to 24 N·m (18 ft. lbs.) torque.

(4) New turbocharger must be pre-lubricated with clean engine lubricating oil before start up. Pour 50-60 cc (2-3 ounces) of oil into supply fitting.

WARNING: DO NOT USE YOUR FINGER TO TURN THE TURBINE WHEEL.

(5) Rotate the turbine wheel to allow oil to enter the turbocharger.

(6) Install the oil supply line. Tighten the oil supply line fitting nut to 15 N·m (11 ft. lbs.) torque.

(7) Position the Charge air cooler (intercooler) inlet duct to the turbocharger. With the clamp in position, tighten the clamp nut to 8 N·m (72 in. lbs.) torque.

(8) Position the air intake pipe and the exhaust pipe onto the turbocharger. Tighten the clamps to 8 N·m (72 in. lbs.) torque.

(9) Connect the negative cable to the battery.

(10) Operate the engine and check for leaks.

WASTEGATE ADJUSTMENT

The wastegate turbocharger provides additional low speed boost without over-boost at high speeds. This increases low speed torque and better driveability.

REMOVAL AND INSTALLATION (Continued)

Proper adjustment of the wastegate assembly is critical to the operation of the wastegate turbocharger (Fig. 38). The control rod is set at the factory and no adjustment should be necessary, unless wastegate assembly is damaged.

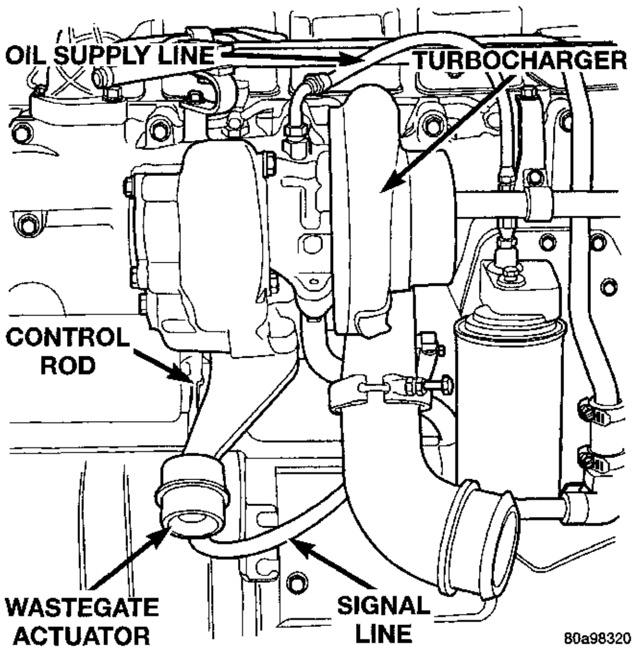

Fig. 38 Wastegate Turbocharger

CAUTION: DO NOT adjust the wastegate so that higher pressures are required to open the wastegate valve. The turbocharger speed will be increased and can cause damage to the turbocharger and cause a loss of engine performance.

(1) Disconnect signal line from wastegate actuator.**The signal line may be installed with tamper-proof clamps. These can be discarded and replaced with standard worm-gear clamps.**

(2) Connect regulated air pressure to the wastegate actuator (Fig. 39). Install a dial indicator to measure the control rod movement. Apply 103 - 138 kPa (15 - 20 psi) to seat the components and take any slack out of the control rod. Release the air pressure and zero the dial indicator gauge.

(3) Apply 193 kPa (28 psi) air pressure to the actuator. The control rod should move 0.33 - 1.33 mm (0.013 - 0.052 in) total travel. If the rod travel is out of limits, the wastegate linkage must be adjusted.

(4) To adjust the wastegate linkage, apply air pressure to the actuator to release the spring tension on the lever. Remove the control rod from the wastegate lever (Fig. 40). Pull the wastegate lever toward the actuator (closed position).

(5) Adjust the length of the clevis end of the control rod to align the clevis pin hole to the wastegate lever. Install the adjusting link and retaining clip (Fig. 40).

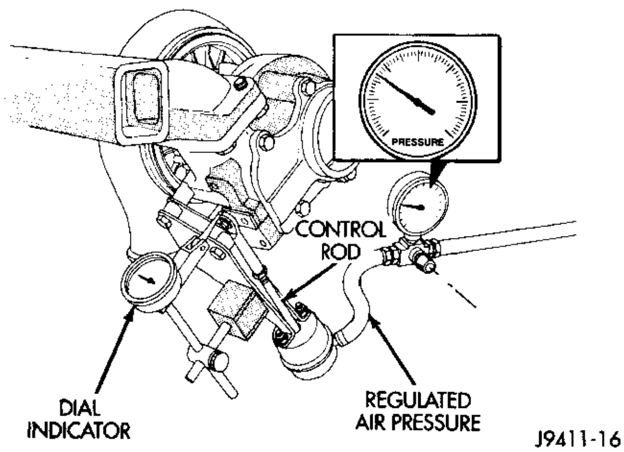

Fig. 39 Wastegate and Dial Indicator

CAUTION: DO NOT pull, push or force the alignment of the clevis pin.

(6) After the adjustment is complete, tighten the actuator rod jam nut.

(7) Recheck the travel on the wastegate control rod. Adjust, if necessary.

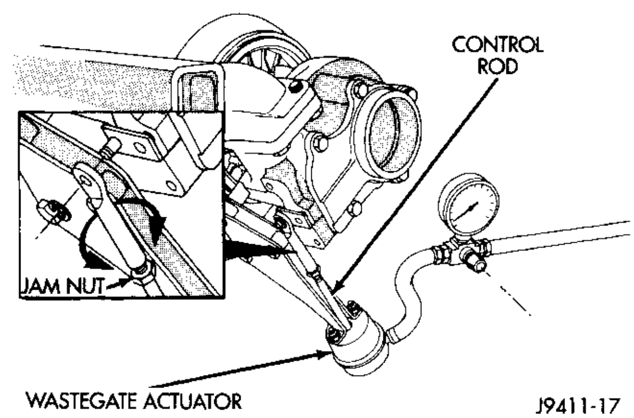

Fig. 40 Adjustment of Wastegate Actuator

CHARGE AIR COOLER—DIESEL

REMOVAL

WARNING: IF THE ENGINE WAS JUST TURNED OFF, THE INTAKE AND OUTLET DUCTS MAY BE HOT.

(1) Remove the front bumper (refer to Group 23, Body for the proper procedure).

(2) Remove the front support bracket (Fig. 41).

(3) If the vehicle is equipped with air conditioning, remove the condenser as follows:

REMOVAL AND INSTALLATION (Continued)

(a) Discharge the air conditioning system (refer to Group 24, Heating and Air Conditioning for the proper procedures).

(b) Remove the bolt from the sealing plate.

(c) Remove the nuts holding the condenser to the charge air cooler. Lift the condenser and sealing plate assembly away from the charge air cooler.

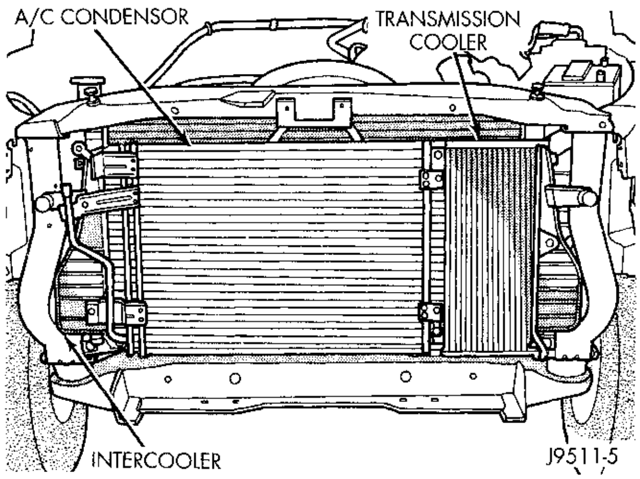

Fig. 41 Condenser and Charge Air Cooler—Intercooler

(4) Remove the inlet and outlet ducts from the charge air cooler (Fig. 42).

(5) Remove the charge air cooler bolts. Pivot the charge air cooler forward and up to remove.

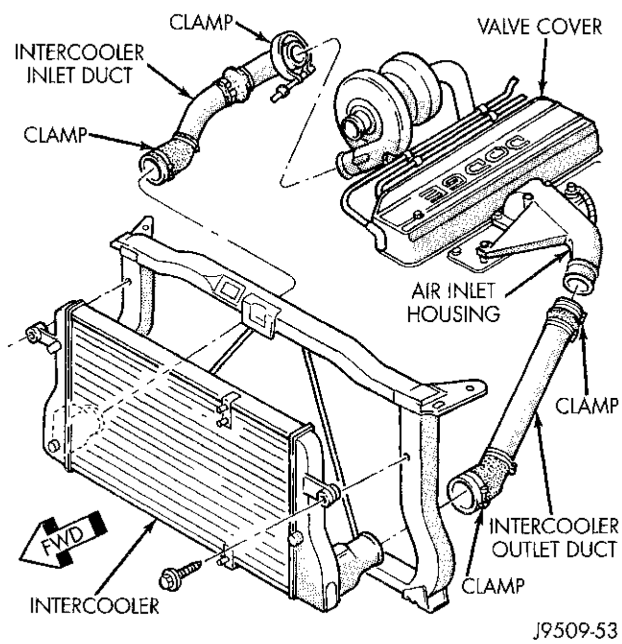

Fig. 42 Charge Air Cooler Intercooler Ducts

INSTALLATION

(1) Position the charge air cooler. Install the bolts and tighten to 2 N·m (17 in. lbs.) torque.

(2) Install the inlet and outlet ducts to the charge air cooler. With the clamps in position, tighten the clamp nut to 8 N·m (72 in. lbs.) torque.

(3) If the vehicle is equipped with air conditioning, install the condenser as follows:

(a) Position the condenser and sealing plate assembly onto the charge air cooler studs. Install the nuts and tighten.

(b) Connect the halves of the sealing plate. Install the bolt and tighten.

(c) Charge the air conditioning system (refer to Group 24, Heating and Air Conditioning for the proper procedures).

(4) Install the front support bracket. Install and tighten the bolts.

(5) Install the front bumper (refer to Group 23, Body for the proper procedure).

CLEANING AND INSPECTION

EXHAUST PIPE

INSPECTION

Discard rusted clamps, broken or worn supports and attaching parts. Replace a component with original equipment parts, or equivalent. This will assure proper alignment with other parts in the system and provide acceptable exhaust noise levels.

CLEANING

Clean ends of pipes to assure mating of all parts.

INTAKE MANIFOLD

CLEANING INTAKE

Clean manifold in solvent and blow dry with compressed air.

Clean cylinder block front and rear gasket surfaces using a suitable solvent.

The plenum pan rail must be clean and dry (free of all foreign material).

INSPECTION

Inspect manifold for cracks.

Inspect mating surfaces of manifold for flatness with a straightedge.

EXHAUST MANIFOLD

CLEANING

Clean mating surfaces on cylinder head and manifold. Wash with solvent and blow dry with compressed air.

CLEANING AND INSPECTION (Continued)

INSPECTION

Inspect manifold for cracks.

Inspect mating surfaces of manifold for flatness with a straight edge. Gasket surfaces must be flat within 0.2 mm per 300 mm (0.008 inch per foot).

CHARGE AIR COOLER

CLEANING

If the engine experiences a turbocharger failure or any other occasion where oil or debris is put into the charge air cooler, the charge air cooler must be cleaned.

(1) Remove the charge air cooler from the vehicle, refer Charge Air Cooler in this section.

(2) Flush the charge air cooler internally with a non caustic solvent in the opposite direction of normal air flow. Shake the charge air cooler and LIGHTLY tap on the end tanks with a rubber mallet to dislodge trapped debris. Continue flushing until all debris or oil is removed.

(3) Use a flashlight and mirror to visually inspect the charge air cooler for internal debris.

CAUTION: If internal debris cannot be removed, scrap the charge air cooler. DO NOT USE CAUSTIC CLEANERS TO CLEAN THE CHARGE AIR COOLER. DAMAGE TO THE CHARGE AIR COOLER WILL RESULT.

(4) After the charge air cooler has been thoroughly cleaned of all oil and debris with the non caustic solvent, wash the charge air cooler internally with hot soapy water to remove the remaining solvent.

(5) Rinse thoroughly with clean water.

(6) Blow compressed air into the charge air cooler in the opposite direction of normal air flow until the charge air cooler is dry internally.

INSPECTION

(1) Visually inspect the charge air cooler

(2) Inspect the tubes, fins and welds for tears, breaks or other damage. If any damage causes the charge air cooler to fail, the charge air cooler must replaced.

CATALYTIC CONVERTER

INSPECTION

Look at the stainless steel body of the converter, inspect for bulging or other distortion that could be a result of overheating. If the converter has a heat shield attached make sure it is not bent or loose.

WARNING: UNLEADED FUEL MUST BE USED TO PREVENT BLOCKAGE OR CONTAMINATION TO THE CATALYST CORE.

If you suspect internal damage to the catalyst, tapping the bottom of the catalyst with a rubber mallet may indicate a damaged core.

CLEANING

Clean ends of pipes and muffler to assure a good seal at mating surfaces.

ADJUSTMENTS

WASTEGATE ADJUSTMENT

The wastegate turbocharger provides additional low speed boost without over-boost at high speeds. This increases low speed torque and better driveability.

Proper adjustment of the wastegate assembly is critical to the operation of the wastegate turbocharger (Fig. 43). The control rod is set at the factory and no adjustment should be necessary, unless wastegate assembly is damaged.

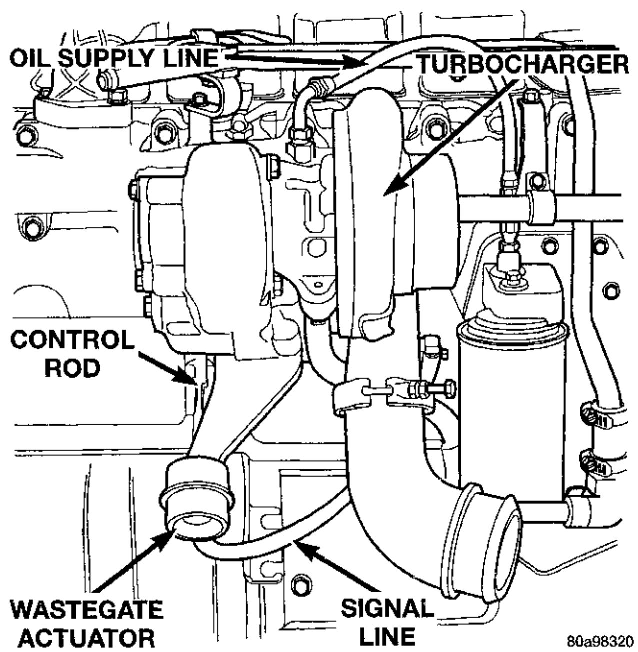

Fig. 43 Wastegate Turbocharger

CAUTION: DO NOT adjust the wastegate so that higher pressures are required to open the wastegate valve. The turbocharger speed will be increased and can cause damage to the turbocharger and cause a loss of engine performance.

(1) Remove signal line from wastegate actuator.**The signal line may be installed with tamper-proof clamps. These can be discarded and replaced with standard worm-gear clamps.**

(2) Connect regulated air pressure to the wastegate actuator (Fig. 44). Install a dial indicator to

ADJUSTMENTS (Continued)

measure the control rod movement. Apply 103 - 138 kPa (15 - 20 psi) to seat the components and take any slack out of the control rod. Release the air pressure and zero the dial indicator gauge.

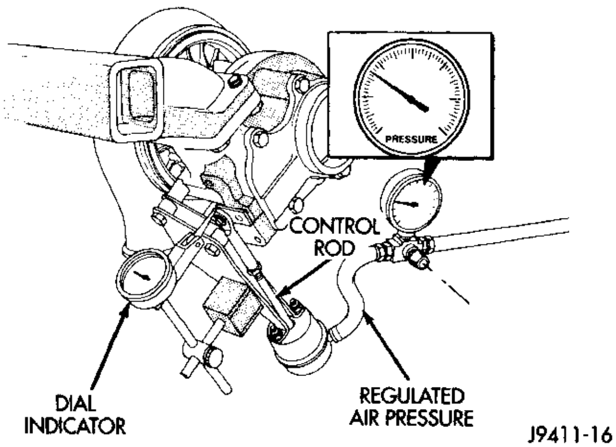

Fig. 44 Wastegate and Dial Indicator

(3) Apply 193 kPa (28 psi) air pressure to the actuator. The control rod should move 0.33 - 1.33 mm (0.013 - 0.052 in) total travel. If the rod travel is out of limits, the wastegate linkage must be adjusted.

(4) To adjust the wastegate linkage, apply air pressure to the actuator to release the spring tension on the lever. Remove the control rod from the wastegate lever (Fig. 45). Pull the wastegate lever toward the actuator (closed position).

(5) Adjust the length of the clevis end of the control rod to align the clevis pin hole to the wastegate lever. Install the adjusting link and retaining clip (Fig. 45).

CAUTION: DO NOT pull, push or force the alignment of the clevis pin.

(6) After the adjustment is complete, tighten the actuator rod jam nut.

(7) Recheck the travel on the wastegate control rod. Adjust, if necessary.

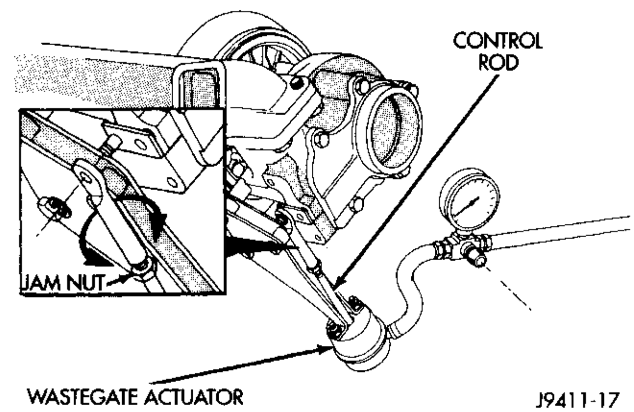

Fig. 45 Adjustment of Wastegate Actuator

SPECIFICATIONS

TURBOCHARGER SPECIFICATIONS

COMPONENT	DIMENSIONS
Air Intake Restrictions	635 mm Water (25 in. Water) Max.
Turbo Radial Clearance	0.300–0.460 mm (0.012–0.018 inch)
Turbo Rotor Assembly End Play	
Before S/N 840638	0.102–0.152 mm (0.004–0.006 inch)
S/N 840638 AND AFTER	0.026–0.076 mm (0.001–0.003 inch)

J9511-23

TORQUE SPECIFICATIONS

DESCRIPTION **TORQUE**

Adjusting Strap
Bolt .23 N·m (200 in. lbs.)
Air Heater Power Supply
Nuts .14 N·m (124 in. lbs.)
Air Inlet Housing
Bolts .24 N·m (18 ft. lbs.)
Cab Heater Supply/Return Line
Nuts .24 N·m (18 ft. lbs.)
EGR Tube (Diesel)
Bolts/Nuts .24 N·m (212 in. lbs.)
Exhaust Clamps (All)
Nuts .43 N·m (32 ft. lbs.)
Exhaust Manifold to Cylinder Head (Diesel)
Bolts .43 N·m (32 ft. lbs.)
Exhaust Manifold to Cylinder Head (3.9/5.2/5.9L)
Bolts .34 N·m (25 ft. lbs.)
Exhaust Manifold to Cylinder Head (8.0L)
Bolts .22 N·m (195 in. lbs.)
Exhaust Pipe to Manifold (All)
Bolts .34 N·m (25 ft. lbs.)

DESCRIPTION **TORQUE**

Fuel Line
Nuts .24 N·m (18 ft. lbs.)
Generator Mounting
Bolts .41 N·m (30 ft. lbs.)
Intake Manifold (3.9/5.2/5.9L)
Bolts .Refer to procedure in this section.
Intake Manifold (8.0L)
Bolts .54 N·m (40 ft. lbs.)
Intake Manifold Cover (Diesel)
Bolts .24 N·m (18 ft. lbs.)
Intercooler Attaching
Bolts .2 N·m (17 in. lbs.)
Intercooler Duct Clamp
Nuts .8 N·m (72 in. lbs.)
Throttle Body (All)
Bolts .23 N·m (200 in. lbs.)
Turbocharger Mounting
Nuts .32 N·m (24 ft. lbs.)
Turbocharger Oil Drain Tube
Bolts .24 N·m (18 ft. lbs.)
Turbocharger Oil Supply Line
Fitting .15 N·m (133 in. lbs.)
Turbocharger V-Band Clamp
Nut .9 N·m (75 in. lbs.)

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FRAME AND BUMPERS

CONTENTS

BUMPERS

INDEX

REMOVAL AND INSTALLATION

FRONT BUMPER

REMOVAL

(1) Support front bumper on a suitable lifting device.

(2) Remove bolt holding front bumper brace to frame rail (Fig. 1).

(3) Remove nuts and stud plates holding front bumper to end of frame rail.

(4) Disengage wire connectors from horns.

(5) Disengage wire connectors from fog lamps, if equipped.

(6) Separate front bumper from vehicle.

INSTALLATION

Reverse the preceding operation.

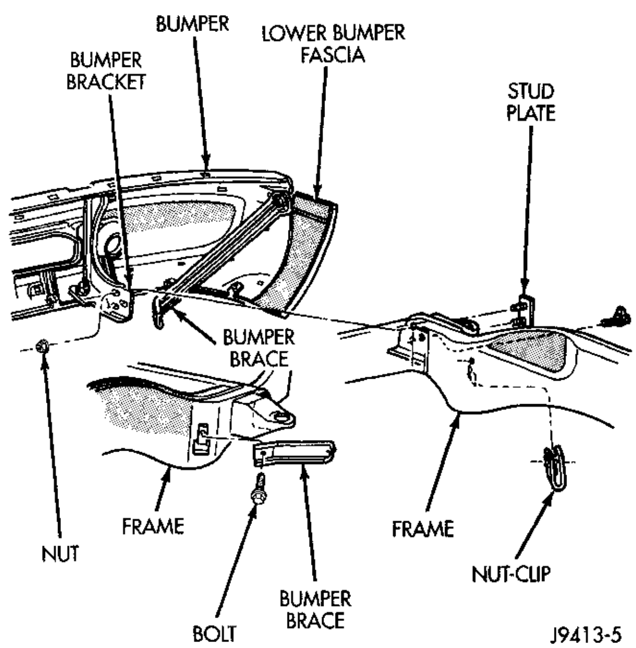

Fig. 1 Front Bumper

FRONT BUMPER UPPER FASCIA

REMOVAL

(1) Open hood.

(2) Remove fasteners at fender side openings.

(3) Disengage clips holding upper fascia to bumper face bar (Fig. 2).

(4) Separate fascia from bumper.

REMOVAL AND INSTALLATION (Continued)

INSTALLATION

Reverse the preceding operation.

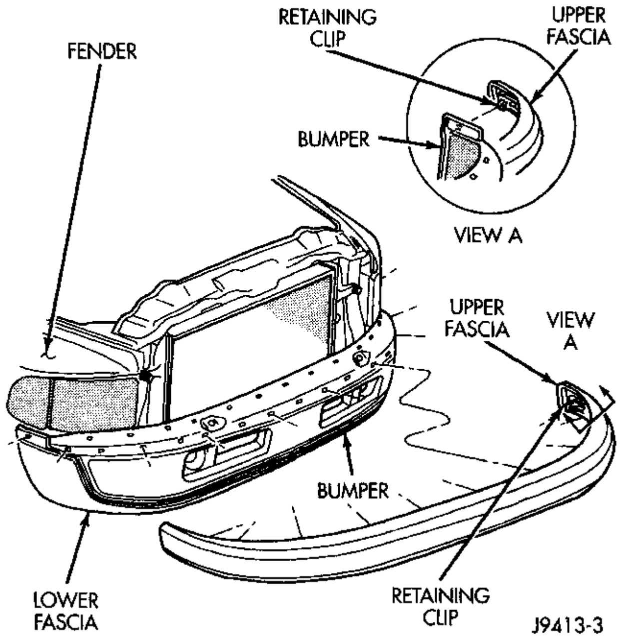

Fig. 2 Front Bumper Upper Fascia

FRONT BUMPER LOWER FASCIA

REMOVAL

(1) Open hood.
(2) Remove fasteners at side fender openings.
(3) Remove lower air dam.
(4) Disengage clips holding end of upper fascia to bumper face bar (Fig. 3).
(5) Disengage clips holding lower fascia to bumper face bar.
(6) Separate lower fascia from bumper.

INSTALLATION

Reverse the preceding operation.

FRONT BUMPER AIR DAM

REMOVAL

(1) Remove Pin-type fasteners holding air dam to bottom of front bumper (Fig. 4).
(2) Remove screws holding air dam to bottom of front bumper.
(3) Separate air dam from vehicle.

INSTALLATION

Reverse the preceding operation.

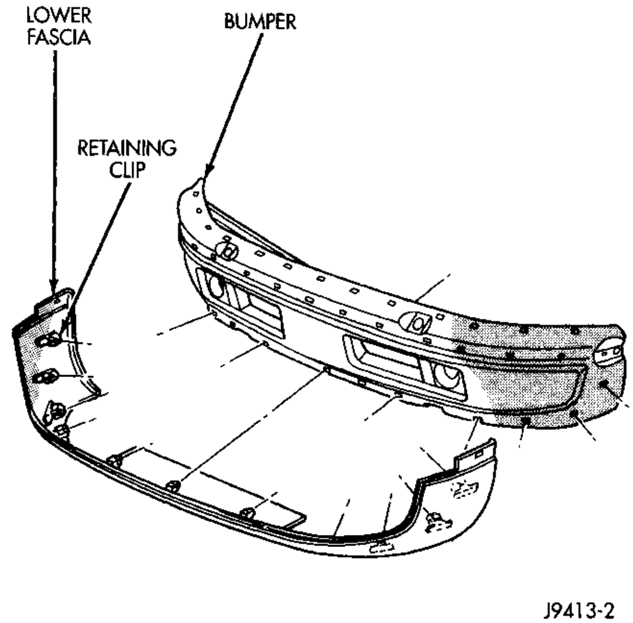

Fig. 3 Front Bumper Lower Fascia

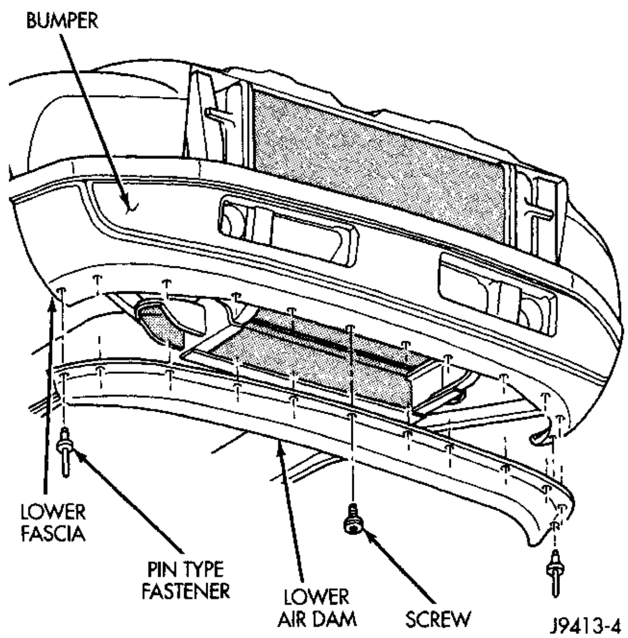

Fig. 4 Front Bumper Air Dam

AUTHENTIC RESTORATION PRODUCT

REMOVAL AND INSTALLATION (Continued)

REAR BUMPER

REMOVAL

(1) Support rear bumper on a suitable lifting device.

(2) Remove bolts holding rear bumper braces to frame rails (Fig. 5).

(3) Disengage license plate lamp wire connector from body wire harness, if equipped.

(4) Separate rear bumper from vehicle.

INSTALLATION

Reverse the preceding operation.

REAR VALENCE PANEL

REMOVAL

(1) Support rear valence panel on a suitable lifting device.

(2) Remove bolts attaching rear valence to frame rails (Fig. 6).

(3) Disengage license plate lamp wire connector from body wire harness, if equipped.

(4) Separate rear valence from vehicle.

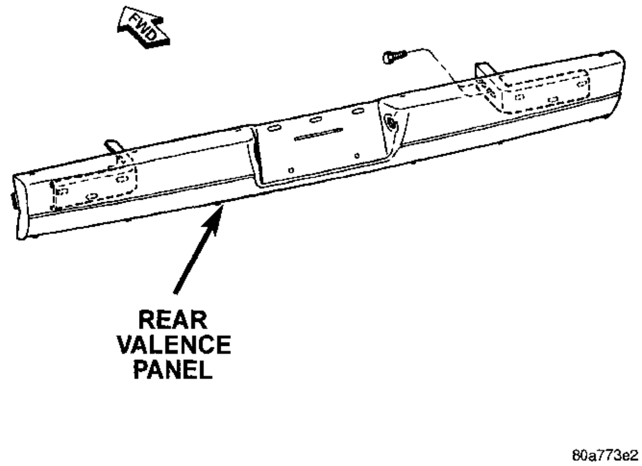

Fig. 6 Rear Valence Panel

INSTALLATION

Reverse the preceding operation.

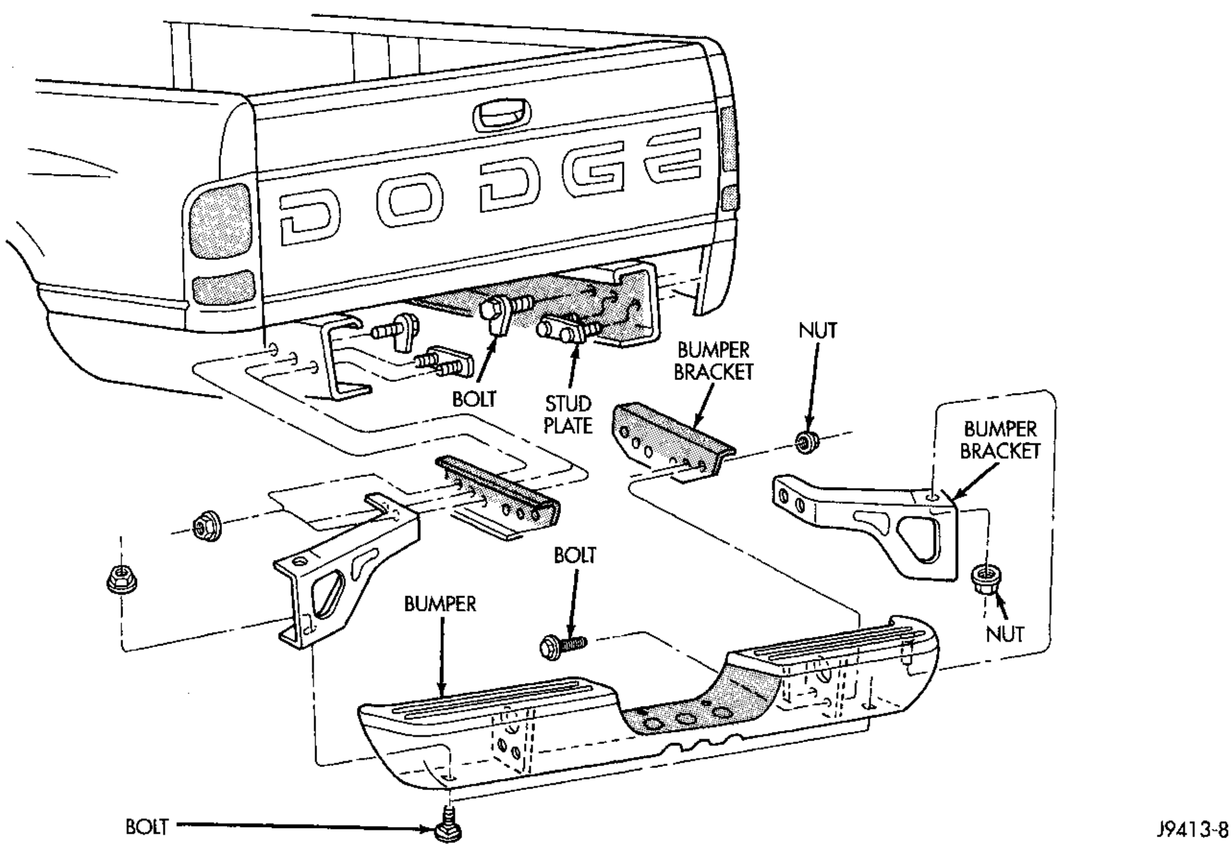

Fig. 5 Rear Bumper

FRAME

INDEX

GENERAL INFORMATION

GENERAL INFORMATION

BR trucks have a ladder-type frame (Fig. 1) with Box-section front rails, dropped center section and open-channel side rails in the rear.

Cross members attached to the frame side rails with rivets, welds or bolts form a ladder-type construction (Fig. 1). The cab is isolated from the frame with rubber load cushions (Fig. 2) with through-bolts. The cargo box or bed is attached to the frame with bolts. Refer to Group 23, Body for cargo box service procedures.

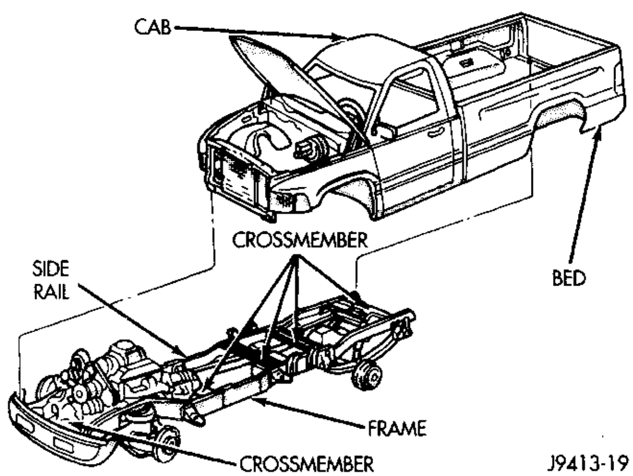

Fig. 1 Frame

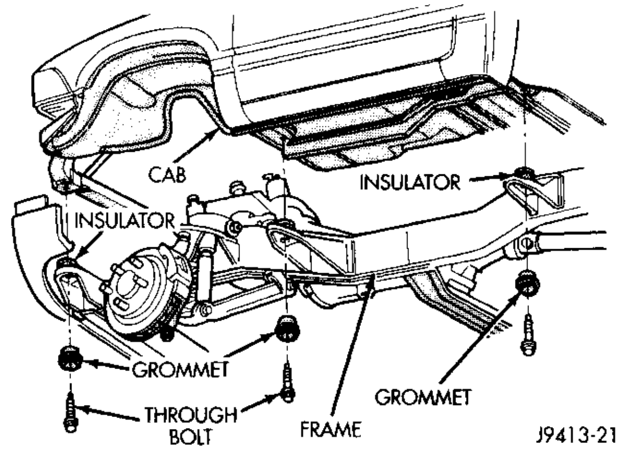

Fig. 2 Cab Mounts

The frame is designed to absorb and dissipate flexing and twisting due to acceleration, braking, cornering and road surface variances without bending when subjected to normal driving conditions. The frame is the mounting platform for the following systems and components:

- Front and rear suspension systems.
- Engine, transmission, and transfer case.
- Steering gear and linkage.
- Exhaust system and heat shields.
- Fuel cell and fuel line tubing.
- Front end sheet metal and radiator closure panel.
- Skid plate.
- Passenger cab.
- Cargo box or bed.
- Spare tire winch.
- Front and rear bumper systems.

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SERVICE PROCEDURES

FRAME SERVICE

SAFETY PRECAUTIONS AND WARNINGS

WARNING: USE EYE PROTECTION WHEN GRINDING OR WELDING METAL, SERIOUS EYE INJURY CAN RESULT. BEFORE PROCEEDING WITH FRAME REPAIR INVOLVING GRINDING OR WELDING, VERIFY THAT VEHICLE FUEL SYSTEM IS NOT LEAKING OR IN CONTACT WITH REPAIR AREA, PERSONAL INJURY CAN RESULT. DO NOT ALLOW OPEN FLAME TO CONTACT PLASTIC BODY PANELS. FIRE OR EXPLOSION CAN RESULT. WHEN WELDED FRAME COMPONENTS ARE REPLACED, 100% PENETRATION WELD MUST BE ACHIEVED DURING INSTALLATION. IF NOT, DANGEROUS OPERATING CONDITIONS CAN RESULT. STAND CLEAR OF CABLES OR CHAINS ON PULLING EQUIPMENT DURING FRAME STRAIGHTENING OPERATIONS, PERSONAL INJURY CAN RESULT. DO NOT VENTURE UNDER A HOISTED VEHICLE THAT IS NOT SUPPORTED ON SAFETY STANDS, PERSONAL INJURY CAN RESULT.

CAUTION: Do not reuse damaged fasteners, quality of repair would be suspect. Do not drill holes in top or bottom frame rail flanges, frame rail failure can result. Do Not use softer than Grade 5 bolts to replace production fasteners, loosening or failure can result. When using heat to straighten frame components do not exceed 566°C (1050°F), metal fatigue can result. Welding the joints around riveted cross members and frame side rails can weaken frame.

FRAME STRAIGHTENING

When necessary, a conventional frame that is bent or twisted can be straightened by application of heat. The temperature must not exceed 566°C (1050°F). The metal will have a dull red glow at the desired temperature. Excessive heat will decrease the strength of the metal and result in a weakened frame.

Welding the joints around riveted cross members and frame side rails is not recommended.

A straightening repair process should be limited to frame members that are not severely damaged. The replacement bolts, nuts and rivets that are used to join the frame members should conform to the same specifications as the original bolts, nuts and rivets.

FRAME REPAIRS

DRILLING HOLES

Do not drill holes in frame side rail top and bottom flanges, metal fatigue can result causing frame failure. Holes drilled in the side of the frame rail must be at least 38 mm (1.5 in.) from the top and bottom flanges.

Additional drill holes should be located away from existing holes.

WELDING

Use MIG, TIG or arc welding equipment to repair welded frame components.

Frame components that have been damaged should be inspected for cracks before returning the vehicle to use. If cracks are found in accessible frame components perform the following procedures.

(1) Drill a hole at each end of the crack with a 3 mm (0.125 in.) diameter drill bit.

(2) Using a suitable die grinder with 3 inch cut off wheel, V-groove the crack to allow 100% weld penetration.

(3) Weld the crack.

(4) If necessary when a side rail is repaired, grind the weld smooth and install a reinforcement channel (Fig. 3) over the repaired area.

NOTE: If a reinforcement channel is required, the top and bottom flanges should be 0.250 inches narrower than the side rail flanges. Weld only in the areas indicated (Fig. 3).

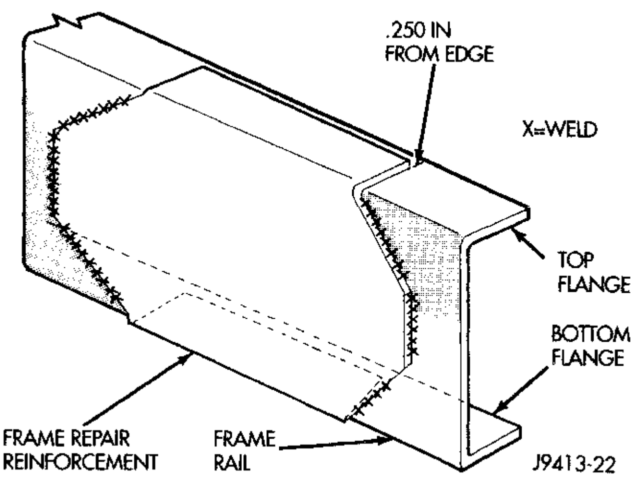

Fig. 3 Frame Reinforcement

FRAME FASTENERS

Bolts, nuts and rivets can be used to repair frames or to install a reinforcement section on the frame. Bolts can be used in place of rivets. When replacing rivets with bolts, install the next larger size diameter

SERVICE PROCEDURES (Continued)

bolt to assure proper fit. If necessary, ream the hole out just enough to sufficiently receive the bolt.

Conical-type washers are preferred over the split-ring type lock washers. Normally, grade-5 bolts are adequate for frame repair. **Grade-3 bolts or softer should not be used.** Tightening bolts/nuts with the correct torque, refer to the Introduction Group at the front of this manual for tightening information.

REMOVAL AND INSTALLATION

CAB CHASSIS ADAPTER BRACKET

REMOVAL

(1) Remove bolts attaching cab chassis adapter brackets to frame rail (Fig. 4)

(2) Separate cab chassis adapter brackets from frame rail

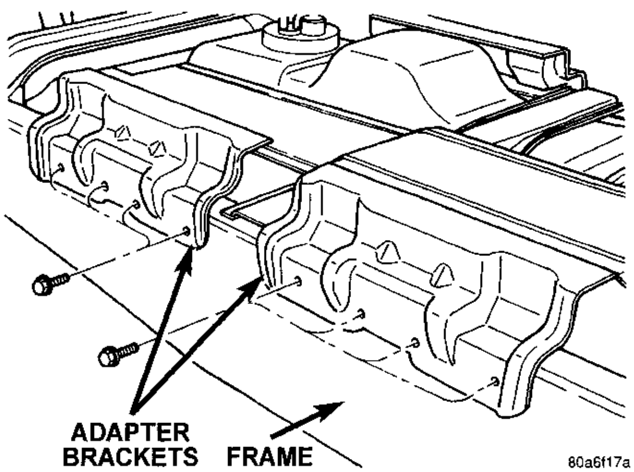

Fig. 4 Cab Chassis Adapter Brackets

INSTALLATION

(1) Position cab chassis adapter brackets on frame rail

(2) Install bolts attaching cab chassis adapter brackets to frame rail.

TRANSFER CASE SKID PLATE

REMOVAL

(1) Hoist and support vehicle on safety stands.

(2) Remove bolts holding skid plate to frame rails (Fig. 5).

(3) Separate skid plate from vehicle.

INSTALLATION

(1) Position skid plate on vehicle.

(2) Install bolts holding skid plate to frame rails.

(3) Remove safety stands and lower vehicle.

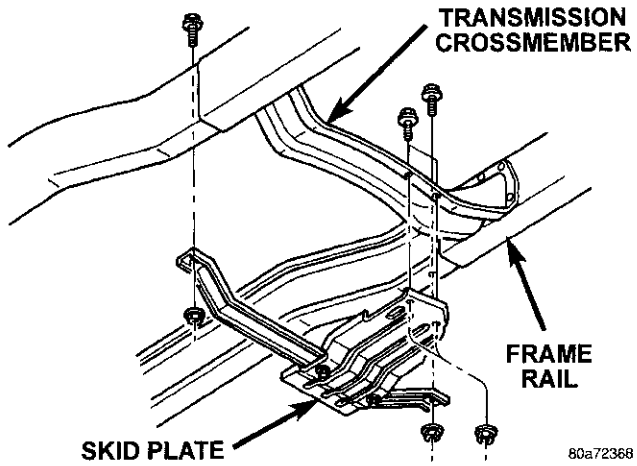

Fig. 5 Skid Plate

SPARE TIRE WINCH

REMOVAL

(1) Remove spare tire from under vehicle.

(2) Remove bolts holding spare tire winch to spare tire bracket (Fig. 6).

(3) Separate spare tire winch from vehicle.

INSTALLATION

(1) Position spare tire winch on vehicle.

(2) Install bolts holding spare tire winch to spare tire bracket.

(3) Install spare tire.

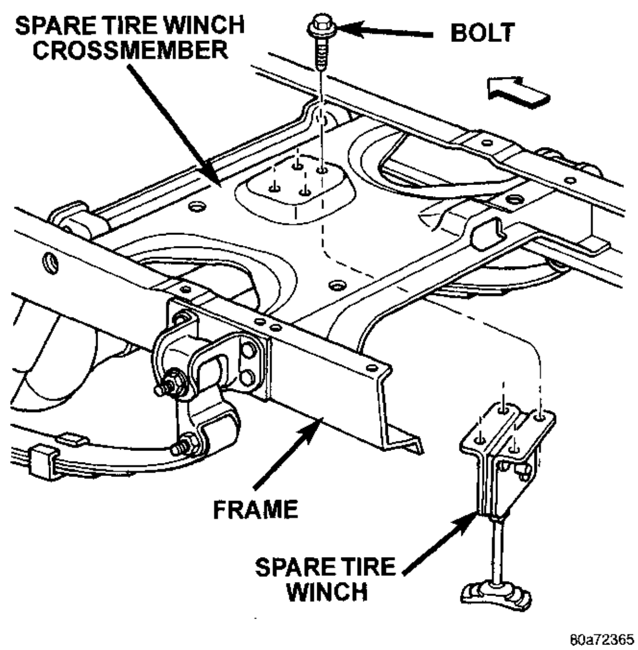

Fig. 6 Spare Tire Winch

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REMOVAL AND INSTALLATION (Continued)

TRAILER HITCH

REMOVAL

(1) Support trailer hitch on a suitable lifting device.

(2) Remove fasteners holding trailer wiring connector to trailer hitch, if equipped.

(3) Remove bolts holding trailer hitch to frame rails (Fig. 7).

(4) Separate trailer hitch from vehicle.

INSTALLATION

(1) Position trailer hitch on vehicle.

(2) Install the bolts holding trailer hitch to frame rails and remove lifting device.

(3) Install fasteners holding trailer wiring connector to trailer hitch, if equipped.

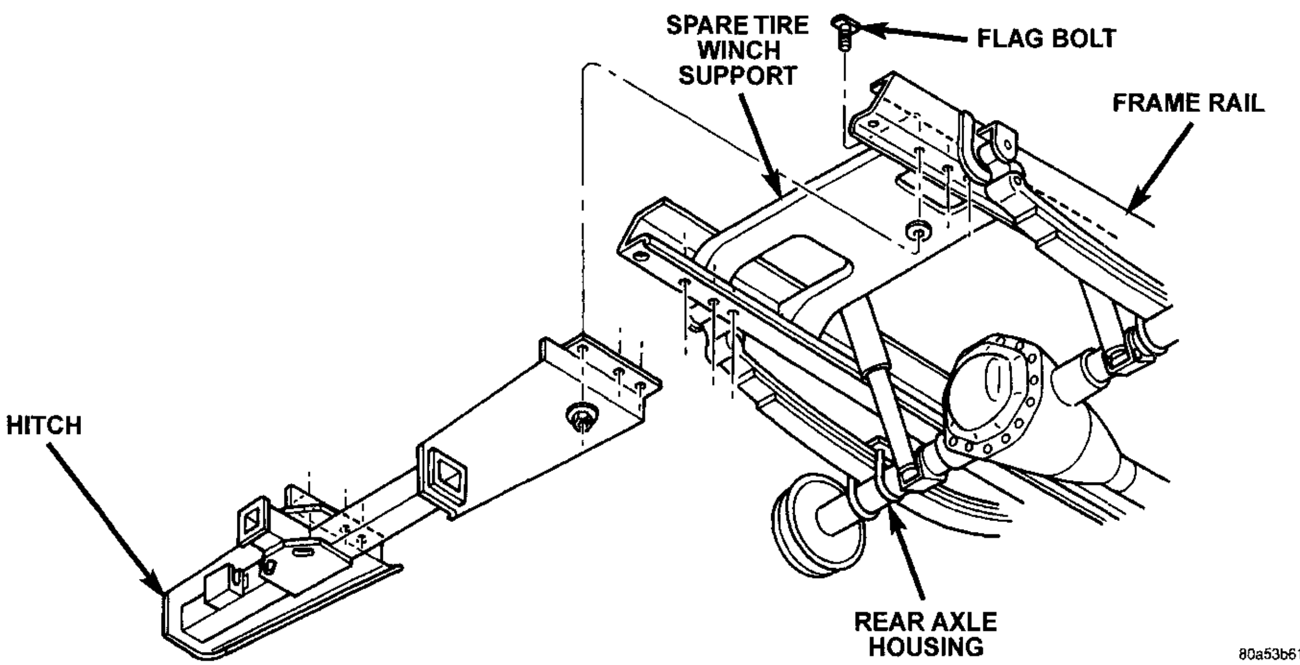


Fig. 7 Trailer Hitch

SPECIFICATIONS

VEHICLE DIMENSIONS

Frame dimensions are listed in inch scale. All dimensions are from center to center of Principal Locating Point (PLP), or from center to center of PLP and fastener location (Fig. 8), (Fig. 9), (Fig. 10), (Fig. 11) and (Fig. 12).

AUTHENTIC RESTORATION

SPECIFICATIONS (Continued)

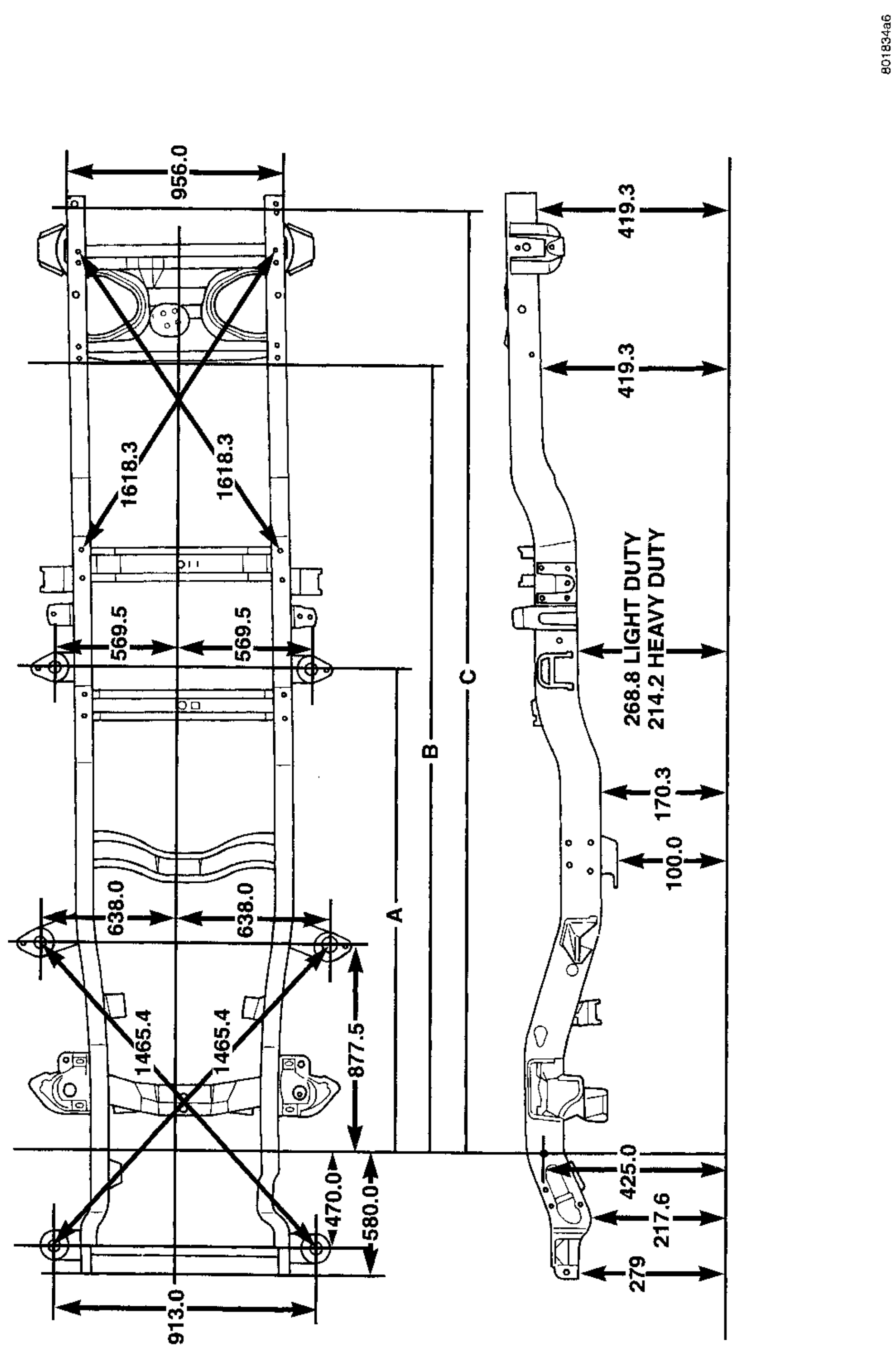


Fig. 8 Frame Dimensions

AUTHENTIC RESTORATION PRODUCT

SPECIFICATIONS (Continued)

*LENGTH DIMENSIONS FOR DIFFERING WHEELBASES**

WHEELBASE	LENGTH A	LENGTH B	LENGTH C
118	2118.0	3663.6	4185.4
134	2118.0	3994.5	4693.4
138	2626.0	4096.1	4693.4
154	2626.0	4502.5	5201.4
162	2118.0	4705.0	5042.5

*Measurements are in Millimeters (mm).

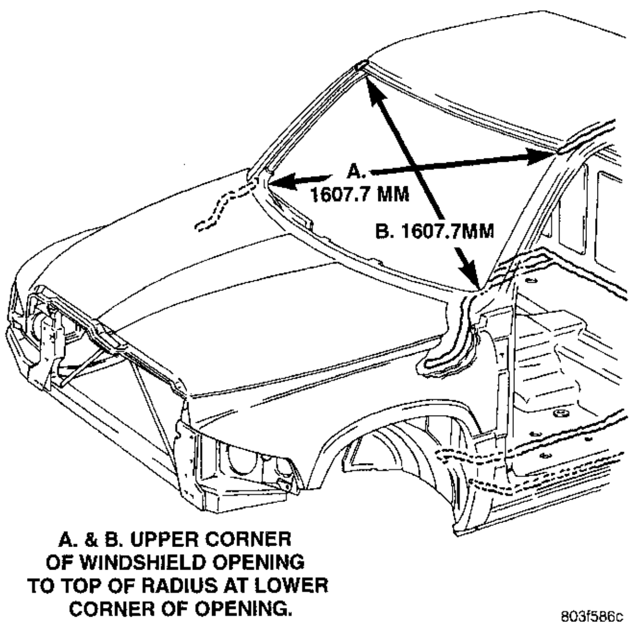
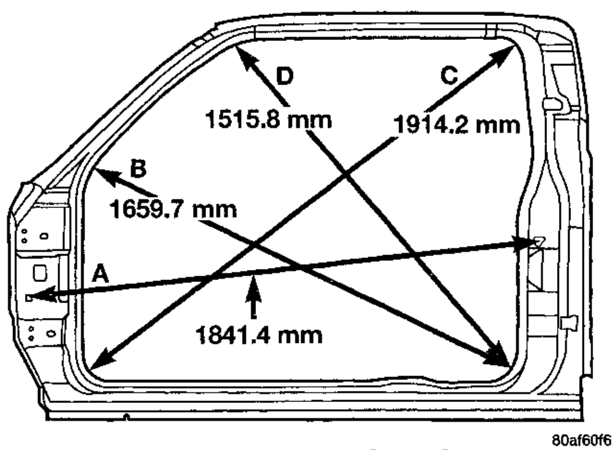
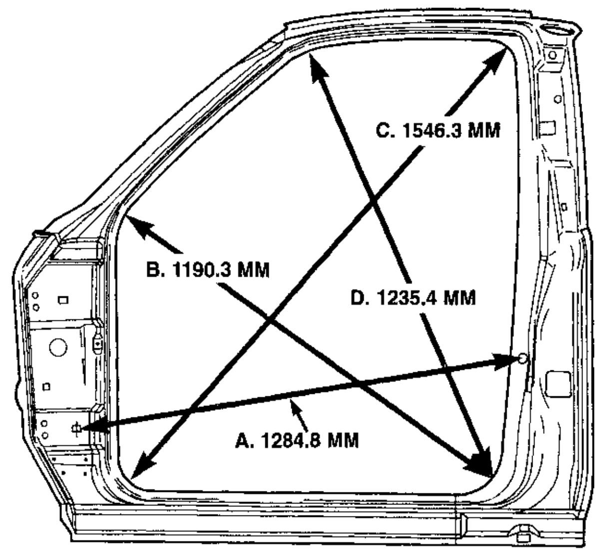


Fig. 9 Body Dimensions—Front View



Body Dimensions—Quad Cab



A. Centerline of A-Pillar gaging hole to centerline of seat belt retractor hole at B-Pillar.

B. Centerline of radius at rear lower door opening flange inner edge to center of radius at cowl flange edge.

C. Centerline of radius at front lower door opening flange inner edge to center of radius at upper opening rear flage inner edge.

D. Centerline of radius at rear lower door opening flange inner edge to center of radius at upper front flange inner edge.

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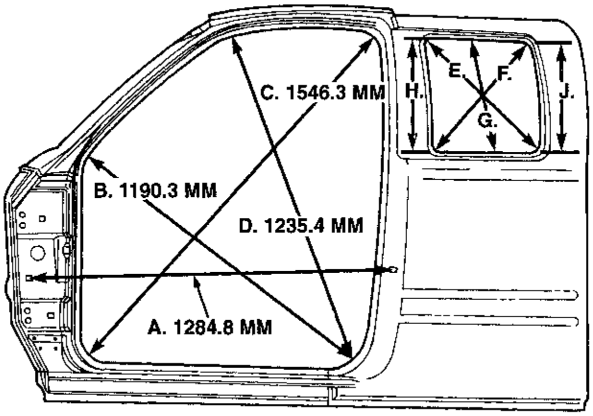
Fig. 10 Body Dimensions—Conventional Cab

SPECIFICATIONS (Continued)



A. 1284.8 MM	D. 1235.4 MM	G. 436.2 MM
B. 1190.3 MM	E. 582.6 MM	H. 440.5 MM
C. 1546.3 MM	F. 538.8 MM	J. 426.8 MM

LH SIDE VIEW

A. Centerline of A-Pillar gaging hole to centerline of seat belt retractor hole at B-Pillar.

B. Center of radius at rear lower door opening flange inner edge to center of radius at cowl flange edge.

C. Center of radius at front lower door opening flange inner edge to center of radius at upper opening rear flange inner edge.

D. Center of radius at rear lower door opening flange inner edge to center of radius at upper front flange inner edge.

E. Lower rear corner inner flange edge to upper front corner inner flange edge of quarter glass opening.

F. Lower front corner inner flange edge to upper rear corner inner flange edge of quarter glass opening.

G. Upper inner flange lower edge to lower flange upper edge of quarter glass opening.

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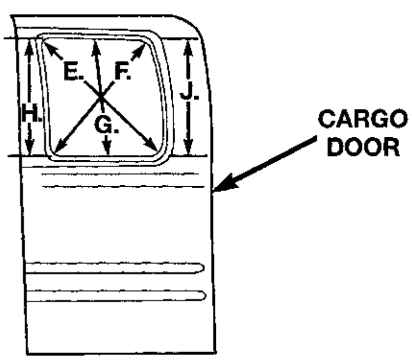
Fig. 11 Body Dimensions—Club Cab



E. 484.14	H. 427.28
F. 456.83	J. 418.38
G. 424.97	

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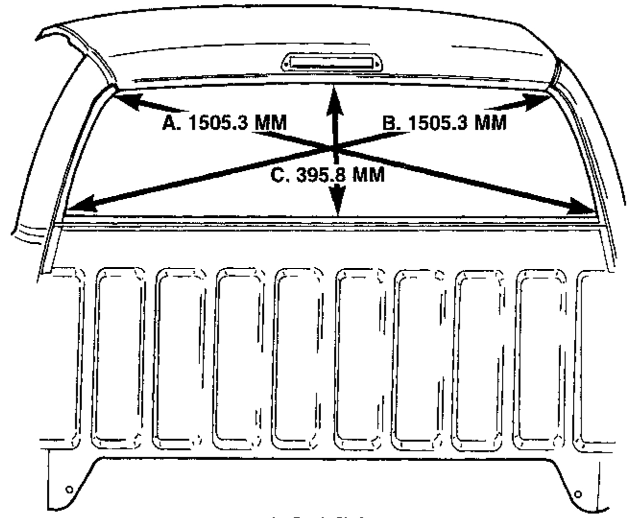
Cargo Door Quarter Glass Opening Dimensions



REAR VIEW

A. & B. Center of radius at top corner to center of radius at lower corner of glass mounting flange.

C. Lower edge of upper back glass mounting flange to upper edge of lower back glass mounting flange measurement taken at centerline of rear glass opening.

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Fig. 12 Body Dimensions—Rear View

TORQUE SPECIFICATIONS

DESCRIPTION	TORQUE
Cab Chassis adapter nut	108 N·m (80 ft. lbs.)
Front bumper brkt-to-frame nut	68 N·m (50 ft. lbs.)
Front bumper outer brace bolt	68 N·m (50 ft. lbs.)
Rear bumper-to-brace nut	40 N·m (30 ft. lbs.)
Rear bumper brace-to-brkt nut	101 N·m (75 ft. lbs.)
Rear bumper brkt-to-frame nut	101 N·m (75 ft. lbs.)
Skid plate crossmember-to-frame bolt	54 N·m (40 ft. lbs.)
Skid plate-to-crossmember bolt	40 N·m (30 ft. lbs.)
Skid plate-to-trans crossmember bolt	54 N·m (40 ft. lbs.)
Spare tire winch bolt	27 N·m (20 ft. lbs.)
Trailer hitch nut	108 N·m (80 ft. lbs.)

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FUEL SYSTEM

CONTENTS

GENERAL INFORMATION

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GENERAL INFORMATION

INTRODUCTION

Throughout this group, references may be made to a particular vehicle by letter or number designation. A chart showing the breakdown of these designations is included in the Introduction Section at the front of this service manual.

The Evaporation Control System, is also considered part of the fuel system. The system reduces the emission of fuel vapor into the atmosphere.

The description and function of the Evaporation Control System is found in Group 25 of this manual.

FUEL REQUIREMENTS

Your vehicle was designed to meet all emission regulations and provide excellent fuel economy when using high quality unleaded gasoline.

Use unleaded gasolines having a minimum posted octane of 87.

If your vehicle develops occasional light spark knock (ping) at low engine speeds this is not harmful. However; continued heavy knock at high speeds can cause damage and should be reported to your dealer immediately. Engine damage as a result of heavy knock operation may not be covered by the new vehicle warranty.

In addition to using unleaded gasoline with the proper octane rating, those that contain detergents, corrosion and stability additives are recommended. Using gasolines that have these additives will help improve fuel economy, reduce emissions, and maintain vehicle performance.

Poor quality gasoline can cause problems such as hard starting, stalling, and stumble. If you experience these problems, try another brand of gasoline before considering service for the vehicle.

GASOLINE/OXYGENATE BLENDS

Some fuel suppliers blend unleaded gasoline with materials that contain oxygen such as alcohol, MTBE (Methyl Tertiary Butyl Ether) and ETBE (Ethyl Tertiary Butyl Ether). Oxygenates are required in some areas of the country during winter months to reduce carbon monoxide emissions. The type and amount of oxygenate used in the blend is important.

The following are generally used in gasoline blends:

Ethanol - (Ethyl or Grain Alcohol) properly blended, is used as a mixture of 10 percent ethanol and 90 percent gasoline. Gasoline blended with ethanol may be used in your vehicle.

MTBE/ETBE - Gasoline and MTBE (Methyl Tertiary Butyl Ether) blends are a mixture of unleaded gasoline and up to 15 percent MTBE. Gasoline and ETBE (Ethyl Tertiary Butyl Ether) are blends of gasoline and up to 17 percent ETBE. Gasoline blended with MTBE or ETBE may be used in your vehicle.

Methanol - Methanol (Methyl or Wood Alcohol) is used in a variety of concentrations blended with unleaded gasoline. You may encounter fuels contain-

GENERAL INFORMATION (Continued)

ing 3 percent or more methanol along with other alcohols called cosolvents.

DO NOT USE GASOLINES CONTAINING METHANOL.

Use of methanol/gasoline blends may result in starting and driveability problems and damage critical fuel system components.

Problems that are the result of using methanol/gasoline blends are not the responsibility of Chrysler Corporation and may not be covered by the vehicle warranty.

Reformulated Gasoline

Many areas of the country are requiring the use of cleaner-burning fuel referred to as **Reformulated Gasoline**. Reformulated gasolines are specially blended to reduce vehicle emissions and improve air quality.

Chrysler Corporation strongly supports the use of reformulated gasolines whenever available. Although your vehicle was designed to provide optimum performance and lowest emissions operating on high quality unleaded gasoline, it will perform equally well and produce even lower emissions when operating on reformulated gasoline.

Materials Added to Fuel

Indiscriminate use of fuel system cleaning agents should be avoided. Many of these materials intended for gum and varnish removal may contain active solvents of similar ingredients that can be harmful to fuel system gasket and diaphragm materials.

FUEL REQUIREMENTS—DIESEL ENGINE

WARNING: Do not use alcohol or gasoline as a fuel blending agent. They can be unstable under certain conditions and hazardous or explosive when mixed with diesel fuel.

Use good quality diesel fuel from a reputable supplier in your Dodge truck. For most year-round service, number 2 diesel fuel meeting ASTM specification D-975 will provide good performance. If the vehicle is exposed to extreme cold (below 0°F/-18°C), or is required to operate at colder-than-normal conditions for prolonged periods, use climatized No. 2 diesel fuel or dilute the No. 2 diesel fuel with 50% kerosene or No. 1 diesel fuel. This will provide better protection from fuel gelling or wax-plugging of the fuel filters.

Diesel fuel is seldom completely free of water. To prevent fuel system trouble, including fuel line freezing in winter, drain the accumulated water from the fuel/water separator using the fuel/water separator drain provided. If you buy good-quality fuel and follow the cold-weather advice above, fuel conditioners should not be required in your vehicle If available in your area, a high cetane “premium” diesel fuel may offer improved cold starting and warm-up performance

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FUEL DELIVERY SYSTEM-GASOLINE ENGINE

INDEX

DESCRIPTION AND OPERATION

FUEL DELIVERY SYSTEM—GASOLINE POWERED ENGINES

The fuel delivery system consists of:

- the fuel pump module containing the electric fuel pump, fuel filter/fuel pressure regulator, rollover valve (certain modules), fuel gauge sending unit (fuel level sensor) and a separate fuel filter located at bottom of pump module
- fuel tubes/lines/hoses
- quick-connect fittings
- fuel injector rail
- fuel injectors
- fuel tank
- fuel tank filler/vent tube assembly
- fuel tank filler tube cap
- accelerator pedal
- throttle cable

Fuel is returned through the fuel pump module and back into the fuel tank through the fuel filter/fuel pressure regulator. A separate fuel return line from the engine to the tank is not used with any gasoline powered engine.

The fuel tank assembly consists of: the fuel tank, fuel pump module assembly, fuel pump module locknut/gasket and rollover valve(s) (refer to Group 25, Emission Control System for rollover valve information).

A fuel filler/vent tube assembly using a pressure/vacuum fuel filler cap is used. On vehicles equipped with the California emissions package, the fuel filler tube contains a spring-loaded flap (door) located below the fuel fill cap. The flap is used as a secondary way of sealing the fuel tank if the fuel fill cap has not been properly tightened. It is part of EVAP monitor system when vehicle is equipped with a Leak Detection Pump (LDP).

Also to be considered part of the fuel system is the evaporation control system. This is designed to reduce the emission of fuel vapors into the atmosphere. The description and function of the Evaporative Control System is found in Group 25, Emission Control Systems.

Both fuel filters (at bottom of fuel pump module and within fuel pressure regulator) are designed for

DESCRIPTION AND OPERATION (Continued)

extended service. They do not require normal scheduled maintenance. Filters should only be replaced if a diagnostic procedure indicates to do so.

FUEL PUMP MODULE

The fuel pump module on all gas powered engines is installed in the top of the fuel tank (Fig. 1) or (Fig. 2). The fuel pump module (Fig. 1), (Fig. 2) or (Fig. 3) contains the following:

- A combination fuel filter/fuel pressure regulator
- Electric fuel pump
- Fuel pump reservoir
- A separate in-tank fuel filter (at bottom of module)
- Rollover valve (certain modules)
- Fuel gauge sending unit (fuel level sensor)
- Fuel supply line connection at filter/regulator
- A threaded locknut retaining pump module to fuel tank
- A gasket between tank flange and module
- Auxiliary non-pressurized fuel supply fitting (not all engines)

The fuel gauge sending unit (fuel level sensor), and pick-up filter (at bottom of module) may be serviced separately. If the electrical fuel pump requires service, the entire fuel pump module must be replaced. The fuel filter/fuel pressure regulator may be serviced separately. Refer to Fuel Filter/Fuel Pressure Regulator Removal/Installation for additional information.

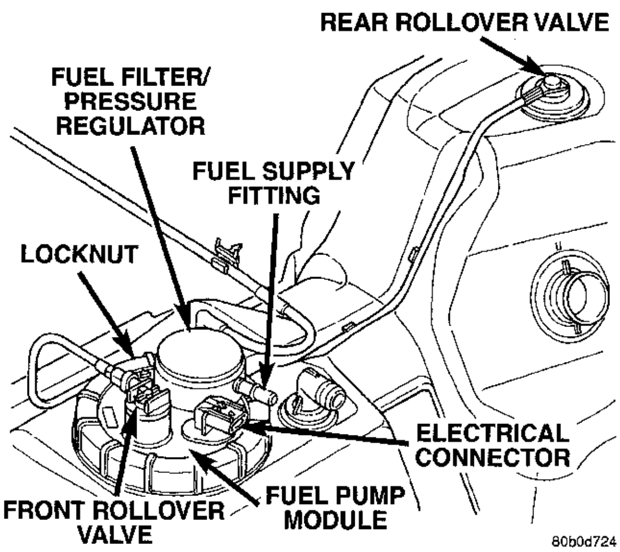

Fig. 1 Top View Fuel Pump Module—Gas Powered With 26 or 34 Gallon Tank—Typical

FUEL PUMP

The fuel pump used in this system has a permanent magnet electric motor. The pump is part of the fuel pump module. Fuel is drawn in through a filter

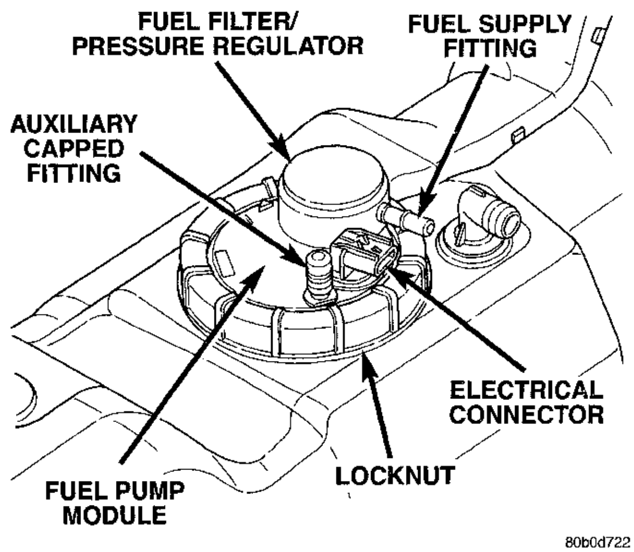

Fig. 2 Top View Fuel Pump Module—Gas Powered With 35 Gallon Tank—Typical

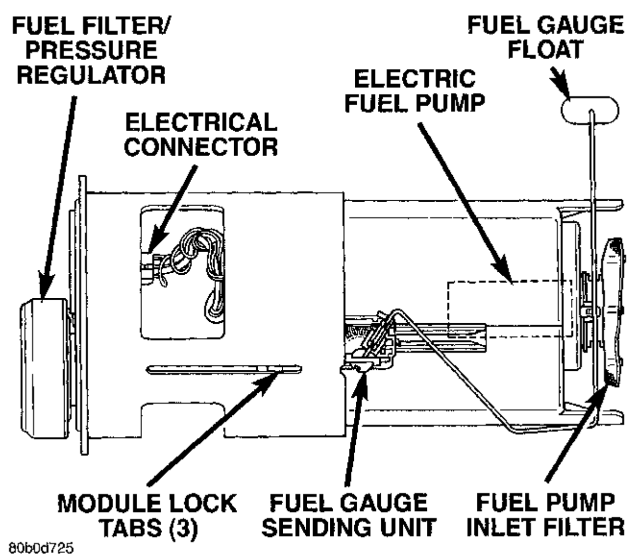

Fig. 3 Fuel Pump Module Components—Gas Powered Engines (Typical Module Shown)

at the bottom of the module and pushed through the electric motor gearset to the pump outlet.

Check Valve Operation: The pump outlet contains a one-way check valve to prevent fuel flow back into the tank and to maintain fuel supply line pressure (engine warm) when pump is not operational. It is also used to keep the fuel supply line full of gasoline when pump is not operational. After the vehicle has cooled down, fuel pressure may drop to 0 psi (cold fluid contracts), but liquid gasoline will remain in fuel supply line between the check valve and fuel injectors. **Fuel pressure that has dropped to 0 psi on a cooled down vehicle (engine off) is a**

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DESCRIPTION AND OPERATION (Continued)

normal condition. Refer to the Fuel Pressure Leak Down Test in this group for more information.

Voltage to operate the electric pump is supplied through the fuel pump relay.

FUEL GAUGE SENDING UNIT

The fuel gauge sending unit (fuel level sensor) is attached to the side of the fuel pump module. The sending unit consists of a float, an arm, and a variable resistor (track). The resistor track is used to send electrical signals to the Powertrain Control Module (PCM) for fuel gauge operation and for OBD II emission requirements.

For fuel gauge operation: As fuel level increases, the float and arm move up. This decreases the sending unit resistance, causing the fuel gauge to read full. As fuel level decreases, the float and arm move down. This increases the sending unit resistance causing the fuel gauge to read empty.

After this fuel level signal is sent to the PCM, the PCM will transmit the data across the CCD bus circuits to the instrument panel. Here it is translated into the appropriate fuel gauge level reading.

For OBD II emission monitor requirements: A voltage signal is sent from the resistor track on the sending unit to the PCM to indicate fuel level. The purpose of this feature is to prevent the OBD II system from recording/setting false misfire and fuel system monitor trouble codes. The feature is activated if the fuel level in the tank is less than approximately 15 percent of its rated capacity. If equipped with a Leak Detection Pump (EVAP system monitor), this feature will also be activated if the fuel level in the tank is more than approximately 85 percent of its rated capacity.

FUEL FILTER/FUEL PRESSURE REGULATOR

A combination fuel filter and fuel pressure regulator (Fig. 4) is used on all engines. It is located on the top of the fuel pump module. A separate frame mounted fuel filter is not used with any engine.

Both fuel filters (at bottom of fuel pump module and within fuel pressure regulator) are designed for extended service. They do not require normal scheduled maintenance. Filters should only be replaced if a diagnostic procedure indicates to do so.

Fuel Pressure Regulator Operation: The pressure regulator is a mechanical device that is not controlled by engine vacuum or the powertrain control module (PCM).

The regulator is calibrated to maintain fuel system operating pressure of approximately 339 kPa ± 34 kPa (49.2 psi ± 5 psi) at the fuel injectors. It contains a diaphragm, calibrated springs and a fuel return valve. The internal fuel filter (Fig. 4) is also part of the assembly.

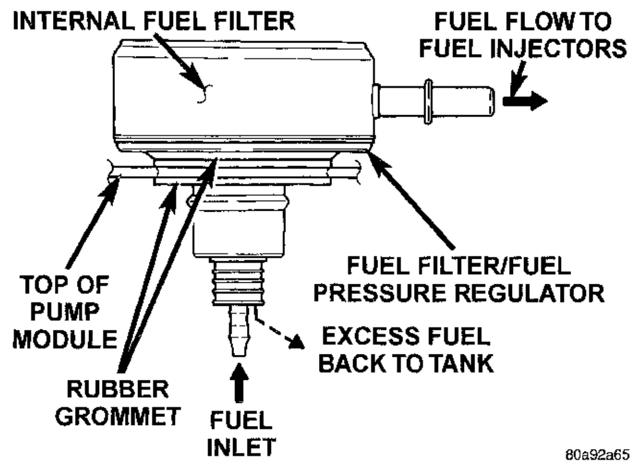


Fig. 4 Side View—Filter/Regulator

Fuel is supplied to the filter/regulator by the electric fuel pump through an opening tube at the bottom of filter/regulator (Fig. 4).

The regulator acts as a check valve to maintain some fuel pressure when the engine is not operating. This will help to start the engine. A second check valve is located at the outlet end of the electric fuel pump. **Refer to Fuel Pump—Description and Operation for more information. Also refer to the Fuel Pressure Leak Down Test and the Fuel Pump Pressure Tests.**

If fuel pressure at the pressure regulator exceeds approximately 49.2 psi, an internal diaphragm opens and excess fuel pressure is routed back into the tank through the bottom of pressure regulator.

FUEL TANK

All models pass a full 360 degree rollover test without fuel leakage. To accomplish this, fuel and vapor flow controls are required for all fuel tank connections.

All models are equipped with either one or two rollover valves mounted into the top of the fuel tank (or pump module). Refer to Group 25, Emission Control System for rollover valve information.

An evaporation control system is connected to the rollover valve(s) to reduce emissions of fuel vapors into the atmosphere. When fuel evaporates from the fuel tank, vapors pass through vent hoses or tubes to a charcoal canister where they are temporarily held. When the engine is running, the vapors are drawn into the intake manifold. Certain models are also equipped with a self-diagnosing system using a Leak Detection Pump (LDP). Refer to Group 25, Emission Control System for additional information.

ROLLOVER VALVE(S)

Refer to Group 25, Emission Control System for information.

DESCRIPTION AND OPERATION (Continued)

FUEL INJECTORS

The fuel injectors (Fig. 5) are electrical solenoids. The injector contains a pintle that closes off an orifice at the nozzle end. When electric current is supplied to the injector, the armature and needle move a short distance against a spring, allowing fuel to flow out the orifice. Because the fuel is under high pressure, a fine spray is developed in the shape of a pencil stream. The spraying action atomizes the fuel, adding it to the air entering the combustion chamber.

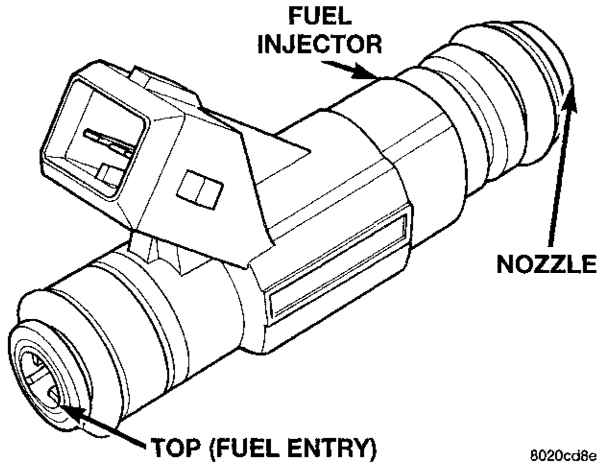


Fig. 5 Fuel Injector—Typical

An individual fuel injector is used for each individual cylinder. The top (fuel entry) end of the injector is attached into an opening on the fuel rail.

The nozzle (outlet) ends of the injectors are positioned into openings in the intake manifold just above the intake valve ports of the cylinder head. The engine wiring harness connector for each fuel injector is equipped with an attached numerical tag (INJ 1, INJ 2 etc.). This is used to identify each fuel injector.

The injectors are energized individually in a sequential order by the powertrain control module (PCM). The PCM will adjust injector pulse width by switching the ground path to each individual injector on and off. Injector pulse width is the period of time that the injector is energized. The PCM will adjust injector pulse width based on various inputs it receives.

During start up, battery voltage is supplied to the injectors through the ASD relay. When the engine is operating, voltage is supplied by the charging system. The PCM determines injector pulse width based on various inputs.

FUEL RAIL—3.9/5.2/5.9L ENGINES

The fuel rail supplies the necessary fuel to each individual fuel injector and is mounted to the intake manifold (Fig. 6). The fuel pressure regulator is not mounted to the fuel rail on any engine. It is located on the fuel tank mounted fuel pump module. Refer to Fuel Filter/Fuel Pressure Regulator in this section of group for information.

The fuel rail is not repairable.

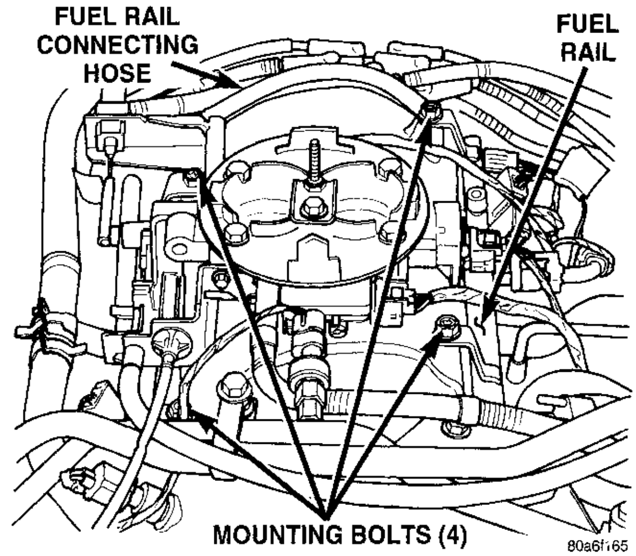


Fig. 6 Fuel Rail—3.9/5.2/5.9L Engine—Typical

CAUTION: The left and right sections of the fuel rail are connected with a flexible connecting hose. Do not attempt to separate the rail halves at this connecting hose. Due to the design of this connecting hose, it does not use any clamps. Never attempt to install a clamping device of any kind to the hose. When removing the fuel rail assembly for any reason, be careful not to bend or kink the connecting hose.

FUEL RAIL—8.0L ENGINE

The fuel rail supplies the necessary fuel to each individual fuel injector and is mounted to the lower half of the two-piece intake manifold (Fig. 7). The metal, one-piece fuel rail is not repairable.

FUEL TANK FILLER TUBE CAP

The loss of any fuel or vapor out of filler neck is prevented by the use of a pressure-vacuum fuel tank filler tube cap. Relief valves inside the cap will release fuel tank pressure at predetermined pressures. Fuel tank vacuum will also be released at predetermined values. This cap must be replaced by a similar unit if replacement is necessary. This is in order for the system to remain effective.

DESCRIPTION AND OPERATION (Continued)

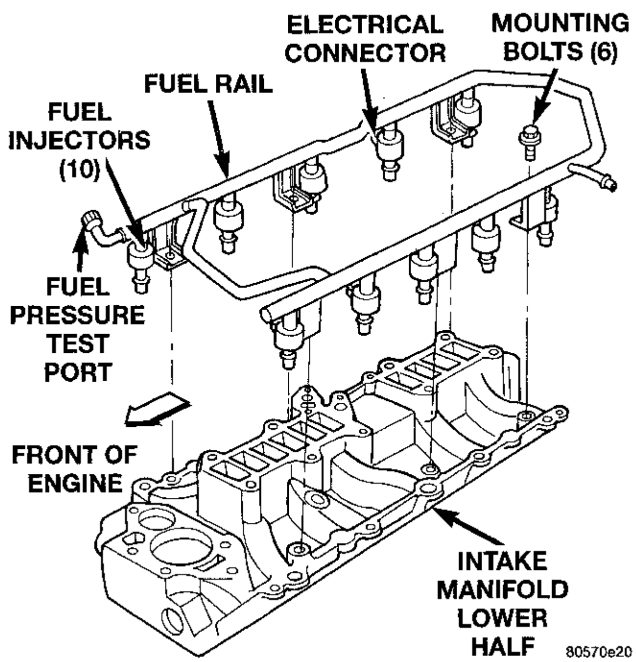


Fig. 7 Fuel Rail—8.0L Engine

CAUTION: Remove fuel tank filler tube cap before servicing any fuel system component. This is done to help relieve tank pressure. If equipped with a California emissions package and a Leak Detection Pump (LDP), the secondary seal below the fill cap must be pressed (opened) to relieve fuel tank pressure.

QUICK-CONNECT FITTINGS

Different types of quick-connect fittings are used to attach various fuel system components. These are: a single-tab type, a two-tab type or a plastic retainer ring type. Some are equipped with safety latch clips. Refer to the Removal/Installation section for more information.

CAUTION: The interior components (o-rings, spacers) of quick-connect fitting are not serviced separately, but new pull tabs are available for some types. Do not attempt to repair damaged fittings or fuel lines/tubes. If repair is necessary, replace the complete fuel tube assembly.

DIAGNOSIS AND TESTING

FUEL PUMP PRESSURE TEST—ALL ENGINES WITH PRESSURE TEST PORT

Use this test in conjunction with the Fuel Pump Capacity Test, Fuel Pressure Leak Down Test and Fuel Pump Amperage Test found elsewhere in this group.

Check Valve Operation: The electric fuel pump outlet contains a one-way check valve to prevent fuel flow back into the tank and to maintain fuel supply line pressure (engine warm) when pump is not operational. It is also used to keep the fuel supply line full of gasoline when pump is not operational. After the vehicle has cooled down, fuel pressure may drop to 0 psi (cold fluid contracts), but liquid gasoline will remain in fuel supply line between the check valve and fuel injectors. **Fuel pressure that has dropped to 0 psi on a cooled down vehicle (engine off) is a normal condition.** When the electric fuel pump is activated, fuel pressure should **immediately** (1–2 seconds) rise to specification.

All fuel systems are equipped with a fuel tank module mounted, combination fuel filter/fuel pressure regulator. The fuel pressure regulator is not controlled by engine vacuum.

WARNING: THE FUEL SYSTEM IS UNDER CONSTANT FUEL PRESSURE EVEN WITH THE ENGINE OFF. BEFORE DISCONNECTING FUEL LINE AT FUEL RAIL, THIS PRESSURE MUST BE RELEASED. REFER TO THE FUEL SYSTEM PRESSURE RELEASE PROCEDURE.

(1) Remove protective cap at fuel rail test port. Connect the 0–414 kPa (0-60 psi) fuel pressure gauge (from gauge set 5069) to test port pressure fitting on fuel rail (Fig. 8).

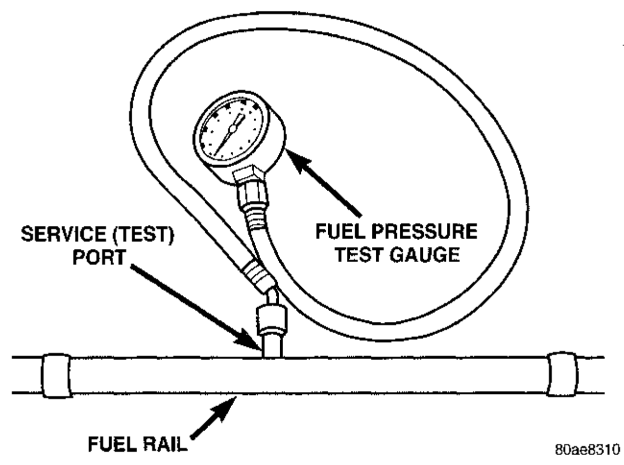


Fig. 8 Fuel Pressure Test Gauge (Typical Gauge Installation at Test Port)

(2) Start and warm engine and note pressure gauge reading. Fuel pressure should be 339 kPa ± 34 kPa (49.2 psi ± 5 psi) at idle.

(3) If engine runs, but pressure is below 44.2 psi, check for a kinked fuel supply line somewhere between fuel rail and fuel pump module. If line is not kinked, but specifications for either the Fuel Pump Capacity, Fuel Pump Amperage or Fuel Pressure

DIAGNOSIS AND TESTING (Continued)

Leak Down Tests were not met, replace fuel pump module assembly. Refer to Fuel Pump Module Removal/Installation.

(4) If operating pressure is above 54.2 psi, electric fuel pump is OK, but fuel pressure regulator is defective. Replace fuel filter/fuel pressure regulator. Refer to Fuel Filter/Fuel Pressure Regulator Removal/Installation for more information.

(5) Install protective cap to fuel rail test port.

FUEL PUMP CAPACITY TEST

Before performing this test, verify fuel pump pressure by performing the Fuel Pump Pressure Test. Use this test in conjunction with the Fuel Pressure Leak Down Test found elsewhere in this group.

(1) Release fuel system pressure. Refer to the Fuel Pressure Release Procedure in this group.

(2) Disconnect fuel supply line at fuel rail. Refer to Quick-Connect Fittings in the Service Procedures section of this group for procedures. Some engines may require air cleaner housing removal before line disconnection.

(3) Connect appropriate Fuel Line Pressure Test Adapter Tool Hose (number 6631, 6923, 6541 or 6539) into disconnected fuel supply line. Insert other end of Adaptor Tool hose into a graduated container.

(4) Remove fuel fill cap.

(5) To activate fuel pump and pressurize system, obtain DRB scan tool and actuate ASD Fuel System Test.

(6) A good fuel pump will deliver at least 1/4 liter of fuel in 7 seconds. Do not operate fuel pump for longer than 7 seconds with fuel line disconnected as fuel pump module reservoir may run empty.

(a) If capacity is lower than specification, but fuel pump can be heard operating through fuel fill cap opening, check for a kinked/damaged fuel supply line somewhere between fuel rail and fuel pump module.

(b) If line is not kinked/damaged, and fuel pressure is OK, but capacity is low, replace fuel filter/fuel pressure regulator. The filter/regulator may be serviced separately on certain applications. Refer to Fuel Filter/Fuel Pressure Regulator Removal/Installation for additional information.

(c) If both fuel pressure and capacity are low, replace fuel pump module assembly. Refer to Fuel Pump Module Removal/Installation.

FUEL PRESSURE LEAK DOWN TEST

Use this test in conjunction with the Fuel Pump Pressure Test and Fuel Pump Capacity Test.

Check Valve Operation: The electric fuel pump outlet contains a one-way check valve to prevent fuel flow back into the tank and to maintain fuel supply line pressure (engine warm) when pump is not operational. It is also used to keep the fuel supply line full of gasoline when pump is not operational. After the vehicle has cooled down, fuel pressure may drop to 0 psi (cold fluid contracts), but liquid gasoline will remain in fuel supply line between the check valve and fuel injectors. **Fuel pressure that has dropped to 0 psi on a cooled down vehicle (engine off) is a normal condition.** When the electric fuel pump is activated, fuel pressure should **immediately** (1–2 seconds) rise to specification.

Abnormally long periods of cranking to restart a **hot** engine that has been shut down for a short period of time may be caused by:

- Fuel pressure bleeding past a fuel injector(s).
- Fuel pressure bleeding past the check valve in the fuel pump module.

(1) Disconnect the fuel inlet line at fuel rail. Refer to Fuel Tubes/Lines/Hoses and Clamps in this section of the group for procedures. On some engines, air cleaner housing removal may be necessary before fuel line disconnection.

(2) Connect the appropriate Fuel Line Pressure Test Adapter Tool (number 6539, 6631, 6541 or 6923) between the disconnected fuel line and fuel rail (Fig. 9) or (Fig. 10).

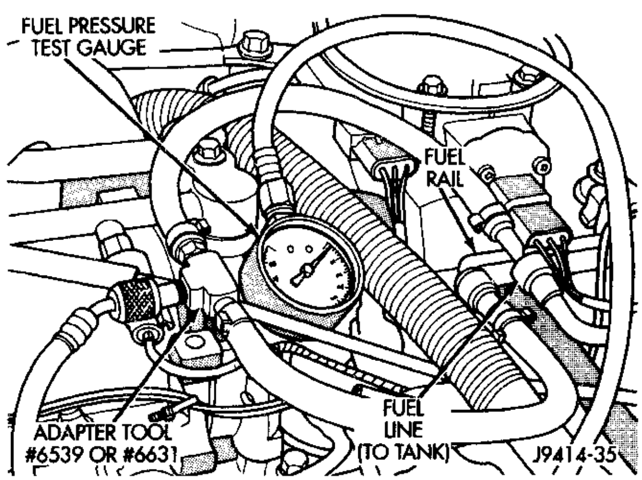


Fig. 9 Connecting Adapter Tool—Typical

(3) Connect the 0-414 kPa (0-60 psi) fuel pressure test gauge (from Gauge Set 5069) to the test port on the appropriate Adaptor Tool. **The fittings on both tools must be in good condition and free from any small leaks before performing the proceeding test.**

(4) Start engine and bring to normal operating temperature.

(5) Observe test gauge. Normal operating pressure should be 339 kPa ± 34 kPa (49.2 psi ± 5 psi).

(6) Shut engine off.

DIAGNOSIS AND TESTING (Continued)

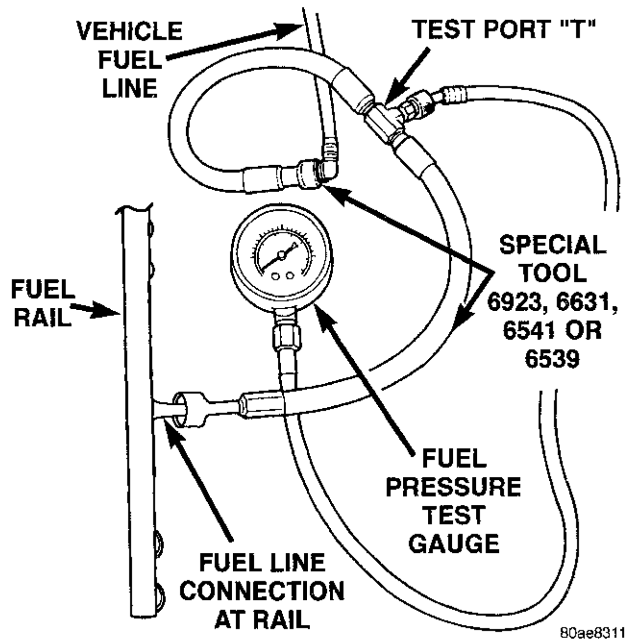


Fig. 10 Connecting Adapter Tool—Typical

(7) Pressure should not fall below **30 psi for five minutes.**

(8) If pressure falls below 30 psi, it must be determined if a fuel injector, the check valve within the fuel pump module, or a fuel tube/line is leaking.

(9) Again, start engine and bring to normal operating temperature.

(10) Shut engine off.

(11) **Testing for fuel injector or fuel rail leakage:** Clamp off the rubber hose portion of Adaptor Tool between the fuel rail and the test port "T" on Adapter Tool. If pressure now holds at or above 30 psi, a fuel injector or the fuel rail is leaking.

(12) **Testing for fuel pump check valve, filter/regulator check valve or fuel tube/line leakage:** Clamp off the rubber hose portion of Adaptor Tool between the vehicle fuel line and test port "T" on Adapter Tool. If pressure now holds at or above 30 psi, a leak may be found at a fuel tube/line. If no leaks are found at fuel tubes or lines, one of the check valves in either the electric fuel pump or filter/regulator may be leaking.

Note: A quick loss of pressure usually indicates a defective check valve in the filter/regulator. A slow loss of pressure usually indicates a defective check valve in the electric fuel pump.

The electric fuel pump is not serviced separately. Replace the fuel pump module assembly. The filter/regulator may be replaced separately on certain applications. Refer to Fuel Filter/Fuel Pressure Regulator Removal/Installation for additional information.

FUEL PUMP AMPERAGE TEST

This amperage (current draw) test is to be done in conjunction with the Fuel Pump Pressure Test, Fuel Pump Capacity Test and Fuel Pressure Leak Down Test. Before performing the amperage test, be sure the temperature of the fuel tank is above 50° F (10° C).

The DRB Scan Tool along with the DRB Low Current Shunt (LCS) adapter (Fig. 11) and its test leads will be used to check fuel pump amperage specifications.

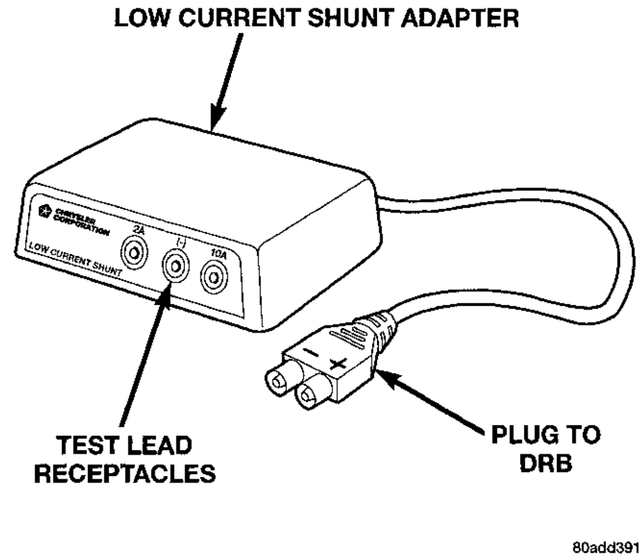


Fig. 11 Low Current Shunt Adapter

(1) Obtain LCS adapter.

(2) Plug cable from LCS adapter into DRB scan tool at SET 1 receptacle.

(3) Plug DRB into vehicle 16–way connector (data link connector).

(4) Connect (-) and (+) test cable leads into LCS adapter receptacles. Use **10 amp (10A +)** receptacle and common (-) receptacles.

(5) Gain access to MAIN MENU on DRB screen.

(6) Press DVOM button on DRB.

(7) Using left/right arrow keys, highlight CHANNEL 1 function on DRB screen.

(8) Press ENTER three times.

(9) Using up/down arrow keys, highlight RANGE on DRB screen (screen will default to 2 amp scale).

(10) Press ENTER to change 2 amp scale to 10 amp scale. **This step must be done to prevent damage to DRB scan tool or LCS adapter (blown fuse).**

(11) Remove cover from Power Distribution Center (PDC).

(12) Remove fuel pump relay from PDC. Refer to label on PDC cover for relay location.

DIAGNOSIS AND TESTING (Continued)

WARNING: BEFORE PROCEEDING TO NEXT STEP, NOTE THE FUEL PUMP WILL BE ACTIVATED AND SYSTEM PRESSURE WILL BE PRESENT. THIS WILL OCCUR AFTER CONNECTING TEST LEADS FROM LCS ADAPTER INTO FUEL PUMP RELAY CAVITIES. THE FUEL PUMP WILL OPERATE EVEN WITH IGNITION KEY IN OFF POSITION. BEFORE ATTACHING TEST LEADS, BE SURE ALL FUEL LINES AND FUEL SYSTEM COMPONENTS ARE CONNECTED.

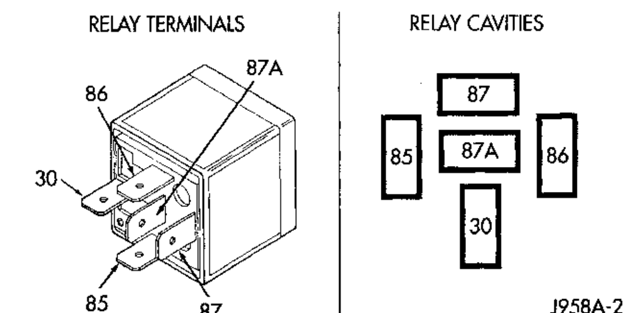
CAUTION: TO PREVENT POSSIBLE DAMAGE TO THE VEHICLE ELECTRICAL SYSTEM AND LCS ADAPTER, THE TEST LEADS MUST BE CONNECTED INTO RELAY CAVITIES EXACTLY AS SHOWN IN FOLLOWING STEPS.

Depending upon vehicle model, year or engine configuration, three different types of relays may be used: Type-1, type-2 and type–3.

(13) If equipped with **type–1 relay** (Fig. 12), attach test leads from LCS adapter into PDC relay cavities number 30 and 87. For location of these cavities, refer to numbers stamped to bottom of relay (Fig. 12).

(14) If equipped with **type–2 relay** (Fig. 13), attach test leads from LCS adapter into PDC relay cavities number 30 and 87. For location of these cavities, refer to numbers stamped to bottom of relay (Fig. 13).

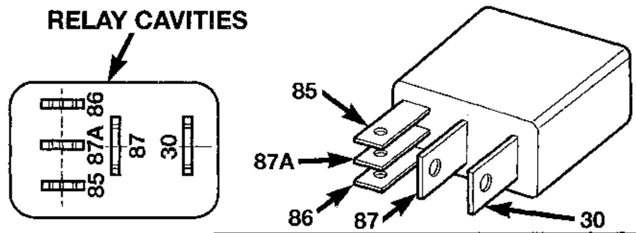
(15) If equipped with **type–3 relay** (Fig. 14), attach test leads from LCS adapter into PDC relay cavities number 3 and 5. For location of these cavities, refer to numbers stamped to bottom of relay (Fig. 14).



TERMINAL LEGEND	
NUMBER	IDENTIFICATION
30	COMMON FEED
85	COIL GROUND
86	COIL BATTERY
87	NORMALLY OPEN
87A	NORMALLY CLOSED

Fig. 12 Type–1 Relay

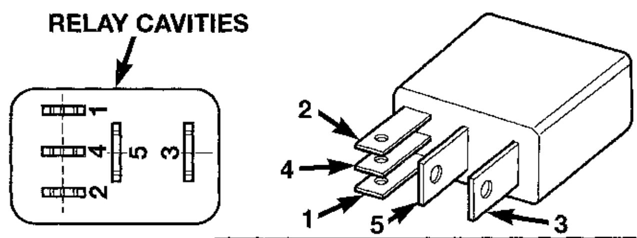
(16) When LCS adapter test leads are attached into relay cavities, fuel pump **will be activated.** Determine fuel pump amperage on DRB screen. Amperage should be below 10.0 amps. If amperage is below 10.0 amps, and specifications for the Fuel Pump Pressure, Fuel Pump Capacity and Fuel Pressure Leak Down tests were met, the fuel pump module is OK.



TERMINAL LEGEND	
NUMBER	IDENTIFICATION
30	COMMON FEED
85	COIL GROUND
86	COIL BATTERY
87	NORMALLY OPEN
87A	NORMALLY CLOSED

80add392

Fig. 13 Type–2 Relay



TERMINAL LEGEND	
NUMBER	IDENTIFICATION
1	COIL BATTERY
2	COIL GROUND
3	COMMON FEED
4	NORMALLY CLOSED
5	NORMALLY OPEN

80add390

Fig. 14 Type–3 Relay

(17) If amperage is more than 10.0 amps, replace fuel pump module assembly. The electric fuel pump is not serviced separately.

(18) Disconnect test leads from relay cavities immediately after testing.

FUEL GAUGE SENDING UNIT

The fuel gauge sending unit contains a variable resistor (track). As the float moves up or down, electrical resistance will change. Refer to Group 8E, Instrument Panel and Gauges for Fuel Gauge testing. To test the gauge sending unit only, it must be removed from vehicle. The unit is part of the fuel pump module. Refer to Fuel Pump Module Removal/ Installation for procedures. Measure the resistance across the sending unit terminals. With float in up position, resistance should be 20 ohms ±6 ohms.

AUTHENTIC RESTORATION PRODUCTS

DIAGNOSIS AND TESTING (Continued)

With float in down position, resistance should be 220 ohms ±6 ohms.

FUEL INJECTOR TEST

To perform a complete test of the fuel injectors and their circuitry, refer to DRB scan tool and appropriate Powertrain Diagnostics Procedures manual. To test the injector only, refer to the following:

Disconnect the fuel injector wire harness connector from the injector. Place an ohmmeter across the injector electrical terminals. Resistance reading should be approximately 12 ohms ±1.2 ohms at 20°C (68°F).

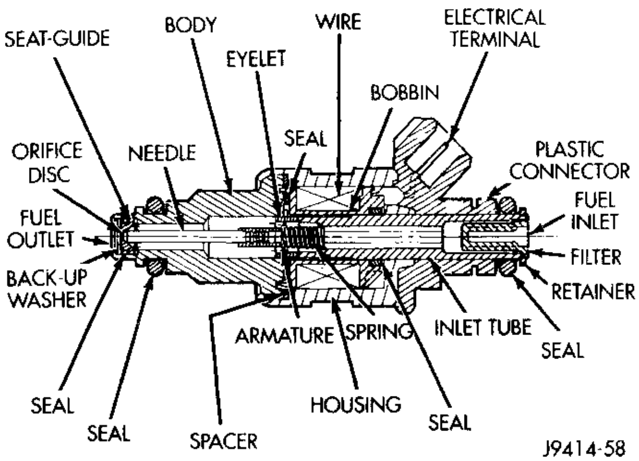


Fig. 15 Fuel Injector Internal Components—Typical

SERVICE PROCEDURES

FUEL SYSTEM PRESSURE RELEASE PROCEDURE

Use following procedure if fuel rail is or is not equipped with fuel pressure test port.

(1) Remove fuel fill cap.

(2) The fuel filler tube contains a spring-loaded flap (door) located below fuel fill cap. The flap is used as a secondary way of sealing fuel tank if fuel fill cap has not been properly tightened. It is part of EVAP monitor system when vehicle is equipped with a Leak Detection Pump (LDP). **The vehicle may be equipped with flap installed into fuel filler tube even though vehicle is not equipped with LDP and EVAP monitor system.** Place a nonmetallic object into fuel fill tube and press on flap to relieve any tank pressure.

(3) Remove Fuel Pump relay from Power Distribution Center (PDC). For location of relay, refer to label on underside of PDC cover.

(4) Start and run engine until it stalls.

(5) Attempt restarting engine until it will no longer run.

(6) Turn ignition key to OFF position.

CAUTION: Steps 1, 2, 3 and 4 must be performed to relieve high pressure fuel from within fuel rail. Do not attempt to use following steps to relieve this pressure as excessive fuel will be forced into a cylinder chamber.

(7) Unplug connector from any injector.

(8) Attach one end of a jumper wire with alligator clips (18 gauge or smaller) to either injector terminal.

(9) Connect other end of jumper wire to positive side of battery.

(10) Connect one end of a second jumper wire to remaining injector terminal.

CAUTION: Powering an injector for more than a few seconds will permanently damage the injector.

(11) Momentarily touch other end of jumper wire to negative terminal of battery for no more than a few seconds.

(12) Place a rag or towel below fuel line quick-connect fitting at fuel rail.

(13) Disconnect quick-connect fitting at fuel rail. Refer to Quick-Connect Fittings in this section.

(14) Return fuel pump relay to PDC.

(15) One or more Diagnostic Trouble Codes (DTC's) may have been stored in PCM memory due to fuel pump relay removal. The DRB scan tool must be used to erase a DTC. Refer to Group 25, Emission Control System. See On-Board Diagnostics.

FUEL TUBES/LINES/HOSES AND CLAMPS

Also refer to the section on Quick-Connect Fittings.

WARNING: THE FUEL SYSTEM IS UNDER A CONSTANT PRESSURE (EVEN WITH THE ENGINE OFF). BEFORE SERVICING ANY FUEL SYSTEM HOSES, FITTINGS OR LINES, THE FUEL SYSTEM PRESSURE MUST BE RELEASED. REFER TO THE FUEL SYSTEM PRESSURE RELEASE PROCEDURE IN THIS GROUP.

Inspect all hose connections such as clamps, couplings and fittings to make sure they are secure and leaks are not present. The component should be replaced immediately if there is any evidence of degradation that could result in failure.

Never attempt to repair a plastic fuel line/tube. Replace as necessary.

Avoid contact of any fuel tubes/hoses with other vehicle components that could cause abrasions or scuffing. Be sure that the plastic fuel lines/tubes are properly routed to prevent pinching and to avoid heat sources.

The lines/tubes/hoses used on fuel injected vehicles are of a special construction. This is due to the higher fuel pressures and the possibility of contami-

SERVICE PROCEDURES (Continued)

nated fuel in this system. If it is necessary to replace these lines/tubes/hoses, only those marked EFM/EFI may be used.

If equipped: The hose clamps used to secure rubber hoses on fuel injected vehicles are of a special rolled edge construction. This construction is used to prevent the edge of the clamp from cutting into the hose. Only these rolled edge type clamps may be used in this system. All other types of clamps may cut into the hoses and cause high-pressure fuel leaks.

Use new original equipment type hose clamps. Tighten hose clamps to 3 N·m (25 in. lbs.) torque.

QUICK-CONNECT FITTINGS

Also refer to the Fuel Tubes/Lines/Hoses and Clamps section.

Different types of quick-connect fittings are used to attach various fuel system components. These are: a single-tab type, a two-tab type, a plastic retainer ring type or a latch clip type. Certain fittings may require the use of a special tool for disconnection.

SINGLE-TAB TYPE

This type of fitting is equipped with a single pull tab (Fig. 16). The tab is removable. After the tab is removed, the quick-connect fitting can be separated from the fuel system component.

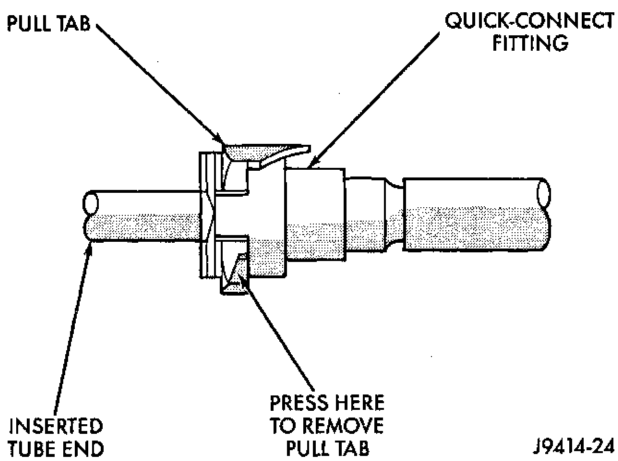


Fig. 16 Single-Tab Type Fitting

CAUTION: The interior components (o-rings, spacers) of this type of quick-connect fitting are not serviced separately, but new pull tabs are available. Do not attempt to repair damaged fittings or fuel lines/ tubes. If repair is necessary, replace the complete fuel tube assembly.

WARNING: THE FUEL SYSTEM IS UNDER A CONSTANT PRESSURE (EVEN WITH THE ENGINE OFF). BEFORE SERVICING ANY FUEL SYSTEM HOSES, FITTINGS OR LINES, THE FUEL SYSTEM PRESSURE MUST BE RELEASED. REFER TO THE FUEL SYSTEM PRESSURE RELEASE PROCEDURE IN THIS GROUP.

DISCONNECTION/CONNECTION

(1) Perform fuel pressure release procedure. Refer to Fuel Pressure Release Procedure in this group.

(2) Disconnect negative battery cable from battery.

(3) Clean fitting of any foreign material before disassembly.

(4) Press release tab on side of fitting to release pull tab (Fig. 17).

CAUTION: If this release tab is not pressed prior to releasing the pull tab, the pull tab will be damaged.

(5) While pressing release tab on side of fitting, use a screwdriver to pry up pull tab (Fig. 17).

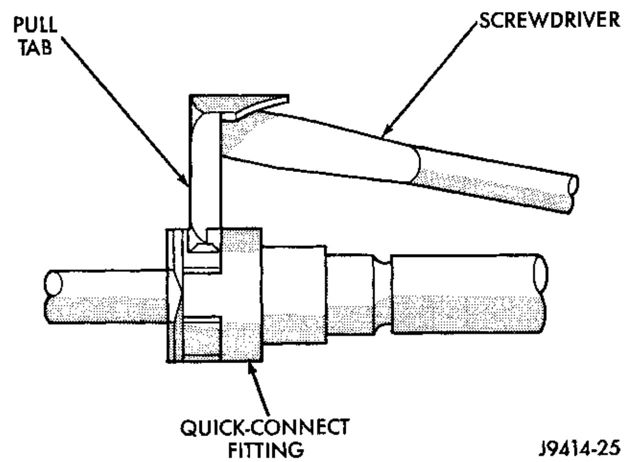


Fig. 17 Disconnecting Single-Tab Type Fitting

(6) Raise pull tab until it separates from quick-connect fitting (Fig. 18). Discard old pull tab.

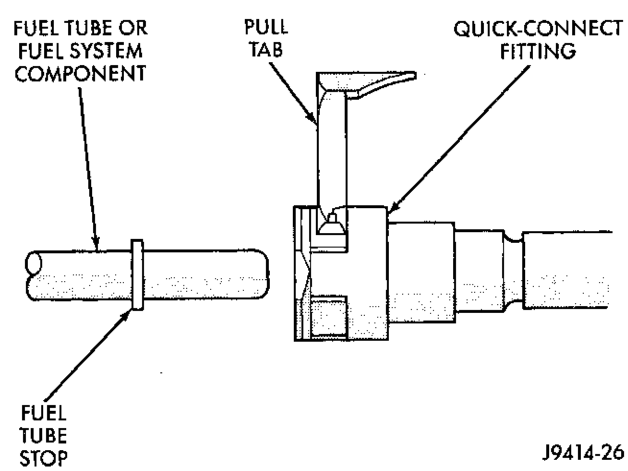


Fig. 18 Removing Pull Tab

SERVICE PROCEDURES (Continued)

(7) Disconnect quick-connect fitting from fuel system component being serviced.

(8) Inspect quick-connect fitting body and fuel system component for damage. Replace as necessary.

(9) Prior to connecting quick-connect fitting to component being serviced, check condition of fitting and component. Clean parts with a lint-free cloth. Lubricate with clean engine oil.

(10) Insert quick-connect fitting into fuel tube or fuel system component until built-on stop on fuel tube or component rests against back of fitting.

(11) Obtain a new pull tab. Push new tab down until it locks into place in quick-connect fitting.

(12) Verify a locked condition by firmly pulling on fuel tube and fitting (15-30 lbs.).

(13) Connect negative cable to battery.

(14) Start engine and check for leaks.

TWO-TAB TYPE FITTING

This type of fitting is equipped with tabs located on both sides of the fitting (Fig. 19). These tabs are supplied for disconnecting the quick-connect fitting from component being serviced.

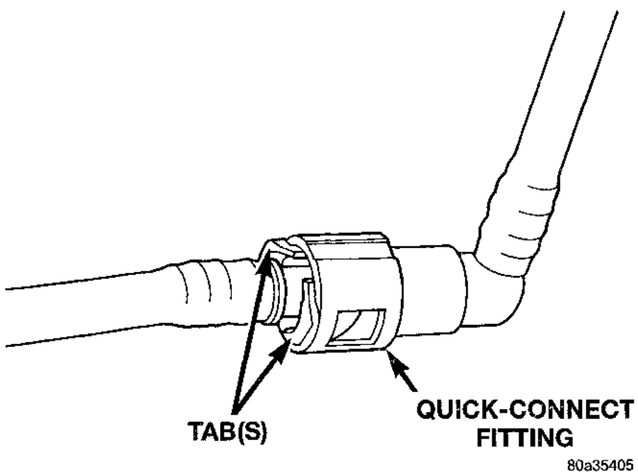


Fig. 19 Typical Two-Tab Type Quick-Connect Fitting

CAUTION: The interior components (o-rings, spacers) of this type of quick-connect fitting are not serviced separately, but new plastic retainers are available. Do not attempt to repair damaged fittings or fuel lines/tubes. If repair is necessary, replace the complete fuel tube assembly.

WARNING: THE FUEL SYSTEM IS UNDER A CONSTANT PRESSURE (EVEN WITH THE ENGINE OFF). BEFORE SERVICING ANY FUEL SYSTEM HOSES, FITTINGS OR LINES, THE FUEL SYSTEM PRESSURE MUST BE RELEASED. REFER TO THE FUEL PRESSURE RELEASE PROCEDURE IN THIS GROUP.

DISCONNECTION/CONNECTION

(1) Perform fuel pressure release procedure. Refer to Fuel Pressure Release Procedure in this group.

(2) Disconnect negative battery cable from battery.

(3) Clean fitting of any foreign material before disassembly.

(4) To disconnect quick-connect fitting, squeeze plastic retainer tabs (Fig. 19) against sides of quick-connect fitting with your fingers. Tool use is not required for removal and may damage plastic retainer. Pull fitting from fuel system component being serviced. The plastic retainer will remain on component being serviced after fitting is disconnected. The o-rings and spacer will remain in quick-connect fitting connector body.

(5) Inspect quick-connect fitting body and component for damage. Replace as necessary.

CAUTION: When the quick-connect fitting was disconnected, the plastic retainer will remain on the component being serviced. If this retainer must be removed, very carefully release the retainer from the component with two small screwdrivers. After removal, inspect the retainer for cracks or any damage.

(6) Prior to connecting quick-connect fitting to component being serviced, check condition of fitting and component. Clean parts with a lint-free cloth. Lubricate with clean engine oil.

(7) Insert quick-connect fitting to component being serviced and into plastic retainer. When a connection is made, a click will be heard.

(8) Verify a locked condition by firmly pulling on fuel tube and fitting (15-30 lbs.).

(9) Connect negative cable to battery.

(10) Start engine and check for leaks.

PLASTIC RETAINER RING TYPE FITTING

This type of fitting can be identified by the use of a full-round plastic retainer ring (Fig. 20) usually black in color.

CAUTION: The interior components (o-rings, spacers, retainers) of this type of quick-connect fitting are not serviced separately. Do not attempt to repair damaged fittings or fuel lines/tubes. If repair is necessary, replace the complete fuel tube assembly.

WARNING: THE FUEL SYSTEM IS UNDER A CONSTANT PRESSURE (EVEN WITH THE ENGINE OFF). BEFORE SERVICING ANY FUEL SYSTEM HOSES, FITTINGS OR LINES, THE FUEL SYSTEM PRESSURE MUST BE RELEASED. REFER TO THE FUEL SYSTEM PRESSURE RELEASE PROCEDURE IN THIS GROUP.

SERVICE PROCEDURES (Continued)

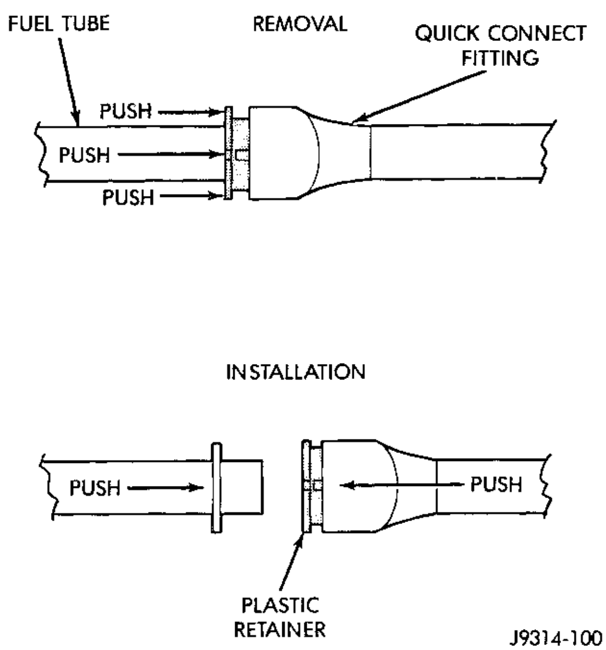


Fig. 20 Plastic Retainer Ring Type Fitting

DISCONNECTION/CONNECTION

(1) Perform fuel pressure release procedure. Refer to Fuel Pressure Release Procedure in this section.

(2) Disconnect negative battery cable from battery.

(3) Clean fitting of any foreign material before disassembly.

(4) To release fuel system component from quick-connect fitting, firmly push fitting towards component being serviced while firmly pushing plastic retainer ring into fitting (Fig. 20). With plastic ring depressed, pull fitting from component. **The plastic retainer ring must be pressed squarely into fitting body. If this retainer is cocked during removal, it may be difficult to disconnect fitting. Use an open-end wrench on shoulder of plastic retainer ring to aid in disconnection.**

(5) After disconnection, plastic retainer ring will remain with quick-connect fitting connector body.

(6) Inspect fitting connector body, plastic retainer ring and fuel system component for damage. Replace as necessary.

(7) Prior to connecting quick-connect fitting to component being serviced, check condition of fitting and component. Clean parts with a lint-free cloth. Lubricate with clean engine oil.

(8) Insert quick-connect fitting into component being serviced until a click is felt.

(9) Verify a locked condition by firmly pulling on fuel tube and fitting (15-30 lbs.).

(10) Connect negative battery cable to battery.

(11) Start engine and check for leaks.

LATCH CLIP FITTING (FUEL LINE-TO-FUEL RAIL)

A tethered latch clip (Fig. 21) is used to secure the fuel line to the fuel rail. A special tool will be necessary to separate fuel line from fuel rail after latch clip is removed. This same latch clip may also be used to secure other different fuel system components.

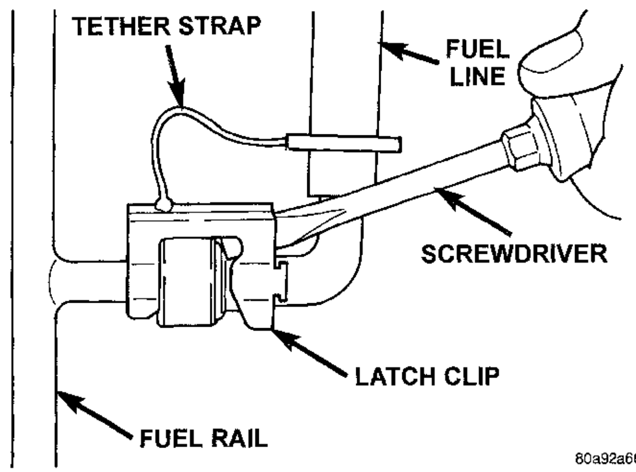


Fig. 21 Latch Clip Removal

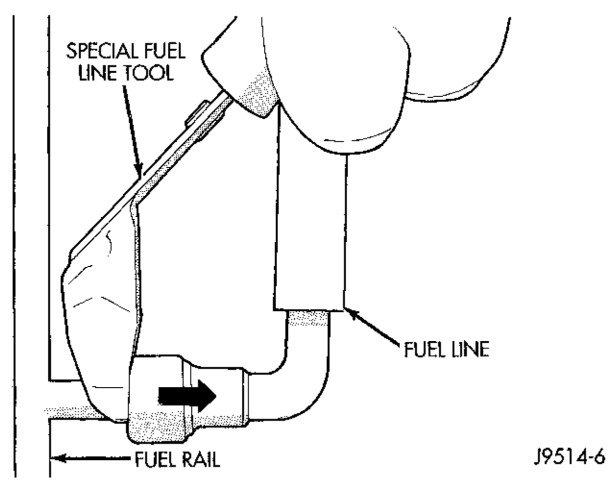


Fig. 22 Fuel Line Disconnection

CAUTION: The interior components (o-rings, spacers, retainers) of this type of quick-connect fitting are not serviced separately. Do not attempt to repair damaged fittings or fuel lines/tubes. If repair is necessary, replace the complete fuel tube assembly.

WARNING: THE FUEL SYSTEM IS UNDER A CONSTANT PRESSURE (EVEN WITH THE ENGINE OFF). BEFORE SERVICING ANY FUEL SYSTEM HOSES, FITTINGS OR LINES, THE FUEL SYSTEM PRESSURE MUST BE RELEASED. REFER TO THE FUEL SYSTEM PRESSURE RELEASE PROCEDURE IN THIS GROUP.

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SERVICE PROCEDURES (Continued)

DISCONNECTION/CONNECTION

(1) Perform fuel pressure release procedure. Refer to Fuel Pressure Release Procedure in this group.

(2) Disconnect negative battery cable from battery.

(3) Clean fitting of any foreign material before disassembly.

(4) Pry up on latch clip with a screwdriver (Fig. 21).

(5) Slide latch clip toward fuel rail while lifting with screwdriver.

(6) Insert special fuel line removal tool (Snap-On number FIH 9055-1 or equivalent) into fuel line (Fig. 22). Use this tool to release locking fingers in end of line.

(7) With special tool still inserted, pull fuel line from fuel rail.

(8) After disconnection, locking fingers will remain within quick-connect fitting at end of fuel line.

(9) Prior to connecting fuel line to fuel rail, check condition of both fittings. Clean parts with a lint-free cloth. Lubricate with clean engine oil.

(10) Insert fuel line onto fuel rail until a click is felt.

(11) Install latch clip (snaps into position). **If latch clip will not fit, this indicates fuel line is not properly installed to fuel rail. Recheck fuel line connection.**

(12) Verify a locked condition by firmly pulling on fuel line and fitting (15-30 lbs.).

(13) Connect negative battery cable to battery.

(14) Start engine and check for leaks.

REMOVAL AND INSTALLATION

FUEL FILTER/FUEL PRESSURE REGULATOR

REMOVAL

WARNING: THE FUEL SYSTEM IS UNDER A CONSTANT PRESSURE, EVEN WITH ENGINE OFF. BEFORE SERVICING FUEL FILTER/FUEL PRESSURE REGULATOR, FUEL SYSTEM PRESSURE MUST BE RELEASED.

Refer to Fuel System Pressure Release in Fuel Delivery System section of this group.

The fuel filter/fuel pressure regulator is located at top of fuel pump module (Fig. 24) or (Fig. 25).

Fuel pump module removal is not necessary.

(1) Drain fuel tank and remove tank. Refer to Fuel Tank Removal/Installation.

(2) The fuel filter/regulator is pressed into a rubber grommet. Remove by twisting and pulling straight up (Fig. 26).

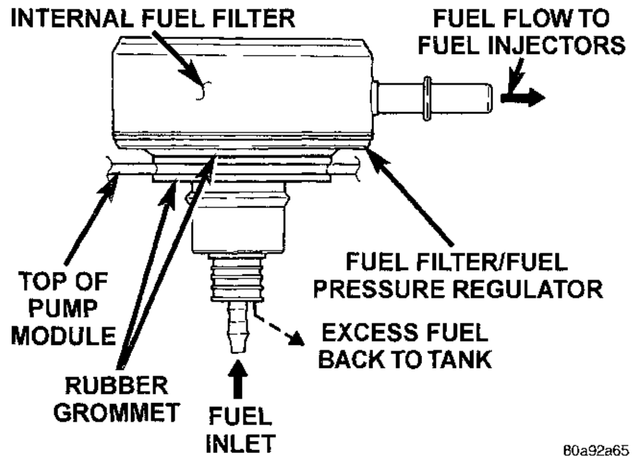

Fig. 23 Fuel Filter/Fuel Pressure Regulator

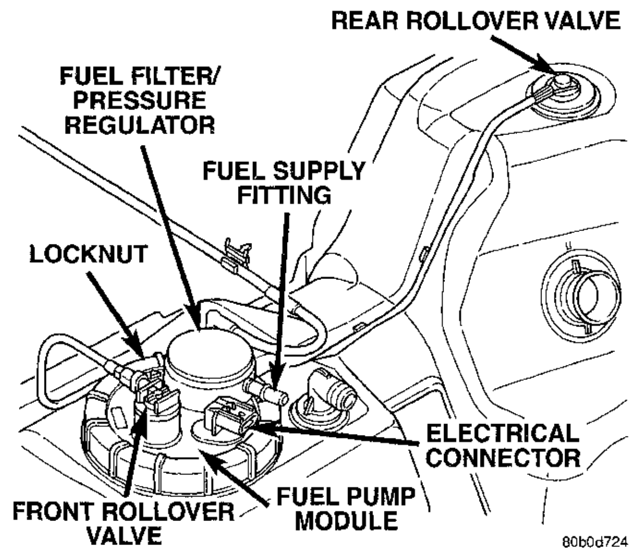

Fig. 24 Filter/Regulator Location—With 26 or 34 Gallon Fuel Tank

CAUTION: Do not pull filter/regulator more than three inches from fuel pump module. Damage to coiled fuel tube (line) may result.

(3) Gently cut old fuel tube (line) clamp (Fig. 27) taking care not to damage plastic fuel tube. Remove and discard old fuel tube clamp.

(4) Remove plastic fuel tube from filter/regulator by gently pulling downward. Remove filter/regulator from fuel pump module.

INSTALLATION

(1) Install a new clamp over plastic fuel tube.

(2) Install filter/regulator to fuel tube. Rotate filter/regulator in fuel tube (line) (Fig. 28) until it is pointed to drivers side of vehicle (Fig. 24) or (Fig. 25).

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REMOVAL AND INSTALLATION (Continued)

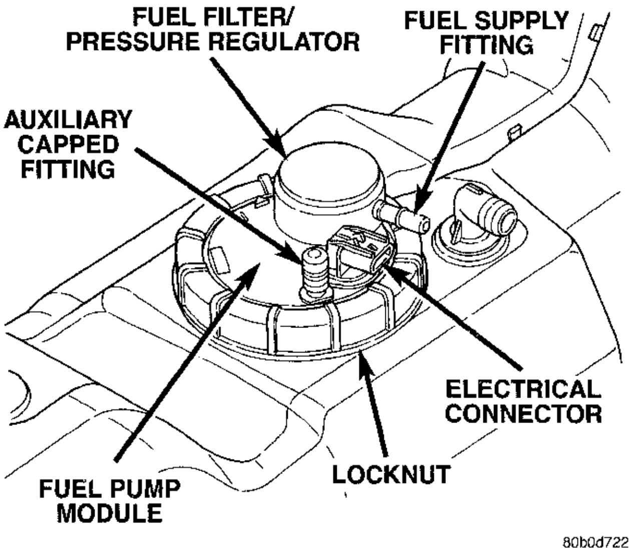

Fig. 25 Filter/Regulator Location—With 35 Gallon Fuel Tank

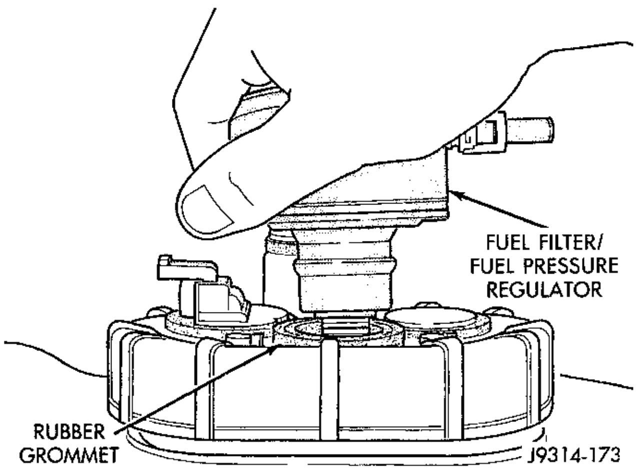

Fig. 26 Filter/Regulator Removal and Installation—TYPICAL

(3) Tighten line clamp to fuel line using special Hose Clamp Pliers number C-4124 or equivalent (Fig. 28). **Do not use conventional side cutters to tighten this type of clamp.**

(4) Press filter/regulator (by hand) into rubber grommet. The assembly should be pointed towards drivers side of vehicle (Fig. 24) or (Fig. 25).

(5) Install fuel tank. Refer to Fuel Tank Removal/Installation.

(6) Check for fuel leaks.

FUEL PUMP MODULE

REMOVAL

WARNING: THE FUEL SYSTEM IS UNDER A CONSTANT PRESSURE (EVEN WITH THE ENGINE OFF).

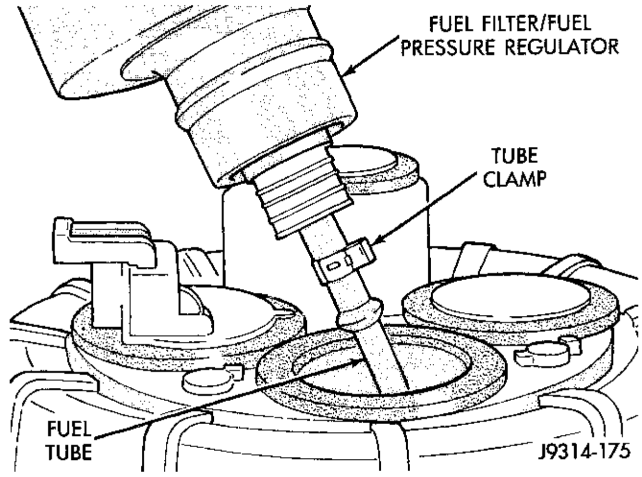

Fig. 27 Fuel Tube and Clamp—TYPICAL

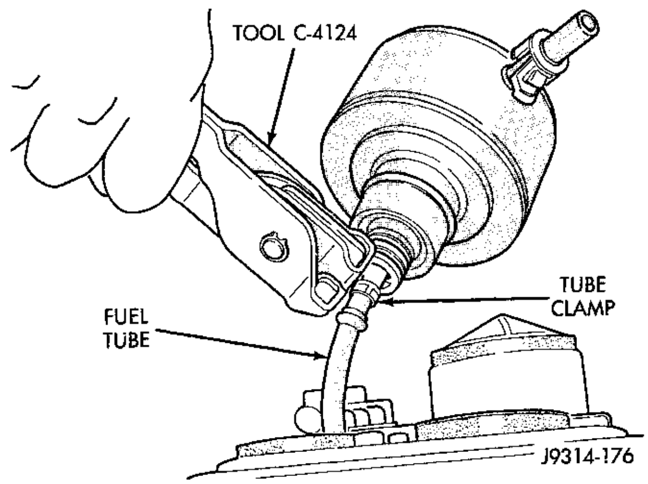

Fig. 28 Tightening Fuel Tube Clamp—TYPICAL

BEFORE SERVICING THE FUEL PUMP MODULE, THE FUEL SYSTEM PRESSURE MUST BE RELEASED.

(1) Drain and remove fuel tank. Refer to Fuel Tank—All Engines in the Removal/Installation section.

(2) The plastic fuel pump module locknut is threaded onto fuel tank (Fig. 29) or (Fig. 30). Install Special Tool 6856 to locknut and remove locknut (Fig. 31). The fuel pump module will spring up when locknut is removed.

(3) Remove module from fuel tank.

INSTALLATION

CAUTION: Whenever the fuel pump module is serviced, the rubber gasket must be replaced.

(1) Using a new gasket, position fuel pump module into opening in fuel tank.

AUTHENTIC RESTORATION

REMOVAL AND INSTALLATION (Continued)

(2) Position locknut over top of fuel pump module. Install locknut finger tight.

(3) Rotate module until positioned as shown in (Fig. 29) or (Fig. 30). This step must be performed to prevent float from contacting side of fuel tank. Be sure fuel filter/fuel pressure regulator is pointed to drivers side of vehicle.

(4) Install Special Tool 6856 to locknut.

(5) Tighten locknut to 24–44 N·m (18–32 ft. lbs.) torque.

(6) Install fuel tank. Refer to Fuel Tank—All Engines in the Removal/Installation section.

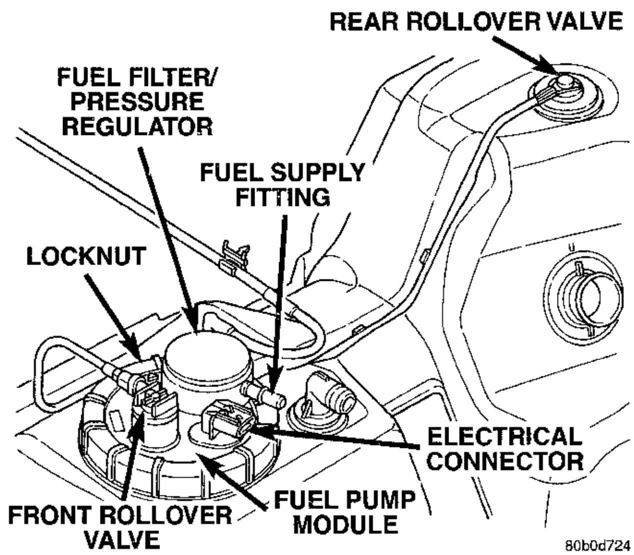

Fig. 29 Fuel Pump Module—26 or 34 Gallon Fuel Tank

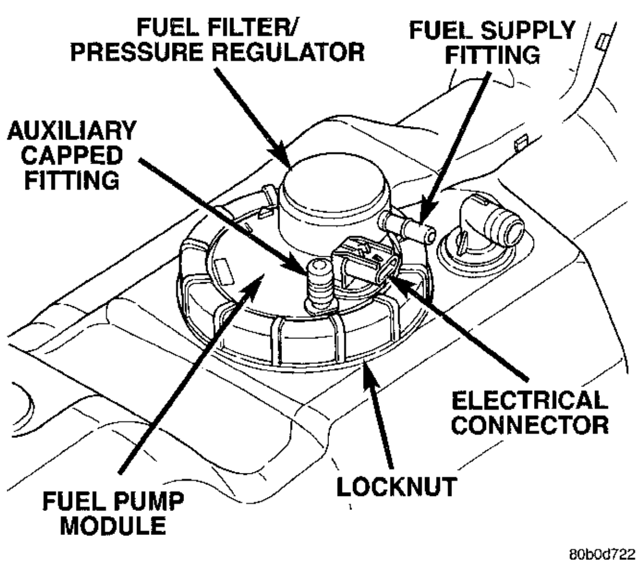

Fig. 30 Fuel Pump Module—35 Gallon Fuel Tank

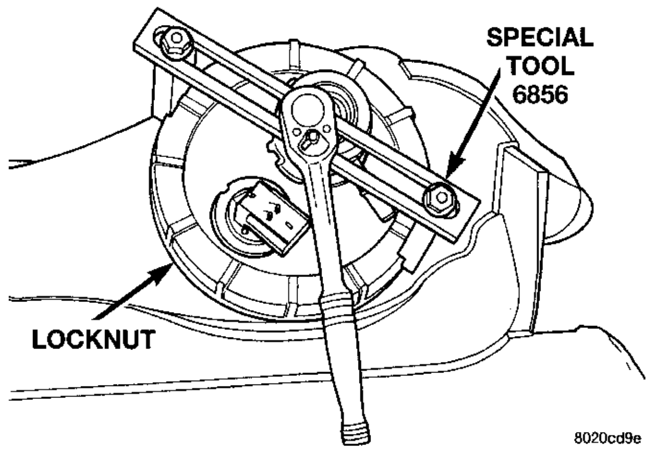

Fig. 31 Locknut Removal/Installation—TYPICAL

FUEL PUMP INLET FILTER

The fuel pump inlet filter (strainer) is located on the bottom of the fuel pump module (Fig. 32). The fuel pump module is located inside of fuel tank.

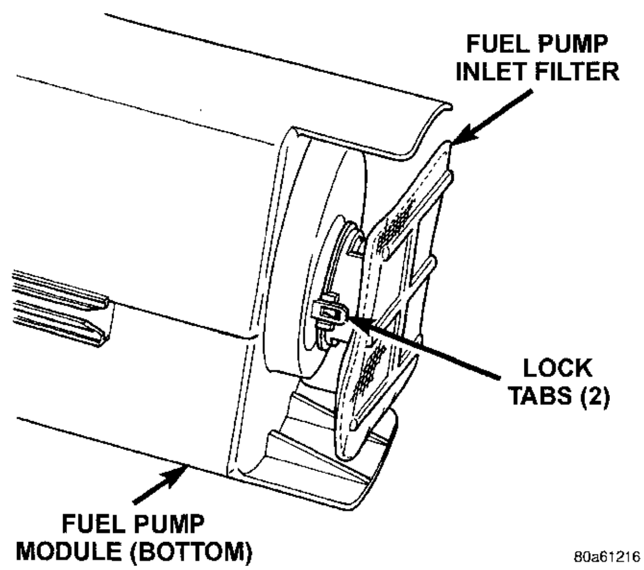

Fig. 32 Fuel Pump Inlet Filter

REMOVAL

(1) Remove fuel tank. Refer to Fuel Tank Removal/ Installation.

(2) Remove fuel pump module. Refer to Fuel Pump Module Removal/Installation.

(3) Remove filter by carefully prying 2 lock tabs at bottom of module with 2 screwdrivers. Filter is snapped to module.

(4) Clean bottom of pump module.

INSTALLATION

(1) Snap new filter to bottom of module. Be sure o-ring is in correct position.

REMOVAL AND INSTALLATION (Continued)

(2) Install fuel pump module. Refer to Fuel Pump Module Removal/Installation.

(3) Install fuel tank. Refer to Fuel Tank Removal/ Installation.

FUEL GAUGE SENDING UNIT

The fuel gauge sending unit (fuel level sensor) and float assembly is located on the side of fuel pump module (Fig. 33). The fuel pump module is located inside of fuel tank.

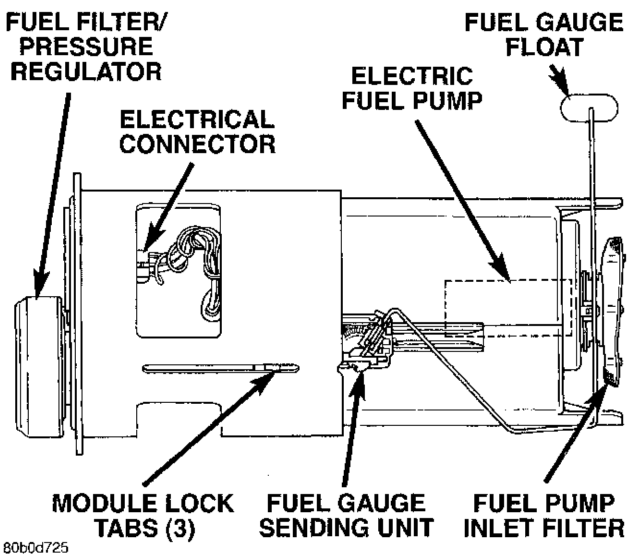

Fig. 33 Fuel Gauge Sending Unit Location—TYPICAL Module

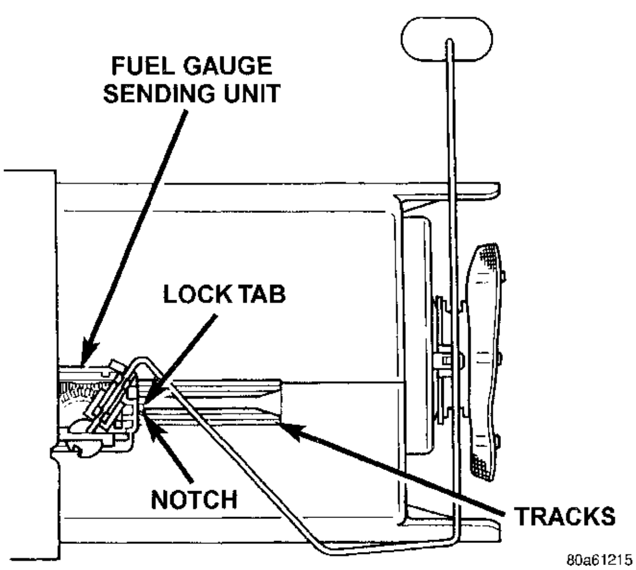

Fig. 34 Fuel Gauge Sending Unit Lock Tab/Tracks

REMOVAL

(1) Remove fuel tank. Refer to Fuel Tank–All Engines in the Removal/Installation section.

(2) Remove fuel pump module. Refer to Fuel Pump Module Removal/Installation.

(3) Unplug 4–way electrical connector (Fig. 33).

(4) Disconnect 2 sending unit wires at 4–way connector. The locking collar of connector must be removed before wires can be released from connector. Note location of wires within 4–way connector.

(5) The sending unit is retained to pump module with a small lock tab and notch (Fig. 34). Carefully push lock tab to the side and away from notch while sliding sending unit downward on tracks for removal. Note wire routing while removing unit from module.

INSTALLATION

(1) Position sending unit into tracks. Note wire routing.

(2) Push unit on tracks until lock tab snaps into notch.

(3) Connect 2 sending unit wires into 4–way connector and install locking collar.

(4) Connect 4–way electrical connector to module.

(5) Install fuel pump module. Refer to Fuel Pump Module Removal/Installation.

(6) Install fuel tank. Refer to Fuel Tank–All Engines in the Removal/Installation section.

FUEL INJECTOR RAIL—3.9L/5.2L/5.9L ENGINES

WARNING: THE FUEL SYSTEM IS UNDER A CONSTANT PRESSURE (EVEN WITH ENGINE TURNED OFF). BEFORE SERVICING FUEL RAIL ASSEMBLY, FUEL SYSTEM PRESSURE MUST BE RELEASED.

To release fuel pressure, refer to Fuel System Pressure Release Procedure found in this group.

CAUTION: The left and right fuel rails are replaced as an assembly. Do not attempt to separate the rail halves at the connecting hose (Fig. 35). Due to the design of this connecting hose, it does use any clamps. Never attempt to install a clamping device of any kind to the hose. When removing the fuel rail assembly for any reason, be careful not to bend or kink the connecting hose.

REMOVAL

(1) Remove negative battery cable at battery.

(2) Remove air cleaner.

(3) Perform fuel pressure release procedure.

(4) Remove throttle body from intake manifold. Refer to Throttle Body removal in this group.

(5) If equipped with air conditioning, remove the A-shaped A/C compressor-to-intake manifold support bracket (three bolts) (Fig. 36).

(6) Disconnect electrical connectors at all fuel injectors (Fig. 37). The factory fuel injection wiring

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REMOVAL AND INSTALLATION (Continued)

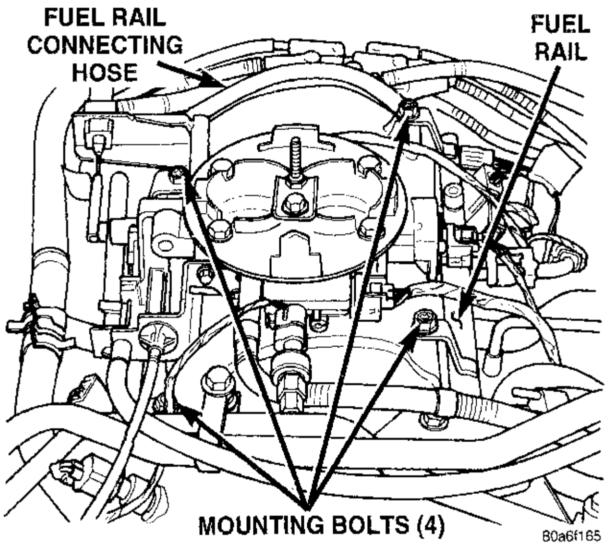

Fig. 35 Fuel Rail Assembly—Typical

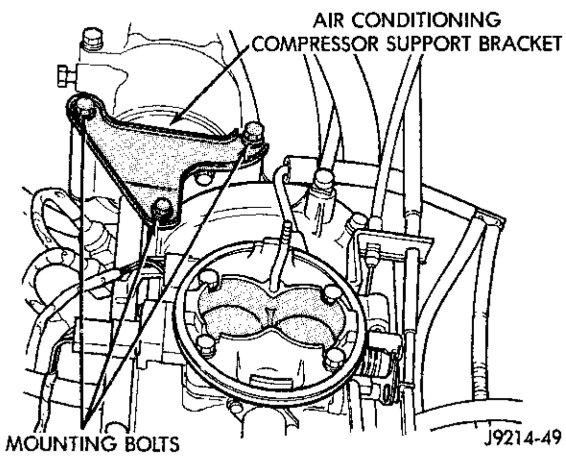

Fig. 36 A/C Compressor Support Bracket—Typical

harness is numerically tagged (INJ 1, INJ 2, etc.) for injector position identification.

(7) 3.9L (V-6) engine only: Disconnect electrical connector at intake manifold air temperature sensor. Do not remove sensor.

(8) Disconnect fuel tube (line) at side of fuel rail. Refer to Quick-Connect Fittings for procedures,

(9) Remove the remaining fuel rail mounting bolts.

(10) Gently rock and pull the **left** fuel rail until the fuel injectors just start to clear the intake manifold. Gently rock and pull the **right** fuel rail until the fuel injectors just start to clear the intake manifold. Repeat this procedure (left/right) until all fuel injectors have cleared the intake manifold.

(11) Remove fuel rail (with injectors attached) from engine.

(12) Remove the clip(s) retaining the injector(s) to fuel rail (Fig. 38) or (Fig. 39).

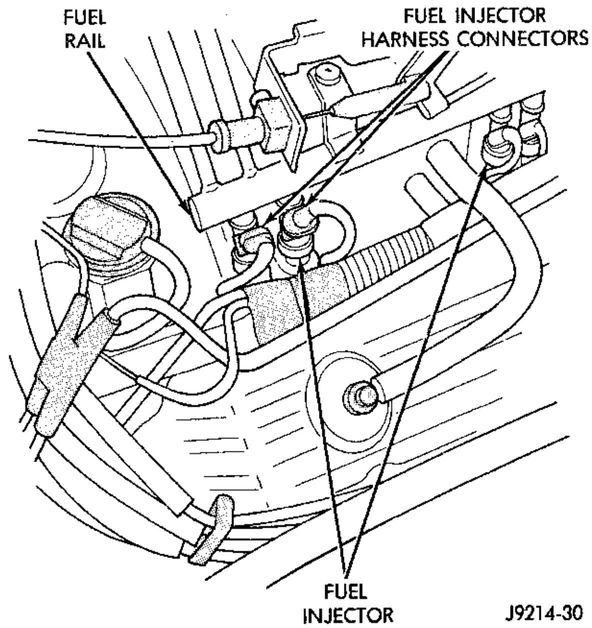

Fig. 37 Fuel Injector Connectors—Typical

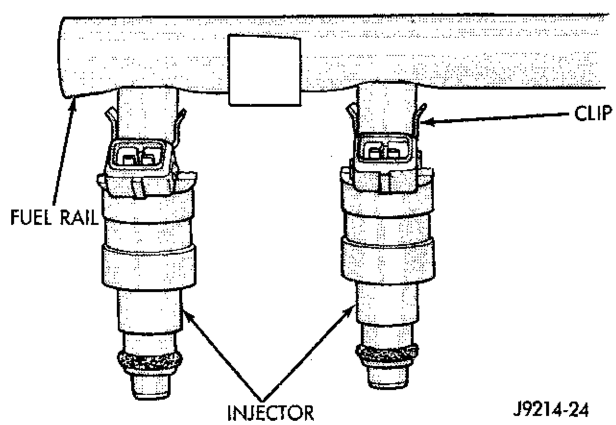

Fig. 38 Fuel Injector Mounting—Typical

INSTALLATION

(1) Apply a small amount of engine oil to each fuel injector o-ring. This will help in fuel rail installation.

(2) Install injector(s) and injector clip(s) to fuel rail.

(3) Position the fuel rail/fuel injector assembly to the injector openings on the intake manifold.

(4) Guide each injector into the intake manifold. Be careful not to tear the injector o-ring.

(5) Push the **right** fuel rail down until fuel injectors have bottomed on injector shoulder. Push the **left** fuel rail down until fuel injectors have bottomed on injector shoulder.

(6) Install fuel rail mounting bolts.

(7) Connect electrical connector to intake manifold air temperature sensor.

AUTHENTIC RESTORATION

REMOVAL AND INSTALLATION (Continued)

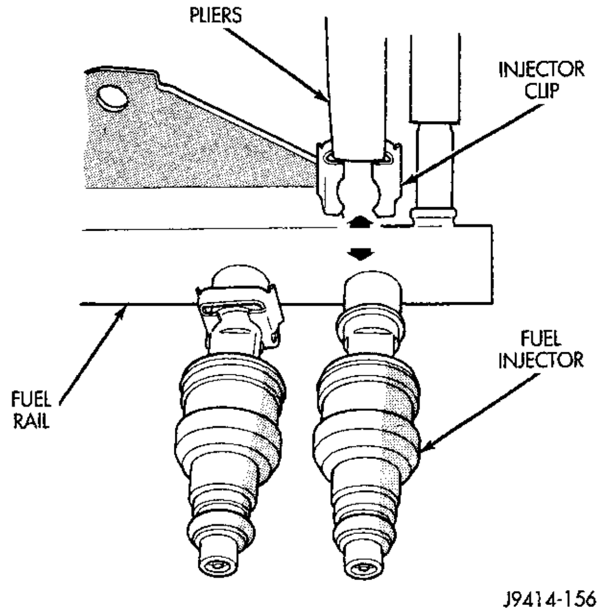

Fig. 39 Injector Retaining Clips—Typical Injector

(8) Connect wiring to all fuel injectors. The injector wiring harness is numerically tagged.

(9) Install the A/C support bracket (if equipped).

(10) Install throttle body to intake manifold. Refer to Throttle Body installation in this section of the group.

(11) Install fuel tube (line) at side of fuel rail. Refer to Quick-Connect Fittings for procedures.

(12) Install air cleaner.

(13) Connect battery cable to battery.

(14) Start engine and check for leaks.

FUEL INJECTOR RAIL—8.0L V-10 ENGINE

REMOVAL

WARNING: THE FUEL SYSTEM IS UNDER A CONSTANT PRESSURE EVEN WITH THE ENGINE OFF. BEFORE SERVICING FUEL RAIL, FUEL SYSTEM PRESSURE MUST BE RELEASED.

(1) Remove negative battery cable at battery.

(2) Remove air cleaner housing and tube.

(3) Perform fuel pressure release procedure. Refer to Fuel Delivery System section of this group.

(4) Disconnect throttle body linkage and remove throttle body from intake manifold. Refer to Throttle Body removal in this group.

(5) Remove ignition coil pack and bracket assembly (Fig. 40) at intake manifold and right engine valve cover (four bolts).

(6) Remove upper half of intake manifold. Refer to Group 11, Exhaust System and Intake Manifold for procedures.

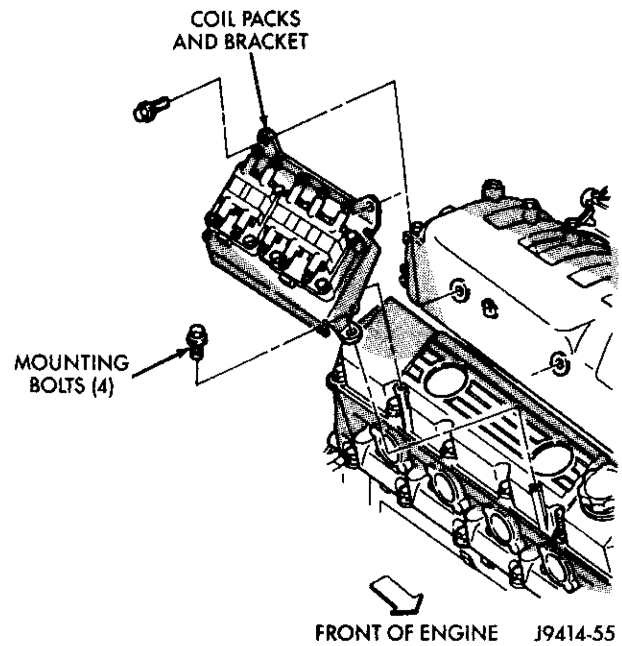

Fig. 40 Ignition Coil Pack and Mounting Bracket—8.0L V-10 Engine

(7) Disconnect electrical connectors at all fuel injectors. The factory fuel injection wiring harness is numerically tagged (INJ 1, INJ 2, etc.) for injector position identification.

(8) Disconnect fuel line quick-connect fitting at left-rear end of fuel rail. A special 3/8 inch fuel line disconnection tool will be necessary.

(9) Remove the six fuel rail mounting bolts from the lower half of intake manifold (Fig. 41).

(10) Gently rock and pull the **left** fuel rail until the fuel injectors just start to clear the intake manifold. Gently rock and pull the **right** fuel rail until the fuel injectors just start to clear the intake manifold. Repeat this procedure (left/right) until all fuel injectors have cleared the intake manifold.

(11) Remove fuel rail (with injectors attached) from engine.

(12) Remove the clip(s) retaining the injector(s) to fuel rail (Fig. 38) or (Fig. 39).

INSTALLATION

(1) Apply a small amount of engine oil to each fuel injector o-ring. This will help in fuel rail installation.

(2) Install injector(s) and injector clip(s) to fuel rail.

NOTE: The fuel injector electrical connectors on all 10 injectors should be facing to the right (passenger) side of the vehicle (Fig. 41).

(3) Position the fuel rail/fuel injector assembly to the injector openings on the intake manifold.

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REMOVAL AND INSTALLATION (Continued)

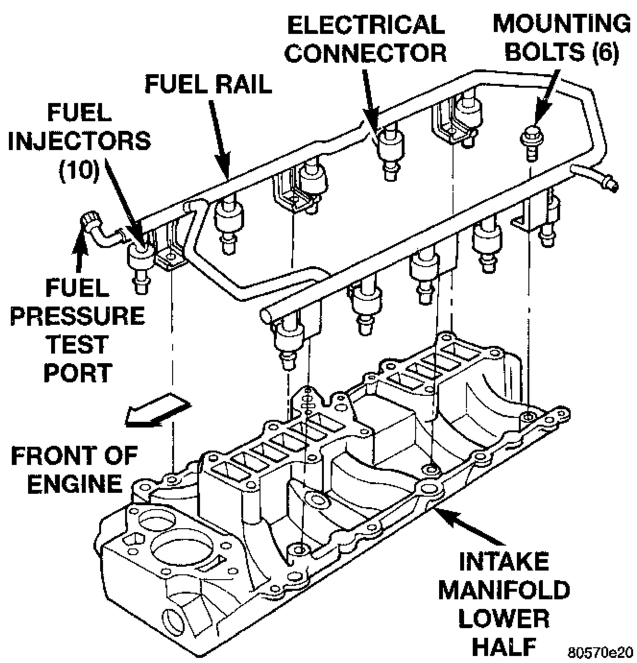

Fig. 41 Fuel Rail Mounting Bolts—8.0L V-10 Engine—Typical

(4) Guide each injector into the intake manifold. Be careful not to tear the injector o-ring.

(5) Push the **right** fuel rail down until fuel injectors have bottomed on injector shoulder. Push the **left** fuel rail down until fuel injectors have bottomed on injector shoulder.

(6) Install the six fuel rail mounting bolts into the lower half of intake manifold. Tighten bolts to 15 N·m (136 in. lbs.) torque.

(7) Connect wiring to all fuel injectors. The injector wiring harness is numerically tagged.

(8) Install upper half of intake manifold. Refer to Group 11, Exhaust System and Intake Manifold for procedures.

(9) Connect main fuel line at fuel rail. Refer to Quick-Connect Fittings for procedures.

(10) Install ignition coil pack and bracket assembly at intake manifold and right engine valve cover (four bolts).

(11) Install throttle body to intake manifold. Refer to Throttle Body removal in this group.

(12) Install throttle body linkage to throttle body.

(13) Install air cleaner tube and housing.

(14) Install negative battery cable at battery.

(15) Start engine and check for leaks.

FUEL INJECTOR(S)—ALL GAS ENGINES

WARNING: THE FUEL SYSTEM IS UNDER A CONSTANT PRESSURE EVEN WITH THE ENGINE TURNED OFF. BEFORE SERVICING THE FUEL INJECTOR(S), THE FUEL SYSTEM PRESSURE MUST BE RELEASED.

To release fuel pressure, refer to the Fuel System Pressure Release Procedure.

To remove one or more fuel injectors, the fuel rail assembly must be removed from engine.

REMOVAL

(1) Remove air cleaner assembly.

(2) Remove fuel injector rail assembly. Refer to Fuel Injector Rail removal in this section.

(3) Remove the clip(s) retaining the injector(s) to fuel rail (Fig. 38) or (Fig. 39).

(4) Remove injector(s) from fuel rail.

INSTALLATION

(1) Apply a small amount of engine oil to each fuel injector o-ring. This will help in fuel rail installation.

(2) Install injector(s) and injector clip(s) to fuel rail.

(3) Install fuel rail assembly. Refer to Fuel Injector Rail installation.

(4) Install air cleaner.

(5) Start engine and check for leaks.

FUEL TANK—ALL ENGINES

WARNING: GASOLINE POWERED ENGINES: THE FUEL SYSTEM IS UNDER A CONSTANT PRESSURE EVEN WITH THE ENGINE OFF. BEFORE SERVICING THE FUEL TANK, FUEL SYSTEM PRESSURE MUST BE RELEASED. REFER TO THE FUEL SYSTEM PRESSURE RELEASE PROCEDURE BEFORE SERVICING THE FUEL TANK.

Two different procedures may be used to drain fuel tank (lowering tank or using DRB scan tool). When equipped with a diesel engine, the DRB scan tool cannot be used (no electric fuel pump).

The quickest draining procedure involves lowering the fuel tank.

Gasoline Powered Engines: As an alternative procedure, the electric fuel pump may be activated allowing tank to be drained at fuel rail connection. Refer to DRB scan tool for fuel pump activation procedures. Before disconnecting fuel line at fuel rail, release fuel pressure. Refer to the Fuel System Pressure Release Procedure in this group for procedures. Attach end of special test hose tool number 6541, 6539, 6631 or 6923 at fuel rail disconnection (tool number will depend on model and/or engine application). Position opposite end of this hose tool to an approved gasoline draining station. Activate fuel pump and drain tank until empty.

REMOVAL AND INSTALLATION (Continued)

If electric fuel pump is not operating, tank must be lowered for fuel draining. Refer to following procedures.

REMOVAL

(1) Remove fuel tank filler tube cap.

(2) Perform Fuel System Pressure Release procedure as described in this group.

(3) Gasoline Engines: Disconnect negative battery cable at battery. Diesel Engines: Disconnect both negative battery cables at both batteries.

(4) Raise vehicle on hoist.

(5) Open fuel fill door and remove screws mounting fuel filler tube assembly to body. Do not disconnect rubber fuel fill or vent hoses from tank at this time.

(6) Place a transmission jack under center of fuel tank. Apply a slight amount of pressure to fuel tank with transmission jack.

(7) Remove fuel tank mounting strap nuts from mounting strap studs (Fig. 42). If equipped, remove fuel tank shield bolts.

(8) Lower fuel tank only enough to allow access to top of tank. The 2 tank fittings (where rubber fuel fill and vent hose connections are made) must be positioned above tank level. Rotate tank slightly to allow these fittings to be above tank level.

WARNING: WRAP SHOP TOWELS AROUND HOSES TO CATCH ANY GASOLINE SPILLAGE.

(9) While working over left rear tire/wheel, disconnect rubber fuel vent hose at fuel tank (Fig. 42) (vent hose is the smallest of 2 hoses). Position fuel siphoning/drain hose into this fitting at tank. Drain fuel into an approved portable holding tank or a properly labeled gasoline (or diesel fuel) safety container.

(10) Disconnect rubber fuel fill hose at fuel tank (Fig. 42).

(11) **Gas Powered Engines:**

(a) While working over left rear tire/wheel, disconnect wiring harness connector from electrical connector at top of fuel pump module (Fig. 43) or (Fig. 44).

(b) If equipped with 26 or 34 gallon fuel tank, two EVAP lines are connected to rollover valves. Disconnect EVAP line from rollover valve at top of module (Fig. 43). Disconnect other EVAP line from rollover valve near rear of tank (Fig. 43).

(c) If equipped with 35 gallon fuel tank, two EVAP lines are connected to rollover valves. Disconnect EVAP lines from rollover valves at top-front and top-rear of fuel tank (Fig. 45).

(d) Disconnect fuel supply line at fuel filter/fuel pressure regulator supply fitting (Fig. 43) or (Fig. 44). Refer to Quick-Connect Fittings for procedures.

(12) **Diesel Powered Engines:**

(a) While working over left rear tire/wheel, disconnect wiring harness connector from electrical connector at top of fuel tank module (Fig. 46).

(b) Disconnect fuel supply and fuel return lines at the fuel tank module fittings (Fig. 46). Refer to Quick-Connect Fittings for procedures.

(13) Gasoline Engines: If fuel pump module removal is necessary, refer to Fuel Pump Module Removal/Installation in this group. Diesel Engines: If fuel tank module removal is necessary, refer to Fuel Tank Module Removal/Installation in this group.

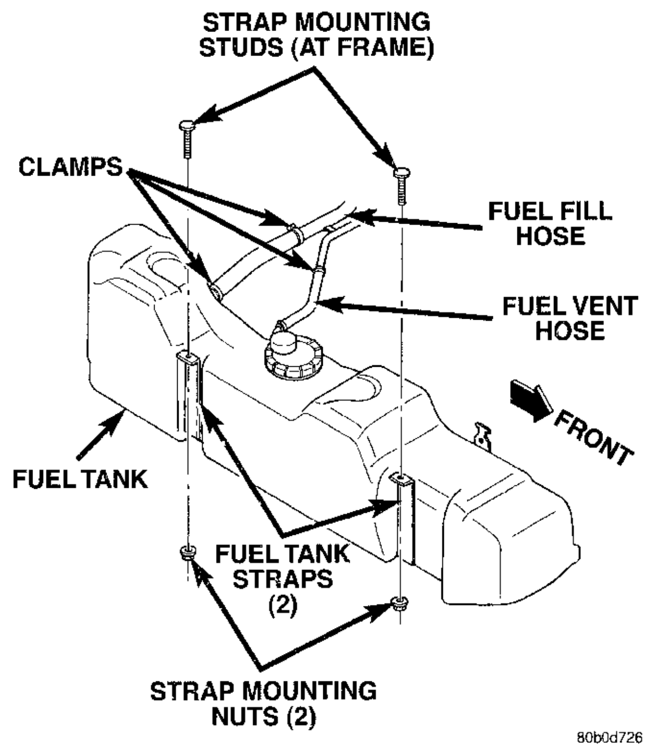

Fig. 42 Fuel Tank Mounting—Typical

INSTALLATION

(1) Gasoline Engines: If fuel pump module is being installed, refer to Fuel Pump Module Removal/Installation in this group. Diesel Engines: If fuel tank module is being installed, refer to Fuel Tank Module Removal/Installation in this group.

(2) Place fuel tank on top of transmission jack.

(3) Install rubber fill and vent lines to tank. Tighten hose clamps to 2.3 N·m (20 in. lbs.) torque.

(4) Raise tank into position while guiding fill and vent hoses to body. Raise tank only enough to allow access to top of tank.

(5) **Gas Powered Engines:**

(a) Connect electrical connector to fuel pump module.

(b) Connect EVAP hoses at rollover valves.

REMOVAL AND INSTALLATION (Continued)

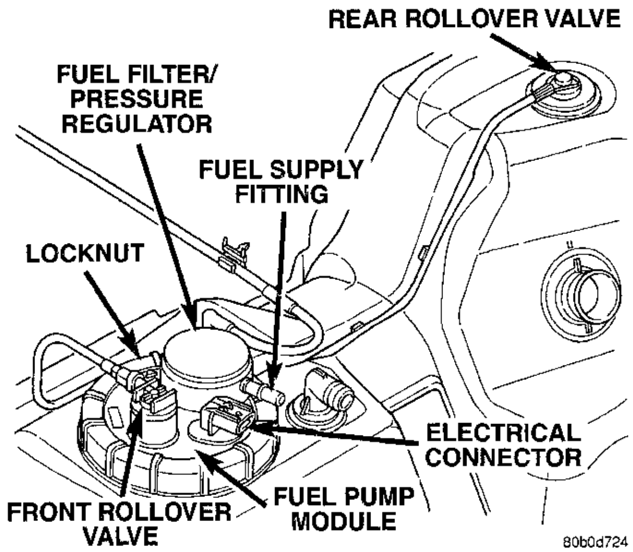

Fig. 43 Fuel Pump Module—Gas Engine With 26 or 34 Gallon Tank

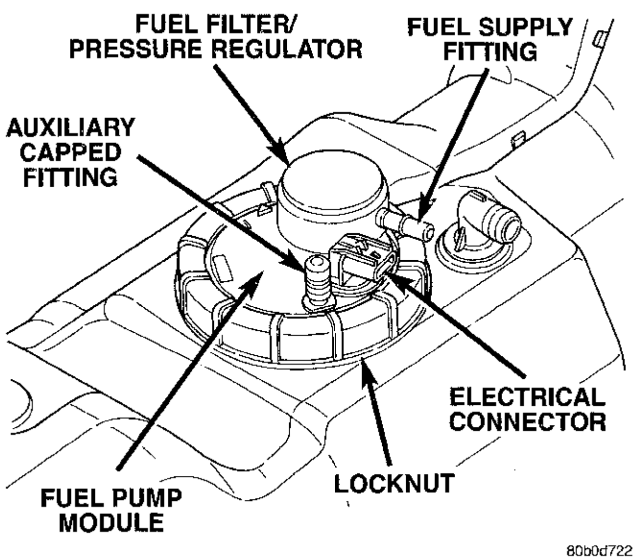

Fig. 44 Fuel Pump Module—Gas Engine With 35 Gallon Tank

(c) Connect fuel supply line at fuel filter/fuel pressure regulator. Refer to Quick-Connect Fittings for procedures.

(6) **Diesel Powered Engines:**

(a) Connect electrical connector to fuel tank module.

(b) Connect fuel supply and fuel return lines to fuel tank module fittings. Refer to Quick-Connect Fittings in this group.

(7) Connect two mounting straps and mounting strap nuts.

(8) Tighten strap nuts to 41 N·m (30 ft. lbs.) torque. Do not over tighten retaining strap nuts.

(9) Remove transmission jack.

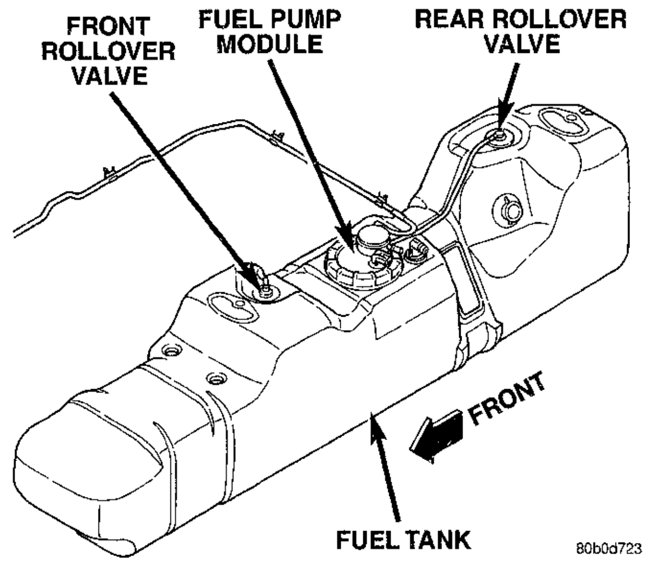

Fig. 45 Rollover Valve Locations—Gas Engine With 35 Gallon Tank

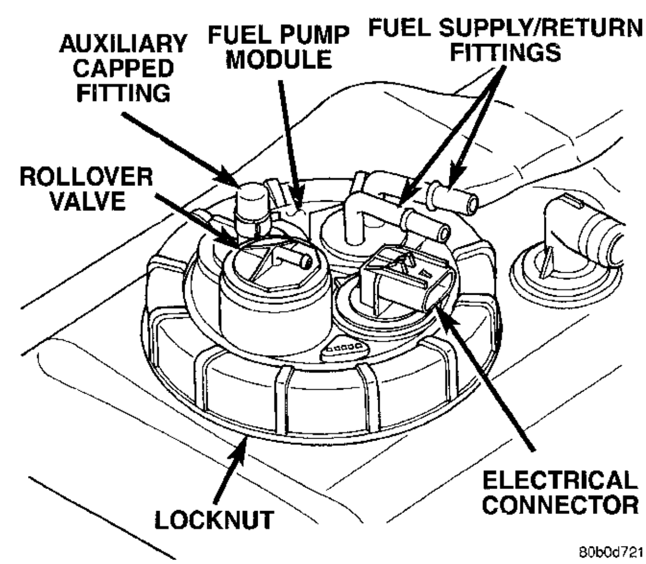

Fig. 46 Fuel Tank Module—Diesel Engine

(10) Connect fuel filler tube assembly to body.

(11) Refill fuel tank and inspect all hoses and lines for leaks.

(12) Connect negative battery cable(s) to battery(s).

FUEL TANK FILLER TUBE CAP

If replacement of the fuel tank filler tube cap is necessary, it must be replaced with an identical cap to be sure of correct system operation.

CAUTION: Remove the fuel tank filler tube cap to relieve fuel tank pressure. The cap must be removed prior to disconnecting any fuel system component or before draining the fuel tank.

REMOVAL AND INSTALLATION (Continued)

ACCELERATOR PEDAL

REMOVAL

CAUTION: Be careful not to damage or kink the cable core wire (within the cable sheathing) while servicing accelerator pedal or cables.

(1) From inside the vehicle, hold up the accelerator pedal. Remove the plastic cable retainer and throttle cable core wire from upper end of pedal arm (Fig. 47). The plastic cable retainer snaps into pedal the arm.

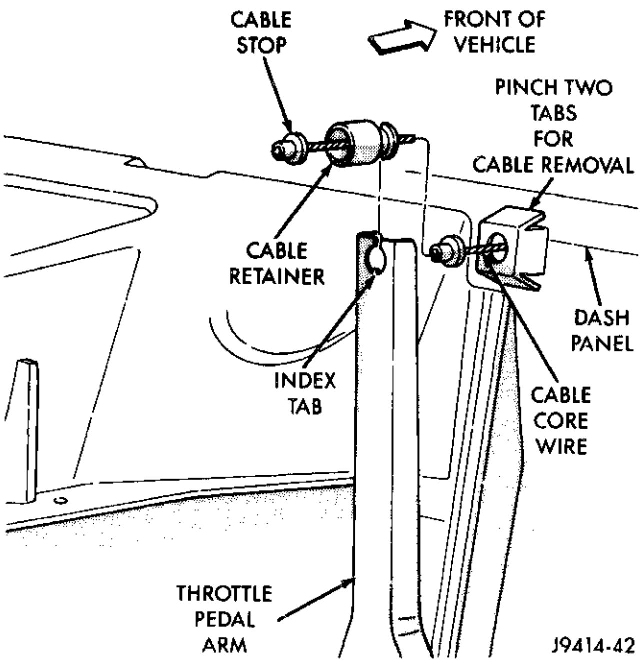

Fig. 47 Cable Removal/Installation

(2) Insert a small screwdriver into the square holes located on the pivots/bushings (Fig. 48). Twist the screwdriver to disengage the pivot locks from the pivot pin. Pivots will be damaged when removing. Discard old pivots.

(3) Remove pedal/bracket assembly from vehicle.

INSTALLATION

(1) Position pedal/bracket assembly over the pivot pin (Fig. 48).

(2) Install two new pivots/bushings. Using large pliers, press both of the bushings together until they bottom on the sides of the pedal/bracket assembly. Bushing retaining ears will snap into position when properly installed.

(3) From inside the vehicle, hold up the accelerator pedal. Install the throttle cable core wire and plastic cable retainer into and through the upper end of the pedal arm (the plastic retainer is snapped into the pedal arm). When installing the plastic retainer to

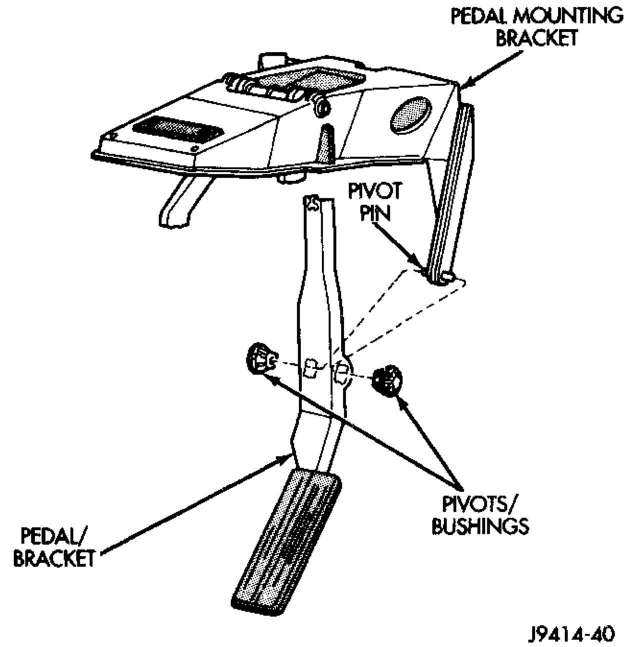

Fig. 48 Accelerator Pedal—Removal or Installation

the accelerator pedal arm, note the index tab on the pedal arm (Fig. 47). Align the index slot on the plastic cable retainer to this index tab.

THROTTLE CABLE

CAUTION: Be careful not to damage or kink the cable core wire (within the cable sheathing) while servicing accelerator pedal or cables.

REMOVAL

(1) From inside the vehicle, hold up the accelerator pedal. Remove the plastic cable retainer and throttle cable core wire from upper end of pedal arm (Fig. 47). The plastic cable retainer snaps into pedal the arm.

(2) Remove the cable core wire at the pedal arm.

(3) Remove the air cleaner housing.

(4) From inside the vehicle, pinch both sides of the plastic cable housing retainer tabs at the dash panel (Fig. 47).

(5) Remove cable housing from dash panel and pull the cable into the engine compartment.

(6) **3.9L/5.2L/5.9L Engines:** Disconnect the cable from the routing/holddown clip at the radiator fan shroud.

(7) **8.0L V-10 Engine:** Remove the throttle cable socket at throttle lever ball. (Fig. 50) (snaps off).

(8) **3.9L/5.2L/5.9L Engines:** Slip the cable end rearward from pin on throttle body (Fig. 49).

(9) Remove cable housing at throttle body mounting bracket by pressing on release tab with a small

REMOVAL AND INSTALLATION (Continued)

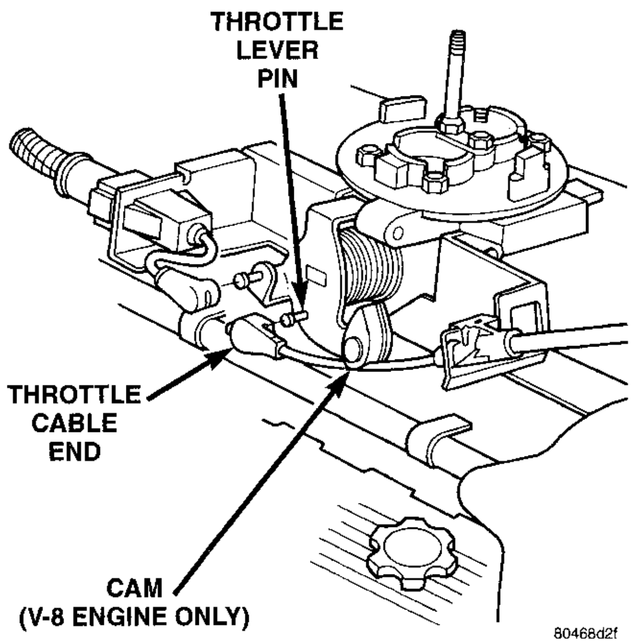

Fig. 49 Throttle Cable at Throttle Body—3.9L/5.2L/5.9L Engines—Typical

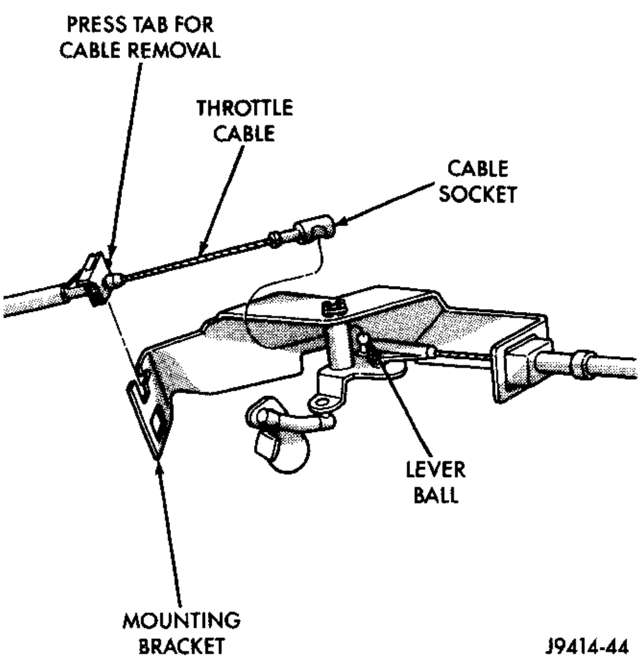

Fig. 50 Throttle Cable at Throttle Body—8.0L V-10 Engine

screwdriver (Fig. 51) or (Fig. 50). **To prevent cable housing breakage, press on the tab only enough to release the cable from the bracket.** Lift the cable housing straight up from bracket while pressing on release tab. Remove throttle cable from vehicle.

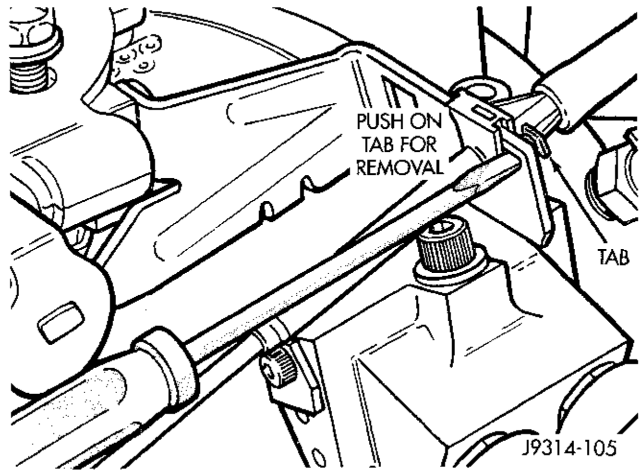

Fig. 51 Cable Release Tab—3.9L/5.2L/5.9L Engines—Typical

INSTALLATION

(1) **3.9L/5.2L/5.9L Engines:**

(a) Rotate and hold the throttle cam in the full wide open position. Snap the cable end onto lever pin (Fig. 49).

(b) Connect cable to throttle body mounting bracket (push down and lock).

(c) Connect cable to fan shroud routing clip.

(2) **8.0L V-10 Engine:**

(a) Connect cable end socket to throttle body lever ball (snaps on) (Fig. 50).

(b) Connect cable to throttle body mounting bracket (push down and lock).

(3) Install the remaining cable housing end into and through the dash panel opening (snaps into position). The two plastic pinch tabs (Fig. 47) should lock the cable to dash panel.

(4) From inside the vehicle, hold up the accelerator pedal. Install the throttle cable core wire and plastic cable retainer into and through the upper end of the pedal arm (the plastic retainer is snapped into the pedal arm). When installing the plastic retainer to the accelerator pedal arm, note the index tab on the pedal arm (Fig. 47). Align the index slot on the plastic cable retainer to this index tab.

SPECIFICATIONS

VECI LABEL

If anything differs between the specifications found on the Vehicle Emission Control Information (VECI) label and the following specifications, use specifications on VECI label. The VECI label is located in the engine compartment.

FUEL TANK CAPACITY—GAS ENGINES

MODEL	LITERS	U.S. GALLONS
Standard (Gas Powered)	98	26
138″ Wheelbase With Extended Cab (Gas Powered)	129	34
Optional/Heavy-Duty Engines (Gas Powered)	132	35
Nominal refill capacities are shown. A variation may be observed from vehicle to vehicle due to manufacturing tolerance and refill procedure.		

FUEL SYSTEM PRESSURE—GAS ENGINES

All Gasoline Powered Engines: 339 kPa ± 34 kPa (49.2 psi ± 5 psi)

TORQUE CHART

DESCRIPTION	TORQUE
Fuel Pump Module Locknut	24–44 N·m (18–32 ft. lbs.)
Fuel Rail Mounting Bolts—3.9L/5.2L/5.9L Engines	23 N·m (200 in. lbs.)
Fuel Rail Mounting Bolts—8.0L Engine	15 N·m (136 in. lbs.)
Fuel Tank Mounting Nuts	41 N·m (30 ft. lbs.)
Fuel Hose Clamps	1 N·m (15 in. lbs.)

Mopar AUTHENTIC RESTORATION PRODUCT

FUEL INJECTION SYSTEM-GASOLINE ENGINES

INDEX

AUTHENTIC RESTORATION PRODUCT

GENERAL INFORMATION

INTRODUCTION

All gasoline powered engines are equipped with sequential Multi-Port Fuel Injection (MFI). The MFI system provides precise air/fuel ratios for all driving conditions.

The powertrain control module (PCM) (Fig. 1) operates the fuel system.

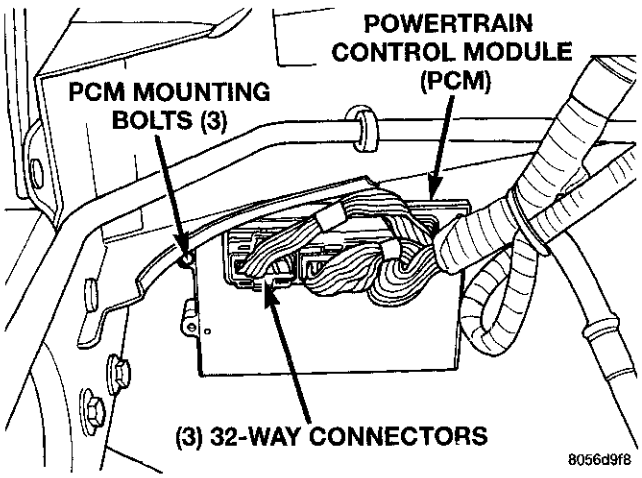

Fig. 1 Powertrain Control Module (PCM)

MODES OF OPERATION

As input signals to the powertrain control module (PCM) change, the PCM adjusts its response to the output devices. For example, the PCM must calculate different injector pulse width and ignition timing for idle than it does for wide open throttle (WOT).

The PCM will operate in two different modes: **Open Loop and Closed Loop**.

During Open Loop modes, the powertrain control module (PCM) receives input signals and responds only according to preset PCM programming. Input from the oxygen (O2S) sensors is not monitored during Open Loop modes.

During Closed Loop modes, the PCM will monitor the oxygen (O2S) sensors input. This input indicates to the PCM whether or not the calculated injector pulse width results in the ideal air-fuel ratio. This ratio is 14.7 parts air-to-1 part fuel. By monitoring the exhaust oxygen content through the O2S sensor, the PCM can fine tune the injector pulse width. This is done to achieve optimum fuel economy combined with low emission engine performance.

The fuel injection system has the following modes of operation:

- Ignition switch ON
- Engine start-up (crank)
- Engine warm-up
- Idle
- Cruise
- Acceleration
- Deceleration
- Wide open throttle (WOT)
- Ignition switch OFF

The ignition switch On, engine start-up (crank), engine warm-up, acceleration, deceleration and wide open throttle modes are Open Loop modes. The idle and cruise modes, (with the engine at operating temperature) are Closed Loop modes.

IGNITION SWITCH (KEY-ON) MODE

This is an Open Loop mode. When the fuel system is activated by the ignition switch, the following actions occur:

- The powertrain control module (PCM) pre-positions the idle air control (IAC) motor.
- The PCM determines atmospheric air pressure from the MAP sensor input to determine basic fuel strategy.
- The PCM monitors the engine coolant temperature sensor input. The PCM modifies fuel strategy based on this input.
- Intake manifold air temperature sensor input is monitored.
- Throttle position sensor (TPS) is monitored.
- The auto shutdown (ASD) relay is energized by the PCM for approximately three seconds.
- The fuel pump is energized through the fuel pump relay by the PCM. The fuel pump will operate for approximately three seconds unless the engine is operating or the starter motor is engaged.
- The O2S sensor heater element is energized via the ASD relay. The O2S sensor input is not used by the PCM to calibrate air-fuel ratio during this mode of operation.

ENGINE START-UP MODE

This is an Open Loop mode. The following actions occur when the starter motor is engaged.

The powertrain control module (PCM) receives inputs from:

- Battery voltage
- Engine coolant temperature sensor
- Crankshaft position sensor
- Intake manifold air temperature sensor
- Manifold absolute pressure (MAP) sensor
- Throttle position sensor (TPS)
- Starter motor relay
- Camshaft position sensor signal

The PCM monitors the crankshaft position sensor. If the PCM does not receive a crankshaft position sensor signal within 3 seconds of cranking the engine, it will shut down the fuel injection system.

The fuel pump is activated by the PCM through the fuel pump relay.

Voltage is applied to the fuel injectors with the ASD relay via the PCM. The PCM will then control

GENERAL INFORMATION (Continued)

the injection sequence and injector pulse width by turning the ground circuit to each individual injector on and off.

The PCM determines the proper ignition timing according to input received from the crankshaft position sensor.

ENGINE WARM-UP MODE

This is an Open Loop mode. During engine warm-up, the powertrain control module (PCM) receives inputs from:

- Battery voltage
- Crankshaft position sensor
- Engine coolant temperature sensor
- Intake manifold air temperature sensor
- Manifold absolute pressure (MAP) sensor
- Throttle position sensor (TPS)
- Camshaft position sensor signal (in the distributor)
- Park/neutral switch (gear indicator signal--auto. trans. only)
- Air conditioning select signal (if equipped)
- Air conditioning request signal (if equipped)

Based on these inputs the following occurs:

- Voltage is applied to the fuel injectors with the ASD relay via the PCM. The PCM will then control the injection sequence and injector pulse width by turning the ground circuit to each individual injector on and off.
- The PCM adjusts engine idle speed through the idle air control (IAC) motor and adjusts ignition timing.
- The PCM operates the A/C compressor clutch through the clutch relay. This is done if A/C has been selected by the vehicle operator and requested by the A/C thermostat.
- When engine has reached operating temperature, the PCM will begin monitoring O2S sensor input. The system will then leave the warm-up mode and go into closed loop operation.

IDLE MODE

When the engine is at operating temperature, this is a Closed Loop mode. At idle speed, the powertrain control module (PCM) receives inputs from:

- Air conditioning select signal (if equipped)
- Air conditioning request signal (if equipped)
- Battery voltage
- Crankshaft position sensor
- Engine coolant temperature sensor
- Intake manifold air temperature sensor
- Manifold absolute pressure (MAP) sensor
- Throttle position sensor (TPS)
- Camshaft position sensor signal (in the distributor)
- Battery voltage
- Park/neutral switch (gear indicator signal—auto. trans. only)
- Oxygen sensors

Based on these inputs, the following occurs:

- Voltage is applied to the fuel injectors with the ASD relay via the PCM. The PCM will then control injection sequence and injector pulse width by turning the ground circuit to each individual injector on and off.
- The PCM monitors the O2S sensor input and adjusts air-fuel ratio by varying injector pulse width. It also adjusts engine idle speed through the idle air control (IAC) motor.
- The PCM adjusts ignition timing by increasing and decreasing spark advance.
- The PCM operates the A/C compressor clutch through the clutch relay. This happens if A/C has been selected by the vehicle operator and requested by the A/C thermostat.

CRUISE MODE

When the engine is at operating temperature, this is a Closed Loop mode. At cruising speed, the powertrain control module (PCM) receives inputs from:

- Air conditioning select signal (if equipped)
- Air conditioning request signal (if equipped)
- Battery voltage
- Engine coolant temperature sensor
- Crankshaft position sensor
- Intake manifold air temperature sensor
- Manifold absolute pressure (MAP) sensor
- Throttle position sensor (TPS)
- Camshaft position sensor signal (in the distributor)
- Park/neutral switch (gear indicator signal—auto. trans. only)
- Oxygen (O2S) sensors

Based on these inputs, the following occurs:

- Voltage is applied to the fuel injectors with the ASD relay via the PCM. The PCM will then adjust the injector pulse width by turning the ground circuit to each individual injector on and off.
- The PCM monitors the O2S sensor input and adjusts air-fuel ratio. It also adjusts engine idle speed through the idle air control (IAC) motor.
- The PCM adjusts ignition timing by turning the ground path to the coil on and off.
- The PCM operates the A/C compressor clutch through the clutch relay. This happens if A/C has been selected by the vehicle operator and requested by the A/C thermostat.

ACCELERATION MODE

This is an Open Loop mode. The powertrain control module (PCM) recognizes an abrupt increase in throttle position or MAP pressure as a demand for increased engine output and vehicle acceleration. The

GENERAL INFORMATION (Continued)

PCM increases injector pulse width in response to increased throttle opening.

DECELERATION MODE

When the engine is at operating temperature, this is an Open Loop mode. During hard deceleration, the powertrain control module (PCM) receives the following inputs.

- Air conditioning select signal (if equipped)
- Air conditioning request signal (if equipped)
- Battery voltage
- Engine coolant temperature sensor
- Crankshaft position sensor
- Intake manifold air temperature sensor
- Manifold absolute pressure (MAP) sensor
- Throttle position sensor (TPS)
- Camshaft position sensor signal (in the distributor)
- Park/neutral switch (gear indicator signal—auto. trans. only)
- Vehicle speed sensor

If the vehicle is under hard deceleration with the proper rpm and closed throttle conditions, the PCM will ignore the oxygen sensor input signal. The PCM will enter a fuel cut-off strategy in which it will not supply a ground to the injectors. If a hard deceleration does not exist, the PCM will determine the proper injector pulse width and continue injection.

Based on the above inputs, the PCM will adjust engine idle speed through the idle air control (IAC) motor.

The PCM adjusts ignition timing by turning the ground path to the coil on and off.

WIDE OPEN THROTTLE MODE

This is an Open Loop mode. During wide open throttle operation, the powertrain control module (PCM) receives the following inputs.

- Battery voltage
- Crankshaft position sensor
- Engine coolant temperature sensor
- Intake manifold air temperature sensor
- Manifold absolute pressure (MAP) sensor
- Throttle position sensor (TPS)
- Camshaft position sensor signal (in the distributor)

During wide open throttle conditions, the following occurs:

- Voltage is applied to the fuel injectors with the ASD relay via the PCM. The PCM will then control the injection sequence and injector pulse width by turning the ground circuit to each individual injector on and off. The PCM ignores the oxygen sensor input signal and provides a predetermined amount of additional fuel. This is done by adjusting injector pulse width.
- The PCM adjusts ignition timing by turning the ground path to the coil on and off.

IGNITION SWITCH OFF MODE

When ignition switch is turned to OFF position, the PCM stops operating the injectors, ignition coil, ASD relay and fuel pump relay.

DESCRIPTION AND OPERATION

POWERTRAIN CONTROL MODULE (PCM)

The powertrain control module (PCM) (Fig. 1) operates the fuel system. The PCM was formerly referred to as the SBEC or engine controller. The PCM is a pre-programmed, triple microprocessor digital computer. It regulates ignition timing, air-fuel ratio, emission control devices, charging system, certain transmission features, speed control, air conditioning compressor clutch engagement and idle speed. The PCM can adapt its programming to meet changing operating conditions.

The PCM receives input signals from various switches and sensors. Based on these inputs, the PCM regulates various engine and vehicle operations through different system components. These components are referred to as Powertrain Control Module (PCM) Outputs. The sensors and switches that provide inputs to the PCM are considered Powertrain Control Module (PCM) Inputs.

The PCM adjusts ignition timing based upon inputs it receives from sensors that react to: engine rpm, manifold absolute pressure, engine coolant temperature, throttle position, transmission gear selection (automatic transmission), vehicle speed and the brake switch.

The PCM adjusts idle speed based on inputs it receives from sensors that react to: throttle position, vehicle speed, transmission gear selection, engine coolant temperature and from inputs it receives from the air conditioning clutch switch and brake switch.

Based on inputs that it receives, the PCM adjusts ignition coil dwell. The PCM also adjusts the generator charge rate through control of the generator field and provides speed control operation.

NOTE: PCM Inputs:

- A/C request (if equipped with factory A/C)
- A/C select (if equipped with factory A/C)
- Auto shutdown (ASD) sense
- Battery temperature
- Battery voltage
- Brake switch
- CCD bus (+) circuits
- CCD bus (-) circuits
- Camshaft position sensor signal

DESCRIPTION AND OPERATION (Continued)

- Crankshaft position sensor
- Data link connection for DRB scan tool
- Engine coolant temperature sensor
- Fuel level
- Generator (battery voltage) output
- Ignition circuit sense (ignition switch in on/off/crank/run position)
- Intake manifold air temperature sensor
- Leak detection pump (switch) sense (if equipped)
- Manifold absolute pressure (MAP) sensor
- Oil pressure
- Output shaft speed sensor
- Overdrive/override switch
- Oxygen sensors
- Park/neutral switch (auto. trans. only)
- Power ground
- Sensor return
- Signal ground
- Speed control multiplexed single wire input
- Throttle position sensor
- Transmission governor pressure sensor
- Transmission temperature sensor
- Vehicle speed inputs from ABS or RWAL system

NOTE: PCM Outputs:

- A/C clutch relay
- Auto shutdown (ASD) relay
- CCD bus (+) circuits
- CCD bus (-) circuits
- Data link connection for DRB scan tool
- EGR valve control solenoid (if equipped)
- EVAP canister purge solenoid
- Five volt sensor supply (primary)
- Five volt sensor supply (secondary)
- Fuel injectors
- Fuel pump relay
- Generator field driver (-)
- Generator field driver (+)
- Generator lamp (if equipped)
- Idle air control (IAC) motor
- Ignition coil
- Leak detection pump (if equipped)
- Malfunction indicator lamp (Check engine lamp). Driven through CCD circuits.
- Overdrive indicator lamp (if equipped)
- Service Reminder Indicator (SRI) Lamp (MAINT REQ'D lamp). Driven through CCD circuits.
- Speed control vacuum solenoid
- Speed control vent solenoid
- Tachometer (if equipped). Driven through CCD circuits.
- Transmission convertor clutch circuit
- Transmission 3–4 shift solenoid
- Transmission relay
- Transmission temperature lamp (if equipped)
- Transmission variable force solenoid

AIR CONDITIONING (A/C) CONTROLS—PCM INPUT

The A/C control system information applies to factory installed air conditioning units.

A/C SELECT SIGNAL: When the A/C switch is in the ON position, an input signal is sent to the powertrain control module (PCM). The signal informs the PCM that the A/C has been selected. The PCM adjusts idle speed to a pre-programmed rpm through the idle air control (IAC) motor to compensate for increased engine load.

A/C REQUEST SIGNAL: Once A/C has been selected, the powertrain control module (PCM) receives the A/C request signal from the clutch cycling pressure switch. The input indicates that the evaporator pressure is in the proper range for A/C application. The PCM uses this input to cycle the A/C compressor clutch (through the A/C relay). It will also determine the correct engine idle speed through the idle air control (IAC) motor position.

If the A/C low-pressure switch or high-pressure switch opens (indicating a low or high refrigerant pressure), the PCM will not receive an A/C request signal. The PCM will then remove the ground from the A/C relay. This will deactivate the A/C compressor clutch.

If the switch opens, (indicating that evaporator is not in proper pressure range), the PCM will not receive the A/C request signal. The PCM will then remove the ground from the A/C relay, deactivating the A/C compressor clutch.

AUTOMATIC SHUTDOWN (ASD) RELAY SENSE—PCM INPUT

A 12 volt signal at this input indicates to the PCM that the ASD has been activated. The ASD relay is located in the Power Distribution Center (PDC). The PDC is located in the engine compartment (Fig. 2). Refer to label on PDC cover for relay location. The relay is used to connect the oxygen sensor heater element(s), ignition coil(s) and fuel injectors to 12 volt + power supply.

This input is used to sense that the ASD relay is energized. If the powertrain control module (PCM) does not see 12 volts at this input when the ASD should be activated, it will set a Diagnostic Trouble Code (DTC).

BATTERY TEMPERATURE SENSOR—PCM INPUT

Provides a signal to the PCM corresponding to the battery temperature. Refer to Group 8C, Charging System for additional information.

BATTERY VOLTAGE—PCM INPUT

The battery voltage input provides power to the Powertrain Control Module (PCM). It also informs

DESCRIPTION AND OPERATION (Continued)

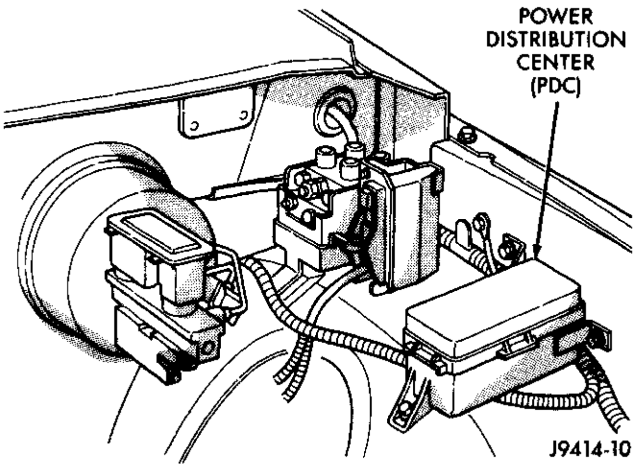

Fig. 2 Power Distribution Center (PDC)

the PCM what voltage level is supplied to the ignition coil and fuel injectors.

If battery voltage is low, the PCM will increase injector pulse width (period of time that the injector is energized). This is done to compensate for the reduced flow through injector caused by the lowered voltage.

BRAKE SWITCH—PCM INPUT

When the brake light switch is activated, the Powertrain Control Module (PCM) receives an input indicating that the brakes are being applied. After receiving this input, the PCM maintains idle speed to a scheduled rpm through control of the Idle Air Control (IAC) motor. The brake switch input is also used to supply/deny power to the speed control servo solenoids.

CAMSHAFT POSITION SENSOR—3.9L/5.2L/5.9L ENGINES—PCM INPUT

A sync signal is provide by the camshaft position sensor located in the distributor (Fig. 3). The sync signal from this sensor works in conjunction with the crankshaft position sensor to provide the powertrain control module (PCM) with inputs. This is done to establish and maintain correct injector firing order.

Refer to Camshaft Position Sensor in Group 8D, Ignition System for more information.

CAMSHAFT POSITION SENSOR—8.0L ENGINÈ—PCM INPUT

A sync signal is provide by the camshaft position sensor. The sensor is located on the side of the timing chain case/cover (Fig. 4). The sync signal from this sensor works in conjunction with the crankshaft position sensor to provide the powertrain control module (PCM) with inputs. This is done to establish and maintain correct injector firing order.

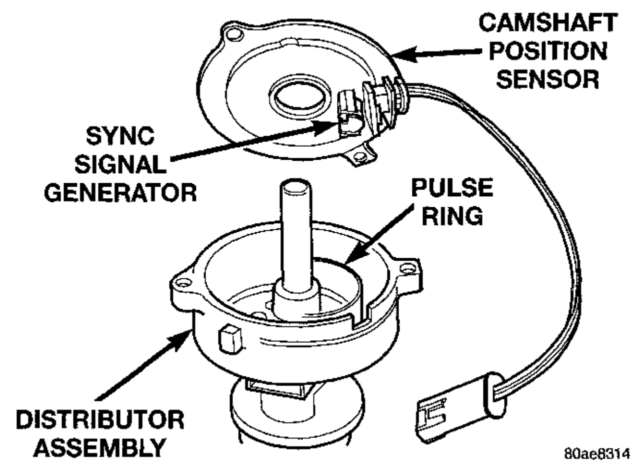

Fig. 3 Camshaft Position Sensor—3.9L/5.2L/5.9L Engines

Refer to Camshaft Position Sensor in Group 8D, Ignition System for more information.

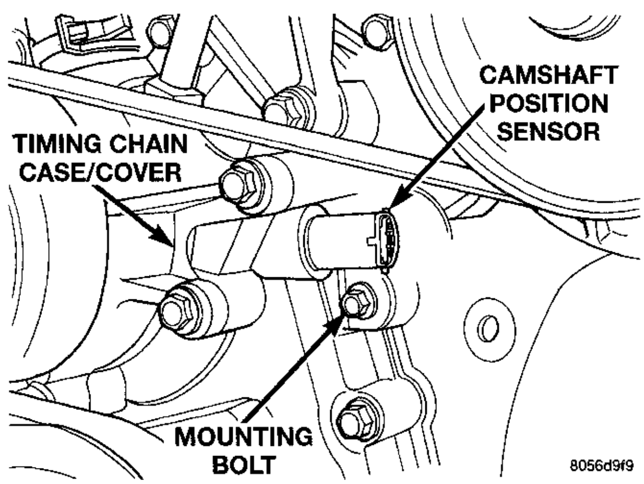

Fig. 4 Camshaft Position Sensor—8.0L Engine

CRANKSHAFT POSITION SENSOR—3.9L/5.2L/5.9L ENGINES—PCM INPUT

This sensor is a hall effect device that detects notches in the flywheel (manual transmission) or flexplate (automatic transmission).

This sensor is used to indicate to the powertrain control module (PCM) that a spark and or fuel injection event is to be required. The output from this sensor, in conjunction with the camshaft position sensor signal, is used to differentiate between fuel injection and spark events. It is also used to synchronize the fuel injectors with their respective cylinders.

The sensor is bolted to the cylinder block near the rear of the right cylinder head (Fig. 5).

Refer to Group 8D, Ignition System for more crankshaft position sensor information.

The engine will not operate if the PCM does not receive a crankshaft position sensor input.

DESCRIPTION AND OPERATION (Continued)

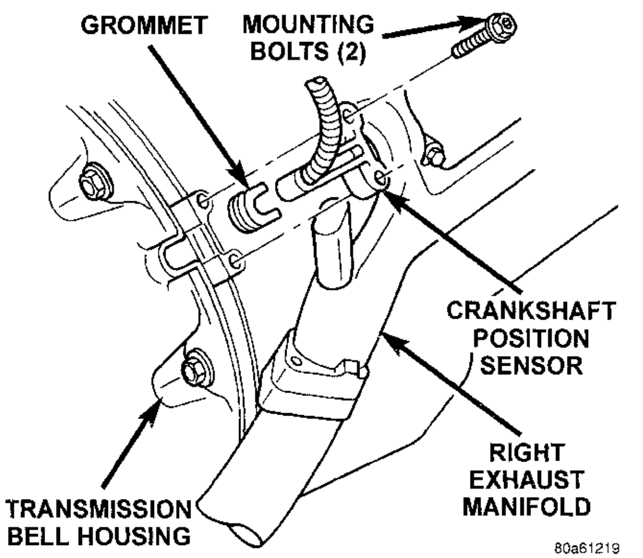

Fig. 5 Crankshaft Position Sensor—3.9L/5.2L/5.9L Engines—Typical

CRANKSHAFT POSITION SENSOR—8.0L ENGINE—PCM INPUT

This sensor is a hall effect device that detects notches in the engine crankshaft.

It is used to indicate to the powertrain control module (PCM) that a spark and or fuel injection event is to be required. The output from this sensor, in conjunction with the camshaft position sensor signal, is used to differentiate between fuel injection and spark events. It is also used to synchronize the fuel injectors with their respective cylinders.

The sensor is bolted to the side of the cylinder block (Fig. 6).

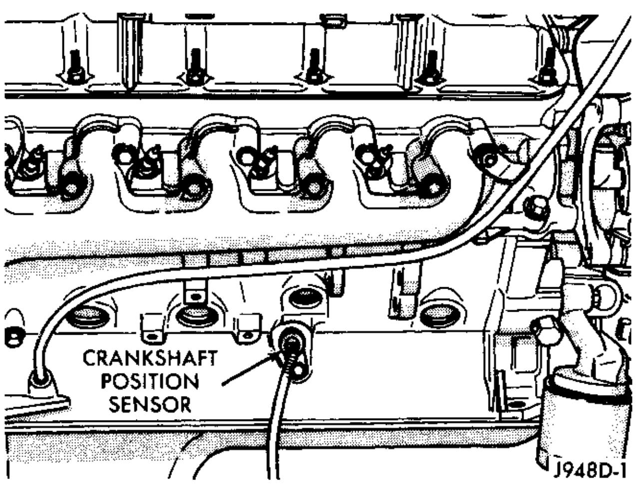

Fig. 6 Crankshaft Position Sensor—8.0L Engine—Typical

Refer to Group 8D, Ignition System for more crankshaft position sensor information.

The engine will not operate if the PCM does not receive a crankshaft position sensor input.

ENGINE COOLANT TEMPERATURE SENSOR—3.9L/5.2L/5.9L ENGINES—PCM INPUT

The engine coolant temperature sensor is installed next to the thermostat housing (Fig. 7) and protrudes into the water jacket. The sensor provides an input voltage to the powertrain control module (PCM) relating coolant temperature. The PCM uses this input along with inputs from other sensors to determine injector pulse width and ignition timing. As coolant temperature varies, the coolant temperature sensor resistance will change. This change in resistance results in a different input voltage to the PCM.

When the engine is cold, the PCM will operate in Open Loop cycle. It will demand slightly richer air-fuel mixtures and higher idle speeds. This is done until normal operating temperatures are reached.

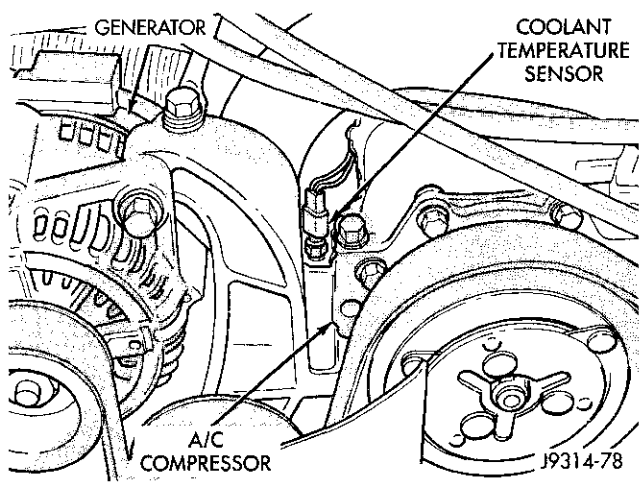

Fig. 7 Engine Coolant Temperature Sensor—3.9L/5.2L/5.9L Engines—Typical

ENGINE COOLANT TEMPERATURE SENSOR—8.0L ENGINE—PCM INPUT

The engine coolant temperature sensor is installed in the thermostat housing (Fig. 8) and protrudes into the water jacket. The sensor provides an input voltage to the powertrain control module (PCM) relating coolant temperature. The PCM uses this input along with inputs from other sensors to determine injector pulse width and ignition timing. As coolant temperature varies, the coolant temperature sensor resistance will change. This change in resistance results in a different input voltage to the PCM.

When the engine is cold, the PCM will operate in Open Loop cycle. It will demand slightly richer air-fuel mixtures and higher idle speeds. This is done until normal operating temperatures are reached.

AUTHENTIC RESTORATION PRODUCT

DESCRIPTION AND OPERATION (Continued)

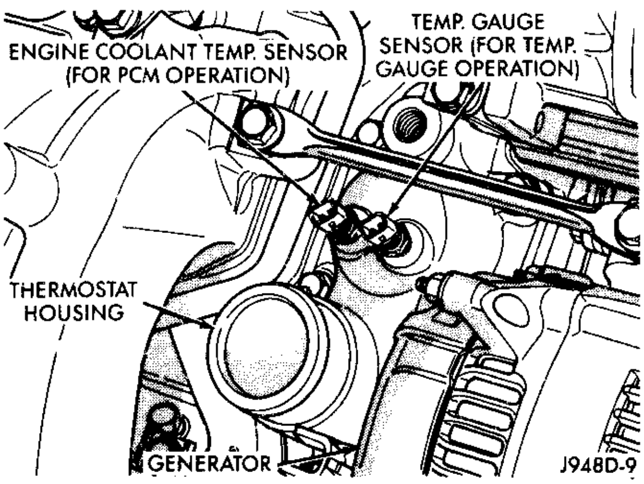

Fig. 8 Engine Coolant Temperature Sensor—8.0L Engine—Typical

FIVE VOLT SENSOR SUPPLY—PRIMARY

Supplies the required 5 volt power source to the crankshaft position sensor, camshaft position sensor, MAP sensor and throttle position sensor.

FIVE VOLT SENSOR SUPPLY—SECONDARY

Supplies the required 5 volt power source to the transmission pressure sensor (if equipped).

FUEL LEVEL SENSOR—PCM INPUT

The Powertrain Control Module (PCM) sends a 5 volt signal to the fuel level sensor (fuel gauge sending unit). The fuel level sensor will then return a signal to the PCM to indicate fuel level. The purpose of this feature is to prevent a false setting of misfire and fuel system monitor trouble codes. This is if the fuel level is less than approximately 15 percent, or, if equipped with a Leak Detection Pump (LDP), more than approximately 85 percent of its rated capacity. This input is also used to send a signal to the PCM for fuel gauge operation via the CCD bus circuits.

IGNITION CIRCUIT SENSE—PCM INPUT

The ignition circuit sense input tells the Powertrain Control Module (PCM) the ignition switch has energized the ignition circuit. Refer to the wiring diagrams for circuit information.

INTAKE MANIFOLD AIR TEMPERATURE SENSOR—3.9L/5.2L/5.9L ENGINES—PCM INPUT

The intake manifold air temperature sensor is installed in the intake manifold with the sensor element extending into the air stream (Fig. 9). The sensor provides an input voltage to the powertrain control module (PCM) indicating intake manifold air temperature. The input is used along with inputs from other sensors to determine injector pulse width. As the temperature of the air-fuel stream in the manifold varies, the sensor resistance changes. This results in a different input voltage to the PCM.

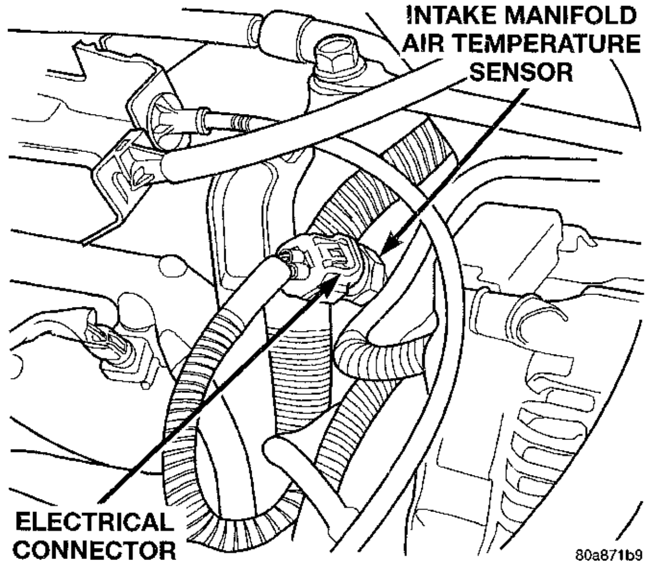

Fig. 9 Intake Manifold Air Temperature Sensor—3.9L/5.2L/5.9L Engine—Typical

INTAKE MANIFOLD AIR TEMPERATURE SENSOR—8.0L ENGINE—PCM INPUT

The intake manifold air temperature sensor is installed in the intake manifold with the sensor element extending into the air stream (Fig. 10). The sensor provides an input voltage to the powertrain control module (PCM) indicating intake manifold air temperature. The input is used along with inputs from other sensors to determine injector pulse width. As the temperature of the air-fuel stream in the manifold varies, the sensor resistance changes. This results in a different input voltage to the PCM.

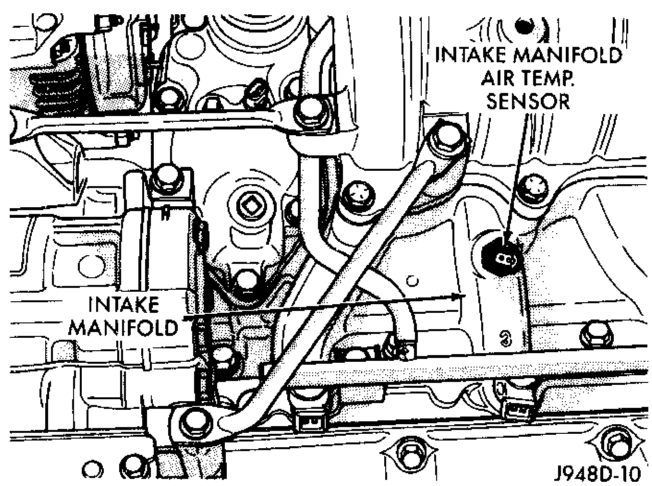

Fig. 10 Intake Manifold Air Temperature Sensor—8.0L Engine—Typical

DESCRIPTION AND OPERATION (Continued)

MANIFOLD ABSOLUTE PRESSURE (MAP) SENSOR—3.9L/5.2L/5.9L ENGINES—PCM INPUT

The MAP sensor reacts to absolute pressure in the intake manifold. It provides an input voltage to the powertrain control module (PCM). As engine load changes, manifold pressure varies. The change in manifold pressure causes MAP sensor voltage to change. The change in MAP sensor voltage results in a different input voltage to the PCM. The input voltage level supplies the PCM with information about ambient barometric pressure during engine start-up (cranking) and engine load while the engine is running. The PCM uses this input along with inputs from other sensors to adjust air-fuel mixture.

The MAP sensor is mounted on the side of the engine throttle body (Fig. 11). The sensor is connected to the throttle body with a rubber L-shaped fitting.

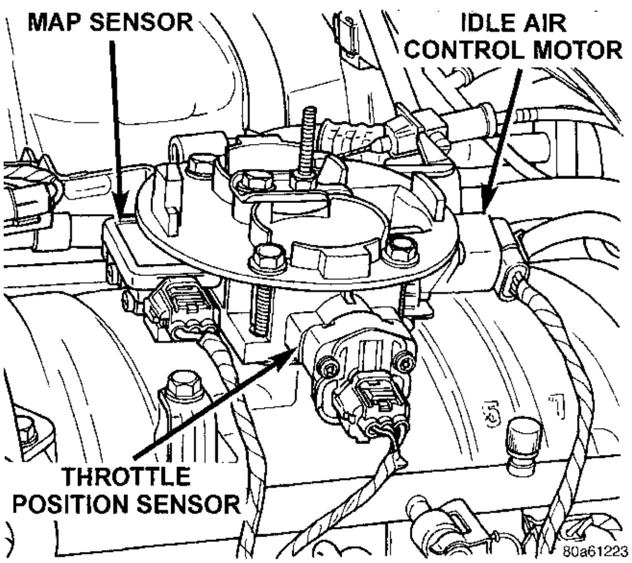

Fig. 11 MAP and Throttle Position Sensor Location—3.9L/5.2L/5.9L Engines—Typical

MANIFOLD ABSOLUTE PRESSURE (MAP) SENSOR—8.0L ENGINE—PCM INPUT

The MAP sensor reacts to absolute pressure in the intake manifold. It provides an input voltage to the powertrain control module (PCM). As engine load changes, manifold pressure varies. The change in manifold pressure causes MAP sensor voltage to change. The change in MAP sensor voltage results in a different input voltage to the PCM. The input voltage level supplies the PCM with information about ambient barometric pressure during engine start-up (cranking) and engine load while the engine is running. The PCM uses this input along with inputs from other sensors to adjust air-fuel mixture.

The MAP sensor is mounted into the right side of the intake manifold. (Fig. 12).

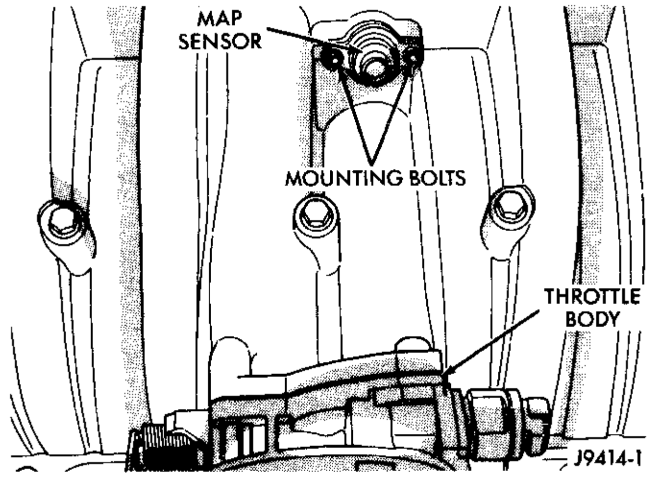

Fig. 12 MAP Sensor Location—8.0L Engine—Typical

OIL PRESSURE SENSOR—PCM INPUT

Sends a signal from the oil pressure sending unit to the Powertrain Control Module (PCM) relating to engine oil pressure.

OUTPUT SHAFT SPEED SENSOR—PCM INPUT

This sensor generates a signal to the PCM relating to the speed of the transmission main drive shaft. This input is used with 4–speed electronic transmissions only.

OVERDRIVE/OVERRIDE SWITCH—PCM INPUT

On vehicles equipped with an automatic transmission and overdrive, the powertrain control module (PCM) regulates the 3-4 overdrive up-shift and downshift through the overdrive solenoid. This solenoid is located in the transmission. An overdrive/override push-button switch is located at the end of transmission shift lever.

The overdrive/override push-button switch is normally open (overdrive allowed) when the lamp is not illuminated. It momentarily closes (overdrive not allowed) when the operator presses the switch and the lamp is illuminated. Overdrive will revert to ON (lamp off) each time the ignition switch in turned on. The transmission downshifts if the operator presses the override switch while in overdrive.

Refer to Group 21 for more transmission information.

OXYGEN SENSOR (O2S)—3.9L/5.2L/5.9L LDC ENGINES—PCM INPUT

Two heated O2S sensors are used (upstream and downstream). The sensors produce voltages from 0 to 1 volt, depending upon the oxygen content of the exhaust gas in the exhaust manifold. When a large amount of oxygen is present (caused by a lean air/fuel mixture), the sensors produces a low voltage.

Mopar AUTHENTIC RESTORATION PRODUCT

DESCRIPTION AND OPERATION (Continued)

When there is a lesser amount present (rich air/fuel mixture) it produces a higher voltage. By monitoring the oxygen content and converting it to electrical voltage, the sensors act as a rich-lean switch.

The oxygen sensors are equipped with a heating element that keeps the sensors at proper operating temperature during all operating modes. Maintaining correct sensor temperature at all times allows the system to enter into closed loop operation sooner. Also, it allows the system to remain in closed loop operation during periods of extended idle.

In Closed Loop operation, the PCM monitors the O2S sensor input (along with other inputs) and adjusts the injector pulse width accordingly. During Open Loop operation, the PCM ignores the O2 sensor input. The PCM adjusts injector pulse width based on preprogrammed (fixed) values and inputs from other sensors.

The Automatic Shutdown (ASD) relay supplies battery voltage to both the upstream and downstream heated oxygen sensors. The oxygen sensors are equipped with a heating element. The heating elements reduce the time required for the sensors to reach operating temperature.

UPSTREAM HEATED OXYGEN SENSOR

The upstream O2S sensor is located in the exhaust downpipe (Fig. 13). It provides an input voltage to the PCM. The input tells the PCM the oxygen content of the exhaust gas. The PCM uses this information to fine tune fuel delivery to maintain the correct oxygen content at the downstream oxygen sensor. The PCM will change the air/fuel ratio until the upstream sensor inputs a voltage that the PCM has determined will make the downstream sensor output (oxygen content) correct.

The upstream oxygen sensor also provides an input to determine catalyst efficiency. Refer to Group 25 Emissions, On-Board Diagnostics, Catalyst Monitor for more information.

DOWNSTREAM HEATED OXYGEN SENSOR

The downstream heated oxygen sensor is located near the outlet end of the catalytic convertor (Fig. 13). The downstream is also used to determine the correct air fuel ratio. As the oxygen content changes at the downstream the PCM calculates how much air fuel ratio change is required. The PCM then looks at the upstream oxygen sensor voltage and changes fuel delivery until the upstream sensor voltage changes enough to correct the downstream sensor voltage (oxygen content).

The downstream oxygen sensor also provides an input to determine catalyst efficiency. Refer to Group 25 Emissions Control Systems, On-Board Diagnostics, Catalyst Monitor for more information.

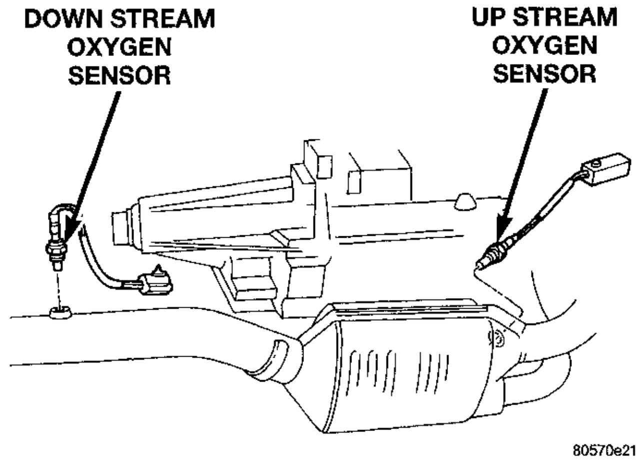

Fig. 13 Upstream/Downstream Oxygen Sensors—LDC Engines

OXYGEN SENSOR (O2S)—HDC ENGINES—PCM INPUT

A total of two heated O2S sensors are used (left and right) on HDC engines. On the 5.9L HDC engine, the left O2S sensor will monitor cylinders 1, 3, 5 and 7. The right sensor will monitor cylinders 2, 4, 6 and 8. On the 8.0L V-10 HDC engine, the left O2S sensor will monitor cylinders 1, 3, 5, 7 and 9. The right sensor will monitor cylinders 2, 4, 6, 8 and 10.

The sensors produce voltages from 0 to 1 volt, depending upon the oxygen content of the exhaust gas in the exhaust manifold. When a large amount of oxygen is present (caused by a lean air/fuel mixture), the sensors produces a low voltage. When there is a lesser amount present (rich air/fuel mixture) it produces a higher voltage. By monitoring the oxygen content and converting it to electrical voltage, the sensors act as a rich-lean switch.

The oxygen sensors are equipped with a heating element that keeps the sensors at proper operating temperature during all operating modes. Maintaining correct sensor temperature at all times allows the system to enter into closed loop operation sooner. Also, it allows the system to remain in closed loop operation during periods of extended idle.

In Closed Loop operation, the PCM monitors the O2S sensor input (along with other inputs) and adjusts the injector pulse width accordingly. During Open Loop operation, the PCM ignores the O2 sensor input. The PCM adjusts injector pulse width based on preprogrammed (fixed) values and inputs from other sensors.

The Automatic Shutdown (ASD) relay supplies battery voltage to both oxygen sensors. The oxygen sensors are equipped with a heating elements. The heating elements reduce the time required for the sensors to reach operating temperature.

DESCRIPTION AND OPERATION (Continued)

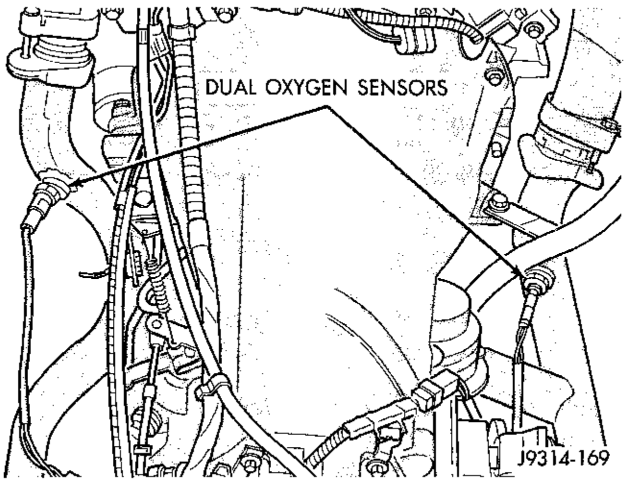

Fig. 14 Left/Right Heated Oxygen Sensors—HDC Engines

OXYGEN SENSOR (O2S)—8.0L MDC ENGINES—PCM INPUT

The 8.0L V-10 engine, when equipped with a Medium Duty Emission Cycle (MDC) package, will use four heated O2S sensors. They are: Left, right, pre-catalyst and post catalyst. The left, right and post catalyst sensors will fine-tune air-fuel ratio. The pre-catalyst and post catalyst sensors will determine catalytic converter efficiency.

Two of these sensors are installed into the left and right exhaust manifold downpipes (Fig. 14). On the 8.0L V-10 MDC engine, the left O2S sensor will monitor cylinders 1, 3, 5, 7 and 9. The right sensor will monitor cylinders 2, 4, 6, 8 and 10.

The sensors produce voltages from 0 to 1 volt, depending upon the oxygen content of the exhaust gas in the exhaust manifold. When a large amount of oxygen is present (caused by a lean air/fuel mixture), the sensors produces a low voltage. When there is a lesser amount present (rich air/fuel mixture) it produces a higher voltage. By monitoring the oxygen content and converting it to electrical voltage, the sensors act as a rich-lean switch.

The oxygen sensors are equipped with a heating element that keeps the sensors at proper operating temperature during all operating modes. Maintaining correct sensor temperature at all times allows the system to enter into closed loop operation sooner. Also, it allows the system to remain in closed loop operation during periods of extended idle.

In Closed Loop operation, the PCM monitors the O2S sensor input (along with other inputs) and adjusts the injector pulse width accordingly. During Open Loop operation, the PCM ignores the O2 sensor input. The PCM adjusts injector pulse width based on preprogrammed (fixed) values and inputs from other sensors.

The Automatic Shutdown (ASD) relay supplies battery voltage to both oxygen sensors. The oxygen sensors are equipped with a heating elements. The heating elements reduce the time required for the sensors to reach operating temperature.

PRE-CATALYST OXYGEN SENSOR

The pre-catalyst O2S sensor is located in the inlet end of the catalytic converter (Fig. 15). It provides an input voltage to the PCM. By comparing the input from the pre-catalyst O2S sensor, with the input from the post catalyst oxygen sensor, the PCM calculates catalytic convertor efficiency.

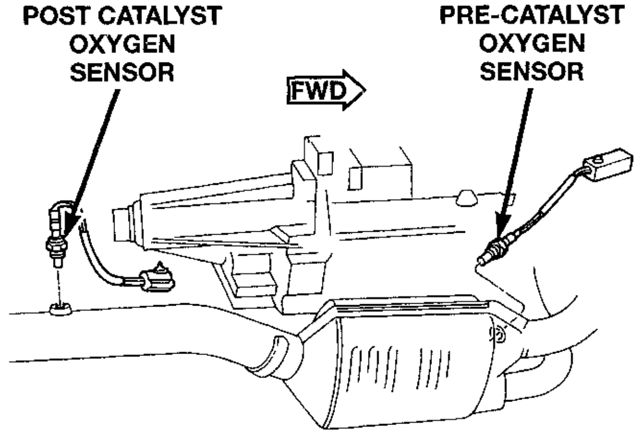

Fig. 15 Pre-Catalyst/Post Catalyst Oxygen Sensors—MDC Engines

POST CATALYST OXYGEN SENSOR

The post catalyst heated oxygen sensor threads into the outlet end of the catalytic convertor (Fig. 15). The post catalyst heated oxygen sensor input is used to detect catalytic convertor deterioration and fine tune the air fuel ratio. As the convertor deteriorates, the input from this sensor begins to match the pre-catalyst sensor input except for a slight time delay. By comparing the inputs from both of these sensors, the PCM calculates catalytic convertor efficiency.

When the catalytic converter efficiency drops below emission standards, the PCM stores a diagnostic trouble code and illuminates the Malfunction Indicator Lamp (MIL). For more information, refer to Group 25, Emission Control Systems.

POWER GROUND

The power ground is used to control ground circuits for the following powertrain control module (PCM) loads:

- Generator field winding
- Fuel injectors
- Ignition coil
- Certain relays/solenoids

AUTHENTIC RESTORATION PRODUCT

DESCRIPTION AND OPERATION (Continued)

PTO SWITCH SENSE—PCM INPUT

This Powertrain Control Module (PCM) input is used only on models equipped with aftermarket Power Take Off (PTO) units.

The input is used only to tell the PCM that the PTO has been engaged. The PCM will disable (temporarily shut down) certain OBD II fault codes when the PTO is engaged.

Operation: When the aftermarket PTO switch has been engaged, a 12V + signal is sent through circuit G113 to PCM pin A13. The PCM will then sense and determine that the PTO has been activated.

SENSOR RETURN—PCM INPUT

Sensor Return provides a low noise ground reference for all engine control system sensors.

SIGNAL GROUND—PCM INPUT

Signal ground provides a low noise ground to the data link connector.

SPEED CONTROL SWITCHES—PCM INPUT

Six different speed control functions, using three momentary contact switches, are monitored through this **multiplexed** input. The resistance monitored at this input, in combination with the length of time the PCM measures the resistance, determines which switch feature has been selected. The three switches are: On/Off, Set/Coast, Cancel and Resume/Accelerate.

Refer to Group 8H, Vehicle Speed Control System for further speed control information.

TRANSMISSION PARK/NEUTRAL SWITCH—PCM INPUT

The park/neutral switch is located on the transmission housing and provides an input to the powertrain control module (PCM). This will indicate that the automatic transmission is in Park, Neutral or a drive gear selection. This input is used to determine idle speed (varying with gear selection), fuel injector pulse width, ignition timing advance and vehicle speed control operation. Refer to Group 21, Transmissions, for testing, replacement and adjustment information.

TRANSMISSION GOVERNOR PRESSURE SENSOR—PCM INPUT

Provides a signal proportional to the transmission governor pressure. It provides feedback for control of the governor pressure solenoid, which regulates transmission governor pressure. This input is used with 4–speed electronic transmissions only.

TRANSMISSION TEMPERATURE SENSOR—PCM INPUT

This input is used in the shift operation for 4–speed electronic transmissions only. The temperature data is used for: torque converter clutch operation, overdrive shift, low temperature shift compensation, wide open throttle shift strategy and governor pressure transducer calibration.

THROTTLE POSITION SENSOR (TPS)—3.9L/5.2L/5.9L ENGINES—PCM INPUT

The throttle position sensor (TPS) is mounted on the throttle body (Fig. 11). The TPS is a variable resistor that provides the powertrain control module (PCM) with an input signal (voltage) that represents throttle blade position. The sensor is connected to the throttle blade shaft. As the position of the throttle blade changes, the resistance of the TPS changes.

The PCM supplies approximately 5 volts to the TPS. The TPS output voltage (input signal to the PCM) represents the throttle blade position. The PCM receives an input signal voltage from the TPS. This will vary in an approximate range of from .25 volts at minimum throttle opening (idle), to 4.8 volts at wide open throttle. Along with inputs from other sensors, the PCM uses the TPS input to determine current engine operating conditions. In response to engine operating conditions, the PCM will adjust fuel injector pulse width and ignition timing.

THROTTLE POSITION SENSOR (TPS)—8.0L ENGINE—PCM INPUT

The throttle position sensor (TPS) is mounted on the throttle body (Fig. 16). The TPS is a variable resistor that provides the powertrain control module (PCM) with an input signal (voltage) that represents throttle blade position. The sensor is connected to the throttle blade shaft. As the position of the throttle blade changes, the resistance of the TPS changes.

The PCM supplies approximately 5 volts to the TPS. The TPS output voltage (input signal to the PCM) represents the throttle blade position. The PCM receives an input signal voltage from the TPS. This will vary in an approximate range of from .25 volts at minimum throttle opening (idle), to 4.8 volts at wide open throttle. Along with inputs from other sensors, the PCM uses the TPS input to determine current engine operating conditions. In response to engine operating conditions, the PCM will adjust fuel injector pulse width and ignition timing.

VEHICLE SPEED AND DISTANCE—PCM INPUT

The Vehicle Speed Sensor (VSS) is no longer used for any Dodge truck in the 1998 model year.

Vehicle speed and distance covered are measured by the Rear Wheel Speed Sensor. The sensor is

DESCRIPTION AND OPERATION (Continued)

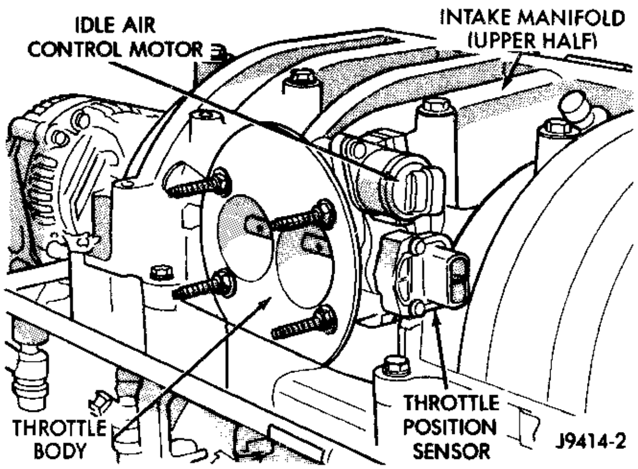

Fig. 16 Sensor Location—8.0L Engine

mounted to the rear axle. A signal is sent from this sensor to the Controller Antilock Brake (CAB) computer. A signal is then sent from the CAB to the Powertrain Control Module (PCM) to determine vehicle speed and distance covered. The PCM will then determine strategies for fuel system and speed control system operation.

Refer to Odometer and Trip Odometer in Group 8E, Instrument Panel for additional information.

AIR CONDITIONING (A/C) CLUTCH RELAY—PCM OUTPUT

The A/C relay is located in the Power Distribution Center (PDC) (Fig. 17). Refer to label on PDC cover for relay location.

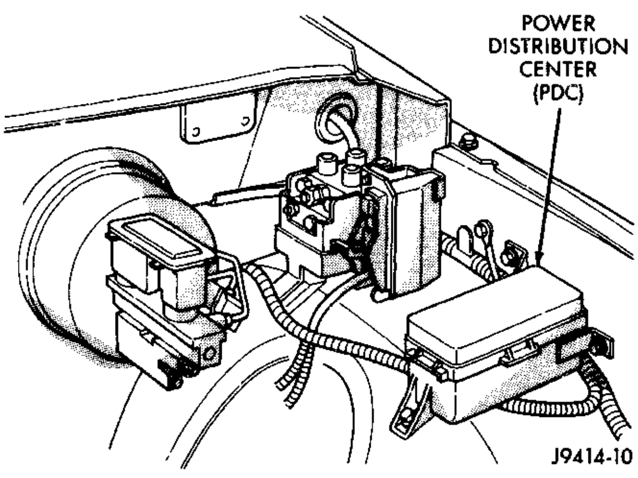

Fig. 17 Power Distribution Center (PDC)

The powertrain control module (PCM) activates the A/C compressor through the A/C clutch relay. The PCM regulates A/C compressor operation by switching the ground circuit for the A/C clutch relay on and off.

When the PCM receives a request for A/C, it will adjust idle air control (IAC) motor position. This is done to increase idle speed. The PCM will then activate the A/C clutch through the A/C clutch relay. The PCM adjusts idle air control (IAC) stepper motor position to compensate for increased engine load from the A/C compressor.

By switching the ground path for the relay on and off, the PCM is able to cycle the A/C compressor clutch. This is based on changes in engine operating conditions. If, during A/C operation, the PCM senses low idle speeds or a wide open throttle condition, it will de-energize the relay. This prevents A/C clutch engagement. The relay will remain de-energized until the idle speed increases or the wide open throttle condition exceeds 15 seconds or no longer exists. The PCM will also de-energize the relay if coolant temperature exceeds 125°C (257°F) or low or high system pressure exists.

AUTO SHUTDOWN (ASD) RELAY—PCM OUTPUT

The ASD relay is located in the Power Distribution Center (PDC) (Fig. 17).

The ASD supplies battery voltage to the fuel injectors, ignition coil and oxygen (O2S) sensor heating elements. The ground circuit for the coil in the ASD relay is controlled by the powertrain control module (PCM). The PCM operates the relay by switching the ground circuit on and off.

CCD BUS (+/-) CIRCUITS-PCM OUTPUTS

The Powertrain Control Module (PCM) sends certain output signals through the CCD bus circuits. These signals are used to control certain instrument panel located items and to determine certain identification numbers.

Refer to Group 8E, Instrument Panel and Gauges for additional information.

DATA LINK CONNECTOR—PCM INPUT AND OUTPUT

The 16–way data link connector (diagnostic scan tool connector) links the Diagnostic Readout Box (DRB) scan tool or the Mopar Diagnostic System (MDS) with the powertrain control module (PCM). The data link connector (Fig. 18) is located at lower edge of instrument panel near steering column. For operation of the DRB scan tool, refer to the appropriate Powertrain Diagnostic Procedures service manual.

DUTY CYCLE EVAP PURGE SOLENOID VALVE-PCM OUTPUT

Refer to Group 25, Emission Control System for information.

DESCRIPTION AND OPERATION (Continued)

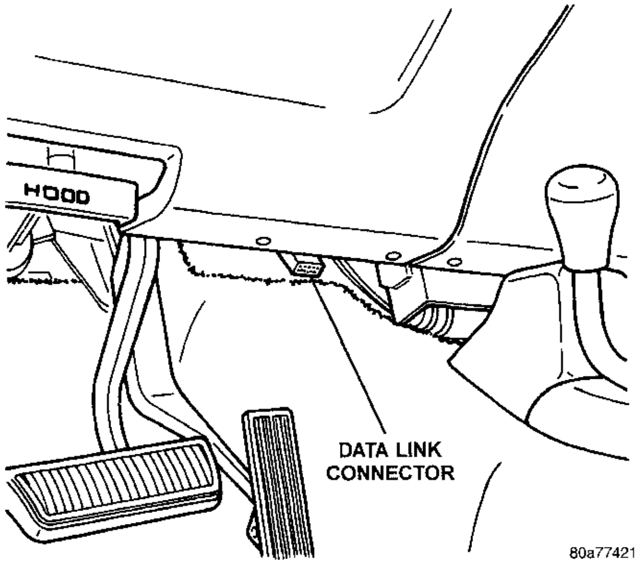

Fig. 18 16–Way Data Link Connector

FUEL INJECTORS—3.9L/5.2L/5.9L ENGINES—PCM OUTPUT

The fuel injectors are attached to the fuel rail (Fig. 19). 3.9L engines use six injectors. 5.2L and 5.9L engines use eight injectors.

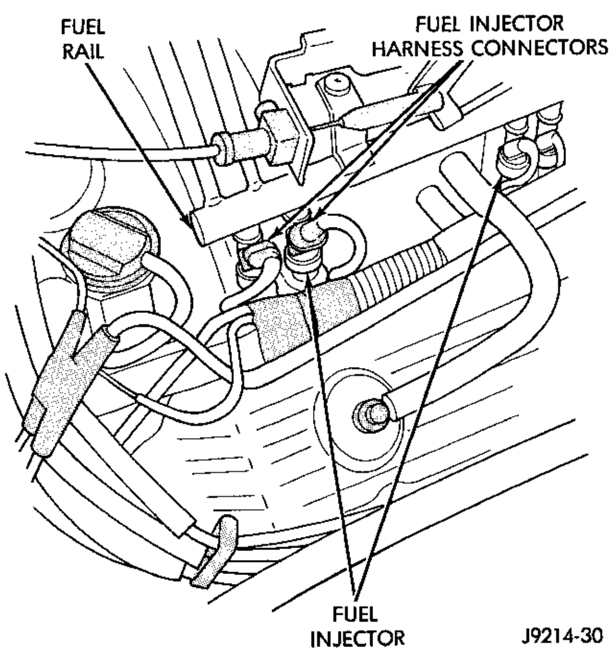

Fig. 19 Fuel Injectors—3.9L/5.2L/5.9L Engines—Typical

The nozzle ends of the injectors are positioned into openings in the intake manifold just above the intake valve ports of the cylinder head. The engine wiring harness connector for each fuel injector is equipped with an attached numerical tag (INJ 1, INJ 2 etc.). This is used to identify each fuel injector with its respective cylinder number.

The injectors are energized individually in a sequential order by the powertrain control module (PCM). The PCM will adjust injector pulse width by switching the ground path to each individual injector on and off. Injector pulse width is the period of time that the injector is energized. The PCM will adjust injector pulse width based on various inputs it receives.

During start up, battery voltage is supplied to the injectors through the ASD relay. When the engine is operating, voltage is supplied by the charging system. The PCM determines injector pulse width based on various inputs.

FUEL INJECTORS—8.0L ENGINE—PCM OUTPUT

The fuel injectors are attached to the fuel rail (Fig. 20). 8.0L V–10 engines use 10 injectors.

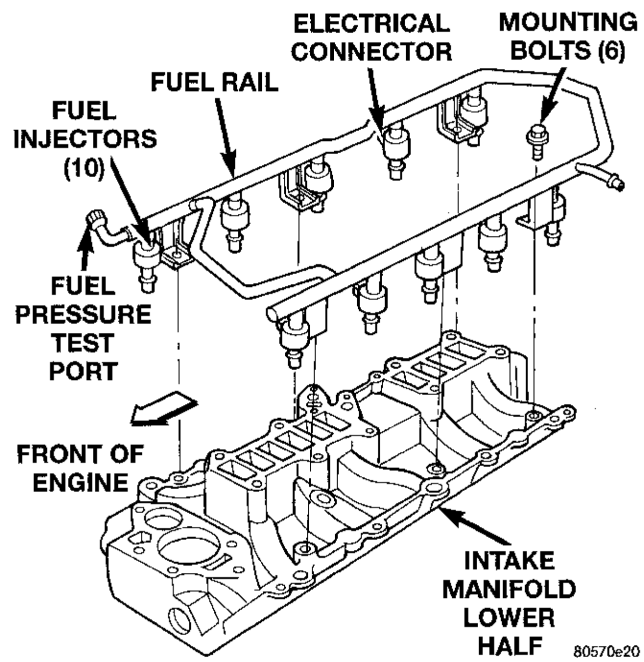

Fig. 20 Fuel Injectors—8.0L Engine—Typical

The nozzle ends of the injectors are positioned into openings in the intake manifold just above the intake valve ports of the cylinder head. The engine wiring harness connector for each fuel injector is equipped with an attached numerical tag (INJ 1, INJ 2 etc.). This is used to identify each fuel injector with its respective cylinder number.

The 10 injectors are energized individually in a sequential order by the powertrain control module (PCM). The PCM will adjust injector pulse width by switching the ground path to each individual injector on and off. Injector pulse width is the period of time that the injector is energized. The PCM will adjust

DESCRIPTION AND OPERATION (Continued)

injector pulse width based on various inputs it receives.

During start up, battery voltage is supplied to the injectors through the ASD relay. When the engine is operating, voltage is supplied by the charging system. The PCM determines injector pulse width based on various inputs.

FUEL PUMP RELAY—PCM OUTPUT

The PCM energizes the electric fuel pump through the fuel pump relay. Battery voltage is applied to the fuel pump relay when the ignition key is ON. The relay is energized when a ground signal is provided by the PCM.

The fuel pump will operate for approximately one second unless the engine is operating or the starter motor is engaged.

The fuel pump relay is located in the Power Distribution Center (PDC) (Fig. 17).

GENERATOR FIELD SOURCE (+)—PCM OUTPUT

This output from the Powertrain Control Module (PCM) regulates charging system voltage to the generator field source (+) circuit. The voltage range is 12.9 to 15.0 volts. Models of previous years had used the ASD relay (directly) to apply the 12 volt + power supply to the generator field source (+) circuit. Refer to Groups 8A and 8C for charging system information.

GENERATOR FIELD DRIVER (-)—PCM OUTPUT

This output from the Powertrain Control Module (PCM) regulates charging system ground control to the generator field driver (-) circuit. Refer to Groups 8A and 8C for charging system information.

GENERATOR LAMP—PCM OUTPUT

If the powertrain control module (PCM) senses a low charging condition in the charging system, it will illuminate the generator lamp (if equipped) on the instrument panel. For example, during low idle with all accessories turned on, the lamp may momentarily go on. Once the PCM corrects idle speed to a higher rpm, the lamp will go out. Refer to Groups 8A and 8C for charging system information.

IDLE AIR CONTROL (IAC) MOTOR—3.9L/5.2L/5.9L ENGINES—PCM OUTPUT

The IAC motor is mounted to the back of the throttle body (Fig. 11) and is controlled by the powertrain control module (PCM).

The throttle body has an air control passage that provides air for the engine at idle (the throttle plate is closed). The IAC motor pintle protrudes into the air control passage (Fig. 21) and regulates air flow through it. Based on various sensor inputs, the powertrain control module (PCM) adjusts engine idle speed by moving the IAC motor pintle in and out of the air control passage. The IAC motor is positioned when the ignition key is turned to the On position.

A (factory adjusted) set screw is used to mechanically limit the position of the throttle body throttle plate. **Never attempt to adjust the engine idle speed using this screw.** All idle speed functions are controlled by the PCM.

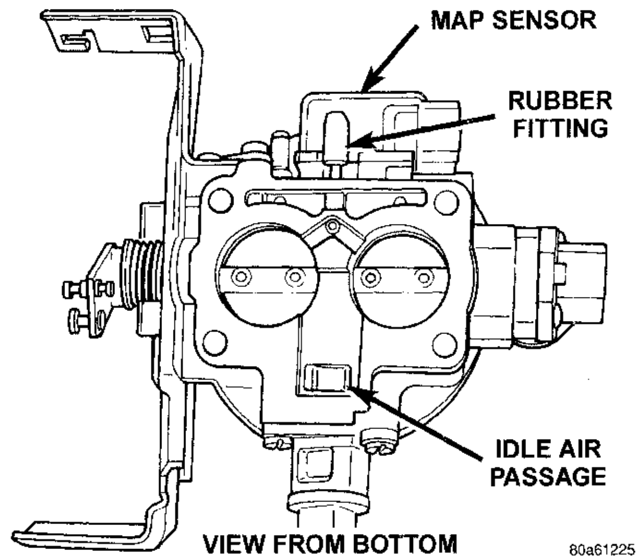

Fig. 21 Throttle Body Air Control Passage—3.9L/5.2L/5.9L Engines

IDLE AIR CONTROL (IAC) MOTOR—8.0L ENGINE—PCM OUTPUT

The IAC motor is mounted to the side of the throttle body (Fig. 22) and is controlled by the powertrain control module (PCM).

The throttle body has an air control passage that provides air for the engine at idle (the throttle plate is closed). The IAC motor pintle protrudes into the air control passage (Fig. 23) and regulates air flow through it. Based on various sensor inputs, the powertrain control module (PCM) adjusts engine idle speed by moving the IAC motor pintle in and out of the air control passage. The IAC motor is positioned when the ignition key is turned to the On position.

A (factory adjusted) set screw is used to mechanically limit the position of the throttle body throttle plate. **Never attempt to adjust the engine idle speed using this screw.** All idle speed functions are controlled by the PCM.

IGNITION COIL—3.9L/5.2L/5.9L ENGINES—PCM OUTPUT

System voltage is supplied to the ignition coil positive terminal. The powertrain control module (PCM) operates the ignition coil. **Base (initial) ignition**

DESCRIPTION AND OPERATION (Continued)

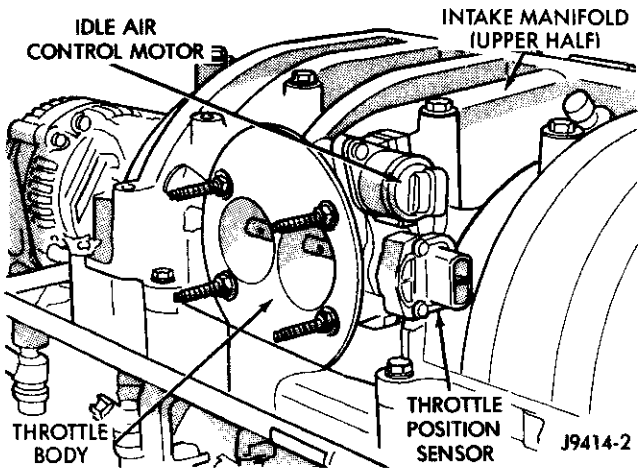

Fig. 22 Idle Air Control Motor Location—8.0L Engine

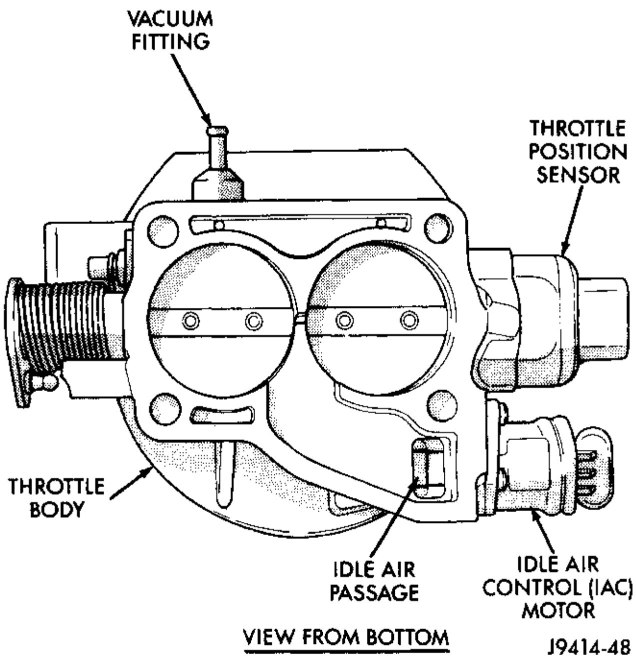

Fig. 23 Idle Air Control Passage—8.0L Engine

timing is not adjustable. The PCM adjusts ignition timing to meet changing engine operating conditions.

The ignition coil is located near the front of the right cylinder head (Fig. 24).

Refer to Group 8D, Ignition System for additional information.

IGNITION COILS—8.0L ENGINE—PCM OUTPUTS

System voltage is supplied to each of the five ignition coil positive terminals. The powertrain control module (PCM) operates the 5 paired ignition coils. **Base (initial) ignition timing is not adjustable.** The PCM adjusts ignition timing to meet changing engine operating conditions.

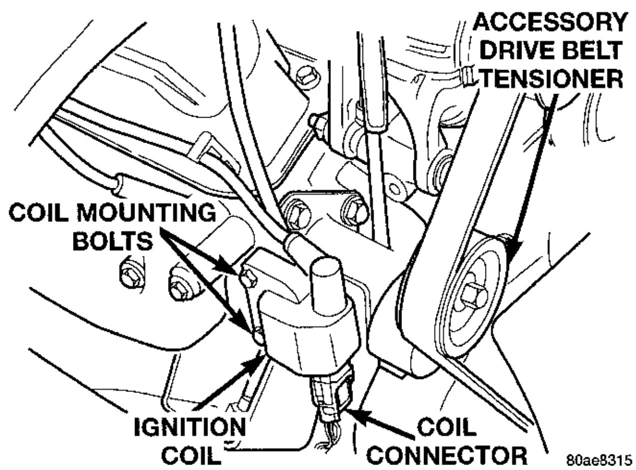

Fig. 24 Ignition Coil—3.9L/5.2L/5.9L Engines—Typical (5.2L Shown)

The ignition coil pack is located above the right engine valve cover (Fig. 25).

Refer to Group 8D, Ignition System for additional information.

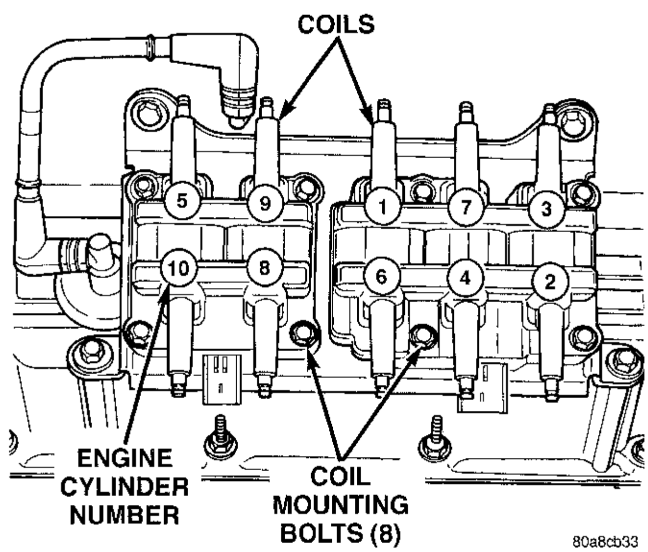

Fig. 25 Ignition Coil Packs—8.0L Engine

MALFUNCTION INDICATOR LAMP—PCM OUTPUT

Refer to Group 25, Emission Control System for information.

OVERDRIVE LAMP—PCM OUTPUT

This circuit controls a signal for the operation of the push-button overdrive lamp switch. When the lamp is illuminated, the overdrive is disengaged.

SPEED CONTROL SOLENOIDS—PCM OUTPUT

Speed control operation is regulated by the powertrain control module (PCM). The PCM controls the vacuum to the throttle actuator through the speed

DESCRIPTION AND OPERATION (Continued)

control vacuum and vent solenoids. Refer to Group 8H for Speed Control Information.

SERVICE REMINDER INDICATOR (SRI) LAMP—PCM OUTPUT

This circuit controls operation of the SRI lamp.

The instrument panel mounted service reminder indicator (SRI) lamp is used only on vehicles equipped with 5.9L V-8 heavy duty cycle (HDC) engines. The lamp is displayed on the instrument panel as the MAINT REQ'D lamp. When the lamp has been activated, certain service/maintenance must be performed.

For required service/maintenance stated in time or mileage, refer to Group 0, Lubrication and Maintenance. Also refer to Group 25, Emission Control System for additional information.

The SRI lamp is not used with diesel engines.

TACHOMETER—PCM OUTPUT

The powertrain control module (PCM) supplies engine rpm values to the instrument cluster tachometer. Refer to Group 8E for tachometer information.

THREE-FOUR SHIFT SOLENOID—PCM OUTPUT

This output is used to control the transmission three-four shift solenoid. It is used on 4–speed electronically controlled automatic transmissions only.

TORQUE CONVERTOR CLUTCH (TCC) SOLENOID—PCM OUTPUT

This circuit controls operation of the transmission mounted torque convertor clutch (TCC) solenoid used for torque convertor engagement.

The powertrain control module (PCM) will determine when to engage and disengage the solenoid by monitoring vehicle miles per hour (mph) versus the output voltage of the throttle position sensor. Also needed are various inputs from:

- Transmission temperature sensor
- Output shaft speed sensor
- Module timer
- Engine rpm
- MAP sensor
- Brake switch

MANUAL TRANSMISSION

If equipped with a manual transmission, this PCM output will control operation of the shift indicator lamp (if equipped with lamp). The lamp is controlled by the powertrain control module (PCM). The lamp illuminates on the instrument panel to indicate when the driver should shift to the next highest gear for best fuel economy. The PCM will turn the lamp OFF after 3 to 5 seconds if the shift of gears is not performed. The lamp will remain off until vehicle stops accelerating and is brought back to range of up-shift lamp operation. This will also happen if vehicle is shifted into fifth gear.

The indicator lamp is normally illuminated when the ignition switch is turned on and it is turned off when the engine is started up. With the engine running, the lamp is turned ON/OFF depending upon engine speed and load.

TRANSMISSION RELAY—PCM OUTPUT

The output to this relay provides battery voltage to the overdrive (OD), torque converter clutch (TCC) and governor pressure solenoids. Once battery voltage is applied to the solenoids, they are individually activated by the PCM through OD, TCC and governor pressure outputs. The relay is located in the Power Distribution Center (PDC). Refer to label on PDC cover for relay location.

GOVERNOR PRESSURE SOLENOID—PCM OUTPUT

This solenoid regulates the transmission fluid line pressure to produce the governor pressure necessary for transmission shift control. It is used on 4–speed electronic transmissions only.

THROTTLE BODY—3.9L/5.2L/5.9L ENGINES

Filtered air from the air cleaner enters the intake manifold through the throttle body (Fig. 26). Fuel does not enter the intake manifold through the throttle body. Fuel is sprayed into the manifold by the fuel injectors. The throttle body is mounted on the intake manifold. It contains an air control passage (Fig. 27) controlled by an idle air control (IAC) motor. The air control passage is used to supply air for idle conditions. A throttle valve (plate) is used to supply air for above idle conditions.

The throttle position sensor (TPS), idle air control (IAC) motor and manifold absolute pressure sensor (MAP) are attached to the throttle body. The accelerator pedal cable, speed control cable and transmission control cable (when equipped) are connected to the throttle arm.

A (factory adjusted) set screw is used to mechanically limit the position of the throttle body throttle plate. **Never attempt to adjust the engine idle speed using this screw.** All idle speed functions are controlled by the PCM.

THROTTLE BODY—8.0L ENGINE

Filtered air from the air cleaner enters the intake manifold through the side mounted throttle body (Fig. 28). Fuel does not enter the intake manifold through the throttle body. Fuel is sprayed into the manifold by the fuel injectors. The throttle body is mounted on the intake manifold. It contains an air control passage (Fig. 29) controlled by an idle air con-

DESCRIPTION AND OPERATION (Continued)

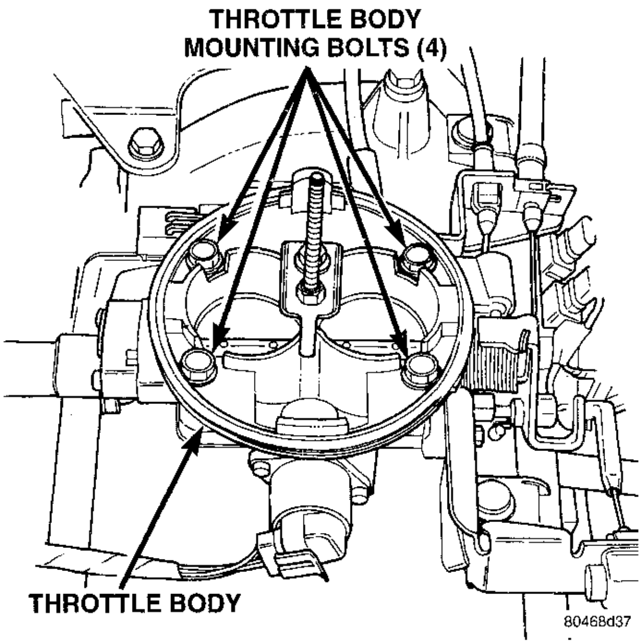

Fig. 26 Throttle Body—3.9L/5.2L/5.9L Engines

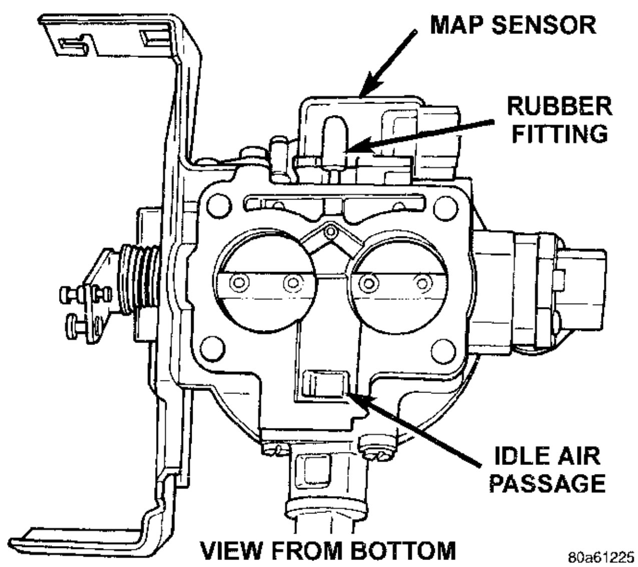

Fig. 27 Air Control Passage—3.9L/5.2L/5.9L Engines

trol (IAC) motor. The air control passage is used to supply air for idle conditions. A throttle valve (plate) is used to supply air for above idle conditions.

The throttle position sensor (TPS) and idle air control (IAC) motor are attached to the throttle body. The accelerator pedal cable, speed control cable and transmission control cable (when equipped) are connected to the throttle arm.

A (factory adjusted) set screw is used to mechanically limit the position of the throttle body throttle plate. **Never attempt to adjust the engine idle**

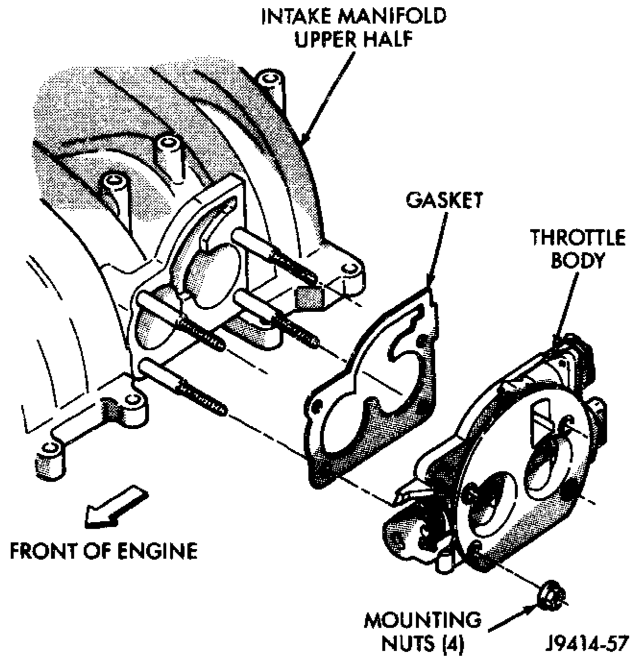

Fig. 28 Throttle Body—8.0L Engine

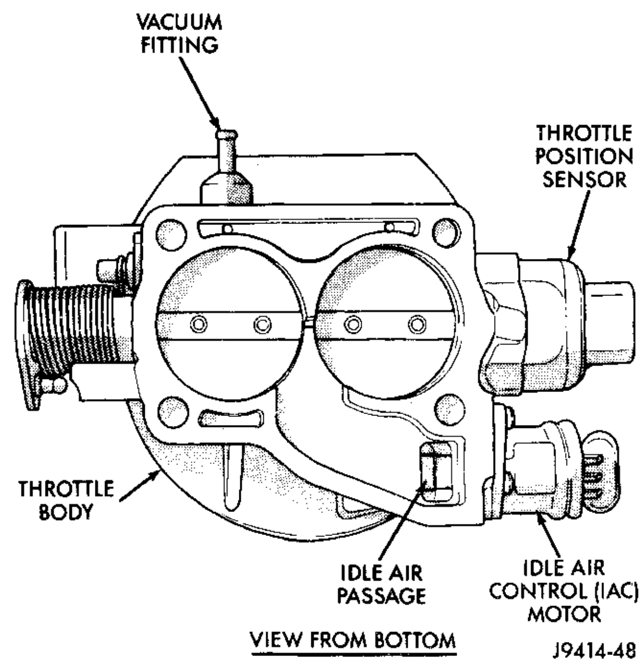

Fig. 29 Air Control Passage—8.0L Engine

speed using this screw. All idle speed functions are controlled by the PCM.

DIAGNOSIS AND TESTING

VISUAL INSPECTION—3.9L/5.2L/5.9L ENGINES

A visual inspection for loose, disconnected or incorrectly routed wires and hoses should be made. This

DIAGNOSIS AND TESTING (Continued)

should be done before attempting to diagnose or service the fuel injection system. A visual check will help spot these faults and save unnecessary test and diagnostic time. A thorough visual inspection will include the following checks:

(1) Verify that the three 32–way electrical connectors are fully inserted into the connector of the powertrain control module (PCM) (Fig. 30).

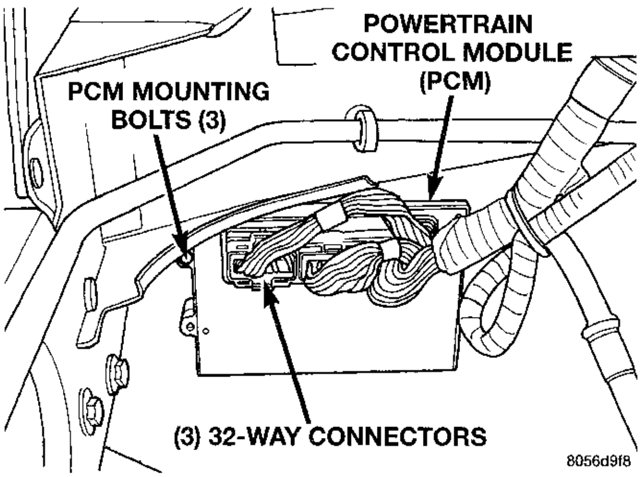

Fig. 30 Powertrain Control Module (PCM)

(2) Inspect the battery cable connections. Be sure that they are clean and tight.

(3) Inspect fuel pump relay and air conditioning compressor clutch relay (if equipped). Inspect the ASD relay connections. Inspect starter motor relay connections. Inspect relays for signs of physical damage and corrosion. The relays are located in the Power Distribution Center (PDC) (Fig. 31). Refer to label on PDC cover for relay location.

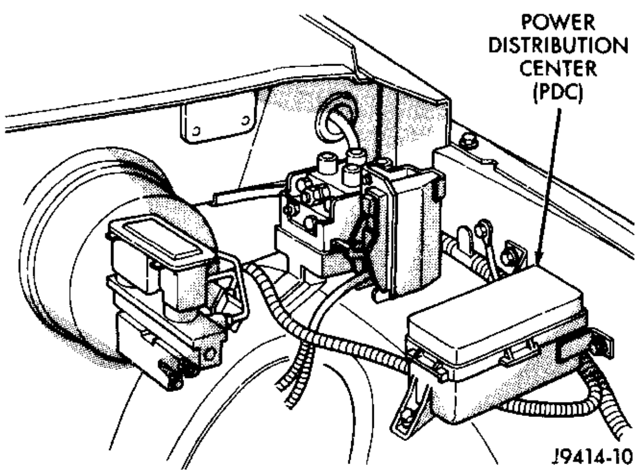

Fig. 31 Power Distribution Center (PDC)

(4) Inspect ignition coil connections. Verify that coil secondary cable is firmly connected to coil (Fig. 32).

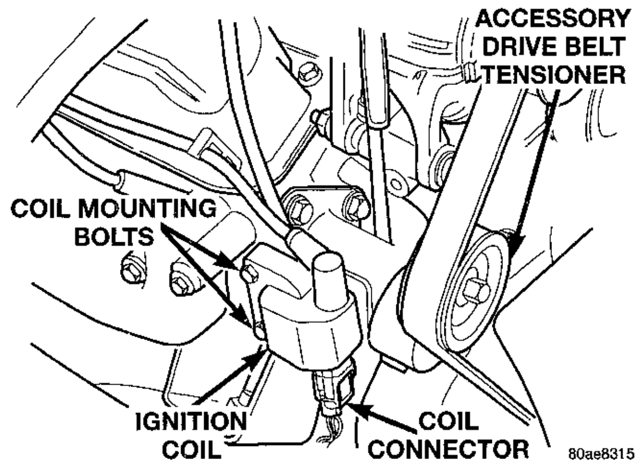

Fig. 32 Ignition Coil—3.9L/5.2L/5.9L Engines—Typical

(5) Verify that distributor cap is correctly attached to distributor. Be sure that spark plug cables are firmly connected to the distributor cap and the spark plugs are in their correct firing order. Be sure that coil cable is firmly connected to distributor cap and coil. Be sure that camshaft position sensor wire connector (at the distributor) is firmly connected to harness connector. Inspect spark plug condition. Refer to Group 8D, Ignition. Connect vehicle to an oscilloscope and inspect spark events for fouled or damaged spark plugs or cables.

(6) Verify that generator output wire, generator connector and ground wire are firmly connected to the generator.

(7) Inspect the system body grounds for loose or dirty connections. Refer to Group 8, Wiring for ground locations.

(8) Verify positive crankcase ventilation (PCV) valve operation. Refer to Group 25, Emission Control System for additional information. Verify PCV valve hose is firmly connected to PCV valve and manifold (Fig. 33).

(9) Inspect fuel tube quick-connect fitting-to-fuel rail connections.

(10) Verify that hose connections to all ports of vacuum fittings on intake manifold are tight and not leaking.

(11) Inspect accelerator cable, transmission throttle cable (if equipped) and cruise control cable connections (if equipped). Check their connections to the throttle arm of throttle body for any binding or restrictions.

(12) If equipped with vacuum brake booster, verify that vacuum booster hose is firmly connected to fitting on intake manifold. Also check connection to brake vacuum booster.

(13) Inspect the air cleaner inlet and air cleaner element for dirt or restrictions.

DIAGNOSIS AND TESTING (Continued)

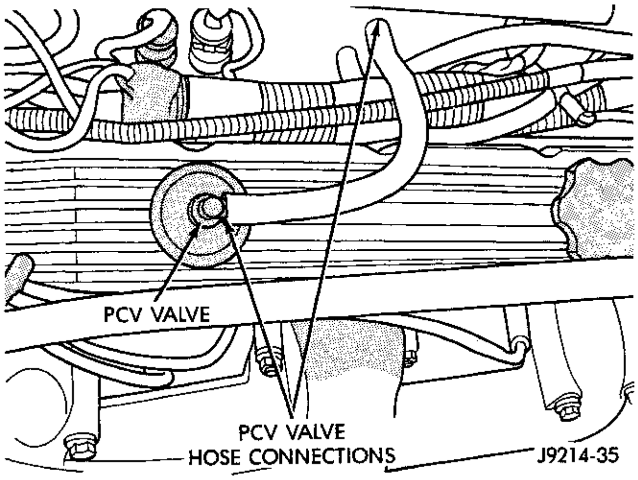

Fig. 33 PCV Valve Hose Connections—3.9L/5.2L/5.9L Engines—Typical

(14) Inspect radiator grille area, radiator fins and air conditioning condenser for restrictions.

(15) Verify that the intake manifold air temperature sensor wire connector is firmly connected to harness connector (Fig. 34).

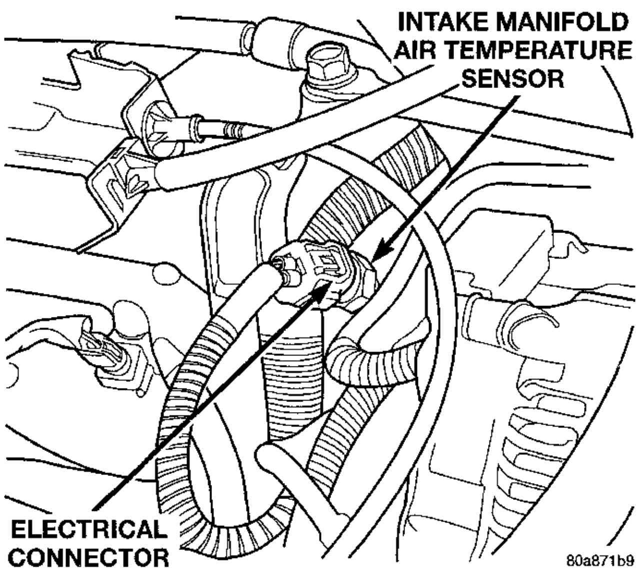

Fig. 34 Air Temperature Sensor—3.9L/5.2L/5.9L—Typical (V-8 Shown)

(16) Verify that MAP sensor electrical connector is firmly connected to MAP sensor (Fig. 35). Also verify that rubber L-shaped fitting from MAP sensor to the throttle body is firmly connected (Fig. 36).

(17) Verify that fuel injector wire harness connectors are firmly connected to injectors in the correct order. Each harness connector is numerically tagged with the injector number (INJ 1, INJ 2 etc.) of its corresponding fuel injector and cylinder number.

(18) Verify harness connectors are firmly connected to idle air control (IAC) motor, throttle position sensor (TPS) and manifold absolute pressure (MAP) sensor (Fig. 35).

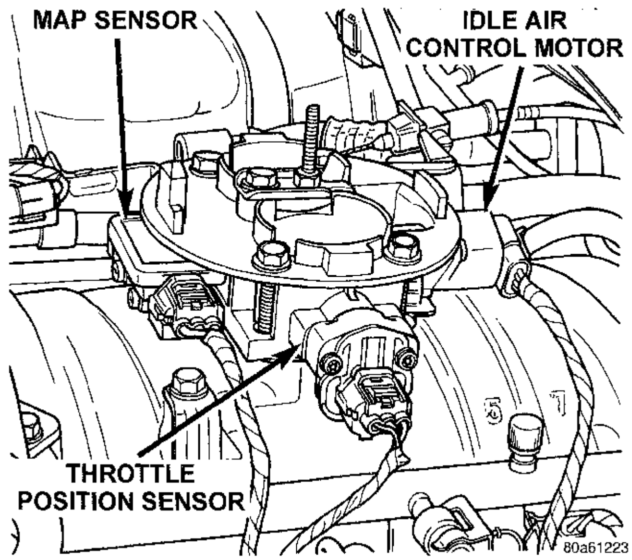

Fig. 35 Sensor and IAC Motor Location—Typical (V-8 Shown)

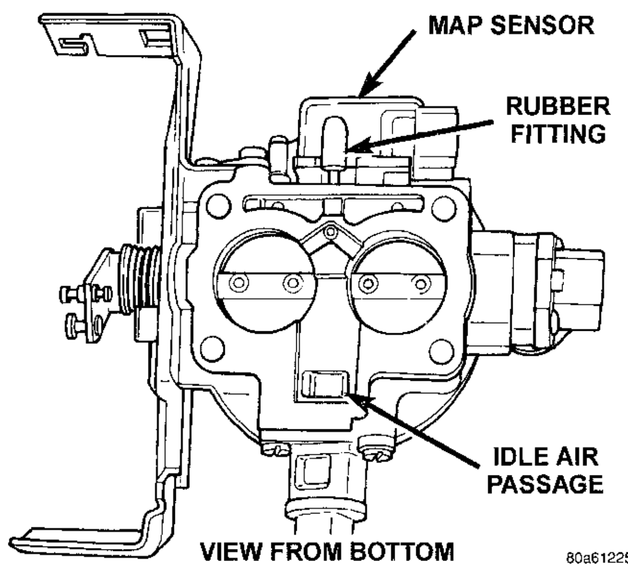

Fig. 36 Rubber L-Shaped Fitting—MAP Sensor-to-Throttle Body—3.9L/5.2L/5.9L Engines

(19) Verify that wire harness connector is firmly connected to the engine coolant temperature sensor (Fig. 37).

(20) Raise and support the vehicle.

(21) On 3.9L/5.2L/5.9L LDC engines, verify that both the upstream and downstream oxygen sensor wire connectors are firmly connected to the sensors. Inspect sensors and connectors for damage (Fig. 38).

(22) On 5.9L HDC engines, verify that both the left and right oxygen sensor wire connectors are

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DIAGNOSIS AND TESTING (Continued)

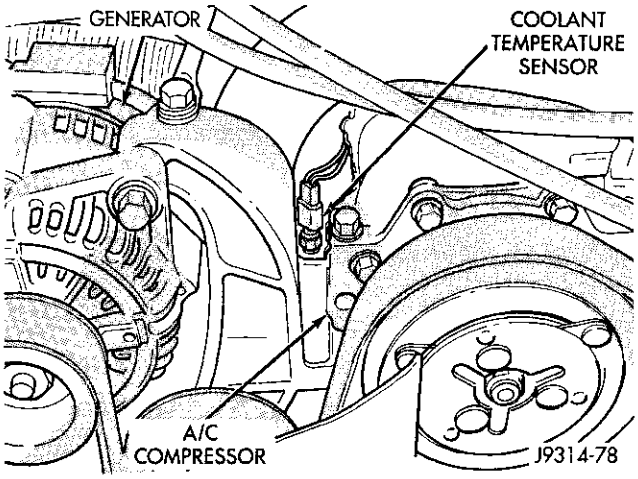


Fig. 37 Engine Coolant Temperature Sensor—3.9L/5.2L/5.9L Engines—Typical

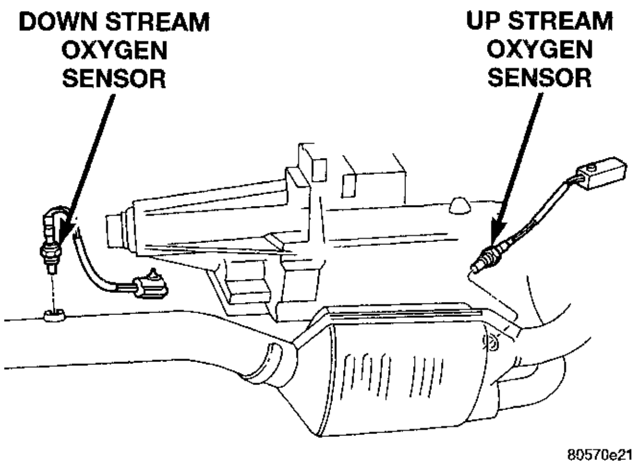


Fig. 38 Upstream/Downstream Oxygen Sensors—3.9L/5.2L/5.9L LDC Engines

firmly connected to the sensors. Inspect sensors and connectors for damage (Fig. 39).

(23) Inspect for pinched or leaking fuel tubes. Inspect for pinched, cracked or leaking fuel hoses.

(24) Inspect for exhaust system restrictions such as pinched exhaust pipes, collapsed muffler or plugged catalytic convertor.

(25) If equipped with automatic transmission, verify that electrical harness is firmly connected to park/neutral switch. Refer to Automatic Transmission section of Group 21.

(26) Verify electrical harness is firmly connected to rear wheel speed sensor. Verify rear wheel speed sensor is firmly attached to rear axle with proper air gap. Refer to Group 5, Brakes for information.

(27) If equipped with 4–wheel antilock brake system, verify electrical harness is firmly connected to each front wheel speed sensor. Verify both front

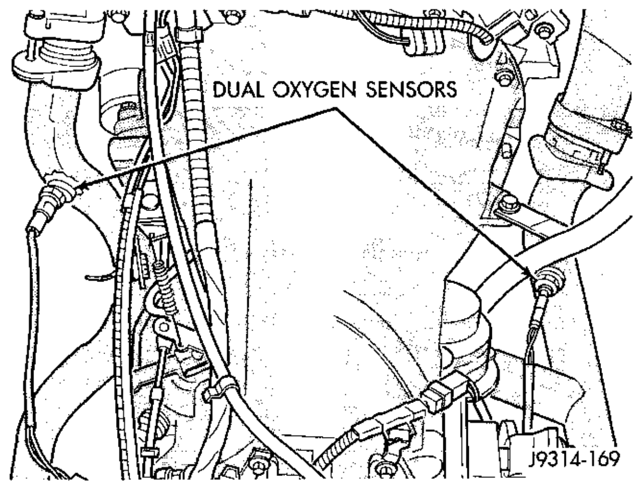


Fig. 39 Left/Right Oxygen Sensors—5.9L HDC Engines

wheel speed sensors are firmly attached. Refer to Group 5, Brakes for information.

(28) Verify that fuel pump/gauge sender unit wire connector is firmly connected to harness connector.

(29) Inspect fuel hoses at fuel pump/gauge sender unit for cracks or leaks.

(30) Inspect transmission torque convertor housing (automatic transmission) or clutch housing (manual transmission) for damage to timing ring on drive plate/flywheel.

(31) Verify that battery cable and solenoid feed wire connections to the starter solenoid are tight and clean. Inspect for chaffed wires or wires rubbing up against other components.

VISUAL INSPECTION—8.0L ENGINE

A visual inspection for loose, disconnected or incorrectly routed wires and hoses should be made. This should be done before attempting to diagnose or service the fuel injection system. A visual check will help spot these faults and save unnecessary test and diagnostic time. A thorough visual inspection will include the following checks:

(1) Verify that the three 32–way electrical connectors are fully inserted into the connector of the powertrain control module (PCM) (Fig. 40).

(2) Inspect the battery cable connections. Be sure that they are clean and tight.

(3) Inspect fuel pump relay and air conditioning compressor clutch relay (if equipped). Inspect the ASD relay connections. Inspect starter motor relay connections. Inspect relays for signs of physical damage and corrosion. The relays are located in the Power Distribution Center (PDC) (Fig. 41). Refer to label on PDC cover for relay location.

DIAGNOSIS AND TESTING (Continued)

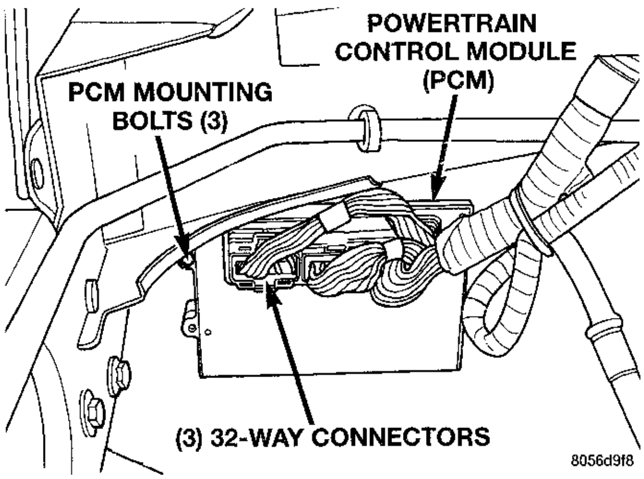


Fig. 40 Powertrain Control Module (PCM)

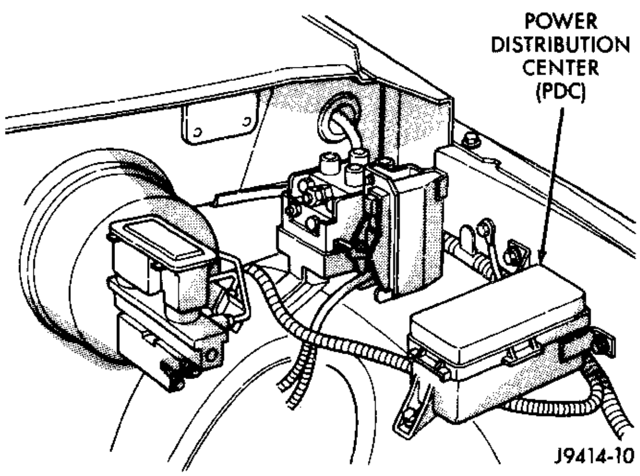


Fig. 41 Power Distribution Center (PDC)

(4) Inspect ignition coil pack primary connections. Verify that secondary cables are firmly connected to coils (Fig. 42).

(5) Be sure that spark plug cables are firmly connected and the spark plugs are in their correct firing order. Be sure that camshaft position sensor wire connector is firmly connected to harness connector. Inspect spark plug condition. Refer to Group 8D, Ignition. Connect vehicle to an oscilloscope and inspect spark events for fouled or damaged spark plugs or cables.

(6) Verify that generator output wire, generator connector and ground wire are firmly connected to the generator.

(7) Inspect the system body grounds for loose or dirty connections. Refer to Group 8, Wiring for ground locations.

(8) Verify crankcase ventilation (CCV) operation. Refer to Group 25, Emission Control System for additional information.

(9) Inspect fuel tube quick-connect fitting-to-fuel rail connections.

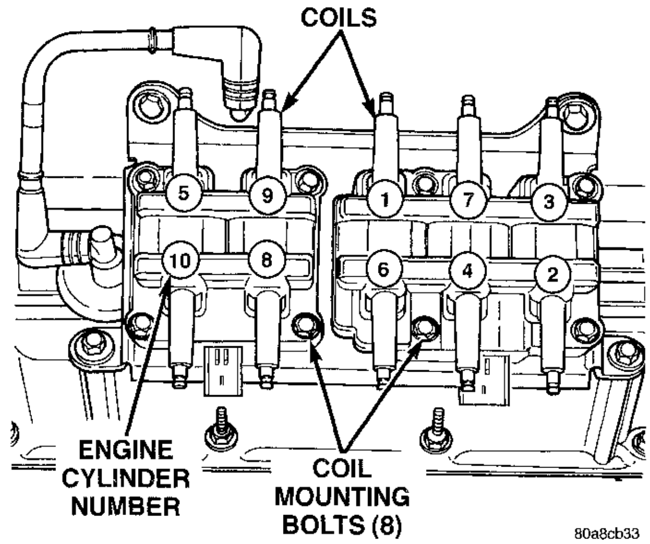


Fig. 42 Ignition Coil Pack—8.0L Engine

(10) Verify that hose connections to all ports of vacuum fittings on intake manifold are tight and not leaking.

(11) Inspect accelerator cable, transmission throttle cable (if equipped) and cruise control cable connections (if equipped). Check their connections to the throttle arm of throttle body for any binding or restrictions.

(12) If equipped with vacuum brake booster, verify that vacuum booster hose is firmly connected to fitting on intake manifold. Also check connection to brake vacuum booster.

(13) Inspect the air cleaner inlet and air cleaner element for dirt or restrictions.

(14) Inspect radiator grille area, radiator fins and air conditioning condenser for restrictions.

(15) Verify that the intake manifold air temperature sensor wire connector is firmly connected to harness connector (Fig. 43).

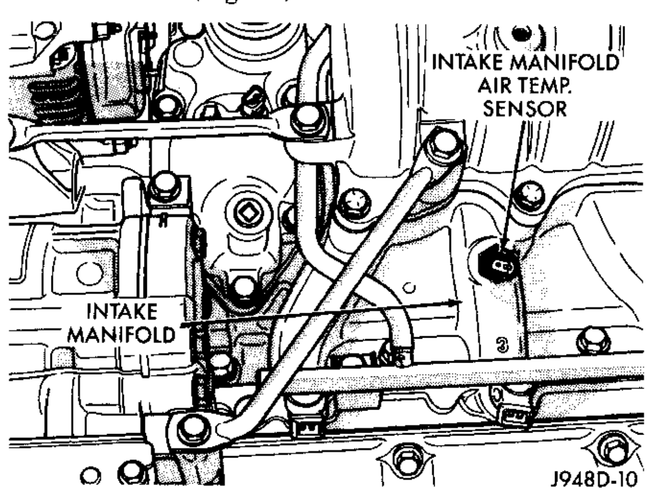


Fig. 43 Air Temperature Sensor—8.0L Engine

DIAGNOSIS AND TESTING (Continued)

(16) Verify that MAP sensor electrical connector is firmly connected to MAP sensor (Fig. 44).

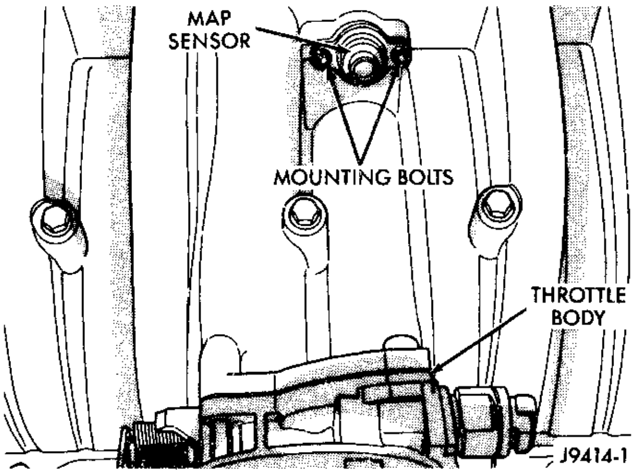


Fig. 44 Map Sensor —8.0L Engine

(17) Verify that fuel injector wire harness connectors are firmly connected to injectors in the correct order. Each harness connector is numerically tagged with the injector number (INJ 1, INJ 2 etc.) of its corresponding fuel injector and cylinder number.

(18) Verify harness connectors are firmly connected to idle air control (IAC) motor and throttle position sensor (TPS).

(19) Verify that wire harness connector is firmly connected to the engine coolant temperature sensor (Fig. 45).

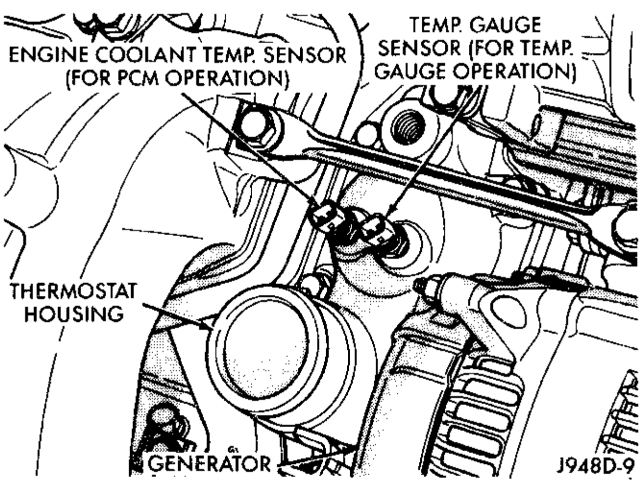


Fig. 45 Engine Coolant Temperature Sensor—8.0L Engine

(20) Raise and support the vehicle.

(21) On all 8.0L engines (HDC or MDC), verify that the left and right oxygen sensor wire connectors are firmly connected to the sensors. Inspect sensors and connectors for damage (Fig. 46).

(22) On 8.0L MDC engine, verify that the pre-catalyst and post catalyst oxygen sensor wire connectors are firmly connected to the sensors. Inspect sensors and connectors for damage (Fig. 47).

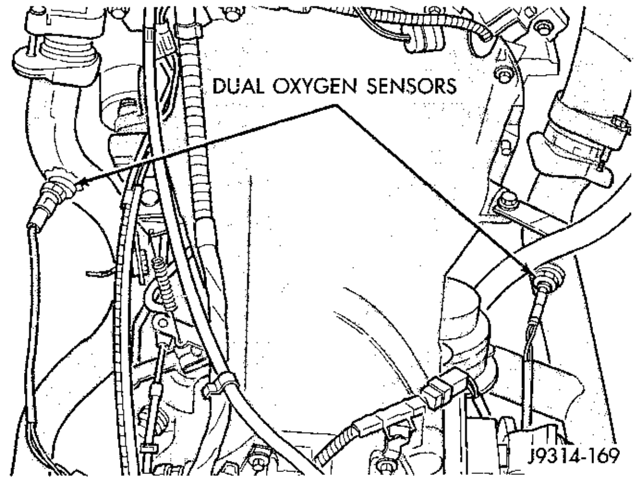


Fig. 46 Left/Right Oxygen Sensors

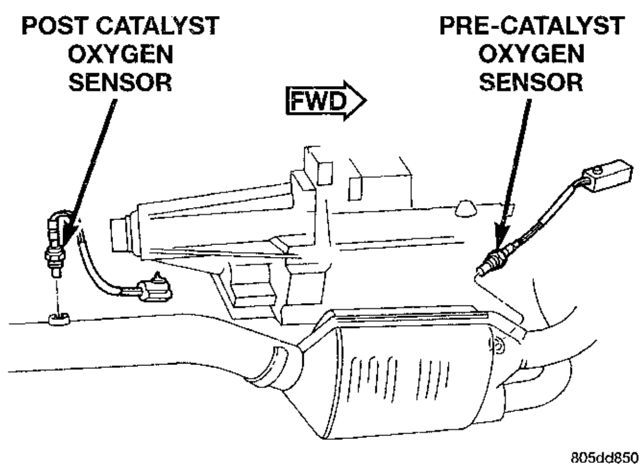


Fig. 47 Pre-Catalyst/Post Catalyst Oxygen Sensors

(23) Inspect for pinched or leaking fuel tubes. Inspect for pinched, cracked or leaking fuel hoses.

(24) Inspect for exhaust system restrictions such as pinched exhaust pipes, collapsed muffler or plugged catalytic convertor.

(25) If equipped with automatic transmission, verify that electrical harness is firmly connected to park/neutral switch. Refer to Automatic Transmission section of Group 21.

(26) Verify electrical harness is firmly connected to rear wheel speed sensor. Verify rear wheel speed sensor is firmly attached to rear axle with proper air gap. Refer to Group 5, Brakes for information.

(27) If equipped with 4–wheel antilock brake system, verify electrical harness is firmly connected to

DIAGNOSIS AND TESTING (Continued)

each front wheel speed sensor. Verify both front wheel speed sensors are firmly attached. Refer to Group 5, Brakes for information.

(28) Verify that fuel pump/gauge sender unit wire connector is firmly connected to harness connector.

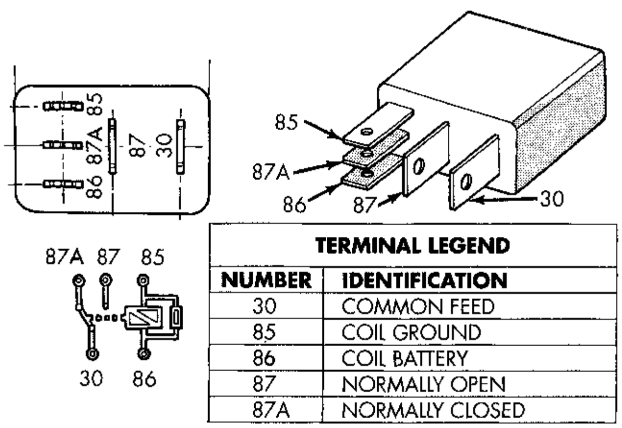
(29) Inspect fuel hoses at fuel pump/gauge sender unit for cracks or leaks.

(30) Inspect transmission torque convertor housing (automatic transmission) or clutch housing (manual transmission) for damage to timing ring on drive plate/flywheel.

(31) Verify that battery cable and solenoid feed wire connections to the starter solenoid are tight and clean. Inspect for chaffed wires or wires rubbing up against other components.

ASD AND FUEL PUMP RELAYS

The following description of operation and tests apply only to the Automatic Shutdown (ASD) and fuel pump relays. The terminals on the bottom of each relay are numbered (Fig. 48).



TERMINAL LEGEND	
NUMBER	**IDENTIFICATION**
30	COMMON FEED
85	COIL GROUND
86	COIL BATTERY
87	NORMALLY OPEN
87A	NORMALLY CLOSED

9514-16

Fig. 48 ASD and Fuel Pump Relay Terminals

OPERATION

- Terminal number 30 is connected to battery voltage. For both the ASD and fuel pump relays, terminal 30 is connected to battery voltage at all times.
- The PCM grounds the coil side of the relay through terminal number 85.
- Terminal number 86 supplies voltage to the coil side of the relay.
- When the PCM de-energizes the ASD and fuel pump relays, terminal number 87A connects to terminal 30. This is the Off position. In the off position, voltage is not supplied to the rest of the circuit. Terminal 87A is the center terminal on the relay.
- When the PCM energizes the ASD and fuel pump relays, terminal 87 connects to terminal 30. This is the On position. Terminal 87 supplies voltage to the rest of the circuit.

TESTING

The following procedure applies to the ASD and fuel pump relays.

(1) Remove relay from connector before testing.

(2) With the relay removed from the vehicle, use an ohmmeter to check the resistance between terminals 85 and 86. The resistance should be 75 ±5 ohms.

(3) Connect the ohmmeter between terminals 30 and 87A. The ohmmeter should show continuity between terminals 30 and 87A.

(4) Connect the ohmmeter between terminals 87 and 30. The ohmmeter should not show continuity at this time.

(5) Connect one end of a jumper wire (16 gauge or smaller) to relay terminal 85. Connect the other end of the jumper wire to the ground side of a 12 volt power source.

(6) Connect one end of another jumper wire (16 gauge or smaller) to the power side of the 12 volt power source. **Do not attach the other end of the jumper wire to the relay at this time.**

WARNING: DO NOT ALLOW OHMMETER TO CONTACT TERMINALS 85 OR 86 DURING THIS TEST.

(7) Attach the other end of the jumper wire to relay terminal 86. This activates the relay. The ohmmeter should now show continuity between relay terminals 87 and 30. The ohmmeter should not show continuity between relay terminals 87A and 30.

(8) Disconnect jumper wires.

(9) Replace the relay if it did not pass the continuity and resistance tests. If the relay passed the tests, it operates properly. Check the remainder of the ASD and fuel pump relay circuits. Refer to group 8W, Wiring Diagrams.

MANIFOLD ABSOLUTE PRESSURE (MAP) SENSOR TEST—3.9L/5.2L/5.9L ENGINES

To perform a complete test of MAP sensor (Fig. 49) and its circuitry, refer to DRB scan tool and appropriate Powertrain Diagnostics Procedures manual. To test the MAP sensor only, refer to the following:

(1) Inspect the rubber L-shaped fitting from the MAP sensor to the throttle body (Fig. 50). Repair as necessary.

CAUTION: When testing the MAP sensor, be sure that the harness wires are not damaged by the test meter probes.

(2) Test the MAP sensor output voltage at the MAP sensor connector between terminals A and B (Fig. 51). With the ignition switch ON and the engine OFF, output voltage should be 4-to-5 volts. The voltage should drop to 1-to-2.1 volts with a hot, neutral

DIAGNOSIS AND TESTING (Continued)

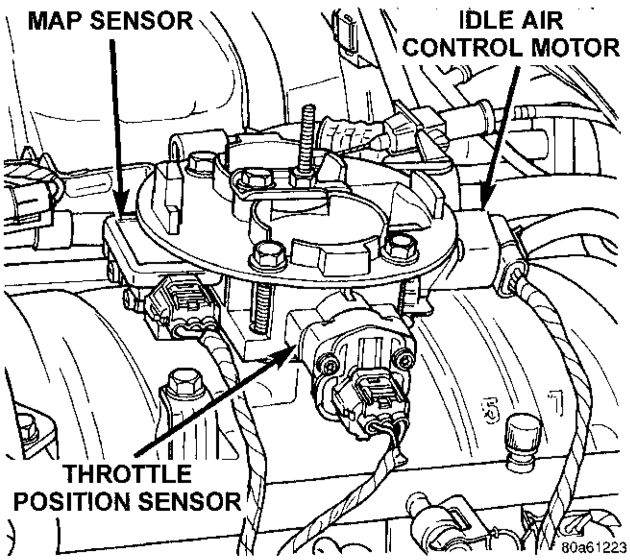


Fig. 49 Manifold Absolute Pressure (MAP) Sensor—3.9L/5.2L/5.9L Engines

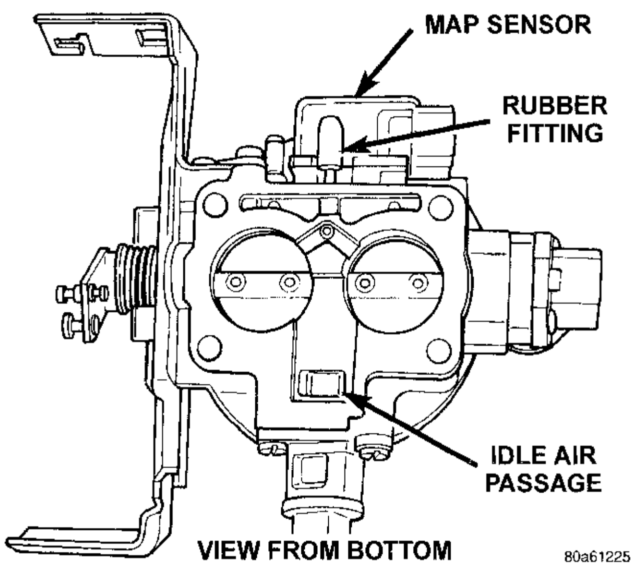


Fig. 50 Rubber L-Shaped Fitting—MAP Sensor-to-Throttle Body—3.9L/5.2L/5.9L Engines

idle speed condition. Voltage at higher elevations may be slightly lower 1–to-2.1 volts.

(3) Test powertrain control module (PCM) cavity A-27 for the same voltage described above to verify the wire harness condition. Repair as necessary.

(4) Test MAP sensor supply voltage at sensor connector between terminals A and C (Fig. 51) with the ignition ON. The voltage should be approximately 5 volts (±0.5V). Five volts (±0.5V) should also be at cavity A-17 of the PCM wire harness connector. Repair or replace the wire harness as necessary.

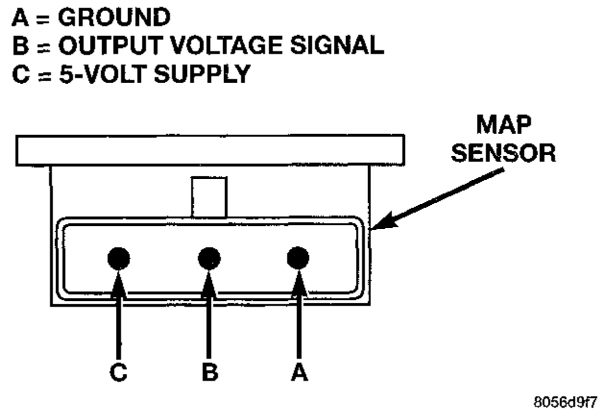


Fig. 51 MAP Sensor Connector Terminals—3.9L/5.2L/5.9L Engines

(5) Test the MAP sensor ground circuit at sensor connector terminal—A (Fig. 51) and PCM connector A-4. Repair the wire harness if necessary.

Refer to Group 8W, Wiring Diagrams for cavity locations.

MANIFOLD ABSOLUTE PRESSURE (MAP) SENSOR TEST—8.0L ENGINE

To perform a complete test of the MAP sensor (Fig. 52) and its circuitry, refer to DRB scan tool and appropriate Powertrain Diagnostics Procedures manual. To test the MAP sensor only, refer to the following:

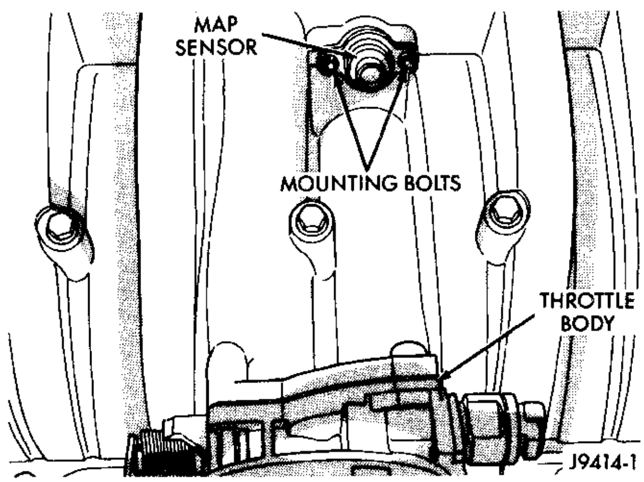


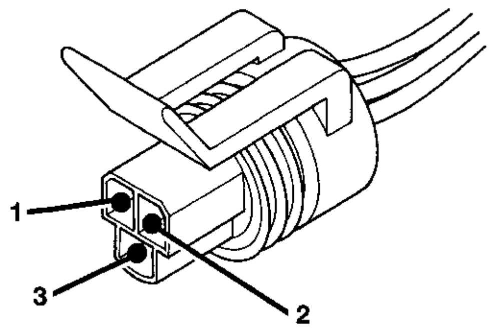
Fig. 52 Manifold Absolute Pressure (MAP) Sensor—8.0L Engine

CAUTION: When testing the MAP sensor, be sure that the harness wires are not damaged by the test meter probes.

(1) Test the MAP sensor output voltage at the MAP sensor connector between terminals 1 and 3

DIAGNOSIS AND TESTING (Continued)

(Fig. 53). With the ignition switch ON and the engine OFF, output voltage should be 4-to-5 volts. The voltage should drop to 1.5-to-2.1 volts with a hot, neutral idle speed condition.



CAVITY	FUNCTION
1	5-Volt Supply
2	Sensor Ground
3	Map Sensor Signal

Fig. 53 MAP Sensor Connector Terminals—8.0L Engine

(2) Test powertrain control module (PCM) cavity A-27 for the same voltage described above to verify the wire harness condition. Repair as necessary.

(3) Test MAP sensor supply voltage at sensor connector between terminals 1 and 2 (Fig. 53) with the ignition ON. The voltage should be approximately 5 volts (±0.5V). Five volts (±0.5V) should also be at cavity A-17 of the PCM wire harness connector. Repair or replace the wire harness as necessary.

(4) Test the MAP sensor ground circuit at sensor connector terminal—2 (Fig. 53) and PCM connector A-4. Repair the wire harness if necessary.

Refer to Group 8W, Wiring Diagrams for cavity locations.

OXYGEN (O2S) SENSORS—3.9L/5.2L/5.9L LCD ENGINES

To perform a complete test of the O2S sensors and their circuitry, refer to the DRB scan tool and appropriate Powertrain Diagnostics Procedures manual. To test the O2S sensors only, refer to the following:

The upstream O2S sensor is located on the inlet end of the catalytic converter (Fig. 54).

The downstream O2S sensor is located on the outlet end of the catalytic converter (Fig. 54).

Each O2S heating element can be tested with an ohmmeter as follows:

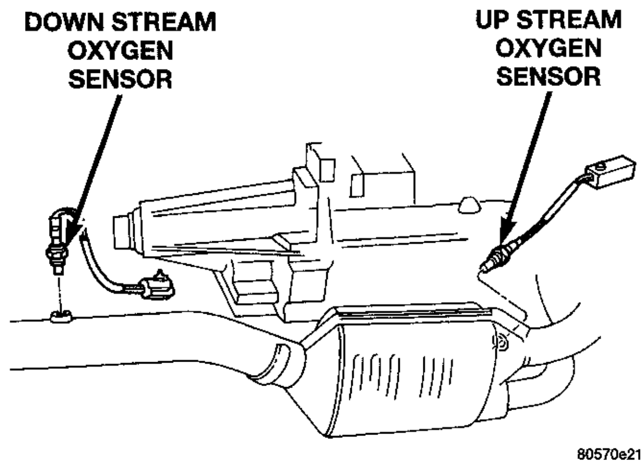


Fig. 54 Upstream/Downstream Oxygen Sensor Location—3.9L/5.2L/5.9L LDC Engines

Disconnect the O2S sensor connector. Connect the ohmmeter test leads across the white wire terminals of the sensor connector. Resistance should be between 4.5 ± .5 ohms and 7 ohms. Replace the sensor if the ohmmeter displays an infinity (open) reading.

OXYGEN (O2S) SENSORS—5.9L HDC ENGINE

To perform a complete test of the dual (left and right) O2S sensors and their circuitry, refer to the DRB scan tool and appropriate Powertrain Diagnostics Procedures manual. To test the O2S sensors only, refer to the following:

The left and right O2S sensors are located on the left and right exhaust downpipes (Fig. 55).

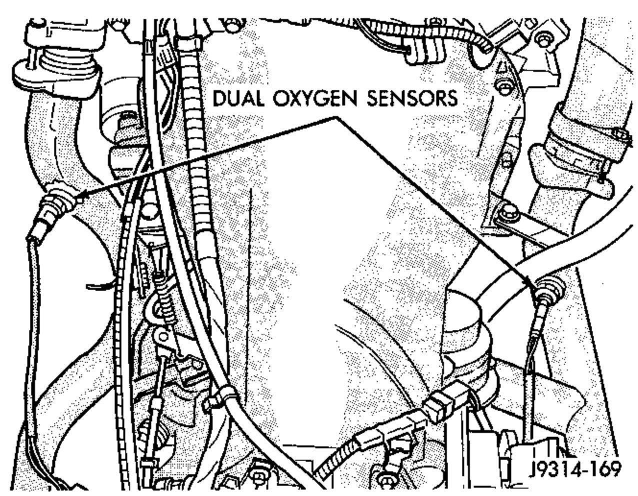


Fig. 55 Left/Right Oxygen Sensor Location—5.9L HDC Engine

Each O2S heating element can be tested with an ohmmeter as follows:

Disconnect the O2S sensor connector. Connect the ohmmeter test leads across the white wire terminals

DIAGNOSIS AND TESTING (Continued)

of the sensor connector. Resistance should be between 4.5 ± .5 ohms and 7 ohms. Replace the sensor if the ohmmeter displays an infinity (open) reading.

OXYGEN (O2S) SENSORS—8.0L HDC/MDC ENGINES

To perform a complete test of the O2S sensors and their circuitry, refer to the DRB scan tool and appropriate Powertrain Diagnostics Procedures manual. To test the O2S sensors only, refer to the following:

A total of 4 oxygen sensors (left, right, pre-catalyst and post catalyst) are used with the 8.0L engine when equipped with the Medium Duty Emission Cycle (MDC) engine package.

Only 2 oxygen sensors (left and right) are used with the 8.0L engine when equipped with the Heavy Duty Emission Cycle (HDC) engine.

The pre-catalyst O2S sensor is located on the inlet end of the catalytic converter (Fig. 56).

The post catalyst O2S sensor is located on the outlet end of the catalytic converter (Fig. 56).

The left and right sensors are located on the left and right exhaust downpipes (Fig. 57).

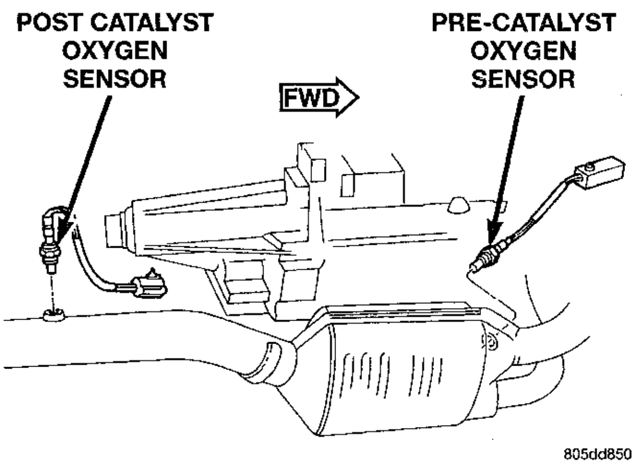


Fig. 56 Pre-Catalyst/Post Catalyst Oxygen Sensor Locations—HDC/MDC Engines

Each O2S heating element can be tested with an ohmmeter as follows:

Disconnect the O2S sensor connector. Connect the ohmmeter test leads across the white wire terminals of the sensor connector. Resistance should be between 4.5 ± .5 ohms and 7 ohms. Replace the sensor if the ohmmeter displays an infinity (open) reading.

CAMSHAFT AND CRANKSHAFT POSITION SENSORS

Refer to Group 8D, Ignition System for information.

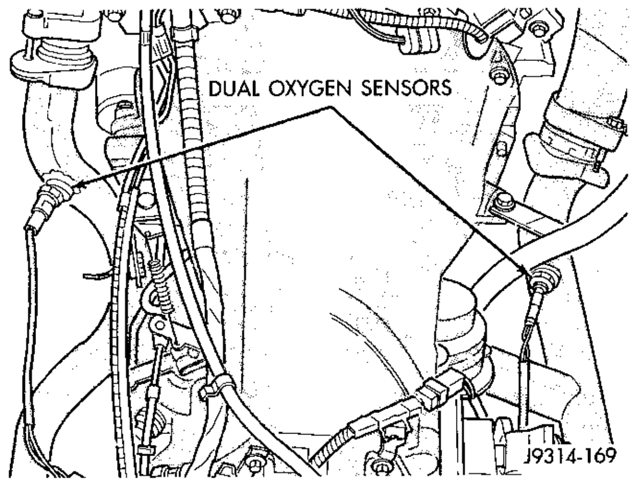


Fig. 57 Left/Right Oxygen Sensor Locations—HDC/MDC Engines

ENGINE COOLANT TEMPERATURE SENSOR—3.9L/5.2L/5.9L ENGINES

To perform a complete test of the engine coolant temperature sensor and its circuitry, refer to DRB scan tool and appropriate Powertrain Diagnostics Procedures manual. To test the sensor only, refer to the following:

(1) Disconnect wire harness connector from coolant temperature sensor (Fig. 58).

(2) **Engines with air conditioning:** When removing the connector from sensor, do not pull directly on wiring harness. Fabricate an L-shaped hook tool from a coat hanger (approximately eight inches long). Place the hook part of tool under the connector for removal. The connector is snapped onto the sensor. It is not equipped with a lock type tab.

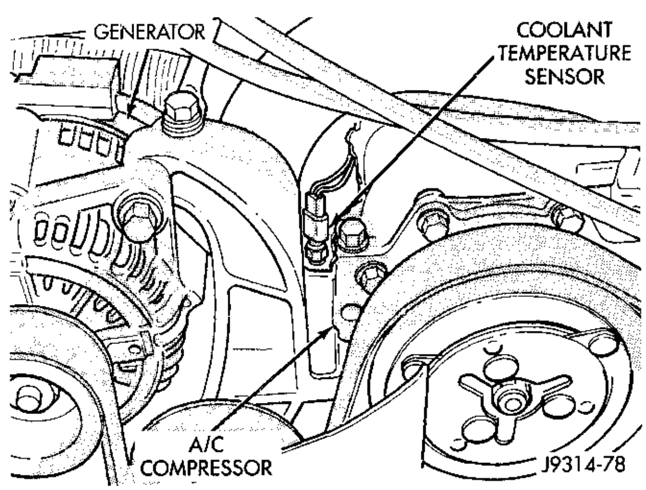


Fig. 58 Engine Coolant Temperature Sensor—3.9L/5.2L/5.9L Engines

(3) Test the resistance of the sensor with a high input impedance (digital) volt-ohmmeter. The resis-

DIAGNOSIS AND TESTING (Continued)

tance (as measured across the sensor terminals) should be as shown in the SENSOR RESISTANCE (OHMS)—COOLANT TEMPERATURE SENSOR/INTAKE AIR TEMPERATURE SENSOR chart. Replace the sensor if it is not within the range of resistance specified in chart.

SENSOR RESISTANCE (OHMS)—COOLANT TEMPERATURE SENSOR/INTAKE AIR TEMPERATURE SENSOR

TEMPERATURE		RESISTANCE (OHMS)	
°CEL.	°FAHR.	MIN.	MAX.
-40	-40	291,490	381,710
-20	-4	85,850	108,390
-10	14	49,250	61,430
0	32	29,330	35,990
10	50	17,990	21,810
20	68	11,370	13,610
25	77	9,120	10,880
30	86	7,370	8,750
40	104	4,900	5,750
50	122	3,330	3,880
60	140	2,310	2,670
70	158	1,630	1,870
80	176	1,170	1,340
90	194	860	970
100	212	640	720
110	230	480	540
120	248	370	410

(4) Test continuity of the wire harness between the PCM wire harness connector and the coolant sensor connector terminals. Refer to Group 8, Wiring for terminal/cavity locations. Repair the wire harness if an open circuit is indicated.

(5) After tests are completed, connect electrical connector to sensor. The sensor connector is symmetrical (not indexed). It can be installed to the sensor in either direction.

ENGINE COOLANT TEMPERATURE SENSOR—8.0L ENGINE

To perform a complete test of the engine coolant temperature sensor and its circuitry, refer to DRB scan tool and appropriate Powertrain Diagnostics Procedures manual. To test the sensor only, refer to the following:

(1) Disconnect wire harness connector from coolant temperature sensor (Fig. 59).

(2) Test the resistance of the sensor with a high input impedance (digital) volt-ohmmeter. The resistance (as measured across the sensor terminals) should be as shown in the SENSOR RESISTANCE (OHMS)—COOLANT TEMPERATURE SENSOR/INTAKE AIR TEMPERATURE SENSOR chart. Replace the sensor if it is not within the range of resistance specified in the chart.

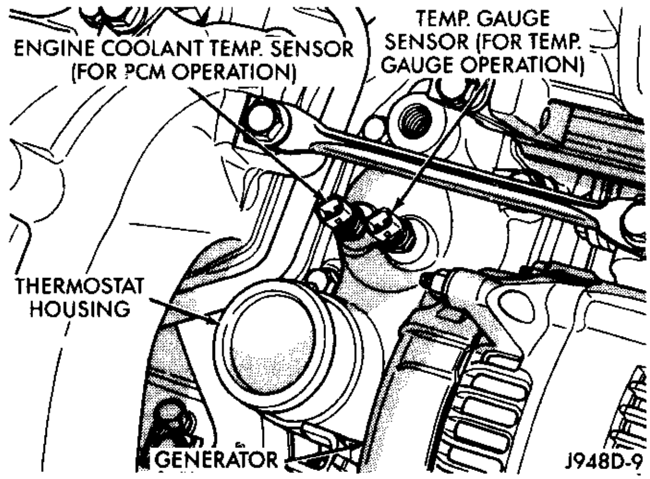


Fig. 59 Engine Coolant Temperature Sensor—8.0L Engine

(3) Test continuity of the wire harness between the PCM wire harness connector and the coolant sensor connector terminals. Refer to Group 8, Wiring for terminal/cavity locations. Repair the wire harness if an open circuit is indicated.

(4) After tests are completed, connect electrical connector to sensor.

IDLE AIR CONTROL (IAC) MOTOR—3.9L/5.2L/5.9L ENGINES

To perform a complete test of the IAC motor and its circuitry, refer to DRB scan tool and appropriate Powertrain Diagnostics Procedures manual.

IDLE AIR CONTROL (IAC) MOTOR—8.0L ENGINE

To perform a complete test of the IAC motor and its circuitry, refer to DRB scan tool and appropriate Powertrain Diagnostics Procedures manual.

INTAKE MANIFOLD AIR TEMPERATURE SENSOR—3.9L/5.2L/5.9L ENGINES

To perform a complete test of the intake manifold air temperature sensor and its circuitry, refer to DRB tester and appropriate Powertrain Diagnostics Procedures manual. To test the sensor only, refer to the following:

(1) Disconnect the wire harness connector from the intake manifold air temperature sensor (Fig. 60).

(2) Test the resistance of the sensor with an input impedance (digital) volt-ohmmeter. The resistance (as measured across the sensor terminals) should be as shown in the SENSOR RESISTANCE (OHMS)—COOLANT TEMPERATURE SENSOR/INTAKE AIR TEMPERATURE SENSOR chart. Replace the sensor

DIAGNOSIS AND TESTING (Continued)

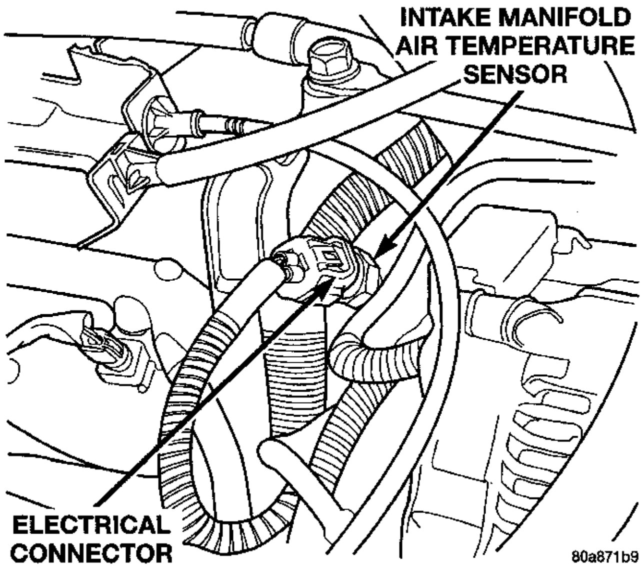


Fig. 60 Intake Manifold Air Temperature Sensor—3.9L/5.2L/5.9L Engines—Typical (V-8 Shown)

if it is not within range of resistance specified in chart.

(3) Test the resistance of the wire harness. Do this between the PCM wire harness connector A-15 and the sensor connector terminal. Also check between PCM connector A-4 to the sensor connector terminal. Repair the wire harness as necessary if the resistance is greater than 1 ohm.

INTAKE MANIFOLD AIR TEMPERATURE SENSOR—8.0L ENGINE

To perform a complete test of the intake manifold air temperature sensor and its circuitry, refer to DRB tester and appropriate Powertrain Diagnostics Procedures manual. To test the sensor only, refer to the following:

(1) Disconnect the wire harness connector from the intake manifold air temperature sensor (Fig. 61).

(2) Test the resistance of the sensor with an input impedance (digital) volt-ohmmeter. The resistance (as measured across the sensor terminals) should be as shown in the SENSOR RESISTANCE (OHMS)—COOLANT TEMPERATURE SENSOR/INTAKE AIR TEMPERATURE SENSOR chart. Replace the sensor if it is not within the range of resistance specified in chart.

(3) Test the resistance of the wire harness. Do this between the PCM wire harness connector A-15 and the sensor connector terminal. Also check between PCM connector A-4 to the sensor connector terminal. Repair the wire harness as necessary if the resistance is greater than 1 ohm.

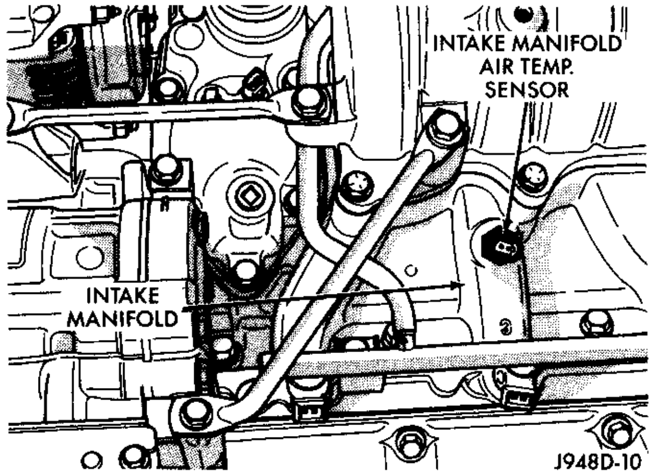


Fig. 61 Intake Manifold Air Temperature Sensor—8.0L Engine

THROTTLE POSITION SENSOR (TPS)—3.9L/5.2L/5.9L ENGINES

To perform a complete test of the TPS and its circuitry, refer to the DRB scan tool and appropriate Powertrain Diagnostics Procedures manual. To test the TPS only, refer to the following:

The TPS can be tested with a digital voltmeter. The center terminal of the TPS is the output terminal (Fig. 62).

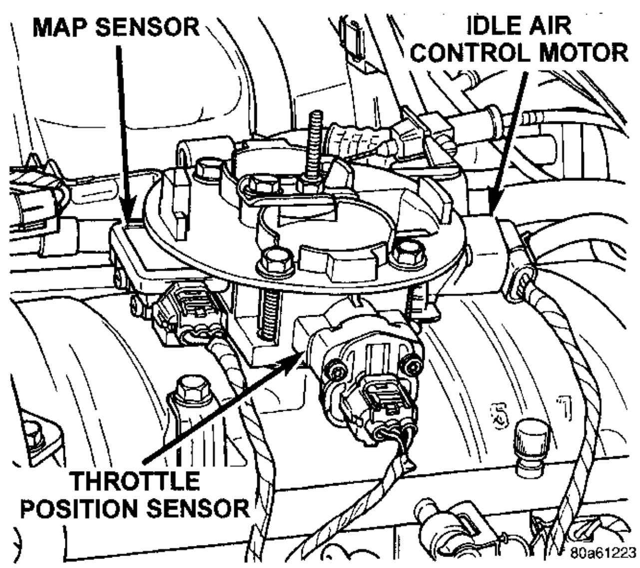


Fig. 62 TPS—3.9L/5.2L/5.9L Engines

With the ignition key in the ON position, check the TPS output voltage at the center terminal wire of the connector. Check this at idle (throttle plate closed) and at wide open throttle (WOT). At idle, TPS output voltage should be greater than .350 millivolts and less than 900 millivolts. At wide open throttle, TPS output voltage must be less than 4.5 volts. The out-

DIAGNOSIS AND TESTING (Continued)

put voltage should increase gradually as the throttle plate is slowly opened from idle to WOT.

THROTTLE POSITION SENSOR (TPS)—8.0L ENGINE

To perform a complete test of the TPS and its circuitry, refer to the DRB scan tool and appropriate Powertrain Diagnostics Procedures manual. To test the TPS only, refer to the following:

The TPS can be tested with a digital voltmeter. The center terminal of the TPS is the output terminal (Fig. 63).

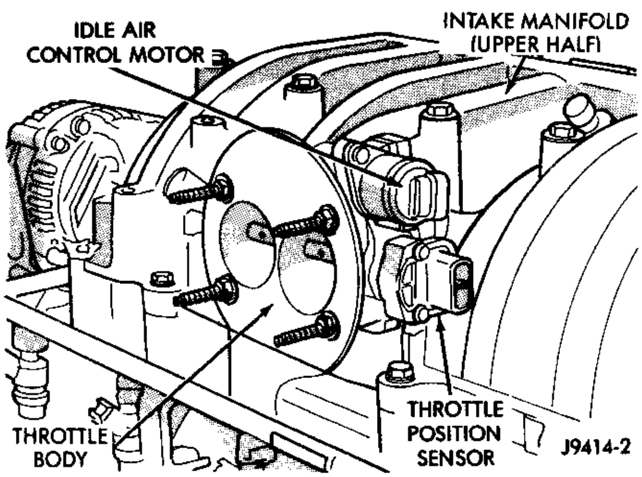


Fig. 63 TPS—8.0L Engine

With the ignition key in the ON position, check the TPS output voltage at the center terminal wire of the connector. Check this at idle (throttle plate closed) and at wide open throttle (WOT). At idle, TPS output voltage should be greater than .350 millivolts and less than 900 millivolts. At wide open throttle, TPS output voltage must be less than 4.5 volts. The output voltage should increase gradually as the throttle plate is slowly opened from idle to WOT.

THROTTLE BODY MINIMUM AIR FLOW CHECK PROCEDURE

3.9/5.2/5.9L ENGINES

The following test procedure has been developed to check throttle body calibrations for correct idle conditions. The procedure should be used to diagnose the throttle body for conditions that may cause idle problems. **This procedure should be used only after normal diagnostic procedures have failed to produce results that indicate a throttle body related problem. Be sure to check for proper operation of the idle air control motor before performing this test.**

A special fixed orifice tool (number 6714) (Fig. 64) must be used for the following test.

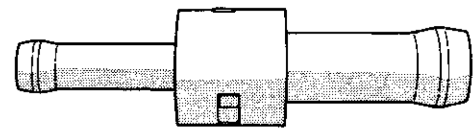


Fig. 64 Fixed Orifice Tool

(1) Start the engine and bring to operating temperature. Be sure all accessories are off before performing this test.

(2) Shut off the engine and remove the air duct at throttle body.

(3) Disconnect the vacuum line at the PCV valve (Fig. 65).

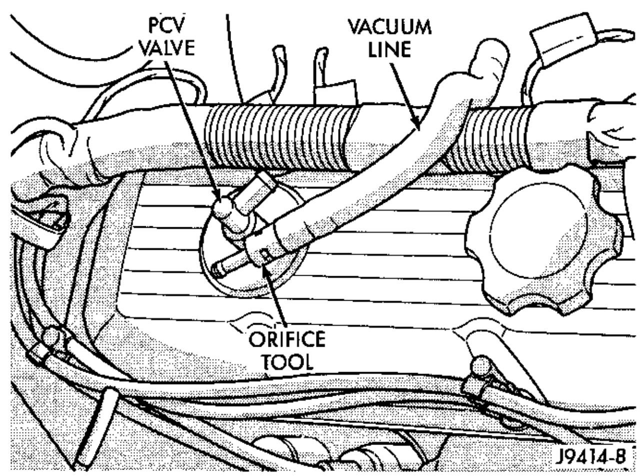


Fig. 65 Install Orifice Tool

(4) Install the 0.185 inch orifice tool (number 6714) into the disconnected vacuum line in place of the PCV valve (Fig. 65).

(5) Disconnect the idle purge vacuum line from fitting at throttle body. This vacuum line is located on the front of throttle body next to the MAP sensor (Fig. 66). Cap the fitting at throttle body after vacuum line has been removed.

(6) Connect the DRB scan tool to the 16–way data link connector. This connector is located under the instrument panel to the left of the steering column. Refer to the appropriate Powertrain Diagnostic Procedures service manual for DRB operation.

(7) Start the engine and allow to warm up.

(8) Using the DRB scan tool, scroll through the menus as follows: select—Stand Alone DRB III, select 1998 Diagnostics, select—Engine, select—System Test, select—Minimum Air Flow.

DIAGNOSIS AND TESTING (Continued)

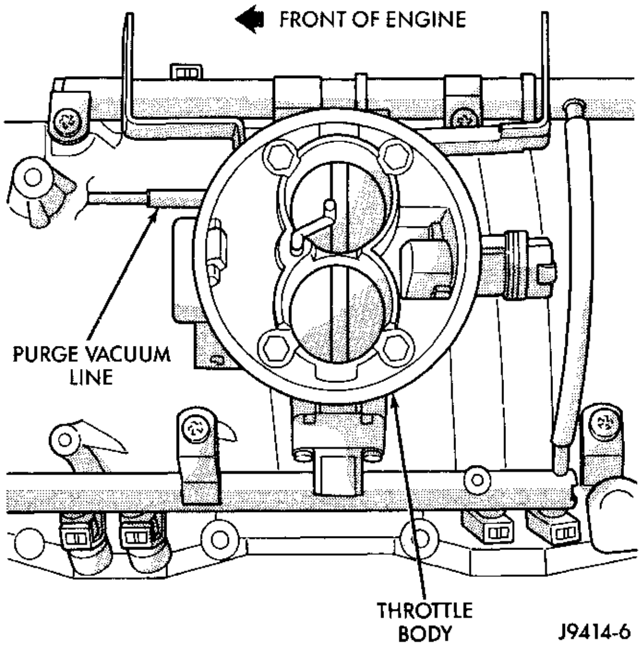


Fig. 66 Idle Purge Line

(9) The DRB scan tool will count down to stabilize the idle rpm and display the minimum air flow idle rpm. The idle rpm should be between **500 and 900 rpm.** If the idle speed is outside of these specifications, replace the throttle body. Refer to Throttle Body in the Component Removal/Installation section of this group.

(10) Disconnect the DRB scan tool from the vehicle.

(11) Remove cap from idle purge fitting at throttle body and install vacuum line.

(12) Remove orifice tool and connect vacuum line to PCV valve.

(13) Install air duct to throttle body.

REMOVAL AND INSTALLATION

AUTOMATIC SHUTDOWN (ASD) RELAY

The ASD relay is located in the Power Distribution Center (PDC) (Fig. 67). Refer to label on PDC cover for relay location.

REMOVAL

(1) Remove PDC cover.

(2) Remove relay from PDC.

(3) Check condition of relay terminals and PDC connector terminals for damage or corrosion. Repair if necessary before installing relay.

(4) Check for pin height (pin height should be the same for all terminals within the PDC connector). Repair if necessary before installing relay.

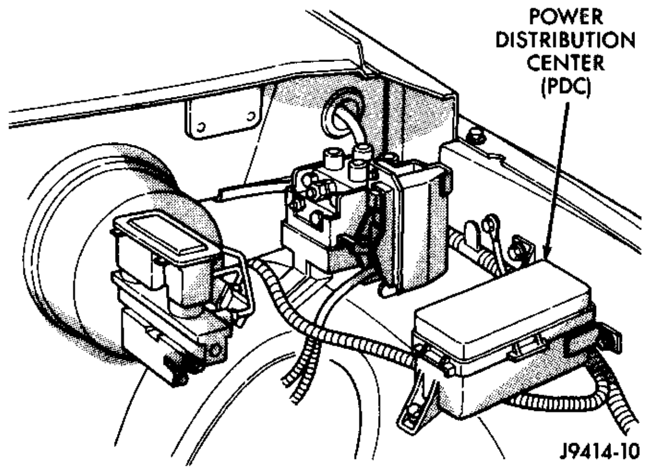


Fig. 67 Power Distribution Center (PDC)

INSTALLATION

(1) Install relay to PDC.

(2) Install cover to PDC.

FUEL PUMP RELAY

The fuel pump relay is located in the Power Distribution Center (PDC) (Fig. 67). Refer to label on PDC cover for relay location.

REMOVAL

(1) Remove PDC cover.

(2) Remove relay from PDC.

(3) Check condition of relay terminals and PDC connector terminals for damage or corrosion. Repair if necessary before installing relay.

(4) Check for pin height (pin height should be the same for all terminals within the PDC connector). Repair if necessary before installing relay.

INSTALLATION

(1) Install relay to PDC.

(2) Install cover to PDC.

THROTTLE BODY—3.9L/5.2L/5.9L ENGINES

A (factory adjusted) set screw is used to mechanically limit the position of the throttle body throttle plate. **Never attempt to adjust the engine idle speed using this screw.** All idle speed functions are controlled by the powertrain control module (PCM).

REMOVAL

(1) Remove the air cleaner.

(2) Disconnect throttle body electrical connectors at MAP sensor, IAC motor and TPS (Fig. 68).

(3) Remove vacuum line at throttle body.

(4) Remove all control cables from throttle body (lever) arm. Refer to the Accelerator Pedal and Throttle Cable section of this group for additional information.

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REMOVAL AND INSTALLATION (Continued)

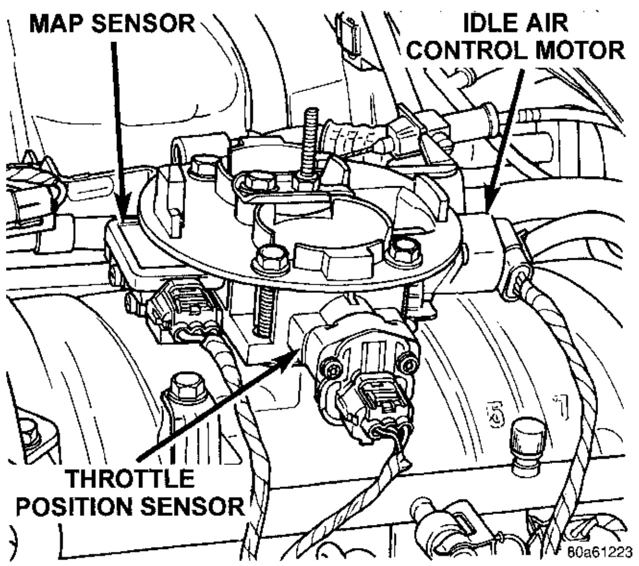


Fig. 68 Sensor Electrical Connectors—3.9L/5.2L/5.9L Engines—Typical

(5) Remove four throttle body mounting bolts (Fig. 69).

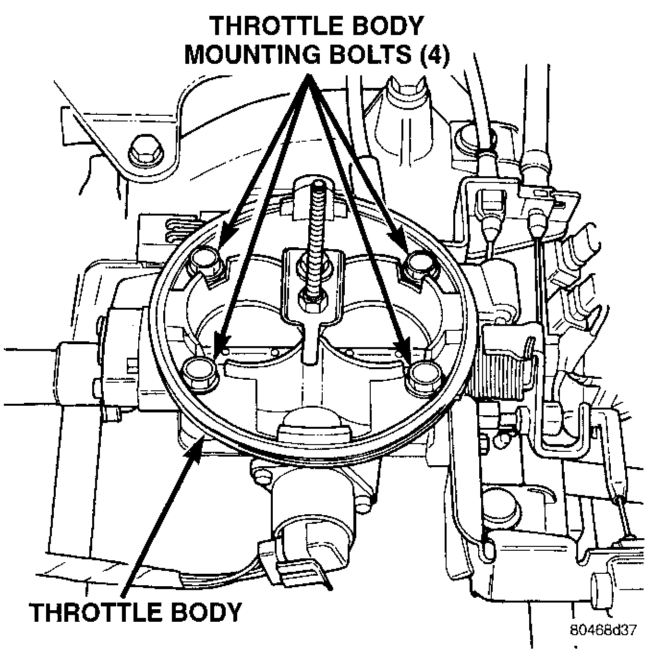


Fig. 69 Throttle Body Mounting Bolts—3.9L/5.2L/5.9L ENGINES—Typical

(6) Remove throttle body from intake manifold.
(7) Discard old throttle body-to-intake manifold gasket.

INSTALLATION

(1) Clean the mating surfaces of the throttle body and the intake manifold.
(2) Install new throttle body-to-intake manifold gasket.
(3) Install throttle body to intake manifold.
(4) Install four mounting bolts. Tighten bolts to 23 N·m (200 in. lbs.) torque.
(5) Install control cables.
(6) Install vacuum line to throttle body.
(7) Install electrical connectors.
(8) Install air cleaner.

THROTTLE BODY—8.0L ENGINE

A (factory adjusted) set screw is used to mechanically limit the position of the throttle body throttle plate. **Never attempt to adjust the engine idle speed using this screw.** All idle speed functions are controlled by the powertrain control module (PCM).

REMOVAL

(1) Remove the air cleaner cover.
(2) Remove the 4 air cleaner housing mounting nuts and remove housing from throttle body.
(3) Disconnect throttle body electrical connectors at the IAC motor and TPS.
(4) Remove all control cables from throttle body (lever) arm. Refer to the Accelerator Pedal and Throttle Cable section of this group for additional information.
(5) Remove four throttle body mounting nuts (Fig. 70).

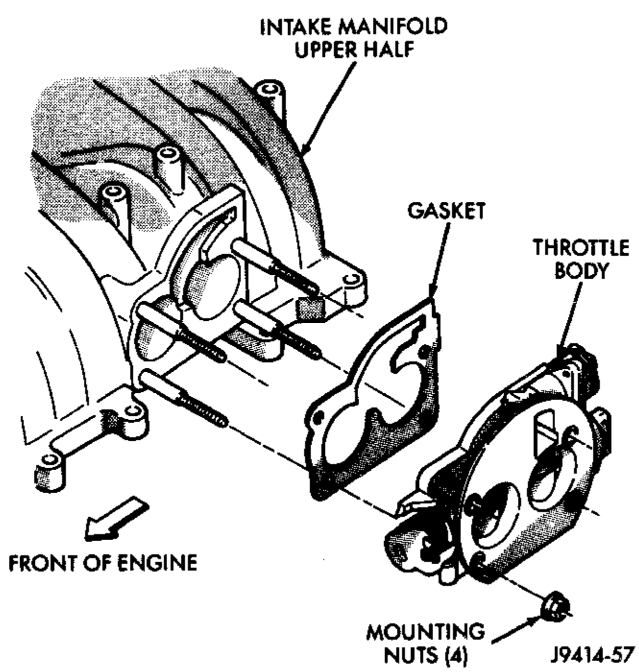


Fig. 70 Throttle Body Mounting Nuts—8.0L Engine

(6) Remove throttle body from intake manifold.
(7) Discard old throttle body-to-intake manifold gasket.

REMOVAL AND INSTALLATION (Continued)

INSTALLATION

(1) Clean the mating surfaces of the throttle body and the intake manifold.

(2) Install new throttle body-to-intake manifold gasket.

(3) Install throttle body to intake manifold.

(4) Install four mounting nuts. Tighten nuts to 22 N·m (192 in. lbs.) torque.

(5) Install control cables.

(6) Install electrical connectors.

(7) Install air cleaner housing to throttle body.

(8) Install 4 air cleaner housing mounting nuts. Tighten nuts to 11 N·m (96 in. lbs.) torque.

(9) Install air cleaner housing cover.

THROTTLE POSITION SENSOR (TPS)—3.9L/5.2L/5.9L ENGINES

REMOVAL

The TPS is located on the side of the throttle body.

(1) Remove air intake tube at throttle body.

(2) Disconnect TPS electrical connector.

(3) Remove two TPS mounting bolts (Fig. 71).

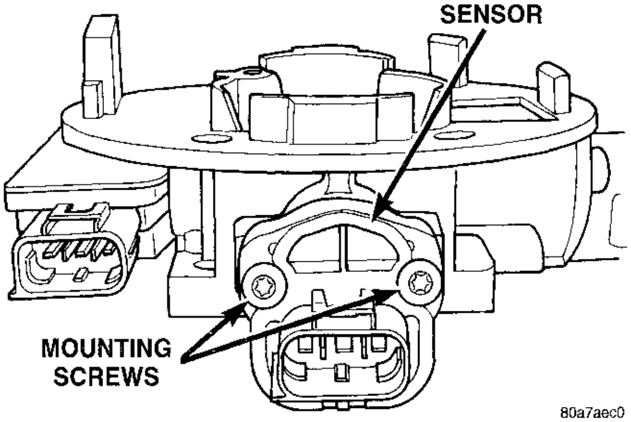


Fig. 71 TPS Mounting Bolts—3.9L/5.2L/5.9L Engines

(4) Remove TPS from throttle body.

INSTALLATION

The throttle shaft end of the throttle body slides into a socket in the TPS (Fig. 72). The TPS must be installed so that it can be rotated a few degrees. If the sensor will not rotate, install the sensor with the throttle shaft on the other side of the socket tangs. The TPS will be under slight tension when rotated.

(1) Install the TPS and two retaining bolts.

(2) Tighten bolts to 7 N·m (60 in. lbs.) torque.

(3) Manually operate the throttle control lever by hand to check for any binding of the TPS.

(4) Connect TPS electrical connector to TPS.

(5) Install air intake tube.

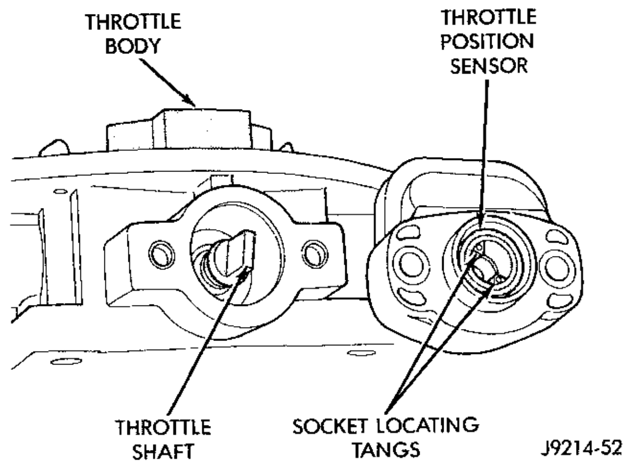


Fig. 72 Installation—3.9L/5.2L/5.9L Engines—Typical

THROTTLE POSITION SENSOR (TPS)—8.0L ENGINE

REMOVAL

The TPS is located on the side of the throttle body (Fig. 73).

(1) Remove air intake tube at air cleaner housing.

(2) Remove the air cleaner cover.

(3) Remove the 4 air cleaner housing mounting nuts and remove housing from throttle body.

(4) Disconnect TPS electrical connector.

(5) Remove two TPS mounting bolts (Fig. 73).

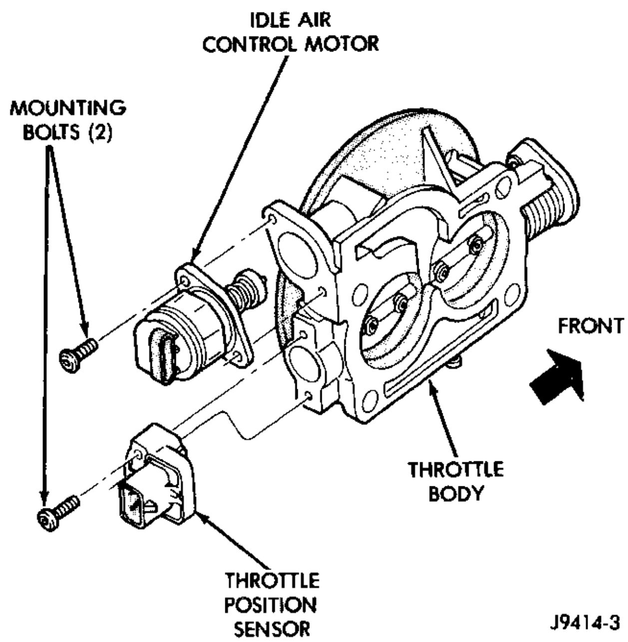


Fig. 73 TPS Mounting Bolts—8.0L Engine

(6) Remove TPS from throttle body.

REMOVAL AND INSTALLATION (Continued)

INSTALLATION

The throttle shaft end of the throttle body slides into a socket in the TPS (Fig. 74). The TPS must be installed so that it can be rotated a few degrees. If the sensor will not rotate, install the sensor with the throttle shaft on the other side of the socket tangs. The TPS will be under slight tension when rotated.

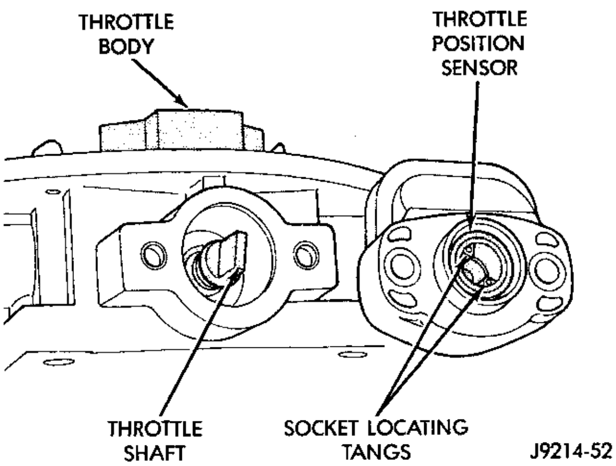


Fig. 74 Installation—Typical Mounting

(1) Install the TPS and two retaining bolts.
(2) Tighten bolts to 7 N·m (60 in. lbs.) torque.
(3) Manually operate the throttle control lever by hand to check for any binding of the TPS.
(4) Connect TPS electrical connector to TPS.
(5) Install air cleaner housing to throttle body.
(6) Install 4 air cleaner housing mounting nuts. Tighten nuts to 11 N·m (96 in. lbs.) torque.
(7) Install air cleaner housing cover.
(8) Install air intake tube to cover.

IDLE AIR CONTROL (IAC) MOTOR—3.9L/5.2L/5.9L ENGINES

The IAC motor is located on the back of the throttle body (Fig. 75).

REMOVAL

(1) Remove air cleaner assembly.
(2) Disconnect electrical connector from IAC motor.
(3) Remove two mounting bolts (screws) (Fig. 75).
(4) Remove IAC motor from throttle body.

INSTALLATION

(1) Install IAC motor to throttle body.
(2) Install and tighten two mounting bolts (screws) to 7 N·m (60 in. lbs.) torque.
(3) Install electrical connector.
(4) Install air cleaner assembly.

IDLE AIR CONTROL (IAC) MOTOR—8.0L ENGINE

The IAC motor is located on the back of the throttle body (Fig. 76).

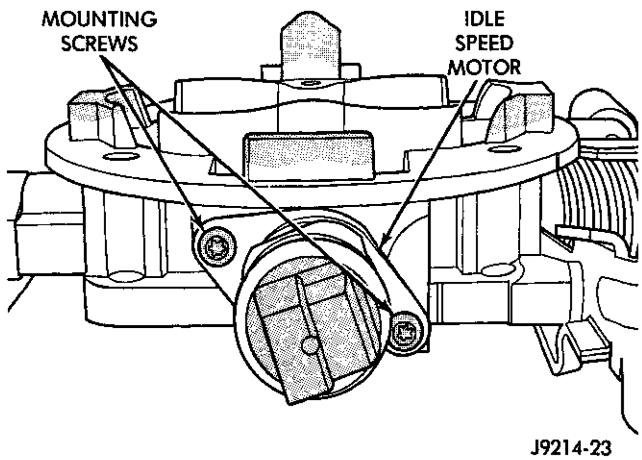


Fig. 75 Mounting Bolts (Screws)—IAC Motor—3.9L/5.2L/5.9L Engines

REMOVAL

(1) Remove the air cleaner cover.
(2) Remove the 4 air cleaner housing mounting nuts and remove housing from throttle body.
(3) Disconnect electrical connector from IAC motor.
(4) Remove two mounting bolts (screw).

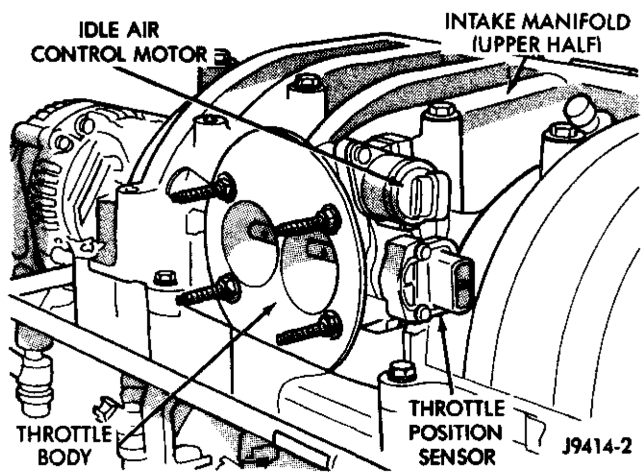


Fig. 76 IAC Motor—8.0L Engine

(5) Remove IAC motor from throttle body.

INSTALLATION

(1) Install IAC motor to throttle body.
(2) Install and tighten two mounting bolts (screws) to 7 N·m (60 in. lbs.) torque.
(3) Install electrical connector.
(4) Install air cleaner housing to throttle body.
(5) Install 4 air cleaner housing mounting nuts. Tighten nuts to 11 N·m (96 in. lbs.) torque.
(6) Install air cleaner housing cover.

REMOVAL AND INSTALLATION (Continued)

MANIFOLD ABSOLUTE PRESSURE (MAP) SENSOR—3.9L/5.2L/5.9L ENGINES

The MAP sensor is located on the front of the throttle body (Fig. 77). An L-shaped rubber fitting is used to connect the MAP sensor to throttle body (Fig. 78).

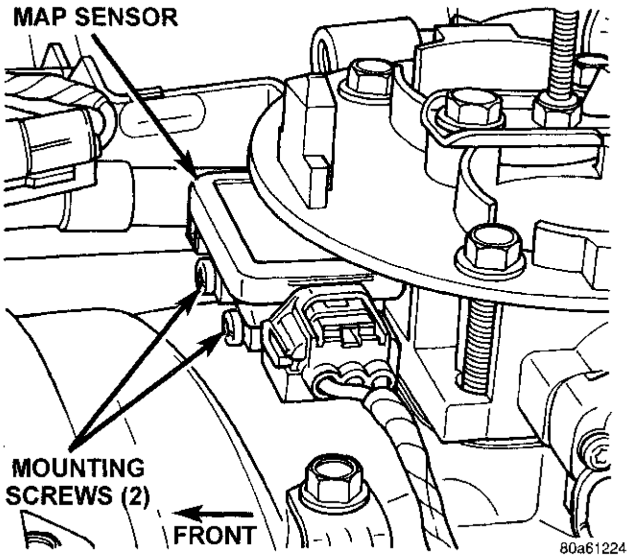


Fig. 77 MAP Sensor Location—3.9L/5.2L/5.9L Engines

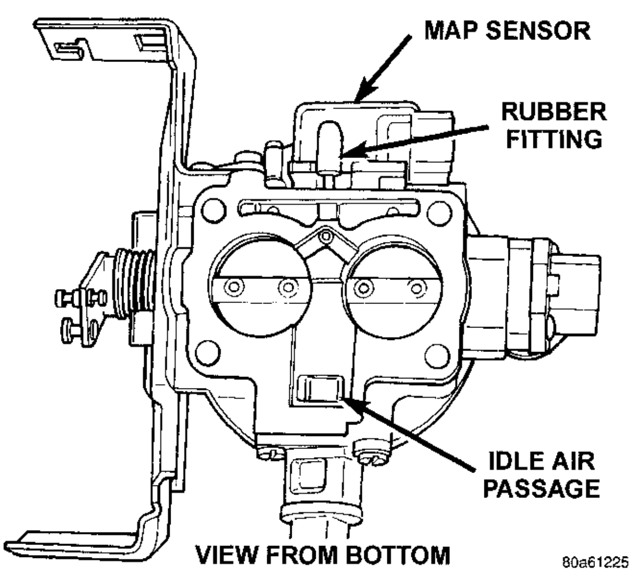


Fig. 78 MAP Sensor L-Shaped Rubber Fitting—3.9L/5.2L/5.9L Engines

REMOVAL

(1) Remove air cleaner assembly.

(2) Remove two MAP sensor mounting bolts (screws) (Fig. 77).

(3) While removing MAP sensor, slide the vacuum rubber L-shaped fitting (Fig. 78) from the throttle body.

(4) Remove rubber L-shaped fitting from MAP sensor.

INSTALLATION

(1) Install rubber L-shaped fitting to MAP sensor.

(2) Position sensor to throttle body while guiding rubber fitting over throttle body vacuum nipple.

(3) Install MAP sensor mounting bolts (screws). Tighten screws to 3 N·m (25 in. lbs.) torque.

(4) Install air cleaner.

MANIFOLD ABSOLUTE PRESSURE (MAP) SENSOR—8.0L ENGINE

The MAP sensor is mounted into the right upper side of the intake manifold (Fig. 79). A rubber gasket is used to seal the sensor to the intake manifold. The rubber gasket is part of the sensor and is not serviced separately.

REMOVAL

(1) Remove the electrical connector at the sensor.

(2) Clean the area around the sensor before removal.

(3) Remove the two sensor mounting bolts.

(4) Remove the sensor from the intake manifold.

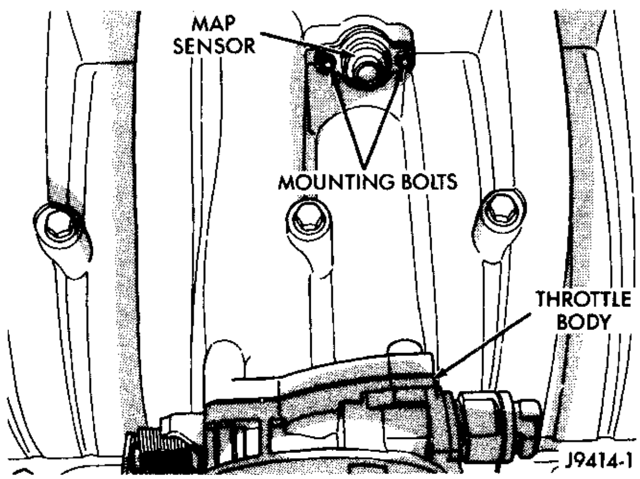


Fig. 79 MAP Sensor Location—8.0L V-10 Engine—Typical

INSTALLATION

(1) Check the condition of the sensor seal. Clean the sensor and lubricate the rubber gasket with clean engine oil.

(2) Clean the sensor opening in the intake manifold.

(3) Install the sensor into the intake manifold.

(4) Install sensor mounting bolts. Tighten bolts to 2 N·m (20 in. lbs.) torque.

(5) Install the electrical connector to sensor.

REMOVAL AND INSTALLATION (Continued)

DUTY CYCLE EVAP CANISTER PURGE SOLENOID

Refer to Group 25, Emission Control System for removal/installation procedures.

POWERTRAIN CONTROL MODULE (PCM)

The PCM is located in the engine compartment (Fig. 80).

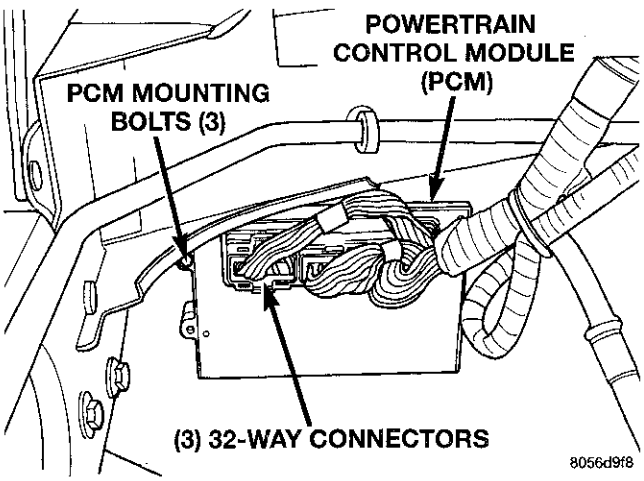


Fig. 80 PCM Location and Mounting

REMOVAL

To avoid possible voltage spike damage to the PCM, ignition key must be off, and negative battery cable must be disconnected before unplugging PCM connectors.

(1) Disconnect negative battery cable(s) at battery(s).

(2) Remove cover over electrical connectors. Cover snaps onto PCM.

(3) Carefully unplug the three 32–way connectors from PCM.

(4) Remove three PCM mounting bolts and remove PCM from vehicle.

INSTALLATION

(1) Install PCM and mounting bolts to vehicle.

(2) Tighten bolts to 4 N·m (35 in. lbs.).

(3) Check pin connectors in the PCM and the three 32–way connectors for corrosion or damage. Repair as necessary.

(4) Install three 32–way connectors.

(5) Install cover over electrical connectors. Cover snaps onto PCM.

(6) Install battery cable(s).

(7) Use the DRB scan tool to reprogram new PCM with vehicles original Identification Number (VIN) and original vehicle mileage. If this step is not done, a Diagnostic Trouble Code (DTC) may be set.

CRANKSHAFT POSITION SENSOR

Refer to Group 8D, Ignition System for removal/installation procedures.

CAMSHAFT POSITION SENSOR

For removal/installation procedures, refer to Group 8D, Ignition System. See Camshaft Position Sensor.

OXYGEN SENSORS—3.9L/5.2L/5.9L LDC/HDC ENGINES

On 3.9L/5.2L/5.9L LDC engines, the upstream and downstream O2S sensors are located at the inlet and outlet ends of the catalytic converter (Fig. 81).

On 5.9L HDC engines, the left and right O2S sensors are located on the left and right exhaust downpipes (Fig. 82).

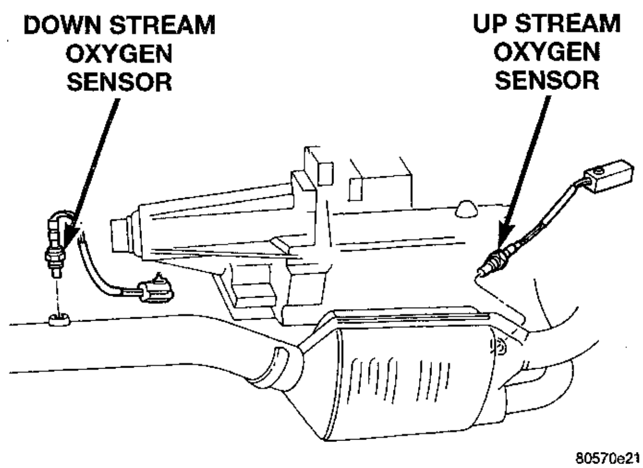


Fig. 81 Oxygen Sensor Location—3.9L/5.2L/5.9L LDC ENGINES

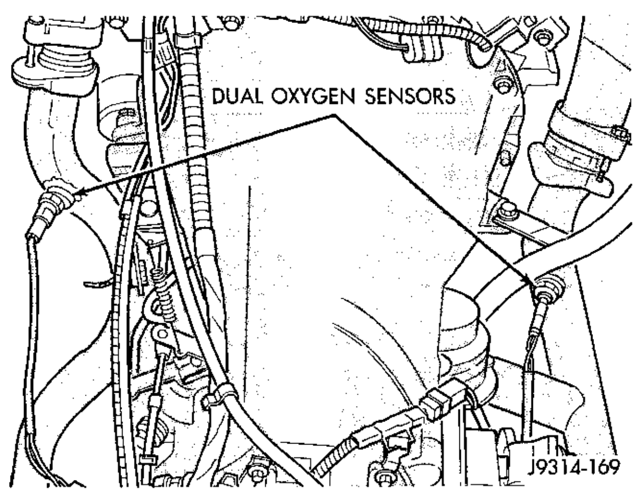


Fig. 82 Oxygen Sensor Location—5.9L HDC ENGINES

REMOVAL

WARNING: THE EXHAUST MANIFOLD, EXHAUST PIPES AND CATALYTIC CONVERTER BECOME VERY HOT DURING ENGINE OPERATION. ALLOW ENGINE TO COOL BEFORE REMOVING OXYGEN SENSOR.

REMOVAL AND INSTALLATION (Continued)

(1) Raise and support the vehicle.

(2) Disconnect the wire connector from the O2S sensor.

CAUTION: When disconnecting the sensor electrical connector, do not pull directly on wire going into sensor.

(3) Remove the O2S sensor. Snap-On oxygen sensor wrench (number YA 8875) may be used for removal and installation.

INSTALLATION

Threads of new oxygen sensors are factory coated with anti-seize compound to aid in removal. **DO NOT add any additional anti-seize compound to the threads of a new oxygen sensor.**

(1) Install the O2S sensor. Tighten to 30 N·m (22 ft. lbs.) torque.

(2) Connect the O2S sensor wire connector.

(3) Lower the vehicle.

OXYGEN SENSORS—8.0L ENGINES

On 8.0L MDC engines, the pre-catalyst and post catalyst O2S sensors are located at the inlet and outlet ends of the catalytic converter (Fig. 83).

On 8.0L MDC or HDC engines, the left and right O2S sensors are located on the left and right exhaust downpipes (Fig. 84).

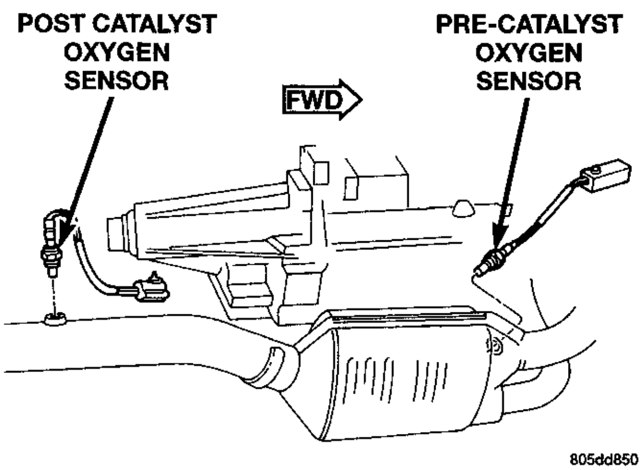


Fig. 83 Pre-Catalyst/Post Catalyst Oxygen Sensor Location—8.0L MDC Engines Only

REMOVAL

WARNING: THE EXHAUST MANIFOLD, EXHAUST PIPES AND CATALYTIC CONVERTER BECOME VERY HOT DURING ENGINE OPERATION. ALLOW ENGINE TO COOL BEFORE REMOVING OXYGEN SENSOR.

(1) Raise and support the vehicle.

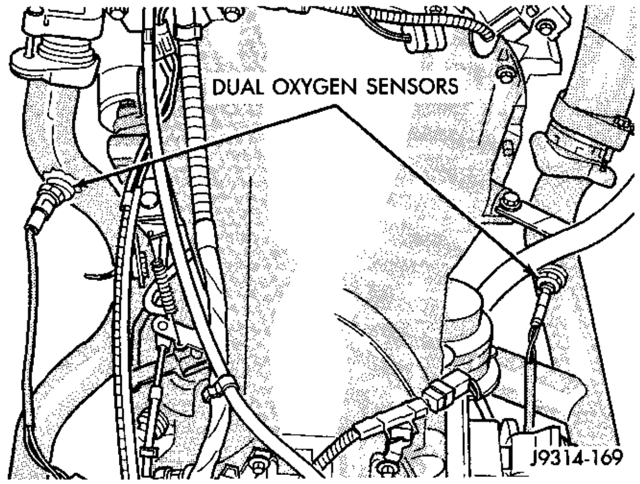


Fig. 84 Left/Right Oxygen Sensor Location—All 8.0L Engines

(2) Disconnect the wire connector from the O2S sensor.

CAUTION: When disconnecting the sensor electrical connector, do not pull directly on wire going into sensor.

(3) Remove the O2S sensor. Snap-On oxygen sensor wrench (number YA 8875) may be used for removal and installation.

INSTALLATION

Threads of new oxygen sensors are factory coated with anti-seize compound to aid in removal. **DO NOT add any additional anti-seize compound to the threads of a new oxygen sensor.**

(1) Install the O2S sensor. Tighten to 30 N·m (22 ft. lbs.) torque.

(2) Connect the O2S sensor wire connector.

(3) Lower the vehicle.

AIR CLEANER HOUSING/AIR CLEANER ELEMENT (FILTER)—3.9L/5.2L/5.9L ENGINES

For air cleaner element required maintenance schedules (listed in time or mileage intervals), refer to Group 0, Lubrication and Maintenance.

REMOVAL/INSTALLATION

CAUTION: Do not attempt to remove the air cleaner element (filter) from the housing by removing the top cover only. To prevent damage to the air cleaner housing, the entire air cleaner housing assembly must be removed from the engine for air cleaner element replacement.

(1) Remove the air inlet tube (Fig. 85) at the side of the air cleaner housing.

REMOVAL AND INSTALLATION (Continued)

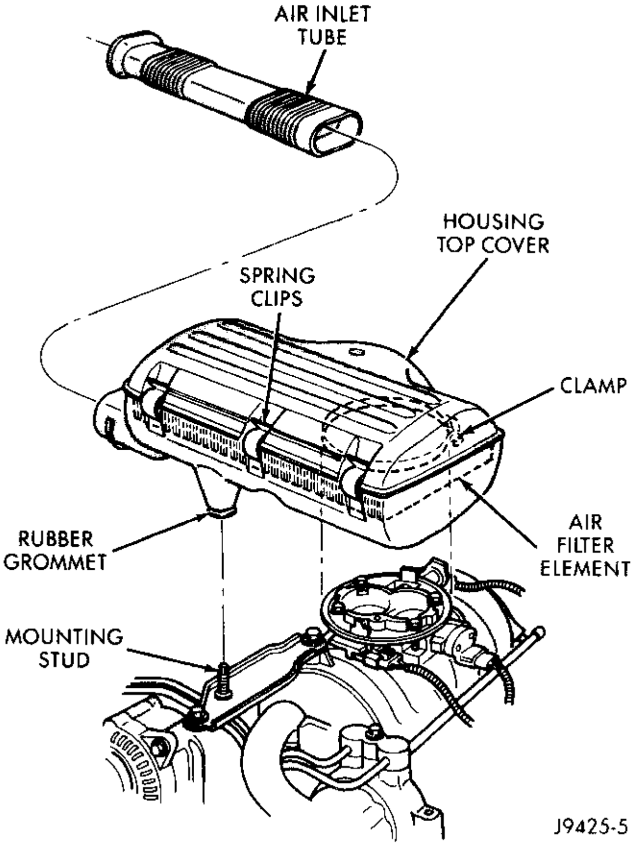


Fig. 85 Air Cleaner Housing—3.9L/5.2L/5.9L Engines

(2) A band-type screw clamp secures the air cleaner housing to the throttle body. Loosen, but do not remove, this screw clamp (Fig. 85). Note the clamp positioning tabs on the air cleaner housing.

(3) All Engines: Disconnect the breather hose at the rear of air cleaner housing.

(4) 5.9L V-8 HDC Engine Only: Disconnect the air pump hose at the air cleaner housing.

(5) The bottom/front of the air cleaner housing is equipped with a rubber grommet (Fig. 85). A mounting stud is attached to the intake manifold (Fig. 85) and is used to position the air cleaner housing into this grommet. Lift the assembly from the throttle body while slipping the assembly from the mounting stud (Fig. 85).

(6) Check condition of gasket at throttle body and replace as necessary.

(7) The housing cover is equipped with three (3) spring clips (Fig. 85) and is hinged at the rear with plastic tabs. Unlatch the clips from the top of air cleaner housing and tilt the housing cover up and rearward for cover removal.

(8) Remove the air cleaner element from air cleaner housing.

(9) Before installing a new air cleaner element, clean inside of air cleaner housing.

(10) Position air cleaner cover to tabs on rear of air cleaner housing. Latch the three spring clips to seal cover to housing.

(11) Position the air cleaner housing assembly to the throttle body while guiding the rubber grommet over the mounting stud. The lower part of the screw clamp should be below the top lip of the throttle body.

(12) Push down on air cleaner housing at rubber grommet to seat housing at intake manifold.

(13) Tighten throttle body-to-air cleaner housing clamp to 4 N·m (35 in. lbs.) torque.

(14) Install the air inlet tube at air cleaner housing inlet.

AIR CLEANER HOUSING/AIR CLEANER ELEMENT (FILTER)—8.0L V-10 ENGINE

For air cleaner element required maintenance schedules (listed in time or mileage intervals), refer to Group 0, Lubrication and Maintenance.

A small amount of engine oil wetting the inside of the air cleaner housing is normal. When servicing, wipe out the oil from the air cleaner housing.

REMOVAL/INSTALLATION

(1) Loosen the clamp (Fig. 86) and remove the air inlet tube (Fig. 87) at the front of the air cleaner housing cover.

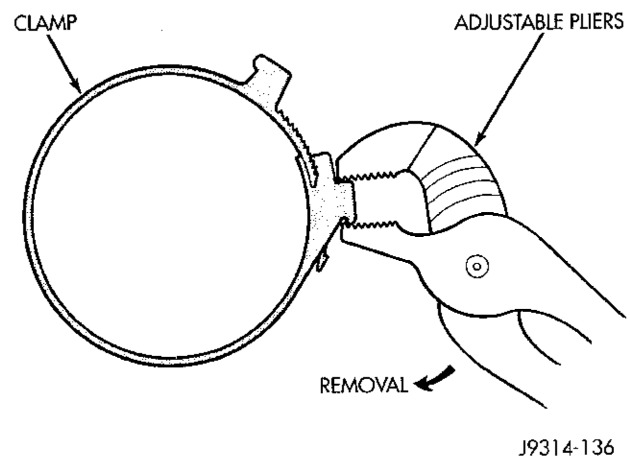


Fig. 86 Clamp Removal—8.0L Engine

(2) The air cleaner housing and air cleaner element cover are equipped with spring clips to seal the cover to housing (Fig. 87). Unlatch the clips from the air cleaner cover and remove cover from air cleaner housing.

(3) Remove the air cleaner element from air cleaner cover.

(4) Before installing a new air cleaner element, clean inside of air cleaner housing.

(5) If housing removal is necessary, remove the 4 housing-to-throttle body nuts.

REMOVAL AND INSTALLATION (Continued)

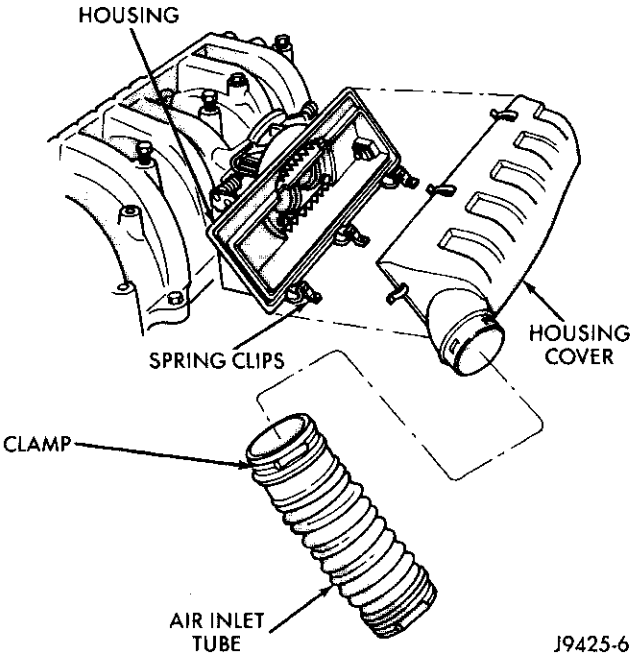


Fig. 87 Air Cleaner Housing—8.0L V-10 Engine

(6) After installing housing, tighten 4 nuts to 11 N·m (96 in. lbs.) torque.

(7) Position air cleaner element (filter) into air cleaner cover. Latch the spring clips to seal cover to housing.

(8) Install the air inlet tube at air cleaner housing inlet.

(9) Install and tighten clamp at air inlet tube (Fig. 88).

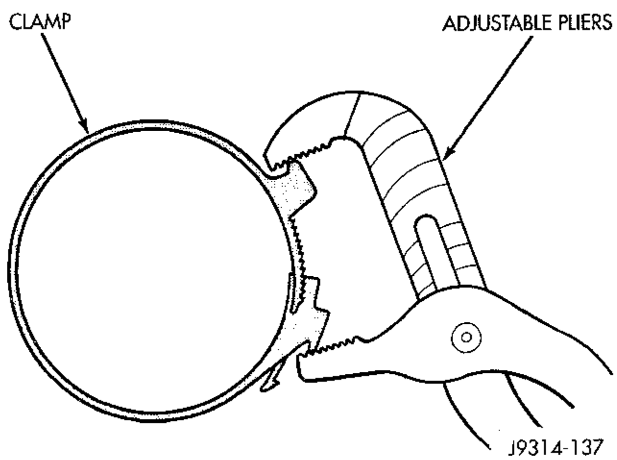


Fig. 88 Clamp Installation—8.0L Engine

ENGINE COOLANT TEMPERATURE SENSOR—3.9L/5.2L/5.9L ENGINES

REMOVAL

WARNING: HOT, PRESSURIZED COOLANT CAN CAUSE INJURY BY SCALDING. COOLING SYSTEM MUST BE PARTIALLY DRAINED BEFORE REMOVING THE COOLANT TEMPERATURE SENSOR. REFER TO GROUP 7, COOLING.

(1) Partially drain cooling system. Refer to Group 7, Cooling.

(2) Remove air cleaner assembly.

(3) Disconnect electrical connector from sensor (Fig. 89).

(4) **Engines with air conditioning:** When removing the connector from sensor, do not pull directly on wiring harness. Fabricate an L-shaped hook tool from a coat hanger (approximately eight inches long). Place the hook part of tool under the connector for removal. The connector is snapped onto the sensor. It is not equipped with a lock type tab.

(5) Remove sensor from intake manifold.

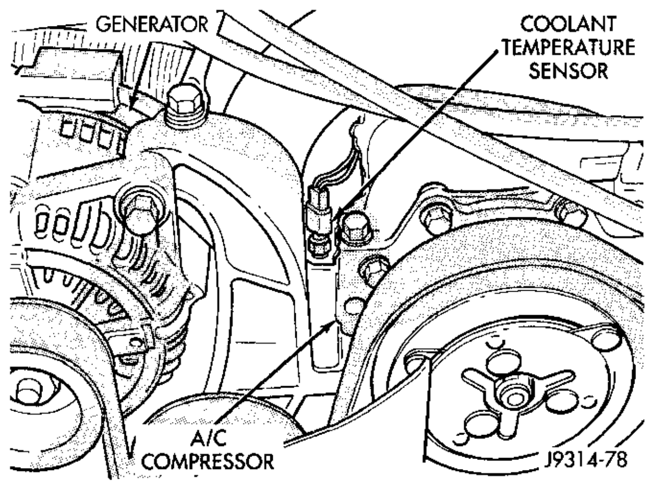


Fig. 89 Engine Coolant Temperature Sensor—3.9L/5.2L/5.9L Engines—Typical

INSTALLATION

(1) Install sensor.

(2) Tighten to 11 N·m (8 ft. lbs.) torque.

(3) Connect electrical connector to sensor. The sensor connector is symmetrical (not indexed). It can be installed to the sensor in either direction.

(4) Install air cleaner assembly.

(5) Replace any lost engine coolant. Refer to Group 7, Cooling System.

AUTHENTIC RESTORATION PRODUCTS

REMOVAL AND INSTALLATION (Continued)

ENGINE COOLANT TEMPERATURE SENSOR—8.0L ENGINE

REMOVAL

WARNING: HOT, PRESSURIZED COOLANT CAN CAUSE INJURY BY SCALDING. COOLING SYSTEM MUST BE PARTIALLY DRAINED BEFORE REMOVING THE COOLANT TEMPERATURE SENSOR. REFER TO GROUP 7, COOLING.

(1) Partially drain cooling system. Refer to Group 7, Cooling.
(2) Disconnect electrical connector from sensor (Fig. 90).
(3) Remove sensor from intake manifold.

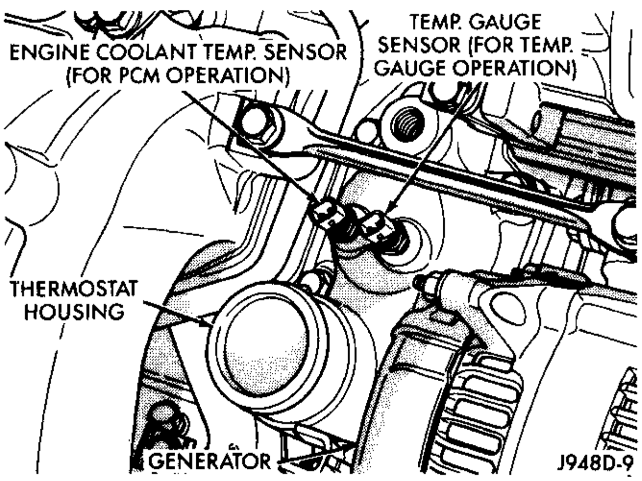


Fig. 90 Engine Coolant Temperature Sensor—8.0L Engine

INSTALLATION

(1) Install sensor.
(2) Tighten to 11 N·m (8 ft. lbs.) torque.
(3) Connect electrical connector to sensor.
(4) Replace any lost engine coolant. Refer to Group 7, Cooling System.

INTAKE MANIFOLD AIR TEMPERATURE SENSOR—3.9L/5.2L/5.9L ENGINES

The intake manifold air temperature sensor is located in the front/side of the intake manifold (Fig. 91).

REMOVAL

(1) Remove air cleaner assembly.
(2) Disconnect electrical connector at sensor (Fig. 91).
(3) Remove sensor from intake manifold.

INSTALLATION

(1) Install sensor to intake manifold. Tighten to 28 N·m (20 ft. lbs.) torque.

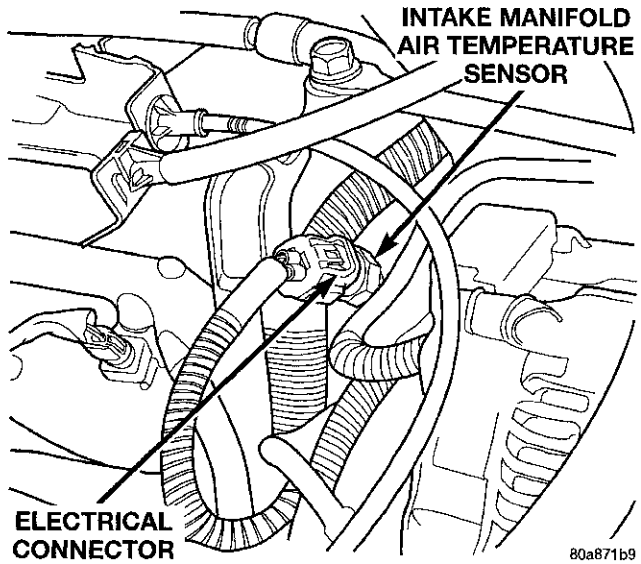


Fig. 91 Air Temperature Sensor—3.9L/5.2L/5.9L Engines—Typical (V-8 Shown)

(2) Install electrical connector.
(3) Install air cleaner.

INTAKE MANIFOLD AIR TEMPERATURE SENSOR—8.0L ENGINE

The intake manifold air temperature sensor is located in the side of the intake manifold near the front of throttle body (Fig. 92).

REMOVAL

(1) Disconnect electrical connector at sensor.
(2) Remove sensor from intake manifold.

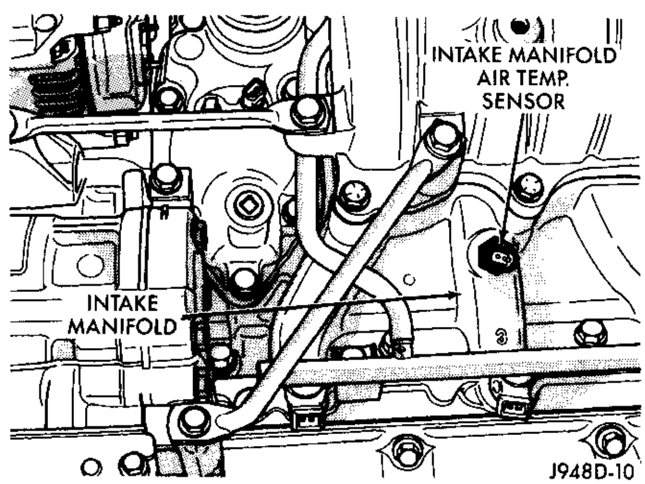


Fig. 92 Air Temperature Sensor—8.0L Engine

INSTALLATION

(1) Install sensor to intake manifold. Tighten to 28 N·m (20 ft. lbs.) torque.
(2) Install electrical connector.

SPECIFICATIONS

VECI LABEL

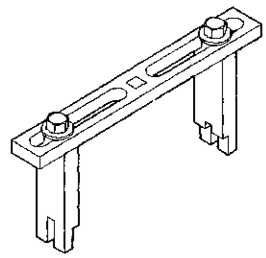
If anything differs between the specifications found on the Vehicle Emission Control Information (VECI) label and the following specifications, use specifications on VECI label. The VECI label is located in the engine compartment.

TORQUE CHART

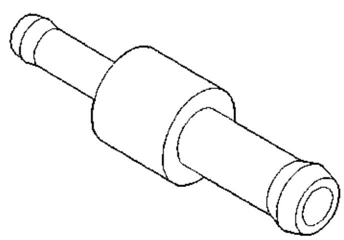
DESCRIPTION	TORQUE
Air Cleaner Housing Mount. Nuts—8.0L Engine	11 N·m (96 in. lbs.)
Air Cleaner Housing Metal Clamp—3.9L/5.2L/5.9L Engines	4 N·m (35 in. lbs.)
Crankshaft Position Sensor Mounting Bolts—All Engines	8 N·m (70 in. lbs.)
Camshaft Position Sensor Mounting—8.0L Engine	6 N·m (50 in. lbs.)
Engine Coolant Temperature Sensor—All Engines	11 N·m (96 in. lbs.)
Fuel Tank Mounting Nuts	41 N·m (30 ft. lbs.)
Fuel Hose Clamps	1 N·m (10 in. lbs.)
IAC Motor-To-Throttle Body Bolts	7 N·m (60 in. lbs.)
Intake Manifold Air Temp. Sensor—All Engines	28 N·m (20 ft. lbs.)
MAP Sensor Mounting Screws—3.9L/5.2L/5.9L Engines	3 N·m (25 in. lbs.)
MAP Sensor Mounting Screws—8.0L Engine	2 N·m (20 in. lbs.)
Oxygen Sensor—All Engines	30 N·m (22 ft. lbs.)
Powertrain Control Module Mounting Screws	4 N·m (35 in. lbs.)
Throttle Body Mounting Bolts—3.9L/5.2L/5.9L Engines	23 N·m (200 in. lbs.)
Throttle Body Mounting Bolts—8.0L Engine	22 N·m (192 in. lbs.)
Throttle Position Sensor Mounting Screws—All Engines	7 N·m (60 in. lbs.)

SPECIAL TOOLS

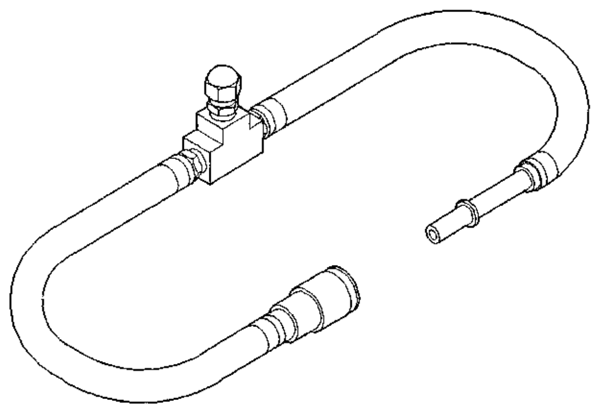
FUEL SYSTEM



Spanner Wrench—6856



Fitting, Air Metering—6714



Adapters, Fuel Pressure Test—6541, 6539, 6631 or 6923

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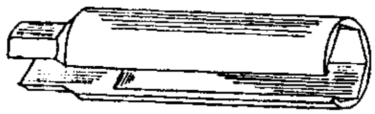
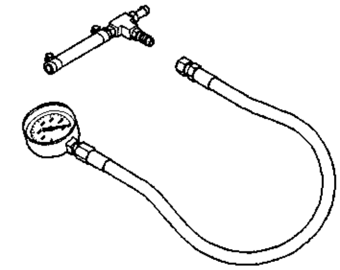
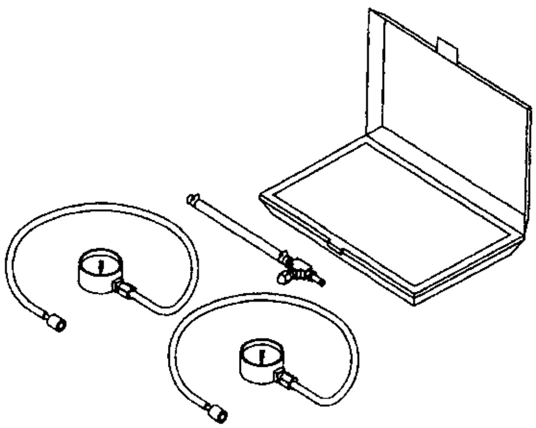
SPECIAL TOOLS (Continued)



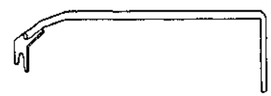
O2S (Oxygen Sensor) Remover/Installer—C-4907



Test Kit, Fuel Pressure—C-4799-B



Test Kit, Fuel Pressure—5069



Fuel Line Removal Tool—6782

mopar AUTHENTIC RESTORATION PRODUCT

FUEL DELIVERY SYSTEM-DIESEL ENGINE

INDEX

DESCRIPTION AND OPERATION

FUEL DELIVERY SYSTEM—DIESEL POWERED ENGINE

Two different fuel systems are used for the diesel engine in the 1998 model year. The **early** '98 fuel system, using the two-valve-per-cylinder engine, will retain the mechanical fuel injection pump as used in previous model years. The **late** '98 fuel system, using the four-valve-per-cylinder engine, will use an electronic fuel injection pump with two control modules. This book will include information for the **early** '98 fuel system only.

This section of the group will cover diesel fuel delivery components **not controlled** by the powertrain control module (PCM). Various components, relays and switches are operated by the PCM. Refer to the Fuel Injection System—Diesel Engine sections of this group for components that are operated by the PCM.

NOTE: Diesel fuel delivery (except for operation of the intake manifold air heater and manifold air heater relays) is not directly regulated by the PCM.

The fuel delivery system of the 5.9L turbo-diesel engine consists of the:

- Accelerator pedal

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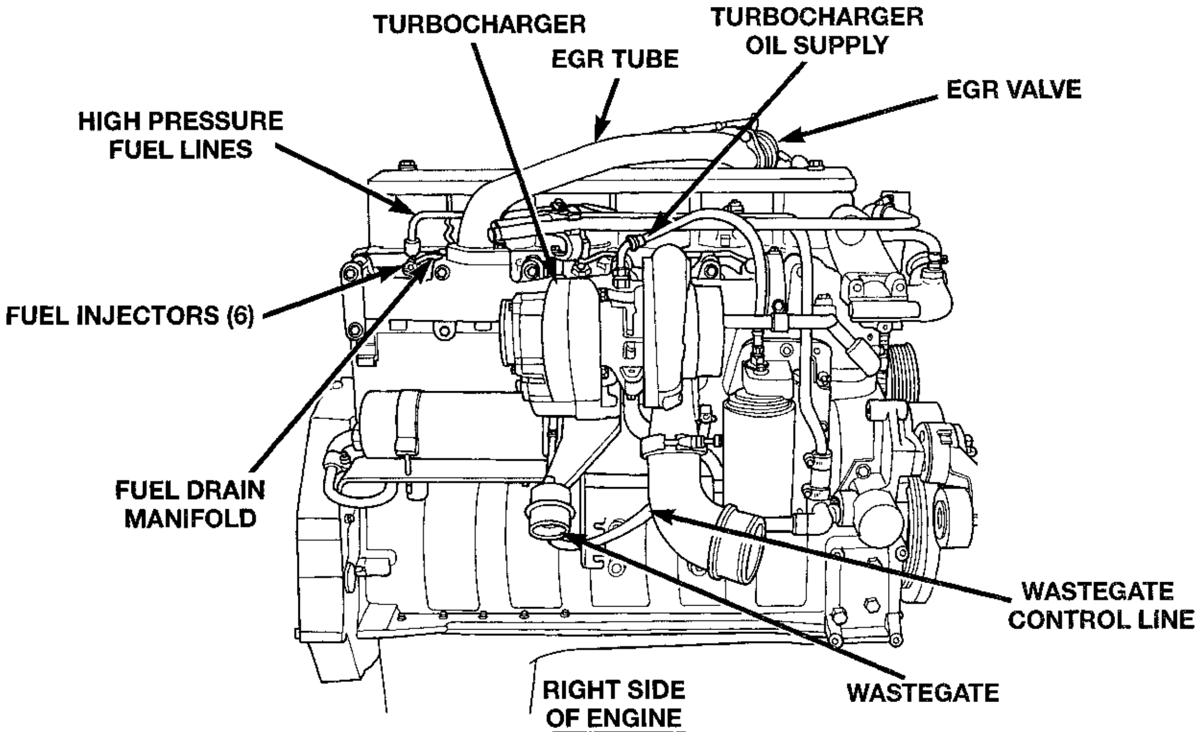
DESCRIPTION AND OPERATION (Continued)



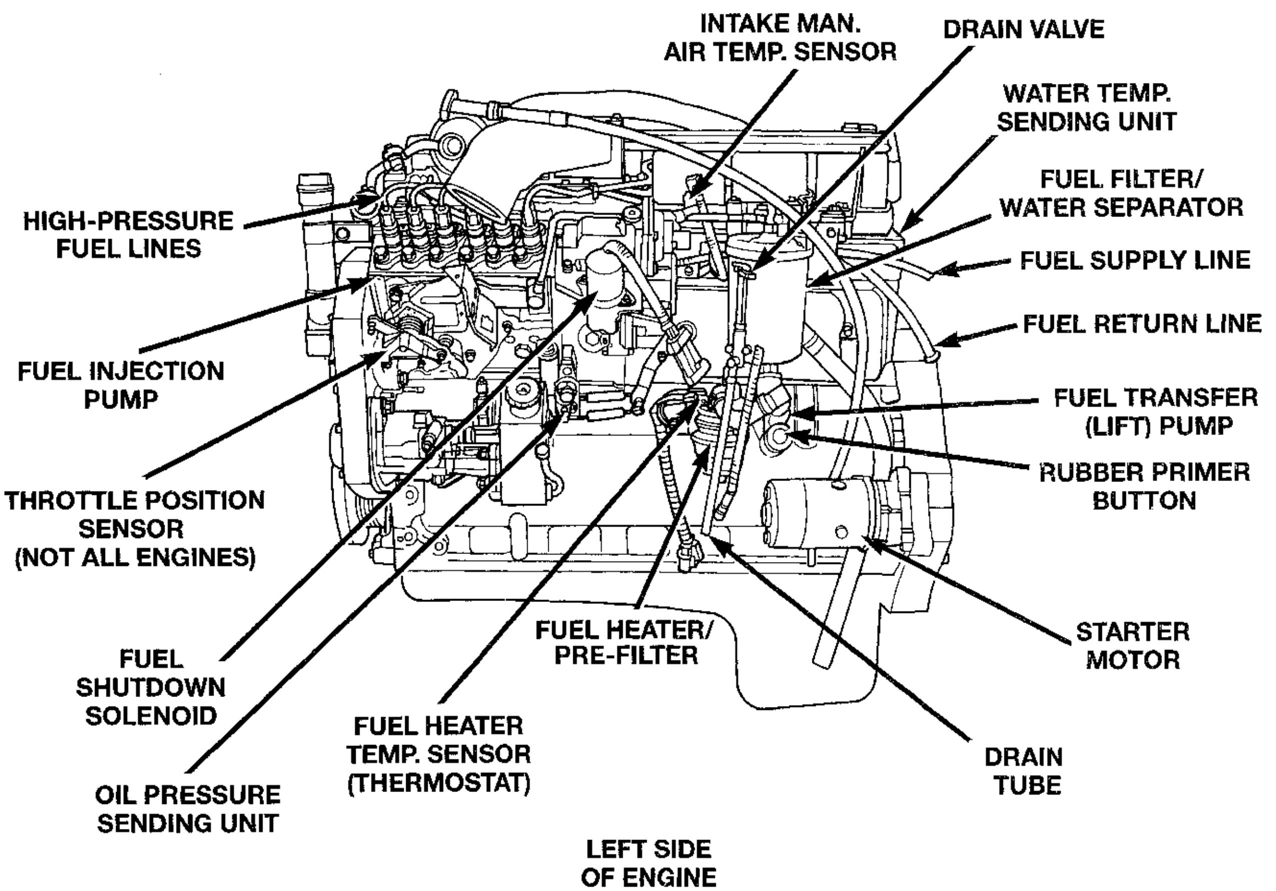


Fig. 1 Fuel System Components—Diesel Engine

DESCRIPTION AND OPERATION (Continued)

- Fuel drain manifold
- Fuel filter/water separator
- Fuel heater
- Fuel heater relay
- Fuel shutdown solenoid
- Fuel shutdown solenoid relay
- Fuel tank
- Fuel tank filler/vent tube assembly
- Fuel tank filler tube cap
- Fuel tank module containing the rollover valve, fuel gauge sending unit (fuel level sensor) and a separate fuel filter located at bottom of tank module
- Fuel tubes/lines/hoses
- High-pressure fuel injection pump
- High-pressure fuel injectors
- High-pressure fuel injector lines
- In-tank fuel filter (at bottom of fuel pump module)
- Low-pressure fuel supply lines
- Low-pressure fuel return line
- Low-pressure, mechanical, fuel transfer pump (fuel lift pump)
- Pre-filter (in the fuel heater)
- Quick-connect fittings
- Throttle cable

FUEL TANK MODULE

An electric fuel pump is **not used** in the fuel tank module for diesel powered engines. Fuel is supplied by the engine mounted fuel transfer pump and the fuel injection pump.

The fuel tank module is installed in the top of the fuel tank (Fig. 2). The fuel tank module (Fig. 2) contains the following components:

- Fuel reservoir
- A separate in-tank fuel filter
- Rollover valve
- Fuel gauge sending unit (fuel level sensor)
- Fuel supply line connection
- Fuel return line connection
- Auxiliary non-pressurized fuel supply fitting

FUEL GAUGE SENDING UNIT

The fuel gauge sending unit (fuel level sensor) is attached to the side of the fuel tank module. The sending unit consists of a float, an arm, and a variable resistor (track). The resistor track is used to send electrical signals to the Powertrain Control Module (PCM) for fuel gauge operation. After this signal is sent to the PCM, the PCM will transmit the data across the CCD bus circuits to the instrument panel. Here it is translated into the appropriate fuel gauge level reading.

As fuel level increases, the float and arm move up. This decreases the sending unit resistance, causing the fuel gauge to read full. As fuel level decreases, the float and arm move down. This increases the sending unit resistance causing the fuel gauge to read empty.

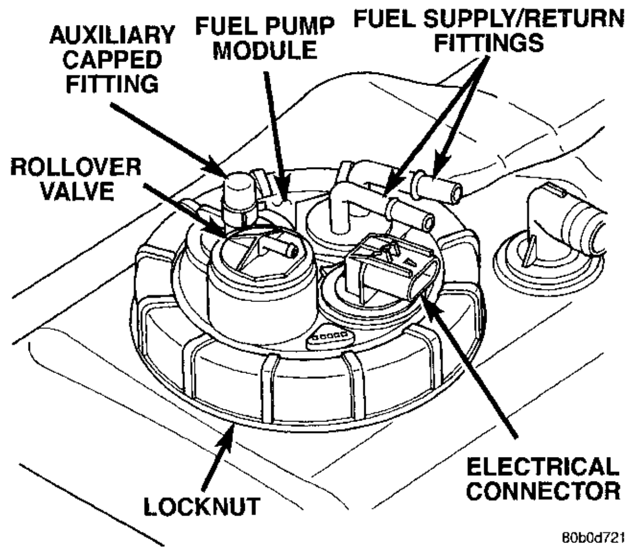


Fig. 2 Top View of Fuel Tank Module—Diesel

FUEL HEATER

The fuel heater is used to prevent diesel fuel from waxing during cold weather operation. The fuel heater is located on the left side of the engine above the starter motor (Fig. 3).

The heater assembly is equipped with a built-in sensor (thermostat) (Fig. 3) that senses fuel temperature. When the temperature is below 40 degrees F, the built-in sensor allows current to flow to the built-in heater element warming the fuel. When the temperature is above 80 degrees F, the sensor stops current flow to the heater element.

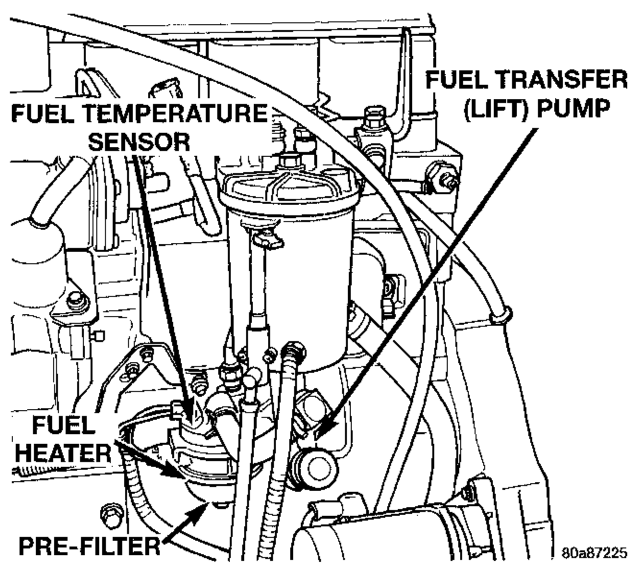


Fig. 3 Fuel Heater and Temperature Sensor Location

DESCRIPTION AND OPERATION (Continued)

Voltage to operate the fuel heater is supplied from the ignition switch and through the fuel heater relay. Also refer to Fuel Heater Relay.

The fuel heater and fuel heater relay are not controlled by the powertrain control module (PCM).

The built-in heater element operates on 12 volts, 300 watts at 0 degrees F.

The fuel heater assembly contains a pre-filter to prevent contaminants from entering the fuel transfer pump.

FUEL HEATER RELAY

Voltage to operate the fuel heater is supplied from the ignition switch through the fuel heater relay. The powertrain control module (PCM) is **not used** to control this relay.

The fuel heater relay is located in the engine compartment near the brake master cylinder (Fig. 4).

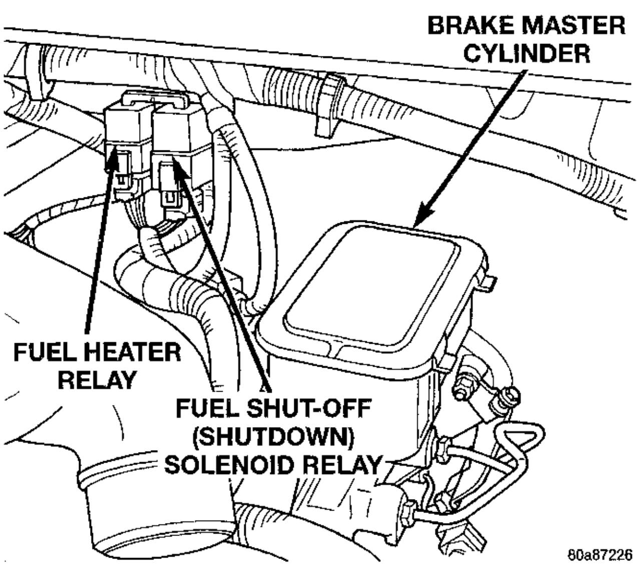


Fig. 4 Fuel Heater Relay—Diesel

FUEL TRANSFER PUMP

The fuel transfer pump (fuel lift pump) is located on the left-rear side of the engine cylinder block above the starter motor (Fig. 1) or (Fig. 3). This mechanically operated pump is not controlled by the powertrain control module (PCM).

The purpose of the fuel transfer pump is to supply (transfer) a low-pressure fuel source of approximately 172 Kpa (25 psi) to the injection pump and fuel filter/water separator from the fuel tank. Here, the low-pressure is raised to a high-pressure by the fuel injection pump for operation of the high-pressure fuel injectors. The transfer pump is driven by an eccentric on the engine camshaft that actuates a spring loaded piston within the pump (Fig. 5). Check valves within the pump, control direction of fuel flow and prevent fuel bleed-back during engine shut down.

The fuel transfer pump should never be operated without the pre-filter installed.

The fuel volume of the transfer pump will vary with engine rpm, but will always provide more fuel than the fuel injection pump requires. Excess fuel is returned to the fuel tank through an overflow valve. The valve is located on the side of the injection pump (Fig. 6) and is used to connect the fuel return line to the side of the injection pump. This valve opens at approximately 152 kPa (22 psi) and returns fuel to the fuel tank through the fuel return line.

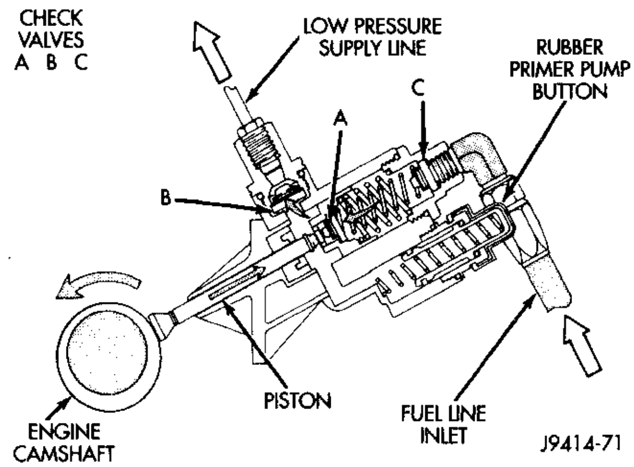


Fig. 5 Transfer Pump Operation—Typical Pump

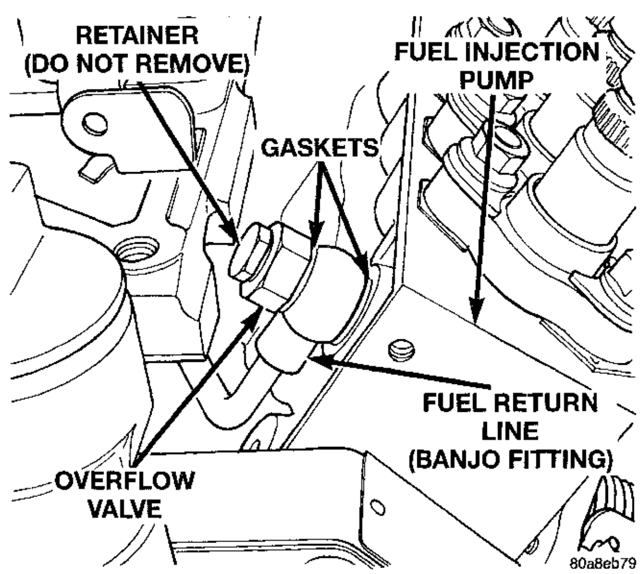


Fig. 6 Injection Pump Overflow Valve

The transfer pump has a primer button (Fig. 5). This rubber primer button is located on the pump housing. The purpose of the button is to prime and bleed air from the fuel system if the vehicle has run out of fuel. Refer to the Air Bleed Procedure in this section of the group for more information.

DESCRIPTION AND OPERATION (Continued)

OVERFLOW VALVE

Fuel volume from the fuel transfer pump will vary with engine rpm, but will always provide more fuel than the fuel injection pump requires. The overflow valve (pressure relief valve) is used to route excess fuel through the fuel return line and back to the fuel tank. The valve is located on the side of the injection pump (Fig. 6). The valve opens at approximately 152 kPa (22 psi). If the check valve within the assembly is sticking, low engine power may result. Refer to Fuel Transfer Pump for additional information.

FUEL TANK

The fuel tank is similar to the tank used with gasoline powered models. The tank is equipped with a separate fuel return line and a different fuel tank module for diesel powered models. A fuel tank mounted, electric fuel pump is not used with diesel powered models. Refer to Fuel Tank Module for additional information.

ROLLOVER VALVE(S)

Refer to Group 25, Emission Control System for information.

FUEL FILTER/WATER SEPARATOR

The fuel filter/water separator protects the fuel injection pump by removing water and contaminants from the fuel. The construction of the filter/separator allows fuel to pass through it, but helps prevent moisture (water) from doing so. Moisture collects at the bottom of the canister.

The fuel filter/water separator assembly is located on left side of engine above starter motor (Fig. 1).

Refer to the maintenance schedules in Group 0 in this manual for the recommended fuel filter replacement intervals.

For draining of water from canister, refer to Fuel Filter/Water Separator in the Removal/Installation section of this group.

A Water-In-Fuel (WIF) sensor is attached to side of canister. Refer to Water-In-Fuel Sensor for additional information.

FUEL SYSTEM PRESSURE WARNING

WARNING: HIGH-PRESSURE FUEL LINES DELIVER DIESEL FUEL UNDER EXTREME PRESSURE FROM THE INJECTION PUMP TO THE FUEL INJECTORS. THIS MAY BE AS HIGH AS 120,000 KPA (17,405 PSI). USE EXTREME CAUTION WHEN INSPECTING FOR HIGH-PRESSURE FUEL LEAKS. INSPECT FOR HIGH-PRESSURE FUEL LEAKS WITH A SHEET OF CARDBOARD. HIGH FUEL INJECTION PRESSURE CAN CAUSE PERSONAL INJURY IF CONTACT IS MADE WITH THE SKIN.

QUICK-CONNECT FITTINGS—DIESEL ENGINE

Refer to Quick-Connect Fittings in the Fuel Delivery System—Gasoline Powered Engine section for information. Also refer to the Fuel Tubes/Lines/Hoses and Clamps section.

HIGH-PRESSURE FUEL LINES

CAUTION: The high-pressure fuel lines must be held securely in place in their holders. The lines cannot contact each other or other components. Do not attempt to weld high-pressure fuel lines or to repair lines that are damaged. Only use the recommended lines when replacement of high-pressure fuel line is necessary.

High-pressure fuel lines deliver fuel under pressure of up to approximately 120,000 kPa (17,405 PSI) from the injection pump to the fuel injectors. The lines expand and contract from the high-pressure fuel pulses generated during the injection process. All high-pressure fuel lines are of the same length and inside diameter. Correct high-pressure fuel line usage and installation is critical to smooth engine operation.

WARNING: USE EXTREME CAUTION WHEN INSPECTING FOR HIGH-PRESSURE FUEL LEAKS. INSPECT FOR HIGH-PRESSURE FUEL LEAKS WITH A SHEET OF CARDBOARD. HIGH FUEL INJECTION PRESSURE CAN CAUSE PERSONAL INJURY IF CONTACT IS MADE WITH THE SKIN.

FUEL INJECTION PUMP

The fuel injection pump is a Bosch P7100 series inline type (Fig. 7). The injection pump is driven by the engine camshaft. A gear on the end of the pump shaft meshes with the camshaft gear. The pump is timed to the engine. Fuel injection occurs near the end of the compression stroke for each cylinder.

The RQV-K governor (Fig. 7) has a pump timing feature. This will allow the pump shaft to be oriented in a position corresponding to top dead center (TDC) for the compression stroke of cylinder number one. Indexing the governor flyweight assembly to the shaft during assembly establishes pump timing.

As engine speed increases, the internal pump pressure increases. An air-fuel control (AFC) (Fig. 8) on the governor ensures that regulated fuel delivery is matched to intake manifold pressure (turbocharger boost) for emission control.

The mechanical fuel transfer pump delivers fuel under a low- pressure of approximately 172 Kpa (25 psi) to the injection pump through the fuel filter/water separator. The injection pump then supplies high-pressure fuel of approximately 120,000 kPa (17,400

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DESCRIPTION AND OPERATION (Continued)

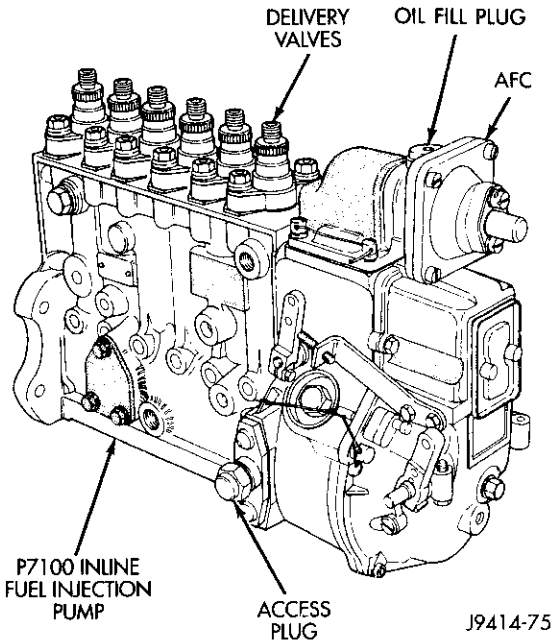

Fig. 7 Fuel Injection Pump

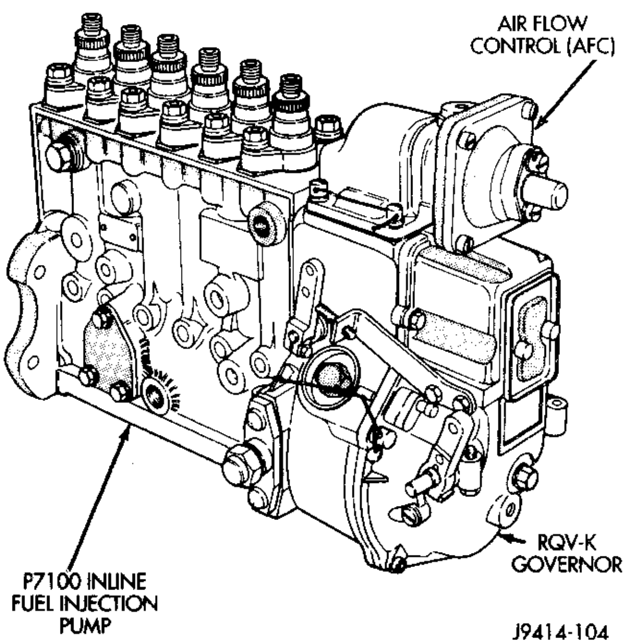

Fig. 8 Injection Pump Governor and AFC

psi) to each injector in precise metered amounts at the correct time.

Excess fuel is returned to the fuel tank by an overflow valve (Fig. 6) on the injection pump. This vent opens at approximately 152 kPa (22 psi) and returns fuel to the fuel tank through the fuel return line.

Diesel fuel and engine oil are used to cool the fuel injection pump. A separate oil feed line from the engine supplies engine oil to the pump. The oil returns to the engine through an opening at the front of pump.

A KSB (cold start) solenoid is not used.

The injection pump high idle speed is factory-sealed and is not adjustable. The low idle speed is adjustable. Refer to Idle Speed Adjustment.

For injection pump timing, refer to Fuel Injection Pump Timing.

FUEL INJECTORS

The fuel injectors are mounted on the left side of the cylinder head (Fig. 9). The injectors are connected to the fuel injection pump by the high-pressure fuel lines. A separate injector is used for each cylinder.

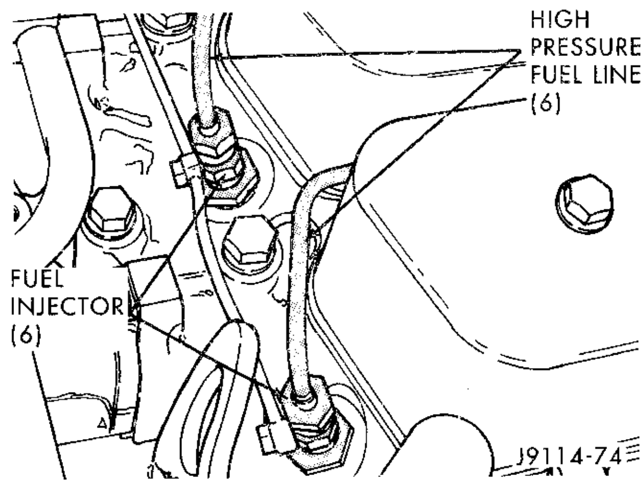

Fig. 9 Fuel Injectors—Typical

The injectors consist of the nozzle holder, o-ring water seal, shims, spring, needle valve and nozzle. Fuel enters the injector at the fuel inlet (top of injector) and is routed to the needle valve bore. When fuel pressure rises to approximately 26,252 kPa (3,822 psi), the needle valve spring tension is overcome. The needle valve rises and fuel flows through the spray holes in the nozzle tip into the combustion chamber. The pressure required to lift the needle valve is the operating pressure setting. This is sometimes referred to as the "pop" pressure setting.

Fuel pressure in the injector circuit decreases after injection. The injector needle valve is immediately closed by the needle valve spring and fuel flow into the combustion chamber is stopped. Exhaust gases are prevented from entering the injector nozzle by the needle valve.

FUEL SHUTDOWN SOLENOID

The fuel shutdown solenoid and fuel shutdown solenoid relay are not controlled by the powertrain control module (PCM).

DESCRIPTION AND OPERATION (Continued)

The fuel shutdown (shut-off) solenoid is used to electrically shut off the diesel fuel supply to the high-pressure fuel injection pump. The solenoid is mounted to the side of the pump (Fig. 10) and is connected to the pump with a lever.

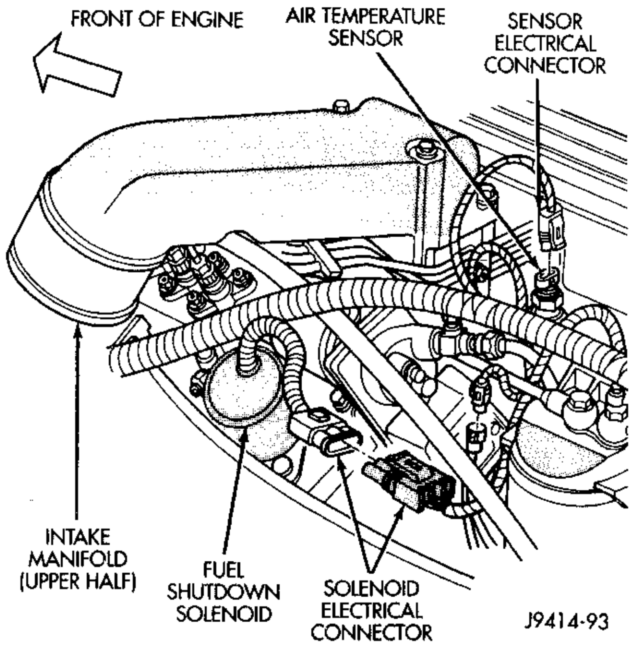

Fig. 10 Fuel Shutdown Solenoid Location

The solenoid controls starting and stopping of the engine regardless of the position of the accelerator pedal. When the ignition switch is off, the solenoid plunger is spring loaded (down) in the shutdown position (Fig. 11) and fuel is shut off to the injection pump.

Two different coils are located within the solenoid and a three-wire pigtail wire harness is attached to the solenoid.

When the ignition switch is turned to the CRANK (starter engaged) position, high-amperage current (approximately 40 amps at 12 volts) is supplied to one of the coils in the shutdown solenoid from the fuel shutdown solenoid relay. This high-amperage current allows the solenoid shaft to pull up on the injection pump lever. The injection pump shutdown lever is then positioned to the run position (Fig. 11).

When the ignition key is released to the ON position, a low-amperage current is supplied to the other coil in the solenoid. This is used to hold the solenoid shaft in the up position. Accelerator pedal position then controls fuel lever position for fuel control at the injection pump.

Voltage to operate the solenoid is supplied from the ignition switch and through the fuel shutdown solenoid relay. Also refer to Fuel Shutdown Solenoid Relay.

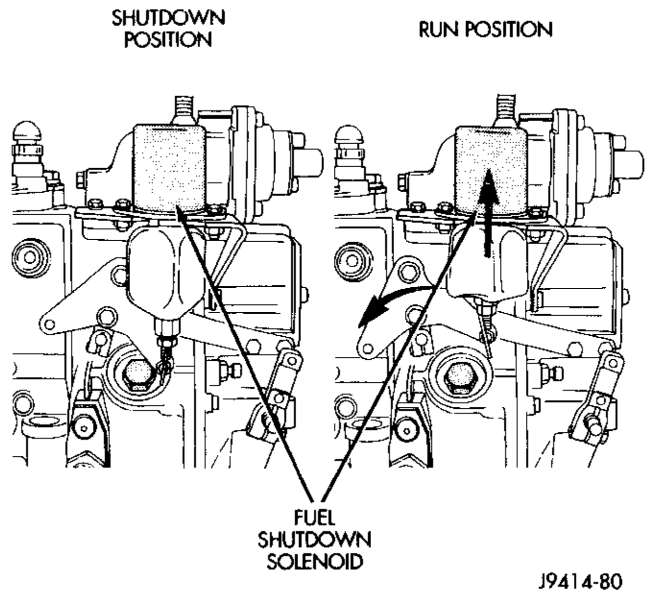

Fig. 11 Fuel Shutdown Solenoid Positions

If the shutdown solenoid is being replaced, its shaft length must be adjusted. For fuel shutdown solenoid removal, installation and solenoid shaft adjustment procedures, refer to Fuel Shutdown Solenoid in the Removal/Installation section of this group.

FUEL SHUTDOWN SOLENOID RELAY

Voltage to operate the fuel shutdown (shut-off) solenoid is supplied from the ignition switch and through the fuel shutdown solenoid relay. The Powertrain Control Module (PCM) has no control over the solenoid. The fuel shutdown solenoid relay is located in the engine compartment near the brake master cylinder (Fig. 12).

FUEL DRAIN MANIFOLD

Some fuel is continually vented from the fuel injection pump to cool the pump and the fuel injectors. During injection, a small amount of fuel flows past the injector nozzle and is not injected into the combustion chamber. This fuel drains into the fuel drain manifold (Fig. 13). Fuel in the drain manifold is then routed back to the fuel filter/water separator.

DIAGNOSIS AND TESTING

LOW-PRESSURE FUEL SYSTEM DIAGNOSIS

The Bosch P7100 inline fuel injection pump is very sensitive to fuel supply pressure variations. If this pressure is low or pulsating excessively, it may cause:

- Low rpm miss/instability
- White smoke

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DIAGNOSIS AND TESTING (Continued)

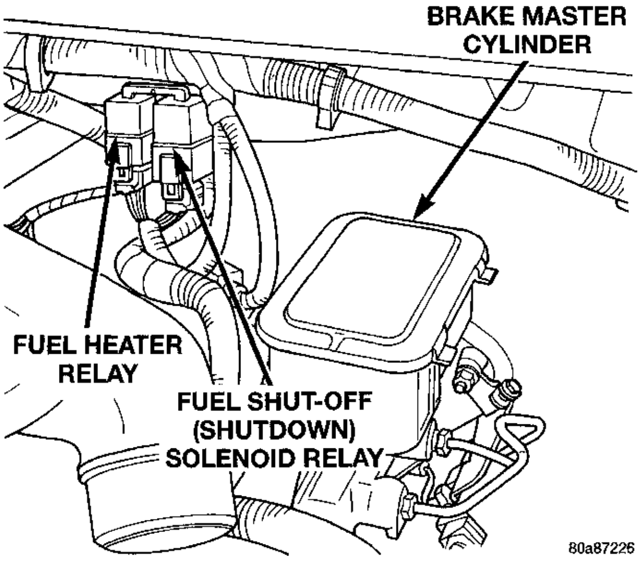

Fig. 12 Fuel Shutdown (Shut-Off) Solenoid Location

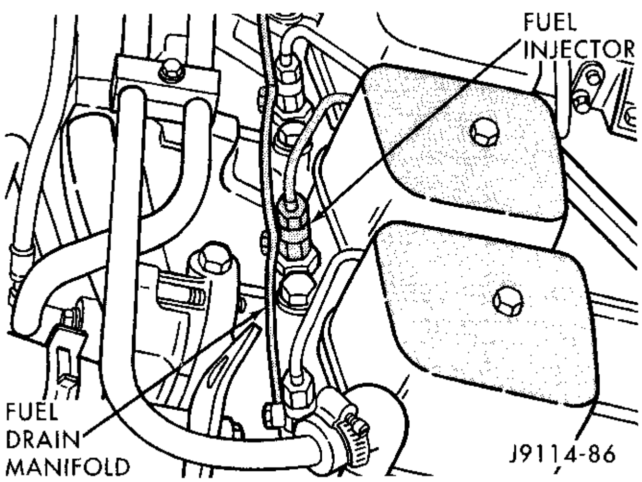

Fig. 13 Fuel Drain Manifold—Typical

- Hard starting
- Engine dies at idle (especially when hot)
- Low power
- Fuel filter cracking (caused by high pressure spikes with restricted overflow valve or fuel return line)

If the preceding symptoms/conditions exist:

(1) Check fuel shutoff solenoid adjustment. Improper adjustment could affect fuel delivery in the injection pump. Refer to Fuel Shutdown (Shutoff) Solenoid Removal/Installation for adjustment procedures.

(2) Visibly check the fuel supply line and fuel return line for kinks, bends or any other damage that would restrict fuel flow.

(3) In addition to contaminants or air, restrictions in the fuel supply to the injection pump caused by a clogged or dirty fuel filter can cause problems. A restricted pre-filter screen within the fuel heater may also have the same results. Refer to Group 0, Lubrication and Maintenance at the front of this manual for recommended filter replacement intervals in time or mileage. Be sure to clean the pre-filter each time the fuel filter is replaced. Refer to Fuel Heater Removal/Installation for pre-filter service procedures.

(4) Check fuel transfer (lift) pump supply pressure to the injection pump. Refer to the Fuel Transfer Pump Pressure/Capacity Test.

(a) Normal pressures are 17–22 psi at idle and 25–30 psi at rated rpm (2500 rpm) with no load.

(b) If supply pressure is low, restrict the fuel return line (pinch off fuel return hose). If pressure returns back to normal or above, the overflow valve must be replaced. Refer to the Fuel Transfer Pump Pressure/Capacity Test.

(c) If fuel supply pressure remains low with the fuel return line pinched, the fuel transfer pump must be replaced. Refer to the Fuel Transfer Pump Pressure/Capacity Test.

(d) High pressure at idle speed indicates a restriction. **Make sure the overflow valve has been installed at the fuel return line (pump outlet) and not at the fuel supply line (pump inlet).**

(e) Fuel pressure must be checked after each corrective action. Other possible causes can be found in the Service Diagnosis, Diesel Performance section of Group 9, Engines.

Whenever the fuel injection pump is being replaced or removed for calibration, the overflow valve must stay with the pump. Make sure a new overflow valve is used with a new injection pump and the old (original) overflow valve is returned to the authorized repair facility with the old injection pump.

AIR IN FUEL SYSTEM

Air will enter the fuel system whenever fuel supply lines, separator filters, injection pump, high-pressure lines or injectors are removed or disconnected. Air trapped in the fuel system can result in hard starting, a rough running engine, engine misfire, low power, excessive smoke and fuel knock. After service is performed, air must be bled from the system before starting the engine.

Inspect the fuel system from the fuel transfer pump to the injectors for loose connections. Leaking fuel is an indicator of loose connections or defective seals. Air can also enter the fuel system between the fuel tank and the transfer pump. Inspect the fuel tank and fuel lines for damage that might allow air into the system.

For air bleeding, refer to the Air Bleed Procedure.

DIAGNOSIS AND TESTING (Continued)

FUEL SUPPLY RESTRICTIONS

LOW-PRESSURE LINES

Fuel supply line restrictions or a defective fuel transfer pump can cause starting problems and prevent the engine from revving up. The starting problems include; low power and blue or white fog like exhaust. Test all fuel supply lines for restrictions or blockage. Flush or replace as necessary. Bleed the fuel system of air once a fuel supply line has been replaced. Refer to the Air Bleed Procedure section of this group for procedures. Also refer to the Fuel Transfer Pump Pressure Test section of this group for restriction tests.

HIGH-PRESSURE LINES

Restricted (kinked or bent) high-pressure lines can cause starting problems, poor engine performance and black smoke from exhaust.

Examine all high-pressure lines for any damage. Each radius on each high-pressure line must be smooth and free of any bends or kinks.

Replace damaged, restricted or leaking high-pressure fuel lines with the correct replacement line.

CAUTION: The high-pressure fuel lines must be clamped securely in place in the holders. The lines cannot contact each other or other components. Do not attempt to weld high-pressure fuel lines or to repair lines that are damaged. Only use the recommended lines when replacement of high-pressure fuel line is necessary.

FUEL TRANSFER PUMP PRESSURE/CAPACITY TEST

For operation of the fuel transfer pump (lift pump) primer button, refer to the Air Bleed Procedure in this group.

The fuel transfer pump is located on the left side of the engine and above the starter motor (Fig. 14).

An improperly operating fuel transfer pump can cause low engine power, excessive white smoke and/or hard engine starting.

Before performing pump pressure testing, inspect the fuel supply and return lines for restrictions, kinks or leaks.

Fuel leaking from the weep hole in the pump casing indicates a leaking pump. The transfer pump must then be replaced.

Low transfer pump output can be caused by a worn eccentric (cam lobe) on the engine camshaft.

In addition to contaminants or air, restrictions in the fuel supply to the injection pump caused by a clogged or dirty fuel filter can cause problems. This may be: low power, poor starting or excessive white smoke. A restricted pre-filter screen within the fuel heater may also have the same results. Refer to Group 0, Lubrication and Maintenance at the front of this manual for recommended filter replacement intervals in time or mileage. Be sure to clean the pre-filter each time the fuel filter is replaced. Refer to Fuel Heater Removal/Installation for pre-filter service procedures.

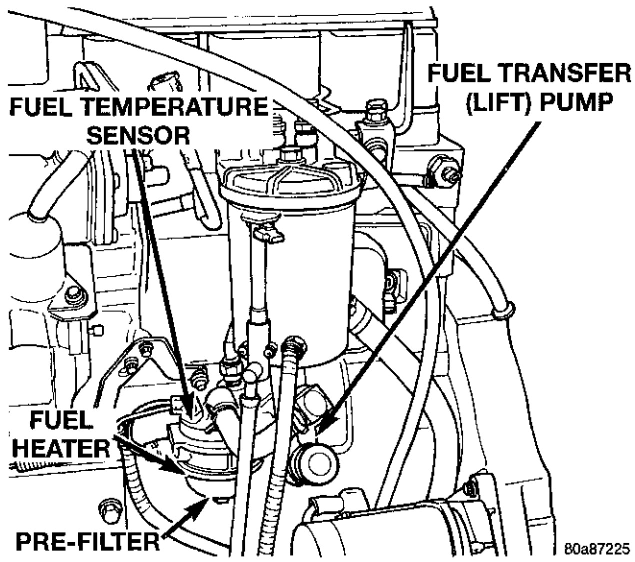

Fig. 14 Fuel Transfer Pump Location

OUTPUT PRESSURE TEST

(1) Place a drain pan below injection pump.

(2) Remove banjo bolt and gaskets from fuel inlet line fitting at side of injection pump (Fig. 15).

(3) Install Special Tool 6976 and tool gaskets from tool kit 6977 in place of the banjo bolt (Fig. 16). Tighten tool into injection pump.

(4) Install a 0-60 or 0-100 psi fuel pressure gauge to adapter tool 6976 (Fig. 16).

(5) Start and warm engine and record fuel pressure. Pressure should be 117–152 kPa (17–22 psi) at idle speed. Pressure of 172–207 kPa (25–30 psi) should be seen after raising engine speed to its rated rpm (2,500 rpm) with no load.

(6) If fuel pressure falls below specifications, do not automatically condemn the transfer pump. The fuel filter or pre-filter may be dirty or clogged. If either of the filters are at fault, the pressure reading will rise after servicing. Recheck fuel pressure after servicing filters.

(7) If pressure is still low, the **overflow valve** (pressure relief valve) (Fig. 17) may be defective. To determine if the overflow valve is causing the low pressure condition:

(a) Locate and disconnect fuel return line quick-connect fitting at left-rear of engine (Fig. 18).

DIAGNOSIS AND TESTING (Continued)

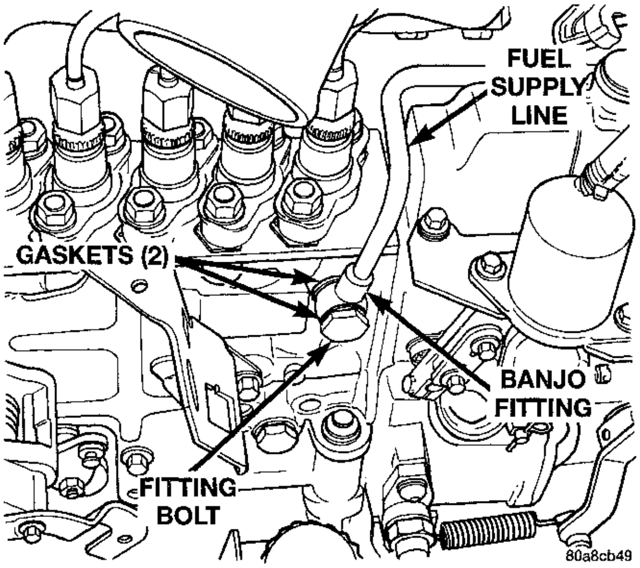

Fig. 15 Fuel Inlet Line at Injection Pump

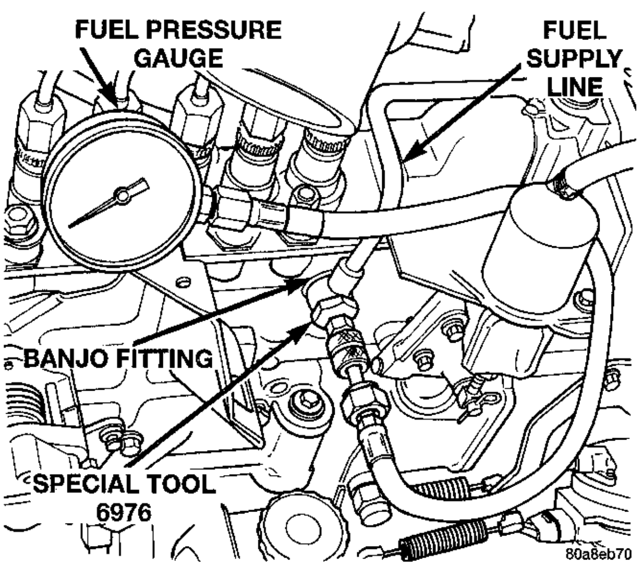

Fig. 16 Checking Fuel Pump Pressure

(b) Install Special Rubber Adapter Hose Tool 6539 into ends of disconnected fuel return line (Fig. 19).

(c) Using smooth-jaw pliers, carefully pinch off rubber hose portion of tool 6539 (Fig. 19). **Tool 6539 MUST be installed for this test. Do not attempt to directly pinch off rubber portion of fuel return line. Although outside of fuel return line is rubber, the inside is not. Damage to fuel return line will result in possible fuel leak.**

(d) If pressure goes back up to normal or above, the overflow valve must be replaced. Before condemning the valve, make sure it is located (has been installed) at the fuel return line (pump outlet) and **not** at the fuel supply line (pump inlet).

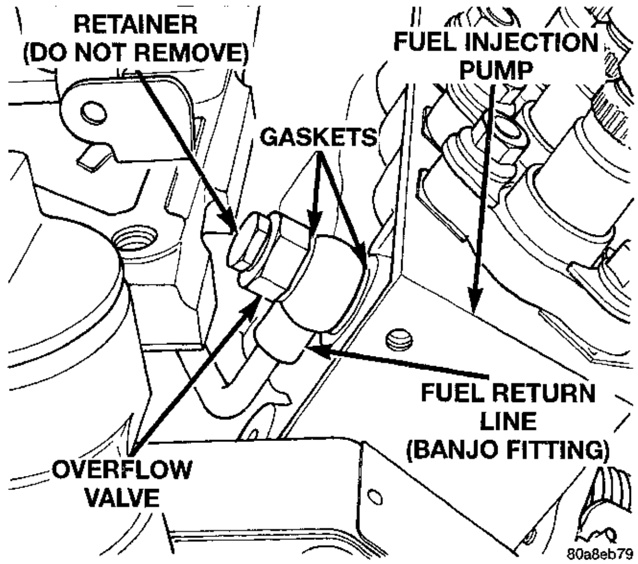

Fig. 17 Overflow Valve Location

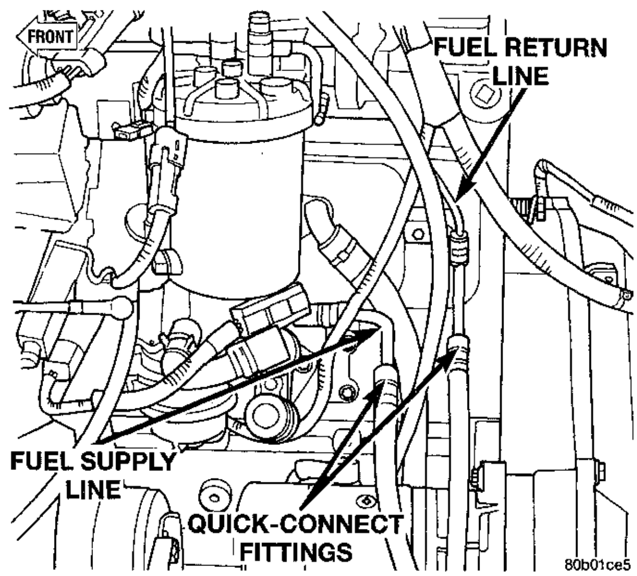

Fig. 18 Fuel Return and Supply Line Quick-Connect Locations

(e) If pressure remains low with return line pinched, the fuel filter or pre-filter may be restricted or the fuel transfer pump may be defective.

(f) If filters are in good condition and pressure is still low, replace the fuel transfer pump.

(8) After testing, install banjo fitting bolt into fuel supply line and tighten to 24 N·m (18 ft. lbs.) torque.

FUEL VOLUME TEST

Fuel volume-versus-engine cranking rpm are used for the test.

DIAGNOSIS AND TESTING (Continued)

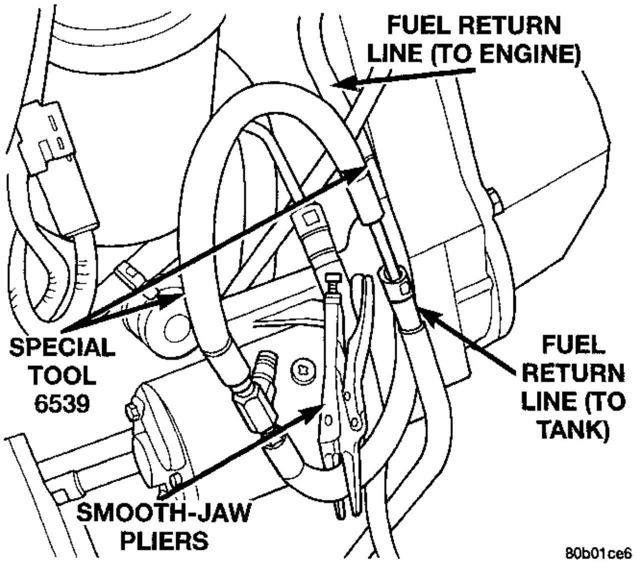

Fig. 19 Pinching Off Fuel Return Hose

WARNING: TO PREVENT THE ENGINE FROM STARTING, DISCONNECT THE PIGTAIL HARNESS AT THE FUEL SHUTDOWN SOLENOID (Fig. 20). USE CAUTION AS RESIDUAL FUEL MAY CAUSE THE ENGINE TO START AND RUN TEMPORARILY. ATTEMPT TO START THE ENGINE A FEW TIMES UNTIL IT QUITS BEFORE PERFORMING THE FUEL VOLUME TEST.

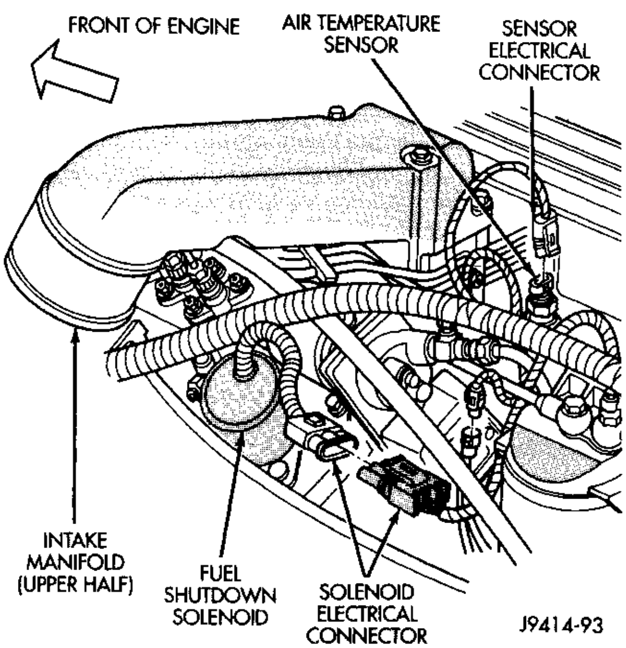

Fig. 20 Fuel Shutdown Solenoid Electrical Connector

(1) Connect a hand held tachometer to the engine. Use Cummins part number 3377462 or an equivalent.

(2) Remove the clamp bolt retaining fuel drain manifold line to cylinder head. This clamp/bolt is located to the left of number–5 cylinder valve cover.

(3) Two fuel lines are attached to top of fuel filter/water separator using banjo fittings and special bolts. Remove the **rear** banjo fitting bolt at the inlet line.

(4) Carefully position the fuel drain manifold line to the side/rear.

(5) Install and tighten Special Adapter Tool 6836 into the top of the fuel inlet line (Fig. 21).

(6) Connect a temporary rubber fuel hose to adapter 6836 (Fig. 21).

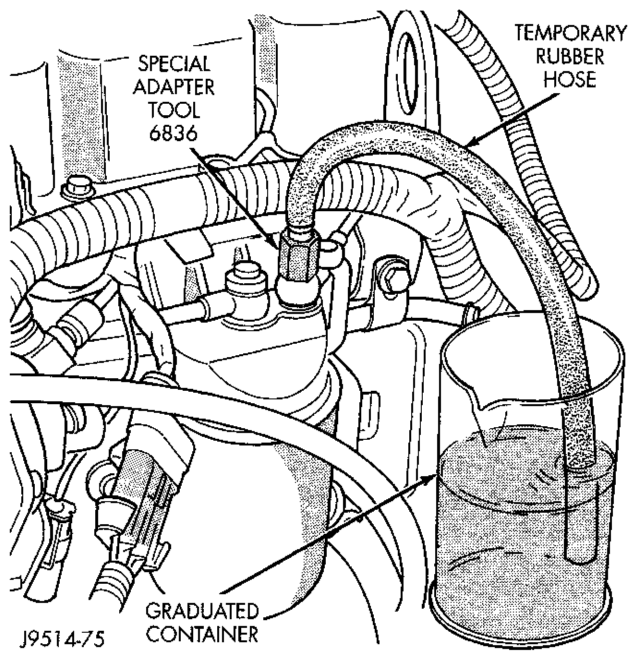

Fig. 21 Performing Fuel Volume Test—Typical

(7) Place the other end of this temporary hose into a graduated container (Fig. 21).

(8) Crank the engine for 30 seconds. Measure the fuel volume in the container after 30 seconds of engine cranking time. **Do not crank the engine for more than 30 seconds at a time. Starter motor damage may result.**

(9) To determine the correct fuel volume, refer to Fuel Volume Specifications (Fig. 22). To use the specifications chart, refer to the following procedure:

- Draw a straight vertical line at the measured rpm.
- Draw a straight horizontal line at the measured fuel volume.
- If these two lines intersect below the flow line (Fig. 22), this indicates a defective fuel transfer pump, a restricted fuel line, or a plugged fuel filter or pre-filter.
- If these two lines intersect above the flow line (Fig. 22), this indicates acceptable fuel flow.

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DIAGNOSIS AND TESTING (Continued)

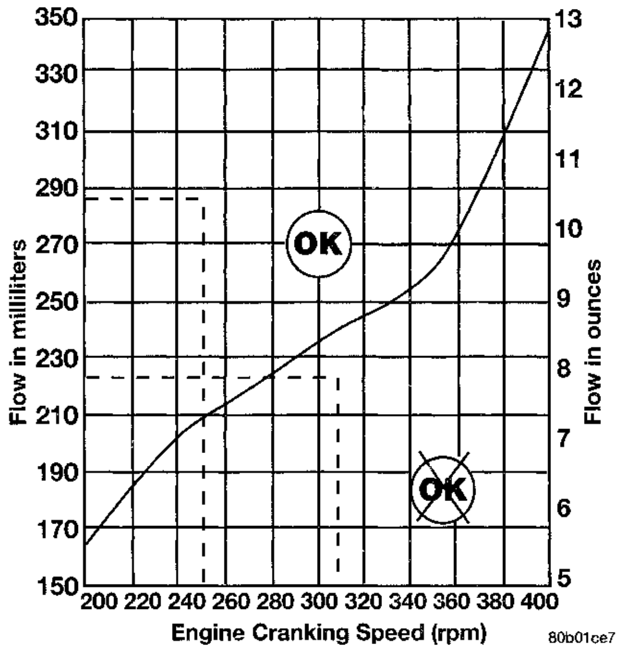

Fig. 22 Fuel Volume Specifications

OVERFLOW VALVE TEST

A sticking check valve within the overflow valve may cause low power. Refer to the Fuel Transfer Pump Pressure/Capacity Test. Overflow valve testing is covered in this test.

Whenever the fuel injection pump is being replaced or removed for calibration, the overflow valve must stay with the pump. Make sure a new overflow valve is used with a new or rebuilt injection pump and the old (original) overflow valve is returned to authorized repair facility with the old injection pump.

Make sure the overflow valve is correctly installed at the fuel return line (pump outlet) (Fig. 17 and not incorrectly installed at the fuel supply li (pump inlet).

FUEL HEATER TEST

The fuel heater is used to prevent diesel fuel from waxing during cold weather operation.

NOTE: The fuel heater element, fuel heater relay and fuel heater temperature sensor are not controlled by the powertrain control module (PCM).

A malfunctioning fuel heater can cause a wax build-up in the fuel filter/water separator. Wax build-up in the filter/separator can cause engine starting problems and prevent the engine from revving up. It can also cause blue or white fog-like exhaust. If the heater is not operating in cold temperatures, the engine may not operate due to fuel waxing.

The fuel heater is located on the left side of the engine above the starter motor (Fig. 23).

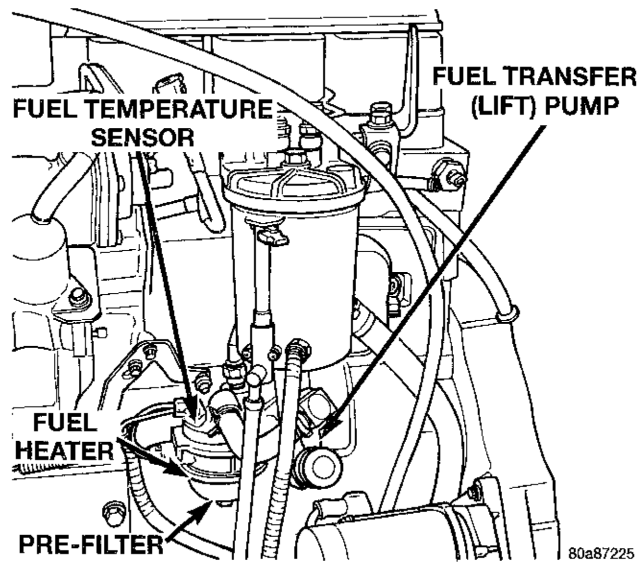

Fig. 23 Fuel Heater Location

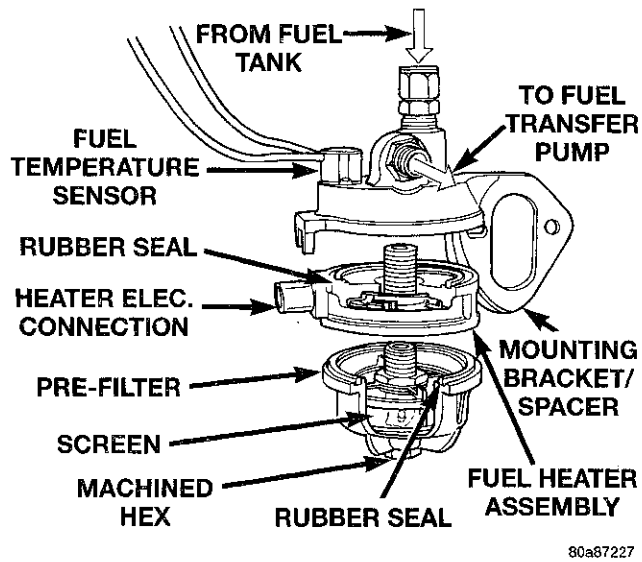

Fig. 24 Fuel Heater Assembly

The heater assembly is equipped with a built-in fuel temperature sensor (thermostat) (Fig. 24) or (Fig. 23) that senses fuel temperature. When the fuel temperature is below 40 degrees F, the sensor allows current to flow to the built-in heater element to warm the fuel. When the fuel temperature is above 80 degrees F, the sensor stops current flow to the heater element (circuit is open).

Voltage to operate the fuel heater element is supplied from the ignition switch, through the fuel heater relay (Fig. 25) (also refer to Fuel Heater Relay), to the fuel temperature sensor and on to the fuel heater element.

DIAGNOSIS AND TESTING (Continued)

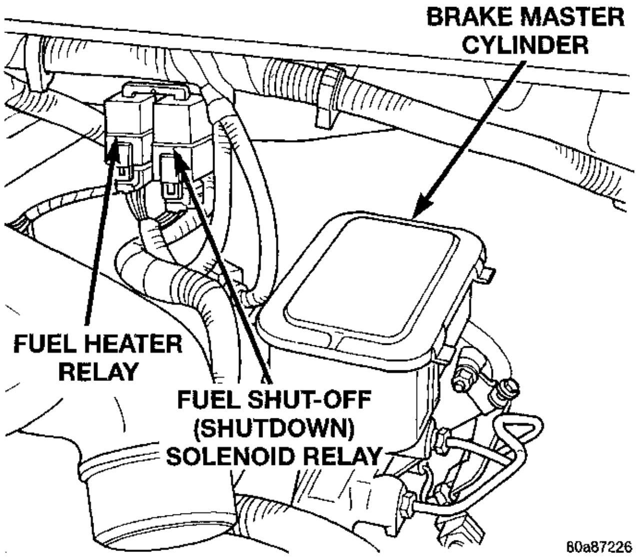

Fig. 25 Fuel Heater Relay Location—Diesel

The built-in heater element operates on 12 volts, 300 watts at 0 degrees F. As temperature increases, power requirements decrease.

The fuel heater assembly contains a pre-filter (Fig. 24) to prevent contaminants from entering the fuel transfer pump.

A minimum of 7 volts is required to operate the fuel heater. The resistance value of the heater element is less than 1 ohm (cold) and up to 1000 ohms warm.

TESTING

(1) Remove the electrical connector at the side of the fuel heater (Fig. 24).

(2) Using an ohmmeter, check the resistance across the two terminals on the side of the heater. Resistance should be approximately 1 ohm (cold) to 1000 ohms (warm).

(3) With the electrical connector still unplugged from the fuel heater, check the electrical operation of the fuel temperature sensor (Fig. 24). Proceed to next step:

(4) Using an ohmmeter, check the resistance across the two terminals in the pigtail wire harness coming from the fuel temperature sensor. The sensor circuit should be open if the fuel temperature is above 80 degrees. The sensor circuit should be closed if the fuel temperature is below 40 degrees.

(5) Check for 12 volts at the disconnected temperature sensor connector with the ignition key ON. Refer to Group 8W, Wiring for electrical schematics.

(6) With ignition ON, check for 12 volts at the fuel heater relay connector. Refer to Group 8W, Wiring for electrical schematics.

(7) Check operation of the fuel heater relay (Fig. 25). Refer to Relay Test—Fuel Heater/Fuel Shutdown Solenoid in this section of the group.

RELAY TEST—FUEL HEATER/FUEL SHUTDOWN SOLENOID

The fuel heater and fuel shutdown solenoid relays are located in the engine compartment near the brake master cylinder (Fig. 25).

To test the fuel heater, refer to Fuel Heater Test in this section of the group. To test the fuel shutdown solenoid, refer to Fuel Shutdown Solenoid Test.

To test either of the relays only, refer to following:

The relay terminal numbers from (Fig. 26) can be found on the bottom of the relay.

- Terminal number 30 is connected to battery voltage and can be switched or B+ (hot) at all times.
- The center terminal number 87A is connected (a circuit is formed) to terminal 30 in the de-energized (normally OFF) position.
- Terminal number 87 is connected (a circuit is formed) to terminal 30 in the energized (ON) position. Terminal number 87 then supplies battery voltage to the component being operated.
- Terminal number 86 is connected to a switched (+) power source.
- Terminal number 85 is grounded by the powertrain control module (PCM).

TESTING

(1) Remove relay before testing.

(2) Using an ohmmeter, perform a resistance test between terminals 85 and 86. Resistance value (ohms) should be 75 ±5 ohms for resistor equipped relays.

(3) Connect the ohmmeter between terminals number 87A and 30. Continuity should be present at this time.

(4) Connect the ohmmeter between terminals number 87 and 30. Continuity should not be present at this time.

(5) Use a set of jumper wires (16 gauge or smaller). Connect one jumper wire between terminal number 85 (on the relay) to the ground side (-) of a 12 Volt power source.

(6) Attach the other jumper wire to the positive side (+) of a 12V power source. Do not connect this jumper wire to relay at this time.

CAUTION: Do not allow the ohmmeter to contact terminals 85 or 86 during these tests. Damage to ohmmeter may result.

(7) Attach the other jumper wire (12V +) to terminal number 86. This will activate the relay. Continuity should now be present between terminals number

DIAGNOSIS AND TESTING (Continued)

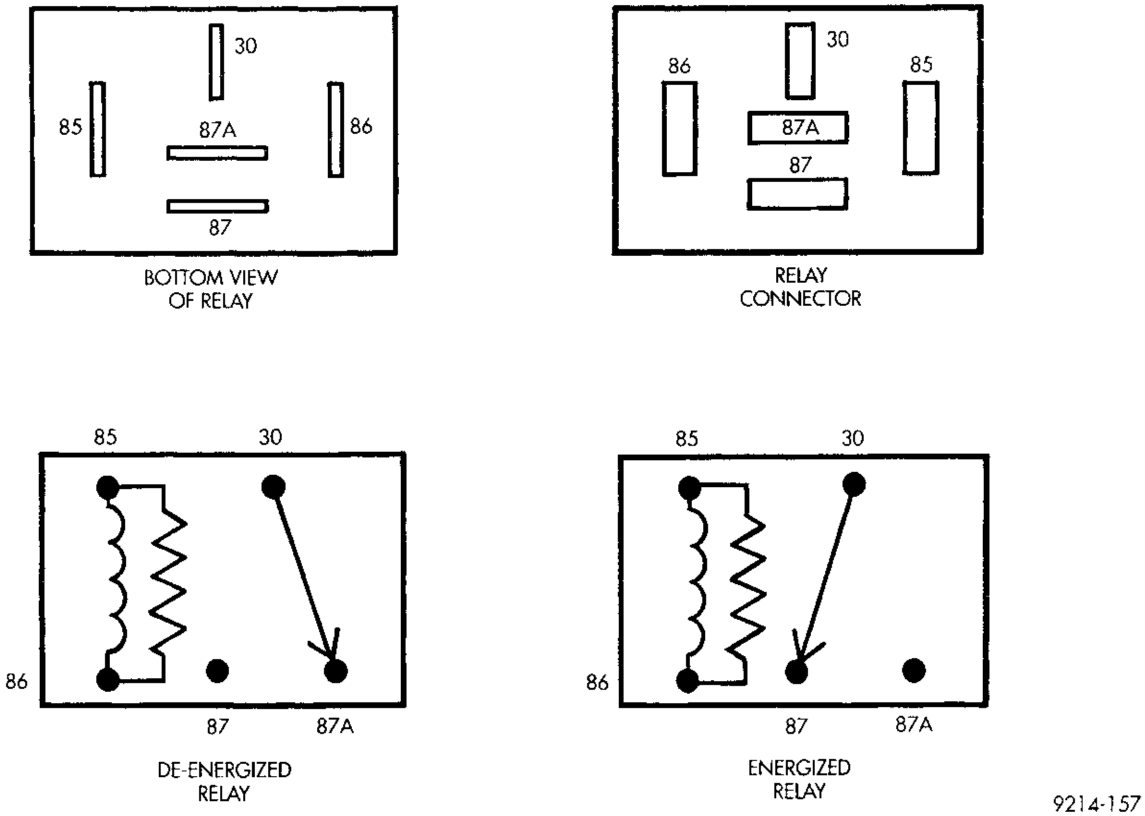

Fig. 26 Relay Terminals

87 and 30. Continuity should not be present between terminals number 87A and 30.

(8) Disconnect jumper wires from relay and 12 Volt power source.

(9) If continuity or resistance tests did not pass, replace relay. If tests passed, refer to Group 8W, Wiring Diagrams for (fuel system) relay wiring schematics and for additional circuit information.

FUEL INJECTOR TEST

A leaking fuel injector can cause fuel knock, poor performance, black smoke, poor fuel economy and rough engine idle. If the fuel injector needle valve does not operate properly, the engine may misfire and produce low power.

A leak in the injection pump-to-injector high-pressure fuel line can cause many of the same symptoms as a malfunctioning injector. Inspect for a leak in the high-pressure lines before checking for a malfunctioning fuel injector.

WARNING: THE INJECTION PUMP SUPPLIES HIGH-PRESSURE FUEL OF UP TO APPROXIMATELY 120,000 KPA (17,400 PSI) TO EACH INDIVIDUAL INJECTOR THROUGH THE HIGH-PRESSURE LINES. FUEL UNDER THIS AMOUNT OF PRESSURE CAN PENETRATE THE SKIN AND CAUSE PERSONAL INJURY. WEAR SAFETY GOGGLES AND ADEQUATE PROTECTIVE CLOTHING. AVOID CONTACT WITH FUEL SPRAY WHEN BLEEDING HIGH-PRESSURE FUEL LINES.

WARNING: DO NOT BLEED AIR FROM THE FUEL SYSTEM OF A HOT ENGINE. DO NOT ALLOW FUEL TO SPRAY ONTO THE EXHAUST MANIFOLD WHEN BLEEDING AIR FROM THE FUEL SYSTEM.

To determine which fuel injector is malfunctioning, run the engine and loosen the high-pressure fuel line nut at the injector (Fig. 27). Listen for a change in engine speed. After testing, tighten the line nut to 30 N·m (22 ft. lbs.) torque. If engine speed drops, the injector was operating normally. If engine speed remains the same, the injector may be malfunctioning. Test all injectors in the same manner one at a time.

Once an injector has been found to be malfunctioning, remove it from the engine and test it. Refer to Fuel Injectors in the Removal/Installation section of this group for procedures.

After the injector has been removed, install it to a bench-mount injector tester (Cummins part number 3376946 or equivalent) (Fig. 28). Position a container

DIAGNOSIS AND TESTING (Continued)

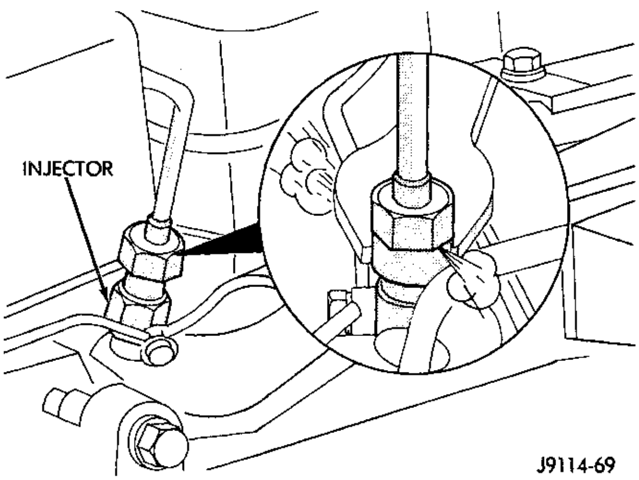

Fig. 27 Inspecting Injector Operation

below the injector before testing. Refer to operating instructions supplied with tester for procedures.

The opening pressure or "pop" pressure should be 23,400–26,800 kPa (234–268 bars) (3394–3887 psi). If the fuel injector needle valve is opening (popping) too early or too late, replace the injector.

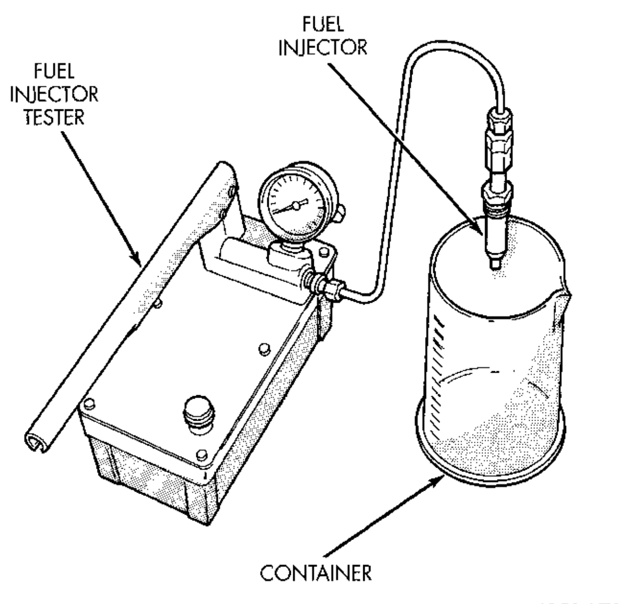

Fig. 28 Typical Fuel Injector Tester

FUEL INJECTION PUMP TEST

The Bosch P7100 inline fuel injection pump is very sensitive to fuel supply pressure variations. If supply pressure is low or pulsating excessively, it may cause problems that appear to be a defective injection pump. Before condemning the injection pump, be sure to check fuel transfer pump pressure. Refer to the Fuel Transfer Pump Pressure/Capacity Test. This test will include testing of the overflow valve. Also be sure fuel filter and pre-filter are in good condition. Visually check the fuel supply line and fuel return line for kinks, bends or any other damage that would restrict fuel flow.

Incorrect injection pump timing can cause poor performance, excessive smoke and emissions and poor fuel economy. Fuel injection pump timing can be checked and adjusted. Refer to Fuel Injection Pump Timing in this group for procedures.

Engine power is also effected by the governor setting and performance. **Do not attempt to adjust the governor. If the governor seals on the external adjustment screw are broken, the fuel rate may be out of adjustment. The warranty of the injection pump and the engine may be void if the seals have been tampered with or removed.**

If all of the preceding tests checked OK, the fuel injection pump must be removed and sent to an authorized diesel injection pump repair facility for testing and calibration. **Whenever the fuel injection pump is being replaced or removed for calibration, the overflow valve must stay with the pump. Make sure a new overflow valve is used with a new injection pump and the old (original) overflow valve is returned to the authorized repair facility with the old injection pump.**

Do not attempt to perform any disassembly of the injection pump. If disassembled, the warranty may be voided. The only serviceable components of the fuel injection pump are the fuel shutdown solenoid, overflow valve, breakover throttle lever, mounting o-ring, banjo washers and oil supply fittings.

FUEL SHUTDOWN SOLENOID TEST

NOTE: The fuel shutdown (shut-off) solenoid (Fig. 29) and fuel shutdown solenoid relay (Fig. 31) are not controlled by the powertrain control module (PCM).

(1) With the ignition switch off, the solenoid shaft should be down and the injection pump lever should be in the shutdown position (no fuel supply to injection pump) (Fig. 30).

(2) Turn the ignition switch to the CRANK (starter engage) position and observe the solenoid shaft and injection pump lever. The shaft should pull up (shaft retracted into the solenoid) and the pump lever should be in the run position (fuel being supplied to injection pump) (Fig. 30).

(3) Release the ignition key from the CRANK to the ON position. The shaft should remain in the up position and the pump lever should remain in the run position (fuel being supplied to injection pump) (Fig. 30). If the solenoid shaft is not moving, refer to the following:

DIAGNOSIS AND TESTING (Continued)

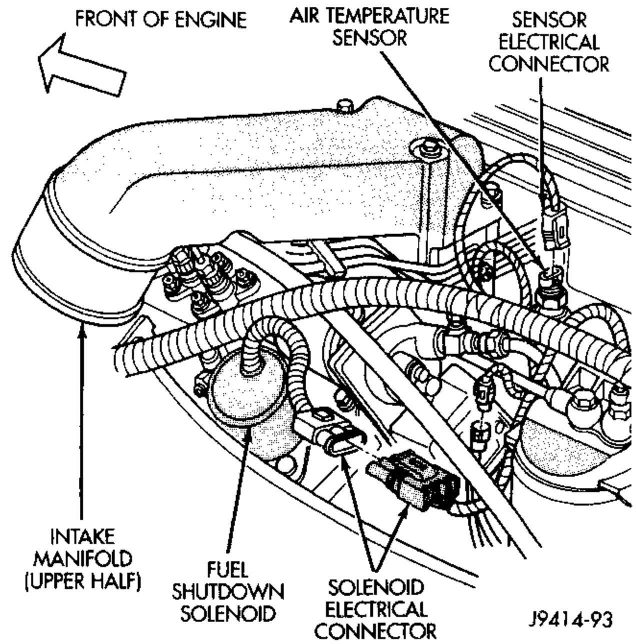

Fig. 29 Fuel Shutdown Solenoid Location

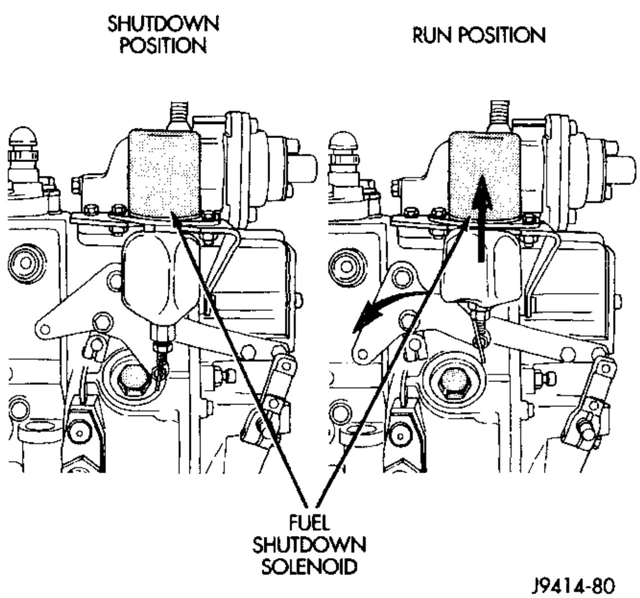

Fig. 30 Fuel Shutdown Solenoid Positions

(4) Disconnect the solenoid three-wire pigtail wire harness from the main engine harness.

(5) If the solenoid shaft did not move up when the ignition switch was in the CRANK position, check for 12 volts at the three-way connector. This will be the circuit coming from the fuel shutdown solenoid relay. Refer to Group 8W, for wire connector pin location and circuit identification. If 12 volts is not present at this circuit when the key is in the CRANK position, check the fuel shutdown solenoid relay. Refer to

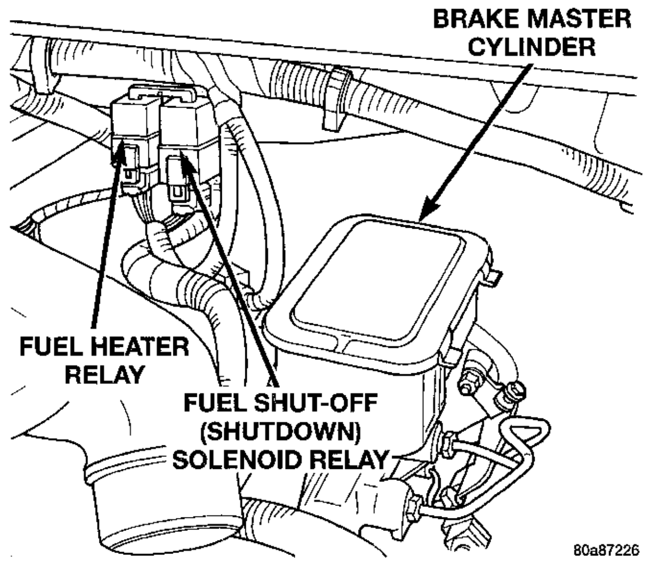

Fig. 31 Fuel Shutdown Solenoid Relay Location

Relay Test—Fuel Heater/Fuel Shutdown Solenoid in this section of the group. Also check the wiring between the relay and the solenoid.

(6) If the solenoid shaft moves up when the ignition switch is in the CRANK position, but moves down when the key is released from the CRANK to the ON position, check the circuit coming from the ignition switch for 12 volts. Refer to Group 8W, for wire connector pin location and circuit identification.

(7) If the shutdown solenoid is being replaced, its shaft length must be adjusted. Refer to Fuel Shutdown Solenoid Removal/Installation for procedures.

HIGH-PRESSURE FUEL LINE LEAK TEST

High-pressure fuel line leaks can cause starting problems and poor engine performance.

WARNING: DUE TO EXTREME FUEL PRESSURES OF UP TO 120,000 kPa (17,400 PSI), USE EXTREME CAUTION WHEN INSPECTING FOR HIGH-PRESSURE FUEL LEAKS. DO NOT GET YOUR HAND NEAR A SUSPECTED LEAK. INSPECT FOR HIGH-PRESSURE FUEL LEAKS WITH A SHEET OF CARDBOARD. HIGH FUEL INJECTION PRESSURE CAN CAUSE PERSONAL INJURY IF CONTACT IS MADE WITH THE SKIN.

Start the engine. Move the cardboard over the high-pressure fuel lines and check for fuel spray onto the cardboard (Fig. 32). If a high-pressure line connection is leaking, bleed the system and tighten the connection. Refer to the Air Bleed Procedure in this group for procedures. Replace damaged, restricted or leaking high-pressure fuel lines with the correct replacement line.

DIAGNOSIS AND TESTING (Continued)

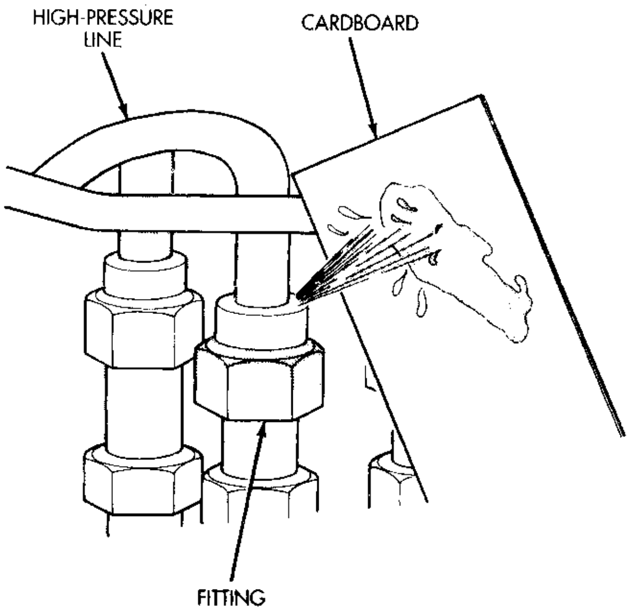

Fig. 32 Typical Test for Leaks with Cardboard

CAUTION: The high-pressure fuel lines must be clamped securely in place in the holders. The lines cannot contact each other or other components. Do not attempt to weld high-pressure fuel lines or to repair lines that are damaged. Only use the recommended lines when replacement of high-pressure fuel line is necessary.

IDLE SPEED ADJUSTMENT

The high idle stop screw is factory sealed and cannot be adjusted. Low-speed idle can be adjusted.

(1) Use an optical tachometer such as Snap-on No. MT139 or MTE (Cummins tool division) No. 3377462 to read the engine rpm.

(2) Bring the engine to normal operating temperature.

(3) Adjust the low idle speed at the low idle speed screw. The screw and locknut are located at the rear of the fuel injection pump (Fig. 33).

(4) Loosen the idle screw lock nut (Fig. 33). Adjust idle screw to obtain specified rpm. Refer to IDLE SPEEDS—DIESEL ENGINE chart.

(5) Tighten the locknut after adjustment.

SERVICE PROCEDURES

AIR BLEED PROCEDURE

A certain amount of air becomes trapped in the fuel system when fuel system components are serviced or replaced. Bleed the system after fuel system service according to the following procedures.

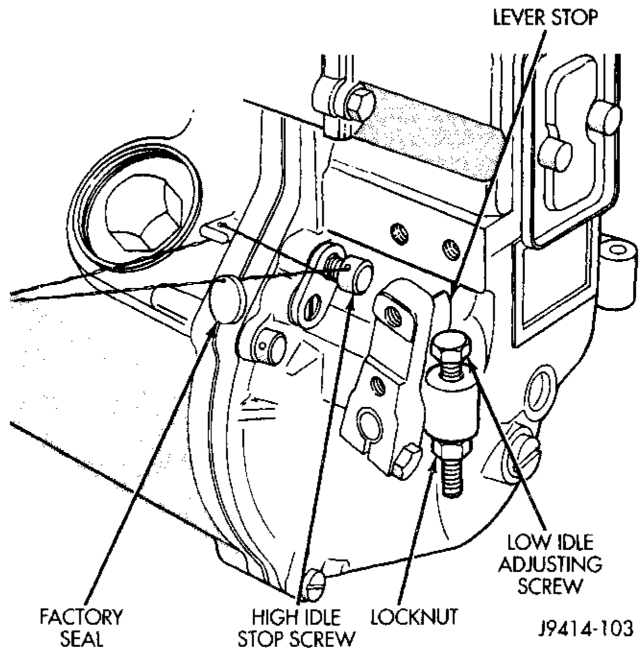

Fig. 33 Low Idle Speed Screw

IDLE SPEEDS—DIESEL ENGINE

LOW IDLE SPEED	HIGH IDLE SPEED
With automatic transmission: * 750-800 RPM with transmission in drive and air conditioning on.	Do not attempt to adjust high idle speed. High idle speed adjustment screw is factory sealed. Breaking seal will void injection pump warranty
With manual transmission: * 780 RPM with transmission in nuetral and air conditioning on.	
* With engine at operating temperature. Refer to text for idle adjustment procedures.	

WARNING: DO NOT BLEED AIR FROM THE FUEL SYSTEM OF A HOT ENGINE. DO NOT ALLOW FUEL TO SPRAY ONTO THE EXHAUST MANIFOLD WHEN BLEEDING AIR FROM THE FUEL SYSTEM.

MANUAL BLEEDING

Some air enters the fuel system when the filters or injection pump supply line are changed. This small amount of air is vented automatically from the injection pump through the fuel drain manifold. This is if the filter was changed according to instructions.

The system may have to be bled manually if:

- The vehicle fuel tank has been allowed to run empty
- The fuel filter is not filled before installation
- The fuel injection pump is replaced

SERVICE PROCEDURES (Continued)

- High-pressure fuel line connections are loosened or lines replaced
- Initial engine start-up or start-up after an extended period of no engine operation.

(1) Loosen the low-pressure bleed bolt (Fig. 34).

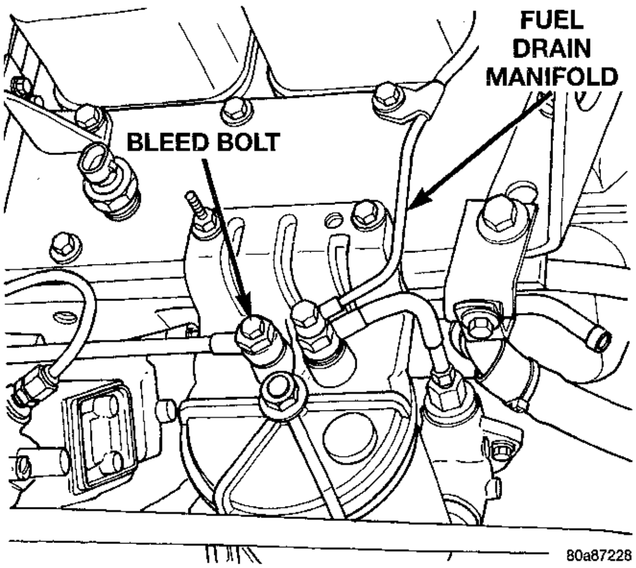

Fig. 34 Low-Pressure Bleed Bolt

(2) Operate the rubber push-button primer on the fuel transfer pump (Fig. 35). Do this until the fuel exiting the low-pressure bleed bolt is free of air.

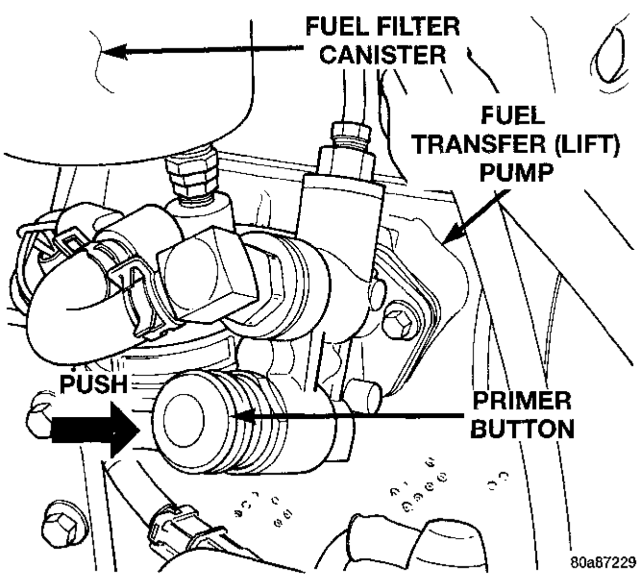

Fig. 35 Fuel Transfer Pump—Manual Operation

(3) Tighten low-pressure bleed screw to 8 N·m (6 ft. lbs.) torque.

FUEL INJECTION PUMP BLEEDING

WARNING: THE ENGINE MAY START WHEN CRANKING TO BLEED AIR FROM THE INJECTION PUMP. PLACE THE TRANSMISSION IN NEUTRAL OR PARK AND SET PARKING BRAKE BEFORE ENGAGING THE STARTER MOTOR.

CAUTION: Do not engage the starter motor for more than 30 seconds at a time. Allow two minutes between cranking intervals.

(1) Perform the previous procedure: Manual Bleeding.

(2) Crank the engine for 30 seconds at a time to allow air trapped in the injection pump to vent out the drain manifold. Observe the previous WARNING and CAUTION.

HIGH-PRESSURE FUEL LINE BLEEDING

WARNING: THE FUEL INJECTION PUMP SUPPLIES HIGH-PRESSURE FUEL OF AS HIGH AS 120,000 KPA (17,405 PSI) TO EACH INDIVIDUAL INJECTOR THROUGH THE HIGH-PRESSURE LINES. FUEL UNDER THIS AMOUNT OF PRESSURE CAN PENETRATE THE SKIN AND CAUSE PERSONAL INJURY. WEAR SAFETY GOGGLES AND ADEQUATE PROTECTIVE CLOTHING AND AVOID CONTACT WITH FUEL SPRAY WHEN BLEEDING HIGH- PRESSURE FUEL LINES.

WARNING: DO NOT BLEED AIR FROM THE FUEL SYSTEM OF A HOT ENGINE. DO NOT ALLOW FUEL TO SPRAY ONTO THE EXHAUST MANIFOLD WHEN BLEEDING AIR FROM THE FUEL SYSTEM.

Bleed air from one injector at time.

(1) Loosen the high-pressure fuel line fitting at the injector (Fig. 36).

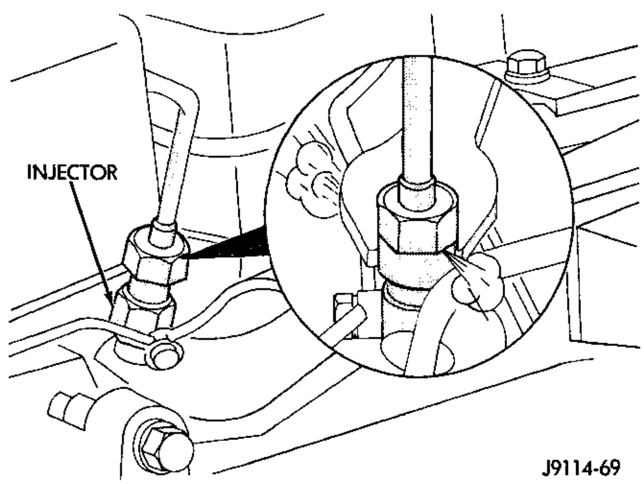

Fig. 36 Bleeding High-Pressure Fuel Lines

(2) Crank the engine until all air is bled from the line. **Do not operate the starter motor for longer**

SERVICE PROCEDURES (Continued)

than 30 seconds. Wait two minutes between cranking intervals.

(3) Start the engine and bleed one injector at a time until the engine runs smoothly.

(4) Tighten fuel line(s) at injector(s) to 30 N·m (22 ft. lbs.) torque.

FUEL INJECTION PUMP TIMING

(1) Thoroughly clean the engine and fuel system before attempting to remove any components. Pay special attention to the top of the fuel injection pump. Use compressed air to remove any water remaining on the fuel pump after the cleaning process.

CAUTION: DO NOT ALLOW ANY DIRT, DEBRIS, OR PAINT CHIPS TO ENTER THE FUEL SYSTEM WHILE IT IS OPEN. IF FOREIGN MATERIAL OF ANY TYPE IS ALLOWED INTO THE PUMP, LINES OR INJECTORS DURING THIS PROCESS IT COULD RESULT IN AN INJECTION PUMP OR FUEL INJECTOR MALFUNCTION.

NOTE: Locate top dead center (TDC) on cylinder #1.

(2) Remove the rubber access plug located in the rear flange of the engine on the exhaust manifold side. (Fig. 37).

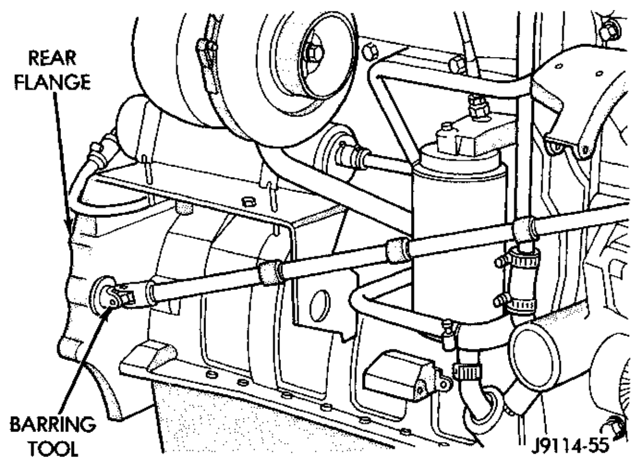

Fig. 37 Rotating Engine With Barring Tool

NOTE: Removing the #1 cylinder valve cover and first barring (rotating) the engine clockwise until both intake and exhaust valves are closed will speed up locating engine TDC as described later in step 4.

(3) Insert the barring tool number 7471B through the access hole and into the flywheel housing (Fig. 37).

(4) While holding tension on the timing pin (toward front of engine), slowly rotate the engine counterclockwise with the barring tool. Hold a slight rearward (pushing) pressure on the barring tool and continue to rotate the tool counterclockwise until the timing pin drops into the machined hole in the back of the camshaft gear. **When the barring tool is rotated counterclockwise, the vibration damper should be rotating clockwise as viewed from front.** When the pin aligns to the gear (Fig. 38), and the intake and exhaust valves are closed at the #1 cylinder, the engine is at the TDC position (compression stroke) at cylinder number 1. Place a paint mark on the dampener to indicate TDC. This mark is to be used as a reference point only and is not to be used for actual pump timing procedure. **Remove the pin. This will prevent damage when barring (rotating) the engine in later steps.**

NOTE: The pin is located above the power steering pump, below and to the inside of the fuel injection pump, on the rear of the cam gear housing (Fig. 39).

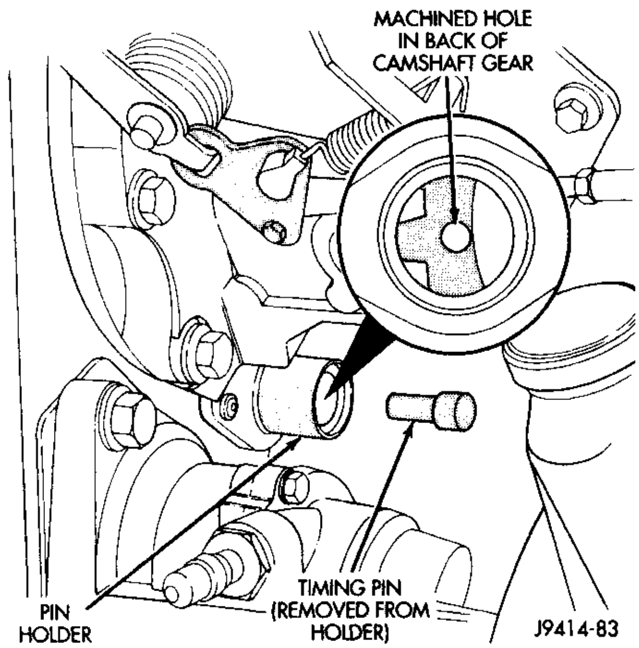

Fig. 38 Back of Camshaft Gear—Typical

(5) Remove #1 fuel injection line from the fuel pump (Fig. 40).

CAUTION: DO NOT BEND THE FUEL LINE. BENDING THE LINE WILL CAUSE LINE OR INJECTOR FAILURE.

(6) With the engine at TDC, loosen but do not remove, the front (#1) delivery valve holder using special socket #6840 (Fig. 41). Remove the socket

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SERVICE PROCEDURES (Continued)

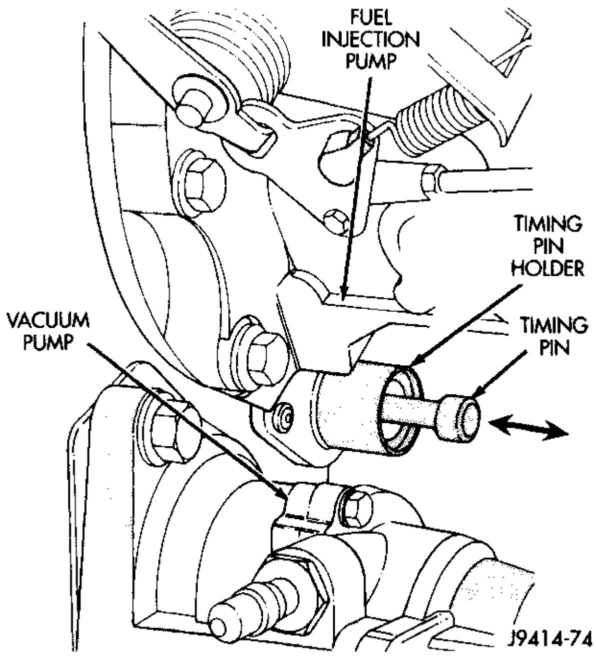

Fig. 39 Timing Pin and Location

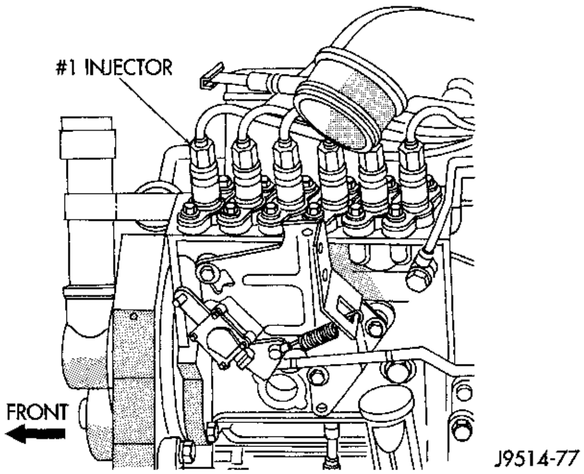

Fig. 40 Number 1 Injection Line

from the valve holder prior to removing the holder from the injection pump.

There is an external o-ring on the holder to help prevent debris from getting into the pump. This may create a slight resistance as the holder is unscrewed.

(7) Remove the delivery valve holder by carefully tipping the holder outboard with one hand while using the other hand to hold the spring, fill piece, and any shims from slipping out of the holder. Place these parts (Fig. 42) as an assembly on a clean surface.

(8) Using a magnet, remove the two piece delivery valve assembly from the pump (Fig. 43). Place these parts on a clean surface.

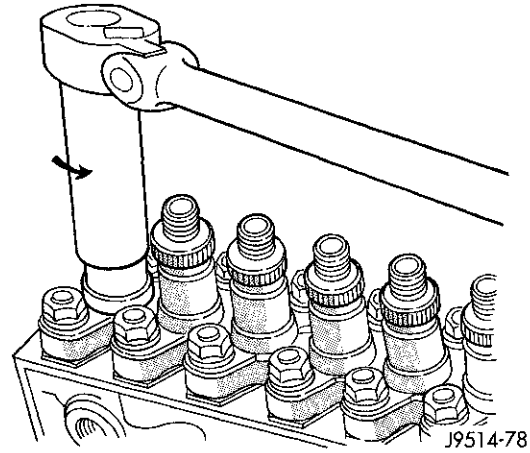

Fig. 41 Delivery Valve Holder Removal

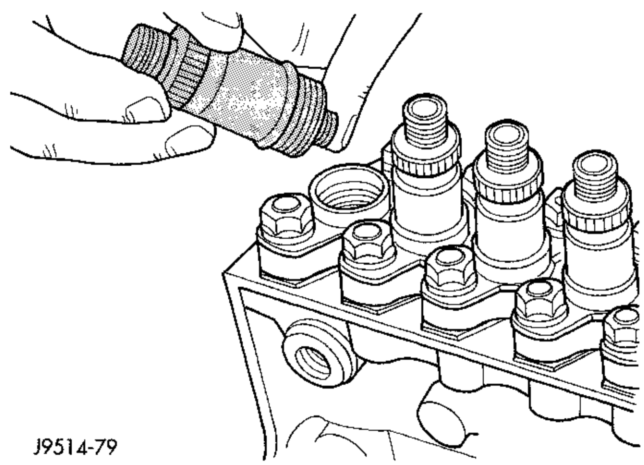

Fig. 42 Delivery Valve Holder

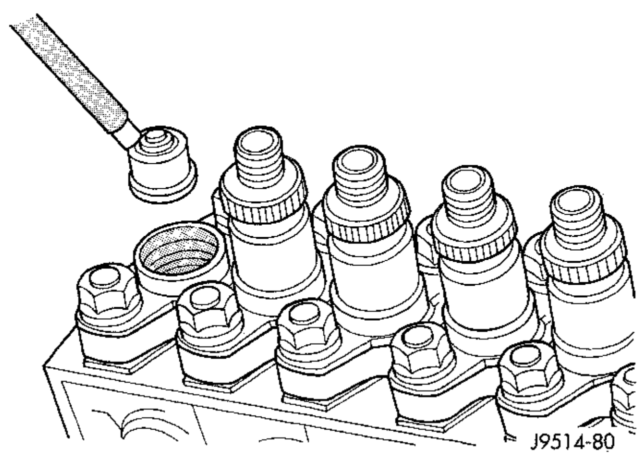

Fig. 43 Delivery Valve Assembly

(9) Install the dial indicator adaptor tool #6842 (Fig. 44) in place of the #1 delivery valve holder and tighten finger tight.

(10) Loosen the set screw on the dial indicator adaptor (Fig. 44). Install the dial indicator #6859 and dial indicator tip #6843 into the adapter. Position the

SERVICE PROCEDURES (Continued)

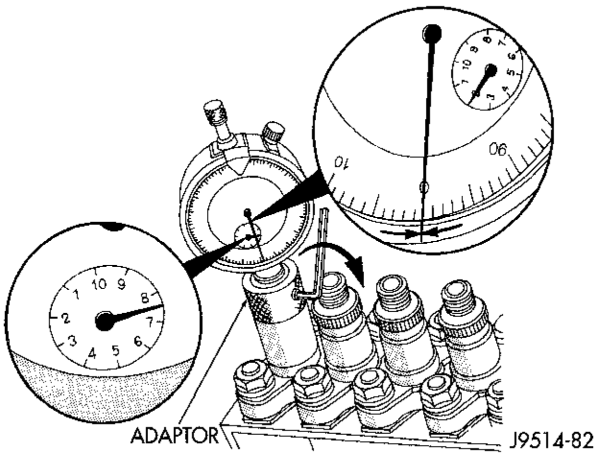

Fig. 44 Installing Special Adapter Tool

dial indicator to read between 7.0 and 9.0 mm and tighten the set screw (Fig. 44). The dial indicator is capable of measuring from 0-20.00 mm lift. The small inner dial is marked in increments of 1 mm. The large outer dial is marked in increments of 0.01 mm. One revolution of the outer dial is equal to 1 mm. The inner dial only indicates 0-10 mm, but will rotate twice as the indicator goes through the full range.

(11) **Be sure the timing pin is disengaged before rotating the engine to avoid damage to the timing pin.**

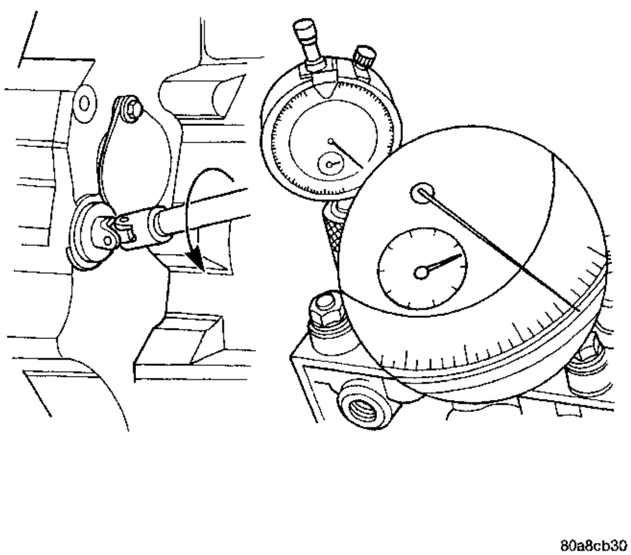

Fig. 45 Setting Dial Indicator

(12) Using the engine barring tool #7471B, rotate the engine in the direction opposite normal direction of engine rotation (counterclockwise from front of engine) 1/4 turn or until you see the dial indicator reading stop dropping. This is the inner base circle of the injection pump cam. Zero the indicator and note the reading on the small inner dial (Fig. 45).

(a) Slowly rotate engine clockwise to TDC. When at TDC, the timing pin should easily push into machined hole in back of camshaft gear. Pull pin from gear after verifying TDC position.

(b) Note the pump lift setting on the dial indicator (Fig. 45).

(c) Note the injection pump CPL number and "Timing-TDC" specification (in degrees) stamped into the engine data plate. The engine data plate is located on the left side of the timing gear cover (Fig. 46).

(d) Refer to the Fuel Injection Pump Plunger Lift charts. The charts contain a nominal timing specification and a pump plunger lift tolerance specification.

(e) If reading on dial indicator, and specification for pump plunger lift match, a fuel timing adjustment **will not** be necessary. Proceed to Step 26.

(f) If reading and specifications **do not match,** a fuel timing adjustment will be necessary. Proceed to next step.

FUEL INJECTION PUMP PLUNGER LIFT—49 STATE AUTO. TRANS. AND ALL CALIFOR. EGR EQUIPPED ENGINES

CPL 2174 AND 2308 (CALIFORNIA)	
STATIC TIMING (DEGREES BTDC)	PLUNGER LIFT AT TDC
14.0 (NOMINAL)	4.29 mm-4.61 mm

FUEL INJECTION PUMP PLUNGER LIFT—49 STATE MANUAL TRANSMISSION

CPL 2175	
STATIC TIMING (DEGREES BTDC)	PLUNGER LIFT AT TDC
13.5 (NOMINAL)	4.89 mm-5.25 mm

Adjusting Timing:

(13) Remove the oil filler tube (Fig. 47) and adapter elbow from the front of the timing gear housing.

(14) Loosen the injection pump shaft nut (use the barring tool to keep the engine from rotating). Before removing pump nut or washer, place a magnet to the end of the injection pump shaft (Fig. 48). This will prevent the nut or washer from falling into the timing gear cover which will require engine disassembly for recovery.

(15) Position a magnet to the end of the injection pump shaft. Install the special bearing and thrust washer kit #6862 (Fig. 49) over the injection pump shaft in this order: 1 thrust washer-1 bearing-1 thrust washer. The thrust washer/bearing kit is used

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SERVICE PROCEDURES (Continued)

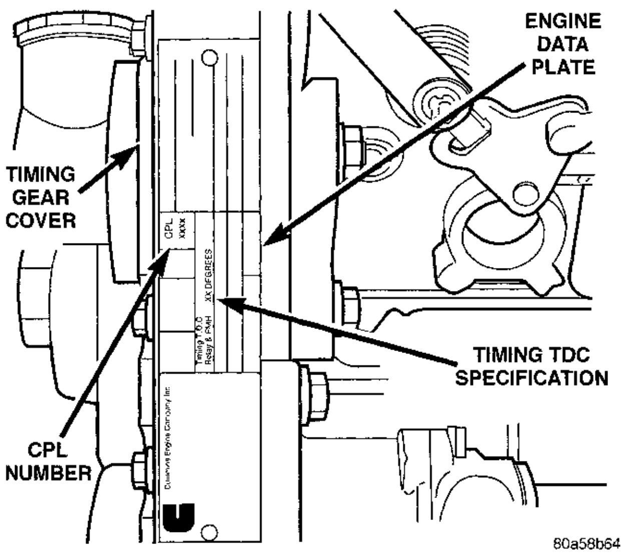

Fig. 46 Engine Data Plate and CPL Number

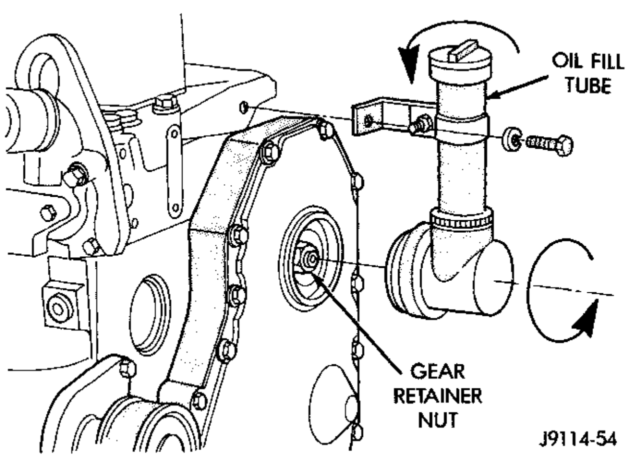

Fig. 47 Oil Filler Tube

to prevent the pump gear from rotating on the pump shaft when tightening the pump nut (step 22). Reinstall pump shaft nut allowing some clearance between the thrust washers. Do not tighten nut at this time.

(16) Slowly rotate the engine clockwise until reaching the required lift setting on the dial indicator. Refer to Fuel Injection Pump Plunger Lift charts. The injection pump should rotate with the engine since the injection pump gear is still locked to the injection pump shaft.

(17) With the injection pump at the correct plunger lift setting, use special gear puller tool #L-4407A to pull the injection pump gear off the taper of the injection pump input shaft. Leave the gear puller installed (Fig. 50). After the gear has been pulled, ensure the lift setting has not changed.

(18) Rotate the engine 20 to 30 degrees counterclockwise, then rotate the engine back clockwise to

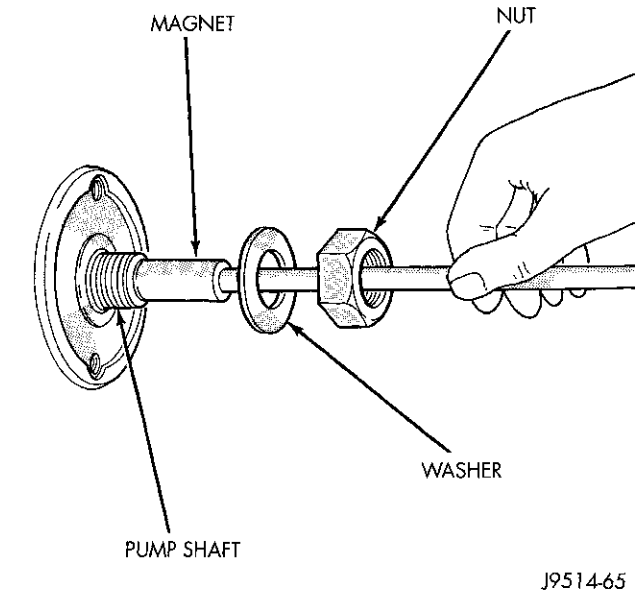

Fig. 48 Positioning Magnet to Pump Shaft

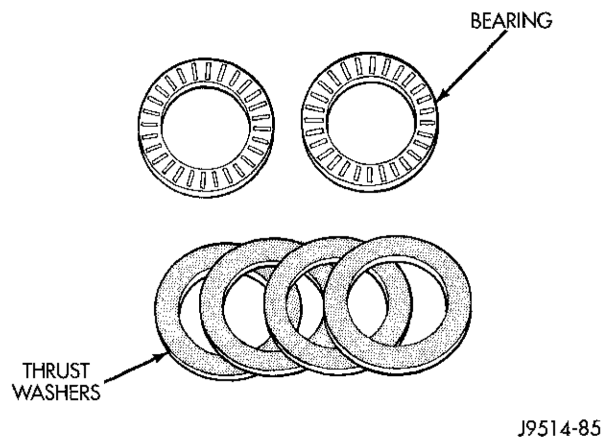

Fig. 49 Bearing/Thrust Washer Tools

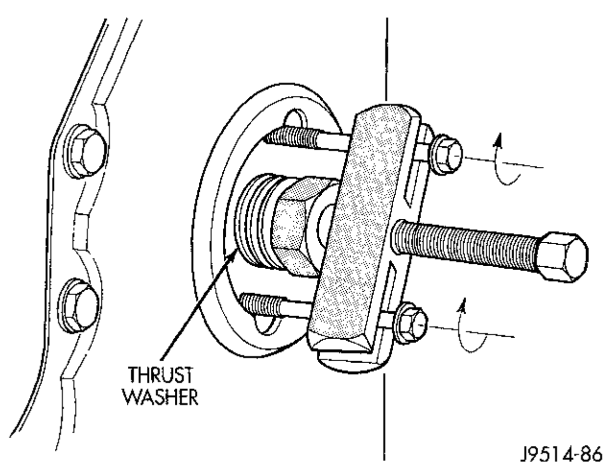

Fig. 50 Gear Puller Tool Installed

SERVICE PROCEDURES (Continued)

TDC (Fig. 51). This removes backlash from the geartrain.

The fuel pump gear and pump shaft tapers must be absolutely clean, dry and free of any oil or dirt. Oil or dirt will prevent seating of the taper and will result in possible slippage of the gear.

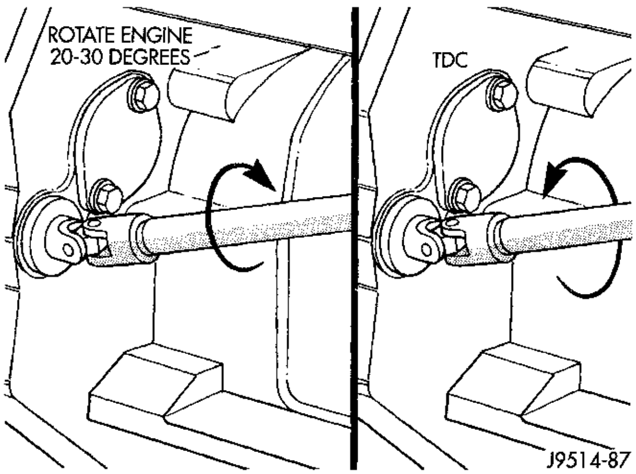

Fig. 51 Rotating Crankshaft

(19) Loosen, but do not remove the gear puller tool bolts. Using the gear puller, rotate pump gear counterclockwise by hand (Fig. 52), while pushing the gear onto the pump shaft. This will remove backlash between the injection pump and camshaft gears.

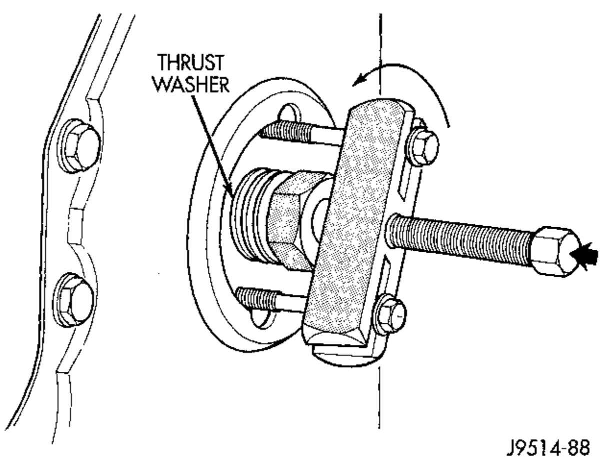

Fig. 52 Rotating Injection Pump Gear

(20) Hand tighten the pump shaft nut (Fig. 53). Remove the gear puller (Fig. 53).

(21) Tighten the pump shaft nut to 15 N·m (11 lb. ft.) torque to seat the gear to the pump shaft taper (Fig. 54).

(22) Remove injection pump shaft nut. Use a magnet on the end of the shaft while removing (Fig. 48).

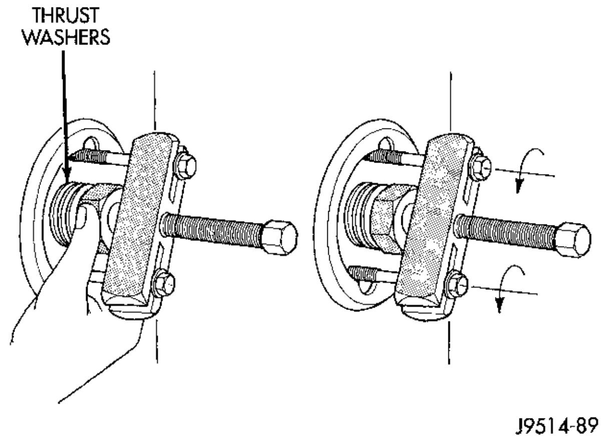

Fig. 53 Removing Gear Puller Tool

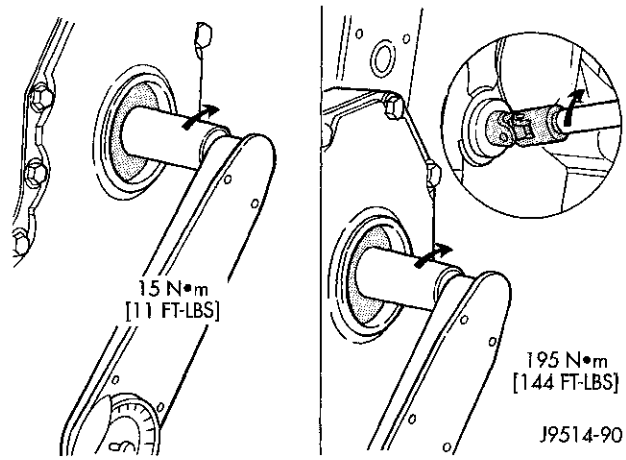

Fig. 54 Tightening Pump Nut

(23) Remove special bearing and thrust washers #6862 from pump shaft. Use a magnet on the end of the shaft while removing.

(24) While preventing the engine from rotating with the barring tool, tighten the shaft nut to 195 N·m (144 lb. ft.) torque (Fig. 54).

(25) Repeat steps 12 and 13 to verify that the final timing setting is correct. If the setting is not correct, repeat steps 15 through 25.

(26) Remove the dial indicator and adaptor from the injection pump.

CAUTION: THE FOLLOWING INSTALLATION AND TORQUING PROCEDURE MUST BE FOLLOWED EXACTLY. IMPROPER INSTALLATION OF THE DELIVERY VALVE WILL RESULT IN DAMAGE OR LEAKS.

(27) Install the delivery valve assembly on top of the sealing washer (Fig. 55) or (Fig. 43).

(28) Lubricate the threads and clamping surface of the delivery valve holder with a few drops of SAE 90

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SERVICE PROCEDURES (Continued)

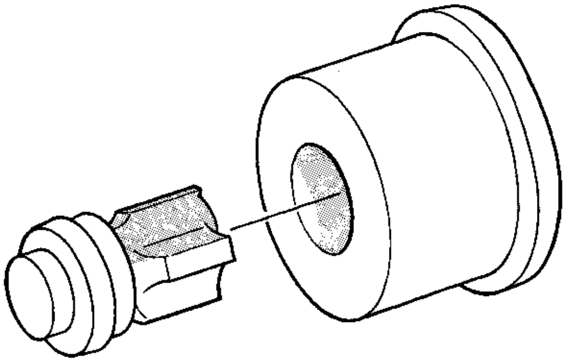

Fig. 55 Delivery Valve Assembly

hypoid gear oil. **Do not lubricate the metal delivery valve washer or its seating area.**

(29) Install the delivery valve holder assembly taking care not to displace the delivery valve spring, fill piece, or any shims (Fig. 56).

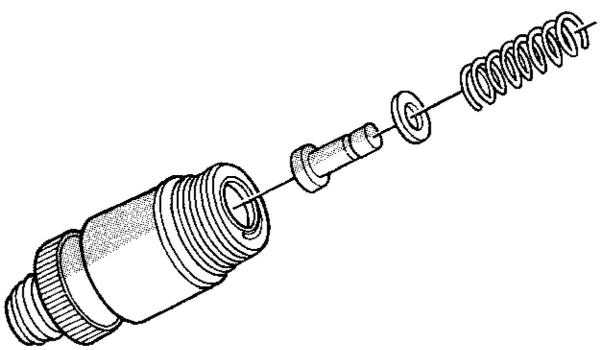

Fig. 56 Delivery Valve Holder

(30) Pre-tighten the delivery valve holder to 40 N·m (29 lb. ft.) torque (Fig. 57). Next, in one motion, tighten the holder to 115 N·m (85 ft. lbs.) torque (Fig. 57).

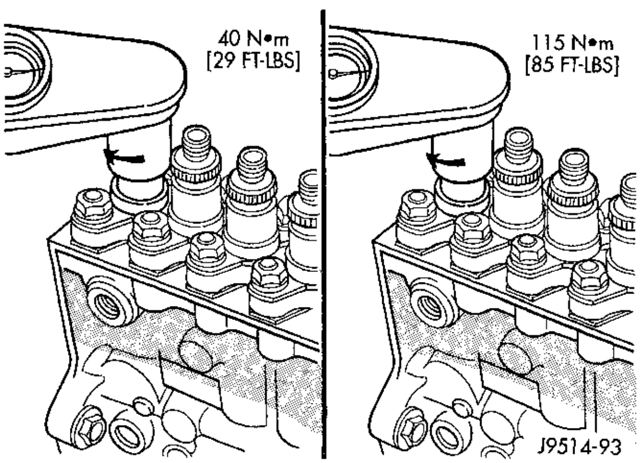

Fig. 57 Tightening Delivery Valve Holder

(31) Install remaining engine components removed during the timing process. Leave the injector end of the #1 high-pressure fuel line loose to facilitate bleeding the air out of the system.

WARNING: THE PRESSURE OF THE FUEL IN THE LINE IS SUFFICIENT TO PENETRATE THE SKIN AND CAUSE SERIOUS BODILY HARM.

(32) Crank the engine until fuel is observed at the #1 injector. Tighten the high-pressure line at the injector. Start the engine and check for leaks.

THROTTLE LINKAGE ADJUSTMENT—DIESEL ENGINE

Refer to WIDE-OPEN-THROTTLE CHECKS—DIESEL ENGINE for linkage adjustment procedures.

If Equipped With Throttle Position Sensor (TPS): Whenever the throttle linkage is adjusted, it will change TPS adjustment. Refer to THROTTLE POSITION SENSOR—DIESEL ENGINE, Removal/Installation/Adjustment in this group for procedures. Adjusting the TPS should always be the **last** adjustment.

WIDE-OPEN-THROTTLE CHECKS—DIESEL ENGINE

If "lack of power" is a complaint, one of the problems may be the inability of attaining wide-open-throttle (WOT). This is observed as throttle lever "breakover". "Breakover" is the continued movement of the throttle lever **after** movement of the throttle lever-to-injection pump lever linkage rod has stopped (Fig. 58). WOT must continue up to, and slightly through throttle lever "breakover". If "breakover" is not attained, WOT is not attained.

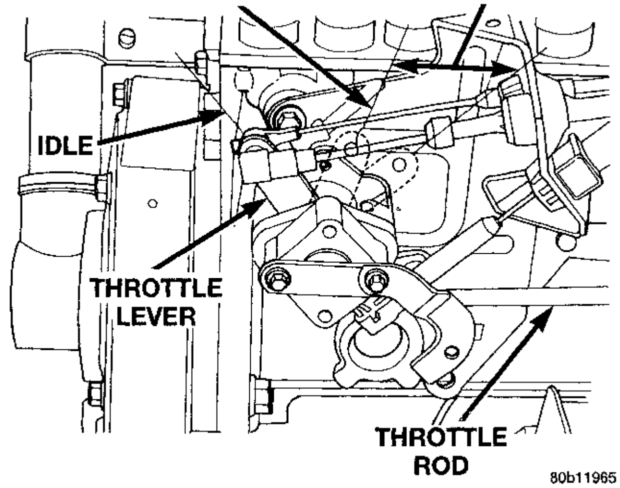

Fig. 58 Throttle Lever "Breakover"—Diesel Engine

SERVICE PROCEDURES (Continued)

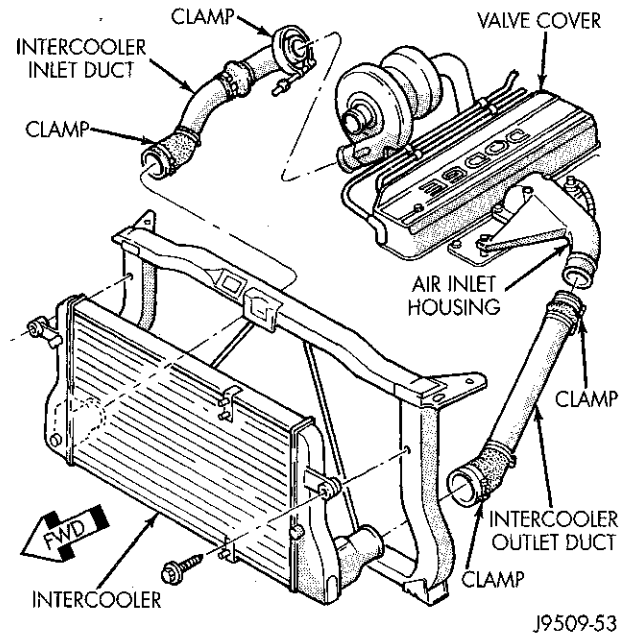

Fig. 59 Intercooler Outlet Duct

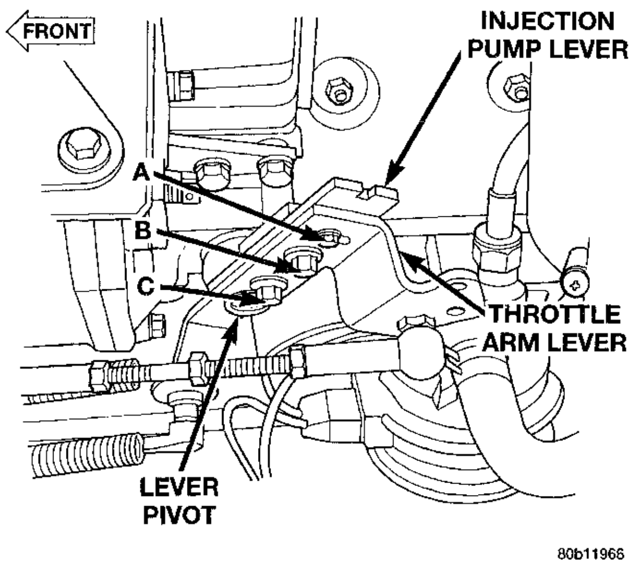

Fig. 60 Fuel Injection Pump Lever / Throttle Arm Lever

(1) Attach DRB scan tool to data link connector.

(2) Start engine and bring to operating temperature.

(3) Use DRB tool to check engine idle speed. Adjust idle speed if necessary. Refer to Idle Speed Adjustment for specifications. This step must be done before checking "breakover".

(4) Key OFF and engine OFF.

(5) Two people are needed for this portion of test. From inside vehicle, press accelerator pedal about half-way to floor. Movement of both throttle lever

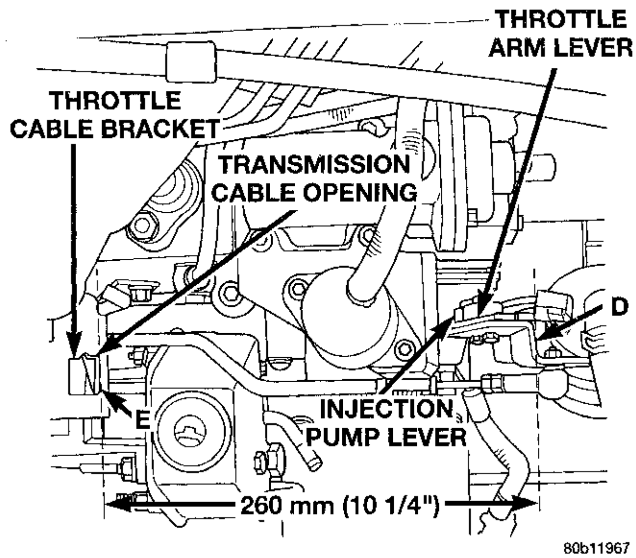

Fig. 61 Breakover Measurement

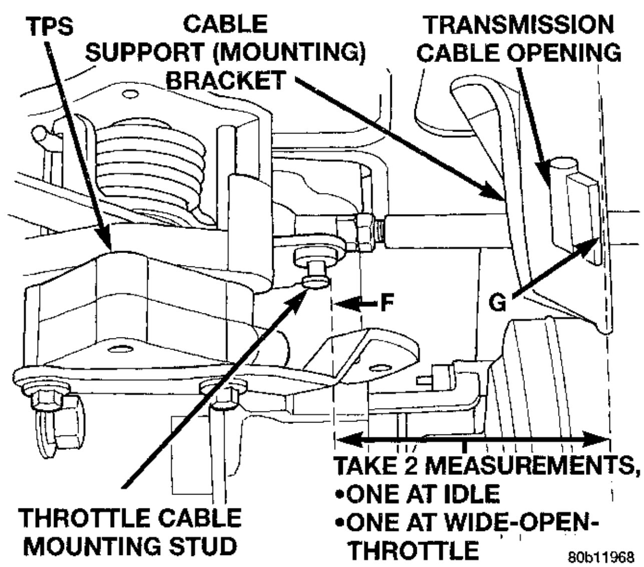

Fig. 62 Breakover Measurement Verification

(Fig. 58) and throttle rod (Fig. 58) should be observed.

(6) Continue to press accelerator pedal to the floor. If throttle lever "breakover" is operating correctly, the throttle rod (Fig. 58) should have stopped moving while the throttle lever (Fig. 58) continues to move towards the rear of vehicle.

(7) If "breakover" is not observed, the throttle linkage must be adjusted. If engine is equipped with a throttle position sensor (TPS), the TPS must also be adjusted **after** "breakover" position is set. Refer to THROTTLE POSITION SENSOR—DIESEL ENGINE in the Removal/Installation section of this group.

(8) At side of fuel injection pump, remove intercooler outlet duct from air inlet housing (Fig. 59).

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SERVICE PROCEDURES (Continued)

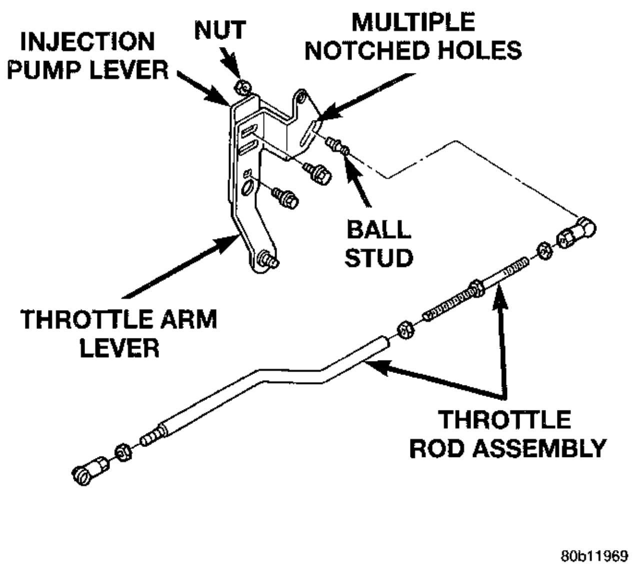

Fig. 63 Ball Stud and Notched Holes at Throttle Arm Lever

(9) Disconnect end of throttle cable at fuel injection pump. Refer to Throttle Cable in the Diesel Removal/Installation section.

(10) Disconnect end of transmission control (throttle valve) cable at fuel injection pump. Refer to Transmission Throttle Valve Cable in Group 21, Transmission.

(11) Disconnect end of speed control cable at fuel injection pump. Refer to Servo Cable in Group 8H, Speed Control System.

(12) Loosen, but do not remove, bolts A, B and C on throttle arm lever (Fig. 60).

(13) Move (pivot) throttle arm lever on injection pump lever (Fig. 60) to attain 260 mm (10 1/4") from point D at back of throttle arm lever, to point E at back of throttle cable bracket (Fig. 61). Take measurement through transmission throttle valve cable opening on throttle cable mounting bracket (Fig. 61). Make sure injection pump lever (Fig. 61) remains at **closed throttle position** during measurement

(14) Tighten bolts A, B and C to 10 N·m (89 in. lbs.) torque.

(15) Verify correct adjustment by measuring distance from back of throttle cable mounting stud on bellcrank (point F) (through transmission throttle valve cable opening) to the rear face of throttle cable mounting bracket (point G) (Fig. 62). This measurement (travel) must be taken twice; once at idle position and once at wide-open-throttle (WOT) position. Be sure injection pump lever (Fig. 61) remains at either idle or WOT position during both measurements. Record both measurements.

(16) The difference between the two measurements (travel) must be 34mm ± 2mm (1 11/32 in. ± 3/64 in.).

(17) If difference in measurement is OK, proceed to Step 22.

(18) If difference in measurement is too small, remove nut securing ball stud to throttle arm lever (Fig. 63) and remove ball stud from lever. Move ball stud upward/rearward one notch on pump lever. Multiple notched holes are provide on lever (Fig. 63). If difference in measurement is too great, move ball stud downward/forward one notch on lever. Each notched hole on throttle arm lever will give approximately a 2mm (3/64 in.) incremental adjustment in chosen direction.

(19) Tighten ball stud nut to 10 N·m (89 in. lbs.) torque.

(20) After repositioning ball stud, again, check for difference in measurement (travel) of 34mm ± 2mm (1 11/32 in. ± 3/64 in.). Readjust if necessary.

(21) After travel has been set, recheck "breakover".

(22) Connect end of throttle cable at fuel injection pump. Refer to Throttle Cable in the Diesel Removal/Installation section.

(23) Connect end of transmission control (throttle valve) cable at fuel injection pump. Refer to Transmission Throttle Valve Cable in Group 21, Transmission.

(24) Connect end of speed control cable at fuel injection pump. Refer to Servo Cable in Group 8H, Speed Control System.

(25) Install intercooler outlet duct to air inlet housing.

(26) If engine is equipped with a throttle position sensor (TPS), the TPS must also be adjusted. Refer to THROTTLE POSITION SENSOR—DIESEL ENGINE in the Removal/Installation section of this group.

REMOVAL AND INSTALLATION

ACCELERATOR PEDAL

Refer to the Fuel Delivery System—Gasoline Engine section for procedures.

FUEL DRAIN MANIFOLD

REMOVAL

(1) Remove two nuts retaining nameplate/cover to top of six engine valve covers (Fig. 64). Remove nameplate/cover from engine.

(2) Remove drain manifold fitting screws (bolts) at each of six injectors (Fig. 65).

(3) Remove fuel drain manifold holdown clamp/bolt (Fig. 66) at top/rear of intake manifold.

(4) Remove fuel drain manifold banjo fitting at top of fuel filter/water separator (one bolt) (Fig. 66).

(5) Remove fuel drain manifold fitting copper gaskets at each fuel injector.

REMOVAL AND INSTALLATION (Continued)

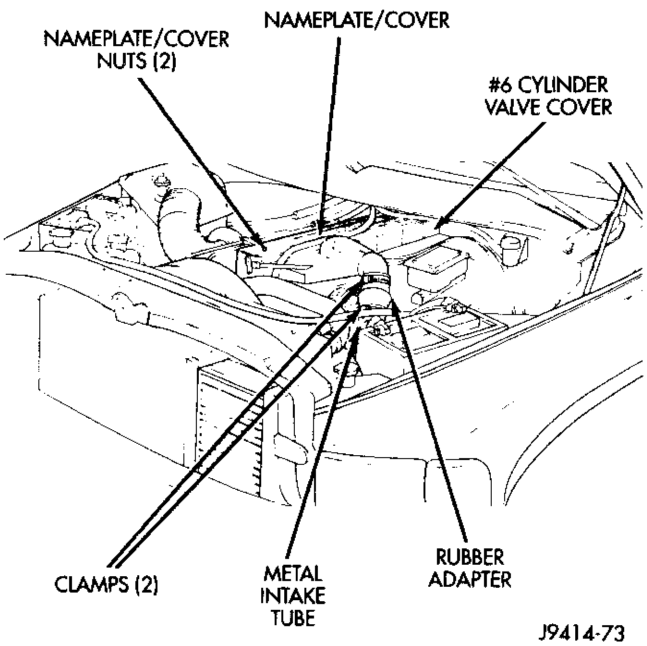

Fig. 64 Nameplate/Cover—Diesel

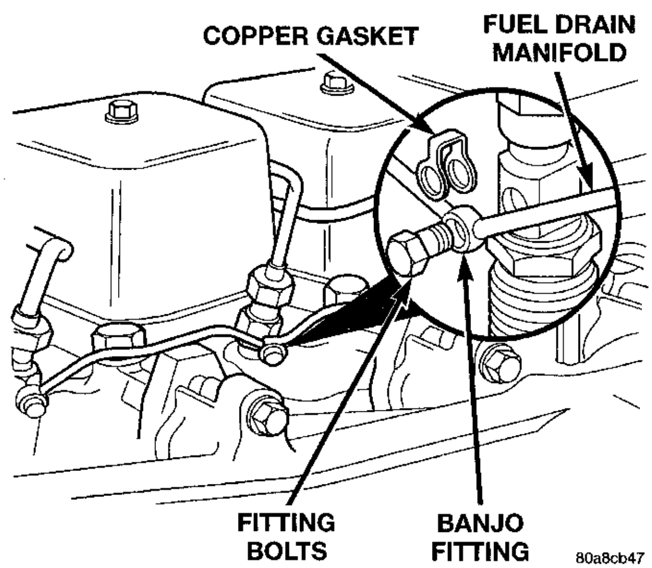

Fig. 65 Fuel Drain Manifold Fittings—Typical

(6) Remove manifold from engine.

INSTALLATION

(1) Using new copper gaskets on all fittings and assemble fuel drain manifold in reverse order of disassembly.

(2) Tighten drain manifold fitting screws (bolts) at injectors to 9 N·m (7 ft. lbs.) torque.

(3) Tighten drain manifold holdown clamp screws (bolts) to 13 N·m (10 ft. lbs.) torque.

(4) Install nameplate/cover.

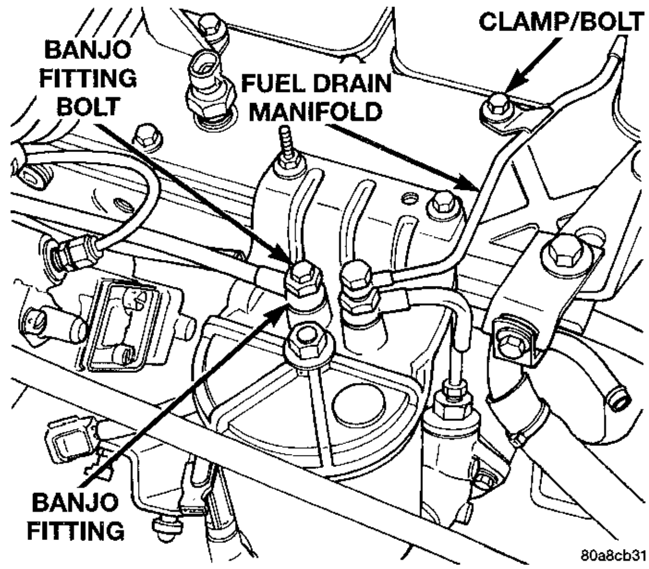

Fig. 66 Fuel Drain Manifold and Fuel Filter/Water Separator

FUEL FILTER/WATER SEPARATOR

Refer to the maintenance schedules in Group 0 in this manual for the recommended fuel filter replacement intervals. Whenever the fuel filter is being replaced, the pre-filter in the fuel heater assembly should be removed and cleaned. Refer to Fuel Heater Removal/Installation for procedures.

The fuel filter/water separator assembly is located on left/rear side of engine above starter motor (Fig. 67). The assembly contains a fuel filter cartridge and Water-In-Fuel (WIF) sensor.

REMOVAL

The canister drain valve (Fig. 67) or (Fig. 68) serves two purposes. One is to partially drain the filter canister of excess water. The other is to completely drain the canister for filter replacement.

DRAINING WATER FROM FILTER CANISTER: The filter should be drained whenever the water-in-fuel warning lamp remains illuminated. (Note that the lamp will be illuminated for approximately two seconds when ignition key is initially placed in ON position for a bulb check).

A drain hose is located at bottom of drain valve (Fig. 69). Place a drain pan under drain hose. **With engine not running,** rotate valve handle forward to DRAIN position (Fig. 68). Hold drain valve open until all water and contaminants have been removed and clean fuel exits the drain hose. If fuel filter or WIF sensor is being replaced, drain the canister completely. Dispose of mixture in drain pan according to applicable regulations. After draining operation, rotate valve handle rearward to CLOSE position (Fig. 68). If fuel filter or WIF sensor is being replaced, proceed to next step.

REMOVAL AND INSTALLATION (Continued)

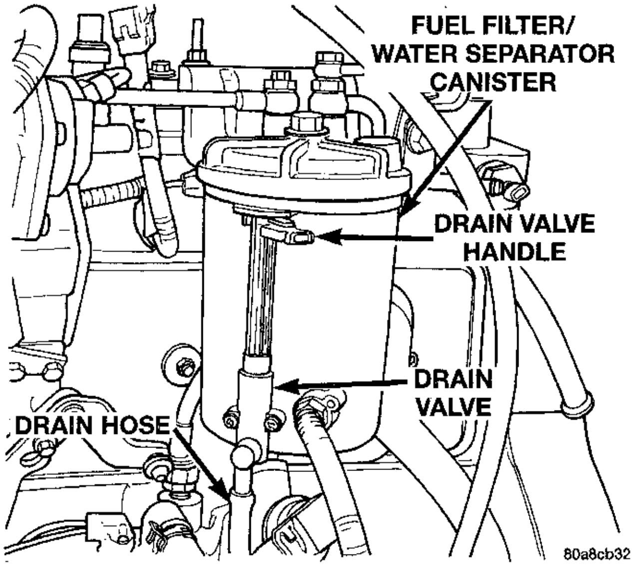

Fig. 67 Fuel Filter/Water Separator Location

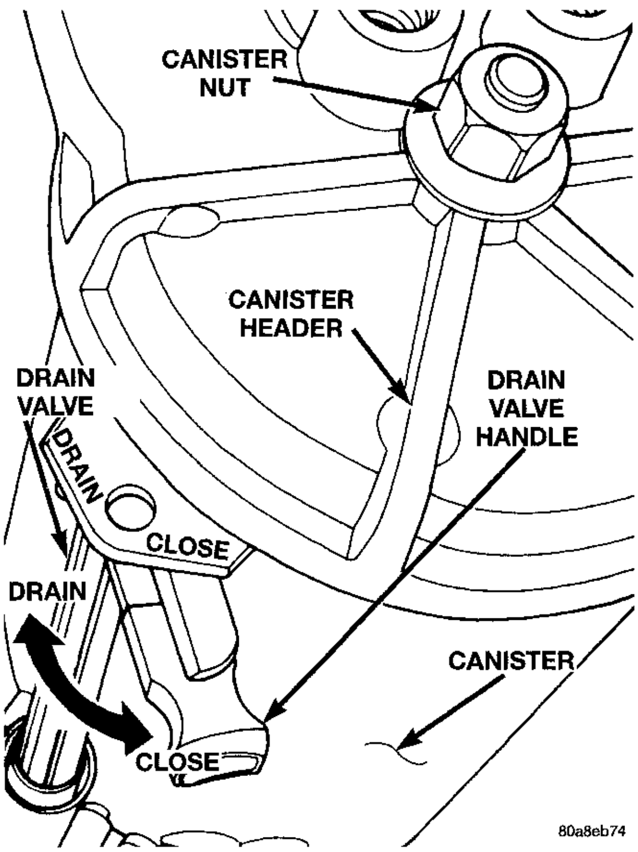

Fig. 68 Drain Valve at Fuel Filter/Water Separator

(1) Remove drain hose at drain valve (Fig. 69).

(2) Disconnect Water-In-Fuel (WIF) sensor electrical connector pigtail harness from main engine wiring harness. The WIF sensor is located at side of filter canister (Fig. 69).

(3) Remove filter canister nut at top of header (Fig. 68).

(4) Lower canister assembly from header.

(5) Remove and discard center o-ring (Fig. 69).

(6) Remove filter element (cartridge) from canister.

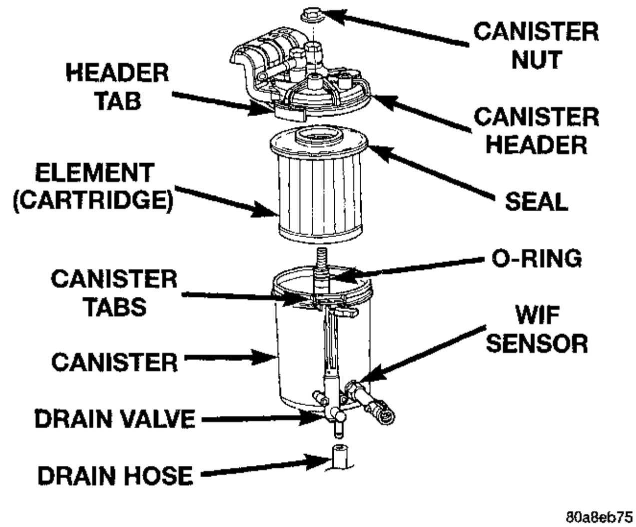

Fig. 69 Fuel Filter/Water Separator Components

(7) Remove WIF sensor and its seal from canister (Fig. 70).

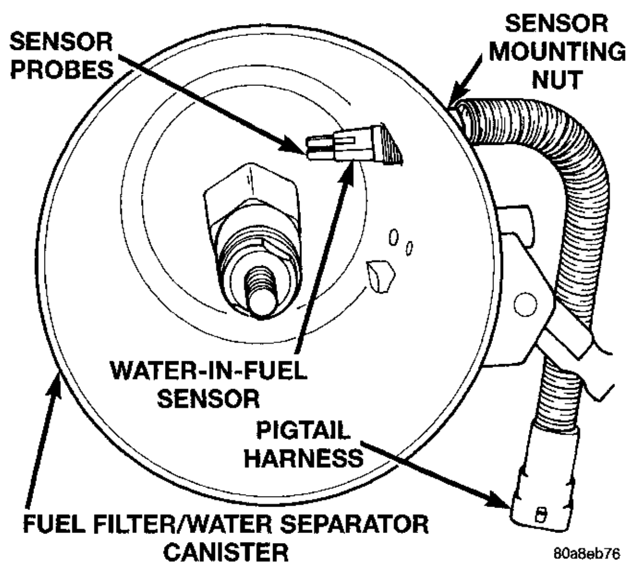

Fig. 70 Water-In-Fuel Sensor

(8) Inspect WIF sensor probes (Fig. 70). Carefully clean contaminants from sensor probes with a cloth if necessary. Replace sensor if probes are covered with contaminants and will not clean up.

INSTALLATION

(1) Clean inside of canister.

(2) Install a new o-ring seal to WIF sensor.

(3) Install WIF sensor to canister. Tighten to 2–3 N·m (15–20 in. lbs.) torque.

REMOVAL AND INSTALLATION (Continued)

(4) If drain valve assembly is being replaced, tighten mounting screws to 3–5 N·m (30–40 in. lbs.) torque.

(5) Install new seal between canister and canister header.

If filter canister is not filled with clean diesel fuel before installation, manual air bleeding of the fuel system may be necessary (temporary rough engine running may occur). If necessary, refer to the Air Bleed Procedure in this group for procedures.

(6) Fill filter canister with clean diesel fuel.

(7) Apply a light film of clean diesel oil to seals.

(8) Position canister assembly to canister header. Note that the locating tabs on canister should align into header tab on canister header (Fig. 69). This step must be followed to prevent damage to canister or header and to prevent contact of drain valve into throttle linkage.

(9) Install canister nut and tighten to 14 N·m (10 ft. lbs.) torque.

(10) Connect electrical connector to WIF sensor.

(11) Connect drain hose to bottom of drain valve.

(12) Start engine and check for leaks.

FUEL TANK

Refer to Fuel Tank—All Engines in the Fuel Delivery System—Gasoline engines section for procedures.

FUEL TANK MODULE

REMOVAL

(1) Drain and remove fuel tank. Refer to Fuel Tanks—All Engines for procedures.

(2) The plastic fuel tank module locknut is threaded onto fuel tank (Fig. 71). Install Special Tool 6856 to locknut and remove locknut (Fig. 72). The fuel tank module will spring up when locknut is removed.

(3) Remove module from fuel tank.

INSTALLATION

CAUTION: Whenever the fuel tank module is serviced, the rubber gasket must be replaced.

(1) Using a new gasket, carefully position fuel tank module into opening in fuel tank.

(2) Position locknut over top of fuel tank module. Install locknut finger tight.

(3) The fuel line connectors, rollover valve and fuel gauge electrical connector should all be pointed to drivers side of vehicle. Rotate module if necessary before tightening locknut. This step must be performed to prevent the float from contacting side of fuel tank.

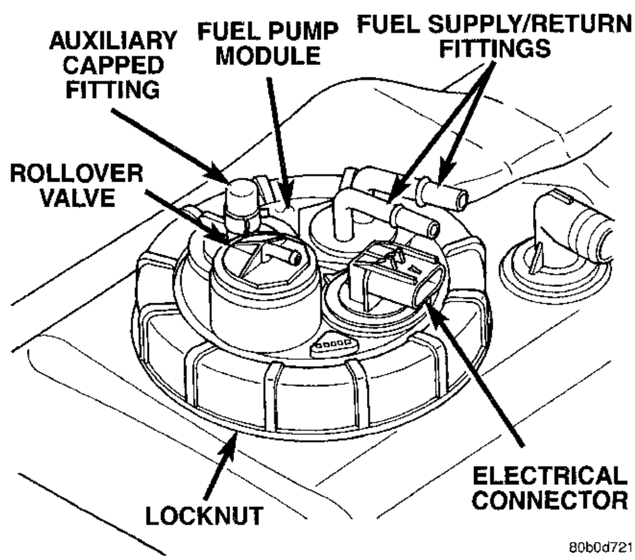

Fig. 71 Top View of Fuel Tank Module—Diesel

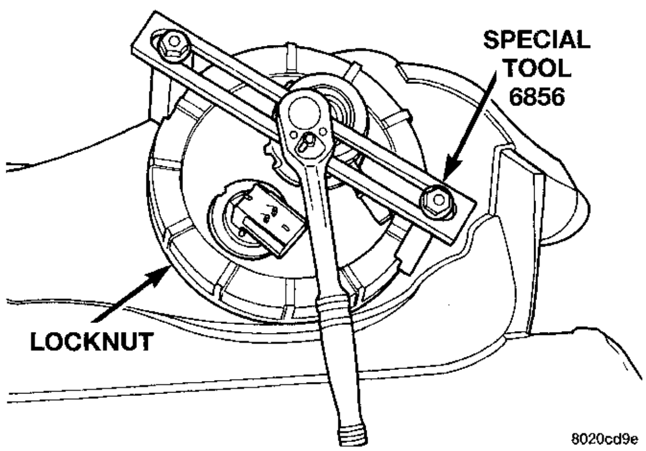

Fig. 72 Locknut Removal/Installation—TYPICAL

(4) Tighten locknut to 24–44 N·m (18–32 ft. lbs.) torque.

(5) Install fuel tank. Refer to Fuel Tanks—All Engines for procedures.

FUEL HEATER

The fuel heater element assembly is located inside of fuel heater housing and above pre-filter (Fig. 73). The fuel temperature sensor is located at top of fuel heater housing (Fig. 73).

If upper section of fuel heater assembly housing is to be removed, the fuel transfer pump must first be removed. The mounting bracket/spacer (Fig. 74) on fuel heater is shared with fuel transfer pump. Refer to Fuel Transfer Pump Removal/Installation for procedures.

REMOVAL AND INSTALLATION (Continued)

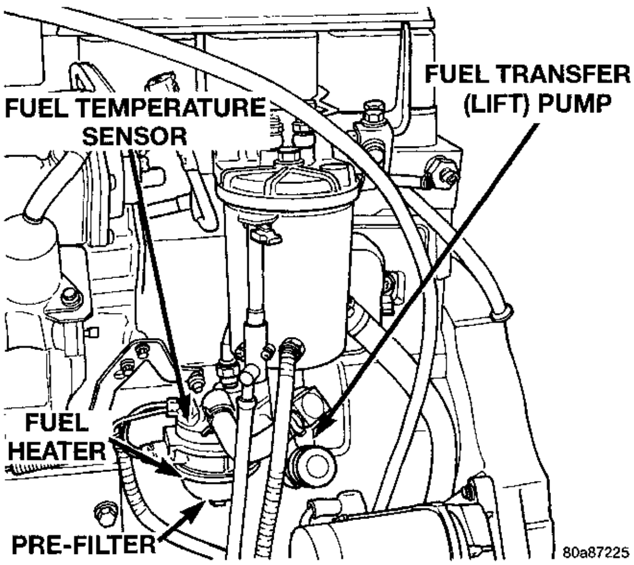

Fig. 73 Fuel Heater and Fuel Temperature Sensor Location

REMOVAL

(1) Disconnect both negative battery cables at both batteries.
(2) Remove starter motor. Refer to Group 8B for procedures.
(3) Disconnect electrical connector at front of fuel heater housing (Fig. 73).
(4) Place a drain pan below fuel heater.
(5) A machined hex is located on bottom of pre-filter housing (Fig. 74). From under vehicle, attach a socket to this hex and remove (unscrew) pre-filter.
(6) Remove fuel heater assembly from housing.
(7) Remove pre-filter and screen from housing.
(8) Remove and discard rubber seals between housing sections.

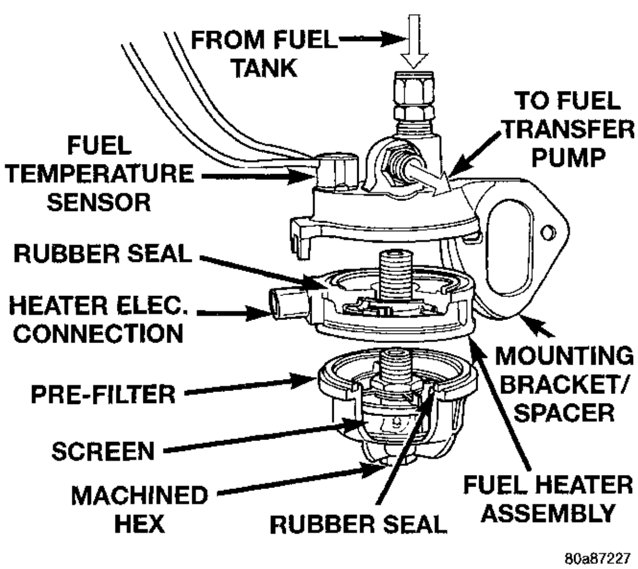

Fig. 74 Fuel Heater and Pre-Filter

INSTALLATION

(1) Clean pre-filter and screen.
(2) Clean all other components before assembly.
(3) Install screen and pre-filter into housing.
(4) Install new rubber seals between housing sections.
(5) Install fuel heater assembly and housing sections.
(6) Rotate fuel heater until fuel temperature sensor is pointed towards front of vehicle.
(7) Tighten hex at bottom of housing.
(8) Connect electrical connector at front of fuel heater housing.
(9) Install starter motor. Refer to Group 8B for procedures.
(10) Connect both negative battery cables at both batteries.

FUEL HEATER RELAY

The fuel heater relay is located in the engine compartment near the brake master cylinder (Fig. 75).

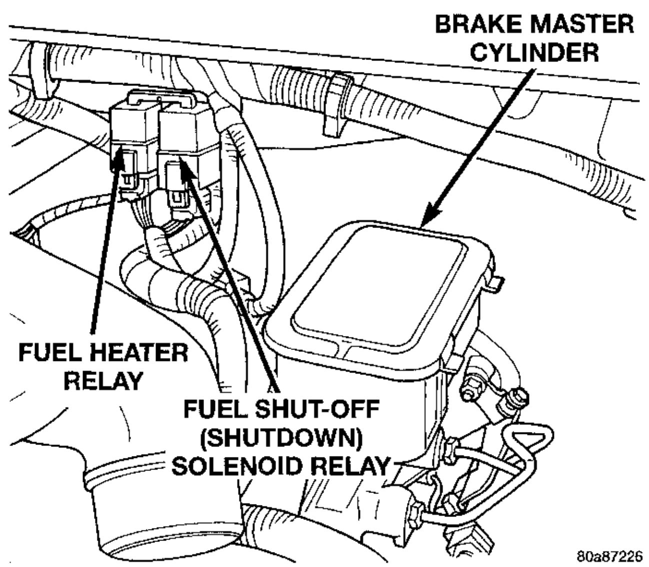

Fig. 75 Fuel Heater Relay—Diesel

REMOVAL

(1) Disconnect both negative battery cables at both batteries.
(2) Disconnect the electrical connector at the relay.
(3) Remove the relay from the mounting bracket.

INSTALLATION

(1) Check the terminals within connector for damage or corrosion. Also check pin height of terminals within connector. Pin heights should be the same. Repair as necessary before connecting relay.
(2) Install the relay to the mounting bracket.
(3) Connect the electrical connector.
(4) Connect battery cables to both batteries.

REMOVAL AND INSTALLATION (Continued)

FUEL INJECTION PUMP

New or remanufactured fuel injection pumps should have a new overflow valve (Fig. 81) temporarily installed into side of pump. **Do not install a used overflow valve into a new or remanufactured injection pump.** If pump is being sent to an authorized repair facility for calibration or testing, be sure to temporarily install old overflow valve into pump.

REMOVAL

(1) Disconnect both negative battery cables at both batteries.

(2) Disconnect electrical connector at throttle position sensor on side of injection pump (if equipped) (Fig. 76).

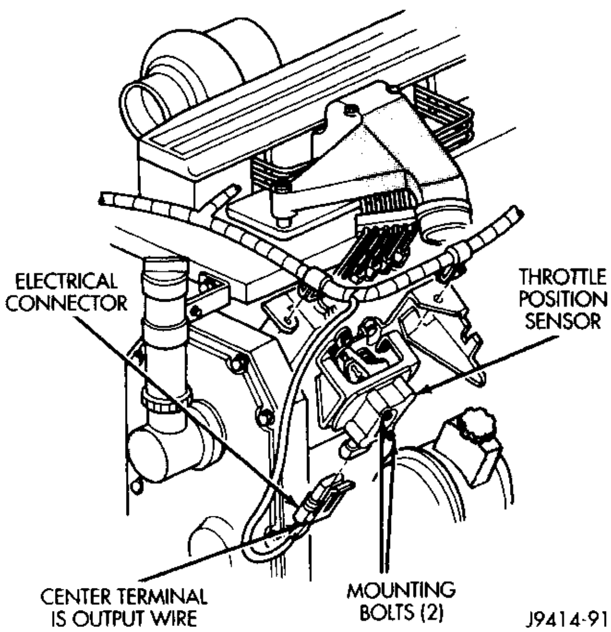

Fig. 76 Throttle Position Sensor—Diesel

(3) Disconnect electrical connector at fuel shutdown solenoid. (Fig. 77).

(4) Remove EGR tube (if equipped). Refer to Group 25, Emission Control System for procedures.

(5) Disconnect main engine wiring harness at top of injection pump and position to side.

(6) Remove metal intake manifold-to-intercooler connecting tube.

(7) Remove engine oil dipstick tube mounting clamp and bolt (Fig. 78). Position dipstick tube to side.

(8) Disconnect two air heater cable nuts (Fig. 78).

(9) Remove five intake manifold bolts (Fig. 78). Discard both old air heater base gaskets.

(10) Remove throttle control bracket, cables and linkage assembly from side of pump (three bolts). Position assembly to side.

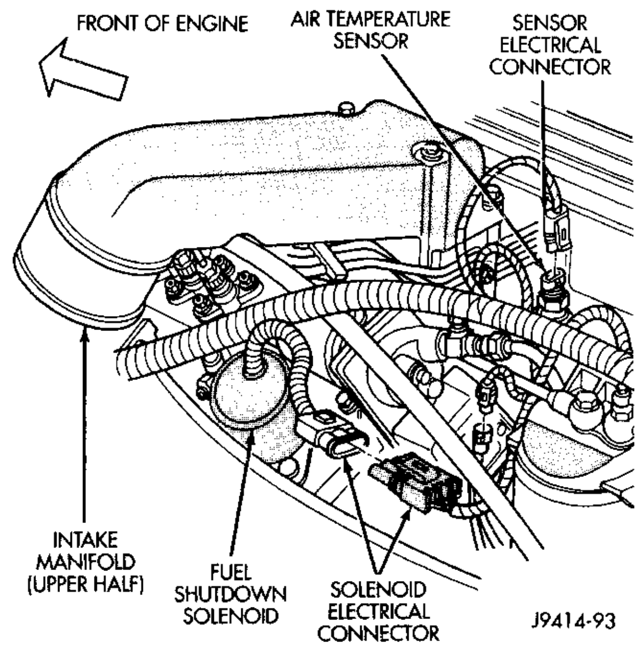

Fig. 77 Fuel Shutdown Solenoid Location

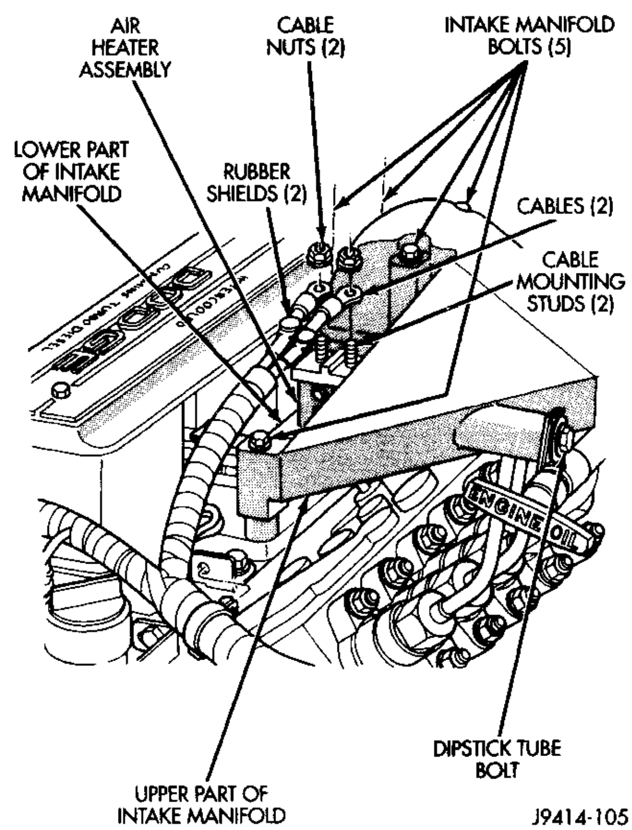

Fig. 78 Intake Manifold Air Heater

(11) Disconnect control line fitting and control from air flow control (AFC) valve at rear of injection pump (Fig. 79).

REMOVAL AND INSTALLATION (Continued)

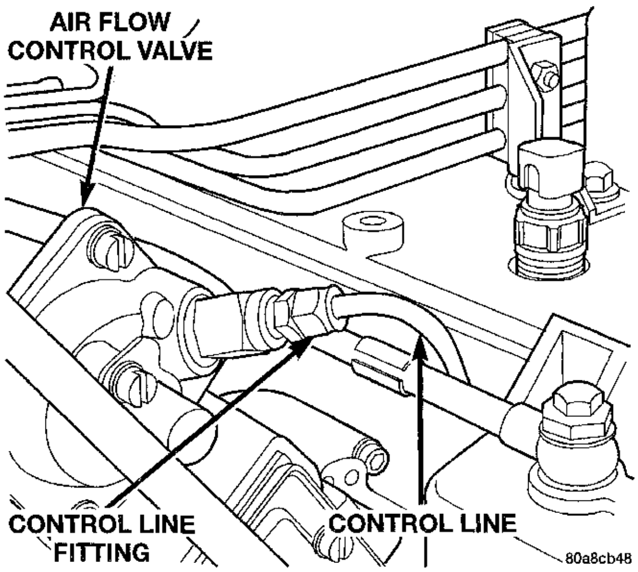

Fig. 79 Control Line at AFC Valve

(12) Remove fuel supply line at both ends (injection pump and fuel filter/water separator) (Fig. 80). For procedures, refer to Fuel Injection Pump Supply Line in this group. Place a rag beneath fitting to catch excess fuel.

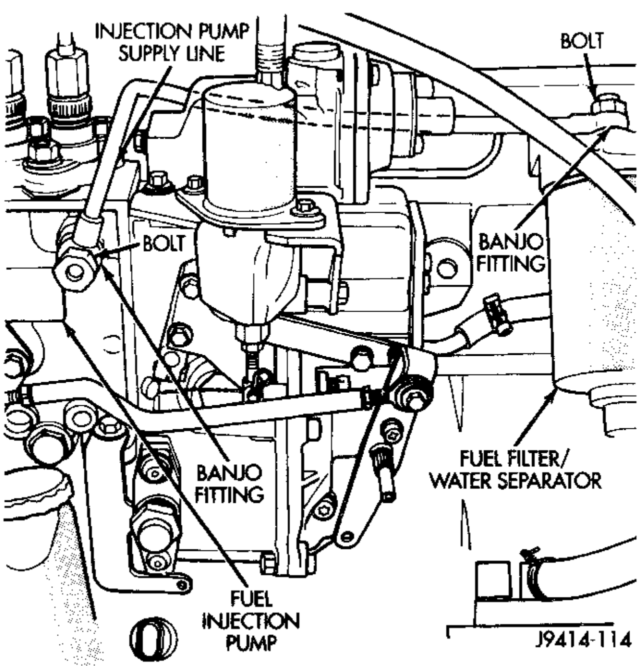

Fig. 80 Fuel Injection Pump Supply Line

(13) The overflow valve is used to retain fuel return line banjo fitting to injection pump. Remove overflow valve and fuel return line at pump (Fig. 81). Place a rag beneath banjo fitting to catch excess fuel.

(14) Disconnect six (6) high-pressure fuel lines from fuel delivery valve holders at top of injection pump (Fig. 82). For procedures, refer to High-Pressure Fuel Lines in this group. Place a rag beneath fittings to catch excess fuel.

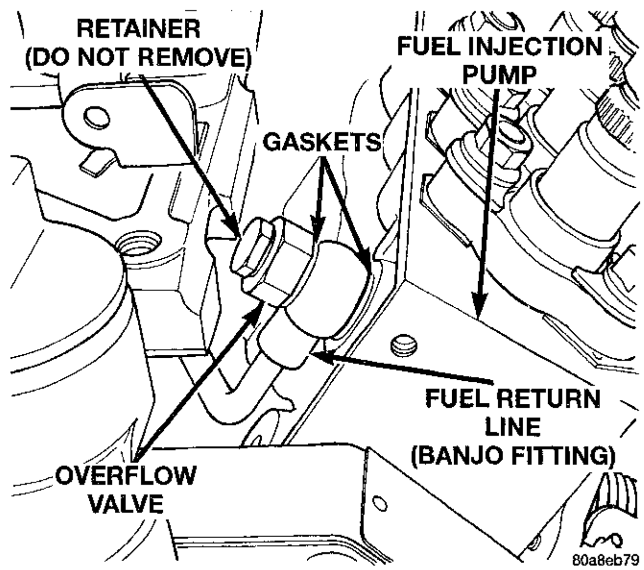

Fig. 81 Injection Pump Overflow Valve

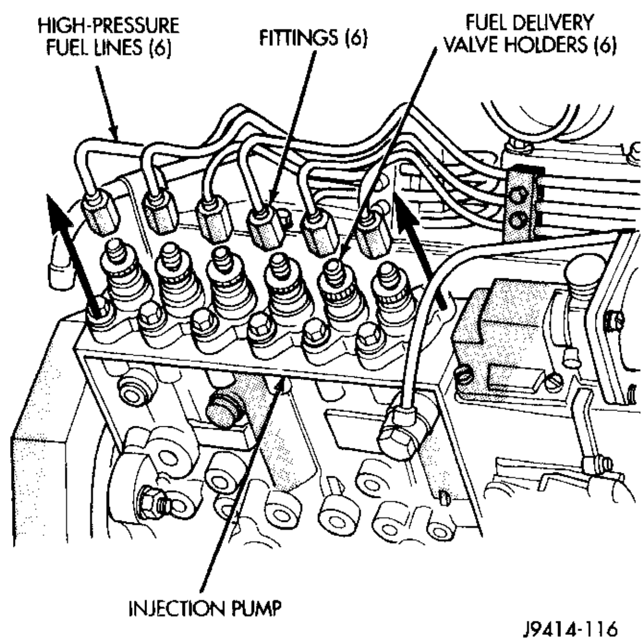

Fig. 82 Fuel Delivery Valve Holders and Pressure Lines

(15) Disconnect engine oil supply line at side of pump (Fig. 83).

(16) Remove oil fill tube bracket mounting bolt (Fig. 84).

(17) Remove oil fill tube from tube-to-gear housing adapter (Fig. 84). Tube is removed by screwing counterclockwise from adapter.

REMOVAL AND INSTALLATION (Continued)

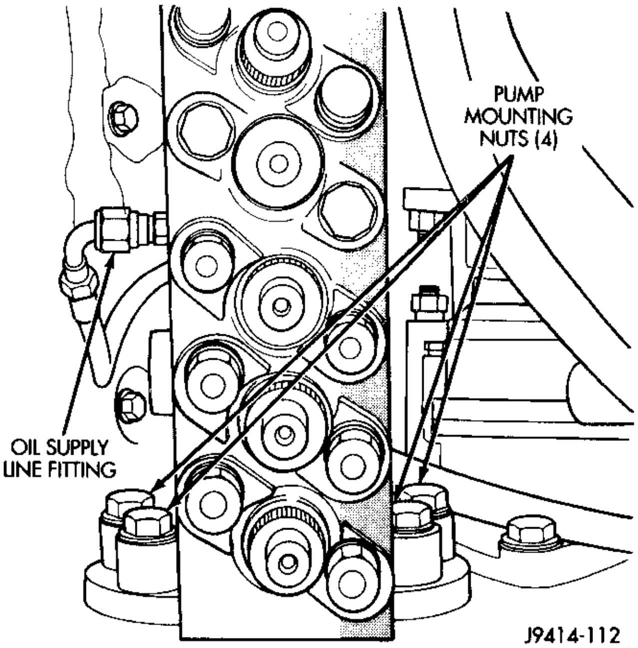

Fig. 83 Engine Oil Supply Line—Pump Mounting Nuts

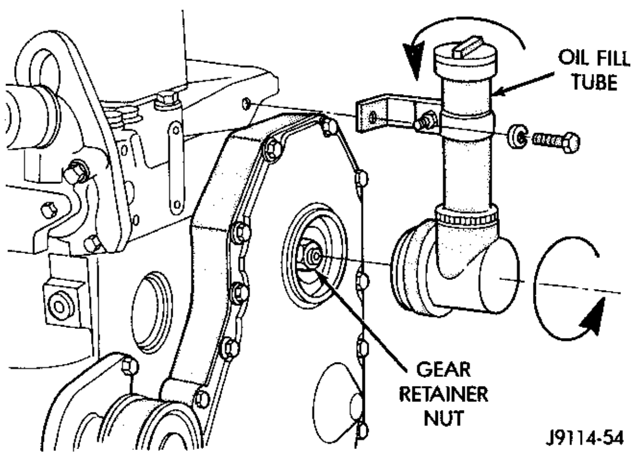

Fig. 84 Oil Fill Tube, Adapter and Mounting Bracket

(18) Remove oil fill tube adapter from gear housing (Fig. 84). Adapter is removed by screwing counterclockwise from gear housing.

(19) **The engine is equipped with a built-in moveable timing pin.** This pin is located above power steering pump, below and to inside of fuel injection pump, on rear of cam gear housing (Fig. 85). The pin will engage into a machined hole in the back of camshaft gear (Fig. 86). It is designed to position engine to TDC (Top Dead Center) on compression stroke of number 1 cylinder.

(20) Remove rubber air tube connecting turbocharger to air cleaner housing.

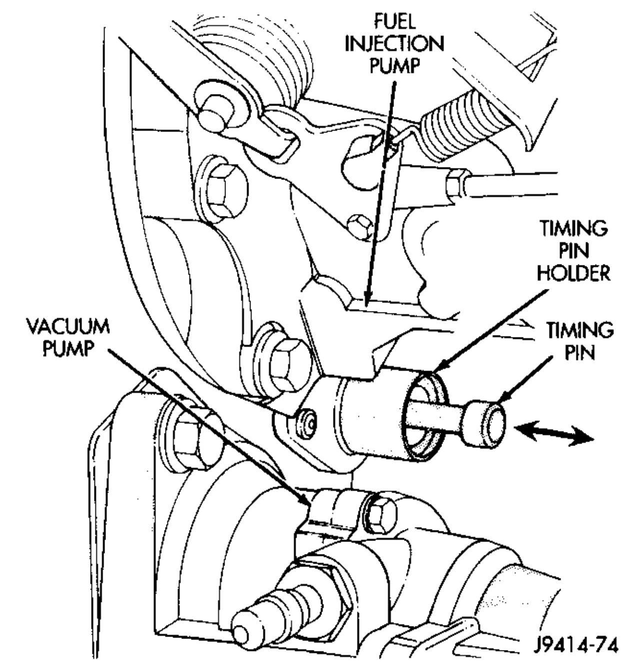

Fig. 85 Timing Pin and Location

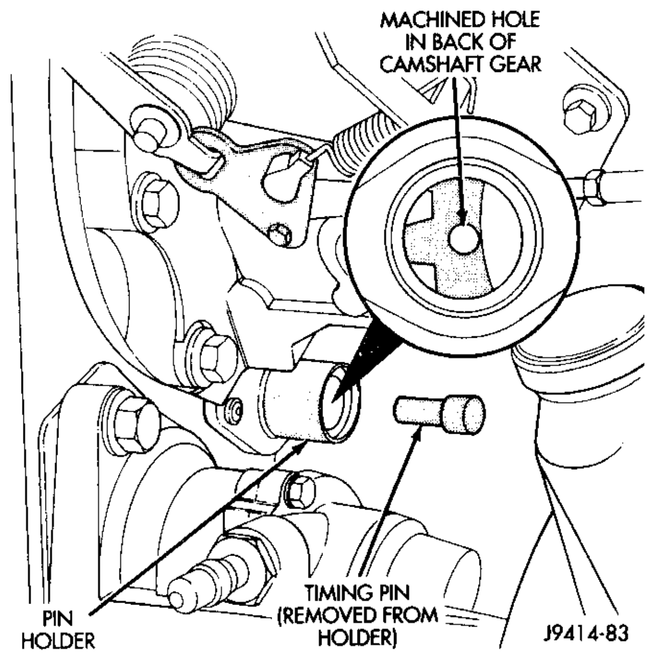

Fig. 86 Back of Camshaft Gear—Typical

(21) The engine can be rotated with a barring tool such as Snap-On No. SP371, MTE No. 3377371 (Cummins Tool Division), or an equivalent.

(22) The opening for barring tool is located in rear flange of engine on exhaust manifold side (Fig. 87). Remove rubber access plug covering this opening.

(23) Insert barring tool into flywheel housing opening (Fig. 87).

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REMOVAL AND INSTALLATION (Continued)

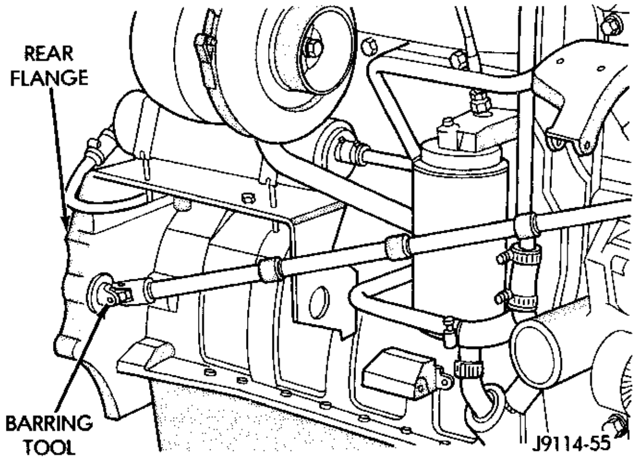

Fig. 87 Rotating Engine with Barring Tool—Typical

(24) While holding tension on timing pin (towards front of engine), very slowly rotate engine (counterclockwise as viewed from front) with barring tool. Rotating barring tool counterclockwise will rotate crankshaft clockwise. Continue to rotate until timing pin drops into machined hole in back of camshaft gear. When pin aligns to gear, engine is now at TDC position (compression stroke) at cylinder number 1.

CAUTION: When installing fuel injection pump and to achieve proper injection pump timing, engine MUST be in TDC position (compression stroke) at cylinder number 1.

Before proceeding to next step, and to prevent shearing of timing pin, temporarily remove timing pin from back of gear.

(25) Remove nut and washer retaining injection pump gear to injection pump shaft (Fig. 88).

(26) Place a shop towel below retainer nut in gear housing cover opening to prevent nut or washer from falling into gear housing.

CAUTION: If gear retainer nut or washer drops into gear housing, cover must be removed to retrieve them before engine is started.

(27) Use a T-bar type puller (Fig. 89) to separate injection pump gear from injection pump shaft. Attach two M8 X 1.24 MM (metric) screws through puller and into the two threaded holes supplied in pump gear. Pull injection pump gear forward until it loosens from injection pump shaft. **Pull on gear only enough to loosen it from injection pump shaft. Pulling gear too far may cause damage or breakage to gear cover.**

(28) Remove two (2) injection pump-to-lower mounting bracket bolts (Fig. 90).

(29) Remove four (4) injection pump-to-gear housing mounting nuts (Fig. 83).

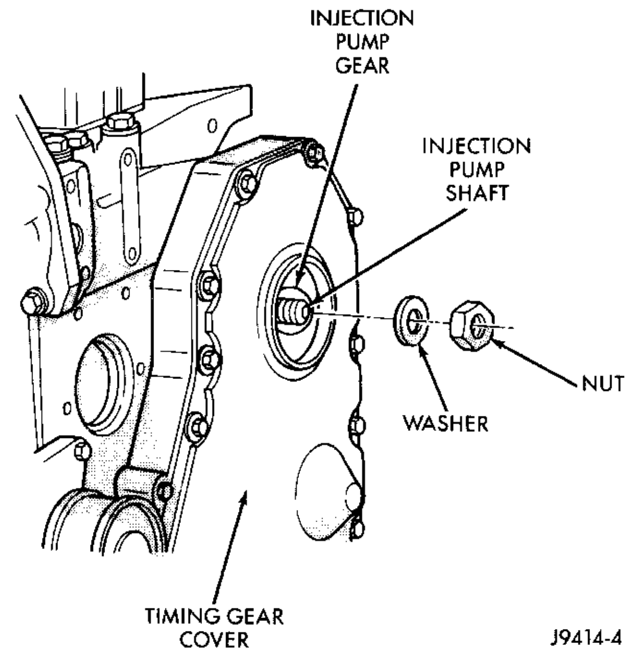

Fig. 88 Injection Pump Gear Washer and Nut

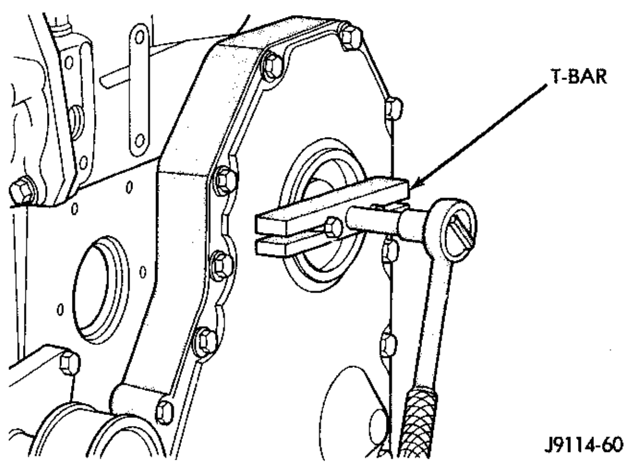

Fig. 89 Separating Injection Pump Gear from Pump Shaft

(30) Remove injection pump from gear housing. **Take care not to nick injection pump shaft on aluminum gear housing when removing pump.**

(31) Clean injection pump o-ring mounting surfaces on both gear housing and pump.

INSTALLATION

CAUTION: Before installing injection pump, be sure that number 1 cylinder is at Top Dead Center (compression stroke) position. Engage timing pin on rear of gear cover (Fig. 85) into rear of camshaft gear. Rotate crankshaft if necessary.

REMOVAL AND INSTALLATION (Continued)

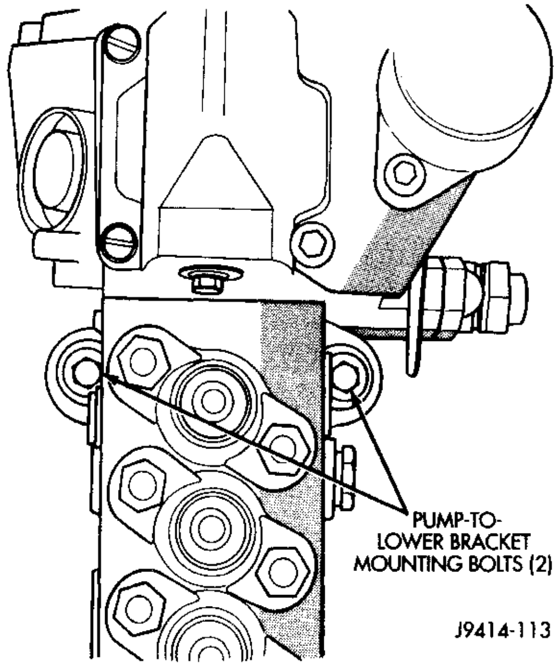

Fig. 90 Pump Mounting Bolts

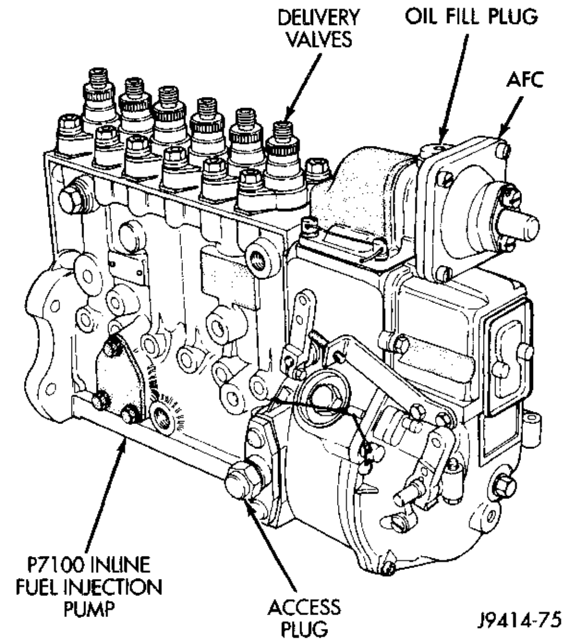

Fig. 91 Injection Pump Access Plug

Before injection pump installation, it must be set (pump shaft rotated) to a certain position to attain accurate pump timing. Remove access plug from side of pump (Fig. 91). Stored behind this access plug is a plastic timing pin tool (Fig. 92). This tool is used to align injection pump timing tooth (Fig. 93) to center of access hole.

Installing Original Pump: If original pump is being reinstalled, the pin tool should already be mounted with slotted end facing outward (Fig. 92). When position of this tool has been reversed, with slotted end facing inward, it is used as a pump timing pin tool.

Installing New or Rebuilt Pump: If a new or rebuilt pump is being installed, the pump should have been shipped with slotted end of timing pin tool engaged to timing tooth in pump.

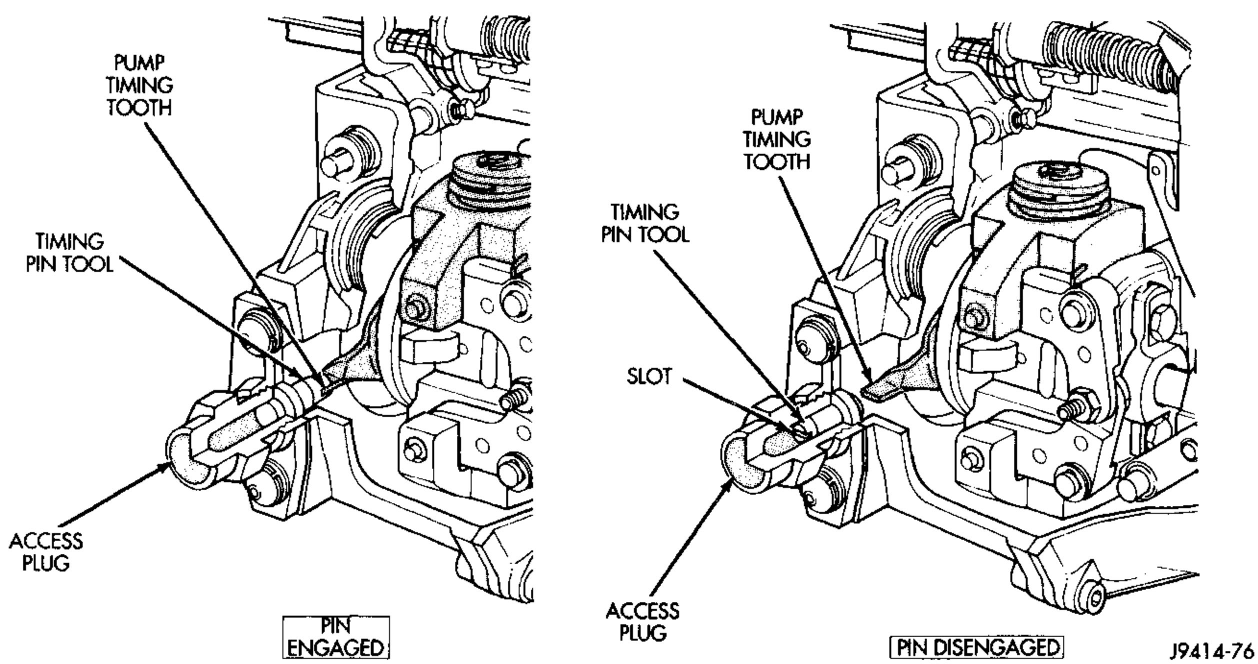

Fig. 92 Injection Pump Timing Pin Tool

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REMOVAL AND INSTALLATION (Continued)

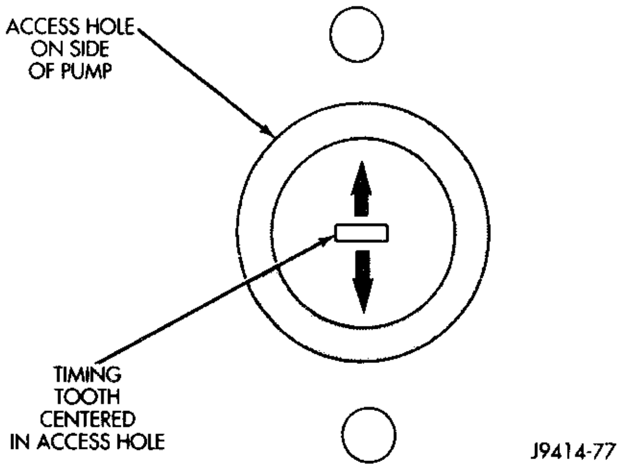


Fig. 93 Injection Pump Timing Tooth

To set injection pump timing on an original pump or when checking timing on a new pump, rotate pump shaft until timing tooth appears in center of plug opening (Fig. 93). Install slotted end of timing pin tool over timing tooth. The pump shaft may have to be rotated slightly to align tool to tooth. Do not force slots in tool over timing tooth.

After tool has been **temporarily** installed to timing tooth, install and loosely tighten access plug. New pumps should have been shipped with this tool already engaged.

(1) If original pump is being installed, check condition of rubber o-ring at pump mounting area. If o-ring has a colored stripe, it must be replaced.

(2) Apply clean engine oil to injection pump mounting flange opening in gear cover housing to allow easier pump installation (Fig. 94), but do not apply engine oil to pump o-ring seal at pump mounting area. **The machined tapers on both injection pump shaft and injection pump gear must be dry, clean and free of any dirt or oil. This will ensure proper gear-to-shaft tightening.**

(3) Position pump assembly to mounting flange on gear cover while aligning injection pump shaft through back of injection pump gear.

(4) Install four pump mounting nuts finger tight. **Do not attempt to tighten (pull) pump to gear cover using mounting nuts. Damage to pump or gear cover may occur. The pump must be positioned flat to its mounting flange before attempting to tighten mounting nuts.**

(5) Install two (vertical) pump mounting bracket bolts finger tight.

(6) Tighten four pump mounting nuts to 43 N·m (32 ft. lbs.) torque. Tighten two pump mounting bracket bolts. **To prevent damage to pump and mounting flange, tighten pump mounting nuts first.**

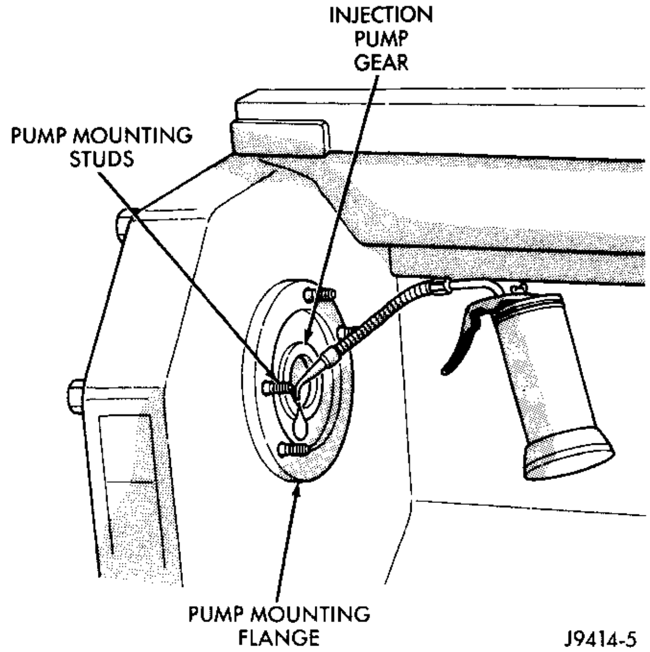


Fig. 94 Apply Oil to Gear Cover

(7) Install injection pump drive shaft-to-injection pump gear retaining nut and washer. **Do a preliminary tightening of this nut to 10 to 15 N·m (7 to 11 ft. lbs.) torque. Do not over tighten. This is not the final tightening torque. To prevent damage to timing pin, do not exceed this torque.**

(8) Disengage timing pin from the rear of camshaft gear by pulling it straight back.

(9) Remove access plug from injection pump (Fig. 91) and remove timing pin tool from pump.

(10) Do a final tightening of injection pump gear-to-injection pump shaft nut. Tighten to 195 N·m (144 ft. lbs.) torque. Use barring tool to prevent engine from rotating when tightening gear.

(11) After injection pump gear has received a final tightening, verify injection pump timing.

(a) Rotate engine counterclockwise with barring tool (clockwise as observed at crankshaft from front of vehicle). Continue rotating engine until timing pin aligns into hole at rear of camshaft gear (Fig. 86). The engine is now at TDC of number cylinder 1.

(b) With timing pin aligned into rear of camshaft gear, timing tooth should also be centered in access hole on side of injection pump (Fig. 93). Install timing pin tool (Fig. 92) to verify.

(c) If timing pin tool will not fit into timing tooth in pump, pump gear nut must be removed. Loosen pump gear from pump shaft with T-bar puller tool. With gear loosened, rotate injection pump shaft until it aligns to center of access hole on side of pump. Tighten injection gear nut and remove barring tool.

REMOVAL AND INSTALLATION (Continued)

(12) Remove timing pin tool from pump. Reverse position of this tool (Fig. 92). The slotted part of tool should be facing outward and will be stored in pump in this direction. Place tool back into pump. Install access plug and its sealing washer. Tighten plug to 15 N·m (11 ft. lbs.) torque.

(13) Install engine oil supply line to pump.

(14) Install fuel return line/overflow valve to pump. New or remanufactured fuel injection pumps should have a new overflow valve temporarily installed into side of pump. **Do not install a used overflow valve into a new or remanufactured pump.** Tighten valve to 30 N·m (24 ft. lbs.) torque.

(15) Install six high-pressure fuel lines to top of pump. Tighten lines to 30 N·m (22 ft. lbs.) torque.

(16) Install low-pressure fuel supply line to pump.

(17) Install AFC valve control line at rear of pump.

(18) **New or rebuilt P7100 series fuel injection pumps must be pre-lubricated before operation. Failure to do so may result in pre-mature governor wear.**

(a) Remove 10 mm hex plug (oil fill plug) on top of injection pump governor (Fig. 91).

(b) Add 750 ml (25 ounces) of clean engine oil through this opening.

(c) Install oil fill plug and tighten to 28 N·m (21 ft. lbs.) torque.

(19) Install throttle linkage assembly to pump. Tighten bolts to 24 N·m (18 ft. lbs.) torque.

(20) Connect electrical connector to fuel solenoid.

(21) Connect main engine wiring harness at top of injection pump.

(22) Install engine oil dipstick tube mounting clamp and bolt at opening to intake manifold.

(23) Install oil fill tube and tube adapter.

(24) Install oil fill tube bracket and mounting bolt.

(25) Install electrical connector to throttle position sensor (if equipped).

(26) Install air cleaner housing-to-turbocharger tube at air cleaner housing.

(27) Using a new gasket, install air heater assembly (five bolts).

(28) Install EGR tube (if equipped). Refer to Group 25, Emission Control System for procedures.

(29) Install intake manifold-to-intercooler tube.

(30) Check and adjust throttle linkage. Refer to Throttle Position Sensor in this group.

(31) Bleed air from fuel system. Refer to the Air Bleed Procedure in this section of the group.

(32) Adjust low idle speed if required. Refer to Idle Speed Adjustment.

(33) Inspect throttle linkage to be sure that control lever is opening to full open position.

(34) Some engine oil was lost when removing pump. Check and adjust engine oil level.

FUEL INJECTORS

REMOVAL

(1) Disconnect both negative battery cables from both batteries.

(2) Remove high-pressure fuel lines. Refer to High-Pressure Fuel Lines in this section. **Do not bend any high-pressure fuel line to gain access to fuel injector.**

(3) Remove fuel drain manifold. Refer to Fuel Drain Manifold in this section.

(4) Thoroughly clean the area around injector.

CAUTION: When rust has formed on the fuel injector nut, the injector (when being removed) can rotate in the cylinder head. This may cause damage to the cylinder head bore. Use a rust penetrating solvent (Fig. 95) before attempting to loosen a rusted holddown nut.

(5) Hold injector body with one wrench while removing injector mounting nut with another (Fig. 96). If nut cannot be rotated, pry out the square cut rubber seal from top of injector mounting nut (Fig. 95) and apply rust penetrating solvent to top of nut. Remove injector from cylinder head.

(6) Remove injector mounting nut (Fig. 97) from injector.

(7) Remove and discard square cut rubber seal (Fig. 97) from injector mounting nut.

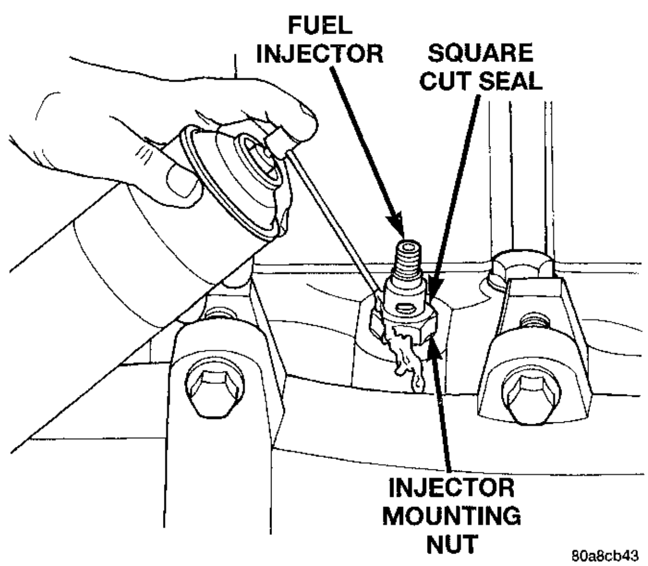


Fig. 95 Applying Rust Penetrating Solvent to Injector Mounting Nut

(8) If injector is tight in cylinder head, hit injector body with a brass drift to loosen it (Fig. 98).

(9) It may be necessary to tap the injector with an injector puller tool (Fig. 99). Use Cummins Fuel Injector Removal Tool number 3823276 or equivalent

REMOVAL AND INSTALLATION (Continued)

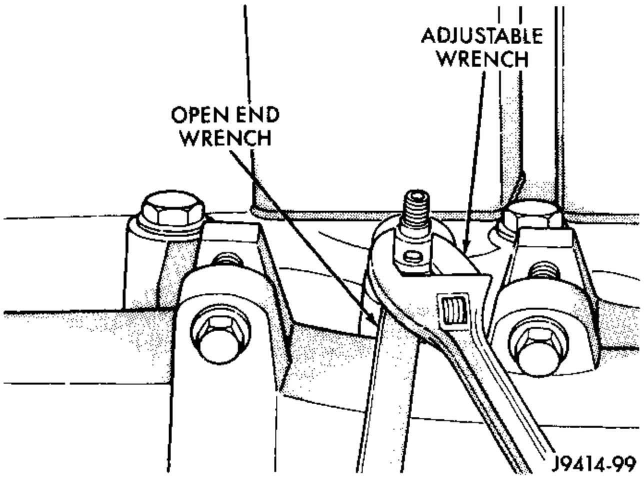


Fig. 96 Loosening Injector Mounting Nut

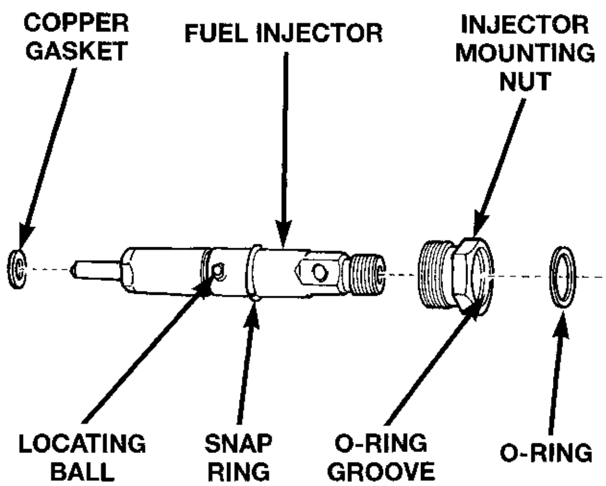


Fig. 97 Fuel Injector Assembly

injector removal tool. If the injector cannot be removed, carbon may have formed at the injector nozzle. In this case, use of carb cleaner is recommended. Spray the carb cleaner along the side of injector bore in the cylinder head. Continue to use the injector removal tool while spraying the injector.

(10) Remove and discard copper washer (gasket) (Fig. 97) from bottom of injector.

INSTALLATION

(1) Clean injector cylinder head bore with special Cummins wire brush tool or equivalent (Fig. 100).

(2) Install a new copper washer to bottom of injector (Fig. 97). Apply a light coating of clean engine oil to this washer. This will keep the washer in place during installation.

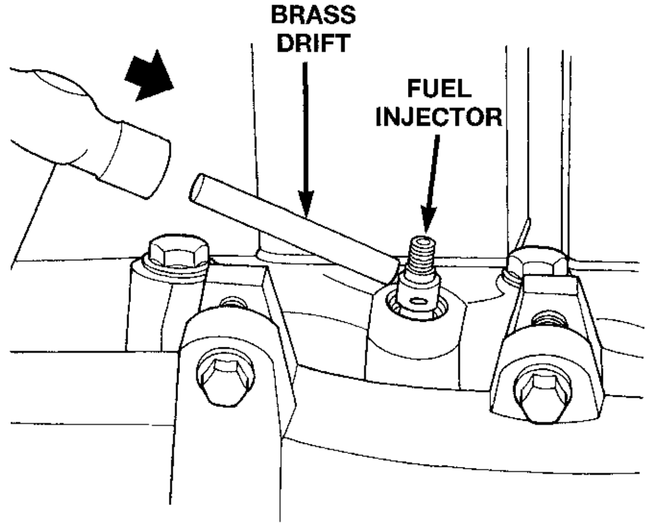


Fig. 98 Loosening Injector Body in Cylinder Head

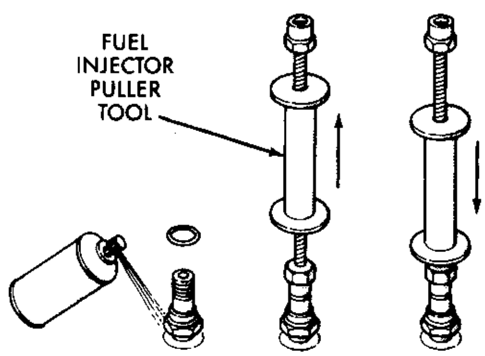


Fig. 99 Removing Injector with Puller Tool

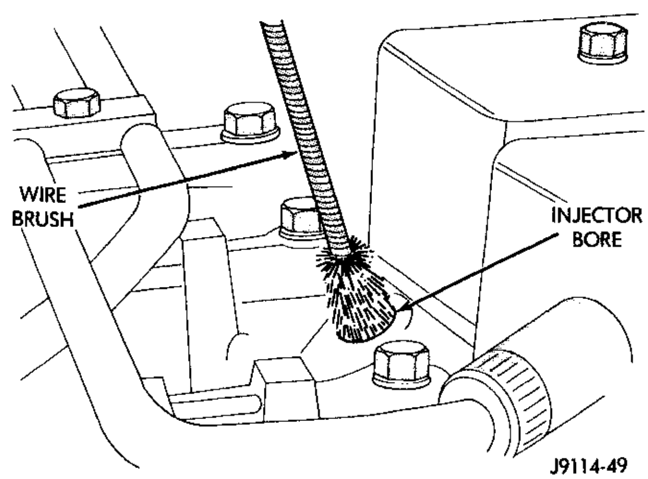


Fig. 100 Cleaning Cylinder Head Injector Bore

REMOVAL AND INSTALLATION (Continued)

(3) Apply a coating of anti-seize compound to the threads of the injector holddown nut and between top of nut and injector body (Fig. 101).

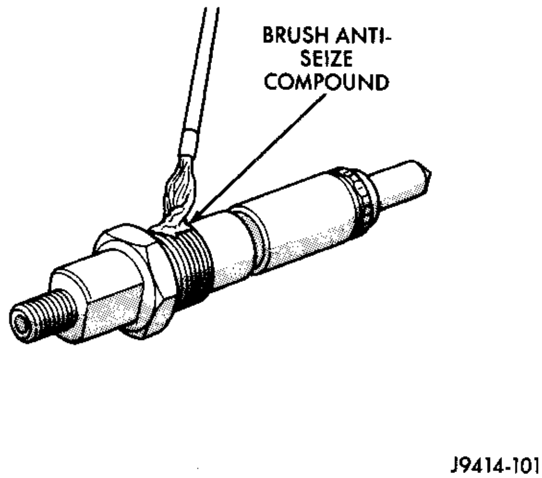


Fig. 101 Apply Anti-Seize Compound

(4) Install injector into cylinder head. **Align ball on side of injector into notch in cylinder head (Fig. 102).**

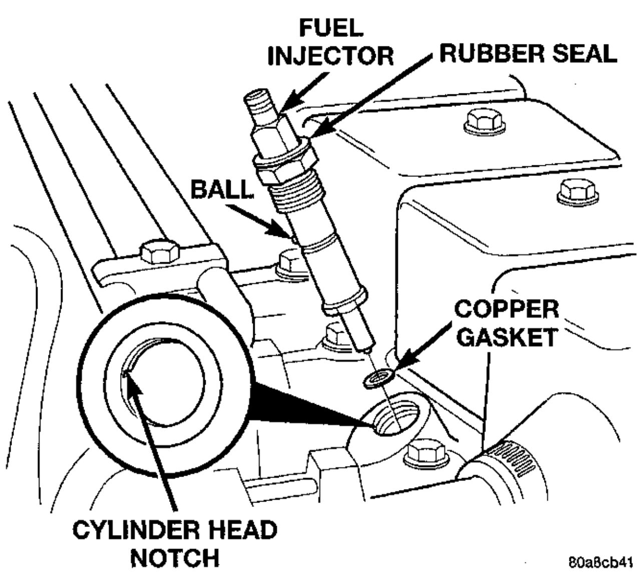


Fig. 102 Installing Injector

(5) Tighten injector holddown nut to 60 N·m (44 ft. lbs.) torque.

(6) After tightening injector holdown (mounting) nut, push the square cut rubber seal into groove on top of injector holdown nut (Fig. 103). This seal will prevent water from entering cylinder head bore.

(7) Connect fuel drain manifold to the injectors. Refer to Fuel Drain Manifold in this section.

(8) Connect high-pressure fuel lines. Refer to High-Pressure Fuel Lines in this section.

(9) Connect negative battery cables to both batteries.

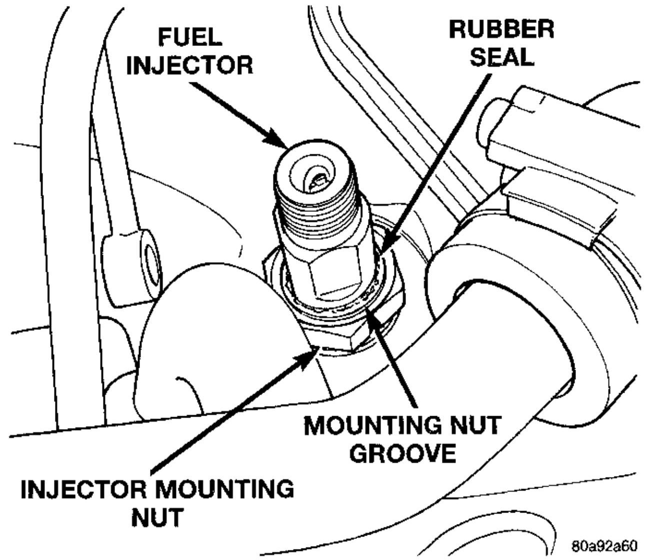


Fig. 103 Rubber Seal at Injector Mounting Nut

(10) Bleed the air from the high-pressure lines. Refer to High-Pressure Line Bleeding in the Air Bleed Procedure section of this group.

FUEL SHUTDOWN SOLENOID

REMOVAL

The fuel shutdown solenoid is mounted to a bracket located on the side of the fuel injection pump (Fig. 104).

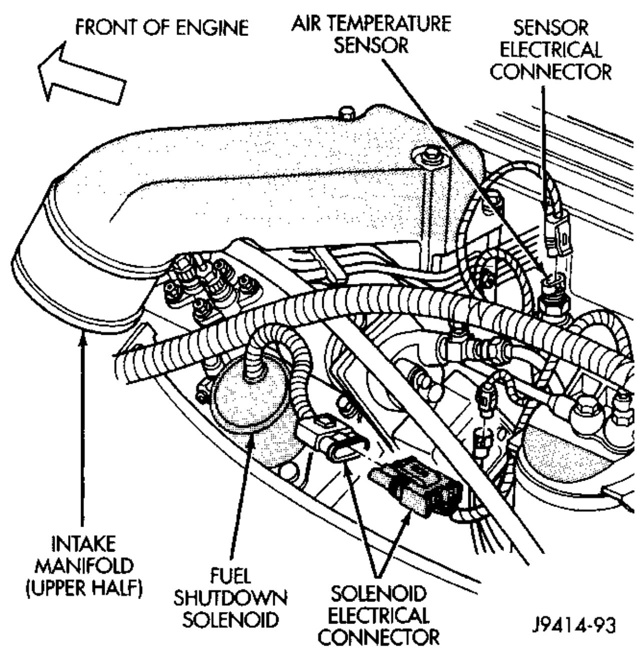


Fig. 104 Fuel Shutdown Solenoid Location

(1) Disconnect the solenoid electrical connector (Fig. 104).

AUTHENTIC RESTORATION PRODUCTS

REMOVAL AND INSTALLATION (Continued)

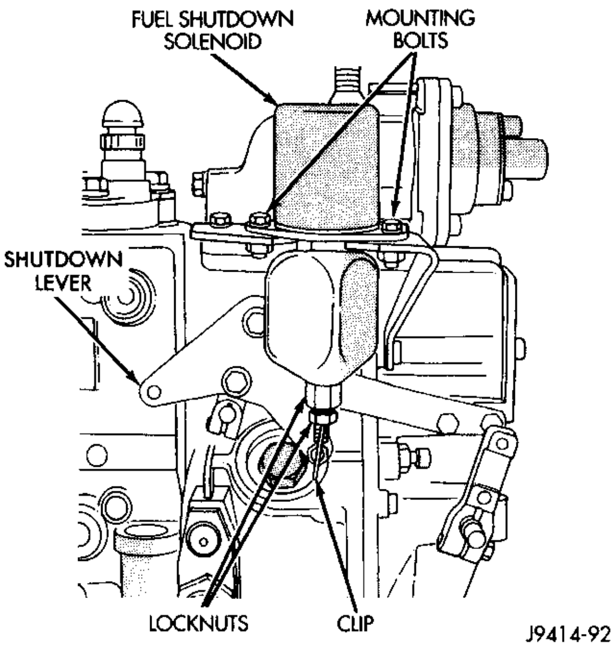


Fig. 105 Fuel Shutdown Solenoid Removal/ Installation

(2) Disconnect clip at injection pump shutdown lever (Fig. 105).
(3) Remove two solenoid mounting bolts.
(4) Remove solenoid from mounting bracket.

INSTALLATION

(1) Position solenoid to mounting bracket and injection pump lever.
(2) Install clip at injection pump lever.
(3) Install and tighten two mounting bolts.
(4) Check and adjust the shaft length of the solenoid. Refer to the following procedure:

SOLENOID SHAFT ADJUSTMENT

After replacing the fuel shutdown solenoid, the solenoid shaft length must be checked and if necessary, adjusted.
(1) Turn the ignition switch ON.
(2) Pull up (by hand) and hold on the solenoid lever (Fig. 106). **If the solenoid is operating correctly, it should remain in the UP position with the key in the ON position.**
(3) Take a measurement from the bottom of the solenoid mounting bracket to the top of the injection pump shutdown lever pin (Fig. 107).
(4) Dimension should be 66.9 mm (2.64 inches).
(5) If adjustment is necessary, loosen the shaft locknut and rotate the adjustment nut (Fig. 108) to attain dimension.

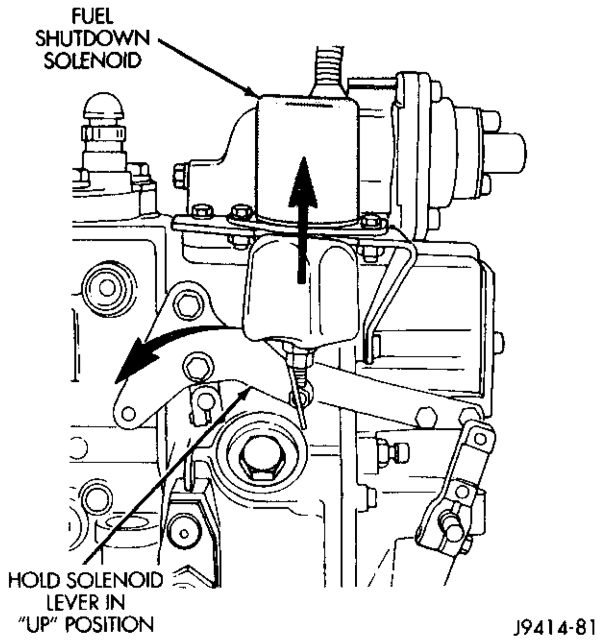


Fig. 106 Fuel Shutdown Solenoid Lever in Up Position

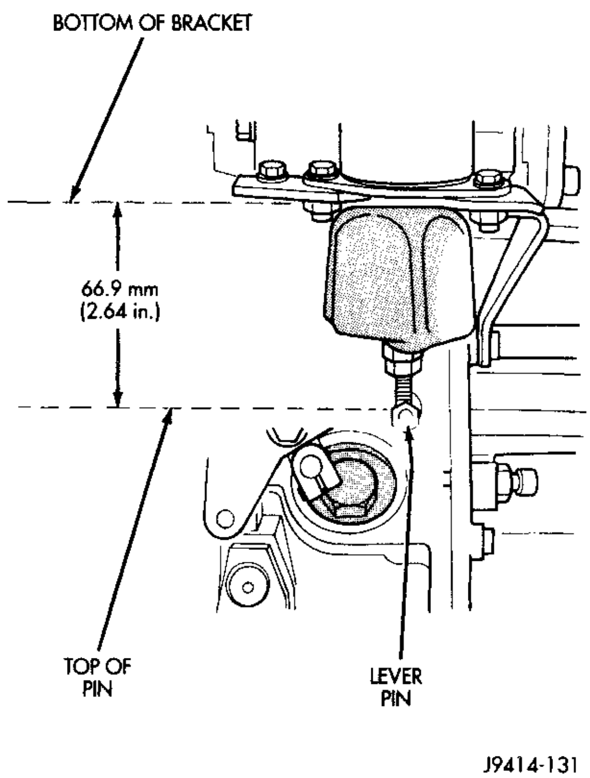


Fig. 107 Solenoid Measurement

REMOVAL AND INSTALLATION (Continued)

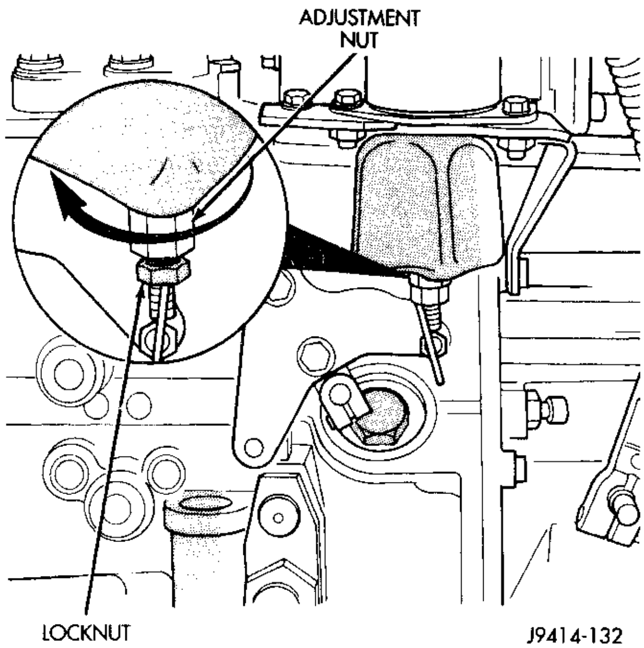


Fig. 108 Solenoid Adjustment

FUEL SHUTDOWN SOLENOID RELAY

The fuel shutdown solenoid relay is located in the engine compartment near the brake master cylinder (Fig. 109).

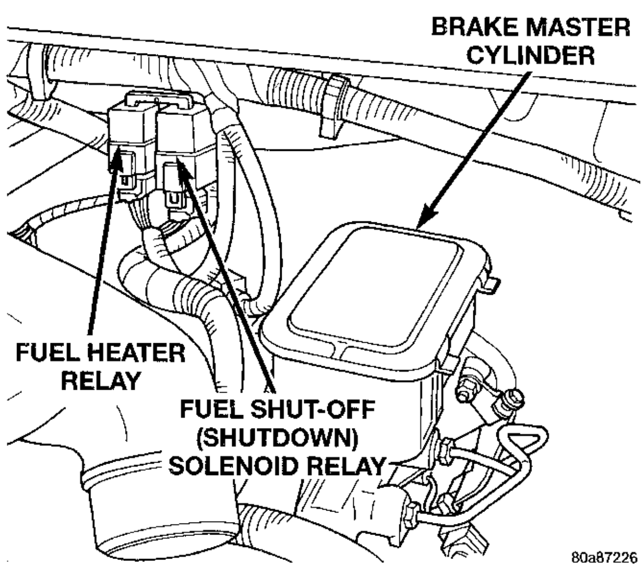


Fig. 109 Fuel Shutdown Solenoid Relay—Diesel

REMOVAL

(1) Disconnect both negative battery cables at both batteries.

(2) Disconnect the electrical connector at the relay.

(3) Remove the relay from the mounting bracket.

INSTALLATION

(1) Check the terminals within connector for damage or corrosion. Also check pin height of terminals within connector. Pin heights should be the same. Repair as necessary before connecting relay.

(2) Install the relay to the mounting bracket.

(3) Connect the electrical connector.

(4) Connect battery cables to both batteries.

FUEL TRANSFER PUMP

For operation of the fuel transfer pump primer button, refer to the Air Bleed Procedure in this group.

The fuel transfer pump (fuel lift pump) is located on the left side of the engine and above the starter motor (Fig. 110). The mounting bracket/spacer for the fuel heater assembly is located between the engine block and the fuel transfer pump (Fig. 111). The fuel heater housing and its bracket assembly must also be removed when removing fuel pump.

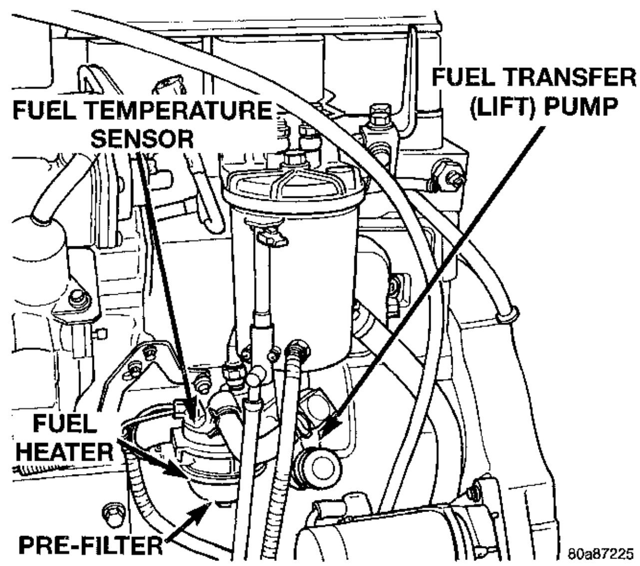


Fig. 110 Fuel Transfer Pump Location

REMOVAL

(1) Disconnect both negative battery cables at both batteries.

(2) Thoroughly clean the area around transfer pump and fuel lines of any contamination.

(3) Remove starter motor. Refer to Starter in Group 8B for procedures.

(4) Place a drain pan below the pump.

(5) Remove fuel line fittings at top of both the fuel pump and fuel heater housing (Fig. 111). Use back-up wrench to prevent damage to fittings.

(6) Remove fuel hose clamps and rubber fuel hose (fuel heater housing-to-fuel pump) (Fig. 111).

(7) The engine camshaft lobe must be at its low point in relation to end of pump piston (Fig. 112). Before removing or installing pump, rotate engine until camshaft is at low point. If cam lobe is at high

REMOVAL AND INSTALLATION (Continued)

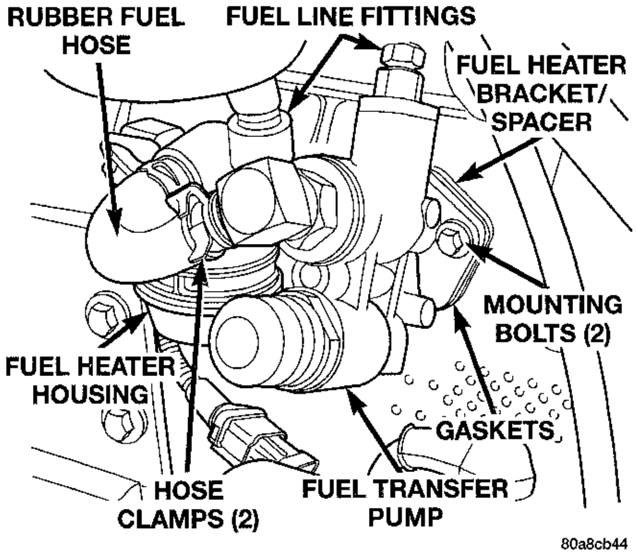


Fig. 111 Pump Removal/Installation

point, removal and installation of pump mounting bolts may be very difficult. Damage to pump may also occur.

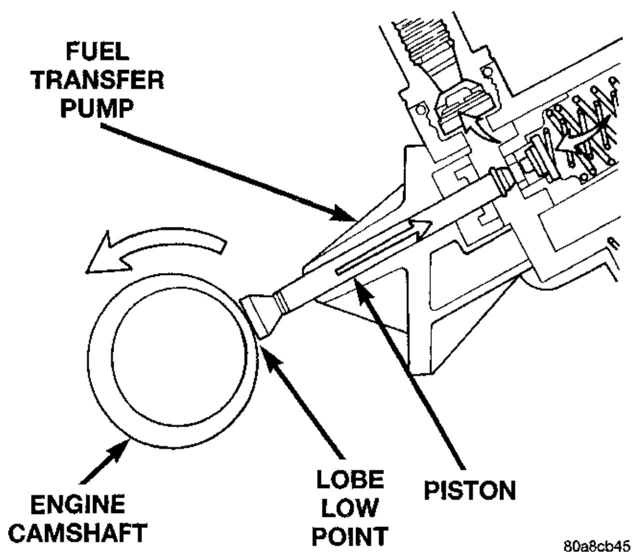


Fig. 112 Fuel Transfer Pump Piston at Engine Camshaft

NOTE: Locate top dead center (TDC) on cylinder #1.

(8) Remove the rubber access plug located in the rear flange of the engine on the exhaust manifold side. (Fig. 113).

NOTE: Removing the #1 cylinder valve cover and first barring (rotating) the engine clockwise until both intake and exhaust valves are closed will speed up locating engine TDC as described later in Step 10.

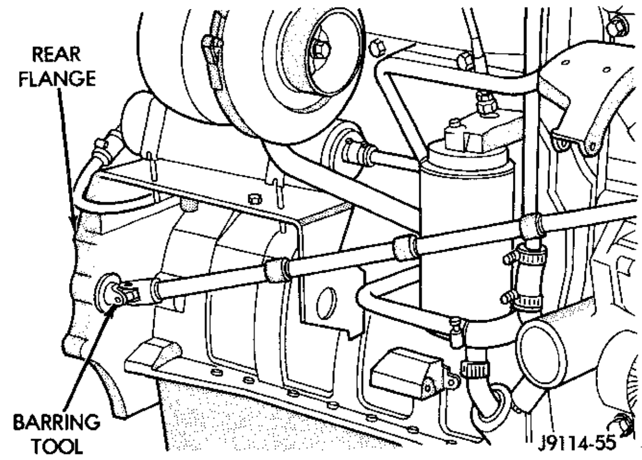


Fig. 113 Rotating Engine With Barring Tool

(9) Insert the barring tool number 7471B through the access hole and into the flywheel housing (Fig. 113).

(10) While holding tension on the timing pin (toward front of engine), slowly rotate the engine with the barring tool. Hold a slight rearward (pushing) pressure on the barring tool and continue to rotate the tool until the timing pin drops into the machined hole in the back of the camshaft gear. When the pin aligns to the gear (Fig. 114), and the intake and exhaust valves are closed at the #1 cylinder, the engine is at the TDC position (compression stroke) at cylinder number 1. **After TDC has been established, remove the pin. This will prevent pin damage when barring (rotating) the engine in later steps.**

NOTE: The pin is located above the power steering pump, below and to the inside of the fuel injection pump, on the rear of the cam gear housing (Fig. 115).

(11) After TDC has been established, rotate engine another 180–270 degrees. The camshaft lobe will now be at its lowest point.

(12) Remove two pump mounting bolts (Fig. 111).

(13) Remove the fuel pump and fuel heater assembly from the engine as one unit.

CAUTION: Do not allow pump plunger (piston) to catch on edge of hole in cylinder block during removal. Plunger may slide out and drop into engine.

INSTALLATION

(1) While fuel heater is off vehicle, disassemble it and clean pre-filter and screen. Install new seals to fuel heater. Refer to Fuel Heater Removal/Installation for procedures.

REMOVAL AND INSTALLATION (Continued)

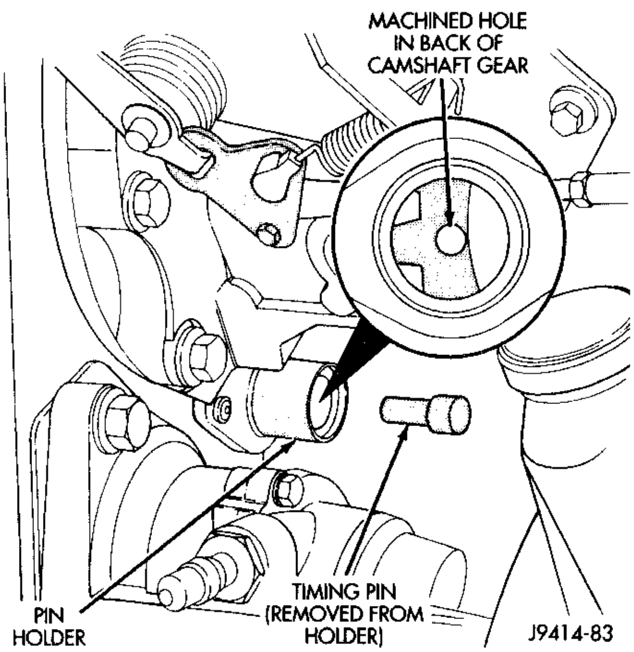


Fig. 114 Back of Camshaft Gear—Typical

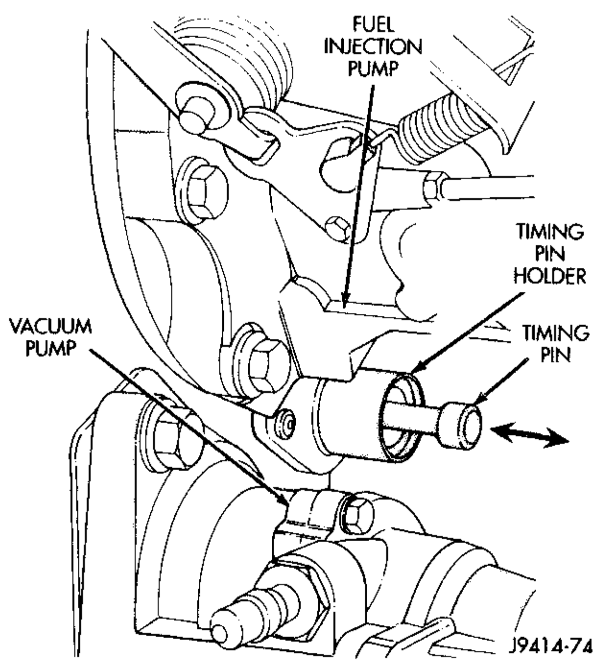


Fig. 115 Timing Pin and Location

(2) Clean the mating surfaces of the fuel heater mounting bracket, the fuel pump and the engine block of any gasket material.

(3) Position the new gaskets, the fuel heater housing mounting bracket and the fuel pump to the engine.

(4) Install the two mounting bolts into the engine. Tighten to 24 N·m (18 ft. lbs.) torque. **As these bolts are tightened, the plunger (piston) within the fuel pump is being compressed. Tighten these two bolts alternately to prevent damage to the fuel pump or camshaft.**

(5) Install fuel line fittings to pump and fuel heater. Tighten to 24 N·m (18 ft. lbs.) torque.

(6) Install a new fuel filter. Refer to Fuel Filter/Water Separator Removal/Installation for procedures.

(7) Install starter motor. Refer to Starter in Group 8B for procedures.

(8) Connect battery cables at both batteries.

(9) Bleed air from fuel system. Refer to the Air Bleed Procedure.

(10) Start engine and check for leaks.

OVERFLOW VALVE

Whenever the fuel injection pump is being replaced or removed for calibration, the overflow valve must stay with the pump. Make sure a new overflow valve is used with a new injection pump and the old (original) overflow valve is returned to the authorized repair facility with the old injection pump.

The overflow valve (pressure relief valve) is located at the inside/front of injection pump (Fig. 116). It connects the fuel return line (banjo fitting) to the pump. The valve has no internal serviceable parts and must be replaced as an assembly. Two sealing gaskets are used. One gasket is located between pump and banjo fitting. The other is located between the banjo fitting and end of valve.

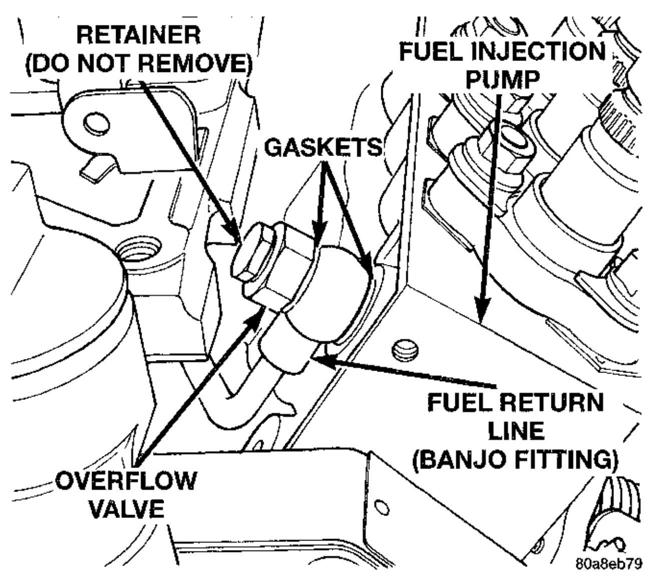


Fig. 116 Overflow Valve Location

REMOVAL

(1) Clean area around overflow valve and fuel return line at injection pump before removal.

(2) Remove valve assembly from pump and banjo fitting. **Do not remove retainer (Fig. 116) from valve. This retainer is spring-loaded.** If fuel

AUTHENTIC RESTORATION PRODUCT

REMOVAL AND INSTALLATION (Continued)

return line must be positioned for removal, very carefully bend line.

(3) Discard old sealing gaskets.

INSTALLATION

(1) Install new sealing gaskets to valve.

(2) Install valve through banjo fitting and into pump.

(3) Tighten to 30 N·m (24 ft. lbs.) torque.

HIGH-PRESSURE FUEL LINES

All high-pressure fuel lines are of the same length and inside diameter. Correct high-pressure fuel line usage and installation is critical to smooth engine operation.

Whenever the high-pressure lines are removed, they should be removed as a bundle (if possible). They should also be tagged for return to original position.

CAUTION: The high-pressure fuel lines must be clamped securely in place in the holders. The lines cannot contact each other or other components. Do not attempt to weld high-pressure fuel lines or to repair lines that are damaged. Only use the recommended lines when replacement of high-pressure fuel line is necessary.

REMOVAL

(1) Disconnect both negative battery cables from both batteries.

(2) Remove the nameplate/cover from the top of the six engine valve covers (two nuts) (Fig. 117).

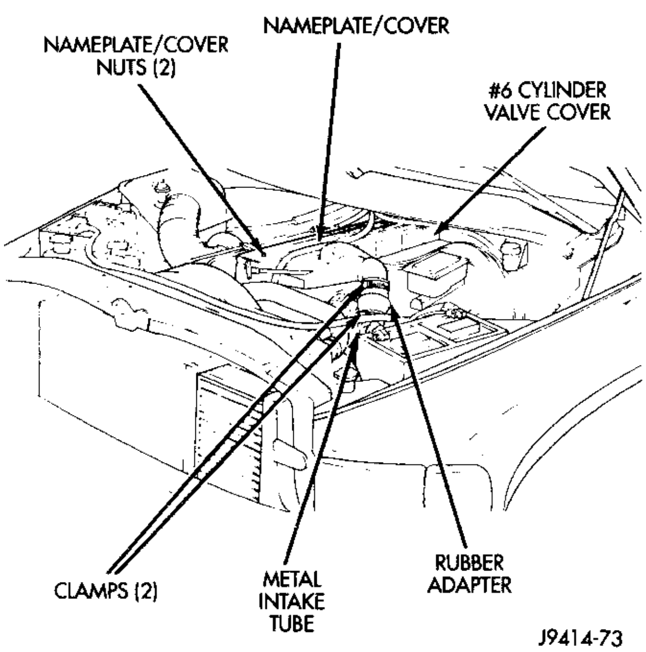


Fig. 117 Nameplate/Cover—Diesel

(3) Remove the necessary clamps holding the lines to the engine.

(4) Clean the area around each line. Disconnect each line at the top of each fuel injector (Fig. 118).

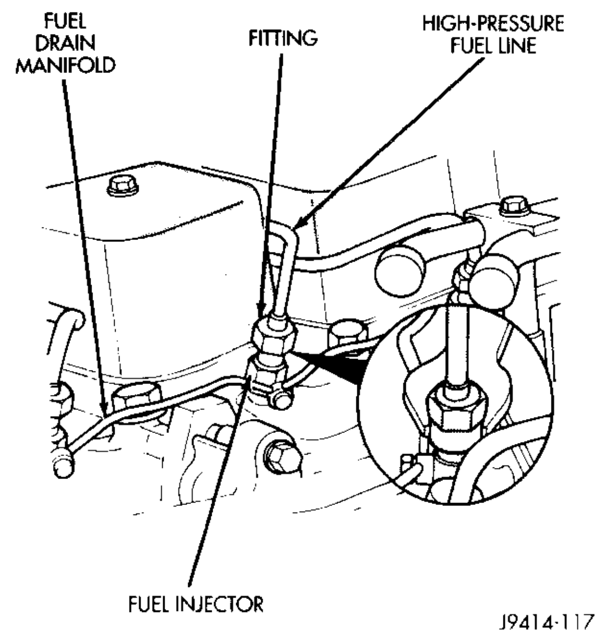


Fig. 118 Fuel Lines at Fuel Injectors

(5) Disconnect each high-pressure line fitting at each fuel injection pump delivery valve holder (Fig. 119).

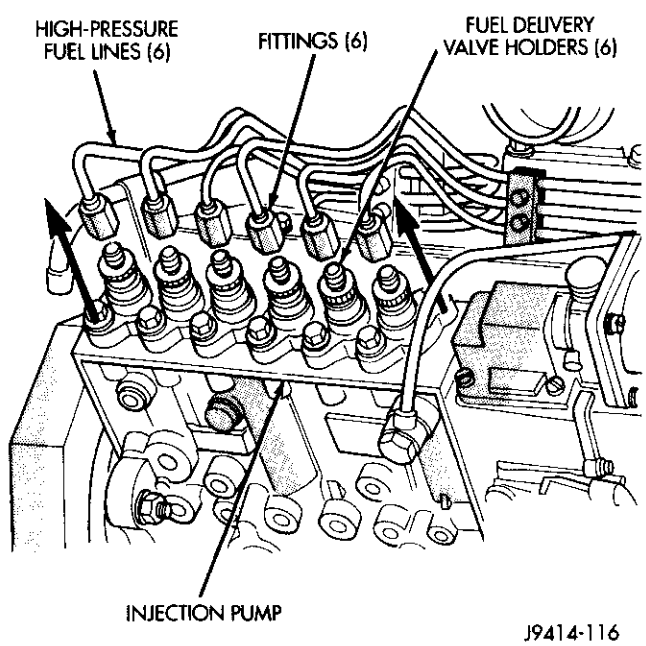


Fig. 119 Fuel Delivery Valve Holders and Pressure Lines

REMOVAL AND INSTALLATION (Continued)

(6) Very carefully remove each line from the engine. **Do not bend the line while removing.**

CAUTION: Be sure that the high-pressure fuel lines are installed in the same order that they were removed.

INSTALLATION

(1) Carefully position each high-pressure fuel line to the fuel injector and fuel injection pump delivery valve holder in the correct firing order. Also position each line in the correct line holder.

(2) Loosely install the line clamp isolator and bracket holder bolts.

(3) Tighten each line at the delivery valve holder to 24 N·m (18 ft. lbs.) torque.

(4) Tighten each line at the fuel injector to 24 N·m (18 ft. lbs.) torque.

CAUTION: Be sure the lines are not contacting each other or any other component. Noise will result.

(5) Tighten the clamp bracket bolts to 24 N·m (18 ft. lbs.) torque.

(6) Bleed air from the fuel system. Refer to High-Pressure Fuel Line Bleeding in the Air Bleed Procedure section of this group.

THROTTLE CABLE

CAUTION: Be careful not to damage or kink the cable core wire (within the cable sheathing) while servicing accelerator pedal or cables.

REMOVAL

(1) From inside the vehicle, hold up the accelerator pedal. Remove the plastic cable retainer and throttle cable core wire from upper end of pedal arm (Fig. 120). The plastic cable retainer snaps into pedal the arm.

(2) Remove the cable core wire at the pedal arm.

(3) From inside the vehicle, pinch both sides of the plastic cable housing retainer tabs at the dash panel (Fig. 120).

(4) Remove cable housing from dash panel and pull the cable into the engine compartment.

(5) Remove the throttle cable socket at fuel injection lever ball (Fig. 121).

(6) A rubber/plastic grommet is molded to the cable (Fig. 121). This grommet is pressed into the back of the cable mounting bracket. Apply lubricant to the rubber grommet (Fig. 121) on both sides of the cable mounting bracket. Work the rubber grommet (rearward) through the mounting bracket with two small screwdrivers. Remove throttle cable from vehicle.

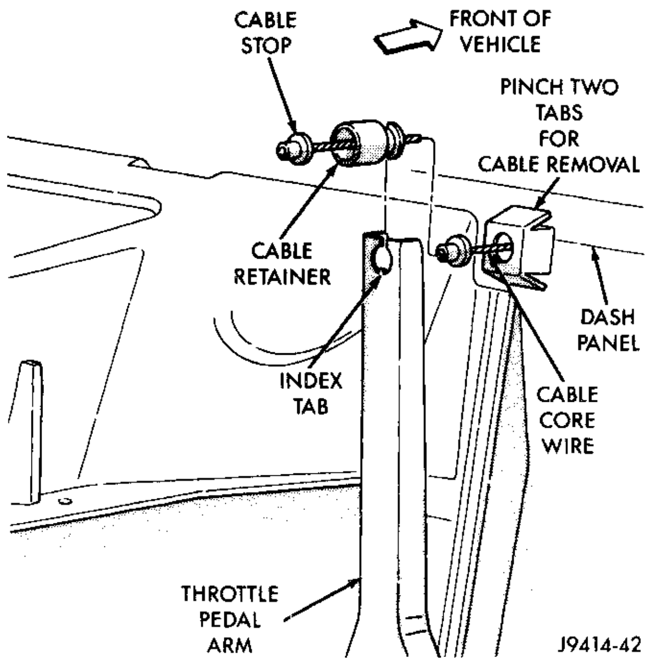


Fig. 120 Cable Removal/Installation

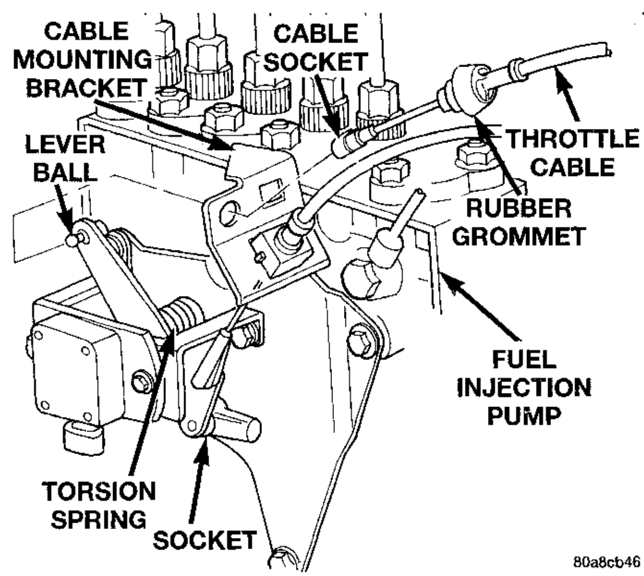


Fig. 121 Throttle Cable at Injection Pump—Diesel Engine

INSTALLATION

(1) Feed the cable through the rear of its mounting bracket (Fig. 121) until the rubber/plastic grommet locks into position on the bracket.

(2) Connect cable end socket to the fuel injection pump lever ball (snaps on).

(3) Install the remaining cable housing end into and through the dash panel opening (snaps into posi-

REMOVAL AND INSTALLATION (Continued)

tion). The two plastic pinch tabs (Fig. 120) should lock the cable to dash panel.

(4) From inside the vehicle, hold up the accelerator pedal. Install the throttle cable core wire and plastic cable retainer into and through the upper end of the pedal arm (the plastic retainer is snapped into the pedal arm). When installing the plastic retainer to the accelerator pedal arm, note the index tab on the pedal arm (Fig. 120). Align the index slot on the plastic cable retainer to this index tab.

SPECIFICATIONS

ENGINE DATA PLATE

If anything differs between the specifications found on the Engine Data Plate, and the specifications used in this manual, use specifications on data plate. The Engine Data Plate is located on the engine timing gear cover (Fig. 122).

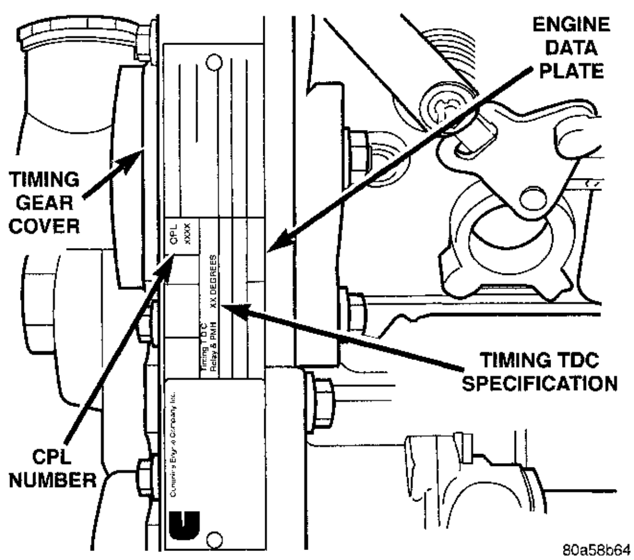


Fig. 122 Engine Data Plate Location

FUEL TANK CAPACITY—DIESEL ENGINE

MODEL	LITERS	U.S. GALLONS
138″ Wheelbase With Extended Cab (Diesel Powered)	129	34
All Other Diesel Powered Models	132	35
Nominal refill capacities are shown. A variation may be observed from vehicle to vehicle due to manufacturing tolerance and refill procedure.		

FUEL SYSTEM PRESSURES—DIESEL ENGINES

DESCRIPTION **PRESSURE**

Fuel Transfer (Lift) Pump Pressure . . . .117–152 kPa (17–22 psi) at idle speed. At 2500 rpm (rated rpm), 172–207 kPa (25–30 psi)

Fuel Injector "Pop Off" Pressure . . . . . .23,400 kPa to 26,800 kPa (234 bars to 268 bars) (3,394 psi to 3,887 psi)

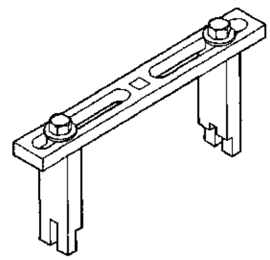
SPECIFICATIONS (Continued)

TORQUE CHART—DIESEL ENGINES

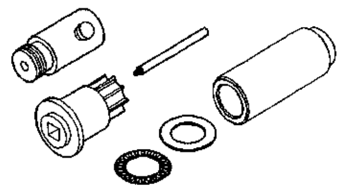
DESCRIPTION	TORQUE
Air-Fuel Control (AFC) Line Fitting	24 N·m (18 ft. lbs.)
Banjo Fitting at top of Filter/Separator	24 N·m (18 ft. lbs.)
Banjo Fitting at side of Fuel Injector	8 N·m (6 ft. lbs.)
Banjo Fitting—Fuel Supply Line at side of Injector Pump	24 N·m (18 ft. lbs.)
Engine Speed Sensor Nuts/Bolts	24 N·m (18 ft. lbs.)
Fuel Drain Manifold Fitting Bolts at Injectors	9 N·m (7 ft. lbs.)
Fuel Filter Mounting Nut	14 N·m (10 ft. lbs.)
Fuel Hose Clamps	1 N·m (15 in. lbs.)
Fuel Injector Retaining Nut	60 N·m (44 ft. lbs.)
Fuel Pump Module Locknut	24–44 N·m (18–32 ft. lbs.)
Fuel Tank Mounting Nuts	41 N·m (30 ft. lbs.)
Fuel Transfer Pump Mounting Bolts	24 N·m (18 ft. lbs.)
High-Pressure Fuel Line Fittings	24 N·m (18 ft. lbs.)
High-Presure Fuel Line Fitting Clamps	6 N·m (4 ft. lbs.)
Injector Pump Access Plug	15 N·m (11 ft. lbs.)
Injection Pump-to-Injection Pump Gear Nut	195 N·m (144 ft. lbs.)
Injection Pump Mounting Nuts	43 N·m (32 ft. lbs.)
Injection Pump Oil Fill Plug	28 N·m (21 ft. lbs.)
Intake Manifold Air Temp. Sensor	28 N·m (20 ft. lbs.)
Intake Manifold Air Heater Relay Bolts	4.5 N·m (40 in. lbs.)
Low-Pressure Bleed Bolt (Screw)	8 N·m (6 ft. lbs.)
Overflow Valve-to-Fuel Injection Pump	30 N·m (24 ft. lbs.)

SPECIAL TOOLS

DIESEL FUEL SYSTEM



Spanner Wrench—6856



Diesel Timing Kit—6714

FUEL INJECTION SYSTEM-DIESEL ENGINE

INDEX

GENERAL INFORMATION

INTRODUCTION

Various components, relays and switches are operated by the powertrain control module (PCM). **This section of the group will cover a description and operation of components controlled by the PCM for vehicles equipped with diesel powered engines.**

Diesel fuel injection system components, except for the intake manifold air heater elements, are **not** directly regulated by the PCM.

Refer to the Fuel Delivery System—Diesel Engine section of this group for fuel components **not** oper-

GENERAL INFORMATION (Continued)

ated or regulated by the PCM. These components are the:

- Fuel tank
- Fuel tank module
- Low and high-pressure fuel supply lines
- Low-pressure, mechanical, fuel transfer pump (fuel lift pump)
- High-pressure fuel injection pump
- Fuel filter/water separator
- Fuel heater
- Fuel heater relay
- Fuel shutdown solenoid
- Fuel shutdown solenoid relay
- High-pressure fuel injectors
- Fuel return line
- Fuel filter (strainer)
- Fuel drain manifold

DESCRIPTION AND OPERATION

POWERTRAIN CONTROL MODULE (PCM)—DIESEL

The powertrain control module (PCM) is located in the right-rear side of the engine compartment (Fig. 1). It is mounted to the dash panel cowl with three bolts. The PCM was formerly referred to as the SBEC or engine controller. Except for operation of the intake manifold air heater elements, the PCM does not regulate or control fuel system operation on the diesel engine.

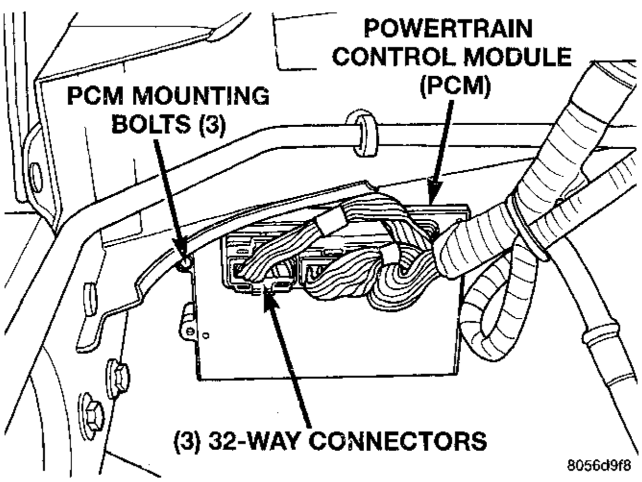


Fig. 1 PCM Location

The PCM is a pre-programmed, triple micro-processor digital computer. Although it does not regulate or control the fuel system on the diesel powered engine, it does operate or regulate the:

- Speed control system
- Charging system
- Certain warning lamps
- Transmission overdrive solenoid
- Torque convertor engagement
- Certain transmission shift features
- ASD relay
- Air conditioning operation
- Tachometer
- Intake manifold air heater

The PCM can adapt its programming to meet changing operating conditions.

The PCM receives input signals from various switches and sensors. Based on these inputs, the PCM regulates various engine and vehicle operations through different system components. These components are referred to as **PCM Outputs.** The sensors and switches that provide inputs to the PCM are considered **PCM Inputs.**

NOTE: PCM Inputs:

- A/C request (if equipped with factory A/C)
- A/C select (if equipped with factory A/C)
- Auto shutdown (ASD) sense
- Battery temperature
- Battery voltage
- Brake switch
- CCD bus (+) circuits
- CCD bus (-) circuits
- Data link connection for DRB scan tool
- Engine coolant temperature sensor (with EGR system)
- Engine speed sensor (rpm)
- Five volt sensor supply (primary)
- Five volt sensor supply (secondary)
- Generator (battery voltage) output
- Intake manifold air temperature sensor
- Oil pressure
- Output shaft speed sensor
- Overdrive/override switch
- Park/neutral switch (auto. trans. only)
- Power ground
- Sensor return
- Signal ground
- Speed control resume switch
- Speed control set switch
- Speed control on/off switch
- Throttle position sensor
- Transmission governor pressure sensor
- Transmission temperature sensor
- Water-in-fuel sensor
- Vehicle speed inputs from ABS or RWAL system

NOTE: PCM Outputs:

After inputs are received by the PCM, certain sensors, switches and components are controlled or regulated by the PCM. These are considered **PCM Outputs.** These outputs are for:

- A/C clutch relay
- Auto shutdown (ASD) relay

DESCRIPTION AND OPERATION (Continued)

- CCD bus (+) circuits (if equipped)
- CCD bus (-) circuits (if equipped)
- Data link connection for DRB scan tool
- EGR valve control solenoid (if equipped)
- Generator field driver (-)
- Generator field driver (+)
- Generator lamp (if equipped)
- Malfunction indicator lamp (Check engine lamp)
- Overdrive warning lamp (if equipped)
- Speed control vacuum solenoid
- Speed control vent solenoid
- Tachometer (if equipped)
- Transmission convertor clutch circuit
- Transmission 3–4 shift solenoid
- Transmission relay
- Transmission temperature lamp (if equipped)
- Transmission variable force solenoid (governor sol.)
- Wait-to-start lamp
- Water-in-fuel lamp
- Intake Manifold Air Heater Element #1
- Intake Manifold Air Heater Element #2

AIR CONDITIONING (A/C) CONTROLS—PCM INPUT

The A/C control system information applies to factory installed air conditioning units.

A/C SELECT SIGNAL: When the A/C switch is in the ON position, an input signal is sent to the powertrain control module (PCM). The signal informs the PCM that the A/C has been selected. The PCM adjusts idle speed to a pre-programmed rpm through the idle air control (IAC) motor to compensate for increased engine load.

A/C REQUEST SIGNAL: Once A/C has been selected, the powertrain control module (PCM) receives the A/C request signal from the clutch cycling pressure switch. The input indicates that the evaporator pressure is in the proper range for A/C application. The PCM uses this input to cycle the A/C compressor clutch (through the A/C relay). It will also determine the correct engine idle speed through the idle air control (IAC) motor position.

If the A/C low-pressure switch or high-pressure switch opens (indicating a low or high refrigerant pressure), the PCM will not receive an A/C request signal. The PCM will then remove the ground from the A/C relay. This will deactivate the A/C compressor clutch.

If the switch opens, (indicating that evaporator is not in proper pressure range), the PCM will not receive the A/C request signal. The PCM will then remove the ground from the A/C relay, deactivating the A/C compressor clutch.

AUTOMATIC SHUTDOWN (ASD) SENSE—PCM INPUT

A 12 volt signal at this input indicates to the PCM that the ASD has been activated. The ASD relay is located in the power distribution center (PDC). The PDC is located in the engine compartment. For the location of the relay within the PDC, refer to PDC cover.

This input is used only to sense that the ASD relay is energized. If the powertrain control module (PCM) does not see 12 volts + at this input when the ASD should be activated, it will set a diagnostic trouble code (DTC).

BATTERY VOLTAGE—PCM INPUT

The battery voltage input provides power to the powertrain control module (PCM). It also informs the PCM what voltage level is being supplied by the generator once the vehicle is running.

The battery input also provides the voltage that is needed to keep the PCM memory alive. The memory stores diagnostic trouble code (DTC) messages, minimum and maximum TPS value from the previous key-on and speed control adaptive memory.

BATTERY TEMPERATURE SENSOR—PCM INPUT

Provides a signal to the PCM corresponding to the battery temperature. Refer to Group 8C, Charging System for additional information.

BRAKE SWITCH—PCM INPUT

When the brake light switch is activated, the powertrain control module (PCM) receives an input indicating that the brakes are being applied. After receiving this input, the PCM is used to control the speed control system. It is also used for electrical operation of the transmission torque converter.

ENGINE SPEED SENSOR—PCM INPUT

The engine speed (rpm) sensor is mounted to the front of engine (Fig. 2). It generates an rpm signal to the PCM. The engine speed sensor input is used along with the vehicle speed sensor and throttle position sensor (TPS) inputs to determine when to shift the automatic transmission into and out of overdrive. The speed sensor signal is also used as an input for the ASD relay (for control of generator field), vehicle speed control, torque convertor electrical engagement and instrument panel mounted tachometer.

INTAKE MANIFOLD AIR TEMPERATURE SENSOR—PCM INPUT

The intake manifold air temperature sensor is a variable, thermistor type. It reacts to temperature changes. At cold air temperatures, its resistance is

DESCRIPTION AND OPERATION (Continued)

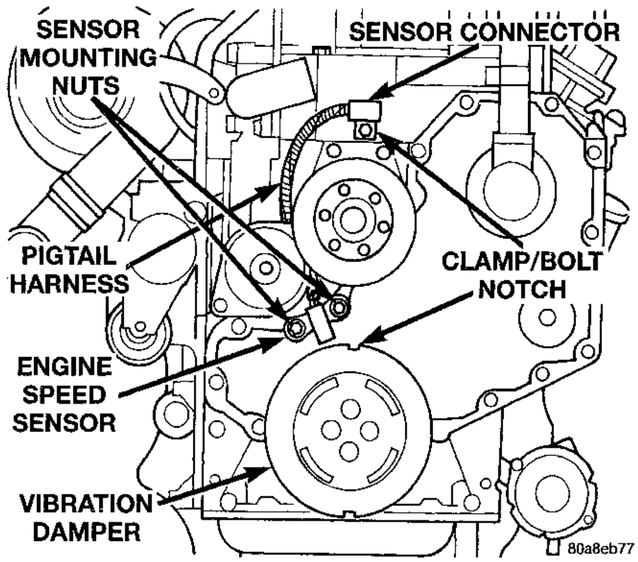


Fig. 2 Engine Speed Sensor Location—Diesel

high. As temperatures increase, its resistance will decrease.

The air temperature sensor element extends into the intake manifold air stream. It provides an input voltage to the PCM indicating intake manifold air temperature. The input from this sensor is used by the PCM to determine if and how long to activate the intake manifold air heater relays. When the relays are activated, current will flow through the relays to the intake manifold air heater element.

As the temperature of the air-fuel stream in the manifold varies, the sensor resistance will change. This will result in a different input voltage to the PCM.

The sensor is located on the top of the intake manifold and to the rear of the intake manifold air heater (Fig. 3).

Also refer to Intake Manifold Air Heater Relays for additional information.

INTAKE MANIFOLD AIR HEATER

The intake manifold air heater element assembly is located in the top of the intake manifold (Fig. 4).

The air heater is used to heat incoming air to the intake manifold to help engine starting and improve driveability with cool or cold outside temperatures.

Two heavy-duty cables (Fig. 5) connect the 2 air heater elements to the 2 air heater relays. Each of these cables will supply approximately 95 amps at 12 volts to an individual heating element within the heater block assembly.

Electrical supply for the 2 air heater elements (Fig. 5) is controlled by the powertrain control module (PCM) through the 2 air heater relays. Refer to Intake Manifold Air Heater Relays for more information.

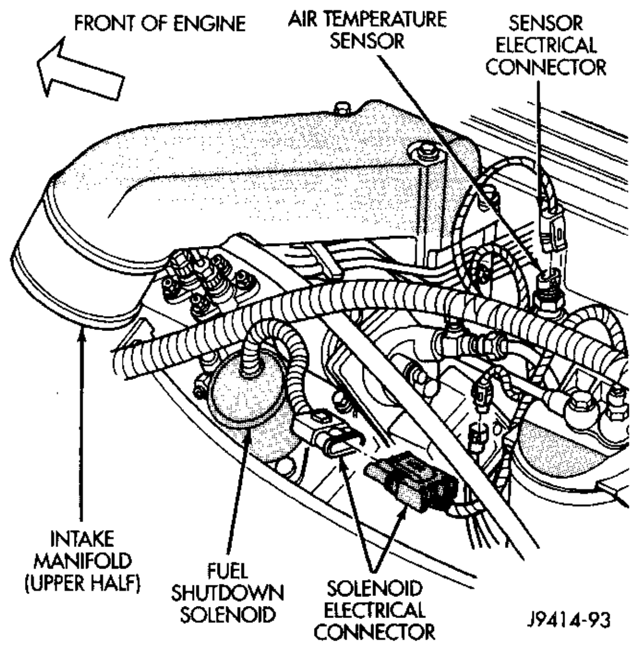


Fig. 3 Air Temperature Sensor Location—Diesel

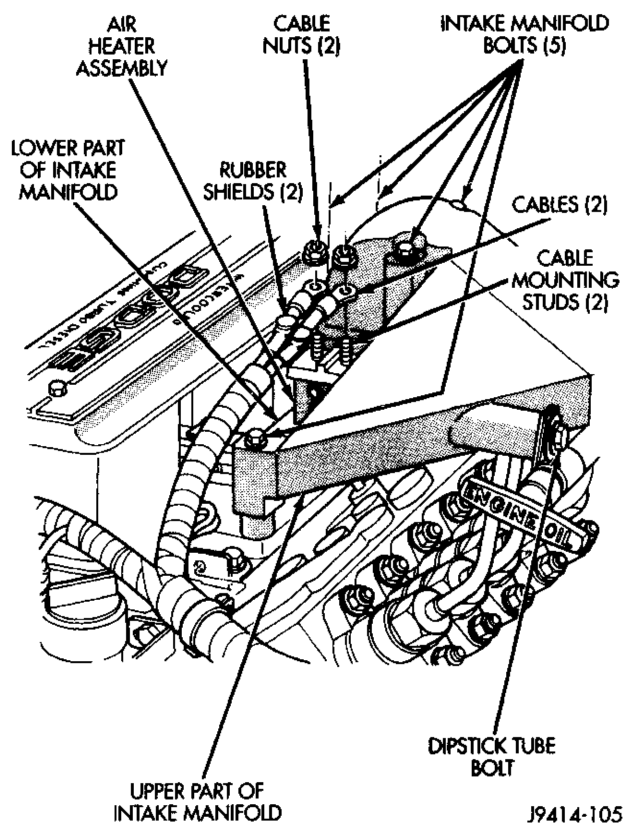


Fig. 4 Air Heater Location

AUTHENTIC RESTORATION PRODUCT

DESCRIPTION AND OPERATION (Continued)

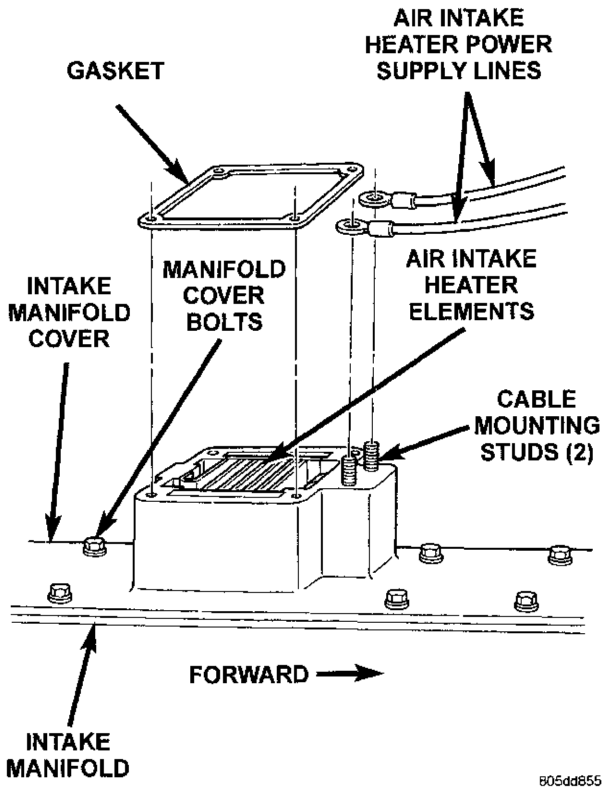


Fig. 5 Air Heater Elements

INTAKE MANIFOLD AIR HEATER RELAYS—PCM OUTPUT

The 2 relays are located in the engine compartment below the left battery (Fig. 6).

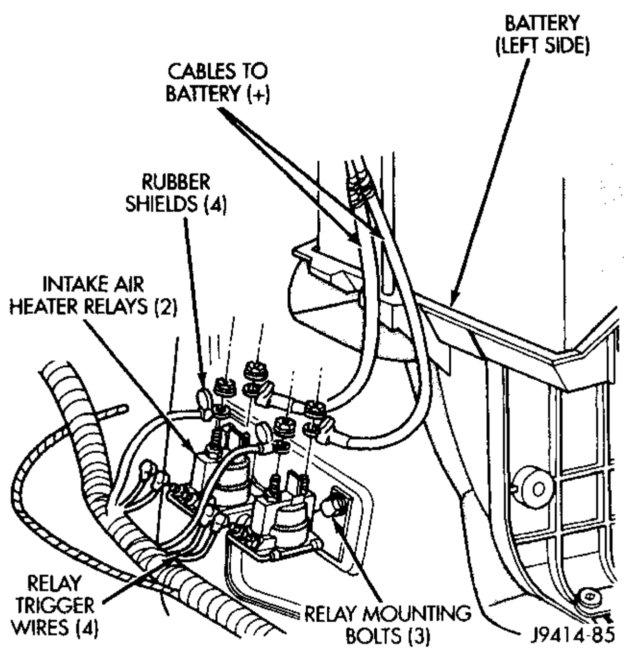


Fig. 6 Intake Manifold Air Heater Relays

The powertrain control module (PCM) operates the 2 heating elements within the air heater assembly through the 2 intake manifold air heater relays. The air heater elements are used to heat incoming air flowing into the intake manifold. This will help engine starting and improve driveability with cool or cold outside temperatures.

The relays may be energized by the PCM before and after cranking. This will depend on inputs the PCM receives from: the intake manifold air temperature sensor, the engine speed sensor and the vehicle speed sensor.

With a cool or cold engine, the air heater relays and the air heater elements may be activated for a maximum time of approximately 3 1/2 minutes. Refer to the following Air Heater Cycle Chart for a temperature/time comparison of relay engagement.

In this chart, Pre-Heat and Post-Heat times are mentioned. Pre-heat is the amount of time the relay circuits are activated when the ignition (key) switch is ON, but the engine has yet to be started. Post-heat is the amount of time the relay circuits are activated after the engine is operating.

The wait-to-start warning lamp is tied to this circuit. Lamp operation is also controlled by the PCM. The wait-to-start warning lamp **will not** be illuminated during the post-heat cycle.

The relays are not energized during engine cranking. When initially energized, they will make a clicking noise.

PREHEAT CYCLE

The PCM will supply a signal to the 2 relays when the ignition (key) switch is initially turned to the ON position. When this signal is supplied, electrical current is passed through the relays for operation of the 2 heating elements.

If the intake manifold air temperature is 15-19°C (59-66°F) or below, the air heater elements are energized and the wait-to-start warning lamp is illuminated. The heater is energized for a specific amount of time. Refer to the following Air Heater Cycle Chart for a temperature/time comparison of relay engagement.

Once the heater has cycled, the wait-to-start warning lamp goes out.

While the engine is cranked, the heater relays are not energized.

POST-HEAT CYCLE

After the pre-heat cycle is completed, the PCM must receive an engine crank signal (engine speed between 32 and 475 rpm) followed by an engine run signal (engine speed above 475 rpm). Intake manifold air temperature must also be below 15–19°C (59–66°F). All of these signals must be seen by the PCM before initiating the post-heat cycle.

DESCRIPTION AND OPERATION (Continued)

Depending upon intake manifold air temperature, engine rpm and predetermined PCM values, one or both of the relays and one or both of the heating elements may be activated. This may be observed as a large needle swing on the vehicle voltmeter and is due to the high-amperage draw of the heating elements. Each heating element will draw approximately 95 amps at 12 volts. **This voltmeter movement is a normal condition during the post-heat cycle.**

Refer to the following Air Heater Cycle Chart for a temperature/time comparison of relay engagement.

The PCM is also programmed with battery saving features. It will shut down the air heater relays if:

- the engine starter is operated during the pre-heat cycle.
- the engine stalls during the post-heat cycle.
- the engine starter is operated for more than 10 seconds during the post-heat cycle.
- the vehicle speed is above 18 mph during the post-heat cycle.

The post-heat cycle will continue for up to 3 1/2 minutes unless the PCM determines one or more of these preceding features interrupts the cycle strategy.

AIR HEATER CYCLE CHART

INTAKE MANIFOLD TEMPERATURE-KEY IN ON POSITION	PRE-HEAT CYCLE TIME-KEY ON, ENGINE NOT RUNNING	POST-HEAT CYCLE -IGNITION ON, ENGINE RUNNING
Above 15-19° C (59-66° F)	0 Seconds	No
-10° C to +19° C (15° F to 66° F)	10 Seconds	Yes
-18° C to -10° C (0° F to 15° F)	15 Seconds	Yes
Below -18° C (0° F)	30 Seconds	Yes

SPEED CONTROL SWITCHES—PCM INPUT

Six different speed control functions, using three momentary contact switches, are monitored through this **multiplexed** input. The resistance monitored at this input, in combination with the length of time the PCM measures the resistance, determines which switch feature has been selected. The three switches are: On/Off, Set/Coast, Cancel and Resume/Accelerate.

Refer to Group 8H, Vehicle Speed Control System for further speed control information.

PARK/NEUTRAL POSITION SWITCH—PCM INPUT

The park/neutral switch provides an input to the powertrain control module (PCM). This will indicate that the automatic transmission is in Park, Neutral or a Drive gear selection. This input is used to determine speed control strategy and electrical operation of both the overdrive and torque convertor solenoids. Refer to Group 21, Transmissions, for testing, replacement and adjustment information.

THROTTLE POSITION SENSOR—PCM INPUT

The throttle position sensor (TPS) is used only on diesel powered engines equipped with an automatic transmission and/or an EGR system.

The TPS is mounted on the side of the fuel injection pump (Fig. 7). The TPS provides an input to the PCM. It senses how far the throttle is open (past the idle position). The PCM uses the TPS input, along with vehicle speed sensor and engine speed sensor inputs to determine 3-4 upshift (overdrive) and 4-3 downshift. It is also used with the vehicle speed sensor and engine speed sensor inputs to engage and disengage the torque convertor solenoid. This solenoid is used for torque convertor engagement.

The TPS is a linear potentiometer. The PCM supplies 5 volts to the sensor. TPS output voltage to the PCM will vary. At idle speed, the voltage should be 1.0 volt (± .2 volts). At wide open throttle (WOT), the output voltage must be 2.2-to-2.9 volts higher than at idle speed.

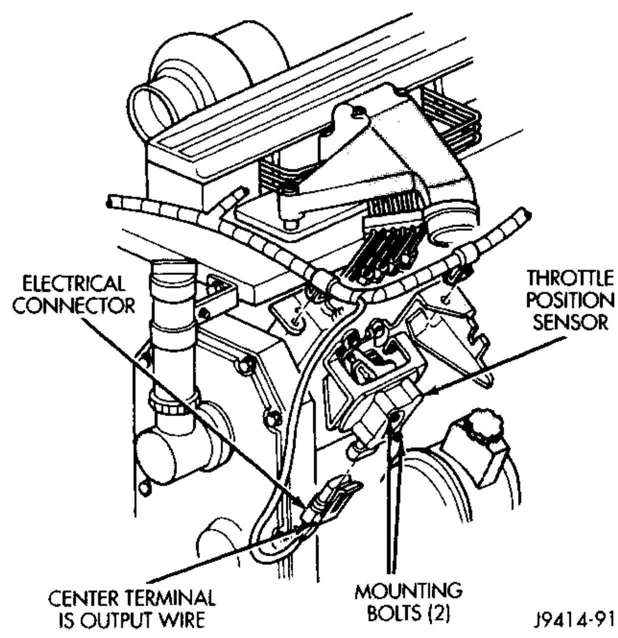


Fig. 7 Throttle Position Sensor Location—Diesel

TRANSMISSION TEMPERATURE SENSOR—PCM INPUT

DIESEL WITH AUTOMATIC TRANSMISSIONS ONLY

The transmission temperature sensor is a variable, thermistor type. It reacts to temperature changes. At

DESCRIPTION AND OPERATION (Continued)

cold transmission oil temperatures, its resistance is high. As temperatures increase, its resistance will decrease.

The transmission temperature sensor is used on models equipped with an automatic transmission. Its purpose is to help control transmission fluid overheating. If transmission overheating has been determined by this sensor (temp. above approximately 280 degrees F), an input is sent to the powertrain control module (PCM). The PCM will then force a 4-3 downshift. Once transmission temperature has cooled below specifications, a 3-4 upshift will be allowed. An instrument panel mounted transmission temperature warning lamp is also used.

This sensor is located in the transmission cooling line on the side of the transmission (Fig. 8).

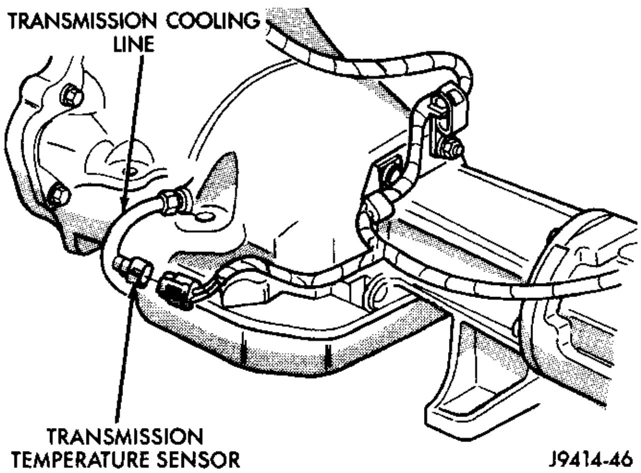


Fig. 8 Transmission Temperature Sensor Location—Typical

TRANSMISSION GOVERNOR PRESSURE SENSOR—PCM INPUT

Provides a signal proportional to the transmission governor pressure. It provides feedback for control of the governor pressure solenoid, which regulates transmission governor pressure. This input is used with 4–speed electronic transmissions only.

VEHICLE SPEED AND DISTANCE—PCM INPUT

The Vehicle Speed Sensor (VSS) is no longer used for any Dodge truck in the 1998 model year.

Vehicle speed and distance covered are measured by the Rear Wheel Speed Sensor. The sensor is mounted to the rear axle. A signal is sent from this sensor to the Controller Antilock Brake (CAB) computer. A signal is then sent from the CAB to the Powertrain Control Module (PCM) to determine vehicle speed and distance covered. The PCM will then determine strategies for fuel system and speed control system operation.

Refer to Odometer and Trip Odometer in Group 8E, Instrument Panel for additional information.

WATER-IN-FUEL SENSOR—PCM INPUT

The water-in-fuel (WIF) sensor is located at the bottom of the fuel filter/water separator canister (Fig. 9).

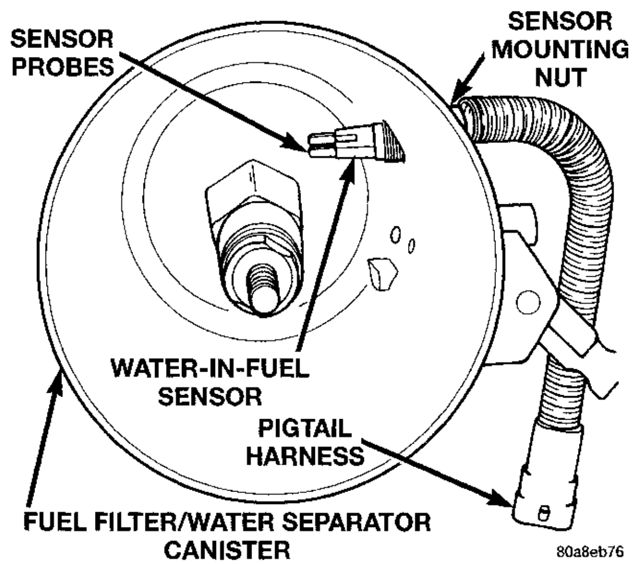


Fig. 9 Water-in-Fuel Sensor Location

The sensor sends an input to the powertrain control module (PCM) when it senses water in the fuel filter/water separator. As the water level in the filter/separator increases, the resistance across the WIF sensor decreases. This decrease in resistance is sent as a signal to the PCM and compared to a high water standard value. Once the value reaches 30 to 40 kilohms, the PCM will activate the instrument panel mounted, water-in-fuel warning lamp. This all takes place when the ignition key is initially put in the ON position. The PCM continues to monitor the input at the end of the intake manifold air heater post-heat cycle.

WATER-IN-FUEL WARNING LAMP—PCM INPUT

The PCM turns the water-in-fuel indicator lamp to the ON position if water is detected in the fuel. The water-in-fuel indicator lamp is located in the instrument panel. The lamp will illuminate for about two seconds each time the ignition key is initially turned to the ON position as a bulb check.

Also refer to Water-In-Fuel Sensor—PCM Input for additional information.

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DESCRIPTION AND OPERATION (Continued)

AIR CONDITIONING CLUTCH RELAY—PCM OUTPUT

The A/C relay is located in the Power Distribution Center (PDC) (Fig. 10). Refer to label on PDC cover for relay location.

The powertrain control module (PCM) activates the A/C compressor through the A/C clutch relay. The PCM regulates A/C compressor operation by switching the ground circuit for the A/C clutch relay on and off.

The PCM will also de-energize the relay if coolant temperature exceeds 125°C (257°F).

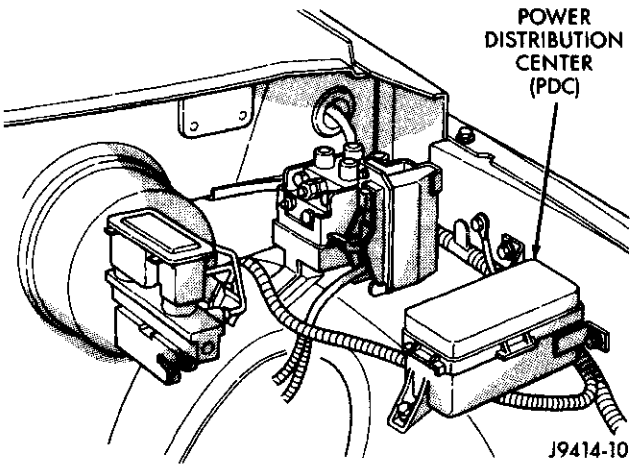

Fig. 10 Power Distribution Center (PDC) Location

AUTOMATIC SHUTDOWN (ASD) RELAY—PCM OUTPUT

This circuit controls operation of the ASD relay. It provides the necessary power to operate the generator field control for charging system operation.

The ASD relay is located in the power distribution center (PDC). The PDC is located in the engine compartment. For location of relay within the PDC, refer to PDC cover.

GENERATOR FIELD SOURCE (+)—PCM OUTPUT

This output from the Powertrain Control Module (PCM) regulates charging system voltage to the generator field source (+) circuit. The voltage range is 12.9 to 15.0 volts. Models of previous years had used the ASD relay (directly) to apply the 12 volt + power supply to the generator field source (+) circuit. Refer to Groups 8A and 8C for charging system information.

GENERATOR FIELD DRIVER (-)—PCM OUTPUT

This output from the Powertrain Control Module (PCM) regulates charging system ground control to the generator field driver (-) circuit. Refer to Groups 8A and 8C for charging system information.

GENERATOR LAMP—PCM OUTPUT

If the powertrain control module (PCM) senses a low charging condition in the charging system, it will illuminate the generator lamp (if equipped) on the instrument panel. For example, during low idle with all accessories turned on, the lamp may momentarily go on. Once the PCM corrects idle speed to a higher rpm, the lamp will go out. Refer to Groups 8A and 8C for charging system information.

DATA LINK CONNECTOR—PCM INPUT AND OUTPUT

The 16–way data link connector (diagnostic scan tool connector) links the Diagnostic Readout Box (DRB) scan tool or the Mopar Diagnostic System (MDS) with the powertrain control module (PCM). The data link connector (Fig. 11) is located at lower edge of instrument panel near steering column. For operation of the DRB scan tool, refer to the appropriate Powertrain Diagnostic Procedures service manual.

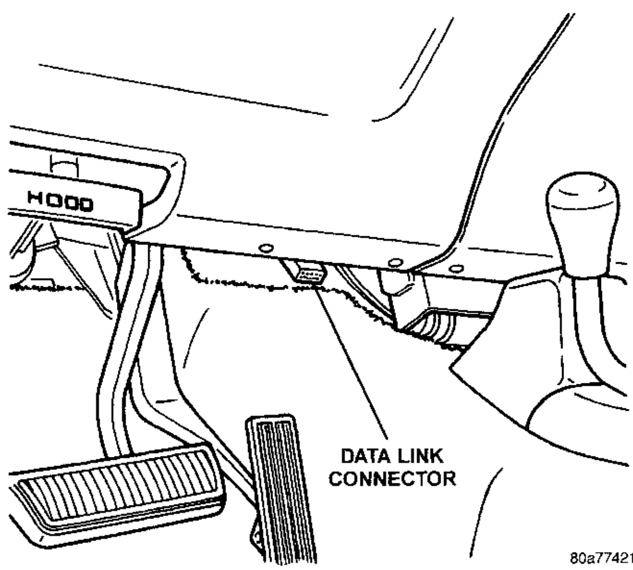

Fig. 11 16–Way Data Link Connector

MALFUNCTION INDICATOR LAMP—PCM OUTPUT

Refer to Group 25, Emission Control System for information.

OVERDRIVE LAMP—PCM OUTPUT

This circuit controls a signal for the operation of the instrument panel mounted push-button overdrive lamp switch. When the lamp is illuminated, the overdrive is disengaged.

OVERDRIVE/OVERRIDE SWITCH-PCM INPUT

On vehicles equipped with an automatic transmission and overdrive, the powertrain control module (PCM) regulates the 3-4 overdrive up-shift and down-

AUTHENTIC RESTORATION PRODUCT

DESCRIPTION AND OPERATION (Continued)

shift through the overdrive solenoid. This solenoid is located in the transmission. An overdrive/override push-button switch is located at the end of the shift lever.

The overdrive/override push-button switch is normally open (overdrive allowed) when the lamp is not illuminated. It momentarily closes (overdrive not allowed) when the operator presses the switch and the lamp is illuminated. Overdrive will revert to ON (lamp off) each time the ignition switch in turned on. The transmission downshifts if the operator presses the override switch while in overdrive.

Refer to Group 21 for more transmission information.

SPEED CONTROL SOLENOIDS—PCM OUTPUT

Speed control operation is regulated by the powertrain control module (PCM). The PCM controls the vacuum to the throttle actuator through the speed control vacuum and vent solenoids. Refer to Group 8H for Speed Control Information.

TACHOMETER—PCM OUTPUT

The powertrain control module (PCM) supplies engine rpm values to the instrument cluster tachometer. Refer to Group 8E for tachometer information.

TORQUE CONVERTOR CLUTCH (TCC) SOLENOID—PCM OUTPUT

This circuit controls operation of the transmission mounted torque convertor clutch (TCC) solenoid used for torque convertor engagement.

The powertrain control module (PCM) will determine when to engage and disengage the solenoid by monitoring vehicle miles per hour (mph) versus the output voltage of the throttle position sensor. Also needed are various inputs from:

- Transmission temperature sensor
- Output shaft speed sensor
- Module timer
- Engine rpm
- Throttle position sensor (if equipped)
- Brake switch

TRANSMISSION TEMPERATURE WARNING LAMP—PCM OUTPUT

AUTOMATIC TRANSMISSION ONLY

An instrument panel mounted lamp is used to warn of a possible transmission fluid overheating condition. When transmission fluid temperature has been determined to be above approximately 280 degrees F by the transmission temperature sensor, a signal is sent to the powertrain control module (PCM). The PCM will then control warning lamp operation. The lamp will illuminate for about two seconds each time the ignition key is initially turned to the ON position as a bulb check.

This feature is used with certain heavy-duty automatic transmissions only.

Also refer to Transmission Temperature Sensor—PCM Input for additional information.

WAIT-TO-START LAMP WARNING LAMP—PCM OUTPUT

The wait-to-start warning lamp is turned on and off by the PCM based on the intake manifold air temperature sensor input. The lamp is located on the instrument panel.

The lamp is turned on when the ignition is first activated. If the PCM reads intake manifold air temperature below 15–19°C (59–66°F), it will turn the wait-to-start warning lamp on for the air heater preheat cycle. The lamp stays on until the preheat cycle is over.

The wait-to-start lamp will flash on and off if the intake manifold air temperature sensor input to the PCM is below minimum value or above maximum value. The PCM stores a DTC when these conditions occur.

Refer to Intake Manifold Air Heater for additional information.

DIAGNOSIS AND TESTING

VISUAL INSPECTION

A visual inspection should be made before attempting to diagnose or service the diesel fuel injection system. A visual check will help find these conditions. It also saves unnecessary test and diagnostic time. A thorough visual inspection of the fuel injection system includes the following checks:

(1) Verify pigtail electrical connector from water-in-fuel (WIF) sensor is firmly attached to main engine wiring harness. The WIF sensor is located on side of Fuel Filter/Water Separator canister. Inspect connector for corrosion or damaged wires.

(2) Check for water in fuel filter/water separator. A water drain is supplied on the filter/separator. Refer to Fuel Filter/Water Separator Removal/Installation for water draining operation.

(3) Verify fuel filter has been serviced according to Maintenance Schedules in Group 0, Lubrication and Maintenance.

(4) Verify pre-filter (within fuel heater) has been cleaned when fuel filter was serviced.

(5) Inspect air cleaner element (filter) for restrictions by using the built-on Filter Minder™ (Fig. 12). Do not remove the top of air cleaner housing to inspect condition of air cleaner element. Refer to Air Cleaner Housing/Air Cleaner Element in the Removal/Installation section for Filter Minder information.

DIAGNOSIS AND TESTING (Continued)

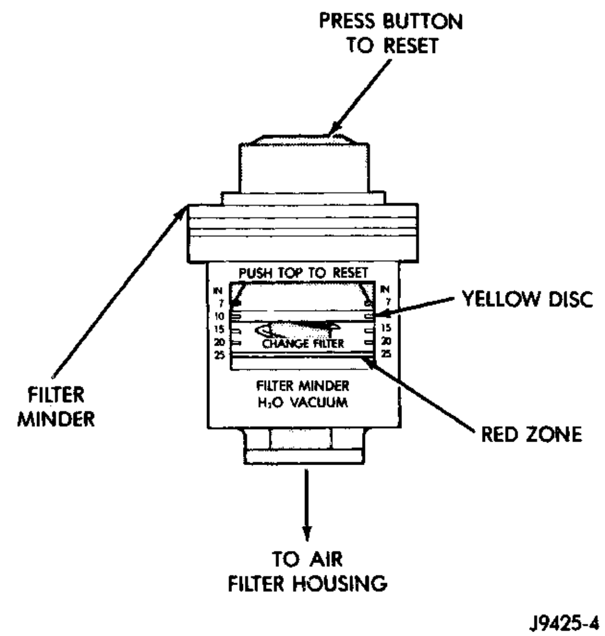

Fig. 12 Filter Minder™

(6) Check front of turbocharger intercooler for restrictions to airflow (insects, debris etc.). Clean if necessary.

(7) Be sure turbocharger output hose is firmly connected to charge air cooler (intercooler) inlet tube. Verify charge air cooler output hose is firmly connected to cooler and intake manifold.

(8) Verify turbocharger wastegate adjustment is correct. Refer to Group 11, Exhaust System and Intake Manifold for procedures.

(9) Verify throttle linkage is "breaking over". Refer to Wide-Open-Throttle Checks—Diesel Engine for procedures.

(10) Verify correct throttle linkage adjustment. Refer to Wide-Open-Throttle Checks—Diesel Engine for procedures.

(11) Verify correct Throttle Position Sensor (TPS) output voltage. Refer to Throttle Position Sensor—Diesel Engine, Removal/Installation/Testing/Adjustment.

(12) Be sure battery connections (on both batteries) are tight and not corroded.

(13) Be sure three 32–way connectors are fully engaged into the powertrain control module (PCM) (Fig. 13).

(14) Verify electrical connector is firmly connected to fuel shutdown solenoid on the injection pump (Fig. 14). Inspect connector for corrosion or damage.

(15) Verify electrical connector is firmly connected to intake manifold air temperature sensor. Inspect connector for corrosion or damaged wires. The sensor is located on top of intake manifold (Fig. 14).

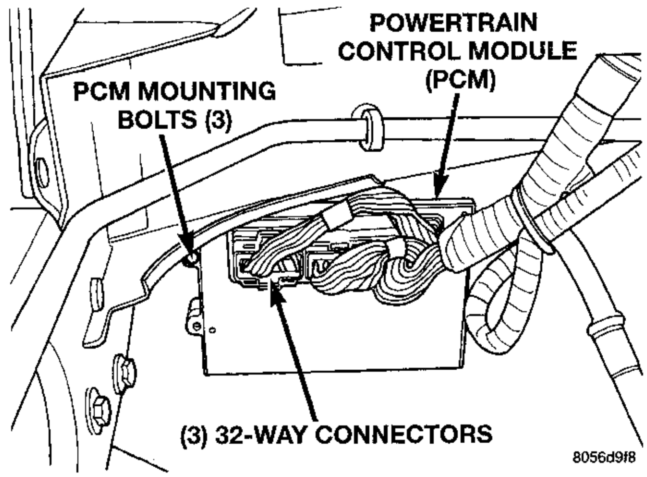

Fig. 13 PCM Location—Typical

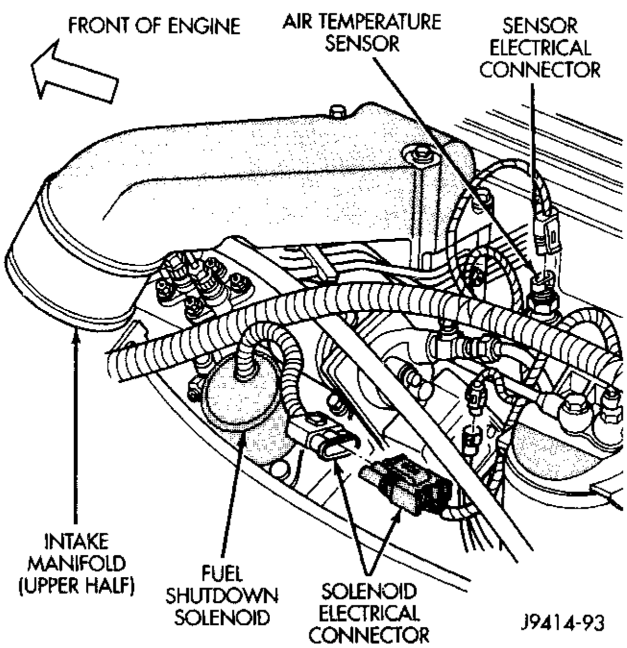

Fig. 14 Air Temperature Sensor and Fuel Shutdown Solenoid

(16) Be sure electrical connections at intake manifold air heater relays (Fig. 15) are tight and not corroded.

(17) Be sure intake manifold air heater electrical cable connections at intake manifold are tight and free of corrosion (Fig. 16).

(18) Inspect all fuel supply and return lines for signs of damage or kinking.

(19) Inspect all fuel supply and return lines for signs of leakage.

(20) Inspect throttle linkage and accelerator linkage for binding.

(21) Be sure throttle return spring is connected.

DIAGNOSIS AND TESTING (Continued)

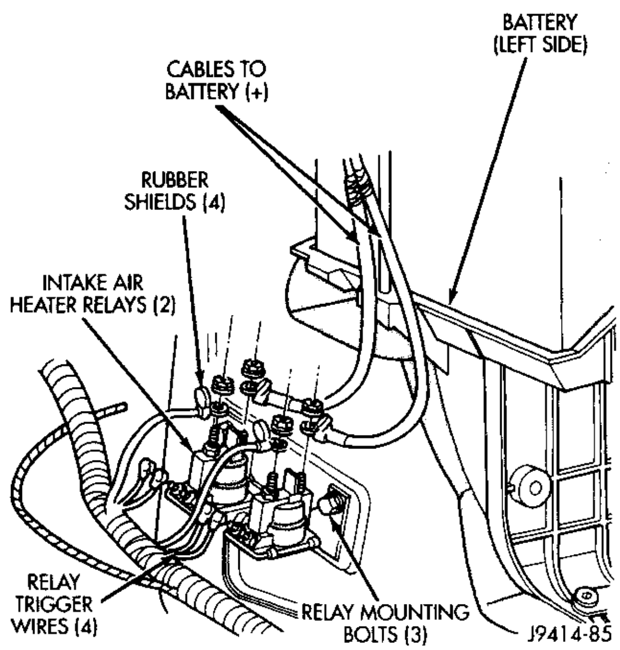

Fig. 15 Intake Manifold Air Heater Relays

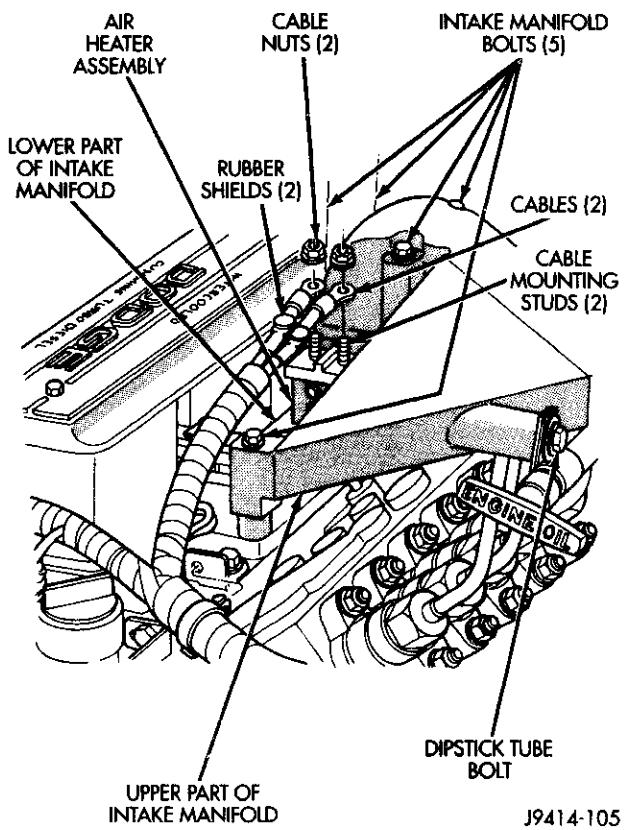

Fig. 16 Air Heater Cable Connections

(22) Be sure ground connections are tight and free of corrosion. Refer to Group 8, Wiring for locations of ground connections.

(23) Be sure accessory drive belt is not damaged or slipping.

(24) Automatic Transmission Only: Be sure electrical connectors are firmly connected to plugs on transmission case.

(25) Inspect starter motor and starter solenoid connections for tightness and corrosion.

AUTOMATIC SHUTDOWN (ASD) RELAY TEST

To perform a complete test of the ASD relay and its circuitry, refer to the DRB scan tool and appropriate Powertrain Diagnostics Procedures manual. To test the relay only, refer to Relays—Operation/Testing in this section of the group.

ENGINE SPEED SENSOR TEST

To perform a complete test of this sensor and its circuitry, refer to the appropriate Powertrain Diagnostic Procedures manual.

INTAKE MANIFOLD AIR TEMPERATURE SENSOR TEST

To perform a complete test of this sensor and its circuitry, refer to DRB scan tool and appropriate Powertrain Diagnostics Procedures manual. To test the sensor only, refer to following:

(1) Disconnect wire harness connector from intake manifold air temperature sensor. The sensor is located on top of intake manifold and to rear of air heater (Fig. 17).

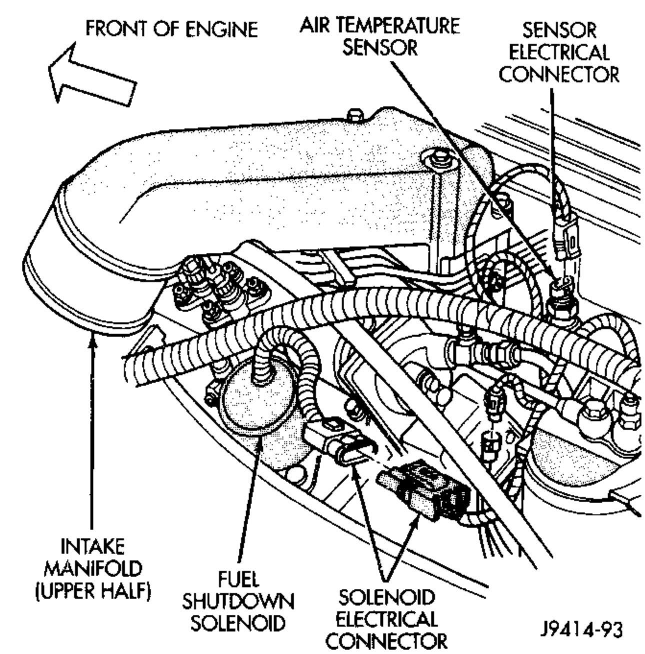

Fig. 17 Air Temperature Sensor Location—Diesel

(2) Test resistance of sensor with an input impedance (digital) volt-ohmmeter. The resistance (as measured across sensor terminals) should be as shown in

DIAGNOSIS AND TESTING (Continued)

the SENSOR RESISTANCE (OHMS)—INTAKE MANIFOLD AIR TEMPERATURE chart. Replace sensor if it is not within range of resistance specified in chart.

SENSOR RESISTANCE (OHMS)—INTAKE MANIFOLD AIR TEMPERATURE SENSOR

TEMPERATURE		RESISTANCE (OHMS)	
°CEL.	°FAHR.	MIN.	MAX.
-40	-40	291,490	381,710
-20	-4	85,850	108,390
-10	14	49,250	61,430
0	32	29,330	35,990
10	50	17,990	21,810
20	68	11,370	13,610
25	77	9,120	10,880
30	86	7,370	8,750
40	104	4,900	5,750
50	122	3,330	3,880
60	140	2,310	2,670
70	158	1,630	1,870
80	176	1,170	1,340
90	194	860	970
100	212	640	720
110	230	480	540
120	248	370	410

(3) Test resistance of wire harness. Do this between powertrain control module (PCM) wire harness connector terminal A–15 and sensor connector terminal. Also check between PCM terminal A–4 (sensor return) to sensor connector terminal. Repair wire harness as necessary if resistance is greater than 1 ohm.

INTAKE MANIFOLD AIR HEATER TEST

The intake manifold air heater (Fig. 18) is controlled by the powertrain control module (PCM) through the intake manifold air heater relays (Fig. 19). This is done after a specified signal is sent to the PCM from the intake manifold air temperature sensor.

Two heating elements are located within the air heater assembly. A separate heavy-duty cable is connected to a separate terminal to supply power for each element.

PREHEAT/POST-HEAT CYCLE

Refer to the Intake Manifold Air Heater Relays—PCM Output for preheat/post heat cycle information.

The PCM provides a ground path for the intake manifold air heater relays. The ground path is provided if intake manifold air temperature is below 15-19°C (59-66°F) when the ignition key is initially placed in the ON position. When the ground is provided, the air heater is energized to start the preheat cycle.

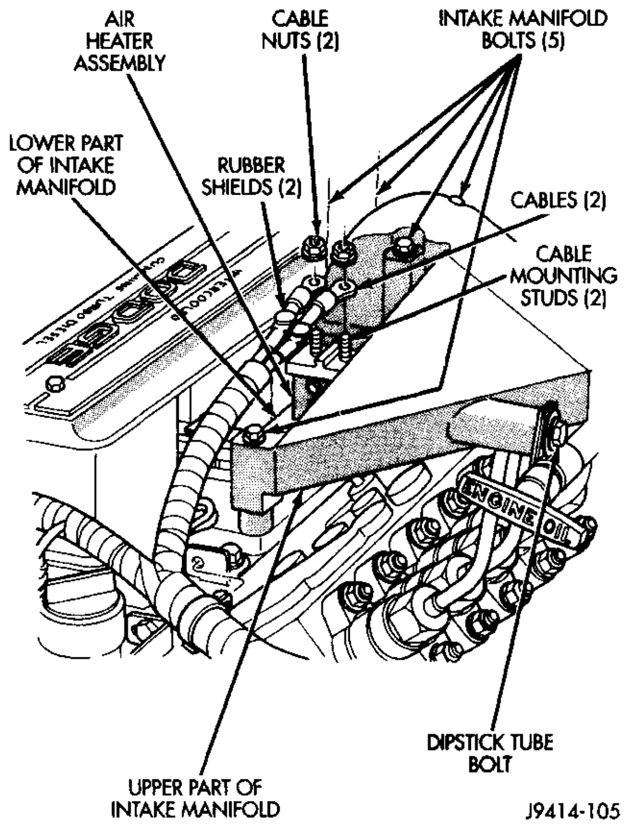

Fig. 18 Intake Manifold Air Heater

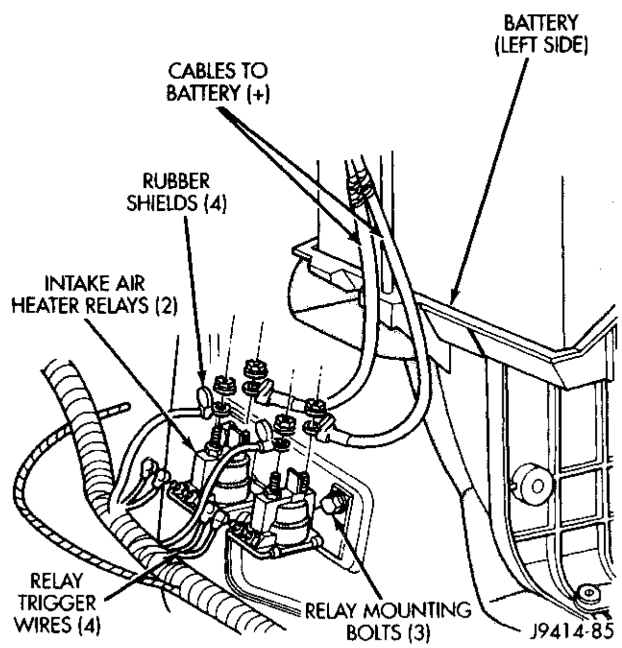

Fig. 19 Intake Manifold Air Heater Relays

DIAGNOSIS AND TESTING (Continued)

The preheat-cycle can be tested with a voltmeter or test light. If the intake manifold air temperature is above 15°C (59°F), the wait-to-start warning lamp will not illuminate and the air heater will not be energized.

(1) With the engine not running, and intake manifold air temperature below 15-19°C (59-66°F), turn the ignition key to the ON position.

(2) The wait-to-start warning lamp will come on and the air heater relays should click ON signaling the start of the preheat cycle. **If the engine starter is engaged before the preheat cycle of the heaters is complete, the PCM will stop the remaining preheat cycle.**

(3) Check for battery voltage at both air heater terminals (Fig. 18). **The heater will only be energized for 10 to 30 seconds.** Refer to the following Air Heater Cycle Chart for a time/temperature comparison.

AIR HEATER CYCLE CHART

INTAKE MANIFOLD TEMPERATURE-KEY IN ON POSITION	PRE-HEAT CYCLE TIME-KEY ON, ENGINE NOT RUNNING	POST-HEAT CYCLE-IGNITION ON, ENGINE RUNNING
Above 15-19° C (59-66° F)	0 Seconds	No
-10° C to +19° C (15° F to 66° F)	10 Seconds	Yes
-18° C to -10° C (0° F to 15° F)	15 Seconds	Yes
Below -18° C (0° F)	30 Seconds	Yes

HEATER TEST

(1) Disconnect both negative battery cables at both batteries.

(2) Lift the rubber shields from each of the cable connectors at the intake manifold air heater (Fig. 18) to expose the cable terminals. Do not disconnect cable nuts.

(3) Use an ohmmeter to test the resistance between the cable terminal (not the mounting stud) and a ground. The resistance should be zero (0). If not, inspect for corroded or dirty cable connections. Clean or repair the connections and retest before replacing heater. If resistance is now anything other than zero (0), proceed to next step.

(4) Disconnect both cables from the intake manifold heater (two nuts) (Fig. 18).

(5) Measure the resistance from each of the air heater terminal threaded studs to a ground. The resistance should be zero (0). If the ohmmeter is still reading anything other than zero (0), replace the intake manifold air heater elements. The heater elements are part of the intake manifold and will require manifold replacement.

(6) After testing and repairing, connect battery cables to both batteries.

INTAKE MANIFOLD AIR HEATER RELAY TEST

To test the intake manifold air heater, refer to the previous Intake Manifold Air Heater Test.

To test the intake manifold air heater relays, refer to the following:

(1) Disconnect both negative battery cables at both batteries.

(2) Disconnect the four small relay trigger wires at both relays (Fig. 19). Note position of wires before removal.

(3) Disconnect the four large cables at each of the relay terminals (four nuts) (Fig. 19). Note position of cables before removal.

(4) Attach an ohmmeter across two of the large studs on one of the relays.

(5) Attach a jumper wire (+ and -) to each of the small terminals on one of the relays. Polarity is not important.

(6) Momentarily touch the jumper wires to the vehicle battery (+ and -). The relay should click and the ohmmeter should show a closed circuit across the large terminals. If not, replace relay and bracket assembly.

(7) Repeat the same test on the opposite relay.

(8) After testing and repairing, connect battery cables to both batteries.

THROTTLE POSITION SENSOR TEST

The throttle position sensor (TPS) is used on diesel engines only when equipped with an automatic transmission and/or an Exhaust Gas Recirculation (EGR) system.

To perform a complete test of this sensor and its circuitry, refer to the appropriate Powertrain Diagnostic Procedures service manual. To test the sensor only, refer to Throttle Position Sensor in the Removal/Installation section of this group. This will give adjustment, testing and removal/installation procedures.

TRANSMISSION TEMPERATURE SENSOR TEST

AUTOMATIC TRANSMISSION ONLY

To perform a complete test of this sensor and its circuitry, refer to DRB scan tool and appropriate Powertrain Diagnostics Procedures manual. To test the sensor only, refer to following:

(1) Disconnect wire harness connector from temperature sensor. The sensor is located on side of transmission in transmission cooling line (Fig. 20).

(2) Test resistance of sensor with an input impedance (digital) volt-ohmmeter. The resistance (as measured across the sensor terminals) should be as shown in SENSOR RESISTANCE (OHMS)—TRANS-

DIAGNOSIS AND TESTING (Continued)

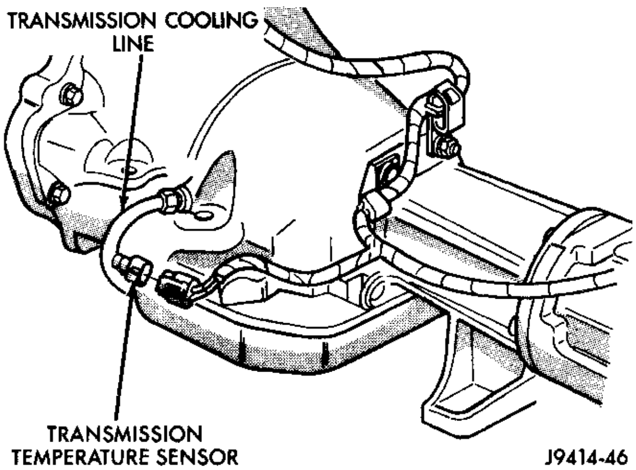

Fig. 20 Transmission Temperature Sensor Location—Typical

MISSION TEMPERATURE SENSOR resistance chart. Replace sensor if it is not within range of resistance specified in chart.

SENSOR RESISTANCE (OHMS)— TRANSMISSION TEMPERATURE SENSOR

TEMPERATURE		RESISTANCE (OHMS)	
°CEL.	°FAHR.	MIN.	MAX.
-40	-40	291,490	381,710
-20	-4	85,850	108,390
-10	14	49,250	61,430
0	32	29,330	35,990
10	50	17,990	21,810
20	68	11,370	13,610
25	77	9,120	10,880
30	86	7,370	8,750
40	104	4,900	5,750
50	122	3,330	3,880
60	140	2,310	2,670
70	158	1,630	1,870
80	176	1,170	1,340
90	194	860	970
100	212	640	720
110	230	480	540
120	248	370	410

(3) Test resistance of the wire harness. Do this between powertrain control module (PCM) wire harness connector terminal B–1 and sensor connector terminal. Also check between PCM terminal A–4 to sensor connector terminal. Repair wire harness as necessary if resistance is greater than 1 ohm.

REMOVAL AND INSTALLATION

ENGINE SPEED SENSOR

The engine speed (rpm) sensor is located on the front of engine (Fig. 21). Spacers located behind the sensor are used to position sensor over the vibration damper.

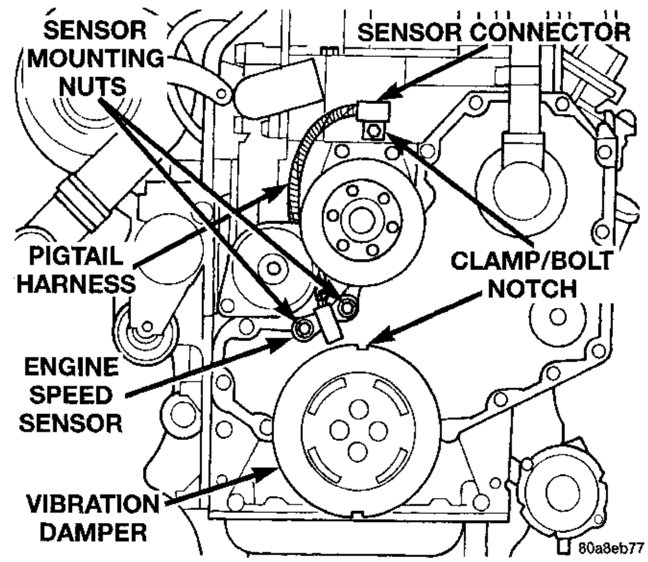

Fig. 21 Engine Speed Sensor Location—Diesel

REMOVAL

Before removing sensor and its pigtail wiring harness, note position and routing of harness. This routing must be maintained to prevent wiring from contacting belt or pulleys.

(1) Disconnect speed sensor pigtail harness from main engine wiring harness near front/top of engine (Fig. 21).

(2) Remove clip bolts from sensor pigtail wiring harness.

(3) Remove two speed sensor mounting nuts (Fig. 21) or (Fig. 22).

(4) Remove speed sensor and its mounting spacers from engine.

INSTALLATION/ADJUSTMENT

The engine speed sensor has 2 slotted holes (Fig. 22) to adjust its depth. A brass (non-magnetic) feeler gauge must be used to adjust sensor.

Sensor-to-vibration damper air gap: **1.25 MM (.049 in.) minimum to 1.30 MM (.051 in.) maximum.**

(1) Position speed sensor, its mounting spacers and two mounting nuts to engine. Install mounting nuts finger tight.

(2) Route sensor wiring harness behind engine pulleys. Install and tighten wiring harness clip bolts.

(3) Place feeler gauge between bottom of sensor and top of vibration dampener.

REMOVAL AND INSTALLATION (Continued)

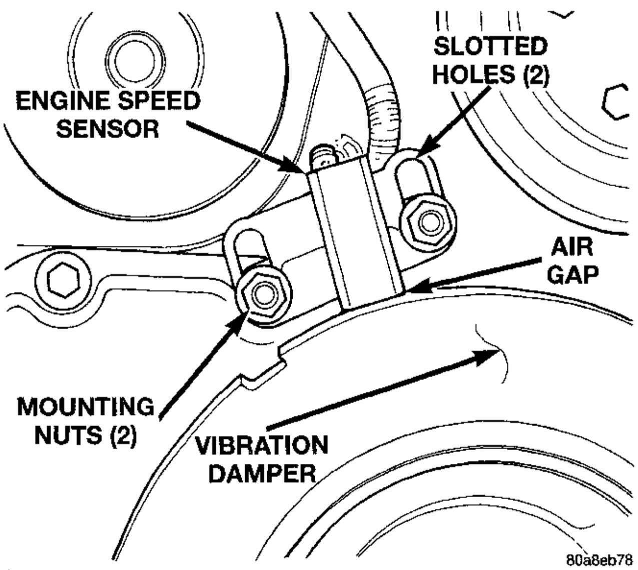

Fig. 22 Engine Speed Sensor—Removal/Installation/ Adjustment

(4) Gently seat (push down) sensor until it contacts feeler gauge. Sensor should be flat to feeler gauge. Slide sensor through slotted holes until flat to feeler gauge. **Be sure sensor is not near either of notches (Fig. 21) on vibration damper. If sensor is adjusted at or near these notches, it will be damaged when engine is started.**

(5) Tighten sensor mounting nuts to 24 N·m (18 ft. lbs.) torque.

(6) Remove feeler gauge.

(7) Connect sensor electrical pigtail connector to main engine wiring harness.

THROTTLE POSITION SENSOR—DIESEL ENGINE

This section will include the removal/installation/adjustment of the Throttle Position Sensor (TPS) plus TPS voltage tests. It also includes throttle linkage adjustment.

The TPS is used on diesel powered engines only when equipped with an automatic transmission and/or an Exhaust Gas Recirculation (EGR) system. If the TPS is to be replaced on a diesel engine, it must be tested and, if necessary, have throttle linkage adjusted after replacement.

REMOVAL

(1) Disconnect electrical connector on bottom of TPS (Fig. 23).

(2) Remove two TPS mounting bolts.

(3) Remove sensor from bracket.

INSTALLATION

(1) Position TPS to mounting bracket. The electrical connector should be facing downward.

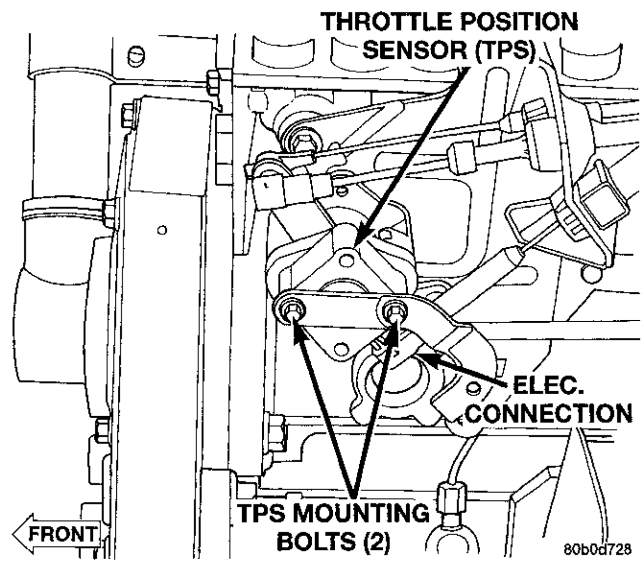

Fig. 23 Throttle Position Sensor Location—Diesel Engine

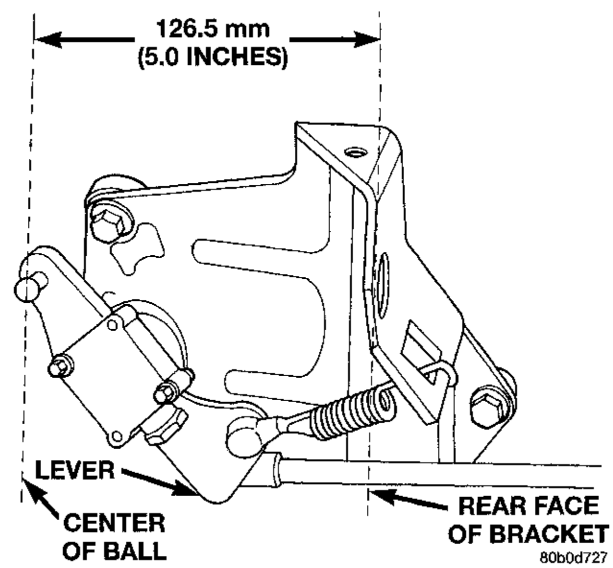

Fig. 24 TPS Linkage Measurement—Diesel

NOTE: The TPS is spring loaded. After positioning the TPS to its mounting bracket, rotate TPS on bracket in a counterclockwise direction until two bolt holes align.

(2) Install and tighten two bolts.

(3) Connect electrical connector on bottom of TPS.

(4) Operate throttle by hand to check for binding.

(5) Be sure of wide open throttle (WOT) when accelerator pedal is pressed to the floor. This is checked by observing throttle lever "breakover" position. Refer to Wide-Open-Throttle Checks—Diesel Engine for procedures. Linkage adjustments for "breakover" must be made **before** attempting to test or adjust TPS.

REMOVAL AND INSTALLATION (Continued)

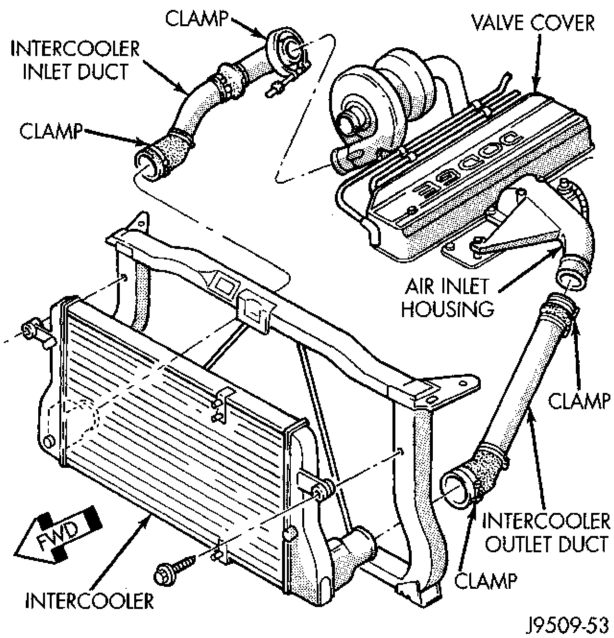

Fig. 25 Intercooler Outlet Duct

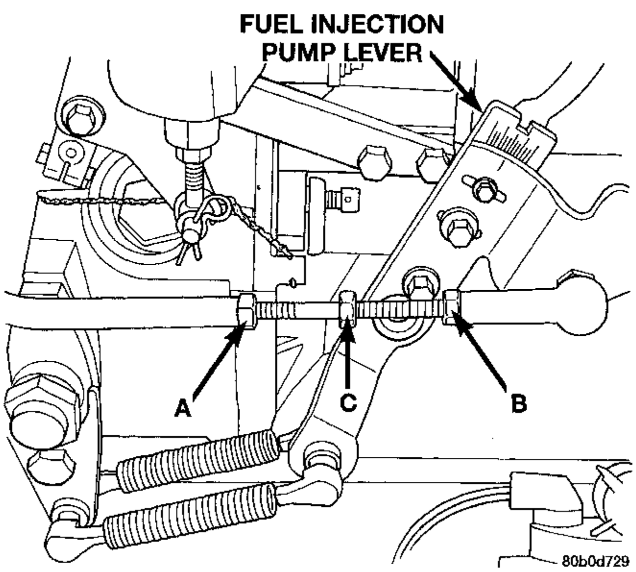

Fig. 26 Throttle Lever Linkage Rod Adjustment—Diesel

(6) After proper "breakover" is observed, test TPS voltage and (if necessary) adjust throttle linkage rod. Refer to the following:

THROTTLE POSITION SENSOR TESTING AND ADJUSTMENT / THROTTLE LINKAGE ADJUSTMENT

CAUTION: Before attempting to test TPS, verify linkage adjustment dimension (Fig. 24). This dimension MUST be 126.5 mm (5.0 inches) BEFORE testing.

(1) Attach DRB scan tool to data link connector.

(2) Warm engine to operating temperature and confirm correct engine idle speed and adjust if necessary. **This step must be done before testing TPS. Refer to Idle Speed Adjustment for specifications.**

(3) Shut engine off.

(4) Access the SENSOR display screen on DRB tool.

(5) Turn ignition switch to ON position. Do not start engine.

(6) TPS voltage should be 1.0 volt (± .2 volt) with linkage at idle position. At wide open throttle (WOT), output voltage must be 2.2-to-2.9 volts higher than at idle speed. If voltage is not correct, proceed to adjusting linkage.

(7) The throttle rod (Fig. 26) connecting throttle lever to fuel injection pump lever is adjustable.

(8) At side of fuel injection pump, remove intercooler outlet duct from air inlet housing (Fig. 25).

(9) Loosen rod nuts A (right-hand-thread) and B (left-hand-thread) while holding studnut C with another wrench (Fig. 26).

(10) Rotate studnut C (Fig. 26) on linkage rod (lengthen or shorten) to achieve 1.0 volt (± .2 volts) on voltmeter with linkage in idle position. At wide open throttle (WOT), output voltage must be 2.2-to-2.9 volts higher than at idle speed. **DO NOT lengthen or shorten linkage rod more than 1 mm from dimension shown in (Fig. 24). If voltage requirements cannot be met by linkage adjustment (125.6 to 127.6 mm), replace TPS.**

(11) Tighten rod nuts A and B (Fig. 26) after adjustment. **After tightening nuts, be sure the rod assembly will rotate (slightly) without binding at each ball end.** If binding occurs, loosen one of the nuts and back off until binding is eliminated. Retighten nut.

(12) With engine OFF, operate throttle from accelerator pedal and check for throttle lever action and binding. Be sure throttle lever stop is against low idle speed screw after throttle is released.

(13) Again, check and verify low idle speed. Adjust if necessary.

(14) Install intercooler outlet duct to air inlet housing.

AIR CLEANER HOUSING/AIR CLEANER ELEMENT

TESTING AIR CLEANER ELEMENT

Do not attempt to unnecessarily remove the top of the air cleaner housing for air cleaner element inspection on diesel engines.

The air cleaner (filter) housing is equipped with an air Filter Minder™ gauge (Fig. 27). This air flow restriction gauge will determine when the air cleaner element is restricted and should be replaced.

AUTHENTIC RESTORATION PRODUCT

REMOVAL AND INSTALLATION (Continued)

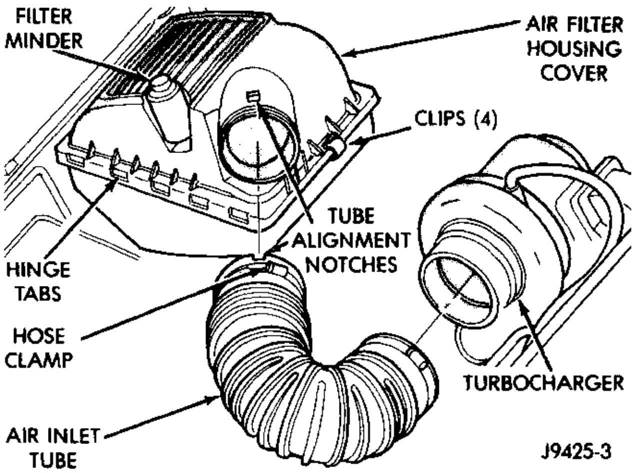

Fig. 27 Filter Minder—Location—Diesel Engine

The Filter Minder® consists of a diaphragm and calibrated spring sealed inside of a plastic housing (Fig. 28). A yellow colored disc attached to the diaphragm moves along a graduated scale on the side of the Filter Minder. After the engine has been shut off, a ratcheting device located within the Filter Minder will hold the yellow disc at the highest restriction that the air cleaner element has experienced. A drop in air pressure due to an air cleaner element restriction moves the diaphragm and the yellow disc will indicate the size of the air drop.

CAUTION: Certain engine degreasers or cleaners may discolor or damage the plastic housing of the Filter Minder. Cover and tape the Filter Minder if any engine degreasers or cleaners are to be used.

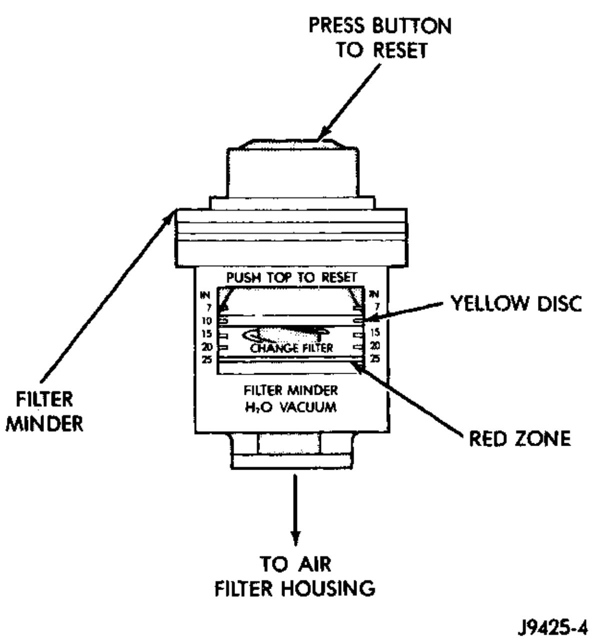

Fig. 28 Filter Minder®—Diesel Engine

To test, turn the engine off. If the yellow disc (Fig. 28) has reached the red colored zone on the graduated scale, the air cleaner element should be replaced. Refer to the proceeding removal/installation paragraphs.

Resetting the Filter Minder: After the air cleaner (filter) element has been replaced, press the rubber button on the top of the Filter Minder (Fig. 28). This will allow the yellow colored disc to reset. After the button has been pressed, the yellow disc should spring back to the UP position.

If the Filter Minder gauge has reached the red colored zone, and after an examination of the air cleaner (filter) element, the element appears to be clean, the high reading may be due to a temporary condition such as snow build-up at the air intake. Temporary high restrictions may also occur if the air cleaner (filter) element has gotten wet such as during a heavy rain or snow. If this occurs, allow the element to dry out during normal engine operation. Reset the rubber button on the top of the Filter Minder and retest after the element has dried.

REMOVAL/INSTALLATION

(1) Loosen the air inlet tube clamp at air cleaner housing inlet (Fig. 27). Remove this tube at air cleaner housing cover.

(2) The housing cover is equipped with four (4) spring clips (Fig. 27) and is hinged at the front with plastic tabs. Unlatch the clips from the top of air cleaner housing and tilt the housing cover up and forward for cover removal.

(3) Remove the air cleaner element from air cleaner housing.

(4) Before installing a new air cleaner element, clean inside of air cleaner housing.

(5) Position air cleaner cover to tabs on front of air cleaner housing. Latch the four spring clips to seal cover to housing.

(6) Install the air inlet tube at air cleaner housing inlet. Note the hose alignment notches at both the inlet hose and air cleaner cover (Fig. 27).

(7) Position the tube clamp to the inlet tube and tighten to 3 N·m (25 in. lbs.) torque.

INTAKE MANIFOLD AIR TEMPERATURE SENSOR

The intake manifold air temperature sensor is located on the top of intake manifold and to the rear of the intake manifold heater (Fig. 29).

REMOVAL

(1) Disconnect the electrical connector at the sensor.

(2) Remove the sensor (Fig. 29) the from intake manifold.

REMOVAL AND INSTALLATION (Continued)

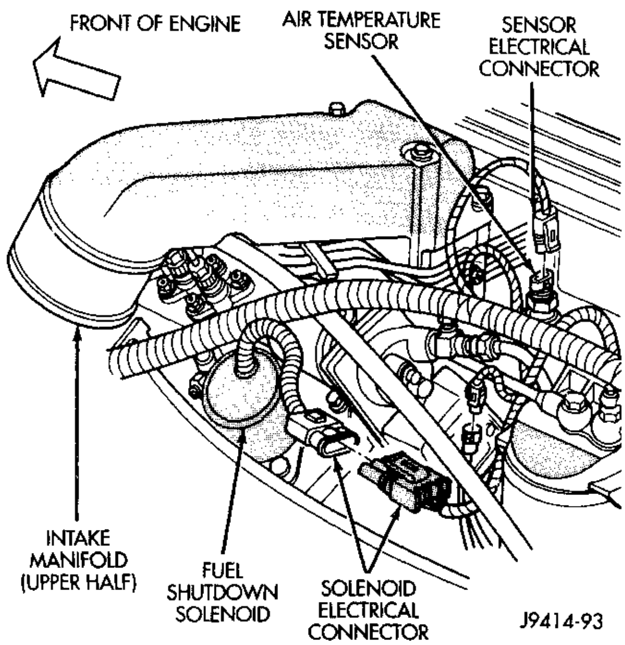

Fig. 29 Air Temperature Sensor Location—Diesel

INSTALLATION

(1) Install sensor to intake manifold. Tighten to 28 N·m (20 ft. lbs.) torque.

(2) Install electrical connector.

INTAKE MANIFOLD AIR HEATER ELEMENTS

The intake manifold air heater elements are located within the top cover of the intake manifold (Fig. 30). If replacement of the elements is necessary, the intake manifold cover must be removed. Refer to Intake Manifold Removal/Installation in Group 11.

INTAKE MANIFOLD AIR HEATER RELAYS

The relays are located in the engine compartment, bolted to the left inner fender below the left battery (Fig. 31).

REMOVAL

The mounting bracket and both relays are replaced as an assembly.

(1) Disconnect both negative battery cables at both batteries.

(2) Disconnect the four relay trigger wires at both relays (Fig. 31). Note the position of wiring before removing.

(3) Lift the four rubber shields from the four cables (Fig. 31).

(4) Remove the four nuts at the cable connectors (Fig. 31). Note the position of wiring before removing.

(5) Remove the three relay mounting bracket bolts (Fig. 31) and remove relay assembly.

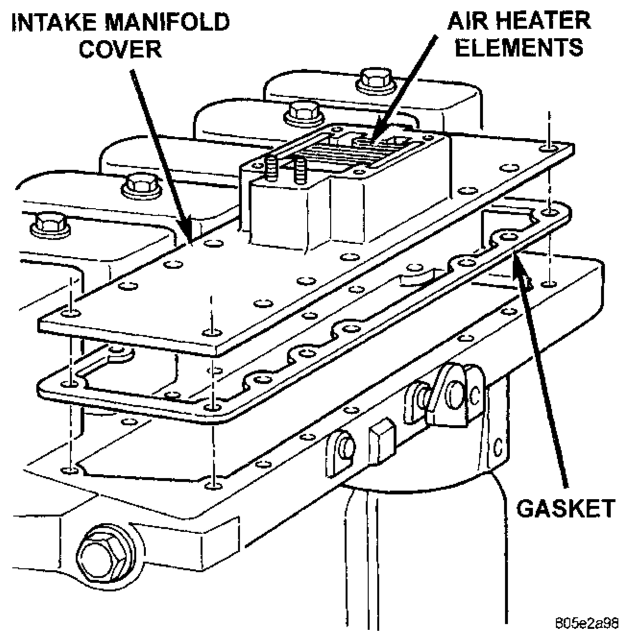

Fig. 30 Intake Manifold Air Heater Elements

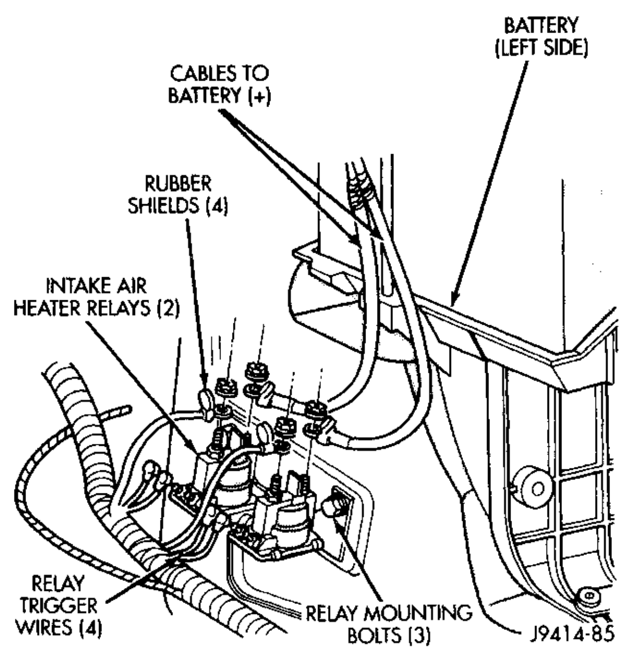

Fig. 31 Intake Manifold Air Heater Relays

INSTALLATION

(1) Install the relay assembly to the inner fender. Tighten mounting bolts to 4.5 N·m (40 in. lbs.) torque.

(2) Connect the eight electrical connectors to the relays.

(3) Connect battery cables to both batteries.

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REMOVAL AND INSTALLATION (Continued)

WATER-IN-FUEL SENSOR

The Water-In-Fuel (WIF) sensor is located at the side of fuel filter/water separator canister. Refer to Fuel Filter/Water Separator Removal/Installation for WIF sensor removal/installation procedures.

SPECIFICATIONS

TORQUE CHART—DIESEL ENGINE

DESCRIPTION	TORQUE
Engine Speed Sensor Nuts	24 N·m (18 ft. lbs.)
Intake Manifold Air Temp. Sensor	28 N·m (20 ft. lbs.)
Intake Manifold Air Heater Relay Bolts	4.5 N·m (40 in. lbs.)
PCM Mounting Bolts	4 N·m (35 in. lbs.)

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STEERING

CONTENTS

POWER STEERING

INDEX

GENERAL INFORMATION

STEERING SYSTEM

The power steering system uses a recirculating-ball type gear. The gear is mounted to the frame rail. The hydraulic pressure for the power steering gear is provided by a P-Series pump. The pump is mounted to the engine and driven by a belt on gasoline engines. On vehicles equipped with a diesel engine the pump is mounted to the back of the vacuum pump. A oil cooler is used on vehicles with the trailer tow option.

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DIAGNOSIS AND TESTING

POWER STEERING SYSTEM

STEERING NOISE

There is some noise in all power steering systems. One of the most common is a hissing sound evident at a standstill parking. Or when the steering wheel is at the end of it's travel. Hiss is a high frequency noise similar to that of a water tap being closed slowly. The noise is present in all valves that have a high velocity fluid passing through an orifice. There is no relationship between this noise and steering performance.

CONDITION	POSSIBLE CAUSES	CORRECTION
OBJECTIONAL HISS OR WHISTLE	1. Steering intermediate shaft to dash panel seal. 2. Noisy valve in power steering gear.	1. Check and repair seal at dash panel. 2. Replace steering gear.
RATTLE OR CLUNK	1. Gear mounting bolts loose. 2. Loose or damaged suspension components. 3. Loose or damaged steering linkage. 4. Internal gear noise. 5. Pressure hose in contact with other components.	1. Tighten bolts to specification. 2. Inspect and repair suspension. 3. Inspect and repair steering linkage. 4. Replace gear. 5. Reposition hose.
CHIRP OR SQUEAL	1. Loose belt.	1. Adjust or replace.
WHINE OR GROWL	1. Low fluid level. 2. Pressure hose in contact with other components. 3. Internal pump noise.	1. Fill to proper level. 2. Reposition hose. 3. Replace pump.
SUCKING AIR SOUND	1. Loose return line clamp. 2. O-ring missing or damaged on hose fitting. 3. Low fluid level. 4. Air leak between pump and reservoir.	1. Replace clamp. 2. Replace o-ring. 3. Fill to proper level. 4. Repair as necessary.
SCRUBBING OR KNOCKING	1. Wrong tire size. 2. Wrong gear.	1. Verify tire size. 2. Verify gear.

BINDING AND STICKING

CONDITION	POSSIBLE CAUSE	CORRECTION
DIFFICULT TO TURN WHEEL STICKS OR BINDS	1. Low fluid level. 2. Tire pressure. 3. Steering components (ball joints/tie rod ends). 4. Loose belt. 5. Low pump pressure. 6. Column shaft coupler binding. 7. Steering gear worn or out of adjustment.	1. Fill to proper level. 2. Adjust tire pressure. 3. Lube, inspect and repair as necessary. 4. Adjust or replace. 5. Pressure test and replace if necessary. 6. Replace coupler. 7. Repair or replace gear.

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DIAGNOSIS AND TESTING (Continued)

INSUFFICIENT ASST. OR POOR RETURN TO CENTER

CONDITION	POSSIBLE CAUSE	CORRECTION
HARD TURNING OR MOMENTARY INCREASE IN TURNING EFFORT	1. Tire pressure. 2. Low fluid level. 3. Loose belt. 4. Lack of lubrication. 5. Low pump pressure. 6. Internal gear leak.	1. Adjust tire pressure. 2. Fill to proper level. 3. Adjust or replace. 4. Inspect and lubricate steering and suspension compnents. 5. Pressure test and repair as necessary. 6. Pressure and flow test, and repair as necessary.
STEERING WHEEL DOES NOT WANT TO RETURN TO CENTER POSITION	1. Tire pressure. 2. Wheel alignment. 3. Lack of lubrication. 4. High friction in steering gear.	1. Adjust tire pressure. 2. Align front end. 3. Inspect and lubricate steering and suspension compnents. 4. Test and adjust as necessary.

LOOSE STEERING AND VEHICLE LEAD

CONDITION	POSSIBLE CAUSE	CORRECTION
EXCESSIVE PLAY IN STEERING WHEEL	1. Worn or loose suspension or steering components. 2. Worn or loose wheel bearings. 3. Steering gear mounting. 4. Gear out of adjustment. 5. Worn or loose steering coupler.	1. Inspect and repair as necessary. 2. Inspect and repair or adjust bearings. 3. Tighten gear mounting bolts to specification. 4. Adjust gear to specification. 5. Inspect and replace as necessary.
VEHICLE PULLS OR LEADS TO ONE SIDE.	1. Tire Pressure. 2. Radial tire lead. 3. Brakes dragging. 4. Wheel alignment.	1. Adjust tire pressure. 2. Rotate tires. 3. Repair as necessary. 4. Align front end.

POWER STEERING PUMP

INDEX

DESCRIPTION AND OPERATION

POWER STEERING PUMP

The P-Series pump is used on these vehicles (Fig. 1).

Hydraulic pressure is provided for the power steering gear by the belt driven power steering pump. The power steering pump is a constant flow rate and displacement, vane-type pump.

The pump is connected to the steering gear via the pressure hose and the return hose. The pump shaft has a pressed-on pulley that is belt driven by the crankshaft pulley.

Trailer tow option vehicles are equipped with a power steering pump oil cooler. The oil cooler is mounted to the radiator support.

NOTE: Power steering pumps are not interchangeable with pumps installed on other vehicles.

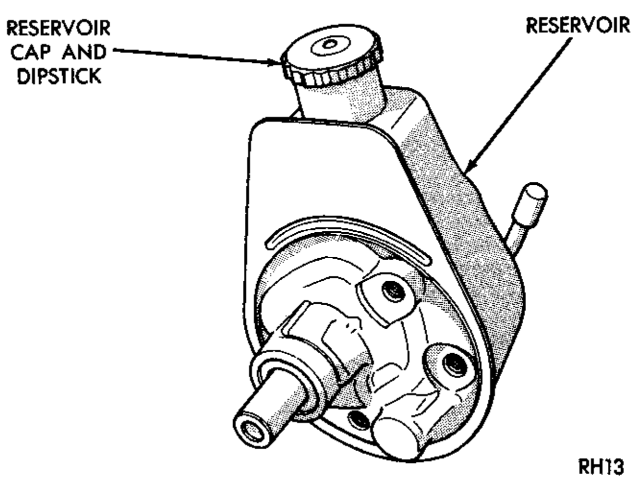


Fig. 1 P-Series—Pump

DIAGNOSIS AND TESTING

PUMP FLOW RATE AND PRESSURE

The following procedure is used to test the operation of the power steering system on the vehicle. This test will provide the flow rate of the power steering pump along with the maximum relief pressure. Perform test any time a power steering system problem is present. This test will determine if the power steering pump or power steering gear is not functioning properly. The following pressure and flow test is performed using Power Steering Analyzer Tool kit 6815 (Fig. 2) and Adapter Kit 6893.

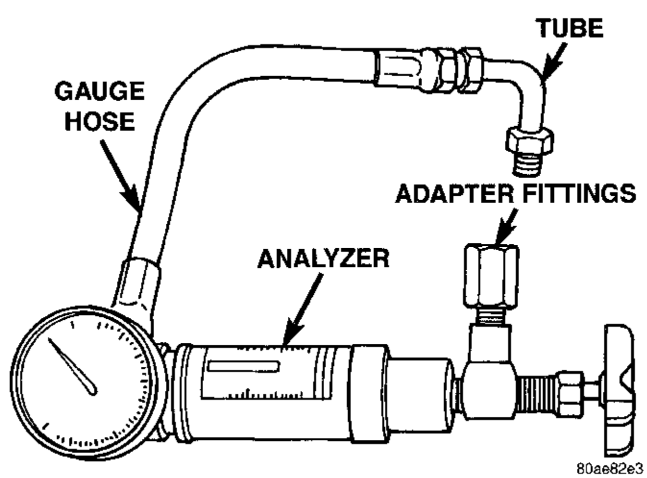


Fig. 2 Pressure Test Gauge

POWER STEERING ANALYZER INSTALLATION

WITHOUT HYDRAULIC BOOSTER

(1) Remove the high pressure hose from the power steering pump.

(2) Connect Tube 6844 into the pump hose fitting.

AUTHENTIC RESTORATION PRODUCT

DIAGNOSIS AND TESTING (Continued)

(3) Connect pressure gauge hose from the Power Steering Analyzer to Tube 6844.

(4) Connect Adapter 6826 to Power Steering Analyzer test valve end.

(5) Connect the power steering hose from the steering gear to Adapter 6826.

WITH HYDRAULIC BOOSTER

(1) Remove high pressure hose which goes to the steering gear from the tube coming out of the booster.

(2) Connect Adapter 6826 to the Power Steering Analyzer pressure gauge hose.

(3) Connect pressure gauge hose to the tube coming out of the booster.

(4) Connect Tube 6844 to the steering gear hose and Power Steering Analyzer test valve end.

FLOW AND PRESSURE TEST

(1) Check belt condition and tension.

(2) Open the test valve completely.

(3) Start engine and let idle long enough to circulate power steering fluid through flow/pressure test gauge and to get air out of the fluid. Then shut off engine.

(4) Check fluid level, add fluid as necessary. Start engine again and let idle.

(5) Gauge should read below 1034 kPa (150 psi), if above, inspect the hoses for restrictions and repair as necessary. The initial pressure reading should be in the range of 345-552 kPa (50-80 psi).

(6) Increase the engine speed to 1500 RPM and read the flow meter. If the flow rate (GPM) is below specification (Refer to pump specification chart for GPM) the pump should be replaced.

CAUTION: The following test procedure involves testing maximum pump pressure output and flow control valve operation. Do not leave valve closed for more than three seconds as the pump could be damaged.

(7) Close valve fully three times and record highest pressure indicated each time. **All three readings must be above specifications and within 345 kPa (50 psi) of each other.**

- Pressures above specifications but not within 345 kPa (50 psi) of each other, replace pump.
- Pressures within 345 kPa (50 psi) of each other but below specifications, replace pump.

(8) Open the test valve and turn the steering wheel to the extreme left and right positions three times against the stops. Record the highest pressure reading at each position. Compare the readings to the pump specifications chart. If pressures readings are not within 50 psi of each other, the gear is leaking internally and must be repaired.

CAUTION: Do not force the pump to operate against the stops for more than 2 to 3 seconds at a time because, pump damage will result.

PUMP SPECIFICATION

ENGINE	RELIEF PRESSURE (P.S.I.)	FLOW (G.P.M.) at 1500 RPM
3.9L	1400 to 1500	2.7 to 3.1
5.2L	1400 to 1500	2.7 to 3.1
5.9L	1400 to 1500	2.7 to 3.1
8.0L	1400 to 1500	2.7 to 3.1
5.9L Diesel	1450 to 1550	3.1 to 3.5
All With Hydraulic Booster	1450 to 1550	3.1 to 3.5

NOTE: After preforming test and removing Power Steering Analyzer, check power steering fluid level.

PUMP LEAKAGE DIAGNOSIS

SERVICE PROCEDURES

POWER STEERING PUMP - INITIAL OPERATION

WARNING: THE FLUID LEVEL SHOULD BE CHECKED WITH ENGINE OFF TO PREVENT INJURY FROM MOVING COMPONENTS.

CAUTION: Use MOPAR Power Steering Fluid or equivalent. Do not use automatic transmission fluid and do not overfill.

Wipe filler cap clean, then check the fluid level. The dipstick should indicate **COLD** when the fluid is at normal temperature.

(1) Fill the pump fluid reservoir to the proper level and let the fluid settle for at least two (2) minutes.

(2) Start the engine and let run for a few seconds then turn engine off.

(3) Add fluid if necessary. Repeat the above procedure until the fluid level remains constant after running the engine.

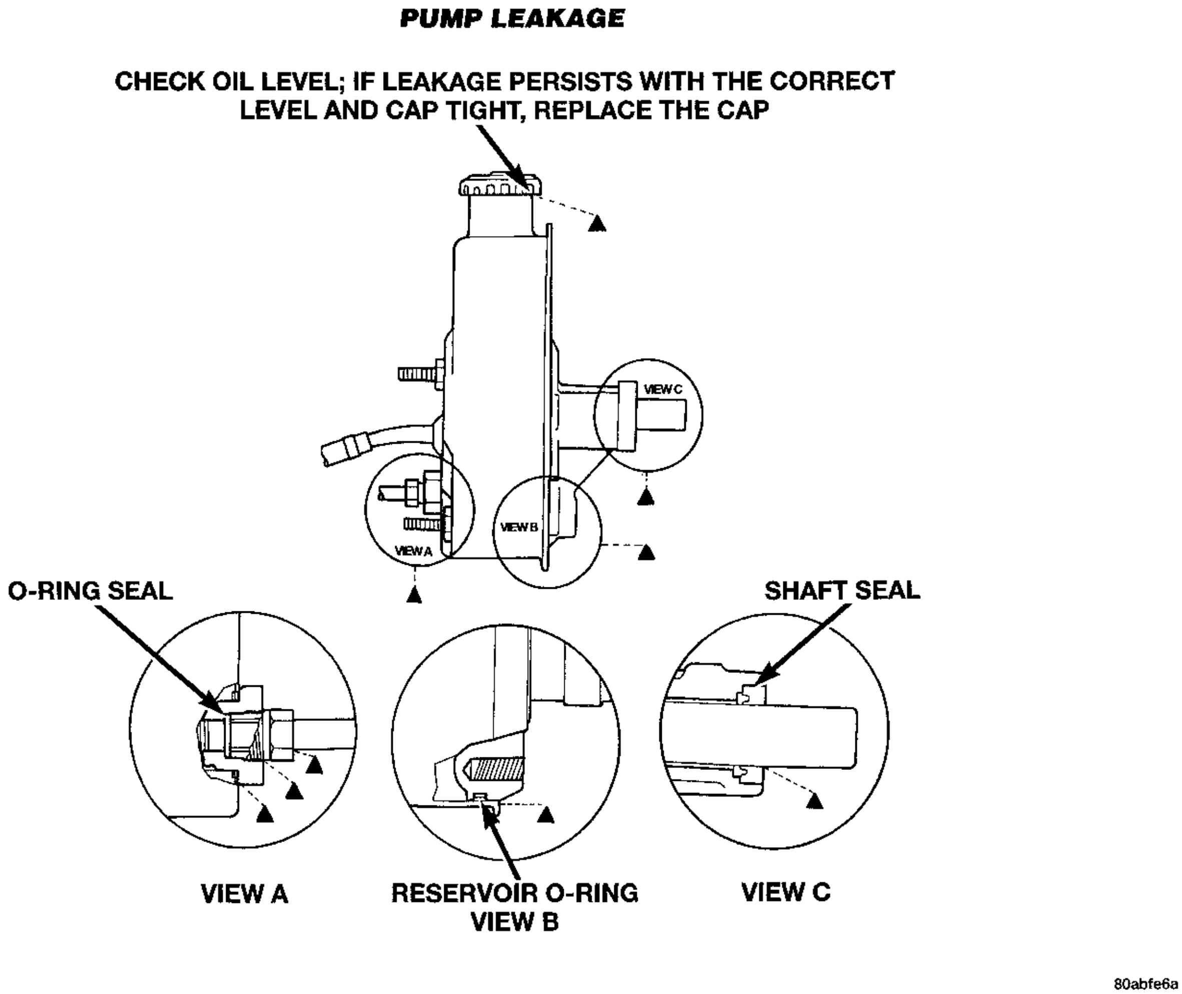
(4) Raise the front wheels off the ground.

(5) Slowly turn the steering wheel right and left, lightly contacting the wheel stops at least 20 times.

(6) Check the fluid level add if necessary.

(7) Lower the vehicle, start the engine and turn the steering wheel slowly from lock to lock.

SERVICE PROCEDURES (Continued)



(8) Stop the engine and check the fluid level and refill as required.

(9) If the fluid is extremely foamy or milky looking, allow the vehicle to stand a few minutes and repeat the procedure.

CAUTION: Do not run a vehicle with foamy fluid for an extended period. This may cause pump damage.

FLUSHING POWER STEERING SYSTEM

Flushing is required when the power steering/hydraulic booster system fluid has become contaminated. Contaminated fluid in the steering/booster system can cause seal deterioration and affect steering gear/booster spool valve operation.

(1) Raise the front end of the vehicle off the ground until the wheels are free to turn.

(2) Remove the return line from the pump.

NOTE: If vehicle is equipped with a hydraulic booster remove both return lines from the pump.

(3) Plug the return line port/ports at the pump.

(4) Position the return line/lines into a large container to catch the fluid.

(5) While an assistant is filling the pump reservoir start the engine.

(6) With the engine running at idle turn the wheel back and forth.

NOTE: Do not contact or hold the wheel against the steering stops.

(7) Run a quart of fluid through the system then stop the engine and install the return line/lines.

(8) Fill the system with fluid and perform Steering Pump Initial Operation.

(9) Start the engine and run it for fifteen minutes then stop the engine.

(10) Remove the return line/lines from the pump and plug the pump port/ports.

(11) Pour fresh fluid into the reservoir and check the draining fluid for contamination. If the fluid is still contaminated, disassemble and clean the steering gear and flush the system again.

(12) Install the return line/lines and perform Steering Pump Initial Operation.

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REMOVAL AND INSTALLATION

POWER STEERING PUMP - GASOLINE ENGINE

WARNING: DO NOT REMOVE THE WATER PUMP COOLANT TUBE UNLESS THE COOLANT SYSTEM HAS BEEN DEPRESSURIZED AND DRAINED.

REMOVAL

(1) Remove the serpentine drive belt, refer to Group 7 Cooling.
(2) Remove the hoses from the power steering pump and cap the fittings.
(3) Remove battery ground cable and unthread stud from cylinder head, do not remove from bracket.
(4) Loosen upper bracket bolt and remove the lower bracket to engine block bolts.
(5) Pivot the pump assembly past the coolant tube.
(6) Remove the upper stud and remove upper bolt from cylinder head.
(7) Remove steering pump and mounting bracket from engine as an assembly.
(8) Remove the pump pulley, to access pump attaching bolts.
(9) Remove the front pump bracket (Fig. 3). On 8.0L engine remove rear pump bracket (Fig. 4).

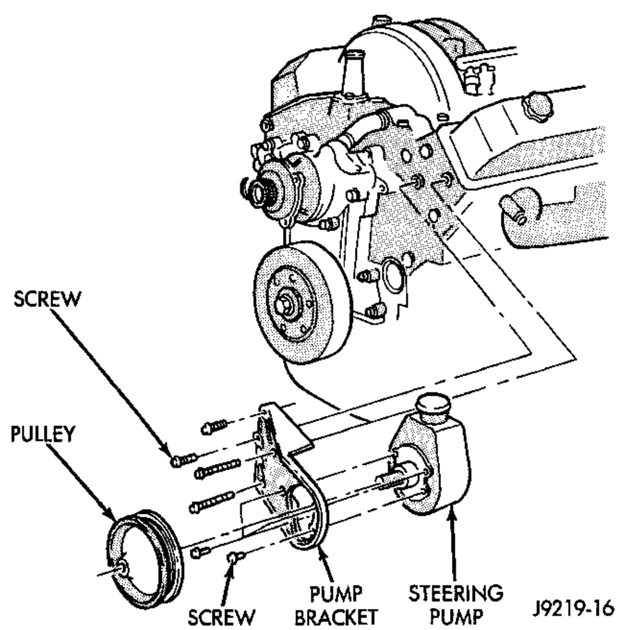

Fig. 3 Pump Mounting 3.9L, 5.2L and 5.9L

INSTALLATION

(1) Install the front pump bracket and tighten bolts to 47 N·m (35 ft. lbs.). On 8.0L engine install rear pump bracket and tighten nut to 47 N·m (35 ft. lbs.), tighten bolts to 24 N·m (18 ft. lbs.).
(2) Install the pump pulley.

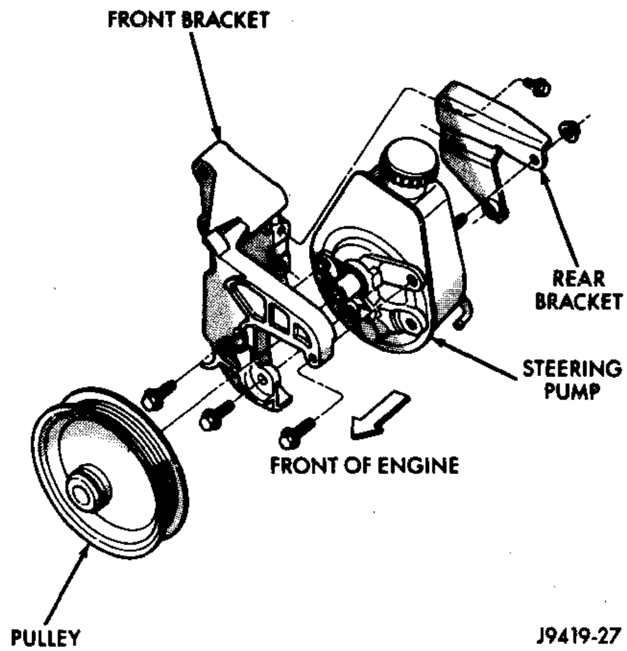

Fig. 4 Pump Mounting 8.0L

(3) Install steering pump assembly on the engine block. Install the upper stud and bolt in bracket.
(4) Pivot the pump down past the coolant tube and install the lower bolts in bracket.
(5) Tighten the bolts and nut to 41 N·m (30 ft. lbs.).
(6) Connect the hoses to the pump.
(7) Install the serpentine drive belt refer to Group 7, Cooling for belt routing.
(8) Fill the reservoir with power steering fluid, refer to Pump Initial Operation.

POWER STEERING PUMP—DIESEL ENGINE

REMOVAL

(1) Remove and cap steering pump hoses and vacuum pump vacuum line.
(2) Remove the sender unit from engine block and plug hole in block (Fig. 5).
(3) Remove and cap the oil feed line from the bottom of the vacuum pump (Fig. 6).
(4) Remove the lower bolt that attaches the vacuum/steering pump assembly to the engine block. Remove the nut from the steering pump attaching bracket (Fig. 6).
(5) Remove upper bolt from the pump assembly (Fig. 7) and remove the assembly.
(6) Remove the mounting gasket.
(7) Remove the steering pump to vacuum pump bracket attaching nuts (Fig. 8).
(8) Slide the steering pump from the bracket. Use care not to damage the internal oil seal in the vacuum pump (Fig. 9).

REMOVAL AND INSTALLATION (Continued)

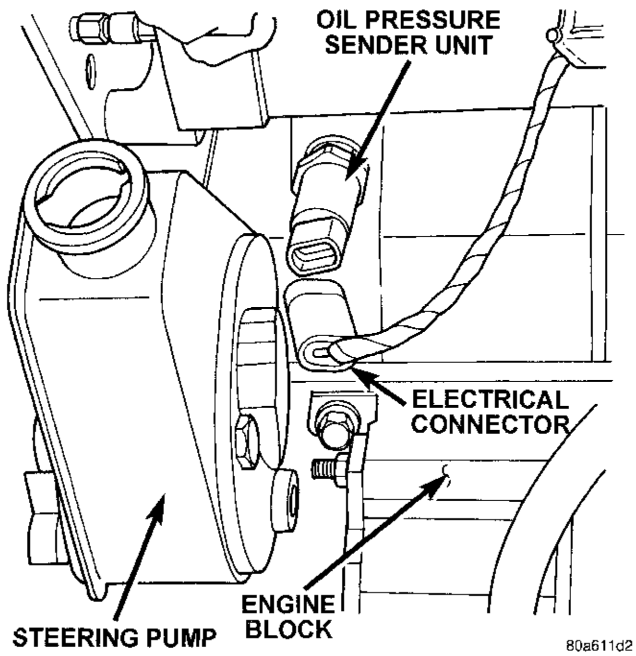

Fig. 5 Oil Pressure Sending Unit

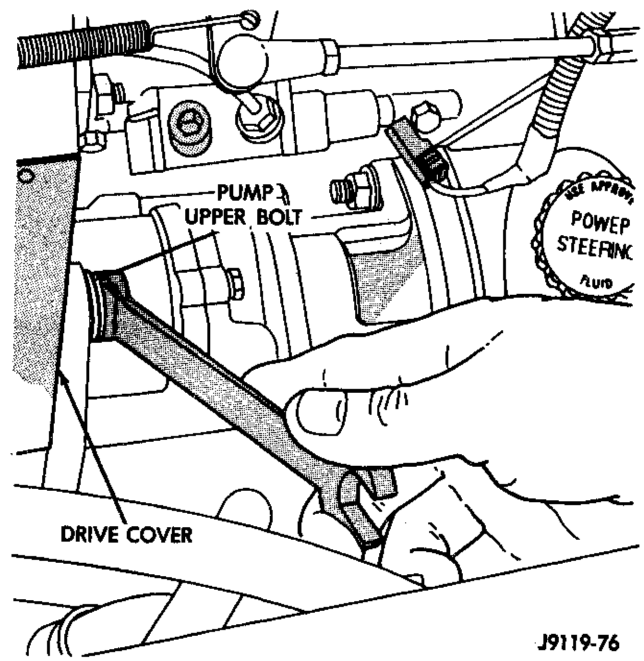

Fig. 7 Pump Assembly Upper Bolt

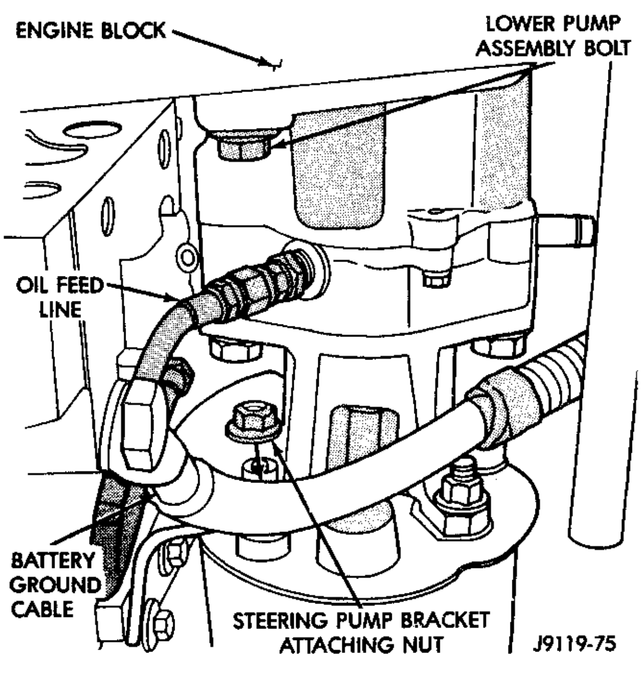

Fig. 6 Oil Feed Line

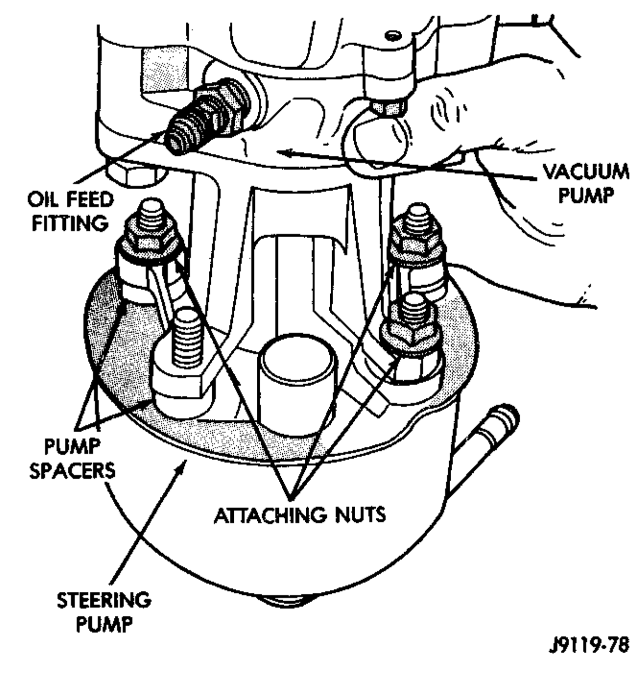

Fig. 8 Bracket Mounting Nuts

(9) Remove the two pump body spacers.

INSTALLATION

(1) Install the two pump body spacers.

(2) Rotate the drive gear until the steering pump and vacuum pump drive dogs align. Install the steering pump onto the vacuum pump bracket. Use care to avoid damaging the oil seal in the vacuum pump during installation. **The steering pump housing and spacers must mate completely with the vacuum pump bracket.**

(3) Install the vacuum pump bracket to steering pump nuts and tighten to 24 N·m (18 ft. lbs.).

(4) Position new gasket on vacuum pump assembly. Use sealer if necessary to retain the gasket.

(5) Align and install the pump assembly on the engine. Ensure the steering pump stud is inserted

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REMOVAL AND INSTALLATION (Continued)

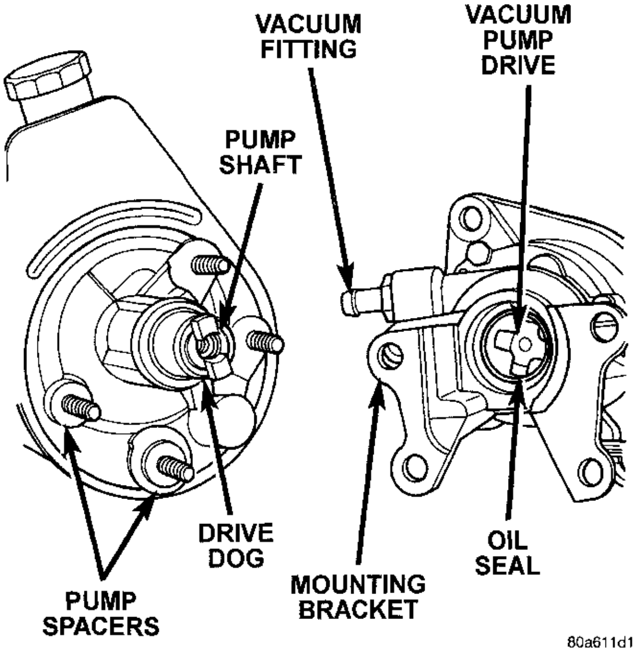


Fig. 9 Steering Pump & Vacuum Pump

into the block bracket. Tighten the pump- to-engine block attaching bolts to 77 N·m (57 ft. lbs.).

(6) Install the steering pump to attaching bracket nut and tighten to 24 N·m (18 ft. lbs.).

(7) Remove plug and install the oil pressure sending unit and electrical connector.

(8) Install the oil feed line to the vacuum pump. Tighten the oil line connection to 7 N·m (60 in. lbs./ 5 ft. lbs.).

(9) Install the fluid hoses to the power steering pump. Tighten the pressure fitting at the pump to 31 N·m (23 ft. lbs.).

(10) Install and clamp the hose on the vacuum pump.

(11) Fill the reservoir with power steering fluid, refer to Pump Initial Operation.

(12) Start the engine and check the operation of the brakes.

DISASSEMBLY AND ASSEMBLY

PUMP PULLEY

DISASSEMBLY

(1) Remove pump assembly.

(2) Remove pulley from pump with Puller C-4333 (Fig. 10).

ASSEMBLY

(1) Replace pulley if bent, cracked, or loose.

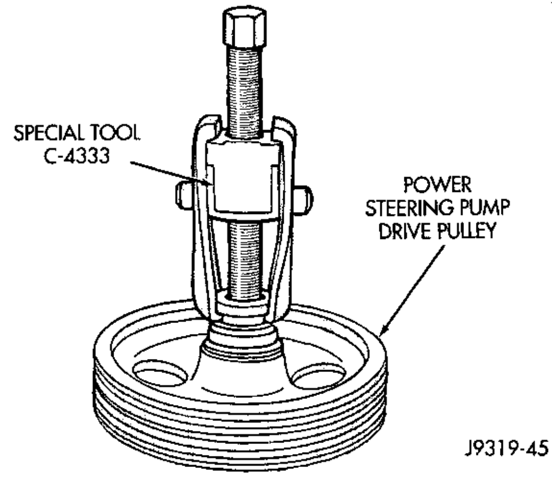


Fig. 10 Pulley Removal

(2) Install pulley on pump with Installer C-4063-B (Fig. 11) flush with the end of the shaft. Ensure the tool and pulley remain aligned with the pump shaft.

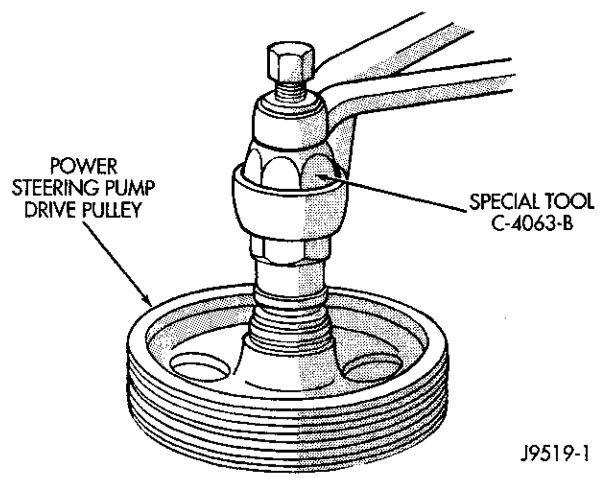


Fig. 11 Pulley Installation

(3) Install pump assembly.

(4) With Serpentine Belts; Run engine until warm (5 min.) and note any belt chirp. If chirp exists, move pulley outward approximately 0.5 mm (0.020 in.). If noise increases, press on 1.0 mm (0.040 in.). **Be careful that pulley does not contact mounting bolts.**

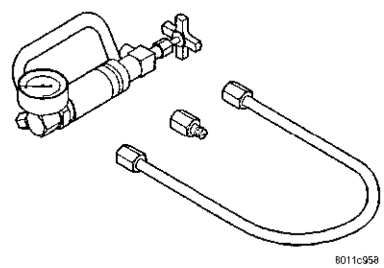
SPECIFICATIONS

TORQUE CHART

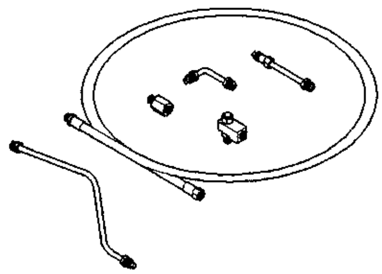
DESCRIPTION	TORQUE
Power Steering Pump	
Reservoir Bolts	56 N·m (42 ft. lbs.)
Flow Control Valve	75 N·m (55 ft. lbs.)
Pressure Line	31 N·m (23 ft. lbs.)
Oil Cooler Bolt	20 N·m (15 ft. lbs.)
Pump Mounting - 3.9L, 5.2L & 5.9L	
Bracket to Pump	47 N·m (35 ft. lbs.)
Bracket to Engine	41 N·m (30 ft. lbs.)
Pump Mounting - 8.0L	
Rear Bracket to Pump	47 N·m (35 ft. lbs.)
Rear Bracket to Front Bracket	24 N·m (18 ft. lbs.)
Bracket to Engine	41 N·m (30 ft. lbs.)
Pump Mounting - Diesel	
Pump to Vacuum Pump	24 N·m (18 ft. lbs.)
Pump Assembly to Engine	77 N·m (57 ft. lbs.)
Pump to Support Bracket	24 N·m (18 ft. lbs.)

SPECIAL TOOLS

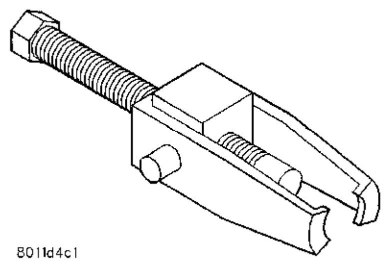
POWER STEERING PUMP



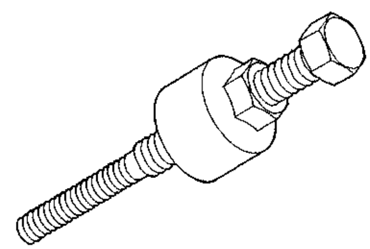
Analyzer Set, Power Steering Flow/Pressure 6815



Adapters, Power Steering Flow/Pressure Tester 6893



Puller C-4333



Installer, Power Steering Pulley C-4063--B

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POWER STEERING GEAR

INDEX

DESCRIPTION AND OPERATION

POWER STEERING GEAR

The power steering gear is a recirculating ball type gear (Fig. 1). The gear acts as a rolling thread between the worm shaft and rack piston. The worm shaft is supported by a thrust bearing at the lower end and a bearing assembly at the upper end. When the worm shaft is turned the rack piston moves. The rack piston teeth mesh with the pitman shaft. Turning the worm shaft turns the pitman shaft, which turns the steering linkage.

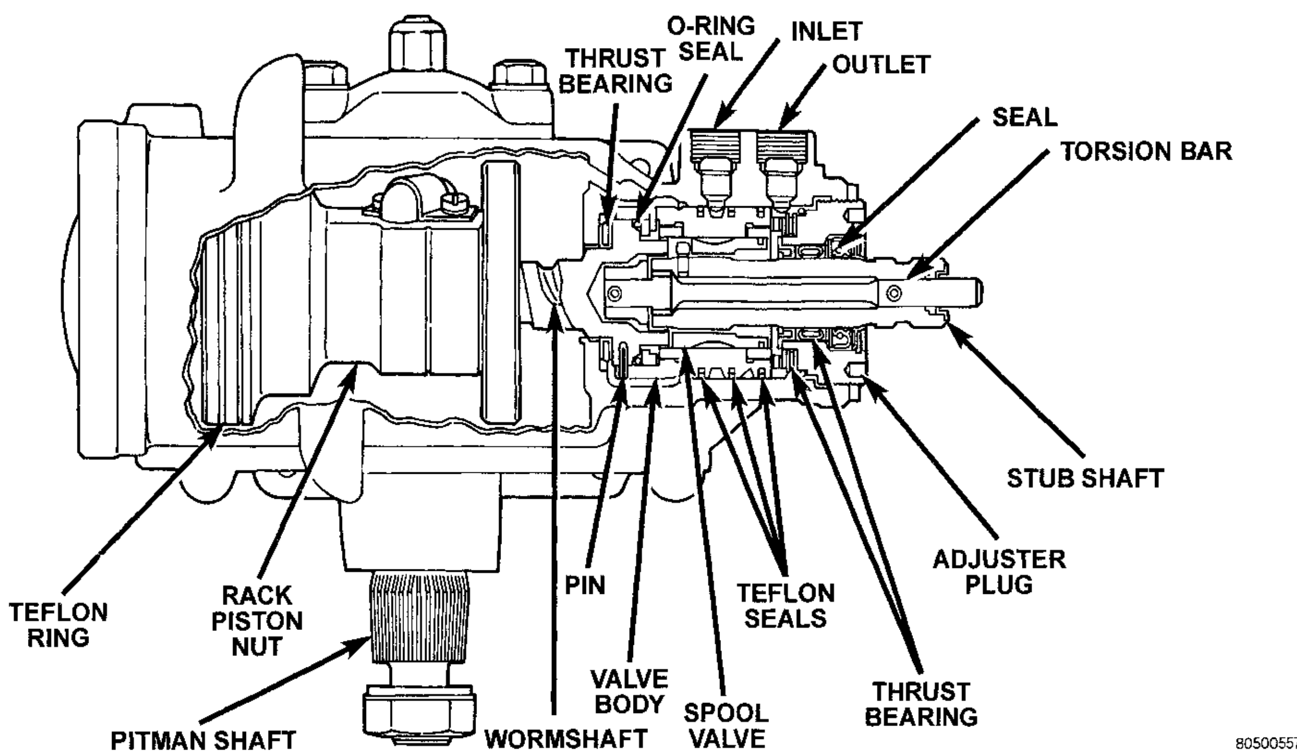
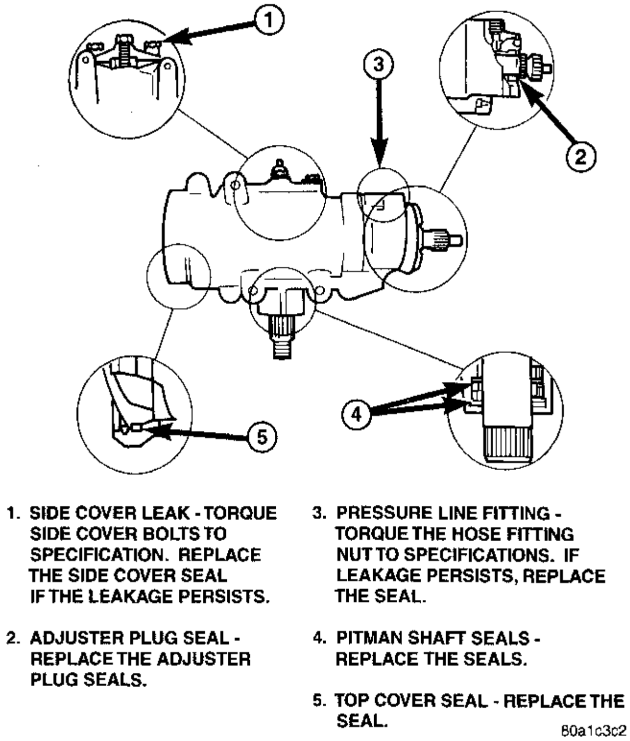


Fig. 1 Power Steering Gear

DIAGNOSIS AND TESTING

POWER STEERING GEAR LEAKAGE DIAGNOSIS



REMOVAL AND INSTALLATION

POWER STEERING GEAR

REMOVAL

(1) Place the front wheels in a straight-ahead position.

(2) Disconnect and cap the fluid hoses from steering gear.

(3) Remove coupler pinch bolt at the steering gear and slide shaft off gear (Fig. 2).

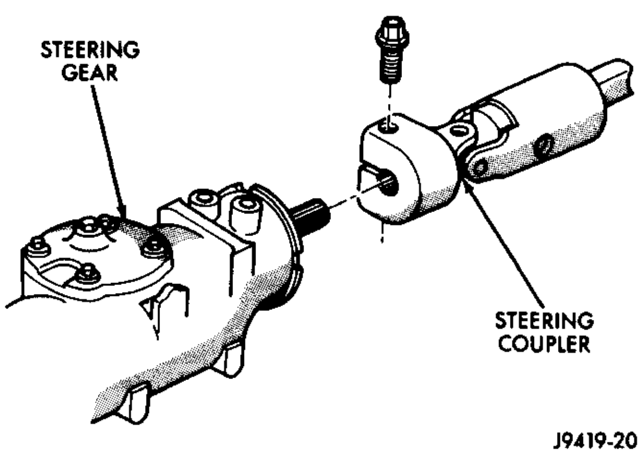


Fig. 2 Column Shaft

(4) Mark the pitman shaft and pitman arm for installation reference. Remove the pitman arm from the shaft with Puller C-4150A (Fig. 3).

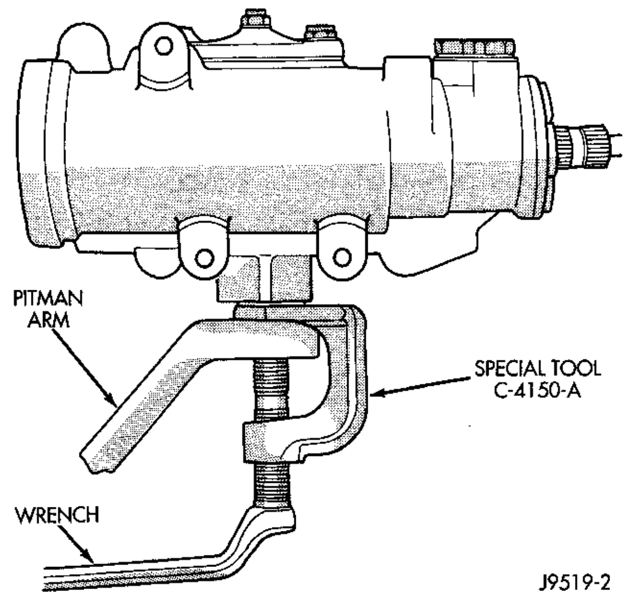


Fig. 3 Pitman Arm

(5) Remove steering gear retaining bolts and nuts. Remove the steering gear from the vehicle.

INSTALLATION

(1) Position the steering gear on the frame rail and install the bolts. Tighten mounting bolts to specifications.

(2) Align steering coupler on gear shaft. Install pinch bolt and tighten to 49 N·m (36 ft. lbs.) torque.

(3) Align and install the pitman arm.

(4) Install the washer and retaining nut on the pitman shaft. Tighten the nut to 251 N·m (185 ft. lbs.).

(5) Connect fluid hoses to steering gear, tighten to 31 N·m (23 ft. lbs.). Add fluid, refer to Power Steering Pump Initial Operation.

DISASSEMBLY AND ASSEMBLY

HOUSING END PLUG

DISASSEMBLY

(1) Unseat and remove retaining ring from groove with a punch through the hole in the end of the housing (Fig. 4).

(2) Slowly rotate stub shaft with 12 point socket COUNTER-CLOCKWISE to force the end plug out from housing.

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DISASSEMBLY AND ASSEMBLY (Continued)

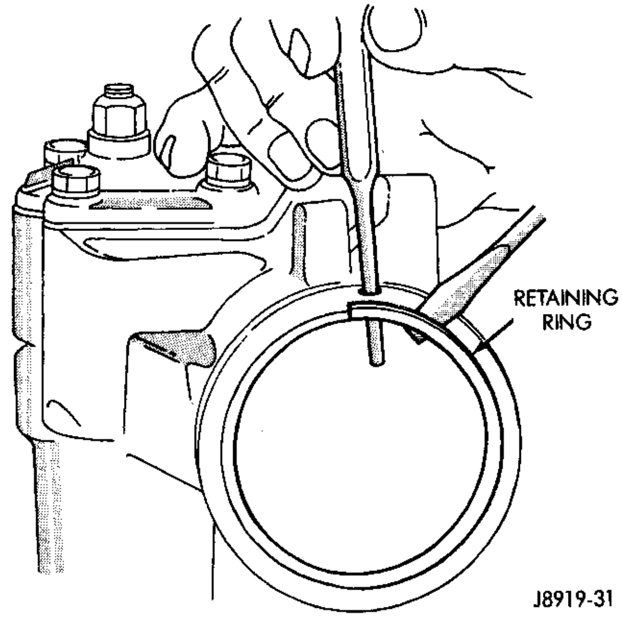

Fig. 4 End Plug Retaining Ring

CAUTION: Do not turn stub shaft any further than necessary. The rack piston balls will drop out of the rack piston circuit if the stub shaft is turned too far.

(3) Remove O-ring from the housing (Fig. 5).

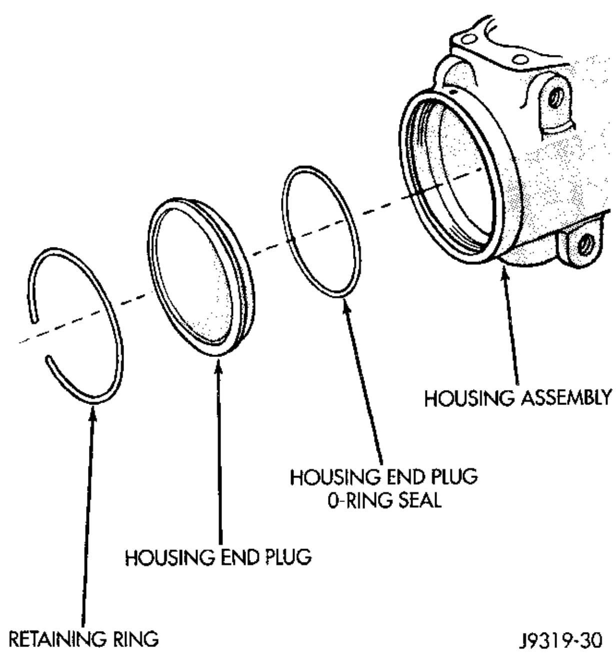

Fig. 5 End Plug Components

ASSEMBLY

(1) Lubricate O-ring with power steering fluid and install into the housing.

(2) Install end plug by tapping the plug lightly with a plastic mallet into the housing.

(3) Install retaining ring so one end of the ring covers the housing access hole (Fig. 6).

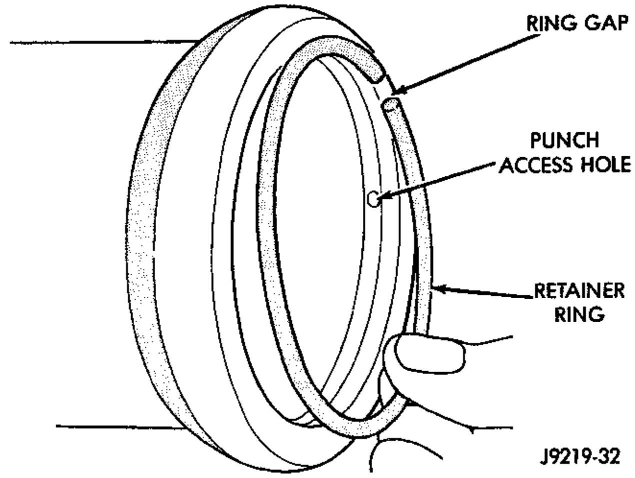

Fig. 6 Installing The Retaining Ring

PITMAN SHAFT/SEALS/BEARING

DISASSEMBLY

(1) Clean exposed end of pitman shaft and housing with a wire brush.

(2) Remove preload adjuster nut (Fig. 7).

(3) Rotate the stub shaft with a 12 point socket from stop to stop and count the number of turns.

(4) Center the stub shaft by rotating it from the stop 1/2 of the total amount of turns.

(5) Remove side cover bolts and remove side cover, gasket and pitman shaft as an assembly (Fig. 7).

NOTE: The pitman shaft will not clear the housing if it is not centered.

(6) Remove pitman shaft from the side cover.

(7) Remove dust seal from the housing with a seal pick (Fig. 8).

CAUTION: Use care not to score the housing bore when prying out seals and washer.

(8) Remove retaining ring with snap ring pliers.

(9) Remove washer from the housing.

(10) Remove oil seal from the housing with a seal pick.

(11) Remove pitman shaft bearing from housing with a bearing driver and handle (Fig. 9).

ASSEMBLY

(1) Install pitman shaft bearing into housing with a bearing driver and handle.

(2) Coat the oil seals and washer with grease.

(3) Install the oil seal with a driver and handle.

(4) Install backup washer.

(5) Install the retainer ring with snap ring pliers.

AUTHENTIC RESTORATION

DISASSEMBLY AND ASSEMBLY (Continued)

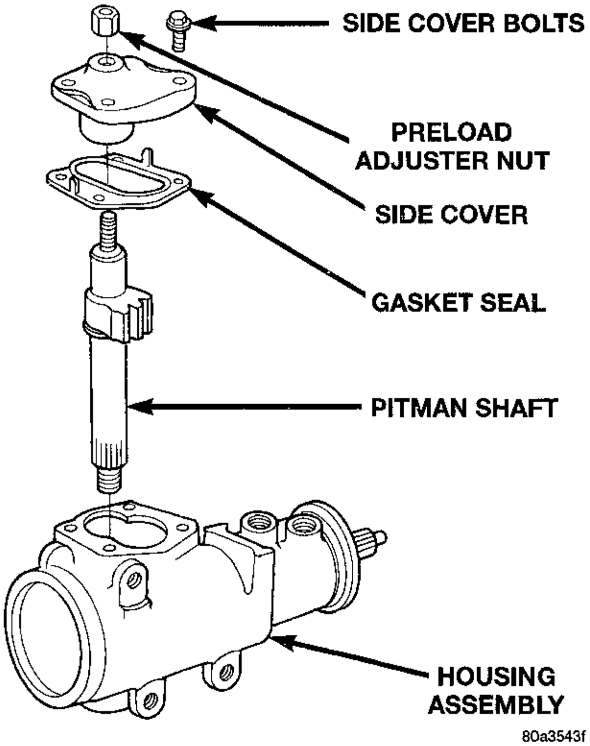

Fig. 7 Side Cover and Pitman Shaft

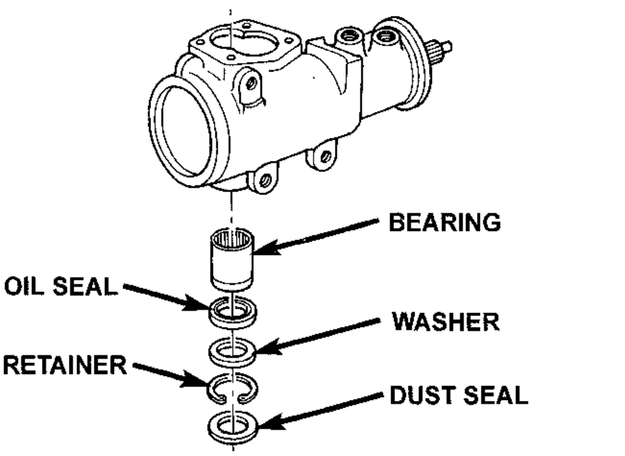

Fig. 8 Pitman Shaft Seals & Bearing

(6) Install dust seal with a driver and handle.

(7) Install pitman shaft to side cover by screwing shaft in until it fully seats to side cover.

(8) Install preload adjuster nut. **Do not tighten nut until after Over-Center Rotation Torque adjustment has been made.**

(9) Install gasket to side cover and bend tabs around edges of side cover (Fig. 7).

(10) Install pitman shaft assembly and side cover to housing.

(11) Install side cover bolts and tighten to 60 N·m (44 ft. lbs.).

(12) Adjust Over-Center Rotation Torque.

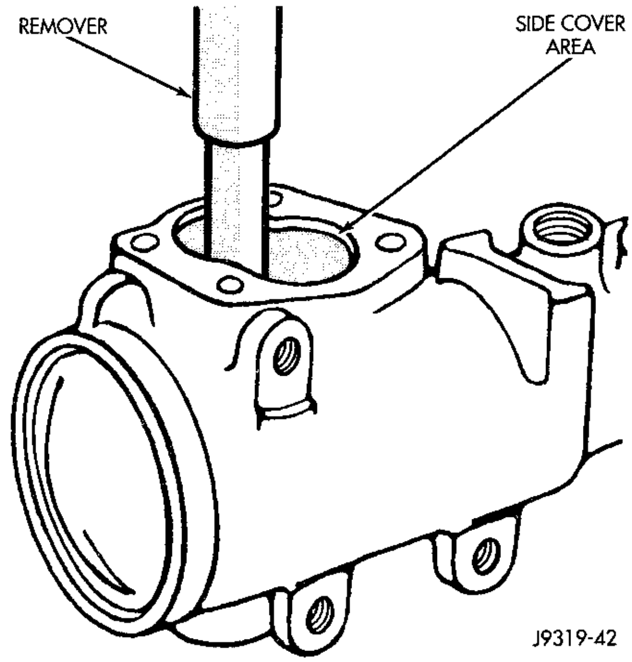

Fig. 9 Needle Bearing Removal

SPOOL VALVE

DISASSEMBLY

(1) Remove lock nut (Fig. 10).

(2) Remove adjuster nut with Spanner Wrench C-4381.

(3) Remove thrust support assembly out of the housing (Fig. 11).

(4) Pull stub shaft and valve assembly from the housing (Fig. 12).

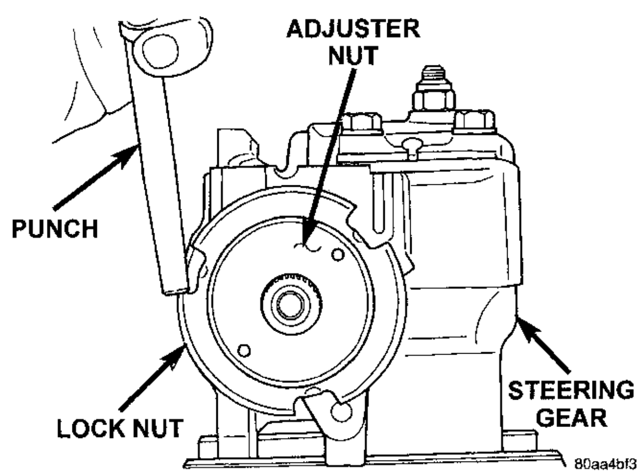

Fig. 10 Lock Nut and Adjuster Nut

(5) Remove stub shaft from valve assembly by lightly tapping shaft on a block of wood to loosen shaft. Then disengage stub shaft pin from hole in spool valve and separate the valve assembly from stub shaft (Fig. 13).

DISASSEMBLY AND ASSEMBLY (Continued)

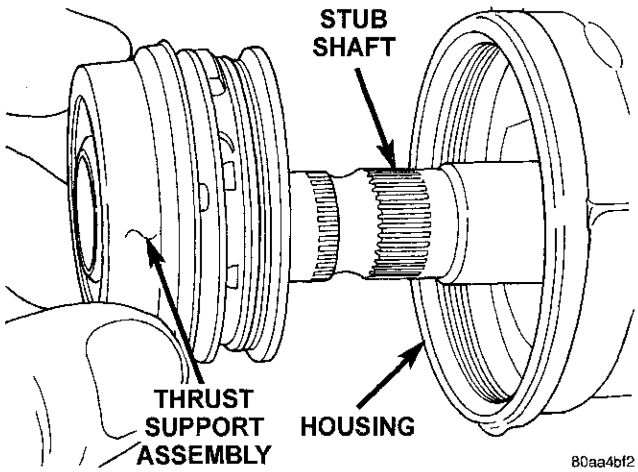

Fig. 11 Thrust Support Assembly

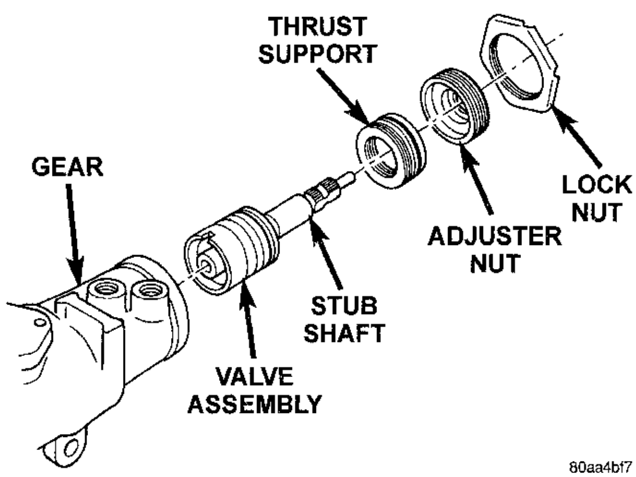

Fig. 12 Valve Assembly With Stub Shaft

(6) Remove spool valve from valve body by pulling and rotating the spool valve from the valve body (Fig. 14).

(7) Remove spool valve O-ring and valve body teflon rings and O-rings underneath the teflon rings (Fig. 15).

(8) Remove the O-ring between the worm shaft and the stub shaft.

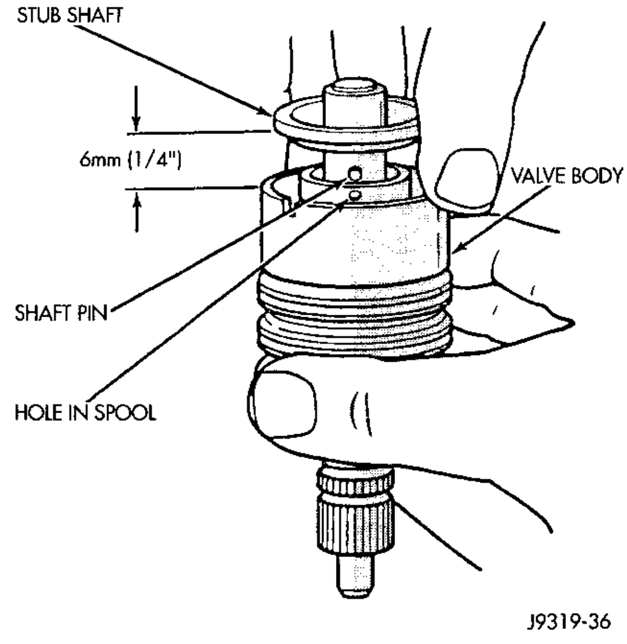

Fig. 13 Stub Shaft

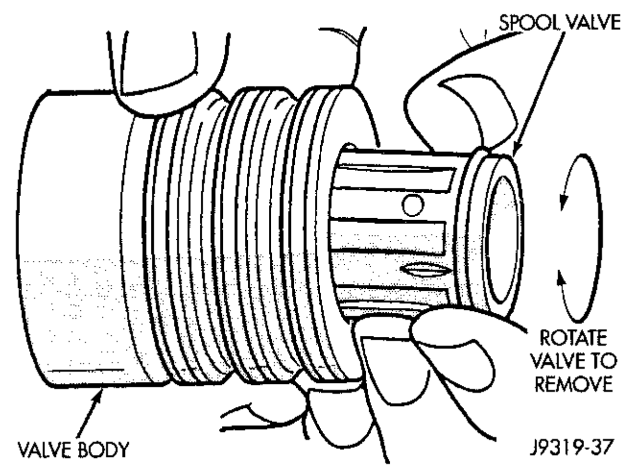

Fig. 14 Spool Valve

NOTE: Notch in stub shaft cap must fully engage valve body pin and seat against valve body shoulder.

ASSEMBLY

NOTE: Clean and dry all components, then lubricate with power steering fluid.

(1) Install spool valve spool O-ring.

(2) Install spool valve in valve body by pushing and rotating. Hole in spool valve for stub shaft pin must be accessible from opposite end of valve body.

(3) Install stub shaft in valve spool and engage locating pin on stub shaft into spool valve hole (Fig. 16).

(4) Install O-rings and teflon rings over the O-rings on valve body.

(5) Install O-ring into the back of the stub shaft cap (Fig. 17).

(6) Install stub shaft and valve assembly in the housing. Line up worm shaft to slots in the valve assembly.

(7) Install thrust support assembly.

NOTE: The thrust support is serviced as an assembly. If any component of the thrust support is damaged the assembly must be replaced.

DISASSEMBLY AND ASSEMBLY (Continued)

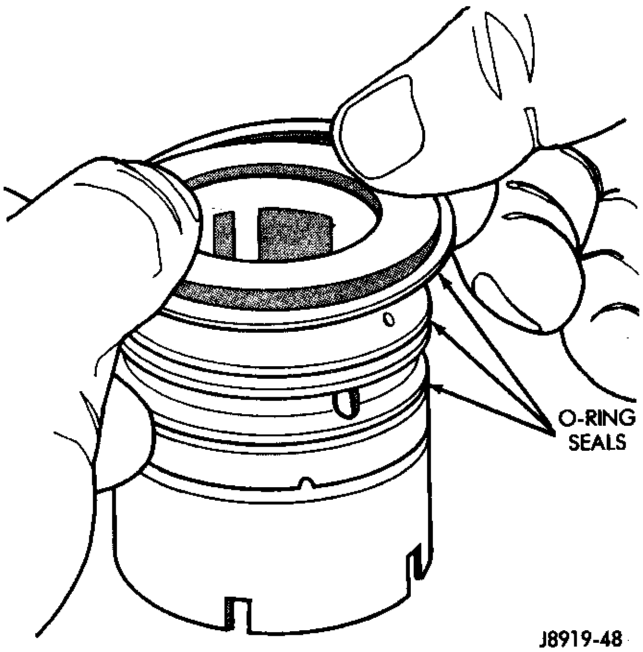

Fig. 15 Valve Seals

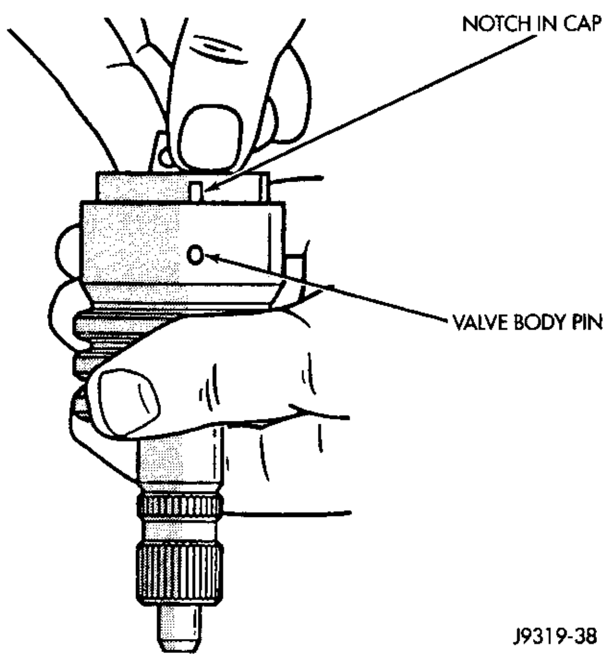

Fig. 16 Stub Shaft Installation

(8) Install adjuster nut and lock nut.

(9) Adjust Thrust Bearing Preload and Over-Center Rotating Torque.

RACK PISTON AND WORM SHAFT

DISASSEMBLY

(1) Remove housing end plug.

(2) Remove rack piston plug (Fig. 18).

(3) Remove side cover and pitman shaft.

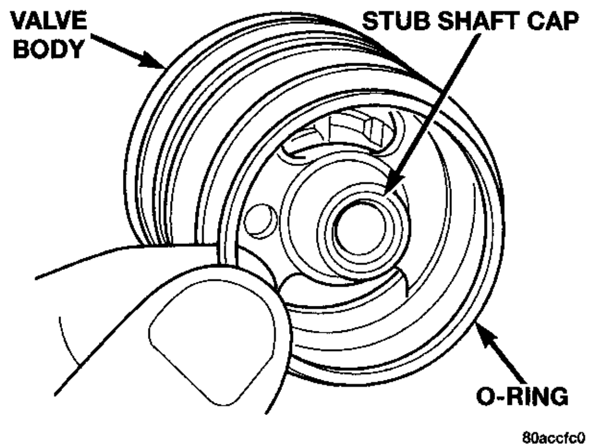

Fig. 17 Stub Shaft Cap O-Ring

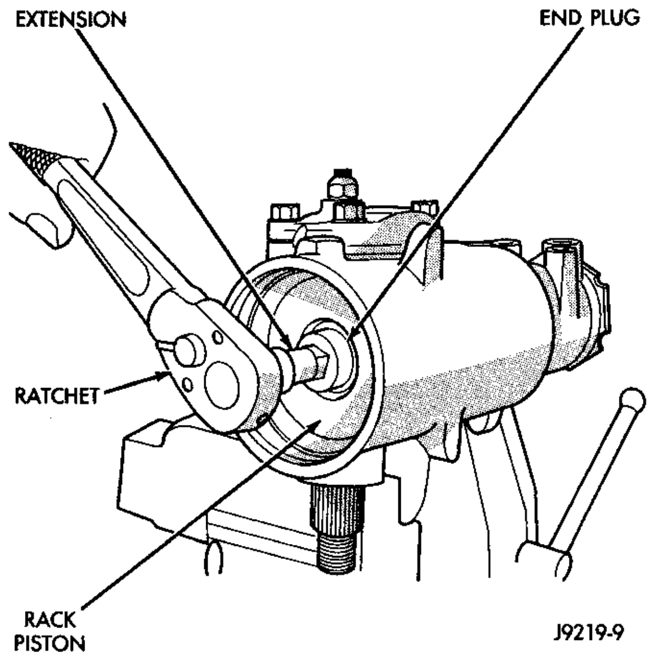

Fig. 18 Rack Piston End Plug

(4) Turn stub shaft COUNTERCLOCKWISE until the rack piston begins to come out of the housing.

(5) Insert Arbor C-4175 into bore of rack piston (Fig. 19) and hold tool tightly against worm shaft.

(6) Turn the stub shaft with a 12 point socket COUNTERCLOCKWISE, this will force the rack piston onto the tool and hold the rack piston balls in place.

(7) Remove the rack piston and tool together from housing.

(8) Remove tool from rack piston.

(9) Remove rack piston balls.

(10) Remove clamp bolts, clamp and ball guide (Fig. 20).

(11) Remove teflon ring and O-ring from the rack piston (Fig. 21).

DISASSEMBLY AND ASSEMBLY (Continued)

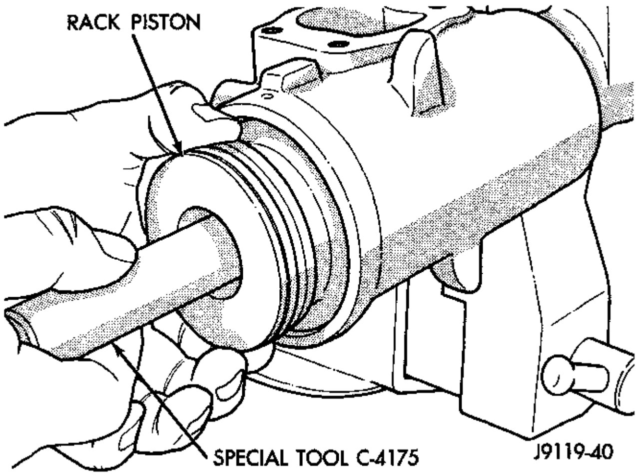

Fig. 19 Rack Piston with Arbor

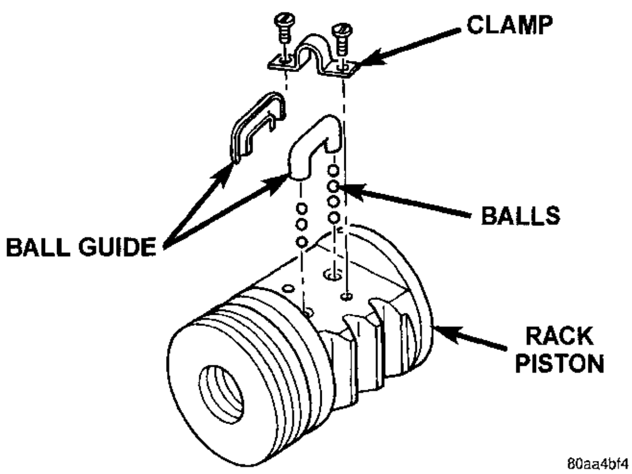

Fig. 20 Rack Piston

(12) Remove the adjuster lock nut and adjuster nut from the stub shaft.

(13) Pull the stub shaft with the spool valve and thrust support assembly out of the housing.

(14) Remove the worm shaft from the housing (Fig. 22).

ASSEMBLY

NOTE: Clean and dry all components and lubricate with power steering fluid.

(1) Check for scores, nicks or burrs on the rack piston finished surface. Slight wear is normal on the worm gear surfaces.

(2) Install O-ring and teflon ring on the rack piston.

(3) Install worm shaft in the rack piston and align worm shaft spiral groove with rack piston ball guide hole (Fig. 23).

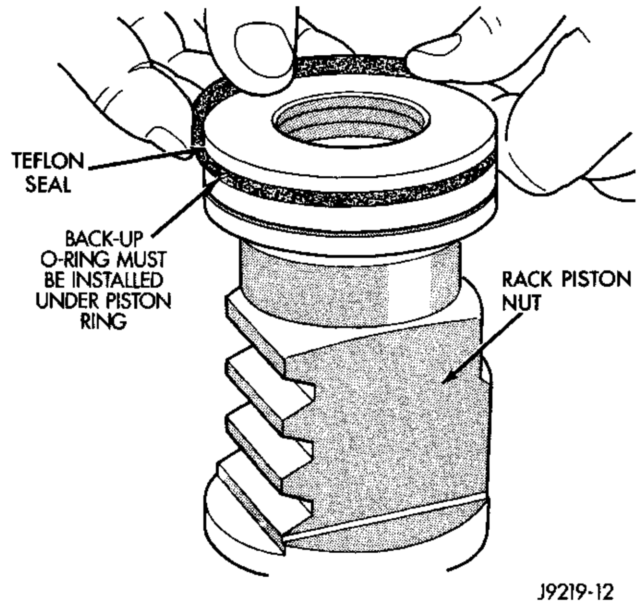

Fig. 21 Rack Piston Teflon Ring and O-Ring

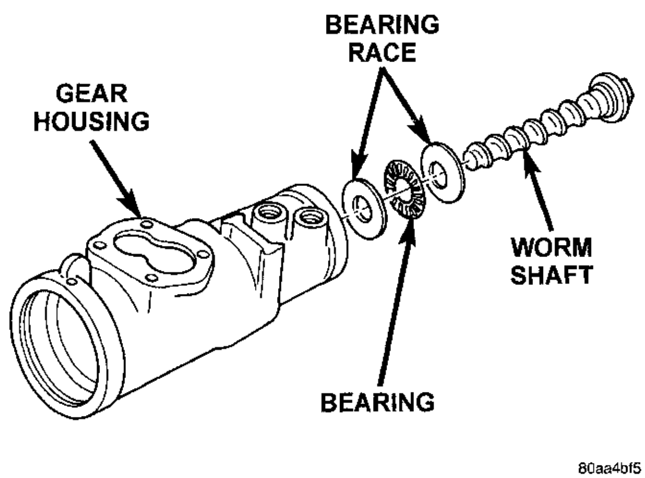

Fig. 22 Worm Shaft

CAUTION: The rack piston balls must be installed alternately into the rack piston and ball guide. This maintains worm shaft preload. There are 12 black balls and 12 silver (Chrome) balls. The black balls are smaller than the silver balls.

(4) Lubricate and install rack piston balls through return guide hole while turning worm shaft COUNTERCLOCKWISE (Fig. 23).

(5) Install remaining balls in guide using grease to hold the balls in place (Fig. 24).

(6) Install the guide onto rack piston and install clamp and clamp bolts. Tighten bolts to 58 N·m (43 ft. lbs.).

(7) Insert Arbor C-4175 into bore of rack piston and hold tool tightly against worm shaft.

DISASSEMBLY AND ASSEMBLY (Continued)

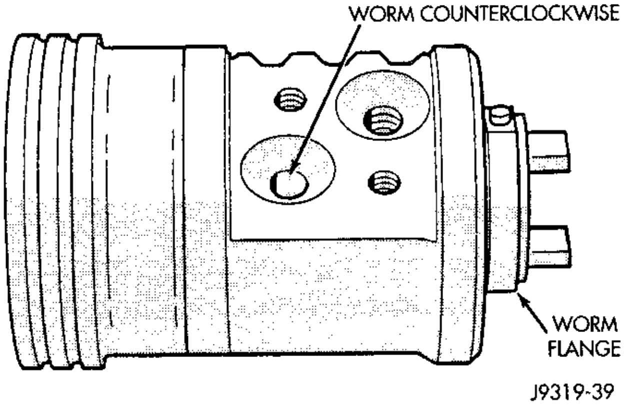

Fig. 23 Installing Balls in Rack Piston

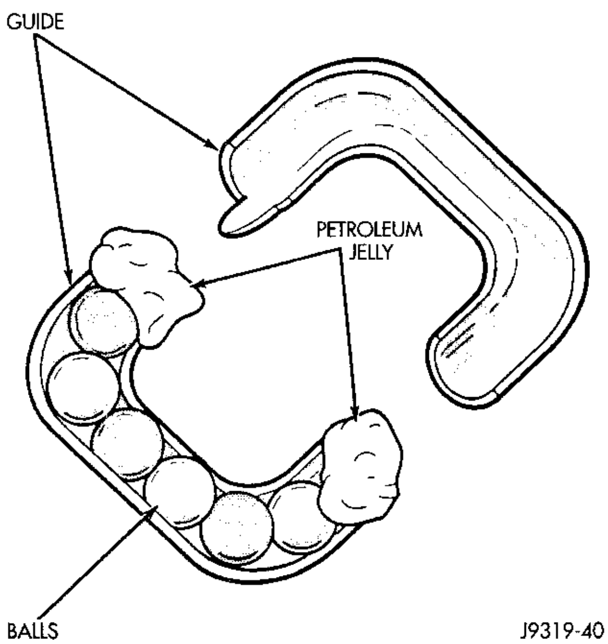

Fig. 24 Balls in the Return Guide

(8) Turn the worm shaft COUNTERCLOCKWISE while pushing on the arbor. This will force the rack piston onto the arbor and hold the rack piston balls in place.

(9) Install the races and thrust bearing on the worm shaft and install shaft in the housing (Fig. 22).

(10) Install the stub shaft with spool valve, thrust support assembly and adjuster nut in the housing.

(11) Install the rack piston and arbor tool into the housing.

(12) Hold arbor tightly against worm shaft and turn stub shaft CLOCKWISE until rack piston is seated on worm shaft.

(13) Install pitman shaft and side cover in the housing.

(14) Install rack piston plug and tighten to 150 N·m (111 ft. lbs.).

(15) Install housing end plug.

(16) Adjust worm shaft thrust bearing preload and over-center rotating torque.

ADJUSTMENTS

STEERING GEAR

CAUTION: Steering gear must be adjusted in the proper order. If adjustments are not performed in order, gear damage and improper steering response may result.

NOTE: Adjusting the steering gear in the vehicle is not recommended. Remove gear from the vehicle and drain the fluid. Then mount gear in a vise to perform adjustments.

WORM THRUST BEARING PRELOAD

(1) Mount the gear carefully into a vise.

CAUTION: Do not overtighten the vise on the gear case. This may affect the adjustment

(2) Remove adjuster plug locknut (Fig. 25).

(3) Rotate the stub shaft back and forth with a 12 point socket to drain the remaining fluid.

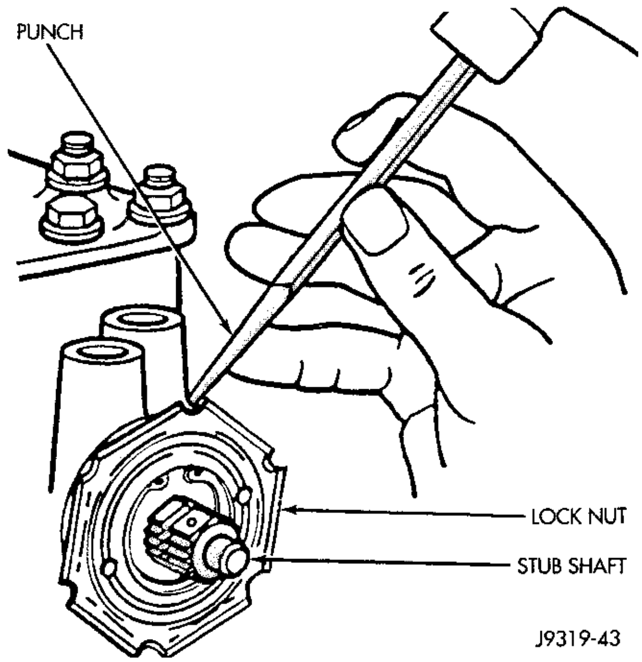

Fig. 25 Loosening the Adjuster Plug

(4) Turn the adjuster in with Spanner Wrench C-4381. Tighten the plug and thrust bearing in the

ADJUSTMENTS (Continued)

housing until firmly bottomed in the housing about 34 N·m (25 ft. lbs.).

(5) Place an index mark on the housing even with one of the holes in adjuster plug (Fig. 26).

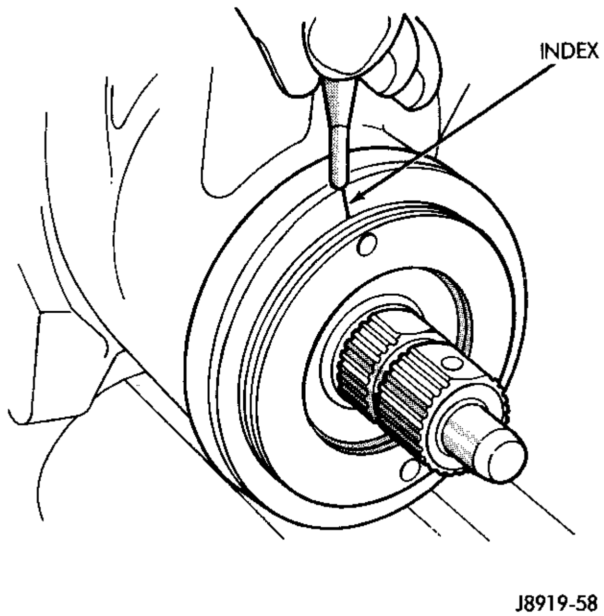

Fig. 26 Alignment Marking On Housing

(6) Measure back (counterclockwise) 10 mm (0.40 in) and mark housing (Fig. 27).

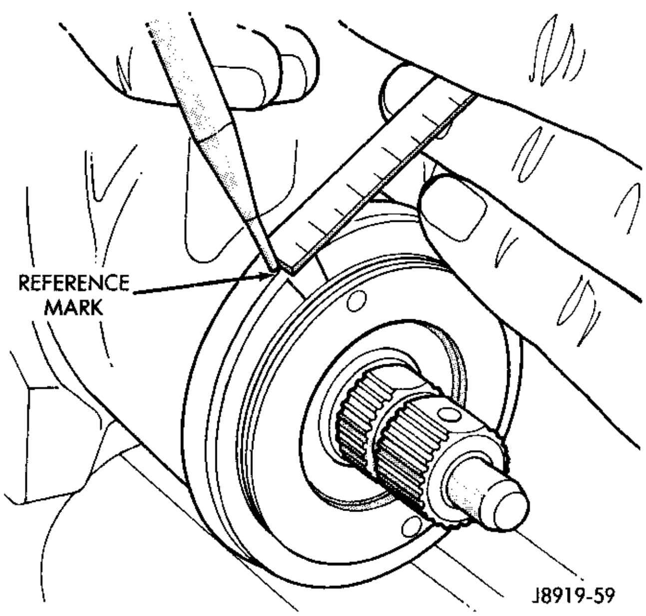

Fig. 27 Second Marking On Housing

(7) Rotate adjustment cap back (counterclockwise) with spanner wrench until hole is aligned with the second mark (Fig. 28).

(8) Install and tighten locknut to 108 N·m (80 ft. lbs.). Be sure adjustment cap does not turn while tightening the locknut.

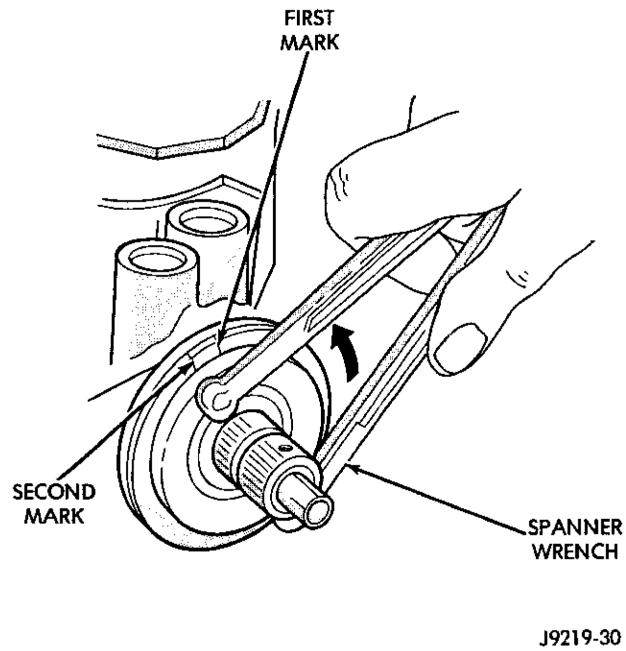

Fig. 28 Aligning To The Second Mark

OVER-CENTER

NOTE: Before performing this procedure, the worm bearing preload adjustment must be performed.

(1) Rotate the stub shaft with a 12 point socket from stop to stop and count the number of turns.

(2) Starting at either stop, turn the stub shaft back 1/2 the total number of turns. This is the center of the gear travel (Fig. 29).

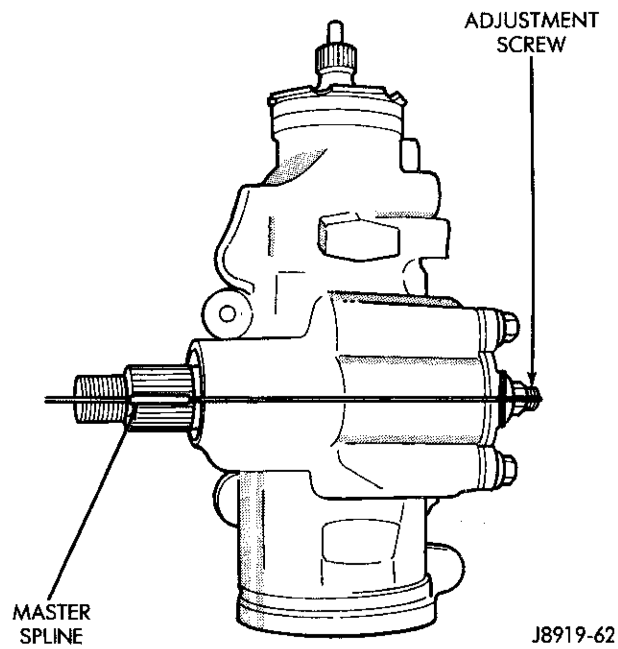

Fig. 29 Steering Gear Centered

ADJUSTMENTS (Continued)

(3) Place the torque wrench in the vertical position on the stub shaft. Rotate the wrench 45 degrees each side of the center and record the highest rotational torque in this range (Fig. 30). This is the Over-Center Rotating Torque.

NOTE: The stub shaft must rotate smoothly without sticking or binding.

(4) Rotate the stud shaft between 90° and 180° to the left of center and record the left off-center preload. Repeat this to the right of center and record the right off-center preload. The average of these two recorded readings is the Preload Rotating Torque.

(5) The Over-Center Rotating Torque should be 0.45-0.9 N·m (4-8 in. lbs.) **higher** than the Preload Rotating Torque.

(6) If an adjustment to the Over-Center Rotating Torque is necessary, first loosen the adjuster lock nut. Then turn the pitman shaft adjuster screw back (COUNTERCLOCKWISE) until fully extended, then turn back in (CLOCKWISE) one full turn.

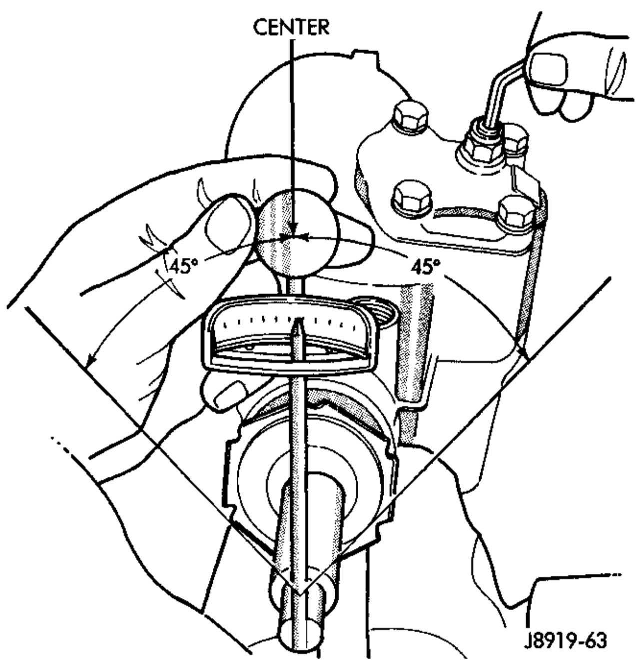

Fig. 30 Checking Over-center Rotation Torque

(7) Remeasure Over-Center Rotating Torque. If necessary turn the adjuster screw and repeat measurement until correct Over-Center Rotating Torque is reached.

NOTE: To increase the Over-Center Rotating Torque turn the screw CLOCKWISE.

(8) Prevent the adjuster screw from turning while tightening adjuster lock nut. Tighten the adjuster lock nut to 49 N·m (36 ft. lbs.).

SPECIFICATIONS

POWER STEERING GEAR

Steering Gear
Type . . . . .Recirculating Ball
Gear Code & Ratio
BN. 17.5:1
HF. 16-13:1
Wormshaft Bearing
Preload. . . . . .0.45–1.13 N·m (10–15 in. lbs.)
Pitman Shaft Overcenter Drag
New Gear (under 400 miles). . . . . . .0.45–0.90 N·m (6–10 in. lbs.) + Wormshaft Preload
Used Gear (over 400 miles) . . . . .0.5–0.6 N·m (4–5 in. lbs.) + Wormshaft Preload

TORQUE CHART

DESCRIPTION	TORQUE
Steering Gear Mounting	
Frame Bolts	176 N·m (130 ft. lbs.)
Line Fittings	
Pressure	31 N·m (23 ft. lbs.)
Return	31 N·m (23 ft. lbs.)
Steering Gear	
Adjustment Cap Locknut	108 N·m (80 ft. lbs.)
Adjustment Screw Locknut	58 N·m (43 ft. lbs.)
Pitman Shaft Nut	251 N·m (185 ft. lbs.)
Rack Piston Plug	149 N·m (110 ft. lbs.)
Side Cover Bolts	61 N·m (45 ft. lbs.)
Return Guide Clamp Bolt	5 N·m (4 ft. lbs.)

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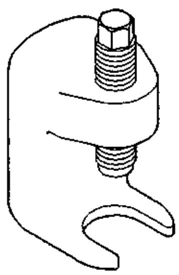
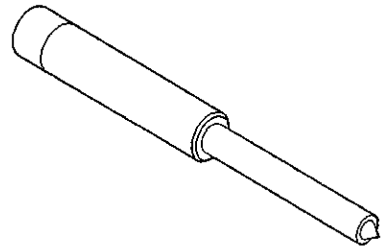
SPECIAL TOOLS

POWER STEERING GEAR

Remover/Installer, Steering Plug C-4381



Remover, Pitman Arm C-4150A



Remover/Installer Steering Rack Piston C-4175

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STEERING COLUMN

INDEX

GENERAL INFORMATION

STEERING COLUMN

The tilt and standard column (Fig. 1) has been designed to be serviced as an assembly; less wiring, switches, shrouds, steering wheel, etc. Most steering column components can be serviced without removing the steering column from the vehicle.

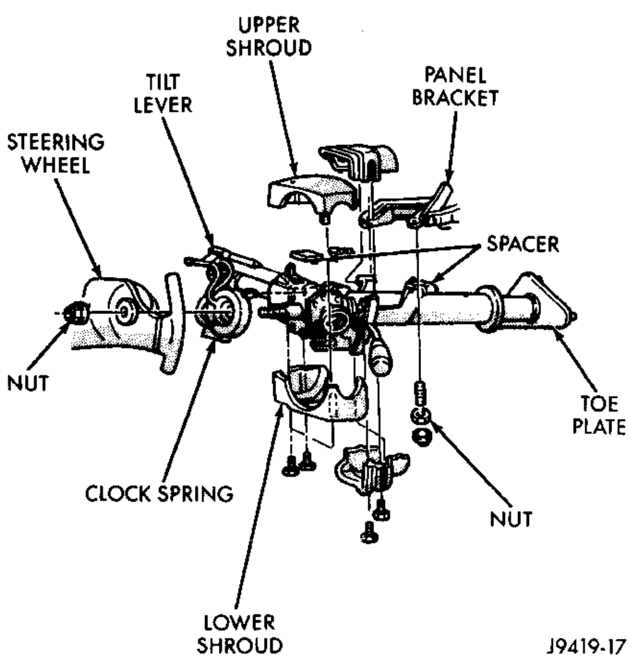

Fig. 1 Steering Column

SERVICE PRECAUTIONS

Safety goggles should be worn at all times when working on steering columns.

To service the steering wheel, switches or the airbag, refer to the appropriate section of Group 8. Follow all WARNINGS.

WARNING: THE AIRBAG SYSTEM IS A SENSITIVE, COMPLEX ELECTRO-MECHANICAL UNIT. BEFORE ATTEMPTING TO DIAGNOSE, REMOVE OR INSTALL THE AIRBAG SYSTEM COMPONENTS YOU MUST FIRST DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE. THEN WAIT TWO MINUTES FOR THE SYSTEM CAPACITOR TO DISCHARGE. FAILURE TO DO SO COULD RESULT IN ACCIDENTAL DEPLOYMENT OF THE AIRBAG AND POSSIBLE PERSONAL INJURY. THE FASTENERS, SCREWS, AND BOLTS, ORIGINALLY USED FOR THE AIRBAG COMPONENTS, HAVE SPECIAL COATINGS AND ARE SPECIFICALLY DESIGNED FOR THE AIRBAG SYSTEM. THEY MUST NEVER BE REPLACED WITH ANY SUBSTITUTES. ANYTIME A NEW FASTENER IS NEEDED, REPLACE WITH THE CORRECT FASTENERS PROVIDED IN THE SERVICE PACKAGE OR FASTENERS LISTED IN THE PARTS BOOKS.

WARNING: THE AIRBAG SYSTEM IS A SENSITIVE, COMPLEX ELECTRO-MECHANICAL UNIT.

CAUTION: Do not hammer on steering column shaft or shift tube. This may cause the shaft or shift tube to collapse.

CAUTION: Do not attempt to remove the pivot pins to disassemble the tilting mechanism. Do not remove ignition locking link, shaft lock plate or plate retainer. This will damage the column (Fig. 2) and (Fig. 3).

DIAGNOSIS AND TESTING

IGNITION SWITCH

TEST AND REPAIR

If the ignition switch effort is excessive, remove the ignition switch from the steering column. Refer to Group 8D Ignition System. Using a key cylinder,

DIAGNOSIS AND TESTING (Continued)

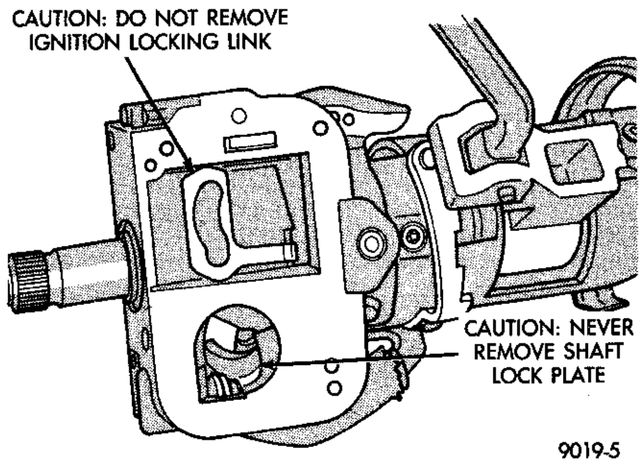

Fig. 2 Observe Cautions

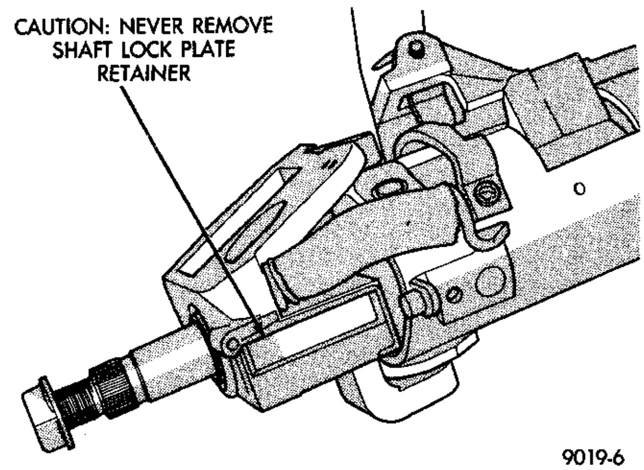

Fig. 3 Observe Cautions

check the turning effort of the switch. If the ignition switch binds look for the following conditions.

(1) Look for rough areas or flash in the casting and if found remove with a file (Fig. 4).

(2) Remove the link and slider and check the link to see if it is bent. If so replace with a new part.

(3) Put the slider in its slot in the sleeve and verify a loose fit over the length of the slot. If the slider binds in the slot at any point lightly file the slider until clearance is achieved.

(4) If no binding is found, lightly file the ramp on the ignition switch, (The ramp fits into the casting) until binding no longer occurs.

REMOVAL AND INSTALLATION

STEERING COLUMN

WARNING: BEFORE SERVICING THE STEERING COLUMN THE AIRBAG SYSTEM MUST BE DISARMED, REFER TO GROUP 8M RESTRAINT SYSTEMS FOR SERVICE PROCEDURES. FAILURE TO DO SO MAY RESULT IN ACCIDENTAL DEPLOYMENT OF THE AIRBAG AND POSSIBLE PERSONAL INJURY.

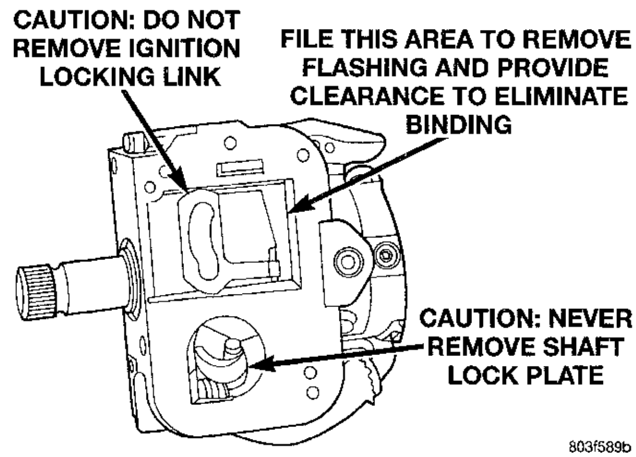

Fig. 4 Steering Column Flash Removal And Non-Serviceable Components

CAUTION: All fasteners must be torque to specification to ensure proper operation of the steering column.

REMOVAL

(1) Position front wheels straight ahead.

(2) Remove the negative (ground) cable from the battery.

(3) Remove airbag, refer to Group 8M Restraint Systems for procedures.

(4) Remove the steering wheel with an appropriate puller.

CAUTION: Ensure the puller bolts are fully engaged into the steering wheel and not into the clockspring, before attempting to remove the wheel. Failure to do so may damage the steering wheel.

(5) Remove the shift link rod in engine compartment (if equipped). Pry rod out from grommet in the shift lever.

(6) Scribe or paint reference mark on the column shaft-to-coupler. This will aid in column shaft installation alignment. Remove the steering column shaft-to-coupler bolt (Fig. 5).

(7) Remove the steering column opening cover/ knee blocker, refer to Group 8E Instrument Panel Systems.

(8) Remove PRNDL cable on column shift vehicles. Put shift lever in **Park** position. Pull cable and twist to remove from position arm. Push tab up on bottom

REMOVAL AND INSTALLATION (Continued)

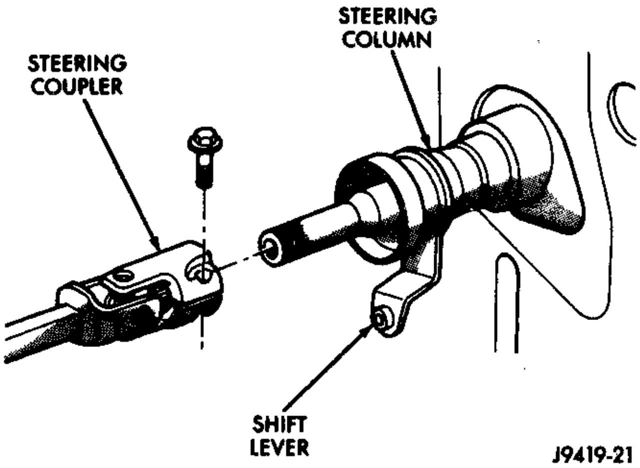

Fig. 5 Steering Coupler

of cable retainer, then squeeze sides to remove retainer from column (Fig. 6).

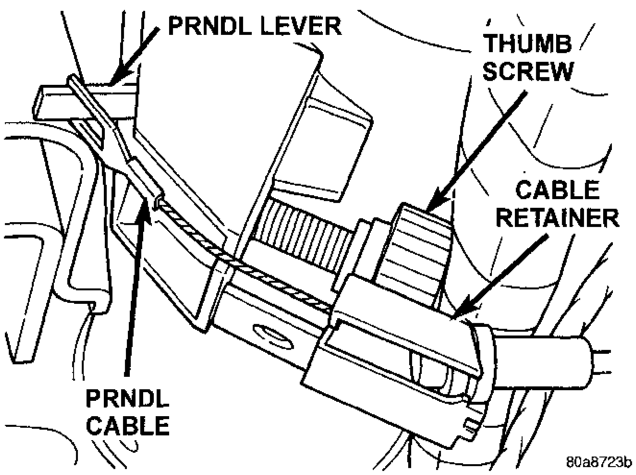

Fig. 6 PRNDL Drive Cable

(9) Remove tilt lever (if equipped) from column.

(10) Remove the upper and lower lock housing shroud and remove the lower fixed shroud.

(11) Remove the turn signal multi-function switch with a 7mm socket (Fig. 7).

(12) Loosen the upper Support Bracket nuts to allow some slack. This will aid in removal of the upper fixed shroud.

(13) Remove electrical connections from Key-in light, Ignition Switch, Horn and Clock Spring (Speed Control) (Fig. 8).

(14) Remove the wiring harness from the column by prying out the plastic retainer buttons.

(15) Remove toe plate fasteners.

(16) Remove column from vehicle.

(17) Remove clock spring and switches, refer to Group 8 Electrical for procedures.

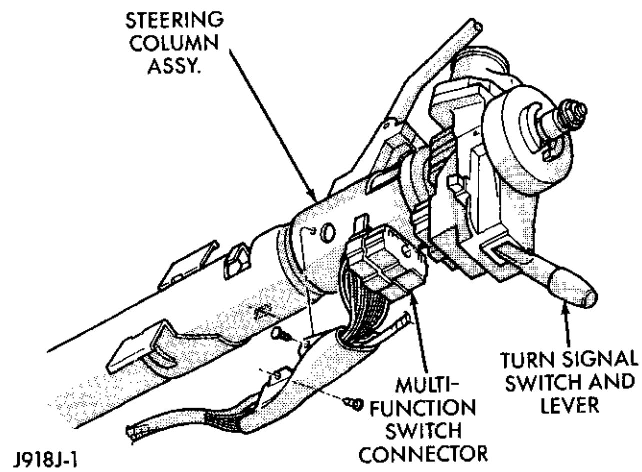

Fig. 7 Multi-function Switch

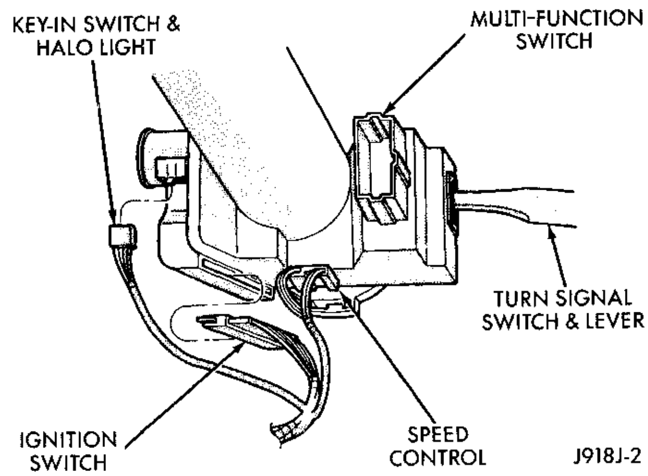

Fig. 8 Steering Column Wiring

INSTALLATION

(1) Install clock spring and switches, refer to Group 8 Electrical for procedures.

(2) Column shift vehicles, install a new grommet. Use multi-purpose lubricant, or equivalent, to aid installation of the grommet.

NOTE: A new grommet should be used when ever the rod is disconnected from the lever.

(3) Remove the shipping lock pin if necessary.

(4) Install the ground clip on the left spacer slot.

(5) Install column through floor pan.

(6) Position the column bracket breakaway capsules on the mounting studs. Install, but **loose assemble** the two upper bracket nuts.

(7) With the front wheels in the straight-ahead position. Align steering column shaft to the coupler. Install a **new** pinch bolt and tighten to 49 N·m (36 ft. lbs.).

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REMOVAL AND INSTALLATION (Continued)

(8) Clip the wiring harness on the steering column. Connect the multi- function switch wiring and tighten with 7mm socket.

(9) Install the upper fixed shroud.

(10) Be sure both breakaway capsules are fully seated in the slots in the column support bracket. Tighten upper bracket nuts to 12 N·m (105 in. lbs.).

(11) Tighten the toe plate to floor pan attaching nuts to 22.5 N·m (200 in. lbs.).

(12) Install the wiring connections to the column. Install the lower fixed shroud.

(13) Column shift vehicles, install the PRNDL driver cable. Place shifter in Park position. If indicator needs adjusting, turn thumb screw on cable retainer to adjust cable.

(14) Install the lock housing shrouds. Install the tilt lever (if equipped).

(15) Install the knee blocker and steering column opening cover, refer to Group 8E Instrument Panel Systems.

(16) Install steering wheel and tighten nut to 61 N·m (45 ft. lbs.).

(17) Install airbag, refer to Group 8M Restraint Systems.

(18) Column shift vehicles, connect the shift link rod to the transmission shift lever. Use multi-purpose lubricant, or an equivalent product, to aid the installation.

(19) Install the battery ground (negative) cable.

(20) Verify operation of the automatic transmission shift linkage and adjust as necessary. Refer to Group 21, Transmission for adjustment procedure.

GEAR SHIFT LEVER

REMOVAL

(1) Support the steering column assembly as shown in (Fig. 9) using a suitable size socket.

(2) Using a drift of the appropriate size drive the roll pin out of the steering column and gear shift lever. Remove the gear shift lever from the steering column assembly.

INSTALLATION

(1) Support the steering column using a suitable size socket.

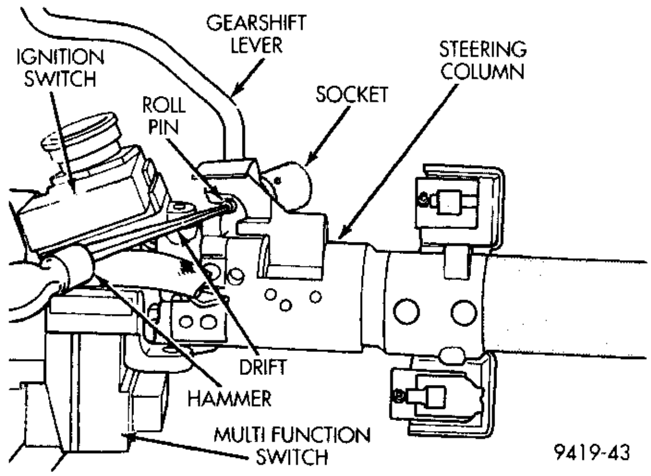

Fig. 9 Gear Shift Lever

(2) Install the gear shift lever into the steering column assembly. Align the roll pin holes in the gear shift lever and the steering column assembly.

(3) Carefully Install the roll pin into the steering column assembly and through the shift lever. If the roll pin binds check the alignment on the holes. Be sure roll pin is fully installed into the steering column assembly.

SPECIFICATIONS

TORQUE CHART

Description	Torque
Steering Wheel	
Nut	61 N·m (45 ft. lbs.)
Steering Coupler	
Bolt	49 N·m (36 ft. lbs.)
Steering Column	
Upper Bracket	12 N·m (105 in. lbs.)
Toe Plate	23 N·m (200 in. lbs.)

STEERING LINKAGE—IFS SUSPENSION

INDEX

GENERAL INFORMATION

IFS-STEERING LINKAGE

Light duty (LD) and heavy duty (HD) steering linkage is used with IFS suspensions (Fig. 1). Heavy duty linkage is used on 8800 and 10500 lb. GVW vehicles. Vehicles with 10500 lb. GVW rating have a steering damper mounted from a frame bracket to the centerlink.

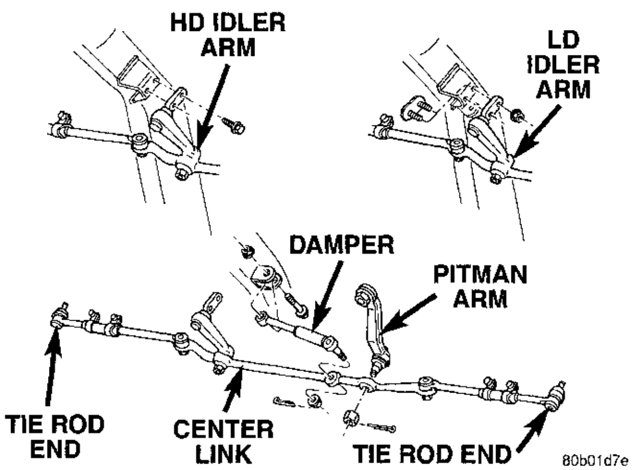

Fig. 1 Steering Linkage

CAUTION: If any steering components are replaced or serviced an alignment must be performed.

CAUTION: Components attached with a nut and cotter pin must be torqued to specification. Then if the slot in the nut does not line up with the cotter pin hole, tighten nut until it is aligned. Never loosen the nut to align the cotter pin hole.

NOTE: Periodic lubrication of the steering system components is required. Refer to Group 0, Lubrication And Maintenance for the recommended maintenance schedule.

NOTE: When servicing the steering linkage, use care to avoid damaging ball stud seals. Use Puller C-3894–A or an appropriate puller to remove tie rod ends (Fig. 2).

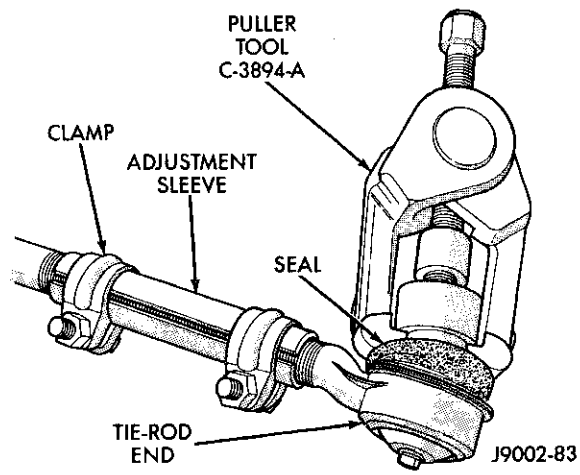

Fig. 2 Tie Rod End

REMOVAL AND INSTALLATION

STEERING LINKAGE

REMOVAL

(1) Remove the cotter pin and nut from the tie-rod.
(2) Remove the tie-rod end ball studs from the steering knuckles with an appropriate puller.
(3) Remove inner tie-rod ends from center link.
(4) If equipped remove steering damper from center link and frame bracket.
(5) Remove idler arm ball stud from center link with an appropriate puller. Remove idler arm mounting nuts (LD) or mounting bolts (HD) from frame bracket.
(6) Remove pitman arm ball stud from center link.
(7) Mark the pitman arm and shaft positions for installation reference. Remove pitman arm with Puller C-4150A (Fig. 3).

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REMOVAL AND INSTALLATION (Continued)

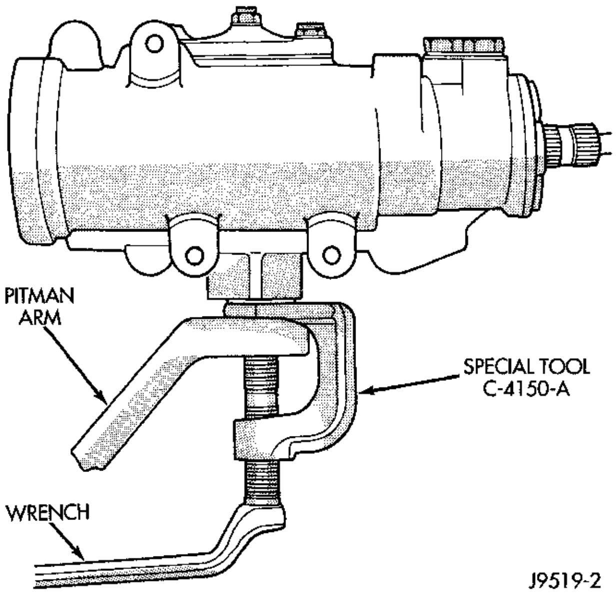


Fig. 3 Pitman Arm

INSTALLATION

(1) Position idler arm on the frame bracket and tighten the mounting nuts (LD) or bolts (HD) to specification.

(2) Center steering gear to alignment marks and install pitman arm.

(3) Install the lock washer and retaining nut on the pitman shaft. Tighten the nut to 251 N·m (185 ft. lbs.).

(4) Install center link to ball studs and tighten retaining nuts to 88 N·m (65 ft. lbs.). Install new cotter pins.

(5) Install tie-rod ends into center link and tighten the nuts to 88 N·m (65 ft. lbs.). Install new cotter pins.

(6) Install steering damper to frame bracket and center link (if equipped). Tighten frame mounting nut to 108 N·m (80 ft. lbs.). Tighten center link mounting nut to 68 N·m (50 ft. lbs.) and install a new cotter pin.

(7) Install tie-rod ends into steering knuckles and tighten nuts to 88 N·m (65 ft. lbs.). Install new cotter pins.

(8) Remove the supports and lower the vehicle to the surface. Center steering wheel and adjust toe (refer to the Alignment Specifications chart within Group 2, Front Suspension).

NOTE: Position the clamp on the sleeve so retaining bolt is located on the bottom side of the sleeve.

(9) After adjustment, tighten the tie-rod adjustment sleeve clamp bolt to 54 N·m (40 ft. lbs.).

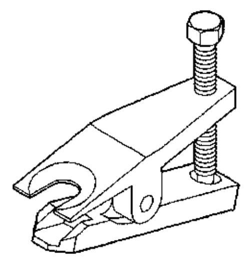
SPECIFICATIONS

TORQUE CART

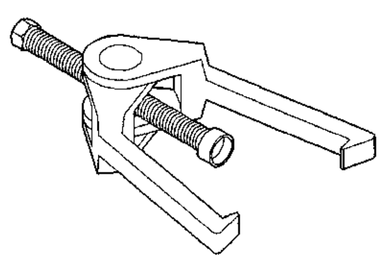
DESCRIPTION	TORQUE
Pitman Arm	
Ball Stud Nut	88 N·m (65 ft. lbs.)
Shaft Nut	251 N·m (185 ft. lbs.)
Idler Arm	
Ball Stud Nut	88 N·m (65 ft. lbs.)
Mounting Nuts LD	68 N·m (50 ft. lbs.)
Mounting Bolts HD	264 N·m (195 ft. lbs.)
Steering Damper	
Frame Nut	108 N·m (80 ft. lbs.)
Center Link Nut	68 N·m (50 ft. lbs.)
Tie Rod	
Ball Stud Nut	88 N·m (65 ft. lbs.)
Tie Rod Clamp	61 N·m (45 ft. lbs.)

SPECIAL TOOLS

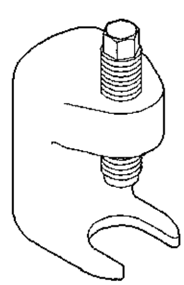
STEERING LINKAGE



Remover Ball Stud MB-991113



Puller Tie Rod C-3894-A



Remover Pitman C-4150A

STEERING LINKAGE—LINK/COIL SUSPENSION

INDEX

GENERAL INFORMATION

LINK/COIL-STEERING LINKAGE

A light duty (LD) steering linkage (Fig. 1) is used on 6400, 6600 and 7500 lb. GVW vehicles. A heavy duty (HD) steering linkage (Fig. 2) is used on 8800 and 11000 lb. GVW vehicles. The steering linkage is comprised of a tie rod end, tie rod, drag link, steering damper and pitman arm .

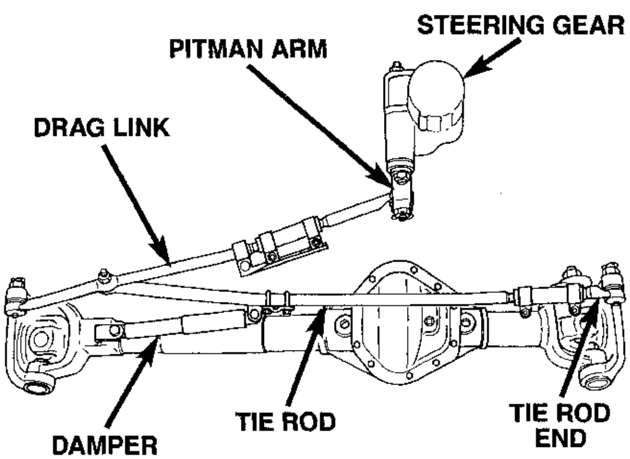


Fig. 1 Light Duty Steering Linkage

CAUTION: If any steering components are replaced or serviced an alignment must be performed.

CAUTION: Components attached with a nut and cotter pin must be torqued to specification. Then if the slot in the nut does not line up with the cotter pin hole, tighten nut until it is aligned. Never loosen the nut to align the cotter pin hole.

NOTE: Periodic lubrication of the steering system components is required. Refer to Group 0, Lubrication And Maintenance for the recommended maintenance schedule.

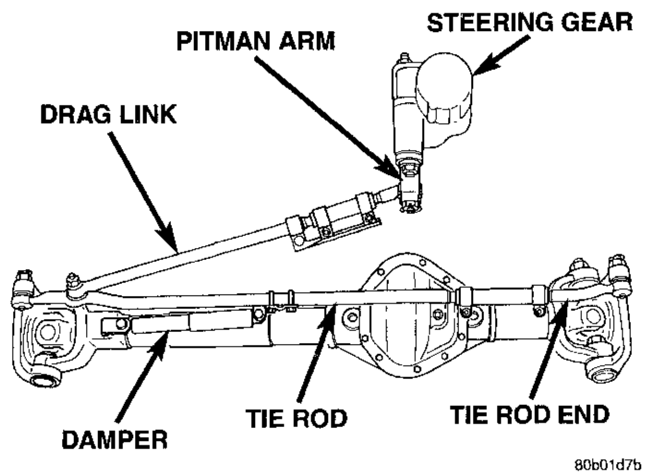


Fig. 2 Heavy Duty Steering Linkage

NOTE: To avoid damaging ball stud seals, use Puller C-3894–A or an appropriate puller to remove tie rod ends (Fig. 3).

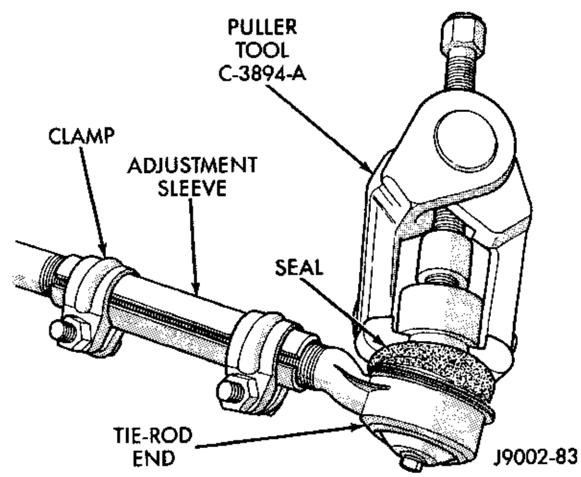


Fig. 3 Tie Rod End

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REMOVAL AND INSTALLATION

STEERING LINKAGE

NOTE: Do not loosen/move alignment bar or alignment bar clamp (Fig. 4). The bar is used as a locator for the adjuster clamps.

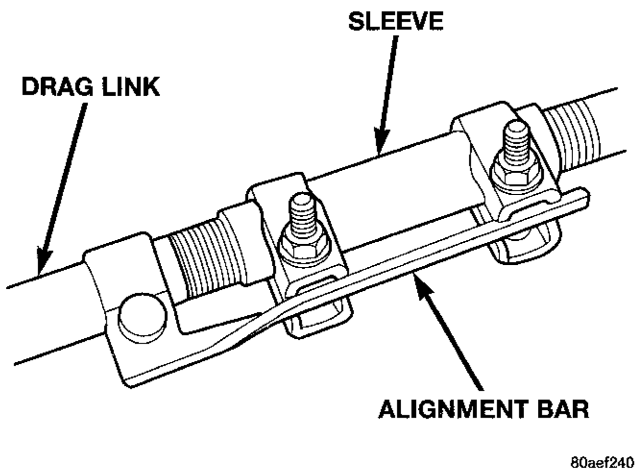


Fig. 4 Alignment Bar

REMOVAL

(1) Remove tie rod from drag link.
(2) Remove steering damper from drag link with Puller C-4150A.
(3) Remove drag link tie rod end from steering knuckle and pitman arm.
(4) Mark the pitman arm and shaft positions for installation reference. Remove the nut and washer from the pitman arm. Remove the pitman arm with Puller C-4150A.
(5) Remove tie rod from steering knuckle.

INSTALLATION

NOTE: When installing linkage tighten nuts to proper torque, then align cotter pin slot by tightening nut if necessary.

(1) Align reference marks and install pitman arm.
(2) Install the lock washer and retaining nut on the pitman shaft and tighten nut to 251 N·m (185 ft. lbs.).
(3) Install drag link ball studs to steering knuckle and pitman arm. Install the retaining nuts and tighten to 88 N·m (65 ft. lbs.). Install new cotter pins.
(4) Install tie rod on steering knuckle and drag link. Tighten the nuts to 88 N·m (65 ft. lbs.). Install new cotter pins.
(5) Install steering damper on drag link and tighten nut to 68 N·m (50 ft. lbs.). Install new cotter pin.
(6) Remove the supports and lower the vehicle to the surface. Center steering wheel and adjust toe, refer to Group 2 Suspension.
(7) After adjustment tighten tie rod adjustment sleeve clamp bolts to 54 N·m (40 ft. lbs.).

NOTE: Position the clamp on the sleeve so retaining bolt is located on the bottom side of the sleeve.

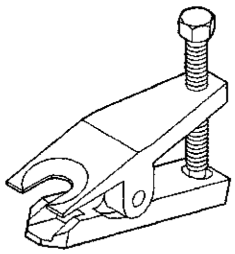
SPECIFICATIONS

TORQUE CHART

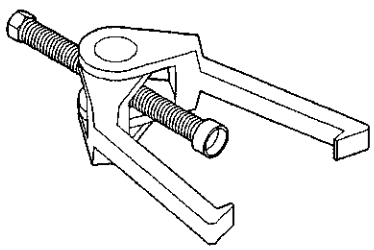
DESCRIPTION	TORQUE
Pitman Arm	
Shaft	251 N·m (185 ft. lbs.)
Drag Link	
Ball Stud	88 N·m (65 ft. lbs.)
Tie Rod End	
Ball Stud	88 N·m (65 ft. lbs.)
Clamp	54 N·m (40 ft. lbs.)
Tie Rod	
Ball Stud	88 N·m (65 ft. lbs.)
Steering Damper	
Frame	88 N·m (65 ft. lbs.)
Drag Link	68 N·m (50 ft. lbs.)

SPECIAL TOOLS

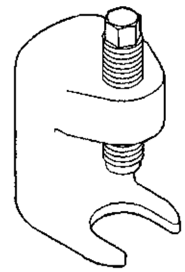
STEERING LINKAGE



Remover Ball Stud MB-991113



Puller Tie Rod C-3894-A



Remover Pitman C-4150A

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TRANSMISSION AND TRANSFER CASE

CONTENTS

NV3500 MANUAL TRANSMISSION

INDEX

GENERAL INFORMATION

NV3500 MANUAL TRANSMISSION

The NV3500 is a medium-duty, 5-speed, constant mesh, fully synchronized manual transmission. Fifth gear is an overdrive range with a ratio of 0.729:1. The NV3500 is available in two and four–wheel drive configurations.

The transmission gear case consists of two aluminum housings (Fig. 1). The clutch housing is not a removable component. It is an integral part of the transmission front housing.

A combination of roller and ball bearings are used to support the transmission shafts in the two housings. The transmission gears all rotate on caged type needle bearings. A roller bearing is used between the input and output shaft.

The NV3500 has a single shaft shift mechanism with three shift forks all mounted on the shaft. The shaft is supported in the front and rear housings by bushings and one linear ball bearing. Internal shift components consist of the forks, shaft, shift lever socket, and detent components (Fig. 2).

TRANSMISSION LUBRICANT

Required lubricant for the NV3500 is Mopar® Manual Transmission Lubricant, P/N 4761526. This is the **only** lubricant to be used in NV3500 transmissions. No other lubricants are acceptable, or recommended.

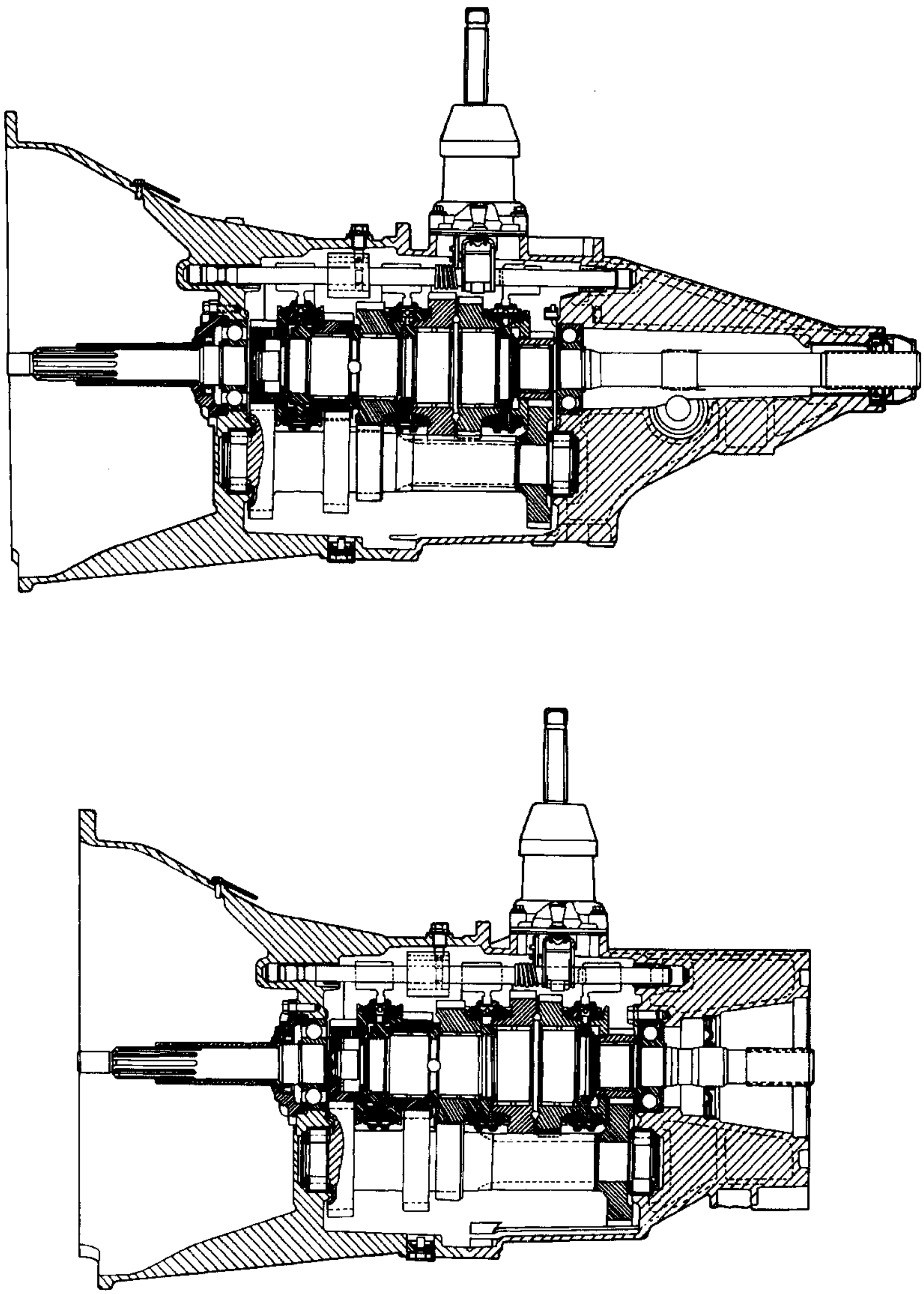
TRANSMISSION LUBRICANT LEVEL AND CAPACITY

The correct transmission lubricant level is to the bottom edge of the fill plug hole (Fig. 3).

The transmission must be level to obtain an accurate lubricant level check. A drive–on type of hoist is recommended for this purpose.

Lubricant capacity of the NV3500 is approximately 2.28 liters (4.8 pints). This represents the approximate quantity needed to refill the transmission after a lubricant change or overhaul.

GENERAL INFORMATION (Continued)



J9421-1

Fig. 1 NV3500 Manual Transmission

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GENERAL INFORMATION (Continued)

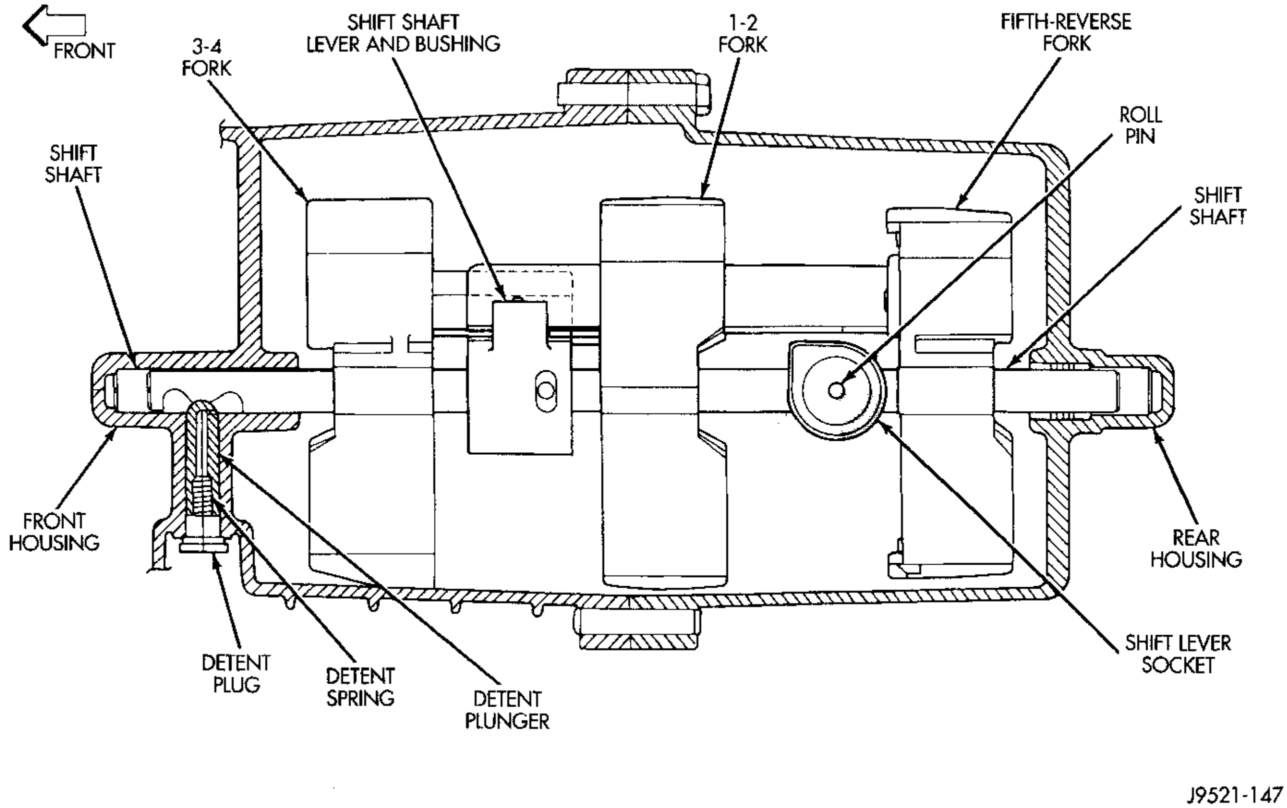

Fig. 2 NV3500 Shift Mechanism

DRAIN AND FILL PLUG LOCATIONS

The NV3500 fill and drain plugs are both located in the front housing. The fill plug is at the passenger side of the housing. The drain plug is at the bottom of the housing (Fig. 3).

TRANSMISSION GEAR RATIOS

Two versions of the NV3500 are available. The wide ratio version has a 4.01 first gear and 2.32 second gear. The close ratio NV3500 has a 3.49 first gear and 2.16 second gear.

DIAGNOSIS AND TESTING

LOW LUBRICANT LEVEL

A low transmission lubricant level is generally the result of a leak, inadequate lubricant fill, or an incorrect lubricant level check.

Leaks can occur at the mating surfaces of the housings, or from the front/rear seals. A suspected leak could also be the result of an overfill condition.

Leaks at component mating surfaces will probably be the result of inadequate sealer, gaps in the sealer, incorrect bolt tightening, or use of a non-recommended sealer.

A leak at the front of the transmission will be from either a loose or damaged, front bearing retainer or

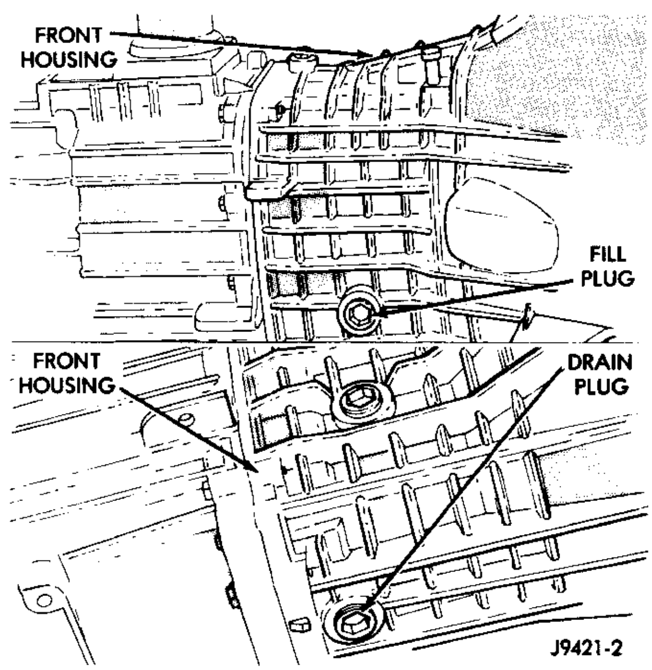

Fig. 3 Drain and Fill Plug Locations

retainer seal. Lubricant may also drip from the transmission clutch housing after extended operation. If the leak is severe, it will contaminate the clutch disc causing slip, grab and chatter.

DIAGNOSIS AND TESTING (Continued)

WIDE RATIO VERSION

RANGE	RATIO
FIRST	4.01:1
SECOND	2.32:1
THIRD =	1.40:1
FOURTH =	1:1
FIFTH =	0.73:1
REVERSE =	3.55:1

CLOSE RATIO VERSION

RANGE	RATIO
FIRST	3.48:1
SECOND	2.16:1
THIRD =	1.40:1
FOURTH =	1:1
FIFTH =	0.73:1
REVERSE =	3.55:1

Transmissions filled from air or electrically powered lubricant containers can be under filled. Always check the lubricant level after filling to avoid an under fill condition.

A correct lubricant level check can only be made when the vehicle is level; use a drive–on hoist to ensure this. Also allow the lubricant to settle for a minute or so before checking. These recommendations will ensure an accurate check and avoid an under-or-overfill condition.

HARD SHIFTING

Hard shifting is usually caused by a low lubricant level, improper or contaminated lubricants, transmission component damage, clutch linkage malfunction, or by a damaged clutch pressure plate or disc.

Substantial lubricant leaks can result in gear, shift component, synchro and bearing damage. If a leak goes undetected for an extended period, the first indications of a problem are usually hard shifting and noise.

Incorrect or contaminated lubricants can also contribute to hard shifting. The consequence of using non–recommended lubricants is noise, excessive wear, internal bind and hard shifting.

Improper clutch release is a frequent cause of hard shifting. Incorrect adjustment or a worn, damaged pressure plate or disc can cause incorrect release. If the clutch problem is advanced, gear clash during shifts can result.

Worn or damaged synchro rings can cause gear clash when shifting into any forward gear. In some new or rebuilt transmissions, new synchro rings may tend to stick slightly causing stiff and/or noisy shifts. In most cases, this condition will decline as the rings wear in.

TRANSMISSION NOISE

Most manual transmissions make some noise during normal operation. Rotating gears can generate a mild whine that may only be audible at extreme speeds.

Severe, obviously audible transmission noise is generally the result of a lubricant problem. Insufficient, improper, or contaminated lubricant can promote rapid wear of gears, synchros, shift rails, forks and bearings. The overheating caused by a lubricant problem, can also lead to gear breakage.

REMOVAL AND INSTALLATION

TRANSMISSION—2WD

REMOVAL

(1) Disconnect battery negative cable.
(2) Shift transmission into Neutral.
(3) Remove shift boot bezel screws and slide boot upward on shift lever extension.
(4) Remove bolts attaching shift tower and lever assembly to rear case. Then remove shift tower and shift lever assembly.
(5) Raise vehicle on hoist.
(6) Remove crankshaft position sensor. Retain sensor attaching bolts.
(7) Remove skid plate, if equipped.
(8) Drain transmission lubricant if transmission will be disassembled for service.
(9) Mark propeller shaft and U-joint for installation reference. Then disconnect and remove propeller shaft.
(10) Disengage harness from clips on transmission housing.
(11) Support engine with adjustable jack stand.
(12) Remove nuts attaching rear mount to crossmember (Fig. 4). Then remove insulator from extension housing if necessary.
(13) Remove bolts and nuts attaching crossmember to frame rails. Rotate crossmember diagonally and remove crossmember.
(14) Disconnect exhaust as necessary.
(15) Remove slave cylinder attaching nuts and remove cylinder from clutch housing.
(16) Remove starter motor.
(17) Support transmission with transmission jack. Secure transmission to jack with safety chains.
(18) Remove nuts/bolts attaching transmission front housing to engine.
(19) Remove transmission dust shield.

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REMOVAL AND INSTALLATION (Continued)

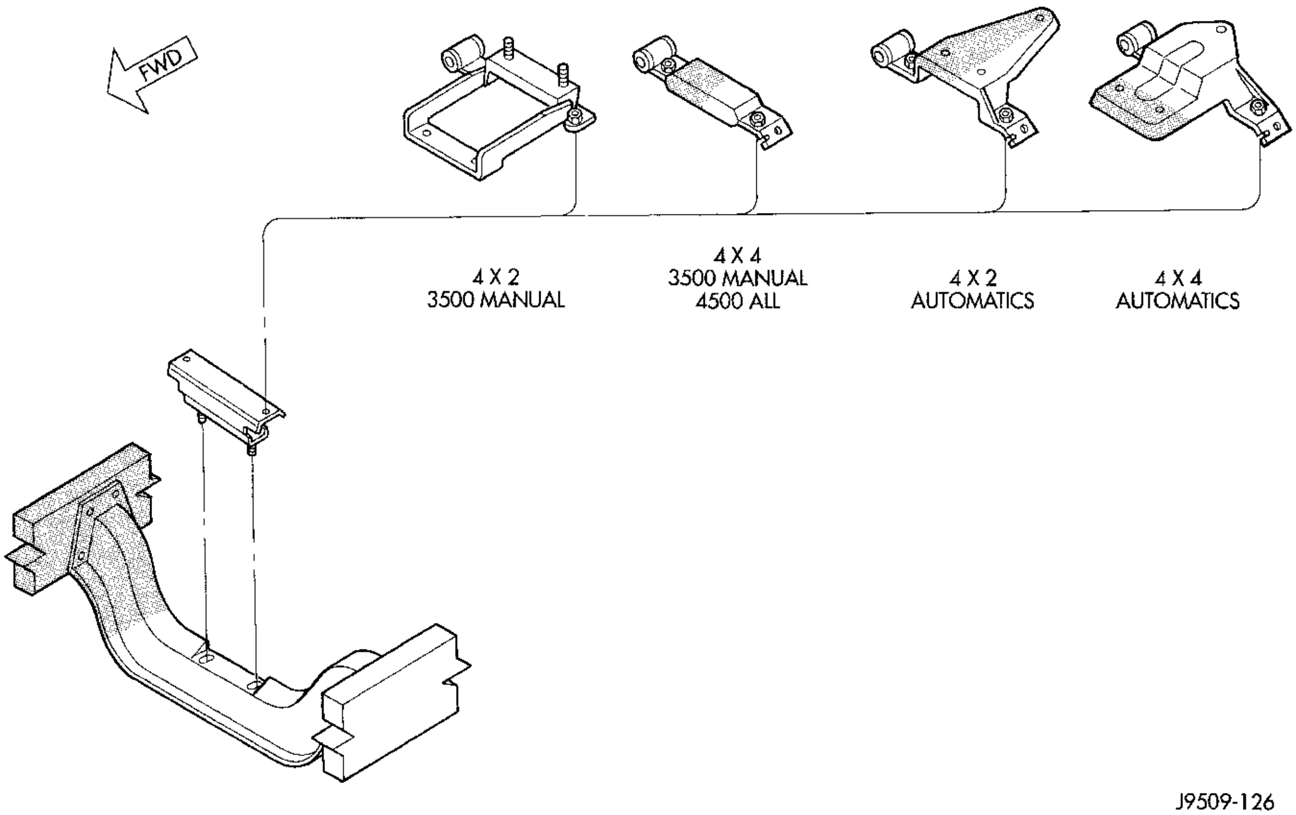

Fig. 4 Transmission Rear Support Brackets

(20) Move transmission rearward until input shaft is clear of clutch disc and cover. Then lower jack and remove transmission from under vehicle.

INSTALLATION

(1) Make sure transmission front housing mounting surface is clean before installation.

(2) Apply light coat of Mopar® high temperature bearing grease to contact surfaces of following components:

- input shaft splines and pilot bearing hub.
- release bearing slide surface of front retainer.
- pilot bearing.
- release bearing bore.
- release fork.
- release ball stud.
- propeller shaft slip yoke.

(3) Mount transmission on jack. Secure transmission to jack with safety chains.

(4) Align transmission input shaft with clutch disc. Then slide transmission into place on engine block.

(5) Install and tighten transmission attaching bolts to 54-61 N·m (40-45 ft. lbs.) torque. Be sure front housing is fully seated before tightening bolts. Install front dust cover after all bolts are tightened.

(6) Fill transmission with Mopar® lubricant P/N 4761526. Correct fill level is to bottom edge of fill plug hole.

(7) Connect backup lamp switch wires.

(8) Connect transmission harnesses to clips on case.

(9) Install crossmember. Tighten crossmember–to–frame bolts to 68 N·m (50 ft. lbs.) torque.

(10) Tighten crossmember-to-transmission insulator nuts to 68 N·m (50 ft. lbs.) torque.

(11) Install slave cylinder. Tighten cylinder nuts to 23 N·m (200 in. lbs.) torque.

(12) Remove jack used to support transmission.

(13) Install strut bolts/nuts, if removed. Also install oil filter if removal was necessary.

(14) Install and connect exhaust system. Align exhaust components before tightening clamp and bracket bolts and nuts. Be sure exhaust components are clear of all chassis and driveline components.

(15) Align and install propeller shaft. Tighten U-joint clamp bolts to 19 N·m (170 in. lbs.) torque.

(16) Verify that all linkage components, hoses and electrical wires have been connected.

(17) Remove any remaining support stands and lower vehicle.

(18) Install crankshaft position sensor.

(19) Connect battery negative cable.

(20) Install shift tower and lever assembly. Tighten shift tower bolts to 7-10 N·m (5-7 ft. lbs.) torque.

(21) Install shift boot and bezel.

REMOVAL AND INSTALLATION (Continued)

TRANSMISSION—4WD

REMOVAL

(1) Disconnect battery negative cable.

(2) Shift transmission into Neutral.

(3) Remove screws attaching shift boot bezel and slide boot upward on shift lever extension.

(4) Remove bolts attaching shift tower and lever assembly to rear case. Then remove shift tower and lever as an assembly.

(5) Remove crankshaft position sensor. Retain sensor attaching bolts.

(6) Raise vehicle on hoist.

(7) Remove skid plate, if equipped.

(8) Drain transmission lubricant if transmission will be disassembled for service.

(9) Mark propeller shafts and U-joints for installation reference. Then disconnect and remove propeller shafts.

(10) Disconnect transfer case shift linkage at transfer case range lever.

(11) Remove bolts attaching shift linkage bracket to transfer case and move linkage and bracket aside.

(12) Support transfer case with transmission jack.

(13) Remove nuts attaching transfer case to transmission adapter housing.

(14) Remove transfer case with aid of helper.

(15) Support engine with adjustable jack stand.

(16) Remove nuts and bolts attaching support bracket and cushions to fixed crossmember.

(17) Remove nuts and bolts attaching removable crossmember to frame rails.

(18) Remove crossmember.

(19) Disconnect exhaust as necessary.

(20) Remove slave cylinder attaching nuts and remove cylinder from clutch housing. Move cylinder aside for working clearance.

(21) Remove clutch housing dust cover.

(22) On some models, it may be necessary to remove front axle struts and oil filter for access and removal clearance. Remove these components if necessary.

(23) Support transmission with transmission jack. Secure transmission to jack with safety chains.

(24) Remove bolts attaching transmission clutch housing to engine block.

(25) Move transmission rearward until transmission input shaft is clear of clutch disc and cover. Then lower jack and remove transmission from under vehicle.

INSTALLATION

(1) Make sure transmission front housing and engine block contact surfaces are clean.

(2) Apply light coat of Mopar® high temperature bearing grease to contact surfaces of following components:

- input shaft splines and pilot bearing hub.
- release bearing slide surface of front retainer.
- pilot bearing.
- release bearing bore.
- release fork.
- release ball stud.
- propeller shaft slip yoke.

(3) Mount transmission on jack. Secure transmission to jack with safety chains.

(4) Align transmission input shaft with clutch disc. Then slide clutch housing into place on engine block.

(5) Install and tighten transmission attaching bolts to 54-61 N·m (40-45 ft. lbs.) torque. Be sure housing is fully seated before tightening bolts. If equipped, install dust cover after tightening housing bolts.

(6) Fill transmission with Mopar® lubricant, P/N 4761526. Correct fill level is to bottom edge of fill plug hole.

(7) Connect backup lamp switch wires.

(8) Connect transmission harnesses and vent line to retainer clips on housing.

(9) Install center crossmember. Tighten crossmember-to-frame bolts to 67 N·m (50 ft. lbs.) torque.

(10) Tighten crossmember-to-support bracket nuts to 54-61 N·m (40-45 ft. lbs.) torque.

(11) Install slave cylinder in transmission clutch housing. Tighten cylinder attaching nuts to 23 N·m (200 in. lbs.) torque.

(12) Remove jack used to support transmission.

(13) Install strut bolts/nuts, if removed.

(14) Install transfer case. Align and position transfer case with transmission jack or aid of helper.

(15) Install and tighten transfer case attaching nuts to 47 N·m (35 ft. lbs.) torque.

(16) Install and connect transfer case shift linkage.

(17) Align and connect exhaust system components. Be sure exhaust components are clear of all chassis and driveline components.

(18) Align and install front and rear propeller shafts. Tighten U-joint clamp bolts to 19 N·m (170 in. lbs.) torque.

(19) Verify that all linkage components, hoses and electrical wires have been connected.

(20) Check transfer case fluid level. Add Mopar® Dexron II, or ATF Plus if necessary. Correct level is to edge of fill plug hole. Be sure transfer case is level before checking or adding fluid.

(21) Check and adjust transfer case shift linkage if necessary.

(22) Install transfer case skid plate, if equipped.

(23) Install crankshaft position sensor.

(24) Remove any remaining support stands and lower vehicle.

(25) Connect battery negative cable.

AUTHENTIC RESTORATION PRODUCT

REMOVAL AND INSTALLATION (Continued)

(26) Install shift tower and lever assembly. Tighten shift tower bolts to 7-10 N·m (5-7 ft. lbs.) torque.

(27) Install shift boot and bezel.

YOKE SEAL REPLACEMENT

REMOVAL

(1) Raise vehicle.

(2) Mark propeller shaft and axle yoke for alignment reference.

(3) Disconnect and remove propeller shaft.

(4) Remove old seal with Seal Remover C-3985-B (Fig. 5) from extension housing.

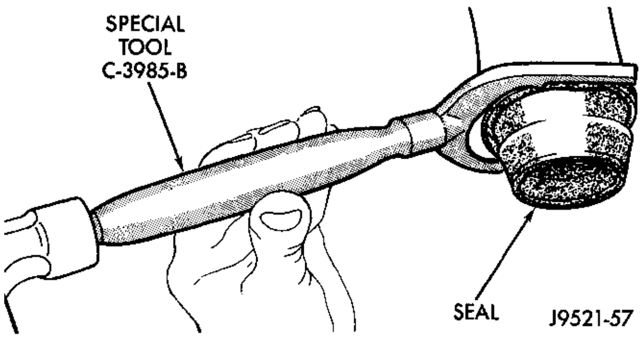

Fig. 5 Removing Extension Housing Yoke Seal

INSTALLATION

(1) Place seal in position on extension housing.

(2) Drive seal into extension housing with Seal Installer C-3972-A (Fig. 6).

(3) Carefully guide propeller shaft slip yoke into housing and onto output shaft splines. Align marks made at removal and connect propeller shaft to rear axle pinion yoke.

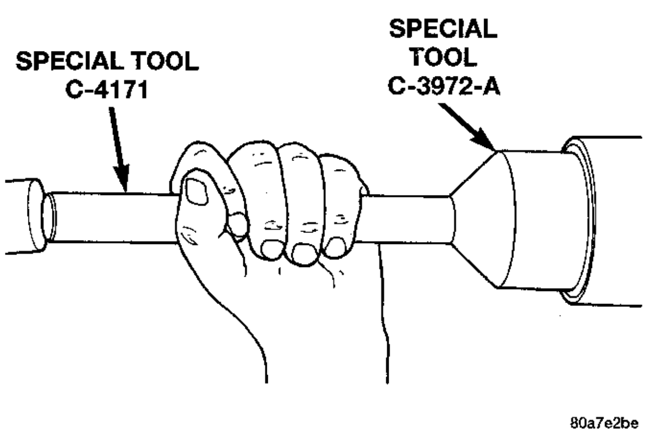

Fig. 6 Installing Extension Housing Yoke Seal

REAR HOUSING YOKE BUSHING

REMOVAL

(1) Remove housing yoke seal.

(2) Insert Remover 6957 into rear housing. Tighten tool to bushing and remove bushing (Fig. 7).

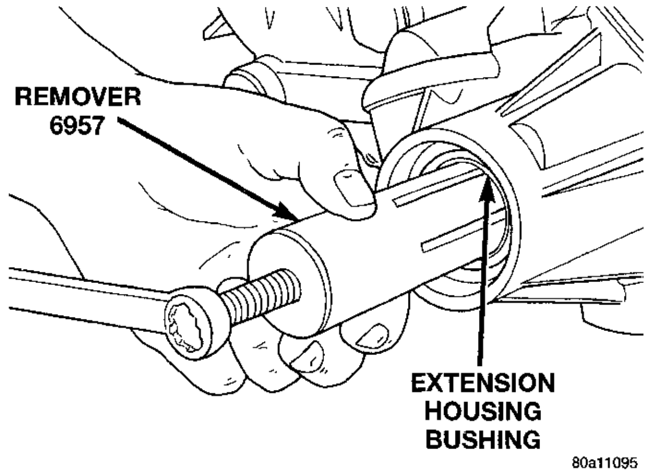

Fig. 7 Bushing Removal—Typical

INSTALLATION

(1) Align bushing oil hole with oil slot in rear housing.

(2) Tap bushing into place with Installer 6951 and Handle C-4171.

(3) Install new oil seal in housing using Seal Installer C-3972–A (Fig. 8).

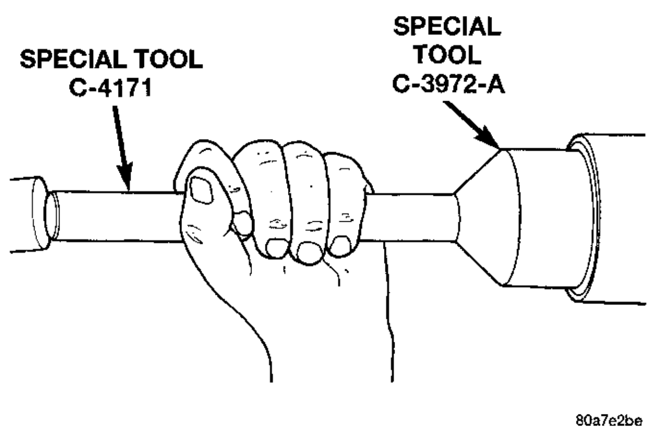

Fig. 8 Rear Housing Seal Installation

DISASSEMBLY AND ASSEMBLY

TRANSMISSION

FRONT HOUSING REMOVAL

(1) If necessary, temporarily reinstall shift lever assembly. Shift transmission into Neutral.

(2) If lubricant was not drained out of transmission during removal, remove drain plug and drain lubricant into container at this time.

(3) Inspect drain plug magnet for debris.

DISASSEMBLY AND ASSEMBLY (Continued)

(4) Remove backup light switch. Switch is located on driver side of rear housing (Fig. 9).

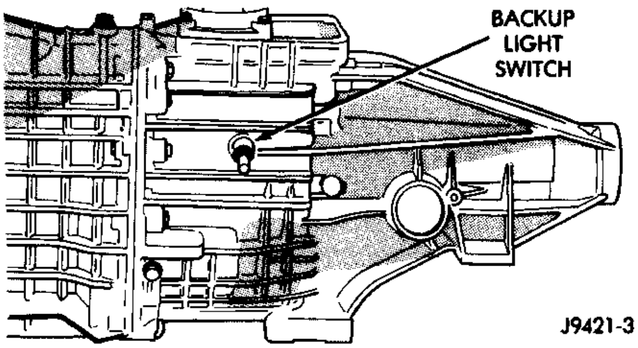

Fig. 9 Backup Light Switch Location

(5) If necessary, remove shift tower bolts and remove tower and lever assembly.

(6) Remove shift shaft lock bolt (Fig. 10). Bolt is located at top of front housing just forward of shift tower. Bolt is a shoulder bolt that secures the shift shaft bushing and lever.

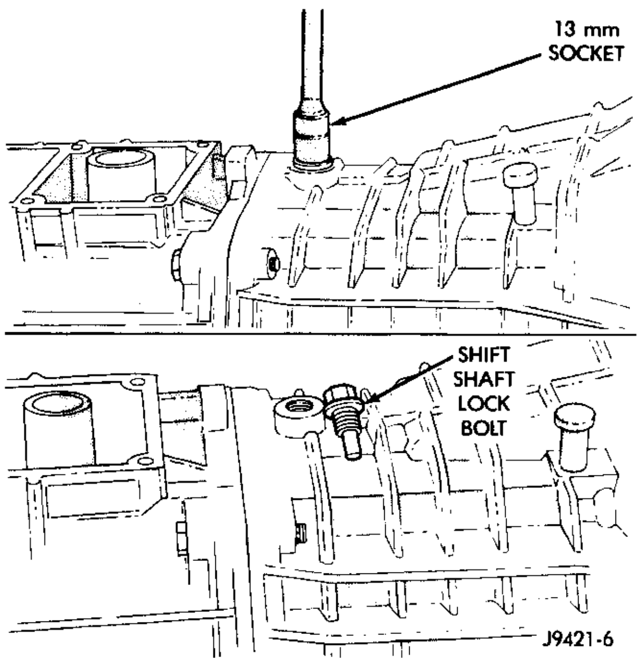

Fig. 10 Shift Shaft Lock Bolt Removal

(7) Remove bolts attaching input shaft bearing retainer in front housing (Fig. 11). Note location of oil feed formation on retainer for installation reference.

(8) Remove input shaft bearing retainer. Use pry tool to carefully lift retainer and break sealer bead (Fig. 12).

(9) Remove bearing retainer from input shaft (Fig. 13).

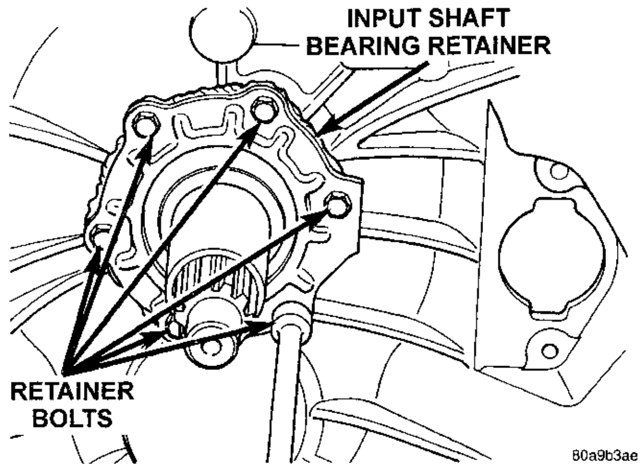

Fig. 11 Input Shaft Bearing Retainer Bolt Removal

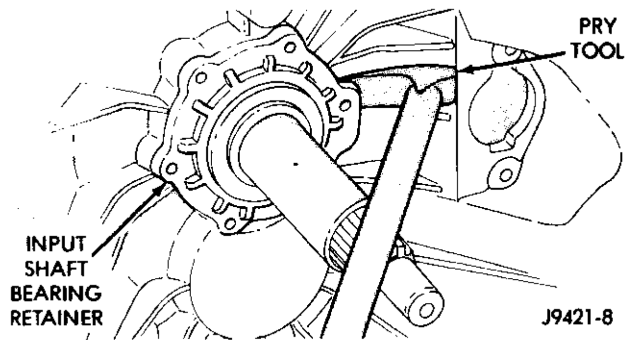

Fig. 12 Loosening Bearing Retainer Sealer Bead

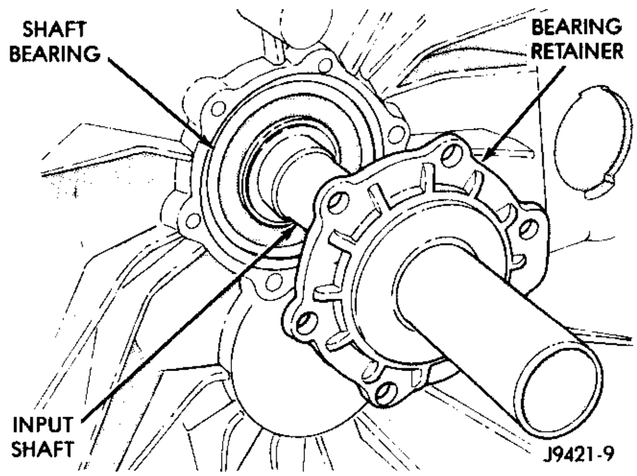

Fig. 13 Input Shaft Bearing Retainer Removal

DISASSEMBLY AND ASSEMBLY (Continued)

(10) Remove snap ring that secures input shaft in front bearing (Fig. 14).

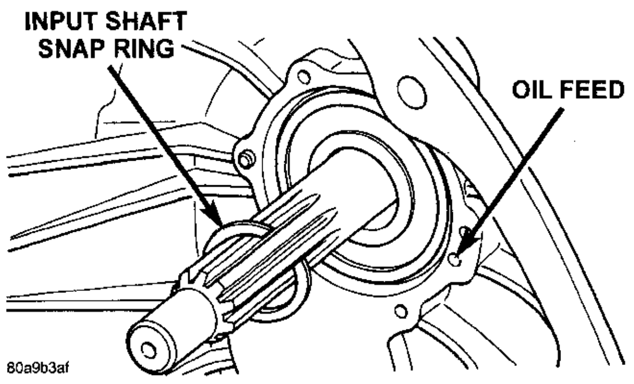

Fig. 14 Input Shaft Snap Ring Removal

(11) Use Remover 8117 and suitable slide hammer to remove shift shaft detent plug.

(12) Remove shift shaft detent plunger and spring (Fig. 15). Use pencil magnet to remove spring then plunger, if necessary.

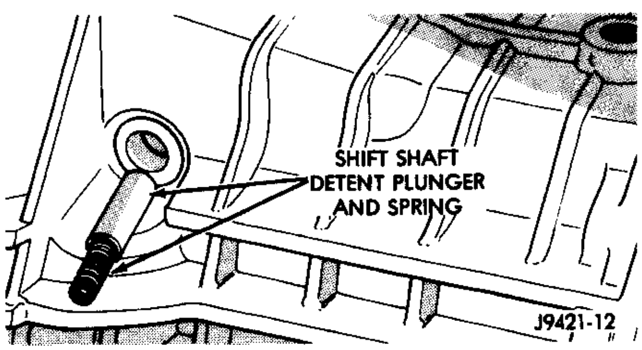

Fig. 15 Detent Plunger And Spring Removal

(13) Remove bolts that attach front housing to rear housing (Fig. 16). Three bolts at extreme rear of housing are actually for the output shaft bearing retainer. It is not necessary to remove all three bolts at this time. Leave at least one bolt in place until rear case is ready to be removed.

(14) Separate front housing from rear housing (Fig. 17). Use plastic mallet to tap front housing off alignment dowels.

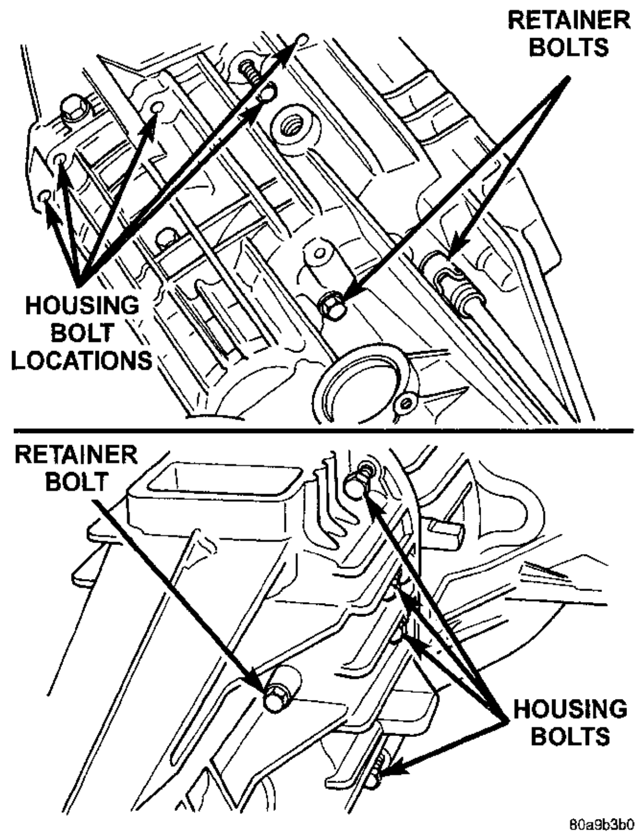

Fig. 16 Housing And Bearing Retainer Bolt Locations

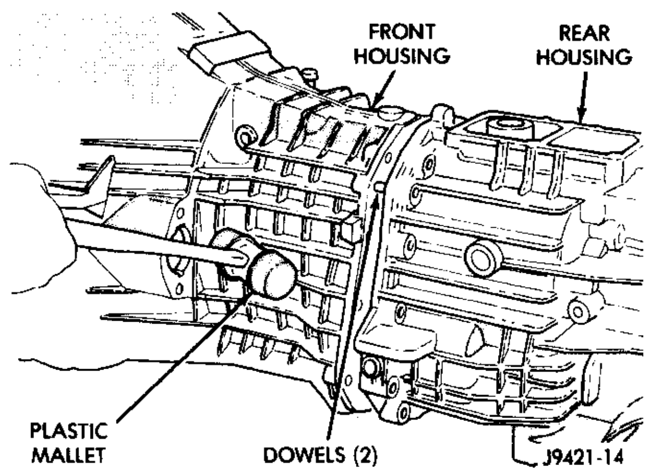

Fig. 17 Front Housing Removal

DISASSEMBLY AND ASSEMBLY (Continued)

(15) Remove input shaft bearing and countershaft front bearing from front case (Fig. 18). Countershaft bearing can be removed by hand.

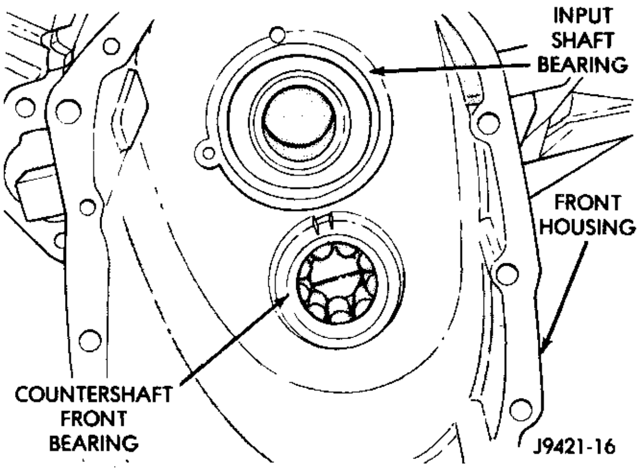

Fig. 18 Input Shaft And Countershaft Front Bearing Location

(16) Note position of input shaft, shift shaft and forks, and geartrain components in housing (Fig. 19).

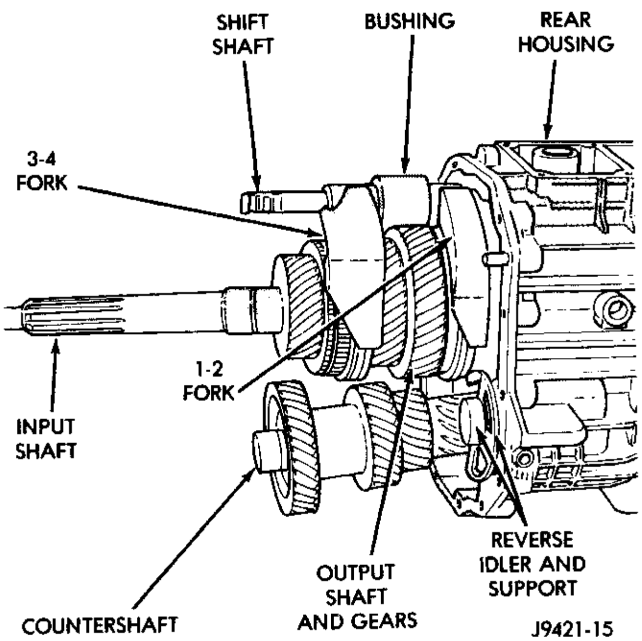

Fig. 19 Geartrain And Shift Component Identification

SHIFT SHAFT, SHIFT FORKS AND REVERSE IDLER SEGMENT REMOVAL

(1) Place shop towel over shaft lever and bushing to contain lever detent ball and spring.

(2) Rotate lever and bushing upward out of shift forks and catch ball and spring as they exit shaft lever (Fig. 20).

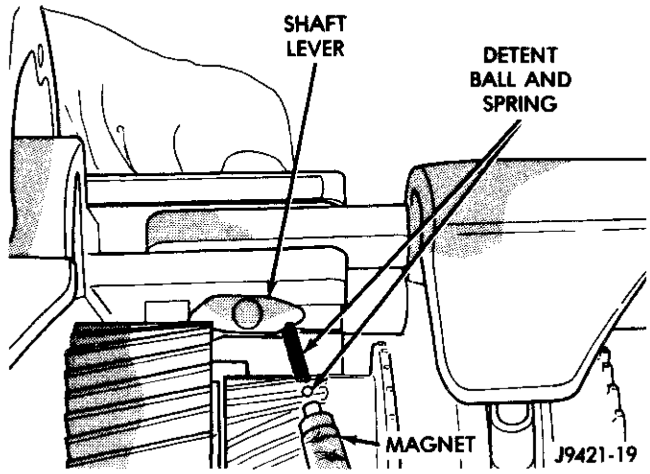

Fig. 20 Removing Shift Shaft Lever Detent Ball And Spring

(3) Unseat roll pin that secures shift socket to shift shaft with Special Tool 6858 as follows:

(a) Position Tool 6858 on shift socket. Then center tool over roll pin. Be sure tool legs are firmly seated on shift socket (Fig. 21).

(b) Tilt socket toward side of case. This places roll pin at slight angle to avoid trapping pin between gear teeth.

(c) Tighten tool punch to press roll pin downward and out of shift socket (Fig. 21). Roll pin does not have to come completely out of shift shaft; it only has to clear shift socket. Be careful not to drive roll pin out of shaft far enough to jam into the geartrain.

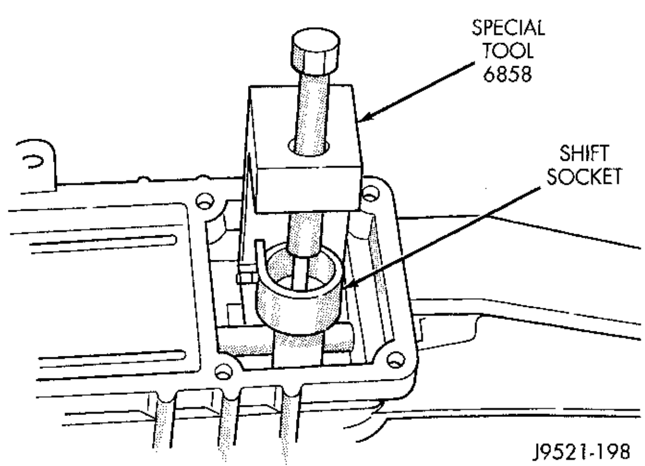

Fig. 21 Unseating Shift Socket Roll Pin With Tool 6858

DISASSEMBLY AND ASSEMBLY (Continued)

(4) Drive out roll pin that secures shift bushing and lever to shift shaft (Fig. 22).

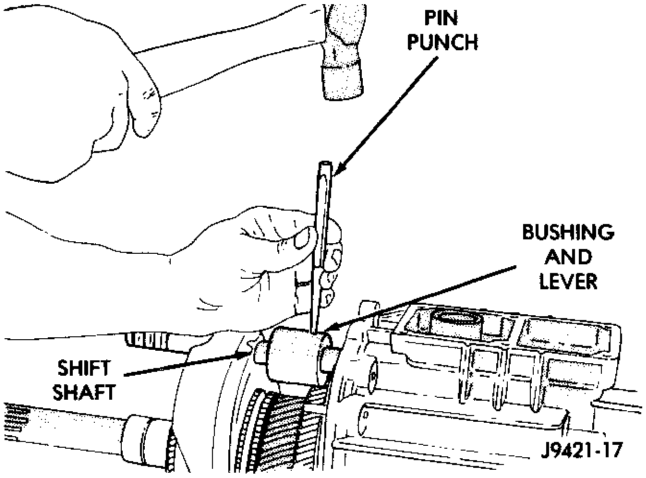

Fig. 22 Removing Shift Shaft Lever And Bushing Roll Pin

(5) Pull shift shaft straight out of rear housing, shift socket, fifth-reverse fork, and 1-2 fork (Fig. 23).

(6) Remove shift socket from rear housing (Fig. 24).

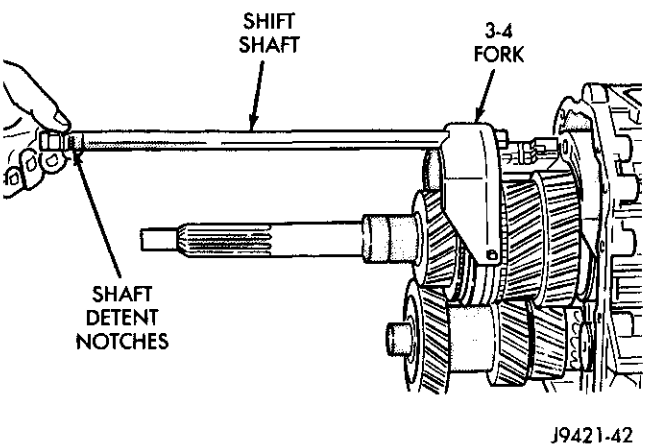

Fig. 23 Shift Shaft Removal

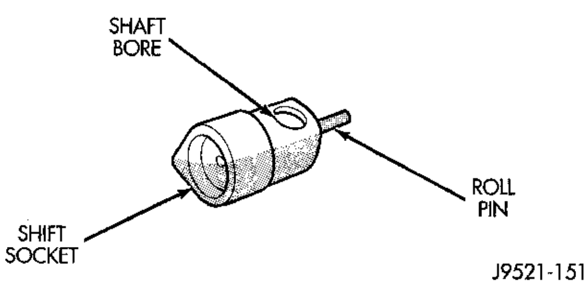

Fig. 24 Shift Socket And Roll Pin

(7) Remove lever and bushing (Fig. 25).

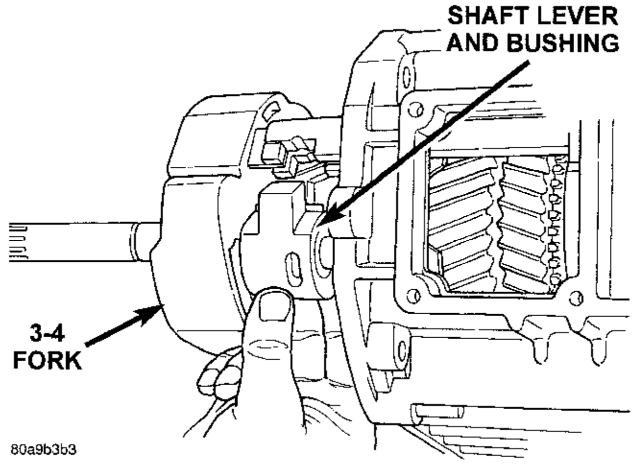

Fig. 25 Removing Shift Shaft Lever And Bushing

(8) Remove 3-4 fork. Rotate 3-4 fork around synchro sleeve until fork clears shift arms on 1-2 and fifth-reverse forks. Then remove 3-4 fork (Fig. 26).

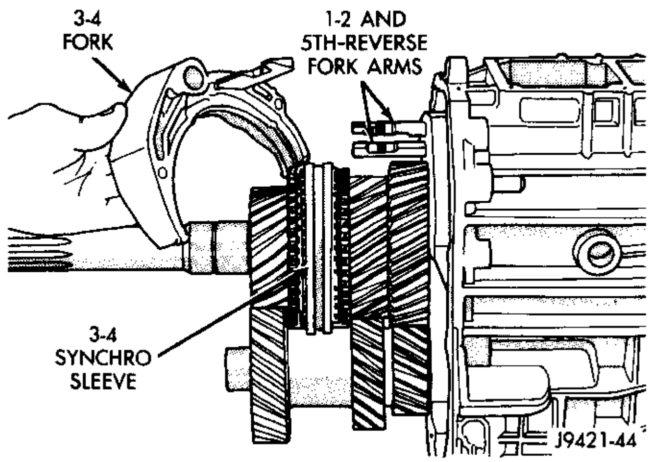

Fig. 26 Removing 3-4 Shift Fork

DISASSEMBLY AND ASSEMBLY (Continued)

(9) Remove the front reverse idler shaft bolt.
(10) Loosen rear reverse idler shaft bolt.
(11) Remove reverse idler shaft support segment by sliding it straight out of housing.
(12) Support geartrain and rear housing on Assembly Fixture Tool 6747 as follows:
(a) Adjust height of reverse idler pedestal rod until the reverse idle shaft bottoms in Cup 8115.
(b) Position Adapters 6747-1A and 6747-2A on Assembly Fixture 6747.
(c) Slide fixture tool onto input shaft, countershaft and idler gear (Fig. 27).
(d) Stand geartrain and rear housing upright on fixture (Fig. 28). Have helper hold fixture tool in place while housing and geartrain is being rotated into upright position.

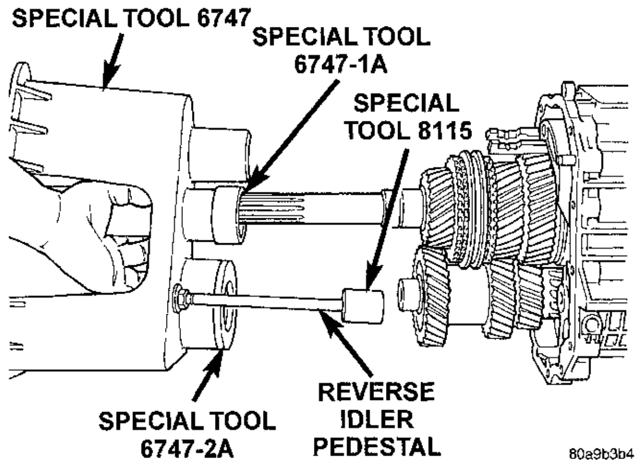

Fig. 27 Installing Assembly Fixture On Geartrain

(13) Remove rear bolt holding reverse idler shaft in housing.

REAR HOUSING REMOVAL—2WD

(1) On 2-wheel drive transmission, remove three bolts that attach output shaft bearing retainer to rear case (Fig. 29). Bolts are rear of shift tower opening.
(2) Unseat output shaft bearing from bearing bore in rear housing. Use plastic or rawhide mallet to tap rear housing upward and off output shaft bearing as shown (Fig. 30).
(3) Lift rear housing up and off geartrain (Fig. 31).
(4) Remove countershaft rear bearing from countershaft (Fig. 32).
(5) Examine condition of bearing bore and idler shaft notch in rear housing. Replace housing if any of these components are damaged.

REAR ADAPTER HOUSING REMOVAL—4WD

(1) Locate dimples in face of rear seal (Fig. 33). Use a suitable slide hammer mounted screw to remove seal by inserting screw into seal at dimple locations (Fig. 34).

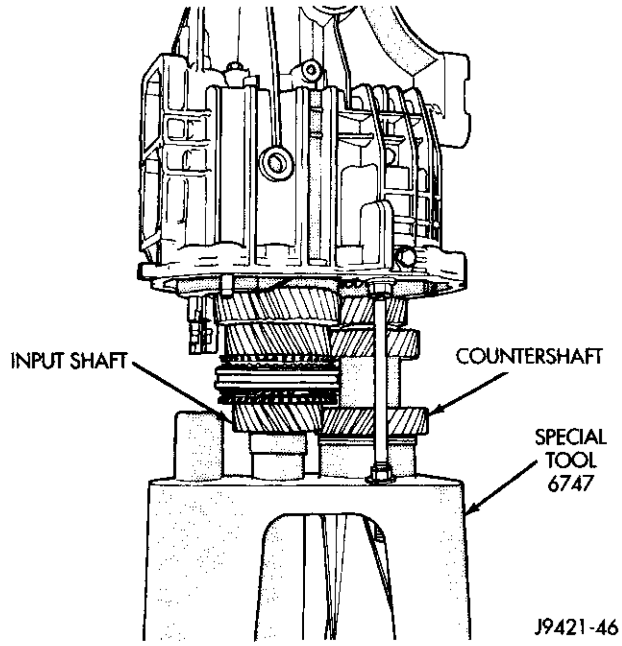

Fig. 28 Geartrain And Housing Mounted On Fixture Tool

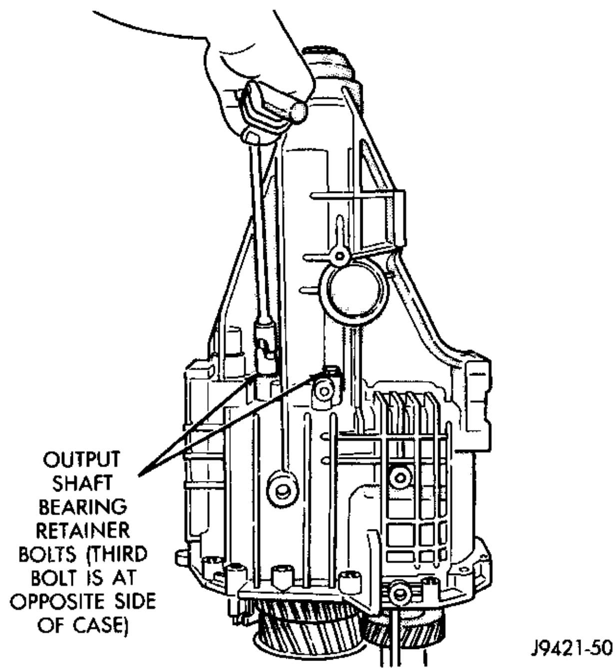

Fig. 29 Removing/Installing Output Shaft Bearing Retainer Bolts—2WD

AUTHENTIC RESTORATION PRODUCTS

DISASSEMBLY AND ASSEMBLY (Continued)

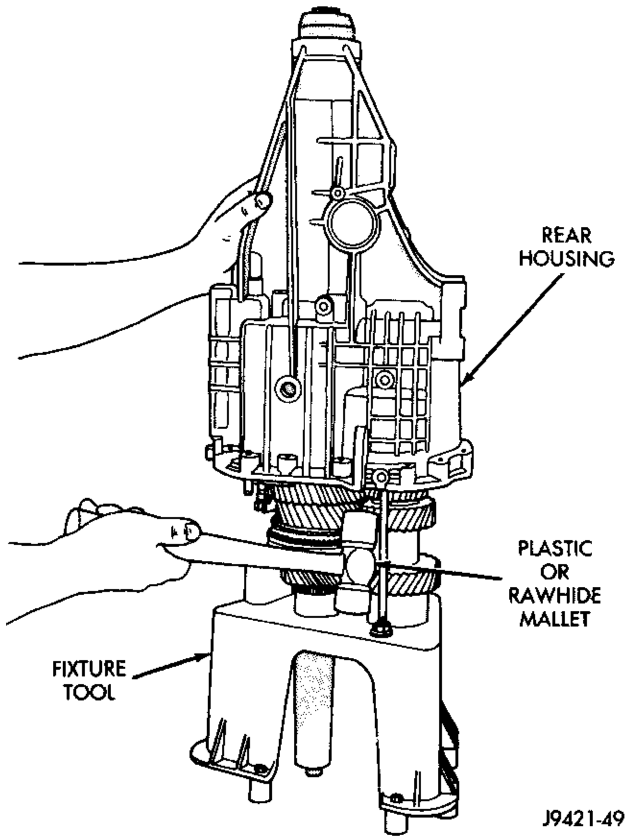

Fig. 30 Unseating Rear Housing From Output Shaft Bearing—2WD

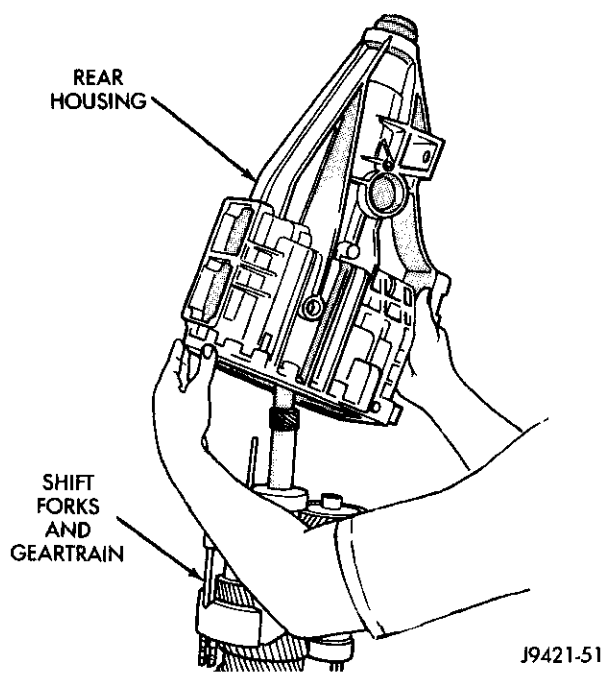

Fig. 31 Rear Housing Removal—2WD

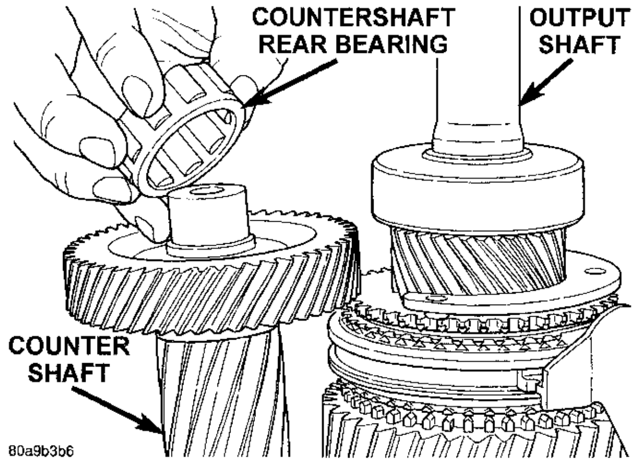

Fig. 32 Remove Countershaft Rear Bearing

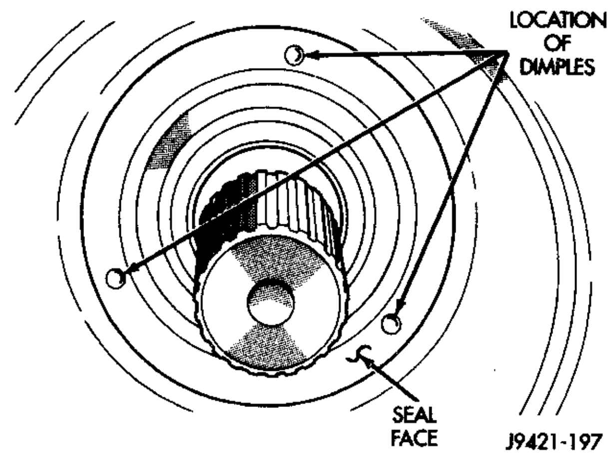

Fig. 33 Location Of Dimples In Seal Face—4WD

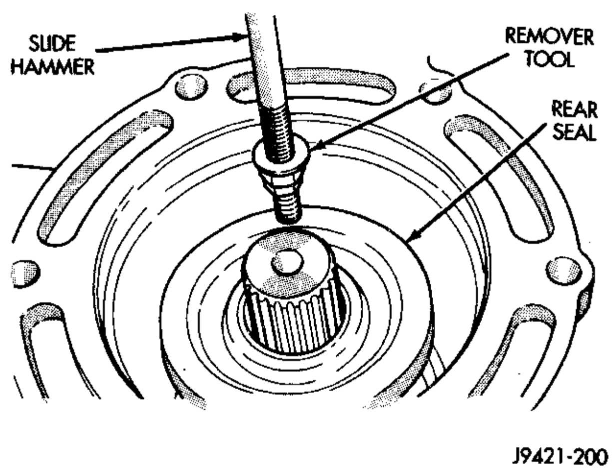

Fig. 34 Rear Seal Removal—4WD

DISASSEMBLY AND ASSEMBLY (Continued)

(2) Remove rear bearing snap ring from output shaft with heavy duty snap ring pliers (Fig. 35).

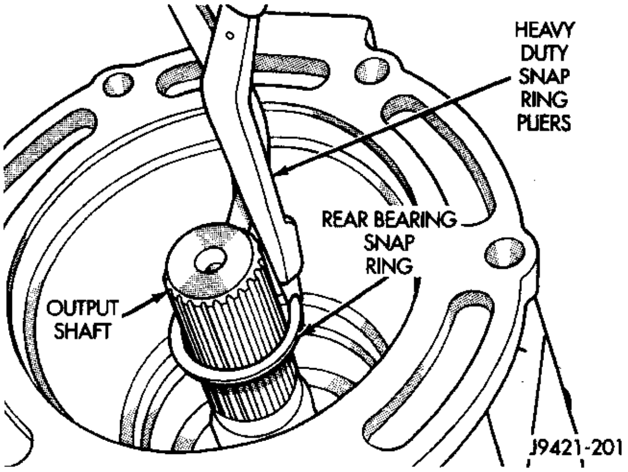

Fig. 35 Rear Bearing Snap Ring Removal—4WD

(3) Lift rear adapter housing upward and off geartrain (Fig. 36).

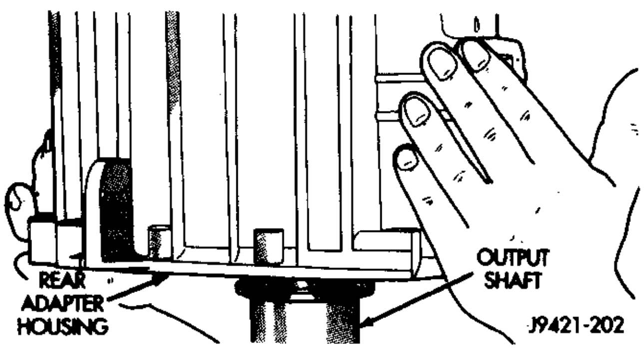

Fig. 36 Rear Adapter Housing Removal

(4) Remove bearing retainer bolts and remove rear bearing retainer and rear bearing (Fig. 37). Use hammer handle to push or tap bearing out of housing if needed.

(5) Examine condition of bearing bore, countershaft rear bearing race and idler shaft notch in rear housing. Replace housing if race, bore or notch are worn or damaged.

GEARTRAIN DISASSEMBLY FROM FIXTURE

(1) Remove reverse idler gear assembly from assembly fixture cup.

(2) Remove 1-2 and fifth-reverse forks from synchro sleeves.

(3) Slide countershaft out of fixture tool.

(4) Remove output shaft bearing retainer from rear surface of fifth gear (retainer will drop onto gear after bolts are removed).

(5) Lift and remove output shaft and gears off input shaft.

(6) Lift and remove input shaft, pilot bearing and fourth gear synchro ring from assembly fixture tool.

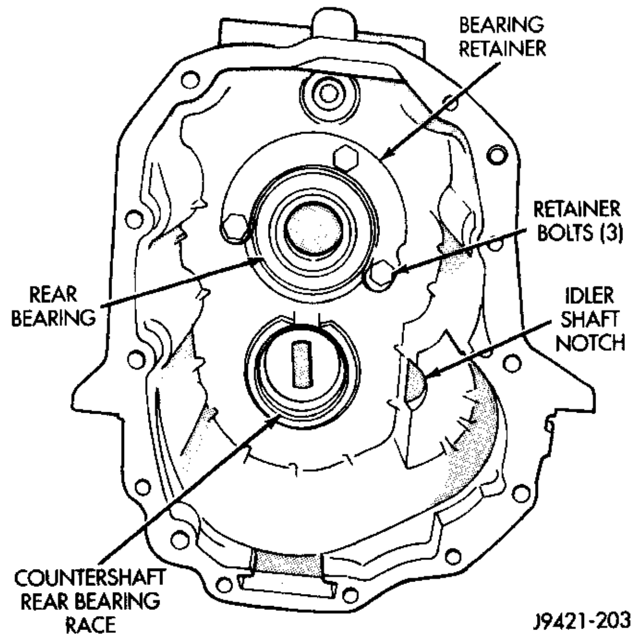

Fig. 37 Rear Adapter Housing Components

OUTPUT SHAFT DISASSEMBLY

NOTE: The synchronizer hubs and sleeves are different and must not be intermixed. It is recommended that each synchronizer unit be removed as an assembly to avoid intermixing parts. It is also recommended that each synchro hub and sleeve be marked with a scriber or paint for correct assembly reference.

(1) Remove snap ring that secures 3-4 synchro hub on output shaft.

(2) Remove 3-4 synchro assembly, third gear synchro ring, and third gear with shop press and Remover Tool 1130. Position Tool 1130 between second and third gears.

(3) Remove third gear needle bearing (Fig. 38).

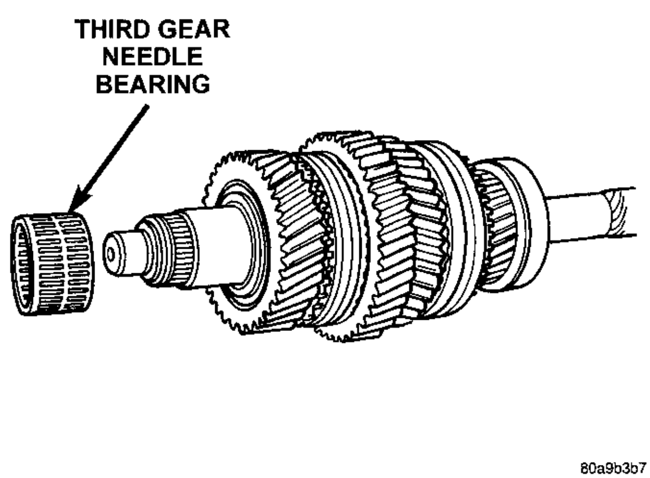

Fig. 38 Third Gear Needle Bearing Removal

DISASSEMBLY AND ASSEMBLY (Continued)

(4) Remove retaining ring that secures two-piece thrust washer on shaft (Fig. 39). Use small pry tool to remove retaining ring.

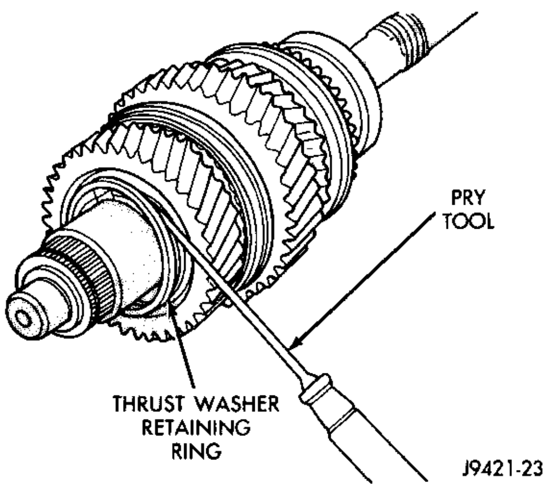

Fig. 39 Thrust Washer Retaining Ring Removal

(5) Remove two-piece thrust washer (Fig. 40). Note position of washer locating lugs in shaft notches for installation reference.

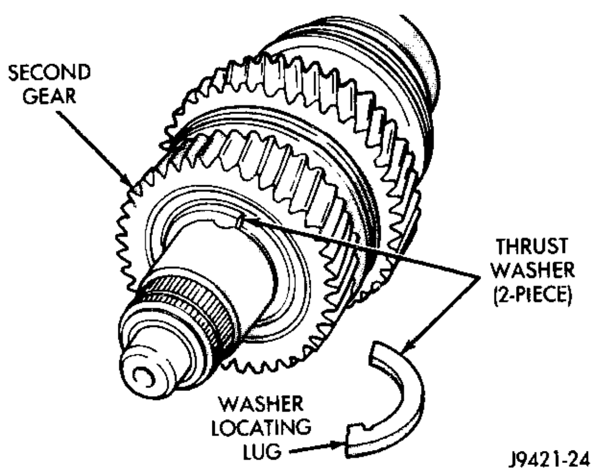

Fig. 40 Two-Piece Thrust Washer Removal

(6) Remove second gear and needle bearing (Fig. 41).

(7) Remove second gear synchro ring (Fig. 42). Then remove the 1–2 synchro hub snap ring.

(8) Remove 1-2 synchro hub and sleeve and first gear from output shaft with shop press and Remover Tool 1130 (Fig. 43). Position Tool 1130 between first and reverse gears.

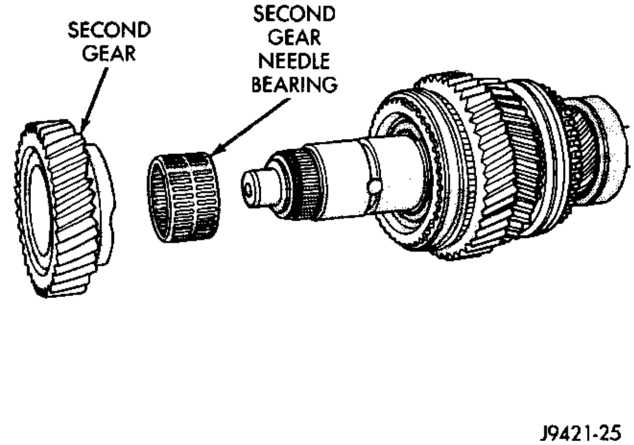

Fig. 41 Second Gear And Needle Bearing Removal

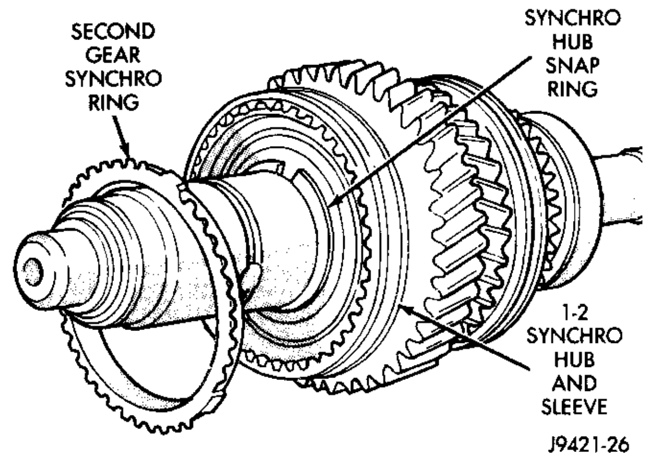

Fig. 42 Second Gear Synchro Ring Removal

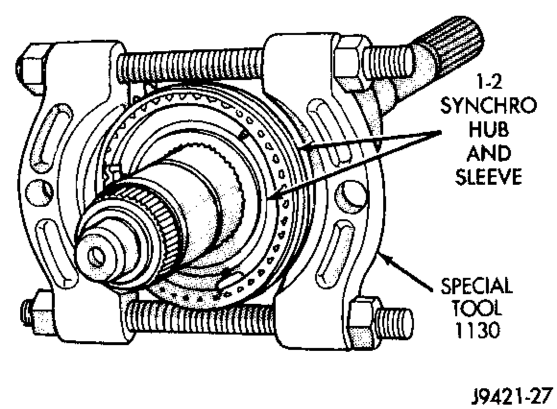

Fig. 43 Hub And Sleeve Removal—1-2 Synchro

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DISASSEMBLY AND ASSEMBLY (Continued)

(9) Remove first gear needle bearing (Fig. 44).

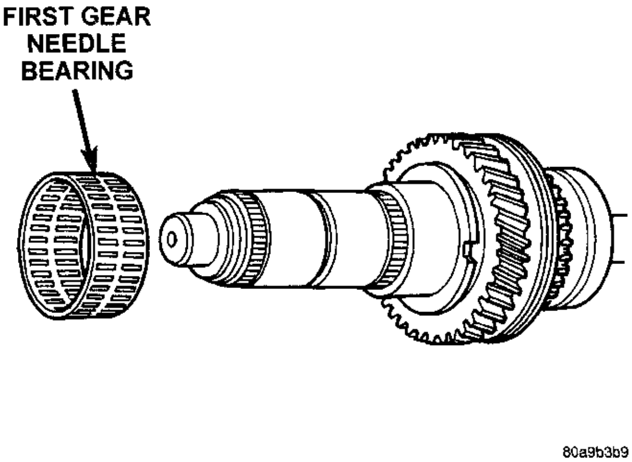

Fig. 44 First Gear Needle Bearing Removal

(10) Remove output shaft bearing snap ring (Fig. 45).

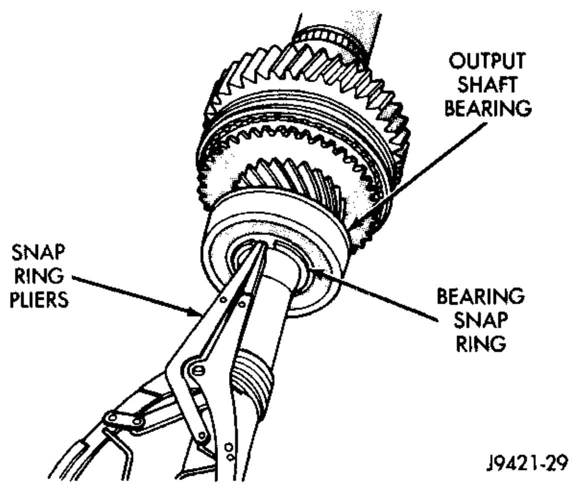

Fig. 45 Output Shaft Bearing Snap Ring Removal

(11) On 2-wheel drive models, remove output shaft bearing.

(12) Remove fifth gear (Fig. 46).

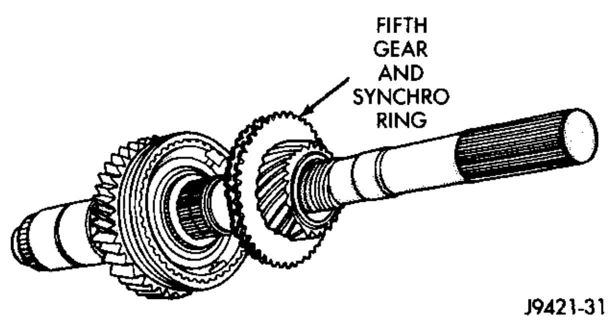

Fig. 46 Fifth Gear Removal

(13) Remove fifth gear needle bearing. Spread bearing apart just enough to clear shoulder on output shaft (Fig. 47).

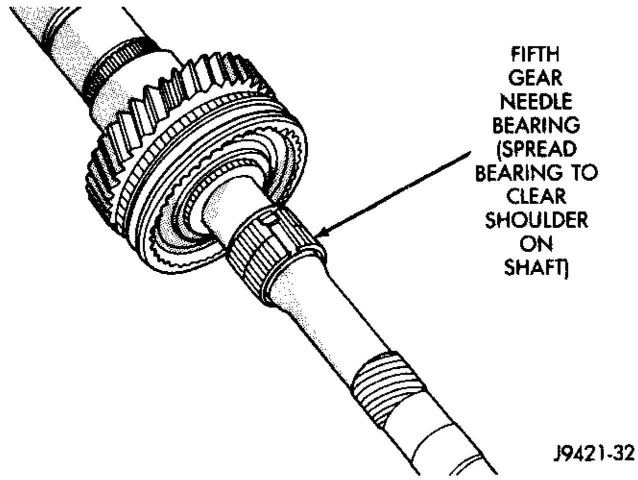

Fig. 47 Fifth Gear Needle Bearing Removal

(14) Remove fifth-reverse synchro hub snap ring (Fig. 48).

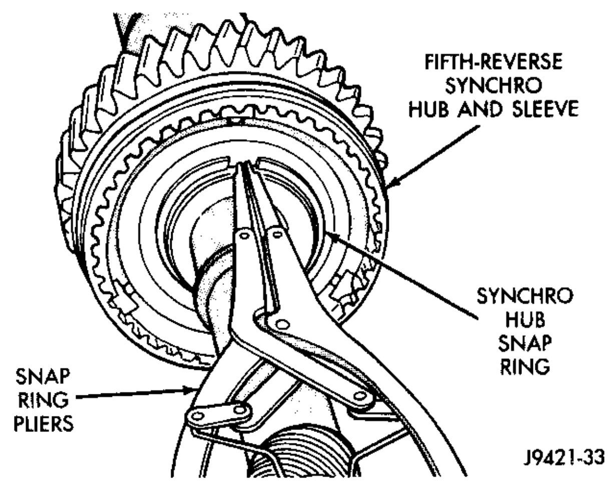

Fig. 48 Fifth-Reverse Synchro Hub Snap Ring Removal

DISASSEMBLY AND ASSEMBLY (Continued)

(15) Remove fifth-reverse synchro hub and sleeve with shop press and Remover 1130 (Fig. 49).

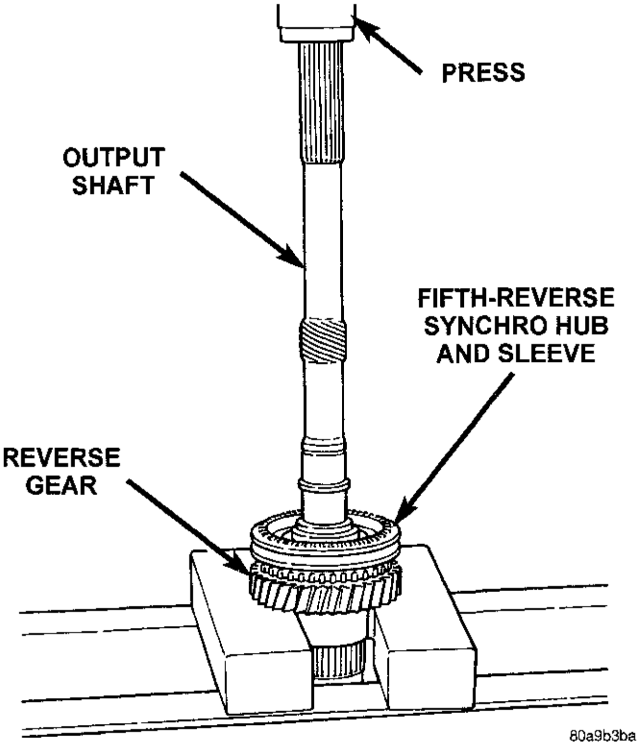

Fig. 49 Fifth-Reverse Synchro Hub And Sleeve Removal

(16) Remove reverse gear and needle bearing (Fig. 50).

REVERSE IDLER DISASSEMBLY

(1) Remove idler gear snap rings (Fig. 51).
(2) Remove thrust washer, wave washer, thrust plate and idler gear from shaft.
(3) Remove idler gear needle bearing from shaft.

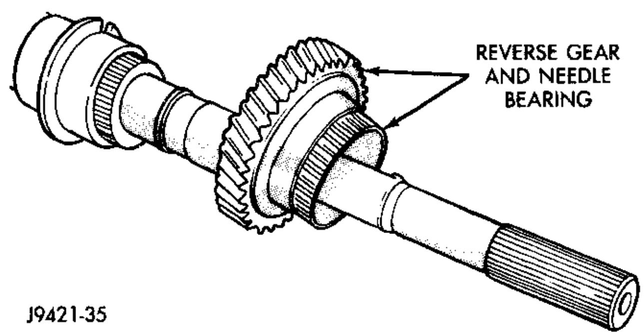

Fig. 50 Reverse Gear And Needle Bearing Removal

ASSEMBLY

Gaskets are not used in the NV3500 transmission. Sealers are used at all case joints. Recommended sealers are Mopar® Gasket Maker for all case joints and Mopar® silicone sealer, or equivalent, for the input shaft bearing retainer. Apply these products as indicated in the assembly procedures.

NOTE: It is very important that the transmission shift components be in Neutral position during assembly. This is necessary to prevent damaging synchro and shift components when the housings are installed.

The 3-4, 1-2 and fifth-reverse synchro hub snap rings can be fitted selectively. New snap rings are available in 0.05 mm (0.0019 in.) thickness increments. Use the thickest snap ring that will fit in each snap ring groove.

SYNCHRO COMPONENT ASSEMBLY

The easiest method of assembling each synchro is to install the springs, struts and detent balls one at a time as follows:

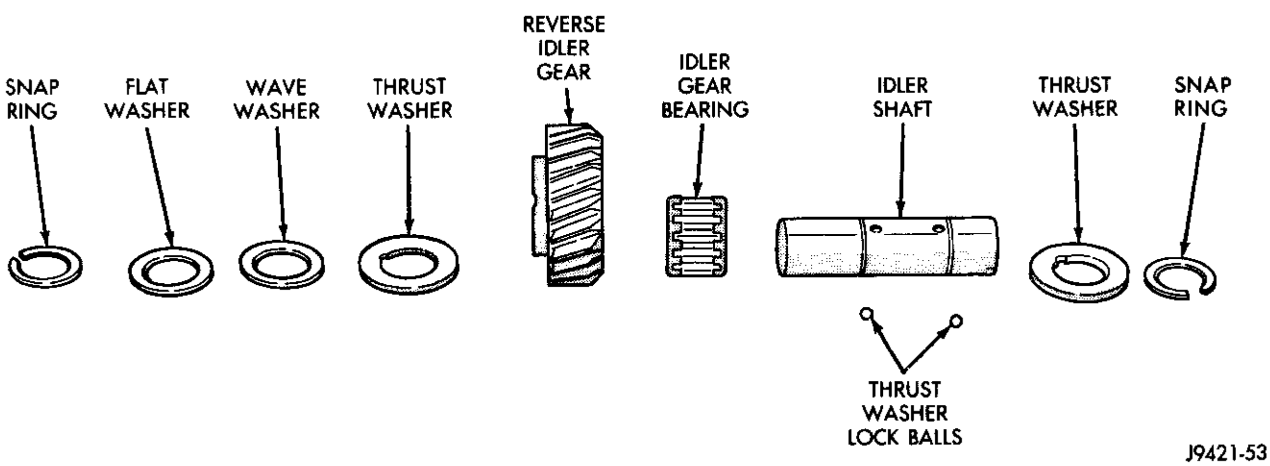

Fig. 51 Reverse Idler Components

DISASSEMBLY AND ASSEMBLY (Continued)

(1) Slide the sleeve part way onto the hub. Leave enough room to install the spring in the hub and the strut in the hub groove.

(2) Install the first spring in the hub. Then install a strut over the spring. Be sure the spring is seated in the spring bore in the strut.

(3) Slide the sleeve onto the hub just far enough to hold the first strut and spring in place.

(4) Place the detent ball in the top of the strut. Then carefully work the sleeve over the ball to hold it in place. A small flat blade screwdriver can be used to press the ball into place while moving the sleeve over it.

(5) Repeat the procedure for the remaining springs, struts and balls. Tape, or a rubber band can be used to temporarily secure each strut and ball as they are installed.

(6) Verify synchro assembly. Be sure the three springs, struts and detent balls are all in place (Fig. 52).

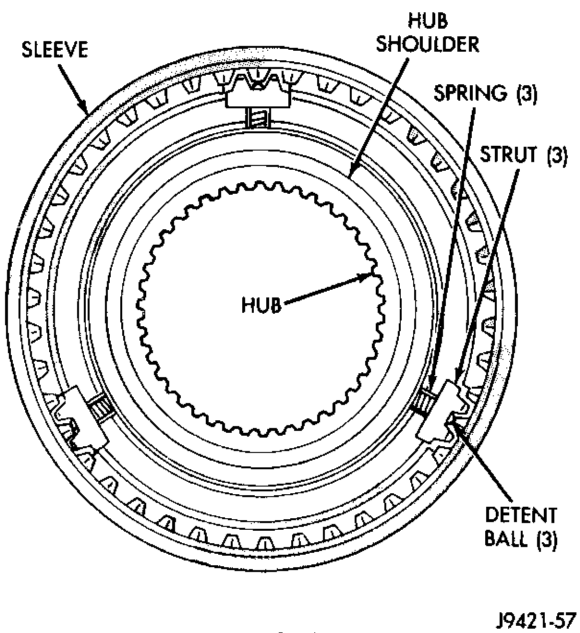

Fig. 52 Assembled View Of Synchro Components

OUTPUT SHAFT ASSEMBLY

(1) Lubricate shaft, gears and bearings with recommended lubricant during assembly. Petroleum jelly can be used to hold parts in place.

(2) Check bearing surfaces of output shaft for nicks or scratches. Smooth surfaces with 320/400 grit emery cloth if necessary. Apply oil to emery cloth and shaft surface before polishing.

(3) Inspect and replace any synchro ring that exhibits wear or damage. Completely immerse each synchro ring in lubricant before installation.

(4) Lubricate and install reverse gear needle bearing on shaft (Fig. 53). Slide bearing up against shoulder on output shaft.

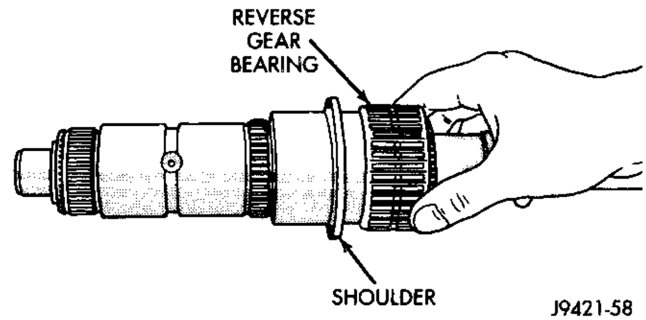

Fig. 53 Reverse Gear Bearing Installation

(5) Install reverse gear over needle bearing (Fig. 54).

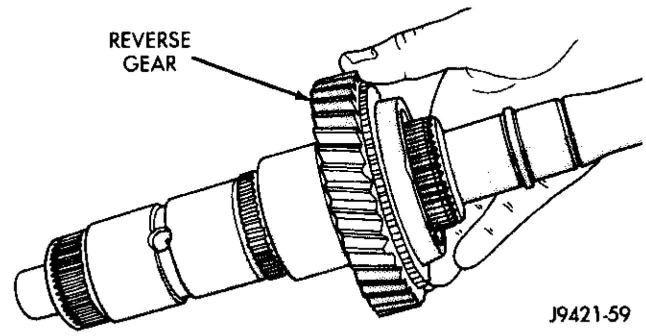

Fig. 54 Reverse Gear Installation

(6) Install solid brass synchro ring on reverse gear (Fig. 55).

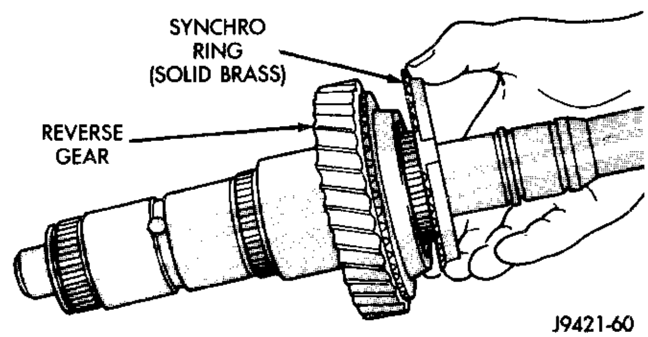

Fig. 55 Reverse Gear Synchro Ring Installation

(7) Assemble fifth-reverse synchro hub, sleeve, struts, springs and detent balls, if not previously done.

CAUTION: The fifth-reverse synchro hub and sleeve can be installed backwards if care is not exercised. One side of the hub has shoulders around the hub bore. Make sure this side of the hub is facing the rear of the shaft. In addition, one side of the sleeve is tapered. Be sure the sleeve is installed so the tapered side will be facing the front of the shaft.

DISASSEMBLY AND ASSEMBLY (Continued)

(8) Start fifth-reverse synchro assembly on output shaft splines by hand. Then seat synchro onto shaft with shop press and Remover 6310-1 (Fig. 56).

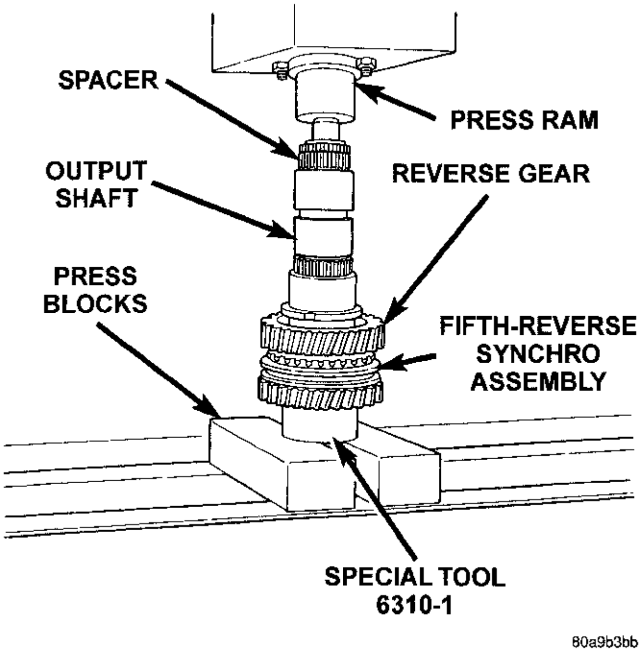

Fig. 56 Fifth-Reverse Synchro Assembly Installation

(9) Install new fifth-reverse hub snap ring (Fig. 57) as follows:

(a) Snap rings are available in thicknesses from 2.00 mm to 2.20 mm (0.078 to 0.086 in.).

(b) Install thickest snap ring that will fit in shaft groove.

(c) Verify that snap ring is completely seated in groove before proceeding.

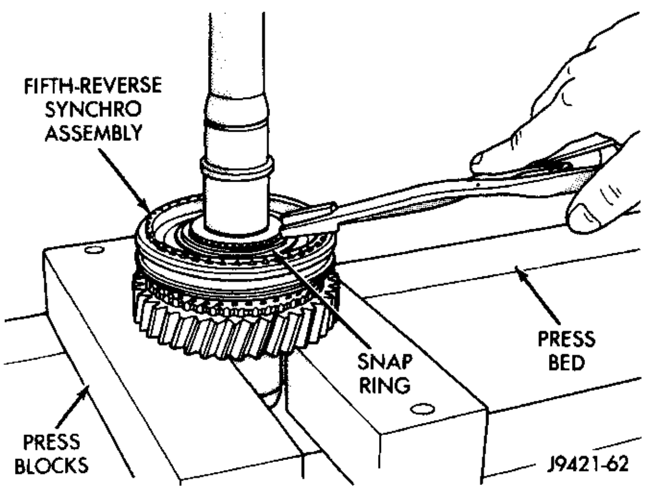

Fig. 57 Installing Fifth-Reverse Synchro Hub Snap Ring

(10) Install fifth gear synchro ring in synchro hub and sleeve (Fig. 58).

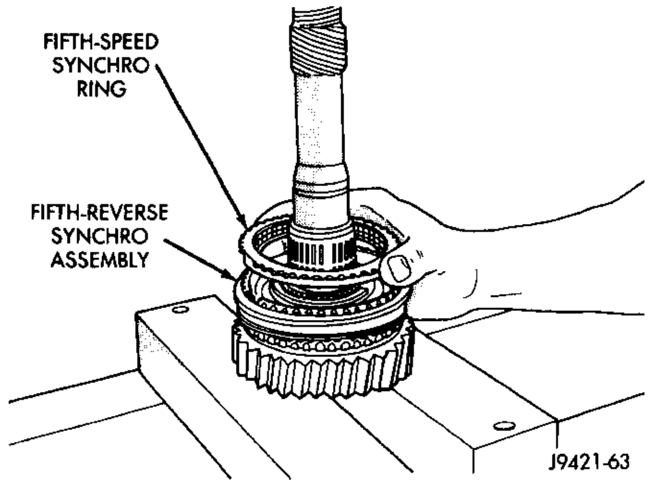

Fig. 58 Installing Fifth Gear Synchro Ring

(11) Install fifth gear bearing. Spread bearing only enough to clear shoulder on output shaft (Fig. 59). Be sure bearing is properly seated after installation.

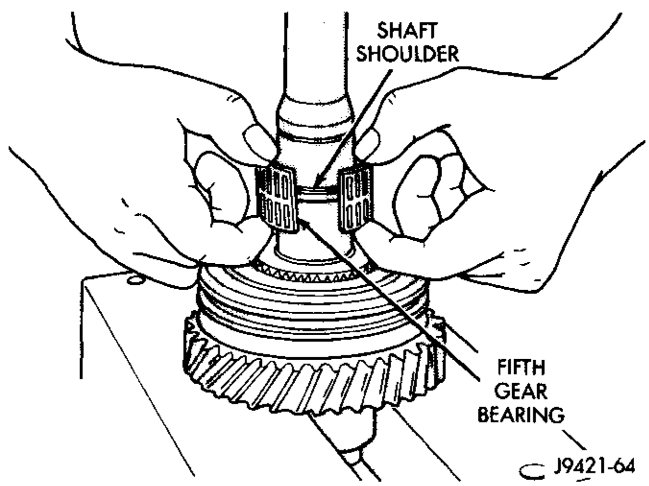

Fig. 59 Installing Fifth Gear Bearing

DISASSEMBLY AND ASSEMBLY (Continued)

(12) Install fifth gear on shaft and onto bearing (Fig. 60).

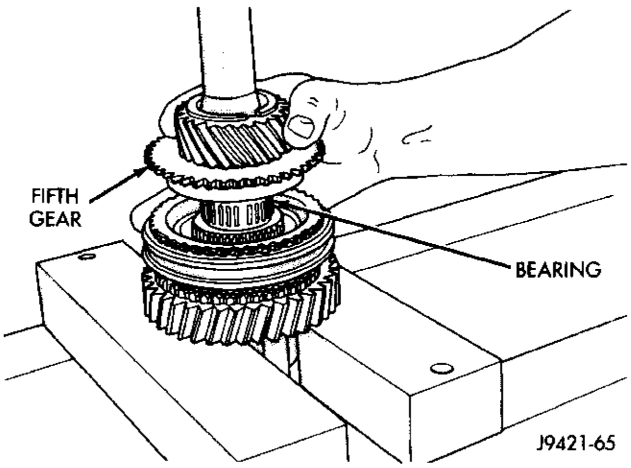

Fig. 60 Fifth Gear Installation

(13) Invert output shaft and set the shaft in Remover 6310-1 so that fifth gear is seated on the tool (Fig. 61).

(14) Install first gear bearing on output shaft (Fig. 61). Be sure bearing is seated on shaft shoulder and is properly joined.

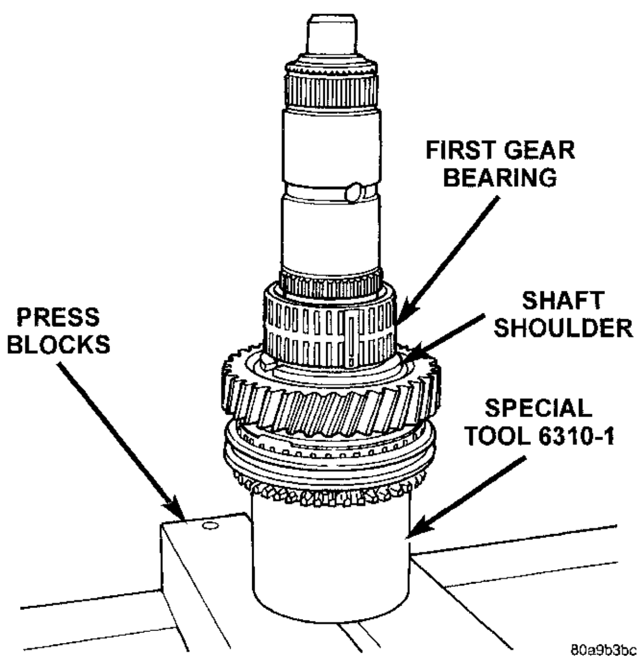

Fig. 61 First Gear Bearing Installation

(15) Install first gear on shaft and over bearing (Fig. 62). Make sure bearing synchro cone is facing up as shown.

(16) Install first gear synchro ring (Fig. 63).

(17) Assemble 1-2 synchro hub sleeve, springs, struts and detent balls.

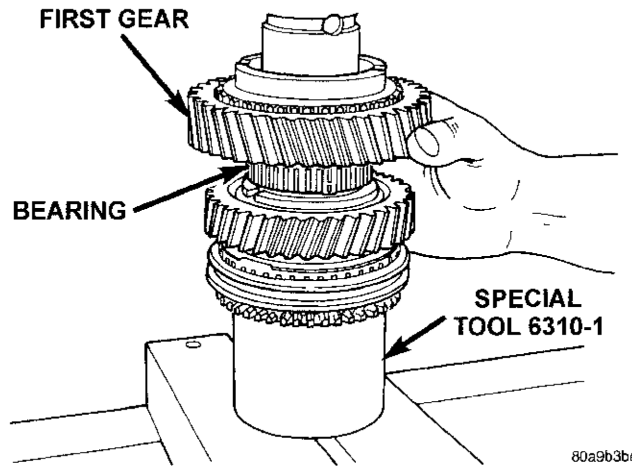

Fig. 62 First Gear Installation

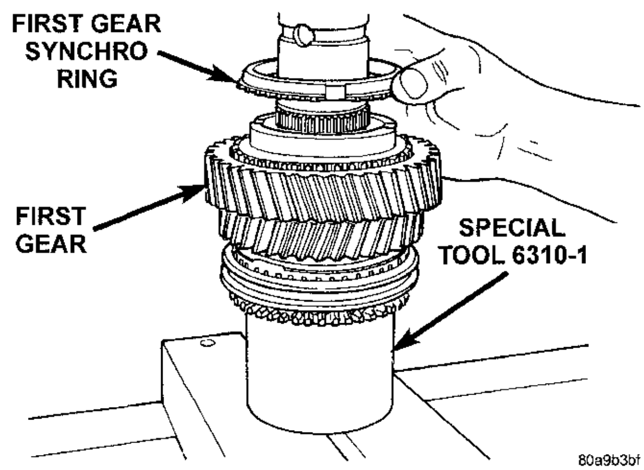

Fig. 63 First Gear Synchro Ring Installation

CAUTION: The 1-2 synchro hub and sleeve can be installed backwards if care is not exercised. One side of the hub has a small diameter shoulder around the hub bore. Make sure this side of the hub faces the forward end of the output shaft. In addition, one side of the synchro sleeve is marked First Gear Side. Be sure this side of the sleeve will face first gear after installation.

(18) Start 1-2 synchro assembly on shaft by hand (Fig. 64). Be sure synchro sleeve is properly positioned. Side marked first side must be facing first gear.

(19) Press 1-2 synchro onto output shaft using suitable size pipe tool and shop press (Fig. 65).

CAUTION: Take time to align the synchro ring and sleeve as hub the is being pressed onto the shaft. The synchro ring can be cracked if it becomes misaligned.

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DISASSEMBLY AND ASSEMBLY (Continued)

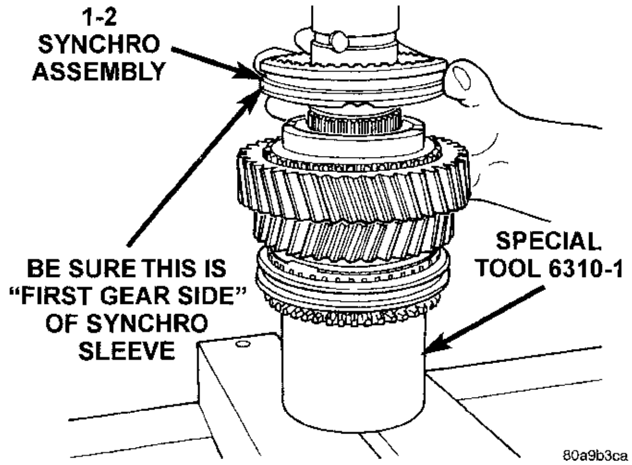

Fig. 64 Starting 1-2 Synchro On Shaft

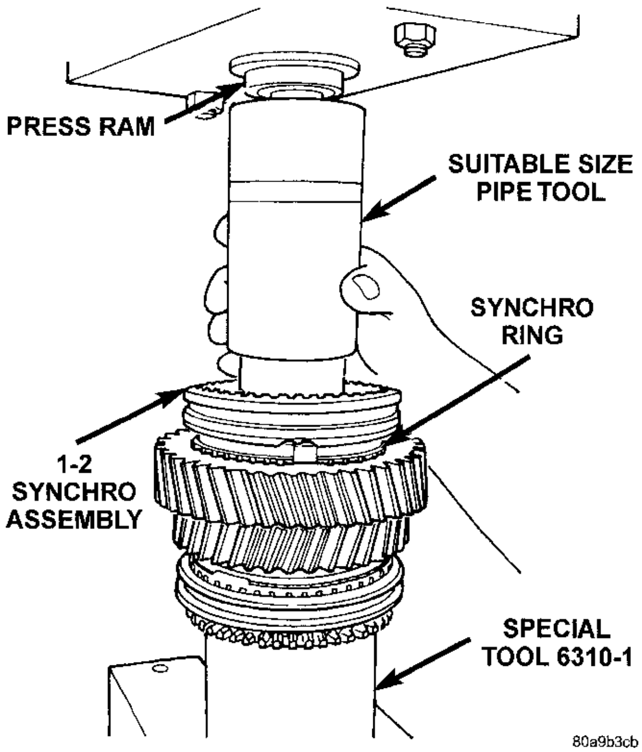

Fig. 65 Pressing 1-2 Synchro Assembly Onto Output Shaft

(20) Install new 1-2 synchro hub snap ring (Fig. 66) as follows:

(a) Snap rings are available in thicknesses from 1.80 mm to 2.00 mm (0.070 to 0.078 in.).

(b) Install thickest snap ring that will fit in shaft groove.

(c) Verify that snap ring is completely seated in groove before proceeding.

(21) Install second gear synchro ring in 1-2 synchro hub and sleeve (Fig. 67). Be sure synchro ring is properly seated in sleeve.

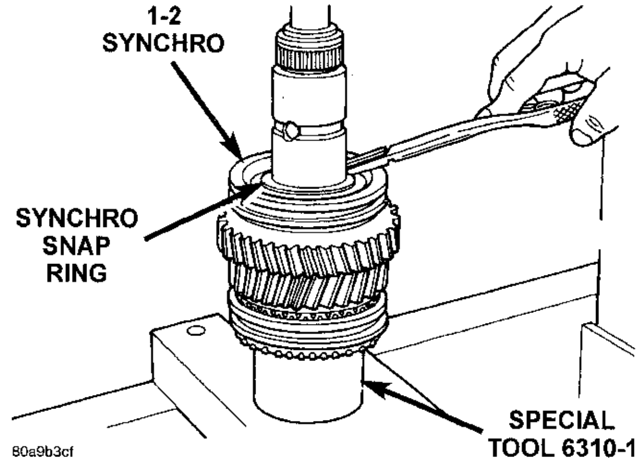

Fig. 66 Installing 1-2 Synchro Hub Snap Ring

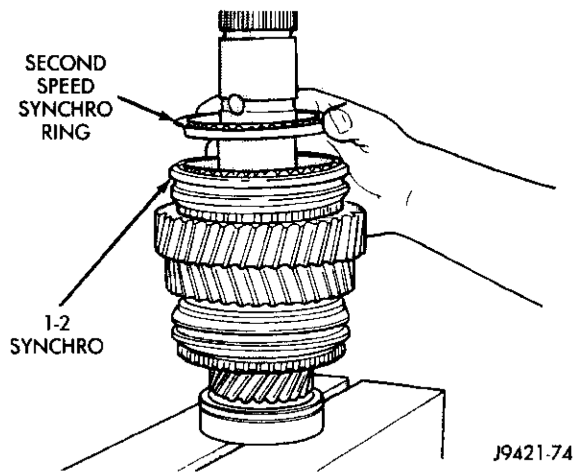

Fig. 67 Second Gear Synchro Ring Installation

(22) Install second gear needle bearing on shaft (Fig. 68).

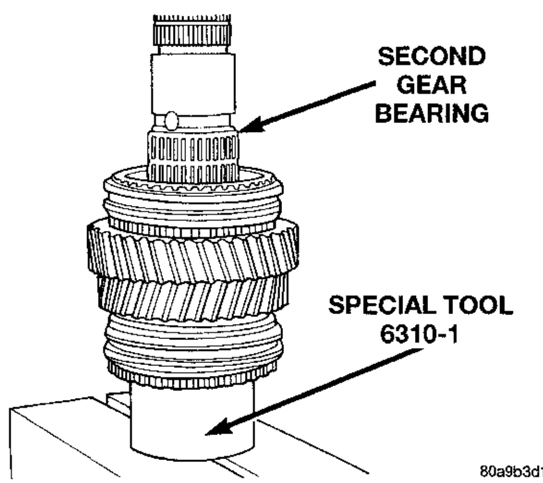

Fig. 68 Second Gear Bearing Installation

DISASSEMBLY AND ASSEMBLY (Continued)

(23) Install second gear onto shaft and bearing (Fig. 69). Make sure that second gear is fully seated on synchro components.

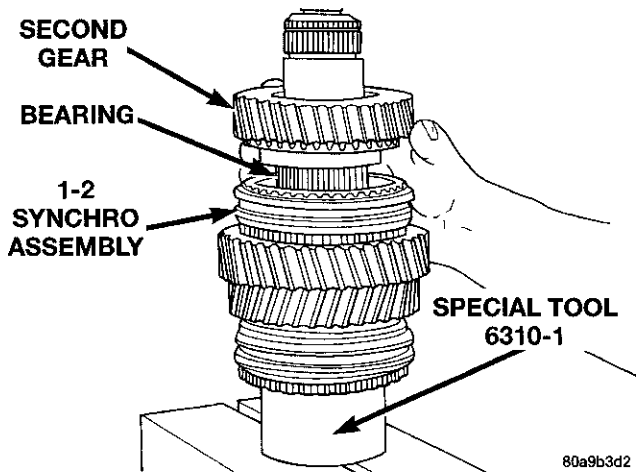

Fig. 69 Second Gear Installation

(24) Install two-piece thrust washer (Fig. 70). Be sure washer halves are seated in shaft groove and that washer lugs are seated in shaft lug bores. Also, ensure that the i.d. grooves and markings noted during removal are facing the correct direction.

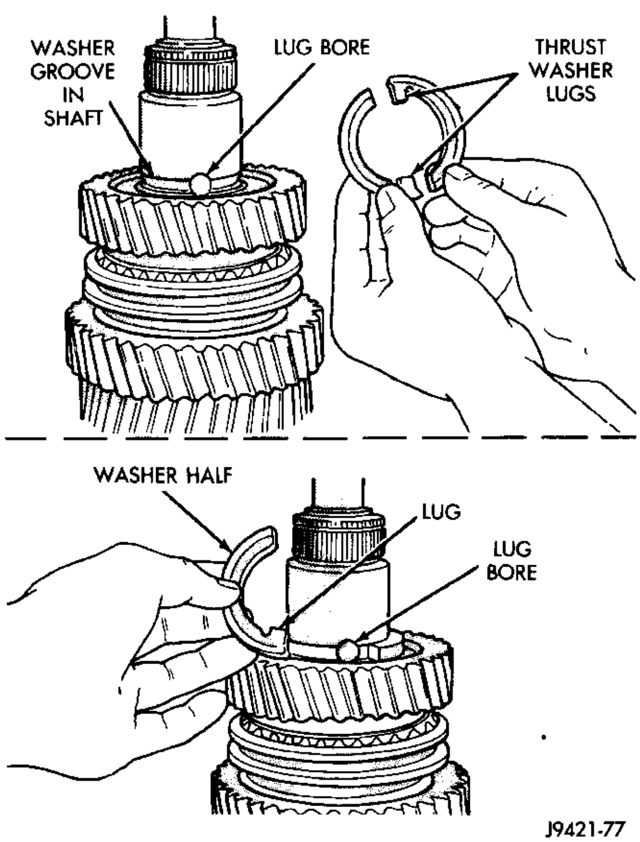

Fig. 70 Installing Two-Piece Thrust Washer

(25) Start retaining ring around two-piece thrust washer (Fig. 71). Make sure that the locating dimple is between the thrust washer halves.

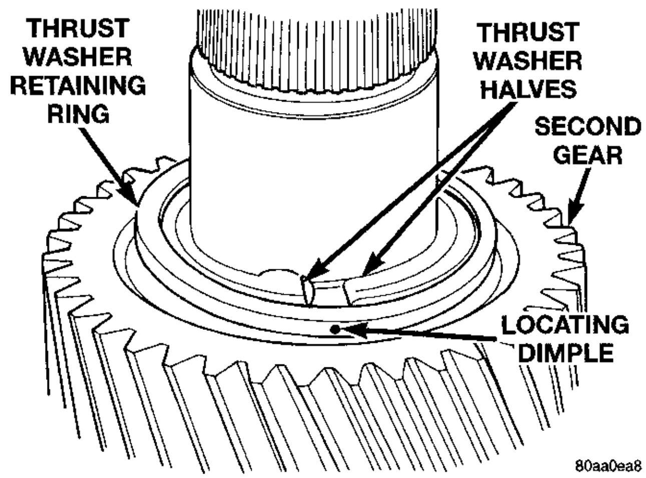

Fig. 71 Starting Retaining Ring Over Two-Piece Thrust Washer

(26) Seat thrust washer retaining ring with plastic mallet (Fig. 72).

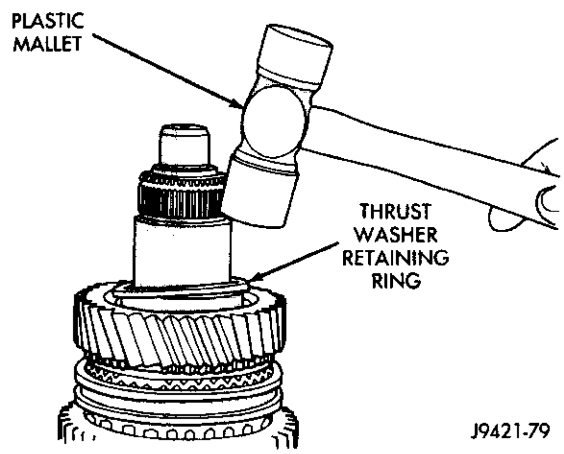

Fig. 72 Seating Thrust Washer Retaining Ring

DISASSEMBLY AND ASSEMBLY (Continued)

(27) Install third gear needle bearing on shaft (Fig. 73).

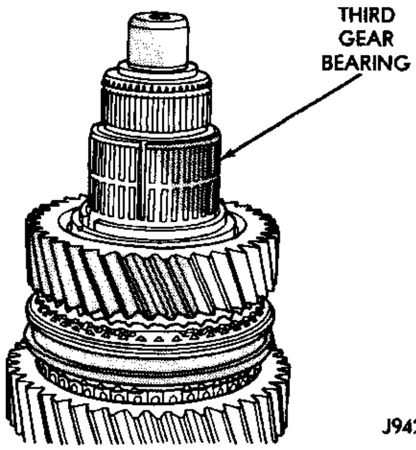

Fig. 73 Third Gear Bearing Installation

(28) Install third gear on shaft and bearing (Fig. 74).

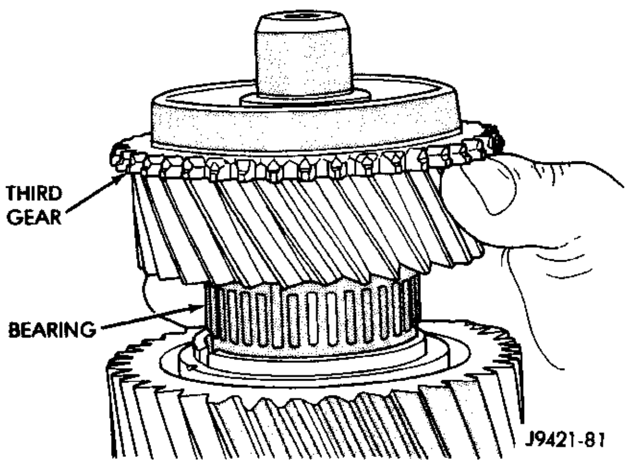

Fig. 74 Installing Third Gear

(29) Install third gear synchro ring on third gear (Fig. 75).

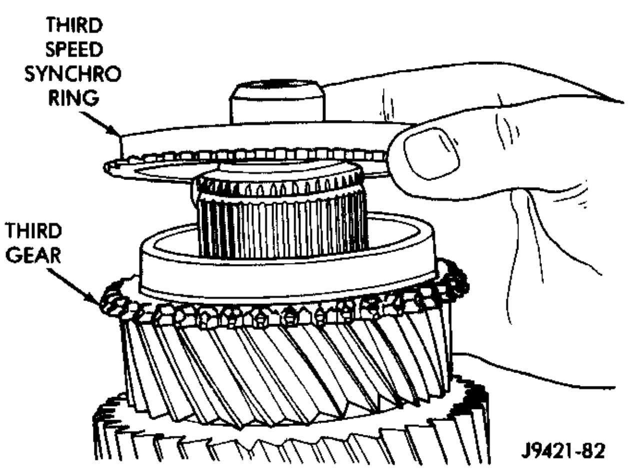

Fig. 75 Third Gear Synchro Ring Installation

(30) Assemble 3-4 synchro hub, sleeve, springs, struts and detent balls.

CAUTION: The 3-4 synchro hub and sleeve can be installed backwards if care is not exercised. One side of the hub has shoulders around the hub bore. Make sure this side of the hub is facing the front of the shaft. In addition, one side of the sleeve has grooves in it. Be sure this side of sleeve is also facing the front of the shaft.

(31) Start 3-4 synchro hub on output shaft splines by hand (Fig. 76).

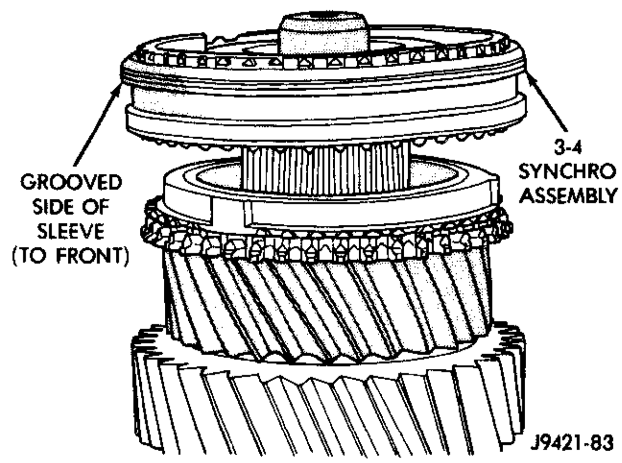

Fig. 76 Starting 3-4 Synchro Hub On Output Shaft

(32) Press 3-4 synchro assembly onto output shaft with shop press and suitable size pipe tool (Fig. 77). Make sure that the tool presses on hub as close to output shaft as possible but does not contact the shaft splines.

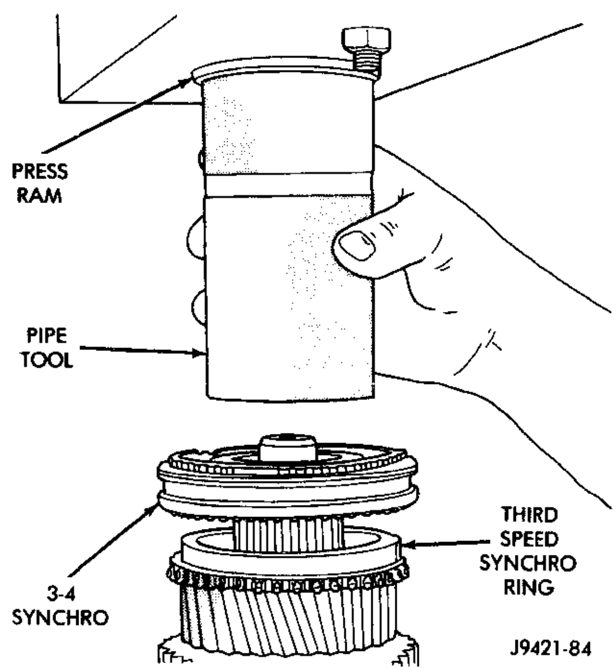

Fig. 77 Pressing 3-4 Synchro Assembly On Output Shaft

DISASSEMBLY AND ASSEMBLY (Continued)

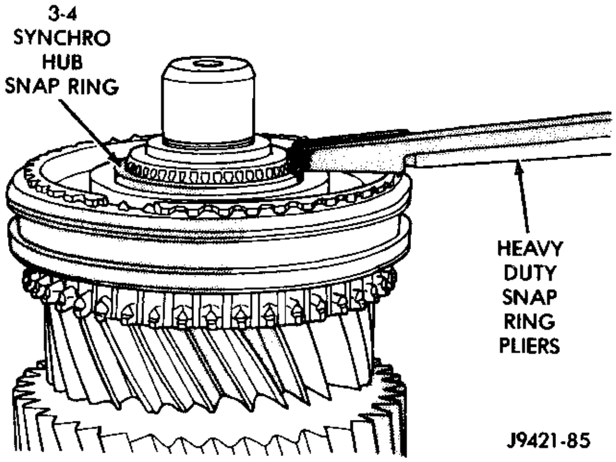

Fig. 78 Installing 3-4 Synchro Hub Snap Ring

(33) Install 3-4 synchro hub snap ring (Fig. 78) as follows:

(a) Snap rings are available in thicknesses from 2.00 mm to 2.30 mm (0.078 to 0.090 in.).

(b) Install thickest snap ring that will fit in shaft groove. Use heavy duty snap ring pliers to install new ring.

(c) Verify that snap ring is completely seated in groove before proceeding.

(34) Install output shaft bearing.

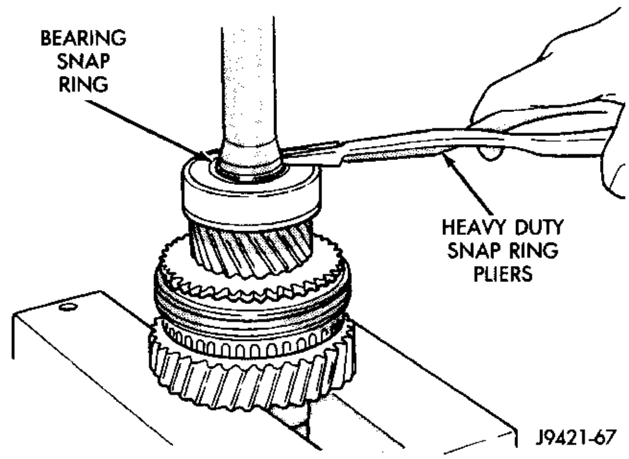

Fig. 79 Installing Output Shaft Bearing Snap Ring

(35) Install output shaft bearing snap ring (Fig. 79). Use heavy duty snap ring pliers and spread snap ring only enough to install it. Be sure snap ring is completely seated in shaft groove before proceeding.

(36) Verify correct position of synchro sleeves before proceeding with assembly operations (Fig. 80). Grooved side of 3-4 sleeve should be facing forward. First gear side of 1-2 sleeve should be facing first gear. Tapered side of fifth-reverse sleeve should be facing forward.

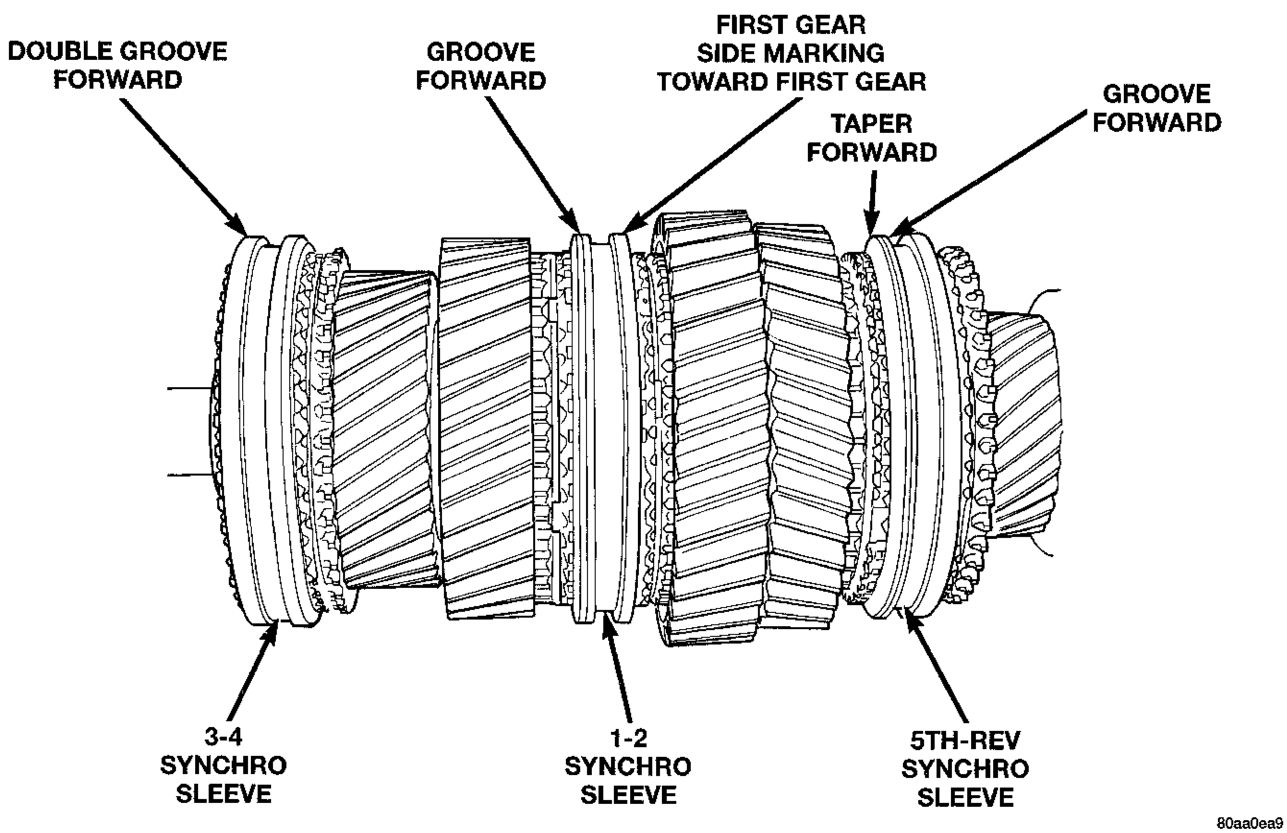

Fig. 80 Correct Synchro Sleeve Position

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DISASSEMBLY AND ASSEMBLY (Continued)

REVERSE IDLER ASSEMBLY

(1) Lubricate idler components with gear lube.

(2) Slide idler gear bearing on shaft (Fig. 81). Bearing fits either way on shaft.

(3) Slide gear onto shaft. Side of gear with recess goes to rear (Fig. 81).

(4) Place first lock ball in dimple at rear end of idler shaft (Fig. 81). Petroleum jelly can be used to hold ball in place if desired.

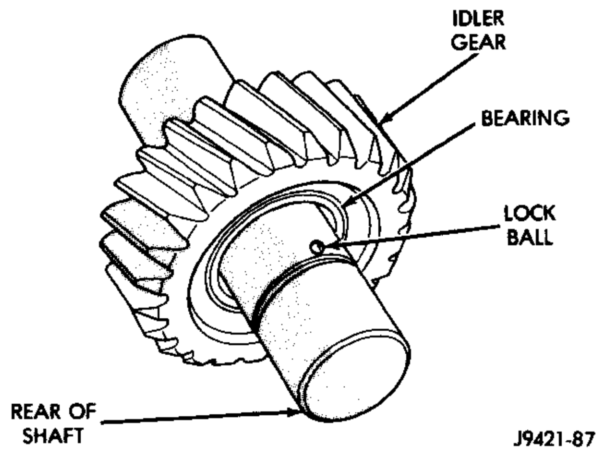

Fig. 81 Idler Gear And Bearing Installation

(5) Slide thrust rear thrust washer onto shaft and over lock ball (Fig. 82).

(6) Install snap ring in groove at rear of shaft (Fig. 82).

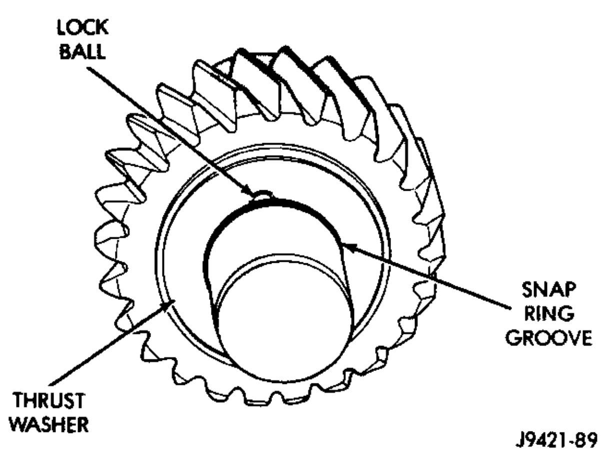

Fig. 82 Idler Gear Rear Thrust Washer Installation

(7) Install lock ball in dimple at front of shaft. Hold ball in place with petroleum jelly if desired.

(8) Install front thrust washer on shaft and slide washer up against gear and over lock ball (Fig. 83).

(9) Install wave washer, flat washer and remaining snap ring on idler shaft (Fig. 83). Be sure snap ring is fully seated.

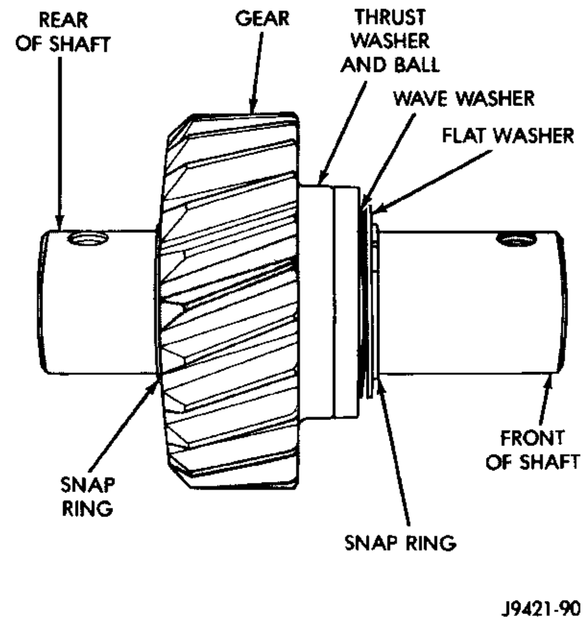

Fig. 83 Idler Gear And Shaft Assembly

SHIFT SHAFT AND DETENT PLUNGER BUSHINGS/BEARINGS

(1) Inspect shift shaft bushing and bearing for damage.

(2) If necessary, the shift shaft bushing can be replaced as follows:

(a) Locate a bolt that will thread into the bushing without great effort.

(b) Thread the bolt into the bushing, allowing the bolt to make its own threads in the bushing.

(c) Attach a slide hammer or suitable puller to the bolt and remove bushing.

(d) Use the short end of Installer 8119 to install the new bushing.

(e) The bushing is correctly installed if the bushing is flush with the transmission case.

(3) If necessary, the shift shaft bearing can be replaced as follows:

(a) Locate a bolt that will thread into the bearing without great effort.

(b) Thread the bolt into the bearing as much as possible.

(c) Attach a slide hammer or suitable puller to the bolt and remove the bearing.

(d) Use the short end of Installer 8119 to install the new bearing.

(e) The bearing is correctly installed if the bearing is flush with the transmission case.

(4) Inspect detent plunger bushings for damage.

DISASSEMBLY AND ASSEMBLY (Continued)

NOTE: The detent plunger bushings are installed to a specific depth. The space between the two bushings when correctly installed contain an oil feed hole. Do not attempt to install the bushings with anything other than the specified tool or this oil hole may become restricted.

(5) If necessary, the detent plunger bushings can be replaced as follows:

(a) Using the long end of Installer 8119, drive the detent bushings through the outer case and into the shift shaft bore.

(b) Remove the bushings from the shift shaft bore.

(c) Install a new detent plunger bushing on the long end of Installer 8118.

(d) Start the bushing in the detent plunger bore in the case.

(e) Drive the bushing into the bore until the tool contacts the transmission case.

(f) Install a new detent plunger bushing on the short end of Installer 8118.

(g) Start the bushing in the detent plunger bore in the case.

(h) Drive the bushing into the bore until the tool contacts the transmission case.

GEARTRAIN ASSEMBLY IN FIXTURE

(1) Install Adapter 6747-1A on input shaft hub of fixture tool (Fig. 84). Then install Adapter 6747-2A on front bearing hub of countershaft. Adapter 6747-2A has a raised shoulder on one side. Be sure the shoulder is seated against the countershaft.

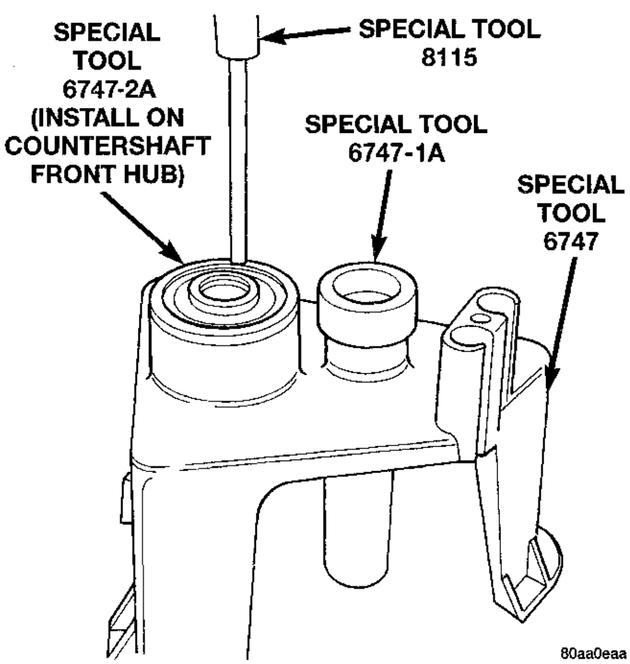

Fig. 84 Preparing Assembly Fixture For Geartrain Build-up

(2) Install input shaft in fixture tool. Make sure Adapter Tool 6747-1A is positioned under shaft as shown (Fig. 85).

(3) Install pilot bearing in input shaft (Fig. 85).

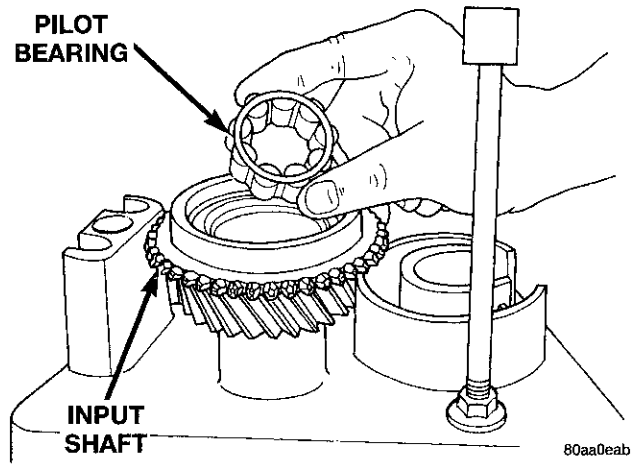

Fig. 85 Installing Pilot Bearing In Input Shaft

(4) Install fourth gear synchro ring on input shaft (Fig. 86).

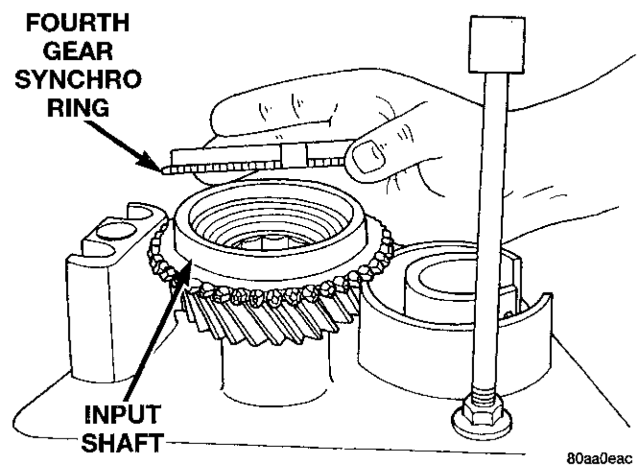

Fig. 86 Installing Fourth Gear Synchro Ring On Input Shaft

DISASSEMBLY AND ASSEMBLY (Continued)

(5) Adjust height of idler gear pedestal on assembly fixture (Fig. 87). Start with a basic height of 18.4 cm (7-1/4 in.). Final adjustment can be made after gear is positioned on pedestal.

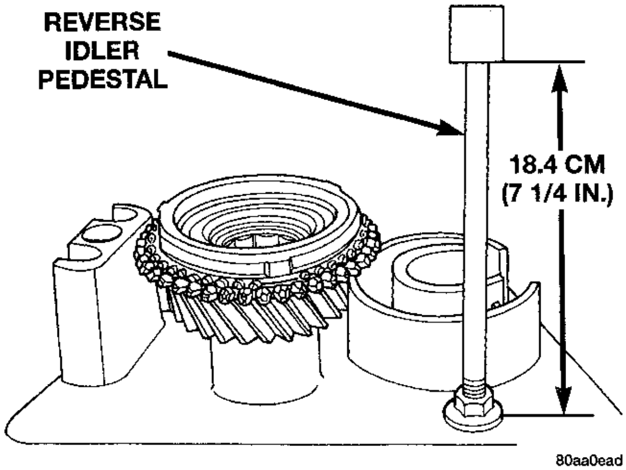

Fig. 87 Idler Pedestal Basic Height Adjustment

(6) Install assembled output shaft and geartrain in input shaft (Fig. 88). Carefully rotate output shaft until the 3–4 synchro ring seats in synchro hub and sleeve.

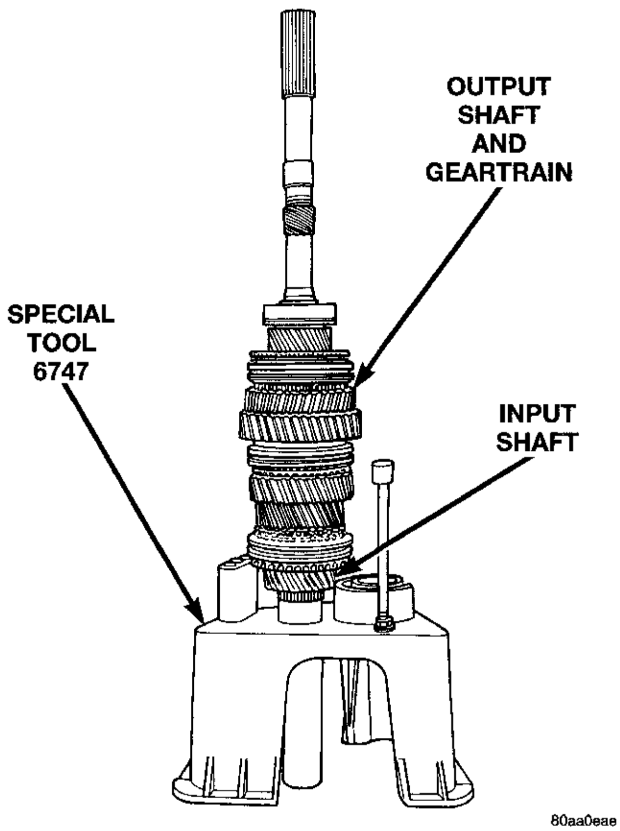

Fig. 88 Output Shaft And Geartrain Installed In Input Shaft

(7) Install Adapter 6747-2A on front bearing hub of countershaft, if not previously done. The adapter has a shoulder on one side. The shoulder goes toward the countershaft.

(8) Slide countershaft (and adapter) into fixture slot. Verify that countershaft and output shaft gears are fully meshed with the mainshaft gears before proceeding (Fig. 89).

(9) Check alignment of countershaft and output shaft gear teeth. Note that gears may not align perfectly. A difference in height of 1.57 to 3.18 mm (1/16 to 1/8 in.) will probably exist. This difference will not interfere with assembly. However, if the difference is greater than this, the countershaft adapter tool is probably upside down. Remove countershaft, reverse adapter tool, reinstall countershaft and check alignment again.

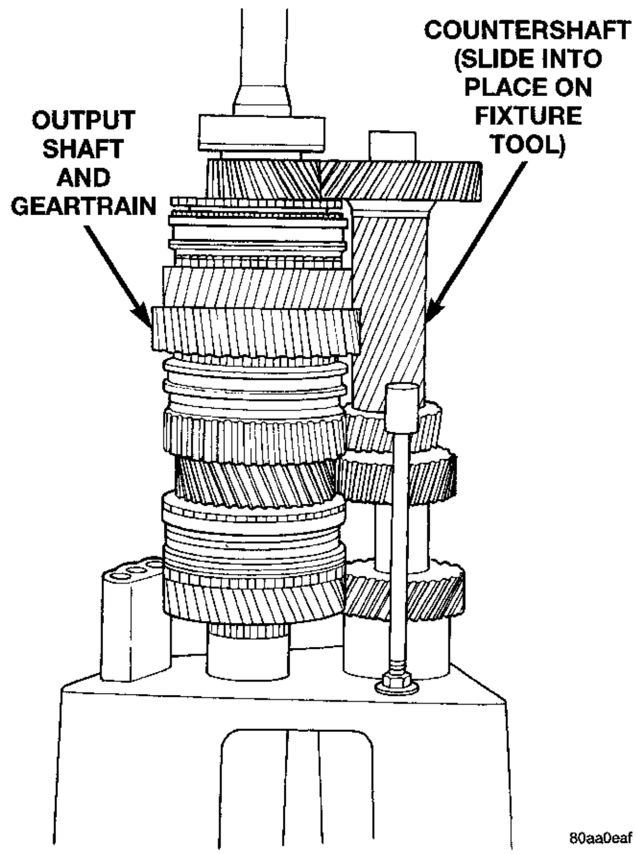

Fig. 89 Countershaft Installed On Fixture Tool

DISASSEMBLY AND ASSEMBLY (Continued)

(10) Position reverse idler in support cup of assembly fixture (Fig. 90). Be sure idler gear is properly meshed and aligned with shaft gear teeth and that bolt holes are facing out and not toward geartrain. Adjust pedestal up or down if necessary. Also be sure that short end of idler shaft is facing up as shown.

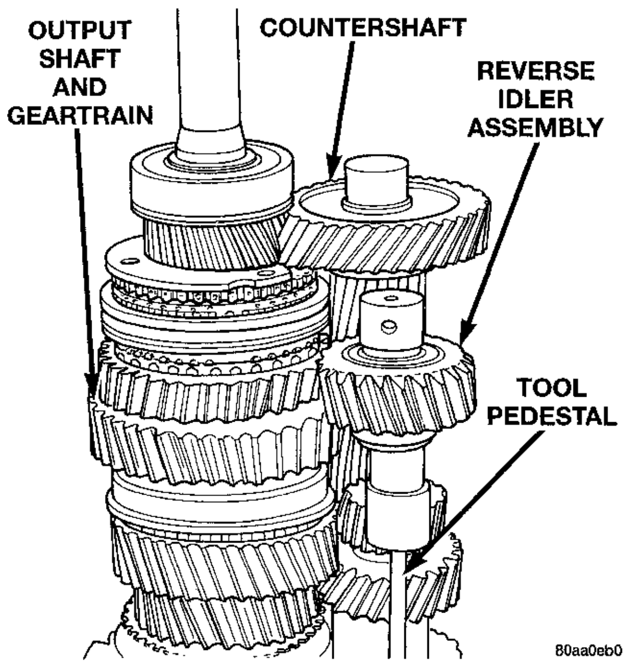

Fig. 90 Reverse Idler Assembly Positioned On Assembly Fixture Pedestal

(11) On 2-wheel drive transmission, thread one Pilot Stud 8120 in center or passenger side hole of output shaft bearing retainer. Then position retainer on fifth gear as shown (Fig. 91).

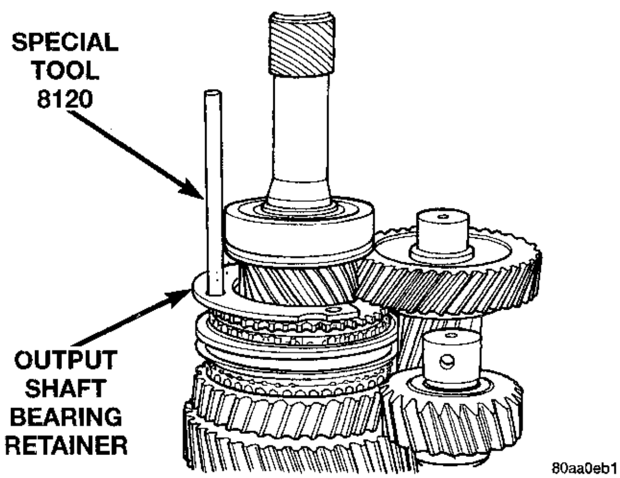

Fig. 91 Positioning Output Shaft Bearing Retainer For Rear Housing Installation

(12) Assemble 1-2 and fifth reverse-shift forks (Fig. 92). Arm of fifth-reverse fork goes through slot in 1-2 fork.

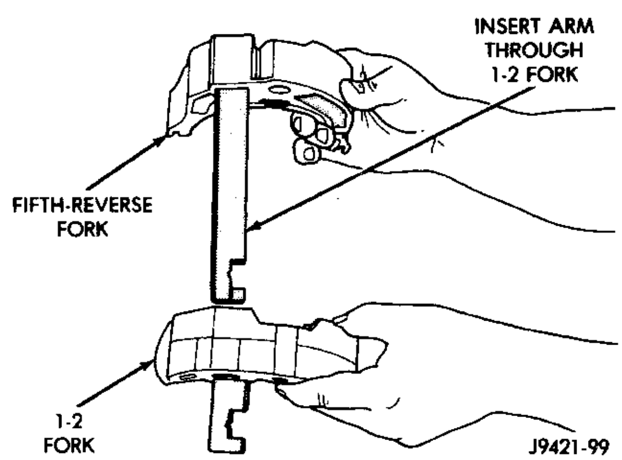

Fig. 92 Assembling 1-2 And Fifth-Reverse Shift Forks

(13) Install assembled shift forks in synchro sleeves (Fig. 93). Be sure forks are properly seated in sleeves.

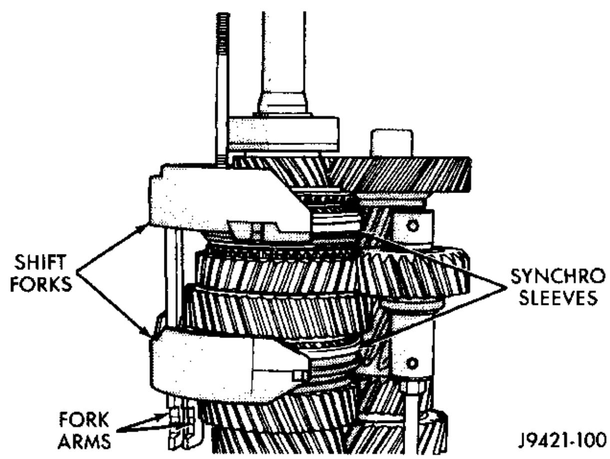

Fig. 93 Shift Forks Installed In Synchro Sleeves

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DISASSEMBLY AND ASSEMBLY (Continued)

REAR HOUSING INSTALLATION—2WD

(1) Drive adapter housing alignment dowels back into housing until dowels are flush with mounting surface (Fig. 94).

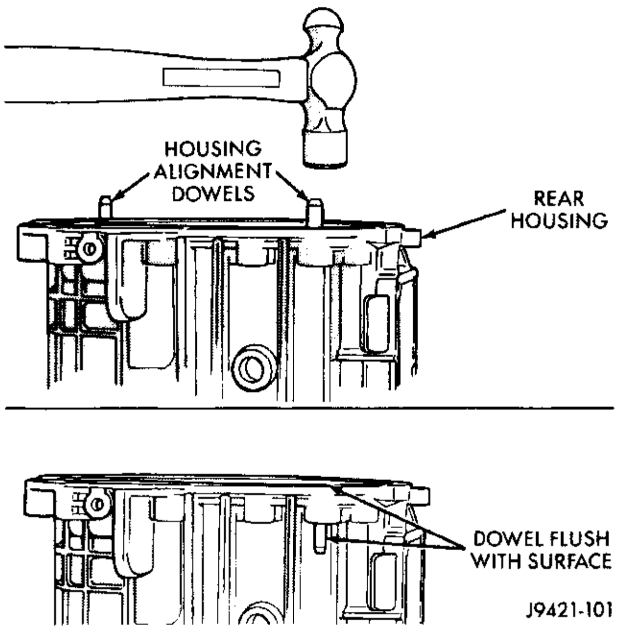

Fig. 94 Preparing Rear Housing Dowels For Installation

(2) Apply liberal quantity of petroleum jelly to countershaft rear bearing and bearing race.

(3) Install countershaft rear bearing in bearing race (Fig. 95).

CAUTION: The countershaft bearings can be installed backwards if care is not exercised. Be sure the large diameter side of the roller retainer faces the countershaft and the small diameter side faces the race and housing (Fig. 96).

(4) Apply extra petroleum jelly to hold countershaft rear bearing in place when housing is installed.

(5) Apply light coat of petroleum jelly to shift shaft bushing/bearing in rear housing (Fig. 96).

(6) Reach into countershaft rear bearing with finger, and push each bearing roller outward against race. Then apply extra petroleum jelly to hold rollers in place. This avoids having rollers becoming displaced during housing installation. This will result in misalignment between bearing and countershaft bearing hub.

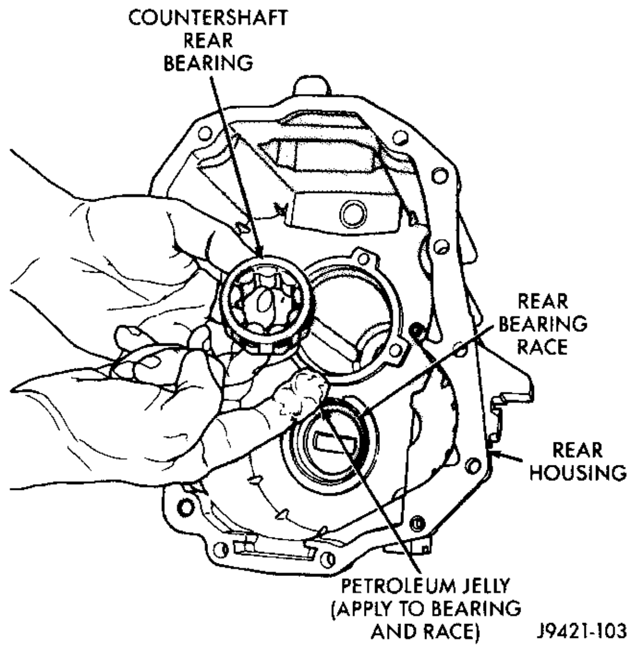

Fig. 95 Lubricating Countershaft Rear Bearing

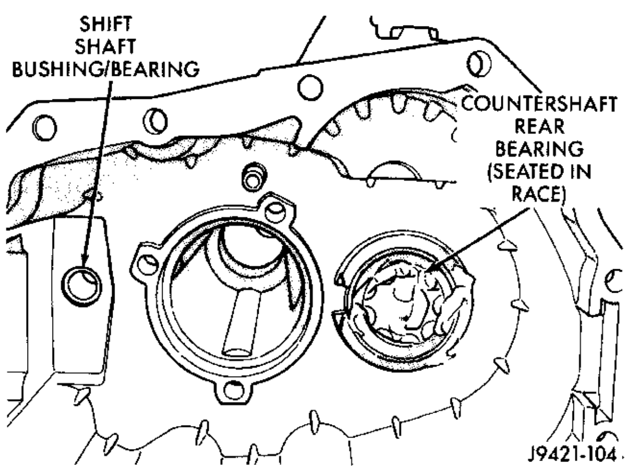

Fig. 96 Countershaft Rear Bearing Seated In Seated in Race

DISASSEMBLY AND ASSEMBLY (Continued)

(7) Install rear housing onto geartrain (Fig. 97). Be sure bearing retainer pilot stud is in correct bolt hole in housing. Also be sure countershaft and output shaft bearings are aligned in housing and on countershaft. It may be necessary to lift upward on countershaft slightly to ensure that the countershaft rear bearing engages to the countershaft before the rear output shaft bearing engages the housing.

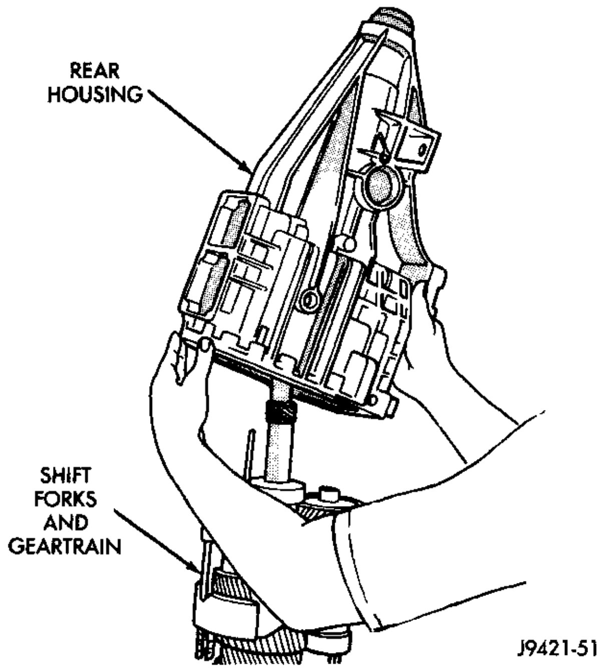

Fig. 97 Rear Housing Installation—2WD

(8) Seat rear housing on output shaft rear bearing and countershaft. Use plastic or rawhide mallet to tap housing into place.

(9) Install the three bolts that secure rear bearing retainer to rear housing as follows:

(a) Apply Mopar® Gasket Maker, or equivalent, to bolt threads, bolt shanks and under bolt heads (Fig. 98).

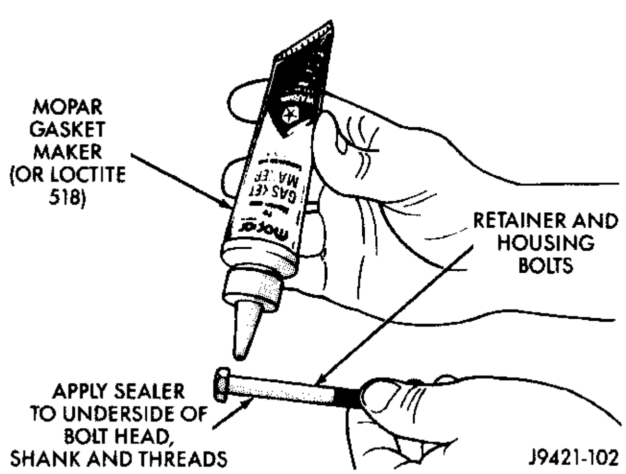

Fig. 98 Applying Sealer To Retainer And Housing Bolts

(b) Start first two bolts in retainer (Fig. 99). It may be necessary to move retainer rearward (with pilot stud) in order to start bolts in retainer.

(c) Remove Pilot Stud 8120 and install last retainer bolt (Fig. 99).

(d) Tighten all three retainer bolts to 30-35 N·m (22-26 ft. lbs.) torque.

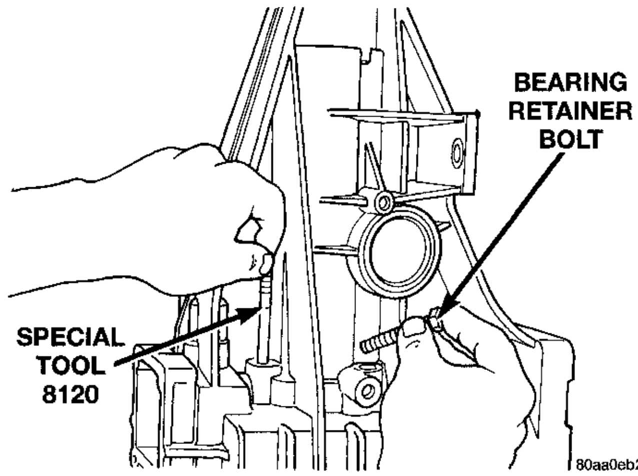

Fig. 99 Removing Pilot Stud Tool And Installing Retainer Bolts—2WD

ADAPTER HOUSING INSTALLATION—4WD

(1) Install rear bearing in adapter housing. Use wood hammer handle or wood dowel to tap bearing into place.

(2) Position rear bearing retainer in adapter housing (Fig. 100).

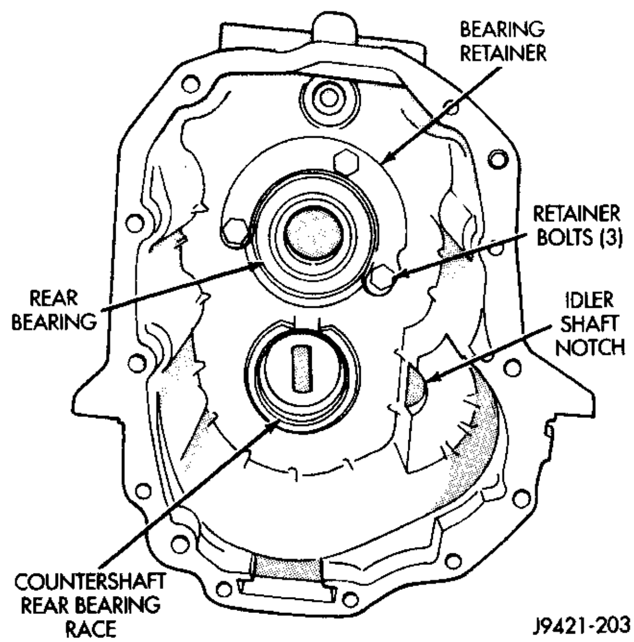

Fig. 100 Preparing Adapter Housing For Installation—4WD

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DISASSEMBLY AND ASSEMBLY (Continued)

(3) Apply Mopar® Gasket Maker, or equivalent, to threads, bolt shanks and under hex heads of bearing retainer bolts (Fig. 101).

(4) Apply liberal quantity of petroleum jelly to countershaft rear bearing and bearing race.

(5) Install countershaft rear bearing in bearing race (Fig. 96).

CAUTION: The countershaft bearings can be installed backwards if care is not exercised. Be sure the large diameter side of the roller retainer faces the countershaft and the small diameter side faces the race and housing (Fig. 96).

(6) Apply extra petroleum jelly to hold countershaft rear bearing in place when housing is installed.

(7) Apply light coat of petroleum jelly to shift shaft bushing/bearing in adapter housing (Fig. 96).

(8) Install adapter housing on geartrain.

(9) Install rear bearing snap ring on output shaft (Fig. 101).

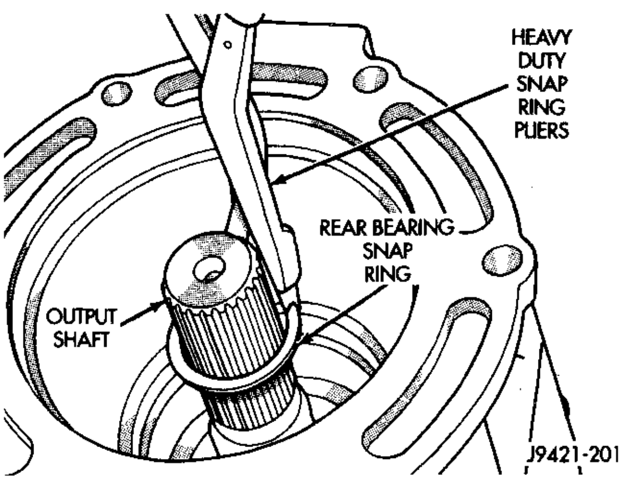

Fig. 101 Installing Rear Bearing Snap Ring—4WD

(10) Lubricate lip of new rear seal (Fig. 102) with Mopar® Door Ease, or transmission fluid.

(11) Install new rear seal in adapter housing bore with Installer C-3860-A. Be sure seal is fully seated in housing bore (Fig. 102).

REVERSE IDLER SEGMENT INSTALLATION

(1) Remove geartrain and housing assembly from fixture with aid of helper.

(2) Apply Mopar® Gasket Maker, or equivalent, sealer to underside of idler shaft bolt heads, bolt shanks and bolt threads (Fig. 98).

(3) Align idler shaft and rear housing bolt holes with drift, pin punch, or Phillips screwdriver.

(4) Work segment upward into housing and onto idler shaft.

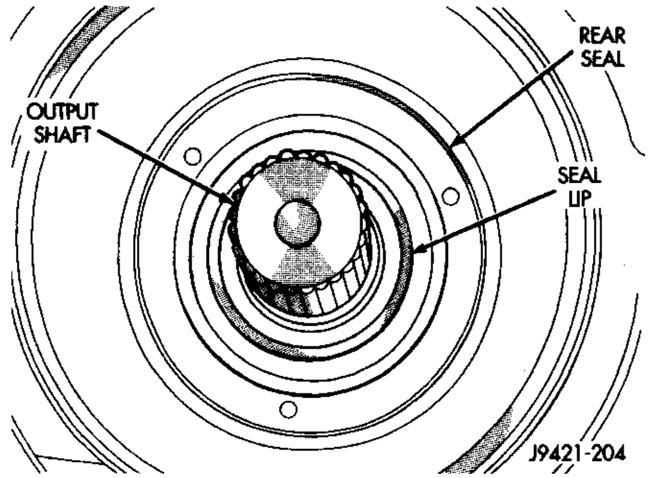

Fig. 102 Rear Seal Installation—4WD

(5) Verify that idler shaft is seated in housing notch before proceeding. Segment and housing can be damaged if idler shaft is misaligned.

(6) Insert idler shaft retaining bolts through housing and segment and into shaft. Long bolt goes through segment and short bolt goes through housing and directly into rear of shaft.

(7) Tighten idler shaft bolts to 19-25 N·m (14-18 ft. lbs.) torque.

CAUTION: Make sure the idler shaft and support segment are properly seated and held firmly in place while tightening the shaft bolts. The segment, housing or shaft threads can be damaged if the idler shaft is allowed to shift out of position in the housing.

SHIFT SHAFT, SHAFT LEVER AND BUSHING AND SHIFT SOCKET INSTALLATION

(1) Before proceeding, verify that all synchro sleeves are in Neutral position (centered on hub). Move sleeves into neutral if necessary.

CAUTION: The transmission synchros must all be in Neutral position for proper reassembly. Otherwise, the housings, shift forks and gears can be damaged during installation of the two housings.

(2) Install 3-4 shift fork in synchro sleeve (Fig. 103). Verify that groove in fork arm is aligned with grooves in 1-2 and fifth-reverse fork arms as shown.

(3) Slide shift shaft through 3-4 shift fork (Fig. 104). Be sure shaft detent notches are to front.

(4) Assemble shift shaft shift lever and bushing (Fig. 105). Be sure slot in bushing is facing up and roll pin hole for lever is aligned with hole in shaft.

(5) Install assembled lever and bushing on shift shaft (Fig. 106).

DISASSEMBLY AND ASSEMBLY (Continued)

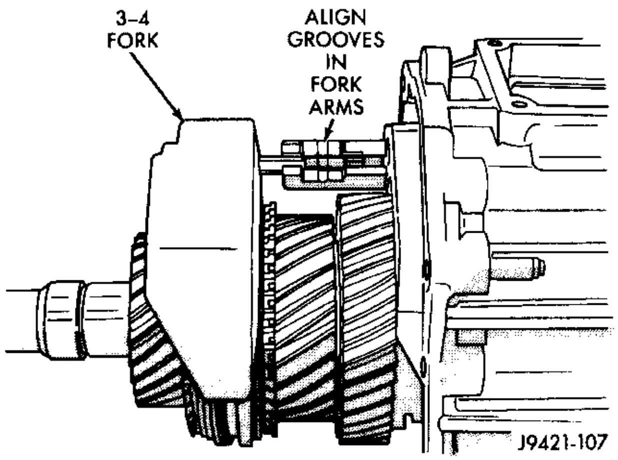

Fig. 103 Installing 3-4 Shift Fork

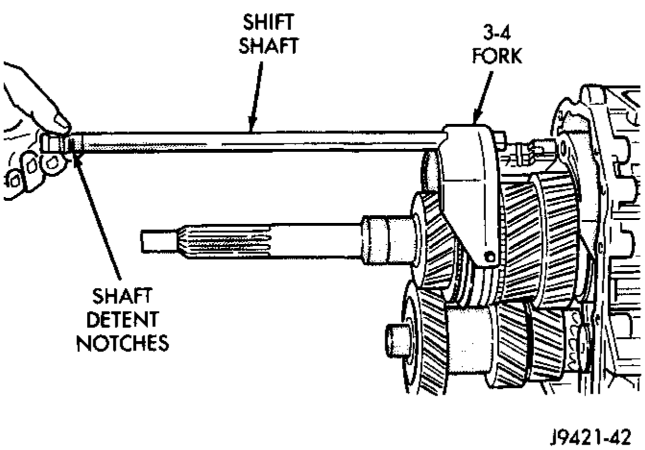

Fig. 104 Shift Shaft Installation

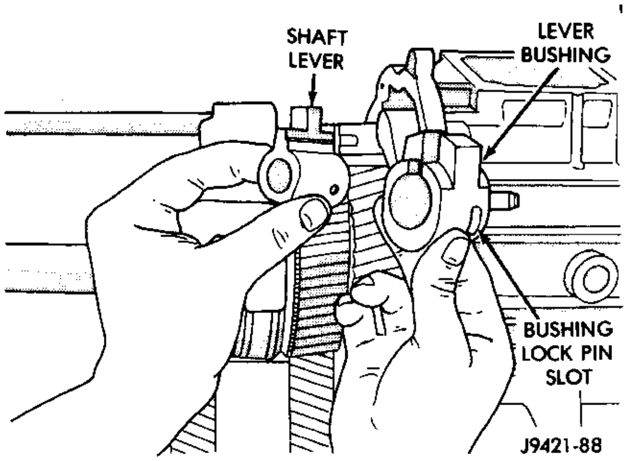

Fig. 105 Assembling Shift Shaft Lever And Bushing

(6) Slide shift shaft through 1-2 and fifth-reverse fork and into shift lever opening in rear housing (Fig. 107).

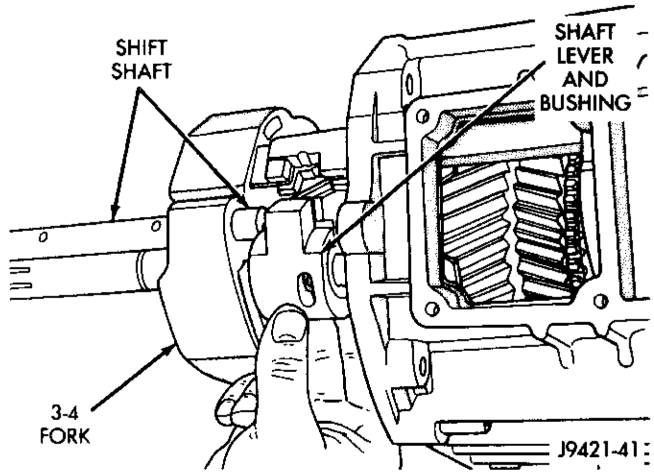

Fig. 106 Installing Shift Shaft Lever And Bushing

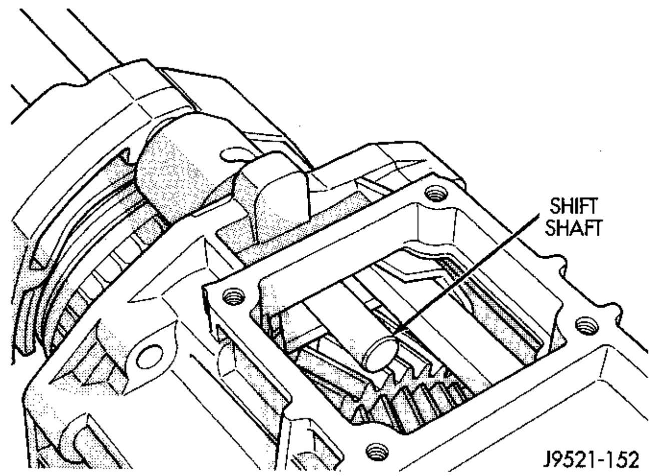

Fig. 107 Inserting Shaft Into Lever Opening In Housing

(7) Align shift socket with shaft and slide shaft through socket and into shift shaft bearing in rear housing (Fig. 108).

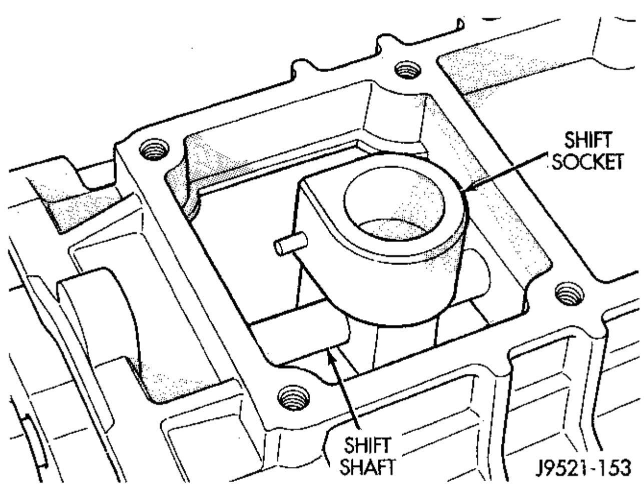

Fig. 108 Shift Socket Installation

DISASSEMBLY AND ASSEMBLY (Continued)

(8) Rotate shift shaft so detent notches in shaft are facing driver side of housing.

CAUTION: Correct positioning of the shift shaft detent notch is important. Both of the shaft roll pins can be installed even when the shaft is 180° off. If this occurs, the transmission will have to be disassembled again to correct shaft alignment.

(9) Select correct new roll pin for shift shaft lever (Fig. 109). Shaft lever roll pin is approximately 22 mm (7/8 in.) long. Shift socket roll pin is approximately 33 mm (1-1/4 in.) long.

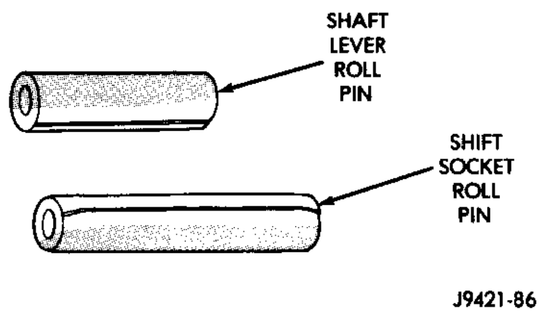

Fig. 109 Roll Pin Identification—Shaft Lever And Shift Socket

(10) Align roll pin holes in shift shaft, lever and bushing. Then start roll pin into shaft lever by hand (Fig. 110).

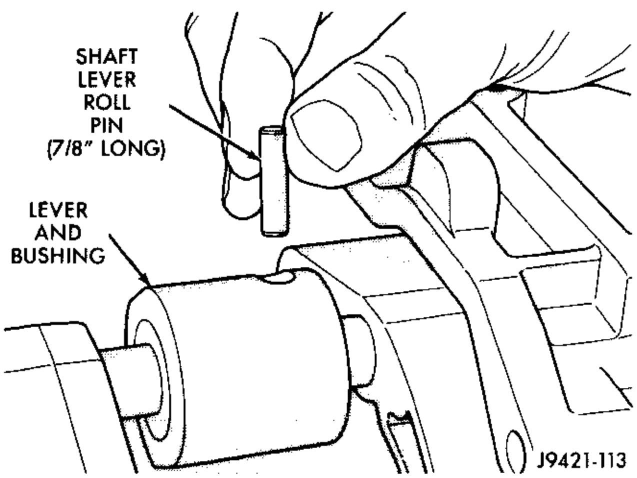

Fig. 110 Starting Roll Pin In Shift Shaft Lever

(11) Seat shaft lever roll pin with pin punch (Fig. 111).

CAUTION: The shaft lever roll pin must be flush with the surface of the lever. The lever bushing will bind on the roll pin if the pin is not seated flush.

(12) Before proceeding, verify that lock pin slot in lever bushing is positioned as shown (Fig. 111).

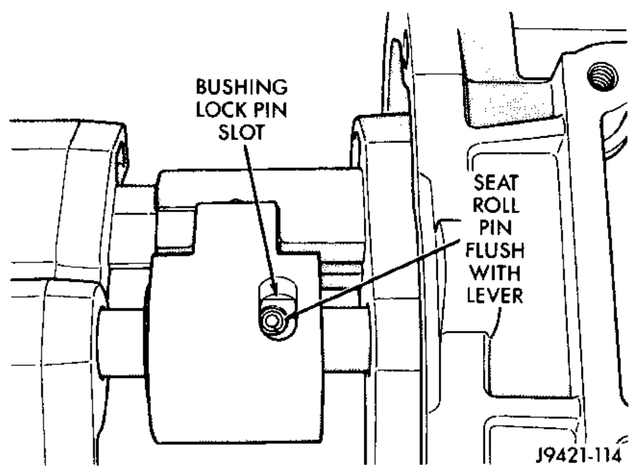

Fig. 111 Correct Seating Of Shift Shaft Lever Roll Pin

(13) Align roll pin holes in shift socket and shift shaft. Then start roll pin into shift shaft by hand (Fig. 112).

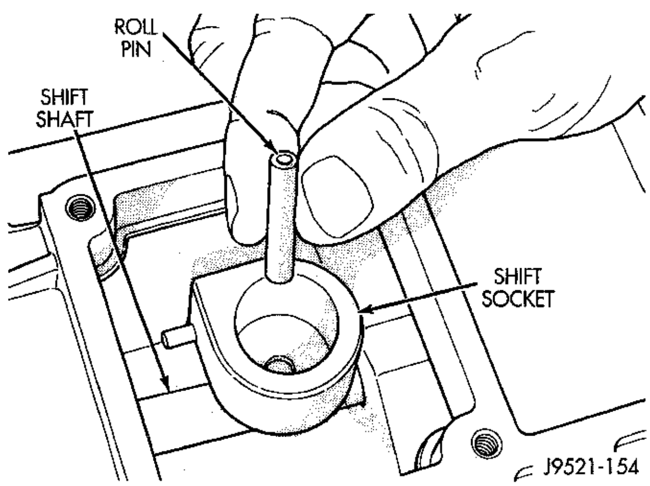

Fig. 112 Starting Roll Pin In Shift Socket

DISASSEMBLY AND ASSEMBLY (Continued)

(14) Seat roll pin in shift socket with pin punch. Roll pin must be flush with socket after installation (Fig. 113).

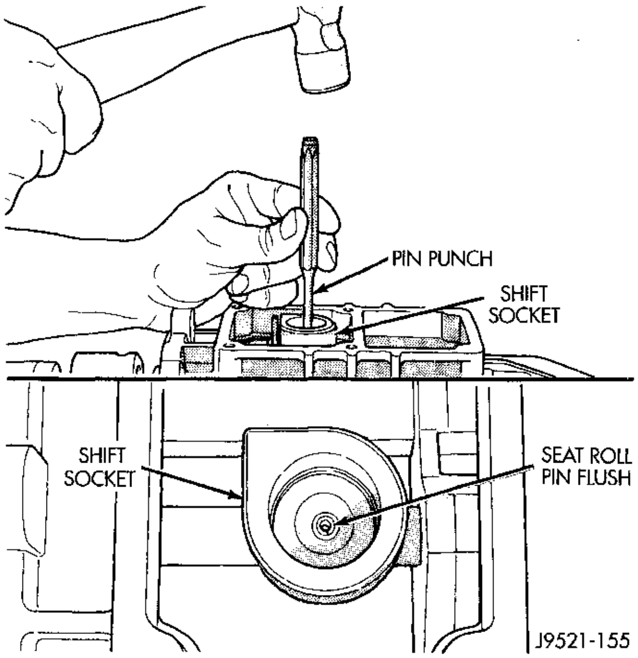

Fig. 113 Seating Shift Socket Roll Pin

(15) Verify that notches in shift fork arms are aligned (Fig. 114). Realign arms if necessary.

(16) Rotate shaft lever and bushing downward (out of fork arms), to expose detent bore in lever (Fig. 114).

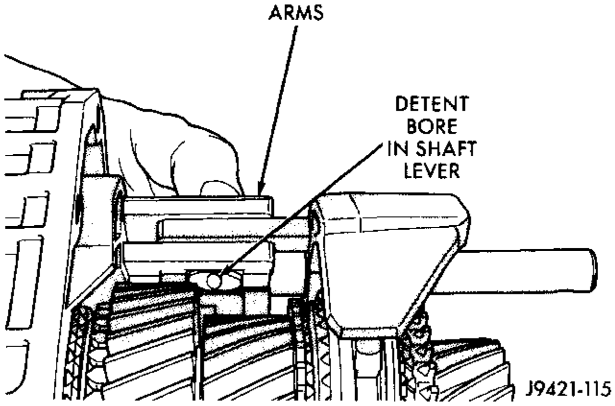

Fig. 114 Shaft Lever Positioned For Detent Ball and Spring Installation

(17) Insert detent spring in lever bore (Fig. 115).

(18) Install detent ball on top of spring in lever bore (Fig. 116).

(19) Press and hold detent ball in lever. Then carefully rotate lever upward into fork arm notches. Be

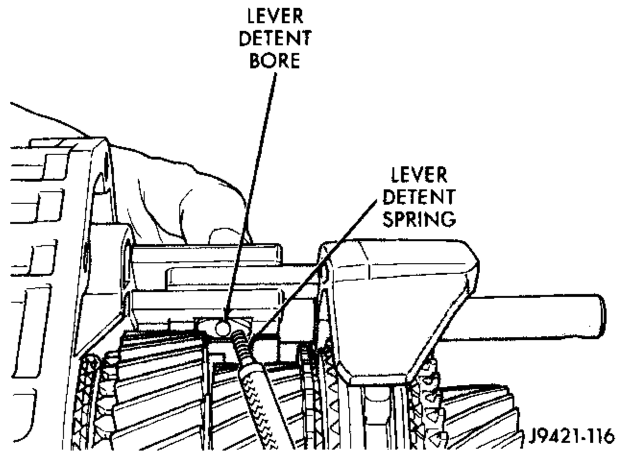

Fig. 115 Installing Detent Spring In Shaft Lever

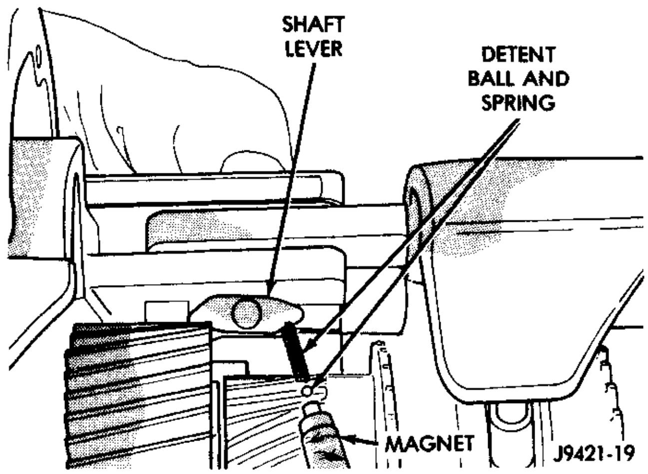

Fig. 116 Installing Detent Ball In Shaft Lever

sure ball is seated in fork arms before proceeding (Fig. 117).

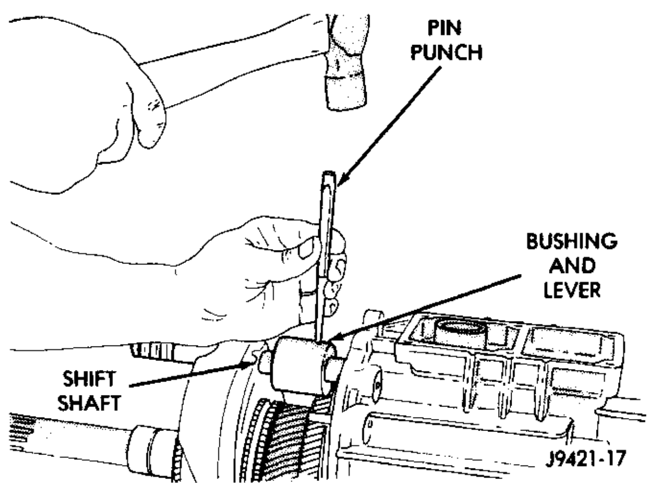

Fig. 117 Correct Seating Of Lever Detent Ball In Shift Fork Arms

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DISASSEMBLY AND ASSEMBLY (Continued)

FRONT HOUSING AND INPUT SHAFT BEARING RETAINER INSTALLATION

(1) Install input shaft bearing in front housing bore (Fig. 118). Use plastic mallet to seat bearing. Bearing goes in from front side of housing only.

(2) Apply liberal quantity of petroleum jelly to countershaft front bearing. Then insert bearing in front housing race (Fig. 119). Large diameter side of bearing cage goes toward countershaft (Fig. 118). Small diameter side goes toward bearing race in housing.

(3) Reach into countershaft front bearing with finger, and push each bearing roller outward against race. Then apply extra petroleum jelly to hold rollers in place. This avoids having rollers becoming displaced during housing installation. This will result in misalignment between bearing and countershaft bearing hub.

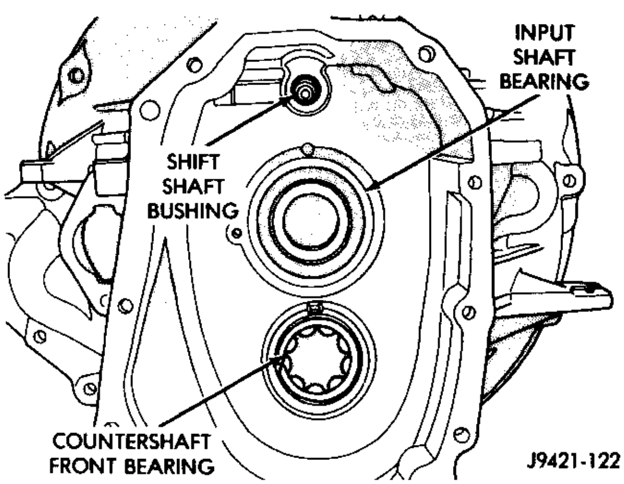

Fig. 118 Input Shaft Bearing And Countershaft Front Bearing Installation

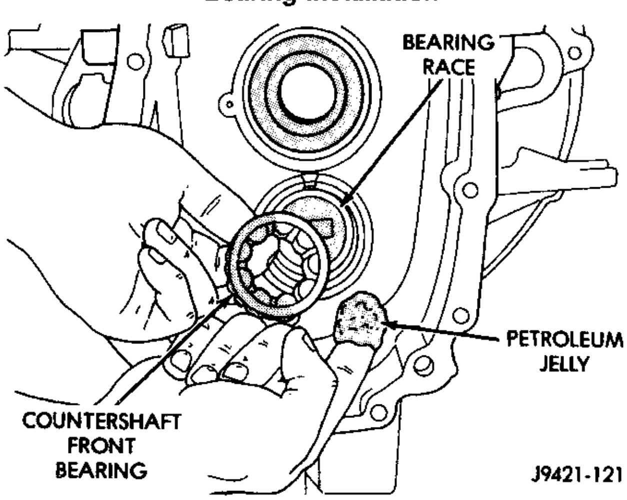

Fig. 119 Lubricating/Positioning Countershaft Front Bearing

(4) Apply small amount of petroleum jelly to shift shaft bushing in front housing (Fig. 120).

(5) Apply 1/8 in. wide bead of Mopar® Gasket Maker, or equivalent, to mating surfaces of front and rear housings (Fig. 120).

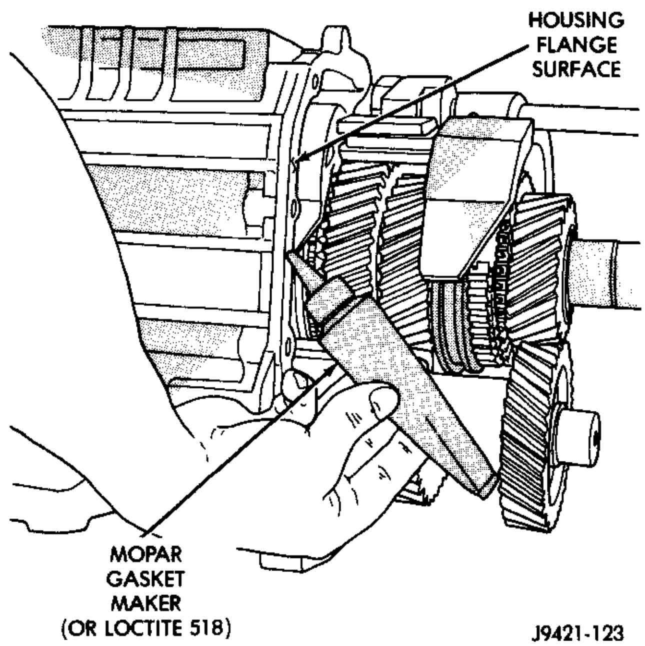

Fig. 120 Applying Sealer To Front/Rear Housings

(6) Have helper hold rear housing and geartrain in upright position. Then install front housing on rear housing and geartrain (Fig. 121).

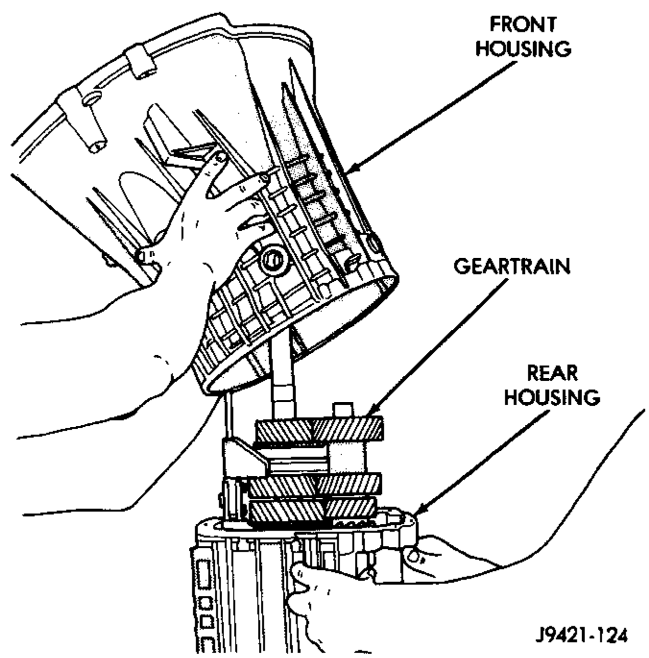

Fig. 121 Front Housing Installation

DISASSEMBLY AND ASSEMBLY (Continued)

(7) Work front housing downward onto geartrain until seated on rear housing.

CAUTION: If the front housing will not seat on the rear housing, either the shift components are not in Neutral, or one or more components are misaligned. Do not force the front housing into place. This will only result in damaged components.

(8) Tap rear housing alignment dowels back into place with hammer and pin punch (Fig. 122). Both dowels should be flush fit in each housing. Have helper hold transmission upright while dowels are tapped back into place.

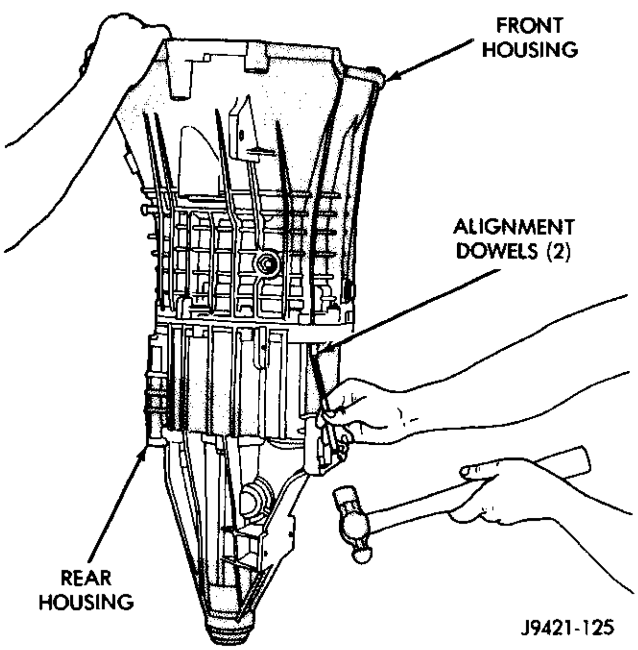

Fig. 122 Reseating Housing Alignment Dowels

(9) Place transmission in horizontal position.

(10) Apply Mopar® Gasket Maker, or equivalent, to housing attaching bolts. Apply sealer material sealer to underside of bolt heads and to bolt shanks and threads (Fig. 123).

(11) Install and start housing attaching bolts by hand (Fig. 123). Then tighten bolts to 30-35 N·m (22-26 ft. lbs.) torque.

(12) Install shift shaft bushing lock bolt (Fig. 124). Apply Mopar® Gasket Maker, or equivalent, to bolt threads, shank and underside of bolt head before installation.

CAUTION: If the lock bolt cannot be fully installed, do not try to force it into place. Either the shift shaft is not in Neutral, or the shaft bushing (or lever) is misaligned (Fig. 125).

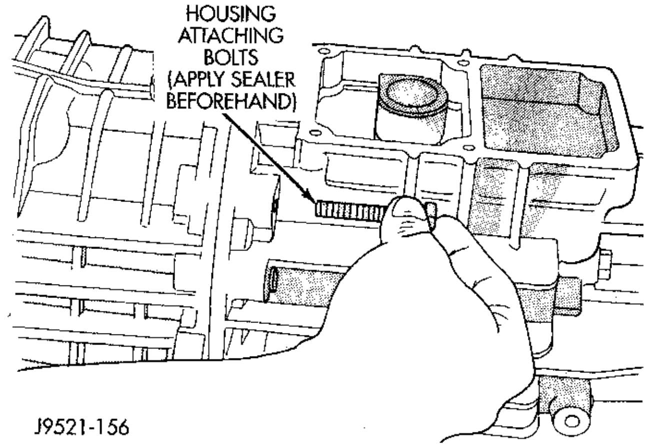

Fig. 123 Installing Housing Attaching Bolts

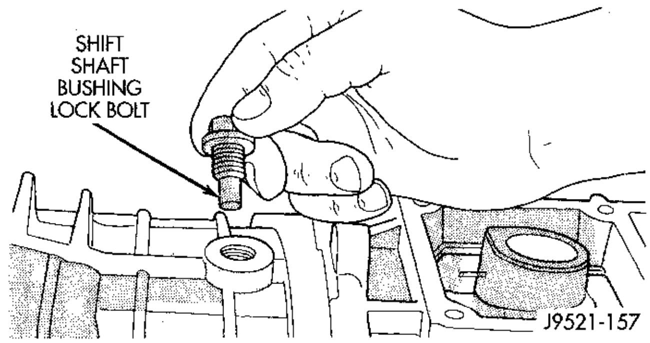

Fig. 124 Installing Shift Shaft Bushing Lock Bolt

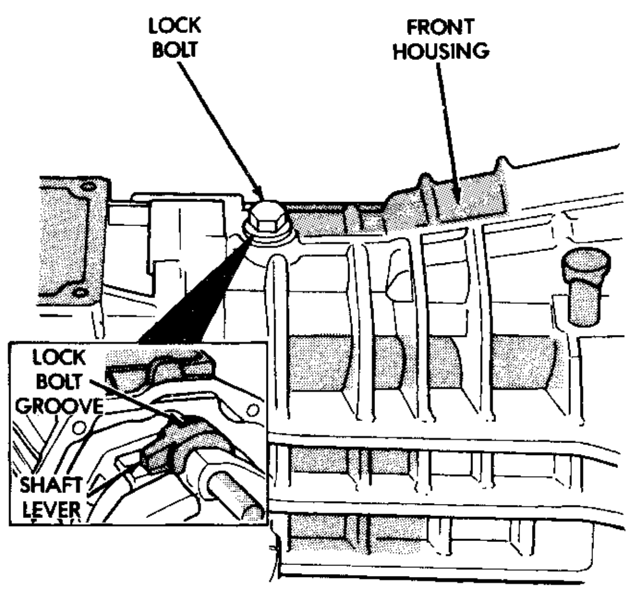

Fig. 125 Correct Alignment Of Lock Bolt And Shaft Bushing

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DISASSEMBLY AND ASSEMBLY (Continued)

(13) Lubricate then install shift shaft detent plunger in housing bore (Fig. 126). Lubricate plunger with petroleum jelly or gear lubricant. **Be sure plunger is fully seated in detent notch in shift shaft.**

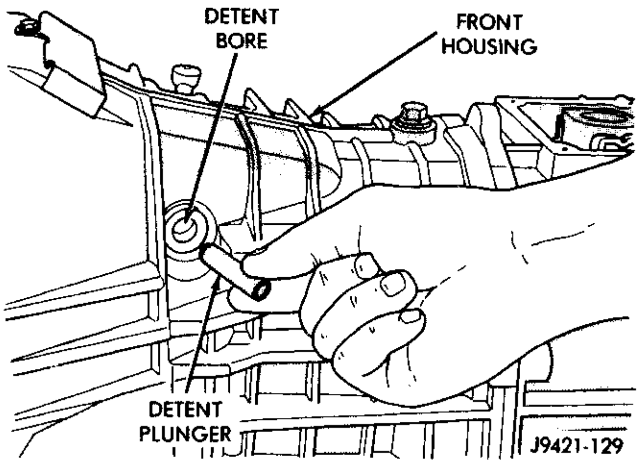

Fig. 126 Installing Shift Shaft Detent Plunger

(14) Install detent spring inside plunger (Fig. 127).

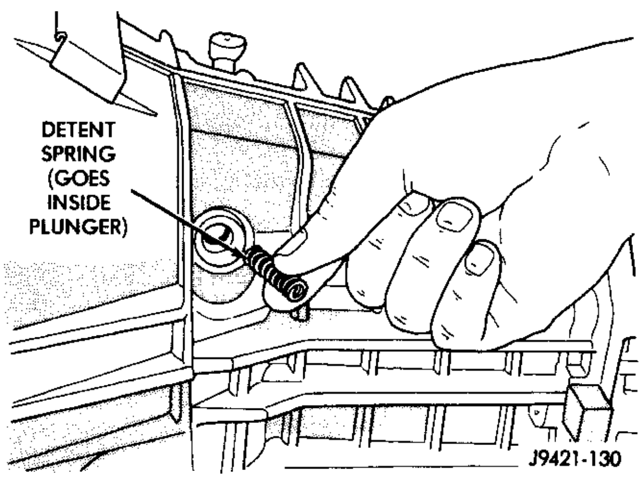

Fig. 127 Installing Detent Plunger Spring

(15) Install detent plug as follows:

(a) Install detent plug in end of Installer 8123.

(b) Position plug on detent spring and compress spring until detent plug pilots in detent plunger bore.

(c) Drive detent plug into transmission case until plug seats.

(16) Install backup light switch (Fig. 128).

(17) Install input shaft snap ring (Fig. 129).

(18) Install new oil seal in front bearing retainer with Installer Tool 6448 (Fig. 130).

(19) Apply bead of Mopar® silicone sealer, or equivalent, to flange surface of front bearing retainer (Fig. 131).

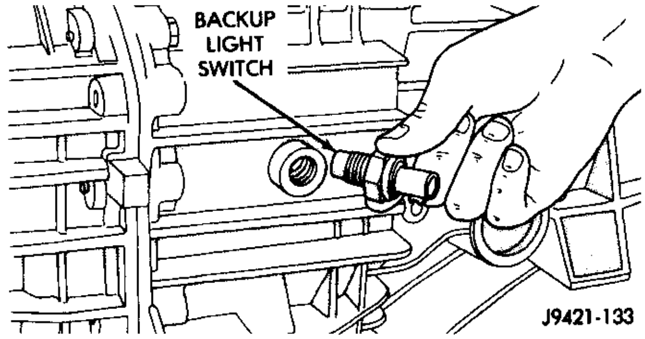

Fig. 128 Installing Backup Light Switch

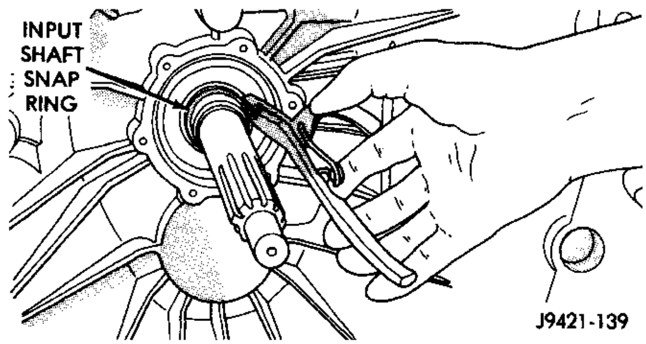

Fig. 129 Installing Input Shaft Snap Ring

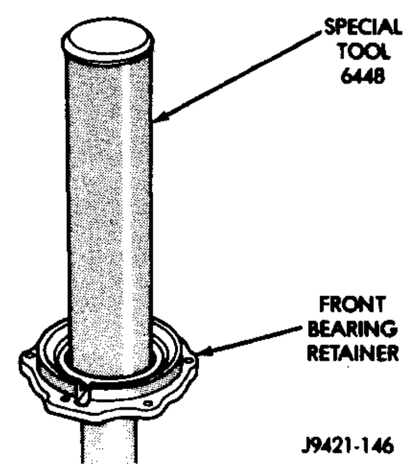

Fig. 130 Installing Oil Seal In Front Bearing Retainer

(20) Align and install front bearing retainer over input shaft and onto housing mounting surface (Fig. 132). Although retainer is one-way fit on housing, be sure bolt holes are aligned before seating retainer. Be sure that no sealer gets into the oil feed hole in the transmission case or bearing retainer.

(21) Install and tighten bearing retainer bolts to 7-10 N·m (5-7 ft. lbs.) torque (Fig. 133).

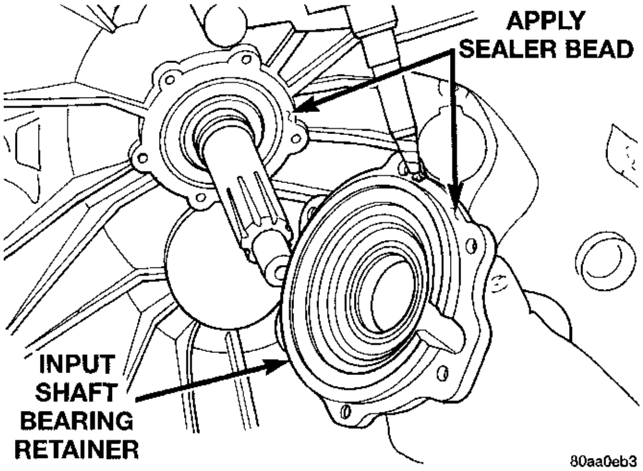

Fig. 131 Applying Sealer To Bearing Retainer And Housing

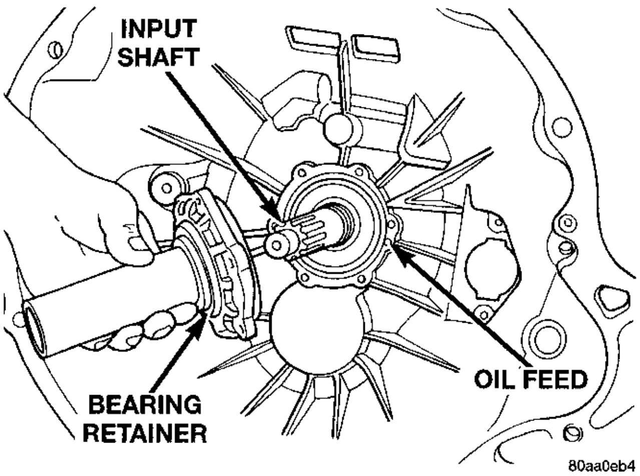

Fig. 132 Installing Input Shaft Bearing Retainer

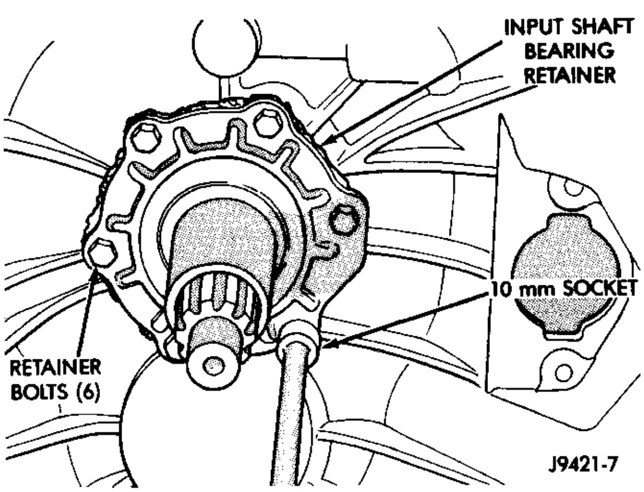

Fig. 133 Installing Input Shaft Bearing Retainer Bolts

SHIFT TOWER AND LEVER ASSEMBLY INSTALLATION

(1) Apply petroleum jelly to ball end of shift lever and interior of shift socket.

(2) Align and install shift tower and lever assembly. Be sure shift ball is seated in socket and the offset in the tower is toward the passenger side of the vehicle before installing tower bolts.

(3) Install shift tower bolts (Fig. 134). Tighten bolts to 7-10 N·m (5-7 ft. lbs.) torque.

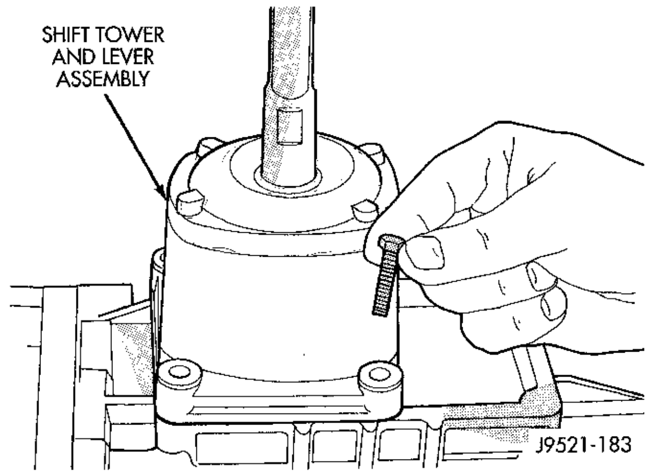

Fig. 134 Shift Tower Bolt Installation

(4) Fill transmission to bottom edge of fill plug hole with Mopar® Transmission Lubricant, P/N 4761526.

(5) Install and tighten fill plug to 19-27 N·m (14-20 ft. lbs.) torque.

(6) Check transmission vent (Fig. 135). Be sure vent is open and not restricted.

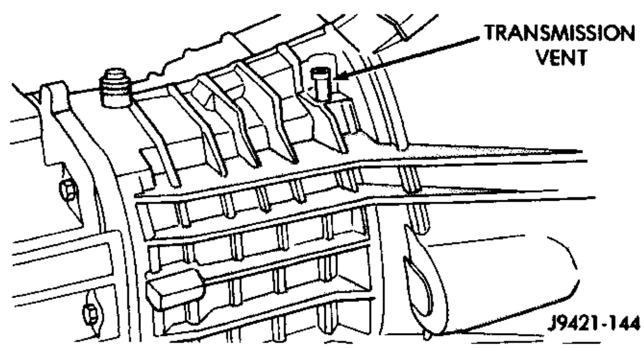

Fig. 135 Vent Location

CLEANING AND INSPECTION

TRANSMISSION COMPONENTS

Clean the gears, shafts, shift components and transmission housings with a standard parts cleaning solvent. Do not use acid or corrosive base solvents. Dry all parts except bearings with compressed air.

AUTHENTIC RESTORATION PRODUCT

CLEANING AND INSPECTION (Continued)

Clean the shaft bearings with a mild solvent such as Mopar® degreasing solvent, Gunk, or similar solvents. Do not dry the bearings with compressed air. Allow the bearings to either air dry, or wipe them dry with clean shop towels.

SHIFT LEVER ASSEMBLY

The shift lever assembly is not serviceable. Replace the lever and shift tower as an assembly if the tower, lever, lever ball, or internal components are worn, or damaged.

SHIFT SHAFT AND FORKS

Inspect the shift fork interlock arms and synchro sleeve contact surfaces (Fig. 136). Replace any fork exhibiting wear or damage in these areas. Do not attempt to salvage shift forks.

Check condition of the shift shaft detent plunger and spring. The plunger should be smooth and free of nicks, or scores. The plunger spring should be straight and not collapsed, or distorted. Minor scratches, or nicks on the plunger can be smoothed with 320/400 grit emery soaked in oil. Replace the plunger and spring if in doubt about condition. Check condition of detent plunger bushings. Replace if damaged.

Inspect the shift shaft, shift shaft bushing and bearing, the shaft lever, and the lever bushing that fits over the lever. Replace the shaft if bent, cracked, or severely scored. Minor burrs, nicks, or scratches can be smoothed off with 320/400 grit emery cloth followed by polishing with crocus cloth. Replace the shift shaft bushing or bearing if damaged.

Replace the shaft lever and bushing if either part is deformed, or worn. Do not attempt to salvage these parts as shift fork binding will occur. Replace the small detent ball and spring that goes in the lever if the ball is worn, or if the spring is bent or collapsed. Replace the roll pin that secures the lever to the shaft.

FRONT/REAR HOUSINGS AND BEARING RETAINERS

Inspect the housings carefully. Look for cracks, stripped threads, scored mating surfaces, damaged bearing bores, or worn dowel pin holes. Minor nicks on mating surfaces can be dressed off with a fine file, or emery cloth. Damaged threads can be renewed by either re-tapping or installing Helicoil inserts.

NOTE: The front housing contains the countershaft front bearing race. The rear housing contains the countershaft rear bearing race. Be advised that these components are NOT serviceable items. The front housing will have to be replaced if the countershaft bearing race is loose, worn, or damaged. The rear housing will have to be replaced if the countershaft rear bearing race is loose, worn, or damaged.

Inspect the input shaft bearing retainer. Be sure the release bearing slide surface of the retainer is in good condition. Minor nicks on the surface can be smoothed off with 320/420 grit emery cloth and final polished with oil coated crocus cloth. Replace the retainer seal if necessary.

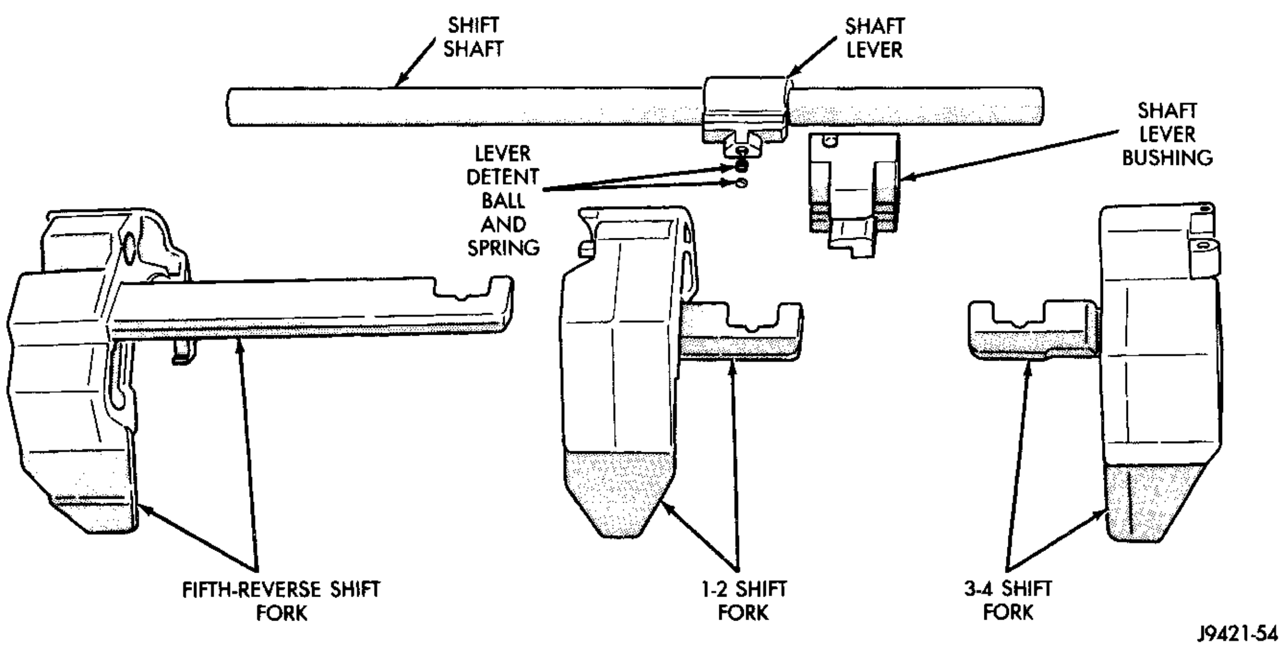

Fig. 136 Shift Forks And Shaft

CLEANING AND INSPECTION (Continued)

Inspect the output shaft bearing retainer. Be sure the U-shaped retainer is flat and free of distortion. Replace the retainer if the threads are damaged, or if the retainer is bent, or cracked.

COUNTERSHAFT BEARINGS AND RACES

The countershaft bearings and races are machine lapped during manufacture to form matched sets. The bearings and races should not be interchanged.

NOTE: The bearing races are a permanent press fit in the housings and are NOT serviceable. If a bearing race becomes damaged, it will be necessary to replace the front or rear housing as necessary. A new countershaft bearing will be supplied with each new housing for service use.

The countershaft bearings can be installed backwards if care is not exercised. The bearing roller cage is a different diameter on each side. Be sure the bearing is installed so the large diameter side of the cage is facing the countershaft gear (Fig. 137). The small diameter side goes in the bearing race.

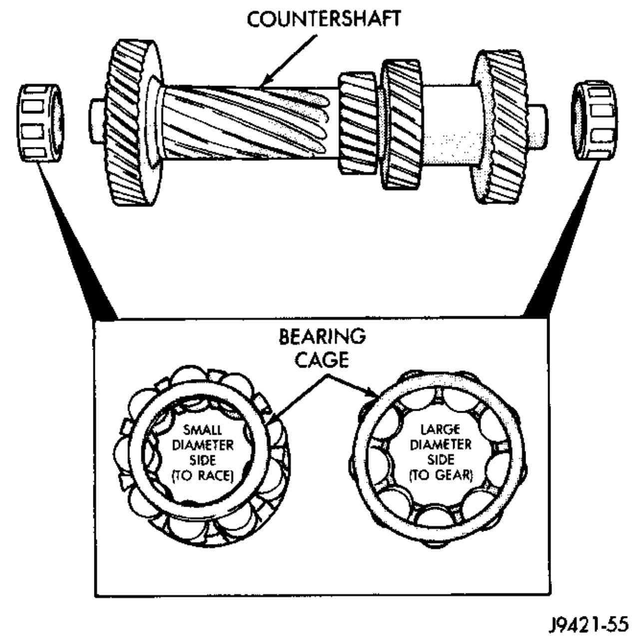

Fig. 137 Correct Countershaft Bearing Installation

REVERSE IDLER COMPONENTS

Inspect the idler gear, bearing, shaft, thrust washer, wave washer and thrust plate. Replace the bearing if any of the needle bearing rollers are worn, chipped, cracked, flat-spotted, or brinnelled. Also replace the bearing if the plastic bearing cage is damaged or distorted.

Replace the thrust washer, wave washer, or thrust plate if cracked, chipped, or worn. Replace the idler gear if the teeth are chipped, cracked or worn thin. Replace the shaft if worn, scored, or the bolt threads are damaged beyond repair. Replace the support segment if cracked, or chipped and replace the idler attaching bolts if the threads are damaged.

Shift Socket

Inspect the shift socket for wear or damage. replace the socket if the roll pin, or shift shaft bores are damaged. Minor nicks in the shift lever ball seat in the socket can be smoothed down with 400 grit emery or wet/dry paper. Replace the socket if the ball seat is worn, or cracked. Do not reuse the original shift socket roll pin. Install a new pin during reassembly. The socket roll pin is approximately is approximately 33 mm (1-1/4 in.) long.

Output Shaft And Geartrain

Inspect all of the gears for worn, cracked, chipped, or broken teeth. Also check condition of the bearing bore in each gear. The bores should be smooth and free of surface damage. Discoloration of the gear bores is a normal occurrence and is not a reason for replacement. Replace gears only when tooth damage has occurred, or if the bores are brinnelled or severely scored.

Inspect the shaft splines and bearings surfaces. Minor nicks on the bearing surfaces can be smoothed with 320/420 grit emery and final polished with crocus cloth. Replace the shaft if the splines are damaged or bearing surfaces are deeply scored, worn, or brinnelled.

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SPECIFICATIONS

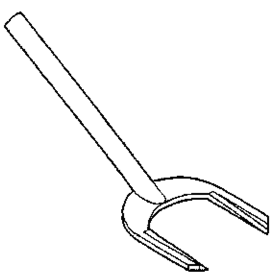
TORQUE

Description	Torque
Clutch Housing Bolts	54–61 N•m (40–45 ft. lbs.)
Crossmember-To-Frame Bolts	61–75 N•m (44–55 ft. lbs.)
Crossmember-To-Insulator Nuts	54–61 N•m (40–45 ft. lbs.)
Drain/Fill Plug	9–27 N•m (14–20 ft. lbs.)
Front-To-Rear Housing Bolts	30–35 N•m (22–26 ft. lbs.)
Front Bearing Retainer Bolts	7–10 N•m (5–7 ft. lbs.)
Idler Shaft Bolts	19–25 N•m (14–18 ft. lbs.)
Rear Bearing Retainer Bolts	30–35 N•m (22–26 ft. lbs.)
Shift Tower Bolts	7–10 N•m (5–7 ft. lbs.)
Slave Cylinder Attaching Nuts	23 N•m (200 in. lbs.)
Transfer Case Attaching Nuts	47 N•m (35 ft. lbs.)
U-Joint Clamp Bolts	19 N•m (170 in. lbs.)

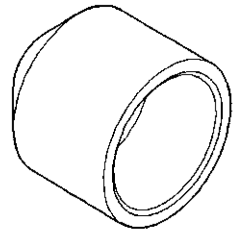
J9421-212

SPECIAL TOOLS

NV3500 MANUAL TRANSMISSION



Remover, Seal—C-3985-B



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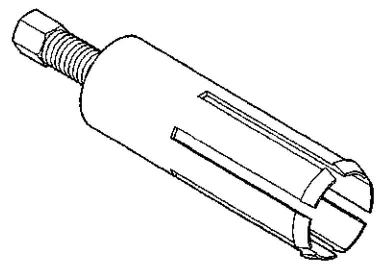
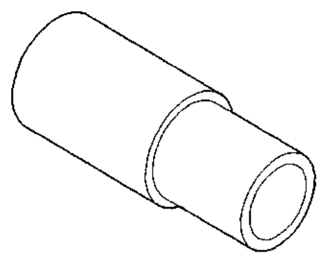
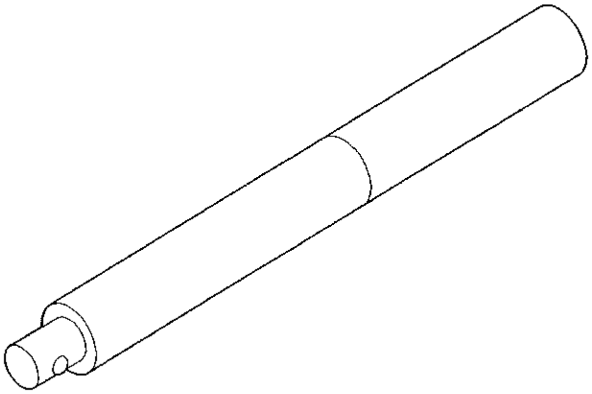


Remover, Bushing—6957

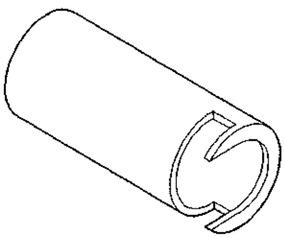


Installer, Bushing—6951

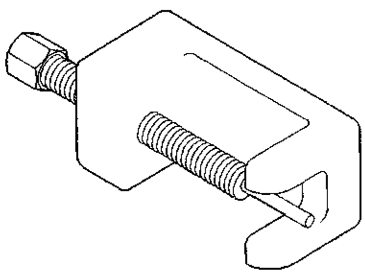
SPECIAL TOOLS (Continued)



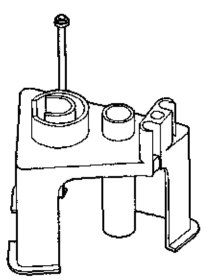
Handle—C-4171



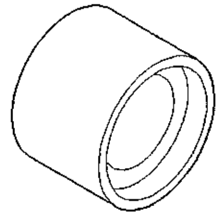
Remover—8117



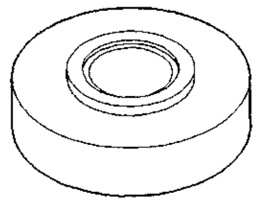
Remover/Installer, NV3500 Shift Rail Roll Pin—6858



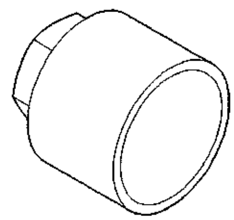
Fixture, NV3500—6747



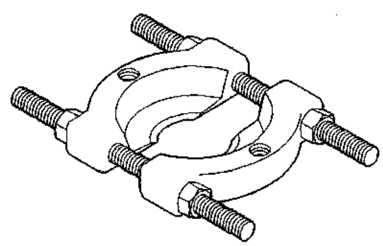
Adapter, Fixture—6747-1A



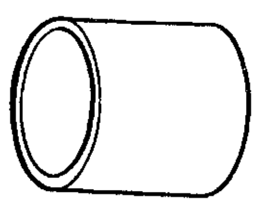
Adapter, Fixture—6747-2A



Cup, Fixture—8115



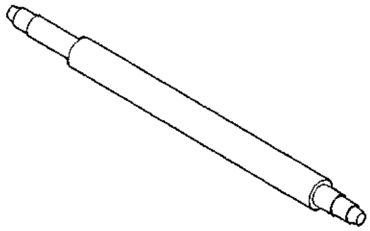
Splitter, Bearing—1130



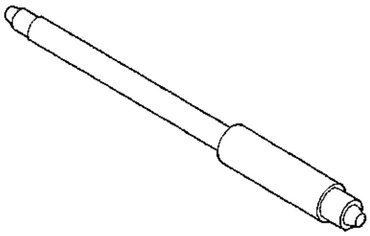
Tube—6310-1

AUTHENTIC RESTORATION PRODUCT

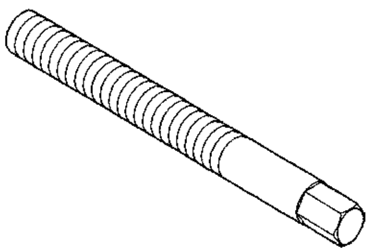
SPECIAL TOOLS (Continued)



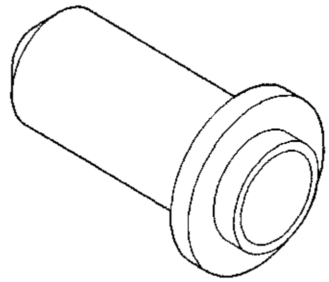
Installer—8118



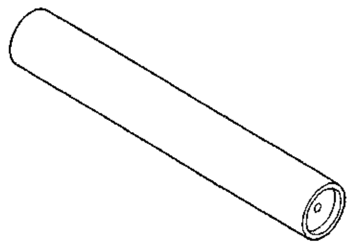
Remover/Installer—8119



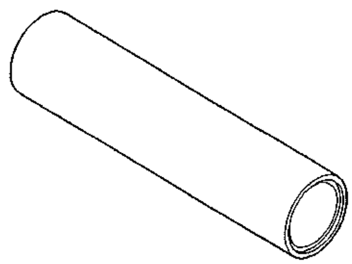
Stud, Alignment—8120



Installer, Seal—C-3860-A



Installer—8123



Installer, Bearing Cone—6448

NV4500 MANUAL TRANSMISSION

INDEX

GENERAL INFORMATION

NV4500 INTRODUCTION

The NV4500 is a five–speed, constant mesh manual transmission (Fig. 1). All gear ranges including reverse are synchronized. Fifth gear is an overdrive range with a ratio of 0.75:1. The transmission has a cast iron gear case and aluminum shift cover.

Two versions of the NV4500 are used. A standard duty version is used for 5.2L and 5.9L applications and a heavy duty version for V10 and Cummins diesel applications. Main differences are the larger diameter input shaft, output shaft, and mainshaft fifth gear in the heavy duty model.

The NV4500 is a top loader style transmission. The shift lever is located in a shifter tower which is bolted to the shift cover and operates the shift forks and rails directly. The shift forks and rails are all located within the aluminum cover which is bolted to the top of the gear case.

Tapered roller bearings support the drive gear, mainshaft and countershaft in the gear case. Pilot roller bearings in the drive gear support the forward end of the mainshaft. The mainshaft gears are all supported on caged type roller bearings. Drive gear thrust reaction is controlled by a needle type thrust bearing. The bearing is located at the forward end of the mainshaft.

AUTHENTIC RESTORATION PRODUCT

GENERAL INFORMATION (Continued)

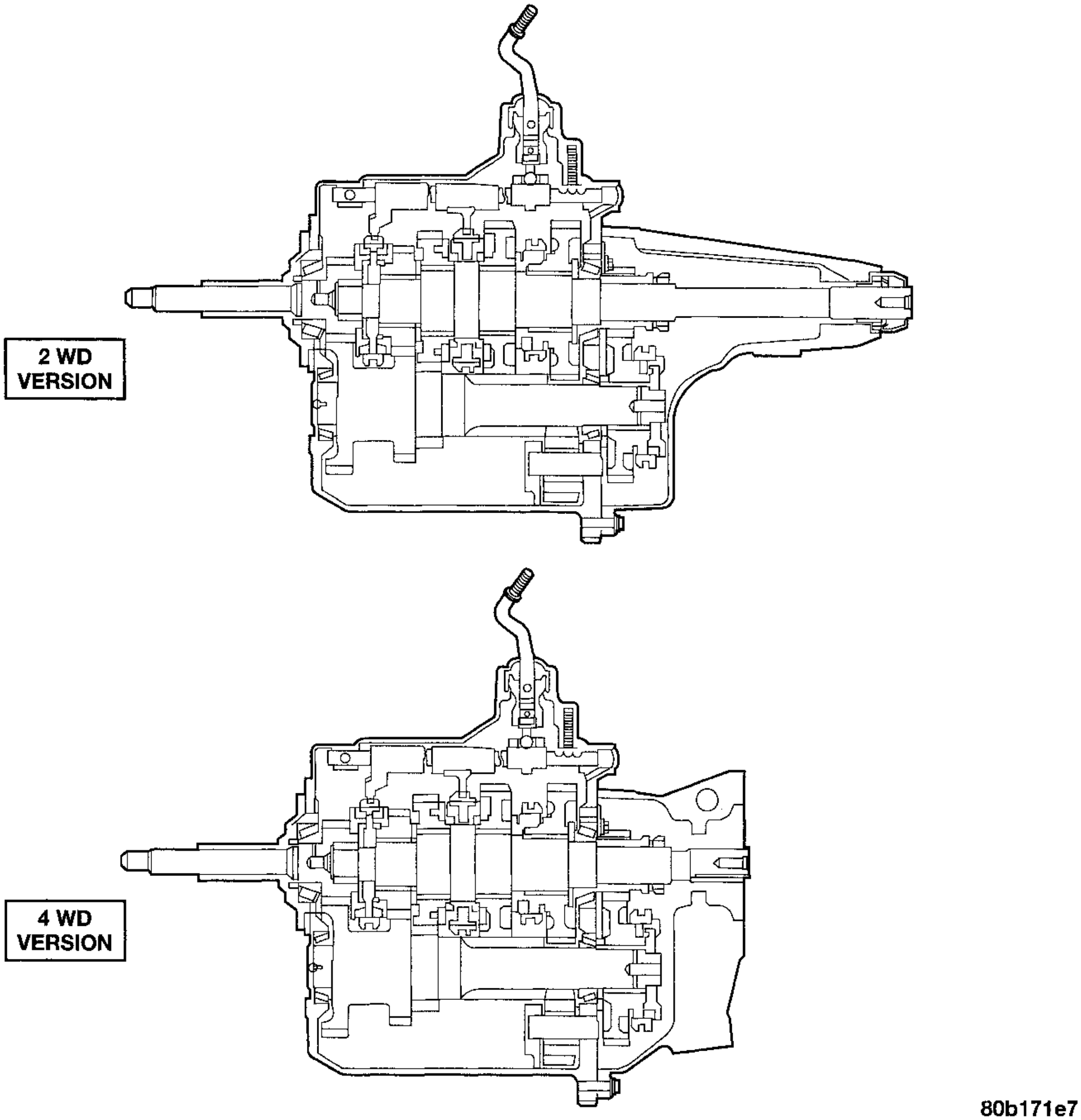


Fig. 1 NV4500 Manual Transmission

GENERAL INFORMATION (Continued)

TRANSMISSION IDENTIFICATION

The NV4500 transmission identification tag is attached to the driver side PTO cover (Fig. 2).

The tag provides the transmission model number, build date and part number. Be sure to reinstall the I.D. tag if removed during service. The information on the tag is essential to correct parts ordering.

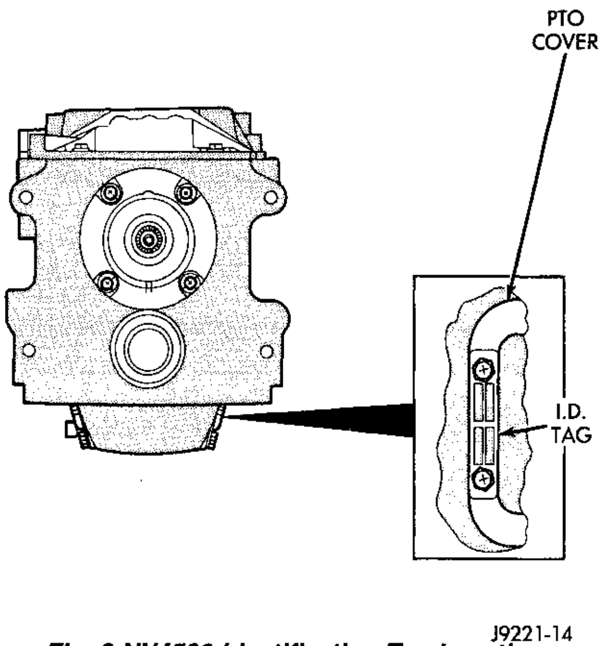


Fig. 2 NV4500 Identification Tag Location

LUBRICANT LEVEL AND CAPACITY

Required lubricant for the NV4500 is Mopar Manual Transmission Lubricant, P/N 4637579. This is the only lubricant recommended for use.

Dry fill lubricant capacity is approximately 3.78 liters (8 pints).

Correct lubricant fill level is to the bottom edge of the fill plug hole (Fig. 3). Check fill level only when the transmission is level.

The transmission lubricant is drained through the PTO cover bottom bolt hole (Fig. 3). It will be necessary to apply sealer to the bolt threads before installing it during a lubricant change.

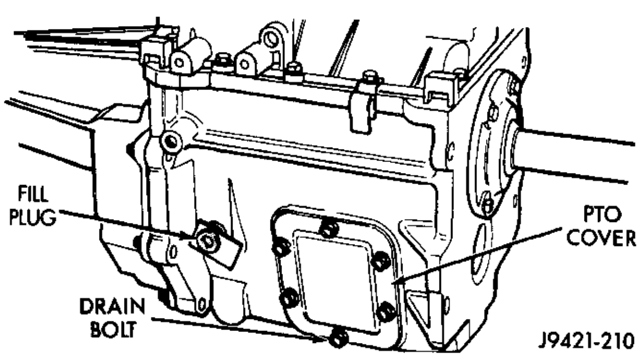


Fig. 3 NV4500 Fill Plug And Drain Bolt

GEAR RATIOS

RANGE	RATIO
First gear	5.61:1
Second Gear	3.04:1
Third Gear	1.67:1
Fourth Gear	1.00:1
Fifth Gear	0.75:1
Reverse gear	5.04:1

SHIFT PATTERN

The NV4500 shift pattern is in a modified H pattern (Fig. 4). Overdrive fifth and reverse gears are in line and outboard of the first through fourth gear positions.

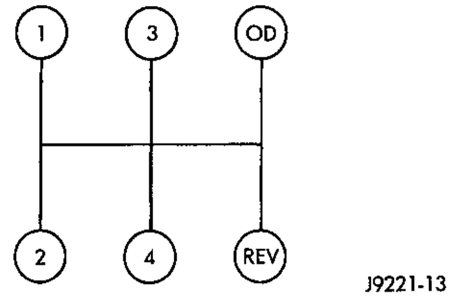


Fig. 4 NV4500 Shift Pattern

DIAGNOSIS AND TESTING

COMMON PROBLEM CAUSES

The majority of transmission malfunctions are a result of:

- insufficient lubricant.
- incorrect lubricant.
- misassembled or damaged internal components.
- improper operation.

HARD SHIFTING

A low lubricant level, loose or worn shift lever, or loose, damaged shift housing components are common causes of hard shifting. If hard shifting is also accompanied by gear clash, synchronizer clutch and stop rings, or mainshaft gear teeth may be worn or damaged.

Hard shifting may also be caused by a loose, or misaligned shift cover, or alignment dowels. Worn, or damaged shift cover components will also cause hard shifting. Any of the foregoing faults will cause component bind and high shift efforts.

Misassembled synchro components will also cause shift problems. Incorrectly installed synchro sleeves, struts, or springs will all cause shift problems.

DIAGNOSIS AND TESTING (Continued)

NOISY OPERATION

Transmission noise is most often a result of worn or damaged components. Chipped, broken gear or synchronizer teeth and brinnelled, spalled bearings all cause noise.

Abnormal wear and damage to internal components is frequently the end result of insufficient lubricant, non–recommended lubricants, or improper operation.

SLIPS OUT OF GEAR

Transmission disengagement may be caused by misaligned or damaged shift components, or worn teeth on the mainshaft gears or synchro components. Incorrect assembly will also contribute to gear disengagement.

LOW LUBRICANT LEVEL

Insufficient transmission lubricant is usually the result of leaks, or inaccurate fluid level check or refill method.

Leaks will be evident by the presence of gear oil around the leak point. If leakage is not evident, the condition is probably the result of an under fill condition.

If air powered lubrication equipment is used to fill a transmission, be sure the equipment is properly calibrated. Equipment out of calibration can lead to an underfill condition.

CLUTCH PROBLEMS

Worn, damaged, or misaligned clutch components can cause difficult shifting, gear clash and noise.

A damaged pilot bearing will cause noise. If bearing damage is severe, drive gear misalignment and hard shifting can also occur.

A worn or damaged clutch disc, pressure plate, or release bearing can cause hard shifting and gear clash.

Damaged or worn clutch hydraulic components, or leaks in the fluid lines or cylinders will cause hard shifting and gear clash. Failure of one of the clutch hydraulic cylinders can result in incomplete clutch release or engagement.

Verify that clutch components are all in good condition before removing the transmission for repair.

SERVICE PROCEDURES

FIFTH–REVERSE SHIFT FORK PADS

The plastic shift fork pads are held in place by a combination of tension and a small locating tang. Three pads are used on the fork (Fig. 5).

The pads can be removed either by hand or with a narrow blade screwdriver. To remove the pads by hand, grasp each pad and tilt it out and off the fork. If the pads prove difficult to remove by hand, insert a screwdriver blade between the pad and fork and pry the pad off.

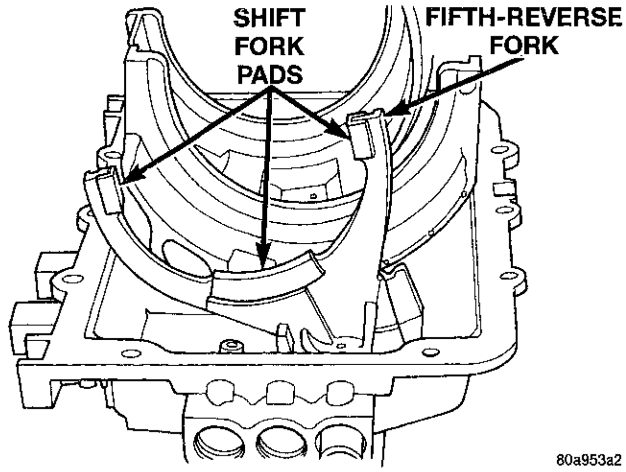


Fig. 5 Shift Fork Pad Locations

SHIFT COVER VENT

The shift cover vent assembly consists of the vent tube, connecting hose, hose clamps, and vent valve (Fig. 6).

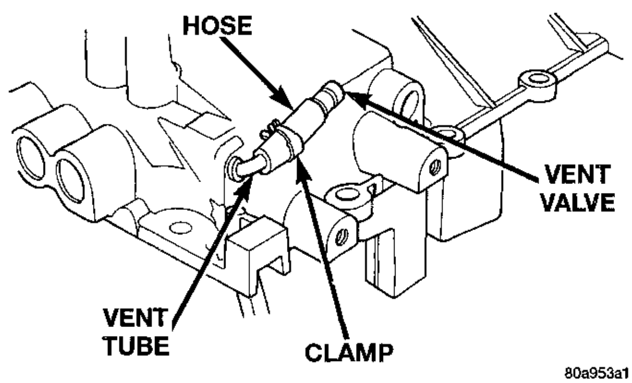


Fig. 6 Shift Cover Vent Components

If the vent tube is removed for replacement or service access, apply Mopar® silicone adhesive/sealer, or equivalent, to the tube to help secure it in the cover. Ensure that the vent is positioned 15–35° from horizontal in order to prevent leaks.

BACKUP LAMP SWITCH REPLACEMENT

The backup light switch is located at the left (driver) side of the cover (Fig. 7). The switch plunger is operated by the fifth–reverse shift rail.

The switch can be replaced with the transmission in, or out of the vehicle. A gasket must used with the switch.

Apply sealer to the switch threads before installation. Tightening torque for the switch is 22–34 N·m (192–300 in. lbs.).

SERVICE PROCEDURES (Continued)

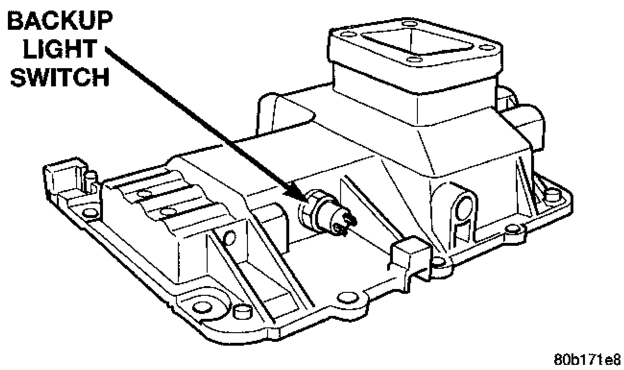


Fig. 7 Backup Light Switch Location

EXPANSION PLUG REPLACEMENT

The expansion plugs at the rear of the shift rail bores (Fig. 8) can be replaced if loose and/or leaking. Replacement procedure is as follows:

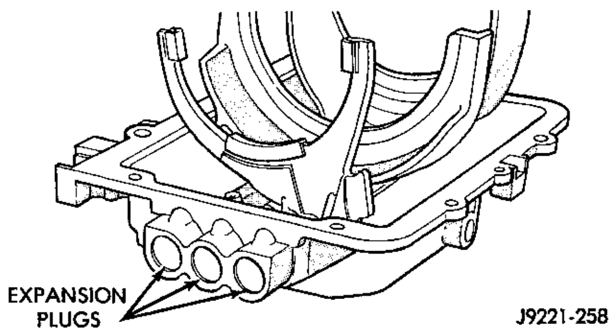


Fig. 8 Expansion Plug Location

(1) Drill 6 mm (1/4 in.) diameter hole in center of each plug to be removed.
(2) Pry plug out of cover with tapered punch.
(3) Clean all chips from shift cover and plug bores. Then clean plug bores with solvent and dry with clean shop towel.
(4) Apply small bead of sealer to outer edge of each new plug. Use Mopar® silicone adhesive/sealer, or equivalent.
(5) Position each new plug in bore and tap into place with hammer and suitable size punch or socket.

REMOVAL AND INSTALLATION

TRANSMISSION—2WD

REMOVAL

(1) Disconnect battery negative cable.
(2) Shift transmission into Neutral.
(3) Remove screws attaching shift boot to floorpan. Then slide boot upward on the shift lever.
(4) Remove the bolts holding the shift tower to the isolator plate and transmission shift cover.
(5) Remove the shift tower and isolator plate from the transmission shift cover.
(6) Raise and support vehicle.
(7) Mark propeller shaft and axle yokes for alignment reference. Use paint, scriber, or chalk to mark yokes.
(8) Remove universal joint strap screws and remove straps.
(9) Remove propeller shaft.
(10) Disconnect and remove exhaust system Y-pipe.
(11) Disconnect wires at speed sensor and backup light switch.
(12) Support engine with adjustable safety stand and wood block.
(13) If transmission is to be disassembled for repair, remove drain bolt at bottom of PTO cover and drain lubricant from transmission (Fig. 9).

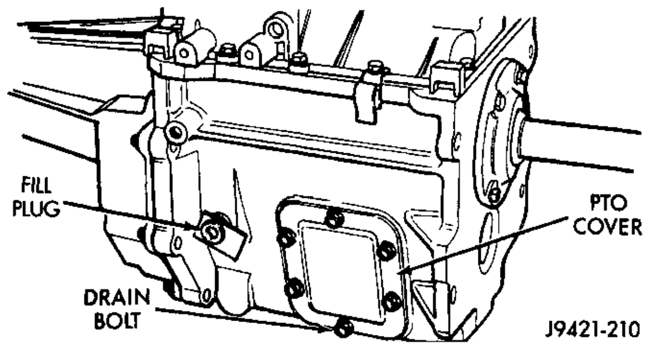


Fig. 9 NV4500 Drain Bolt

(14) Remove bolts/nuts attaching transmission to rear mount.
(15) Support transmission with a transmission jack. Secure transmission to jack with safety chains.
(16) Remove rear crossmember.
(17) Remove bolts attaching clutch slave cylinder to clutch housing. Then move cylinder aside for working clearance.
(18) Remove transmission harness wires from clips on transmission shift cover.
(19) Remove bolts attaching transmission to clutch housing.
(20) Slide transmission and jack rearward until input shaft clears clutch housing.
(21) Lower transmission jack and remove transmission from under vehicle.

INSTALLATION

(1) Apply light coat of Mopar® high temperature bearing grease to contact surfaces of following components:
- input shaft splines and pilot bearing hub.
- release bearing slide surface of front retainer.
- pilot bearing.
- release bearing bore.
- release fork.

REMOVAL AND INSTALLATION (Continued)

- release fork ball stud.
- propeller shaft slip yoke.

(2) Apply sealer to threads of bottom PTO cover bolt and install bolt in case.

(3) Mount transmission on jack and position transmission under vehicle.

(4) Raise transmission until input shaft is centered in release bearing and clutch disc hub.

(5) Move transmission forward and start input shaft in release bearing, clutch disc and pilot bushing.

(6) Work transmission forward until seated against clutch housing. Do not allow transmission to remain unsupported after input shaft has entered clutch disc.

(7) Install and tighten transmission-to-clutch housing bolts to 108 N·m (80 ft. lbs.) torque.

(8) Install clutch slave cylinder.

(9) Connect speed sensor and backup light switch wires.

(10) Fill transmission with recommended lubricant. Correct fill level is bottom edge of fill plug hole.

(11) Position transmission harness wires in clips on shift cover.

(12) Install transmission mount on transmission or rear crossmember.

(13) Install rear crossmember.

(14) Remove transmission jack and engine support fixture.

(15) Align and install propeller shaft.

(16) Lower vehicle.

(17) Clean the mating surfaces of shift tower, isolator plate, and shift cover with suitable wax and grease remover.

(18) Apply Mopar® Gasket Maker, or equivalent, to the sealing surface of the shift cover. Do not over apply sealant.

(19) Install the isolator plate onto the shift cover, metal side down.

(20) Install the shift tower onto the isolator plate. No sealant is necessary between the shift tower and the isolator plate.

(21) Verify that the shift tower, isolator plate, and the shift tower bushings are properly aligned.

(22) Install the bolts to hold the shift tower to the isolator plate and the shift cover. Tighten the shift tower bolts to 10.2–11.25 N·m (7.5–8.3 ft. lbs.).

(23) Install shift boot and bezel.

(24) Connect battery negative cable.

TRANSMISSION—4WD

REMOVAL

(1) Disconnect battery negative cable.

(2) Shift transmission into Neutral.

(3) Remove screws attaching shift boot to floorpan. Then slide boot upward on the shift lever.

(4) Remove the bolts holding the shift tower to the isolator plate and transmission shift cover.

(5) Remove the shift tower and isolator plate from the transmission shift cover.

(6) Raise and support vehicle.

(7) Remove skid plate, if equipped.

(8) If transmission will be disassembled for repair, remove drain bolt at bottom of PTO cover and drain lubricant from transmission (Fig. 10).

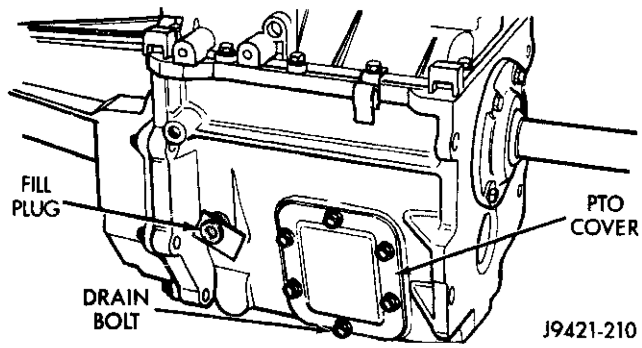


Fig. 10 NV4500 Drain Bolt

(9) Mark propeller shafts and yokes for assembly reference.

(10) Disconnect propeller shafts and remove propeller shafts.

(11) Disconnect and remove exhaust system Y-pipe. Then disconnect and lower remaining exhaust pipes for clearance as necessary.

(12) Support engine with adjustable safety stand.

(13) Disconnect speed sensor wires.

(14) Disconnect backup lamp switch wires.

(15) Disconnect transfer case shift linkage at transfer case range lever. Then remove transfer case shift mechanism from transmission (Fig. 11).

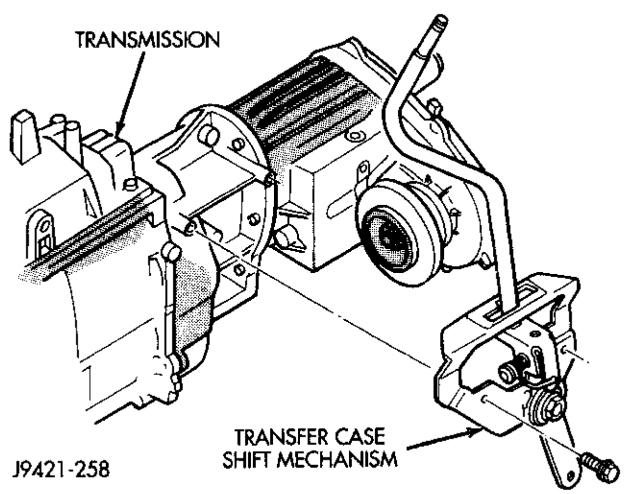


Fig. 11 Transfer Case Shift Mechanism—Typical

(16) Support transfer case with transmission jack. Secure transfer case to jack with safety chains.

REMOVAL AND INSTALLATION (Continued)

(17) Remove transfer case attaching nuts.

(18) Move transfer case rearward until input gear clears transmission mainshaft.

(19) Lower transfer case assembly and move it from under vehicle.

(20) Support transmission with transmission jack. Secure transmission to jack with safety chains.

(21) Remove transmission harness from retaining clips on transmission shift cover.

(22) Remove bolts/nuts attaching transmission mount to rear crossmember.

(23) Remove rear crossmember.

(24) Remove clutch slave cylinder splash shield, if equipped.

(25) Loosen clutch slave cylinder attaching nuts until cylinder piston rod is clear of release lever. This reduces pressure on lever and release bearing making transmission removal/installation easier. Cylinder does not have to be removed completely.

(26) Remove bolts attaching transmission to clutch housing.

(27) Move transmission rearward until input shaft clears clutch disc and release bearing.

(28) Lower transmission and remove it from under vehicle.

INSTALLATION

(1) Apply light coat of Mopar® high temperature bearing grease to contact surfaces of following components:

- input shaft splines and pilot bearing hub.
- release bearing slide surface of front retainer.
- pilot bearing.
- release bearing bore.
- release fork.
- release fork ball stud.
- propeller shaft slip yoke.

(2) Apply sealer to threads of PTO cover bottom drain bolt then install bolt in case.

(3) Mount transmission on jack and position transmission under vehicle. Secure transmission to jack with safety chains.

(4) Raise transmission until input shaft is centered in release bearing and clutch disc hub.

(5) Move transmission forward and start input shaft in release bearing, clutch disc, and pilot bearing.

(6) Work transmission forward until seated against clutch housing. Do not allow transmission to remain unsupported after input shaft has entered clutch disc.

(7) Install and tighten transmission-to-clutch housing bolts to 108 N·m (80 ft. lbs.) torque.

(8) Install transmission mount on transmission or rear crossmember.

(9) Install rear crossmember.

(10) Remove transmission jack and engine support fixture.

(11) Position transmission harness wires in clips on shift cover.

(12) Tighten slave cylinder attaching nuts and install slave cylinder shield, if equipped.

(13) Install transfer case shift mechanism on transmission (Fig. 11).

(14) Install transfer case on transmission jack. Secure transfer case to jack with safety chains.

(15) Raise jack and align transfer case input gear with transmission mainshaft.

(16) Move transfer case forward and seat it on adapter.

(17) Install and tighten transfer case attaching nuts. Tighten nuts to 41-47 N·m (30-35 ft. lbs.) if case has 3/8 studs, or 30-41 N·m (22-30 ft. lbs.) if case has 5/16 studs.

(18) Connect speed sensor and backup lamp switch wires.

(19) Install transfer case shift mechanism to side of transfer case.

(20) Connect transfer case shift lever to range lever on transfer case.

(21) Align and connect propeller shafts. Tighten universal joint clamp strap bolts to 19 N·m (170 in. lbs.) torque.

(22) Fill transmission with required lubricant. Check lubricant level in transfer case and add lubricant if necessary.

(23) Install transfer case skid plate, if equipped, and crossmember. Tighten attaching bolts/nuts to 41 N·m (30 ft. lbs.) torque.

(24) Install exhaust system components.

(25) Lower vehicle.

(26) Clean the mating surfaces of shift tower, isolator plate, and shift cover with suitable wax and grease remover.

(27) Apply Mopar® Gasket Maker, or equivalent, to the sealing surface of the shift cover. Do not over apply sealant.

(28) Install the isolator plate onto the shift cover, metal side down.

(29) Install the shift tower onto the isolator plate. No sealant is necessary between the shift tower and the isolator plate.

(30) Verify that the shift tower, isolator plate, and the shift tower bushings are properly aligned.

(31) Install the bolts to hold the shift tower to the isolator plate and the shift cover. Tighten the shift tower bolts to 10.2–11.25 N·m (7.5–8.3 ft. lbs.).

(32) Install shift lever boot and bezel.

(33) Connect battery negative cable.

REMOVAL AND INSTALLATION (Continued)

SHIFT TOWER

REMOVAL

(1) Shift transmission into Neutral.

(2) Unscrew and remove the shift lever extension from the shift

(3) Remove screws attaching shift boot to floorpan. Then slide boot upward on the shift lever.

(4) Remove the bolts holding the shift tower to the isolator plate and transmission shift cover.

(5) Remove the shift tower and isolator plate from the transmission shift cover.

INSTALLATION

(1) Clean the mating surfaces of shift tower, isolator plate, and shift cover with suitable wax and grease remover.

(2) Apply Mopar® Gasket Maker, or equivalent, to the sealing surface of the shift cover. Do not over apply sealant.

(3) Install the isolator plate onto the shift cover, metal side down.

(4) Install the shift tower onto the isolator plate. No sealant is necessary between the shift tower and the isolator plate.

(5) Verify that the shift tower, isolator plate, and the shift tower bushings are properly aligned.

(6) Install the bolts to hold the shift tower to the isolator plate and the shift cover. Tighten the shift tower bolts to 10.2–11.25 N·m (7.5–8.3 ft. lbs.).

(7) Install the shift lever extension, shift boot, and bezel.

SHIFT COVER

REMOVAL

(1) Remove transmission from vehicle.

(2) Remove shift cover bolts (Fig. 12).

(3) Loosen shift cover with pry tool. To avoid damaging cover seal surface, insert pry tool only in slots provided in cover (Fig. 13).

(4) Raise cover enough to disengage it from alignment dowels in gear case (Fig. 14).

(5) Raise front of shift cover and lift cover up and off gear case (Fig. 14).

INSTALLATION

(1) Clean mating surfaces of shift cover and gear case with wax and grease remover.

(2) Apply Mopar® Gasket Maker, or equivalent, to sealing surface of shift cover or gear case. Do not over–apply sealer material. Excess can be squeezed into gear case and could block lubricant feed holes in time.

(3) Lubricate synchro sleeves with Castrol Syntorq gear lubricant. Then apply light coat of petroleum jelly to shift fork contact surfaces.

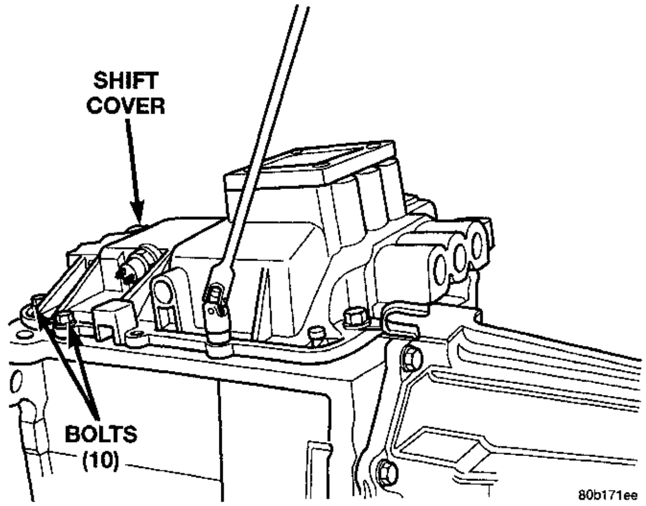


Fig. 12 Shift Cover Bolts

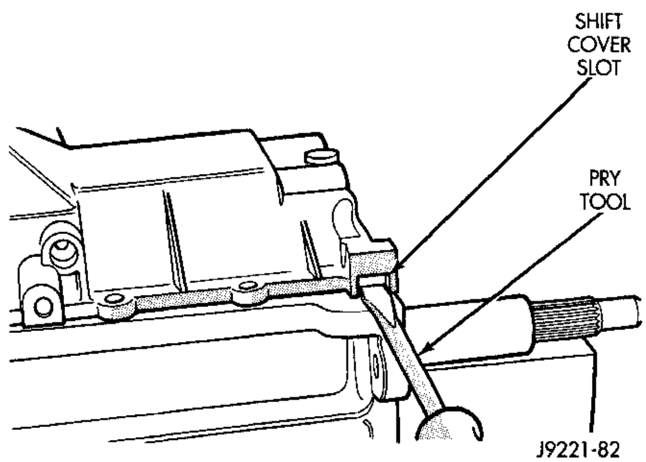


Fig. 13 Loosening Shift Cover

(4) Verify that the shift fork pads (Fig. 15) are properly and securely positioned on the fifth-reverse fork

(5) Verify that 1–2 and 3–4 synchro sleeves are in neutral position. Also verify that forks in shift cover are in neutral position.

(6) Align and install shift cover (Fig. 14). If cover will not seat, it is either not aligned on gear case dowels, or shift forks are not aligned with sleeves and shift lug.

(7) Apply Mopar® Lock N' Seal, or equivalent, to threads of shift cover bolts.

(8) Install and tighten shift cover bolts to 27–31 N·m (216–276 in. lbs.) torque.

(9) Install backup lamp switch and gasket in cover. Apply sealer to switch threads before installation and tighten switch to 22–34 N·m (193–265 in. lbs.).

(10) Install vent assembly, if removed. Apply an adhesive/sealer to vent tube to help secure it in cover.

REMOVAL AND INSTALLATION (Continued)

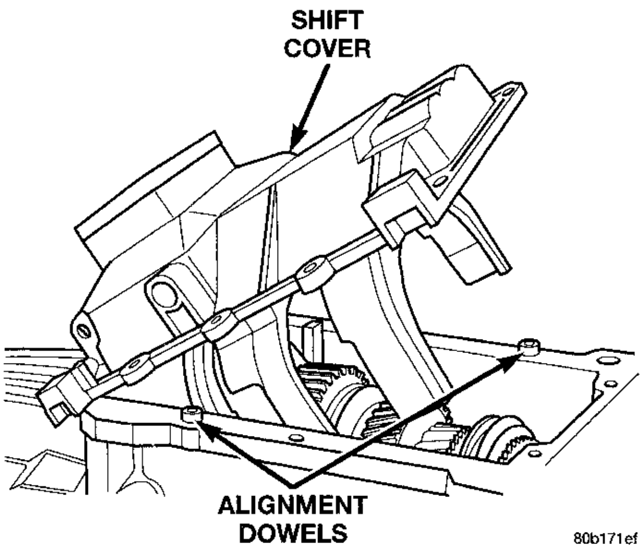


Fig. 14 Shift Cover

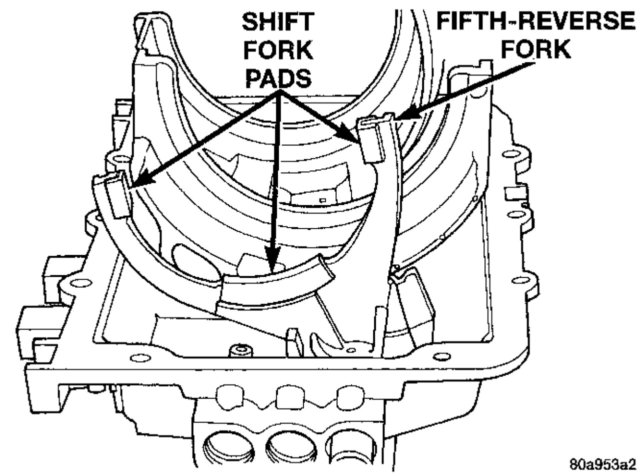


Fig. 15 Fifth-Reverse Shift Fork Pads

(11) Install transmission.

EXTENSION/ADAPTER HOUSING

REMOVAL

(1) Raise and support vehicle.
(2) Remove rear propeller shaft.
(3) Support transmission with suitable transmission jack.
(4) Remove engine rear support. Refer to Group 9, Engine, for proper procedures.
(5) Remove transfer case, if equipped.
(6) Remove bolts attaching extension/adapter housing to gear case (Fig. 16).
(7) Remove extension/adapter housing (Fig. 17). There is one alignment dowel in the gear case and one in the extension/adapter housing.
(8) Remove rubber spline seal from end of mainshaft (Fig. 18). The seal can be reused or discarded as desired. The seal is not an essential part and can be reused or discarded as desired. The seal is mainly used to prevent lubricant loss during shipping and does not have to be replaced if damaged.

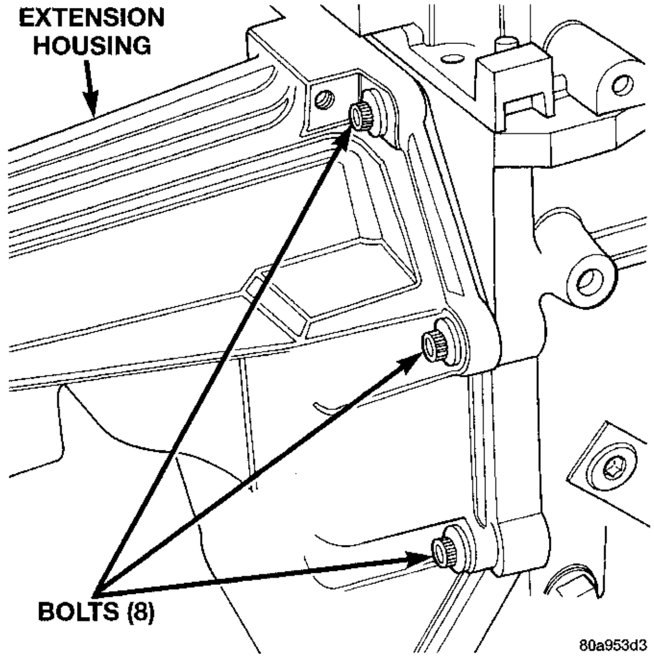


Fig. 16 Extension/Adapter Housing Bolts

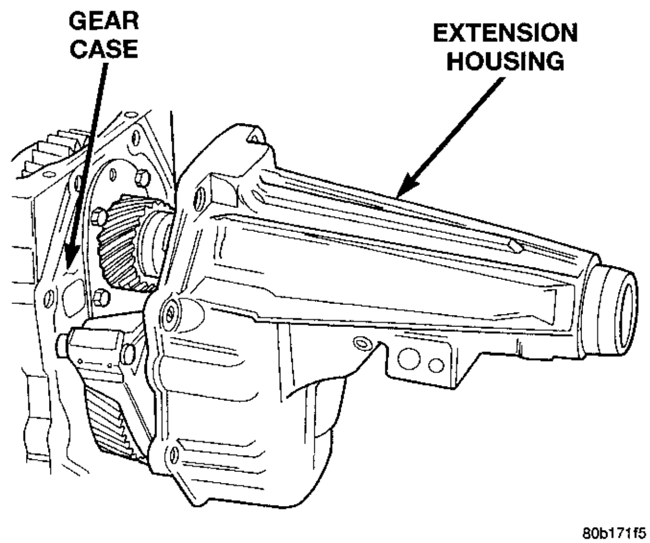


Fig. 17 Extension/Adapter Housing

INSTALLATION

(1) Clean mating surfaces of extension/adapter housing and gear case with a wax and grease remover.
(2) Check alignment dowels in gear case and housing or adapter. Be sure dowels are in position and seated.

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REMOVAL AND INSTALLATION (Continued)

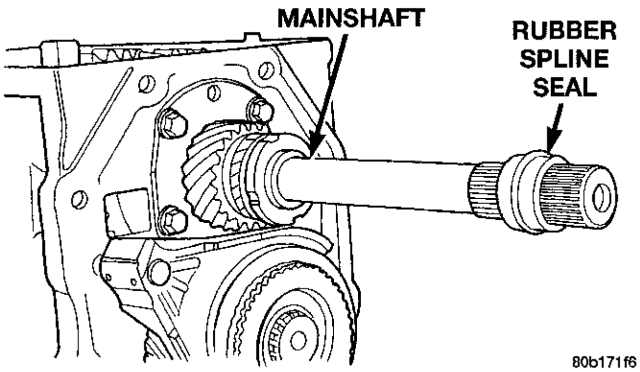

Fig. 18 Mainshaft Spline Seal

(3) Apply Mopar® Gasket Maker to gear case and housing mating surfaces.

(4) Align and install extension/adapter housing on gear case (Fig. 19).

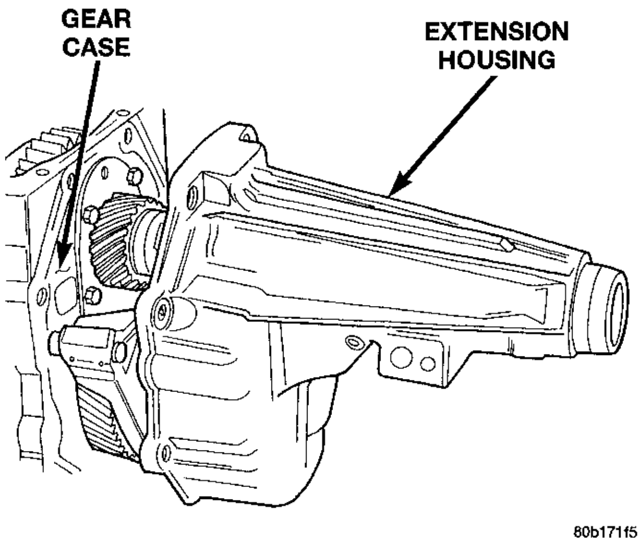

Fig. 19 Installing Extension/Adapter Housing

(5) Apply Mopar® Lock N' Seal, or equivalent, to threads of extension/adapter housing bolts.

(6) Install and tighten housing bolts to 54 N·m (40 ft. lbs.) torque.

(7) Install transfer case, if equipped.

(8) Install engine rear support. Refer to Group 9, Engine, for proper procedures.

(9) Install propeller shaft(s).

(10) Remove transmission support stand and lower vehicle.

EXTENSION/ADAPTER HOUSING SEAL AND BUSHING

REMOVAL

(1) On 4X2 vehicles, remove the propeller shaft.

(2) On 4X4 vehicles, remove the transfer case.

(3) On light duty 4X2 vehicles, remove extension housing seal (Fig. 20) using Remover C-3985-B.

(4) On heavy duty 4X2 vehicles, remove extension housing seal with a suitable pry tool or a slide hammer mounted screw.

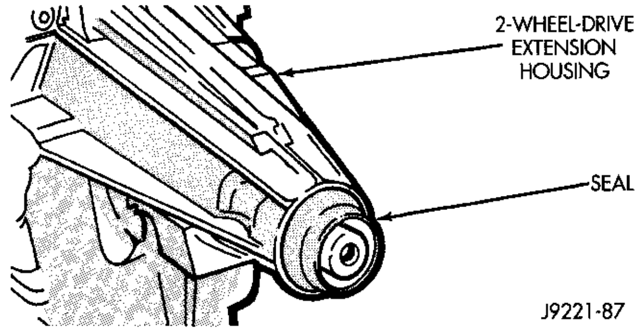

Fig. 20 Extension Housing And Seal (2-Wheel Drive Models)

(5) On 4X4 vehicles, use a suitable pry tool, or a slide hammer mounted screw, to remove the adapter housing seal (Fig. 21).

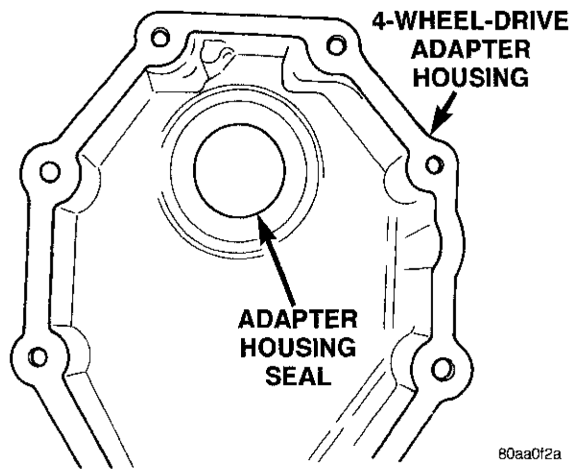

Fig. 21 Adapter Housing (4-Wheel Drive Models)

(6) On light duty transmissions, remove the extension housing bushing with Remover 6957.

(7) On heavy duty transmissions, remove the extension housing bushing with Remover 8155.

INSTALLATION

(1) On light duty transmissions, install the extension housing bushing with Installer 6951 and Handle C-4171 (Fig. 22).

(2) On heavy duty transmissions, install the extension housing bushing with Installer 8156 and Handle C-4171.

(3) On light duty 4X2 transmissions, install the extension housing seal with Installer C-3972-A and Handle C-4171 (Fig. 23).

REMOVAL AND INSTALLATION (Continued)

(4) On heavy duty 4X2 transmissions, install the extension housing seal with Installer 8154 and Handle C-4171.

(5) On 4X4 transmissions, install the adapter housing seal with Installer C-3860-A and Handle C-4171.

(6) Install transfer case, if necessary, and propeller shaft(s).

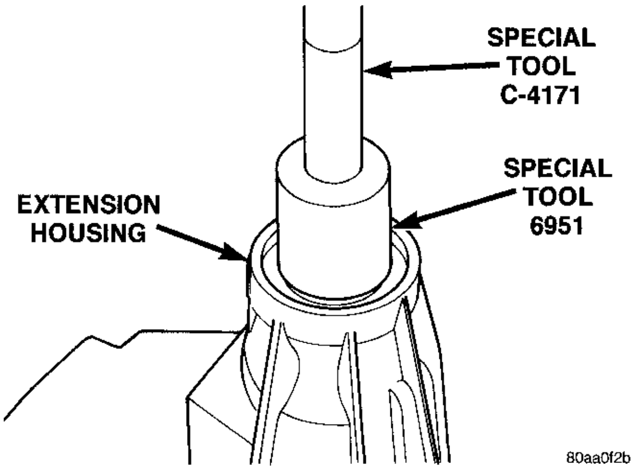

Fig. 22 Install Extension Housing Bushing

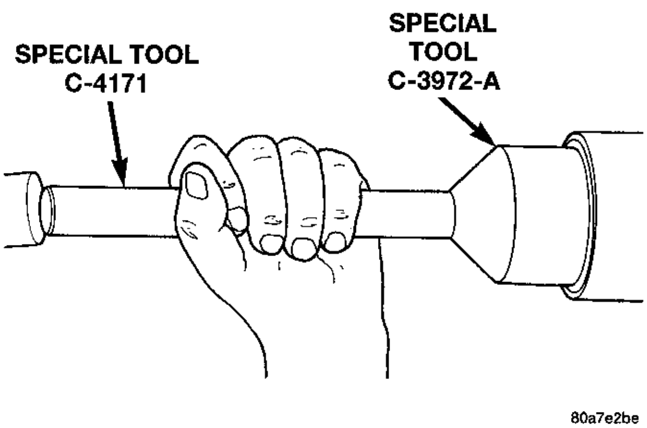

Fig. 23 Install Extension Housing Seal

DISASSEMBLY AND ASSEMBLY

TRANSMISSION

DISASSEMBLY

FIFTH GEAR REMOVAL

(1) Remove mainshaft fifth gear nut as follows:

(a) Install nut wrench on fifth gear nut (Fig. 24). Use Nut Wrench 6443 on standard duty models and Wrench 6743 on heavy duty models.

(b) Note that wrench only fits one way on nut. Be sure wrench is fully engaged in nut slots and is not cocked.

(c) There are four splined sockets available to retain the mainshaft while removing the fifth gear nut.

- Socket 6441 fits light duty 4X2 mainshafts.
- Socket 6442 fits light duty 4X4 mainshafts.
- Socket 6993 fits heavy duty 4X2 mainshafts.
- Socket 6984 fits heavy duty 4X4 mainshafts.

(d) Install breaker bar in appropriate socket wrench (Fig. 25).

(e) Wedge breaker bar handle against workbench. Purpose of socket wrench and breaker bar is to prevent mainshaft from turning while nut is loosened.

(f) Position small end of Nut Wrench 6443 at approximately 10 o'clock position (Fig. 24).

(g) Strike small end of nut wrench with heavy copper hammer to break nut loose. Nut is secured by interference fit thread plus Loctite adhesive and will require several firm blows to loosen it (nut torque is in 300 ft. lb. range).

(h) Once nut is loose, it can be removed by holding nut wrench with breaker bar and rotating output shaft with socket wrench and ratchet.

(i) Remove and discard fifth gear nut (Fig. 26).

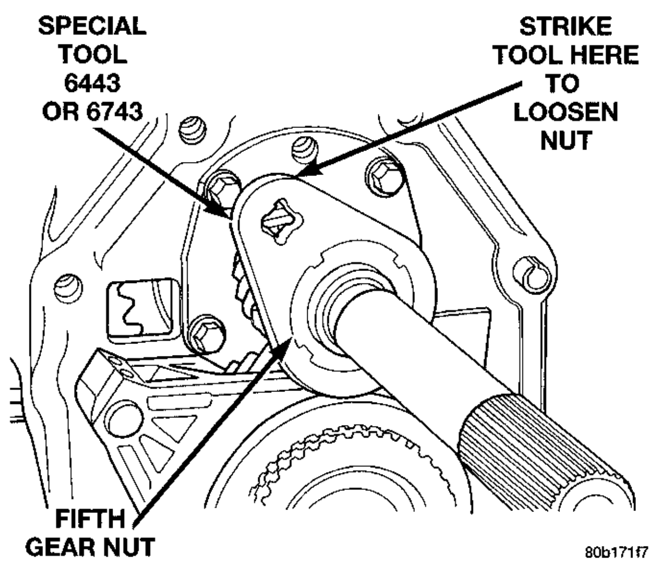

Fig. 24 Installing Nut Wrench On Mainshaft Fifth Gear

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DISASSEMBLY AND ASSEMBLY (Continued)

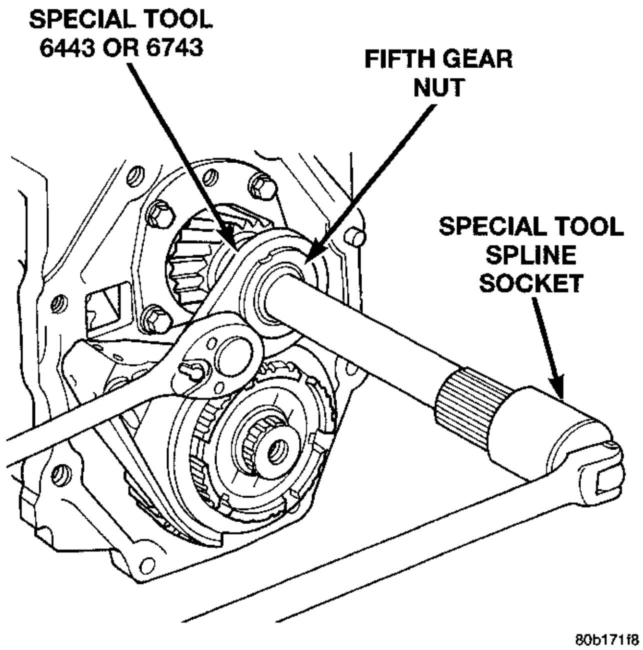

Fig. 25 RemoveMainshaft Fifth Gear Nut

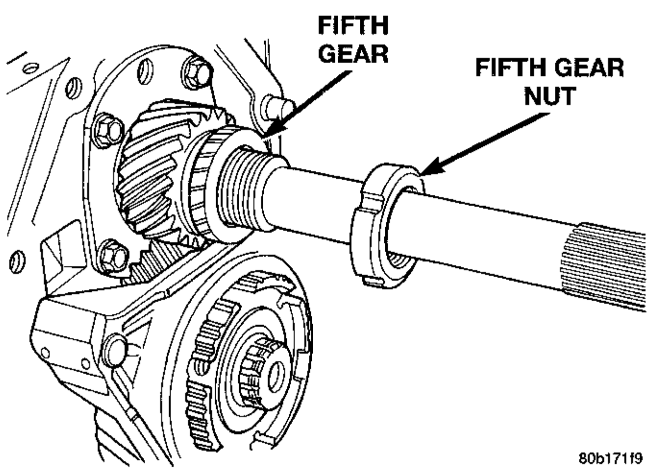

Fig. 26 Mainshaft Fifth Gear Nut Removal

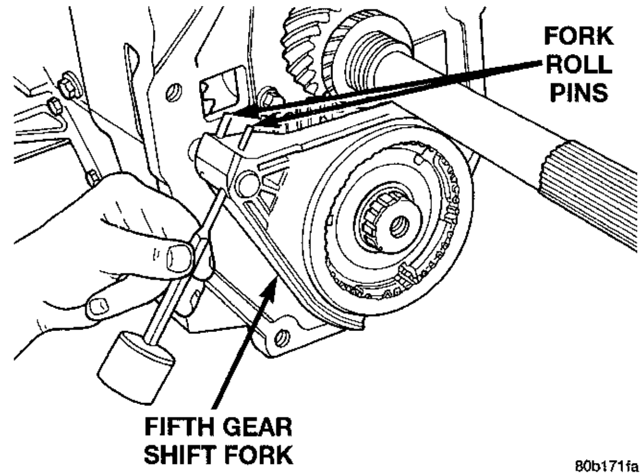

Fig. 27 Removing Fifth Gear Shift Fork Roll Pins

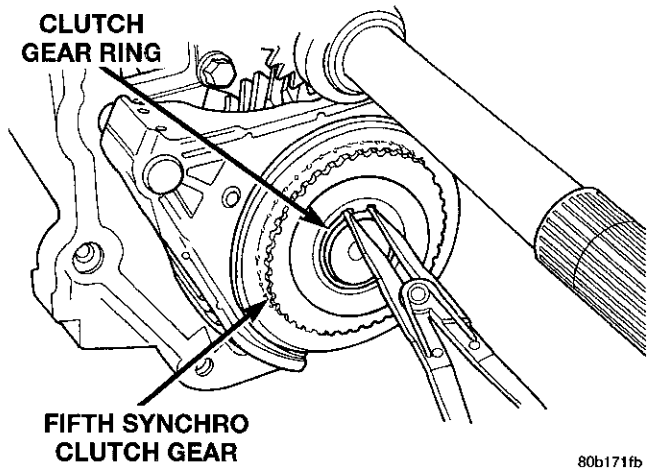

Fig. 28 Removing Countershaft Fifth Gear Clutch Gear Snap Ring

(2) Remove roll pins that secure countershaft fifth gear shift fork to shift rail with pin punch (Fig. 27). Roll pins are driven out from bottom of fork and not from top.

(3) Remove snap ring that secures fifth gear clutch hub and gear on countershaft (Fig. 28).

(4) Remove fifth gear shift fork and gear assembly. Remove assembly by tapping fork off rail with plastic mallet.

(5) Remove countershaft fifth gear clutch gear and stop ring.

(6) Remove fifth gear shift fork from sleeve.

(7) Remove sleeve, struts, and strut springs from countershaft fifth gear hub, if necessary.

(8) Remove countershaft fifth gear needle bearing assembly (Fig. 29).

(9) Remove cone shaped rear bearing thrust washer from end of countershaft (Fig. 30). Note position of washer for assembly reference. Also note that washer bore has notch for locating pin.

(10) Remove and retain thrust washer locating pin from countershaft.

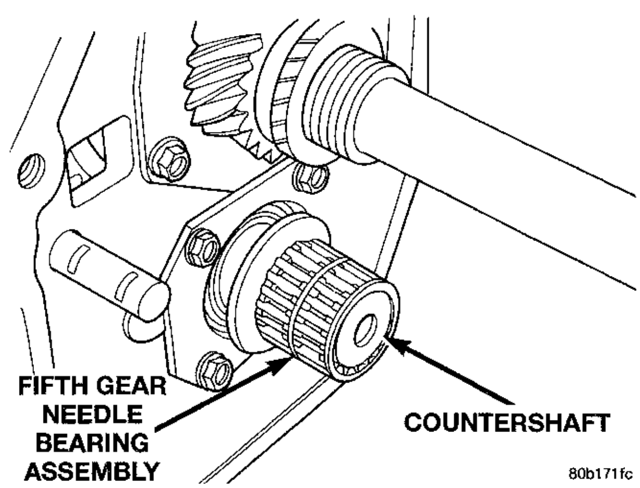

Fig. 29 Countershaft Fifth Gear Needle Bearing Removal

DISASSEMBLY AND ASSEMBLY (Continued)

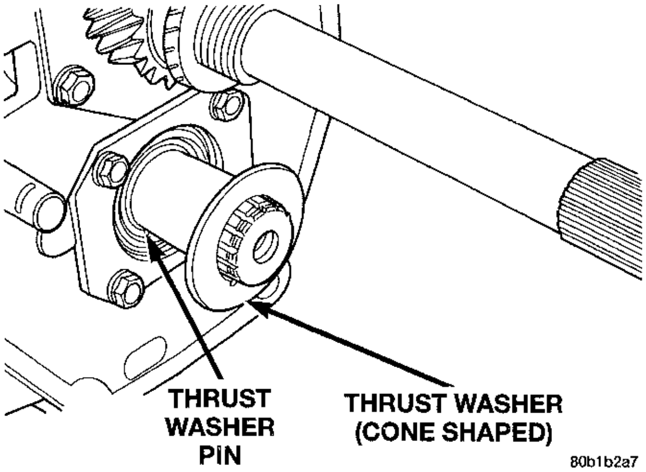

Fig. 30 Countershaft Rear Bearing Thrust Washer Removal

(11) Remove mainshaft overdrive fifth gear with Puller Tool Set 6444. Note that puller set can be used on both standard and heavy duty transmissions.

(12) Gear removal procedure is as follows:

(a) Position first puller jaw on gear (Fig. 31). Use Puller Jaws 6459 on standard duty models and Puller Jaws 6820 on heavy duty models.

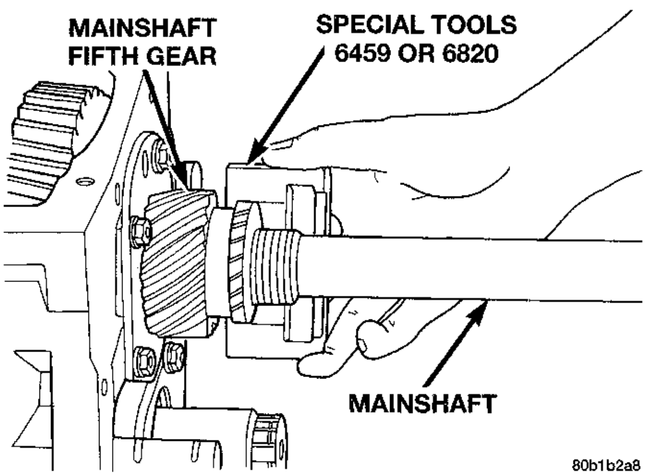

Fig. 31 Installing First Puller Jaw On Mainshaft Fifth (Overdrive) Gear

(b) Assemble Puller Flange 6444-1 and Puller Rods 6444-3 for 4X2 vehicles, or 6444–4 for 4X4 vehicles, (Fig. 32).

(c) Slide assembled puller flange and rods onto output shaft. Then seat flange in notch of puller jaw (Fig. 32).

(d) Position second puller jaw (6459 or 6820) on gear and in notch of puller flange (Fig. 33).

(e) Slide Retaining Collar 6444-8 over puller jaws to hold them in place (Fig. 33).

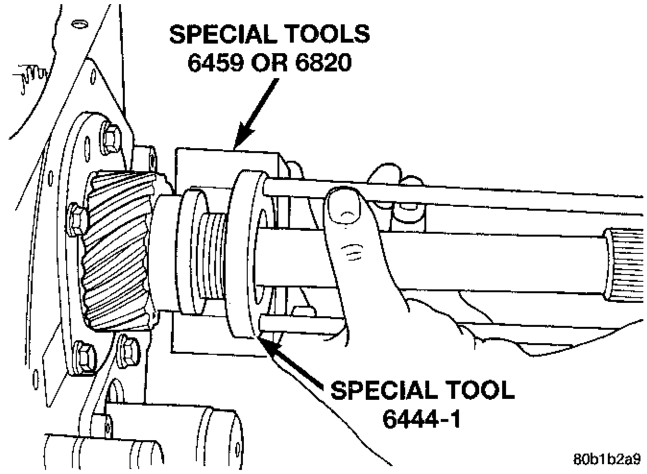

Fig. 32 Seating Puller Flange In First Puller Jaw

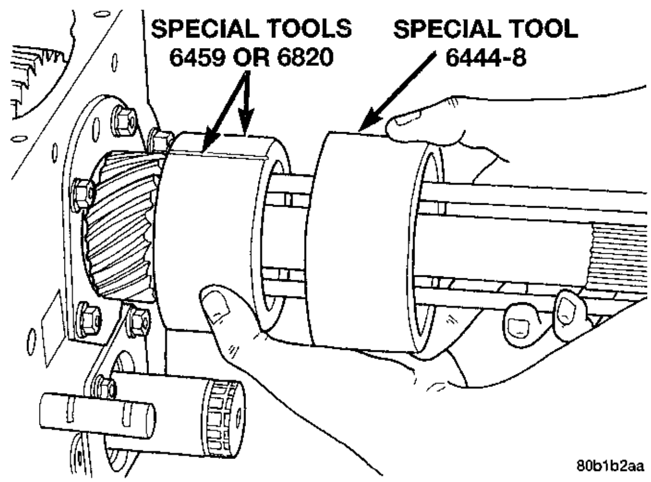

Fig. 33 Installing Retaining Collar Over Puller Jaws

(f) Install Puller and Bolt 6444 on puller rods. Then secure puller to rods with retaining nuts (Fig. 34).

(g) Tighten puller bolt to remove gear from shaft splines (Fig. 34).

(13) Remove bolts attaching mainshaft rear bearing plate to gear case and remove fifth gear plate end play shims and bearing cup (Fig. 35).

FRONT RETAINER REMOVAL

(1) Remove front retainer bolts (Fig. 36). Discard retainer bolts. They should not be reused.

(2) Remove front retainer by lightly tapping it back and forth with plastic mallet to loosen it. Then rock retainer back and forth by hand to work it out of gear case. Note that retainer flange extends into the transmission case and is a snug fit into case bore.

(3) Remove seal from front retainer (Fig. 37). Use small chisel to collapse one side of seal then pry it out with suitable tool.

(4) Remove bearing cup from front retainer as follows:

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DISASSEMBLY AND ASSEMBLY (Continued)

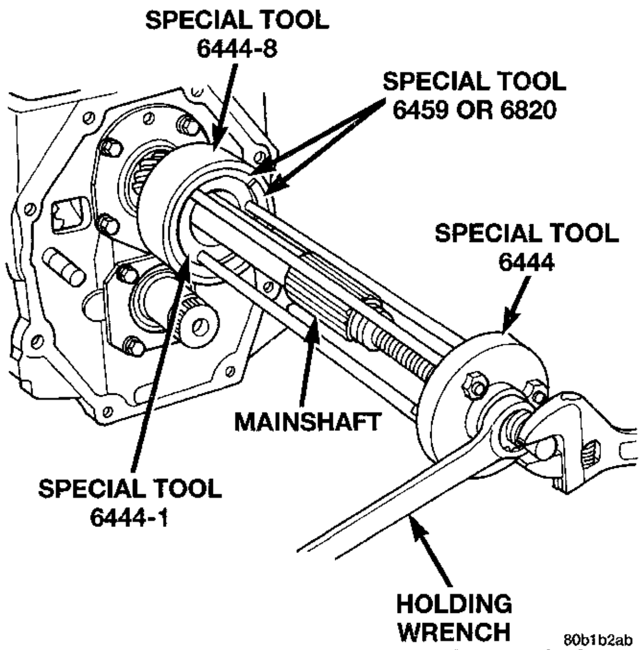

Fig. 34 Removing Fifth Gear From Mainshaft Splines

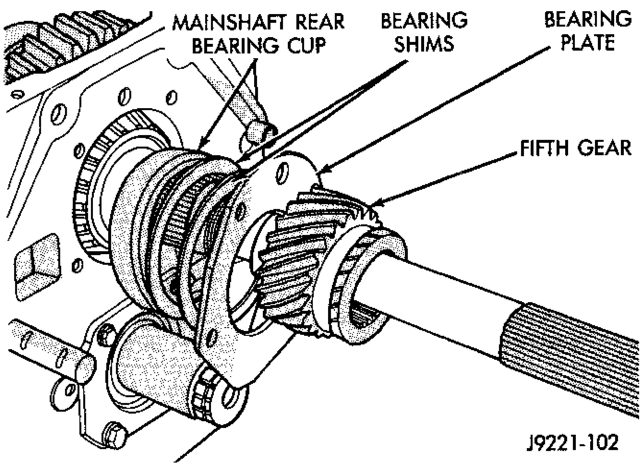

Fig. 35 Removing Mainshaft Fifth Gear Bearing Plate, Bearing Shims, And Rear Bearing Cup

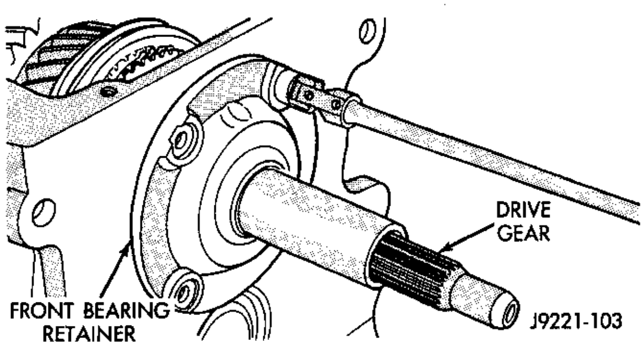

Fig. 36 Removing Front Bearing Retainer Bolts

(a) Assemble Puller Flange 6444-1 and Puller Rods 6444-4 (Fig. 38).

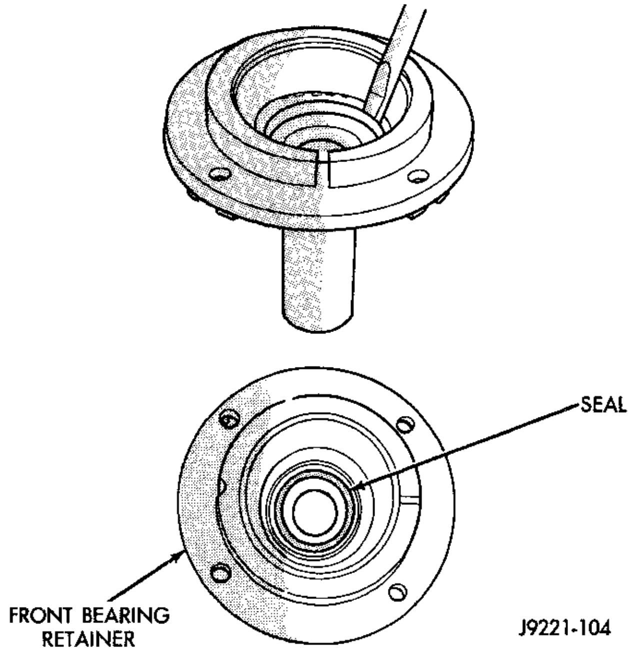

Fig. 37 Removing Bearing Retainer Seal

(b) Insert Puller Jaws 6453-1 in puller flange (Fig. 38). Narrow lip of puller jaws will go under bearing cup.

(c) Install Disc C-4487-1 into bearing retainer on heavy duty transmissions for Insert 6453-2 to rest upon.

(d) Install assembled tools in front retainer (Fig. 39). Be sure puller jaws are seated under bearing cup.

(e) Place Insert Tool 6453-2 in center of puller jaws (Fig. 39). Insert tool is used to hold puller jaws in place.

(f) Install Puller 6444 on puller rods (Fig. 40). Then install retaining nuts on puller rods.

(g) Tighten puller bolt to draw bearing cup out of retainer (Fig. 40).

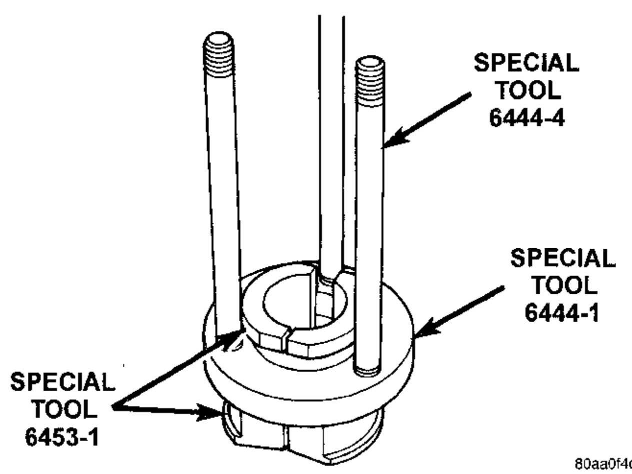

Fig. 38 Assembling Puller Rods, Flange And Jaws

DISASSEMBLY AND ASSEMBLY (Continued)

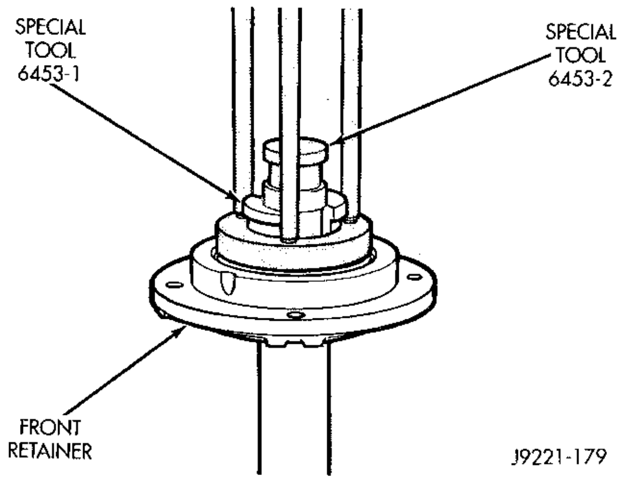

Fig. 39 Installing Puller Tools In Front Retainer

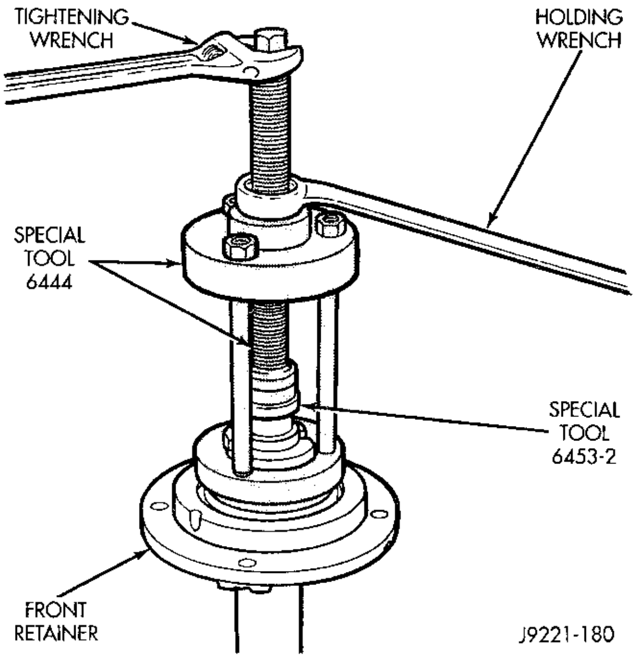

Fig. 40 Removing Bearing Cup From Front Retainer

DRIVE GEAR REMOVAL

(1) Remove drive gear (Fig. 41).

(2) Remove pilot bearing from drive gear (Fig. 42).

(3) Remove tapered bearing from drive gear as follows:

(a) Assemble Puller Flange 6444-1 and Puller Rods 6444-6. Then position first Puller Jaw 6447 on bearing (Fig. 43).

(b) Slide assembled puller flange and rod tools onto input shaft. Then seat flange in notch of puller jaw (Fig. 43).

(c) Position second Puller Jaw 6447 on gear and in notch of puller flange (Fig. 43).

(d) Slide Retaining Collar 6444-8 over puller jaws to hold them in place (Fig. 43).

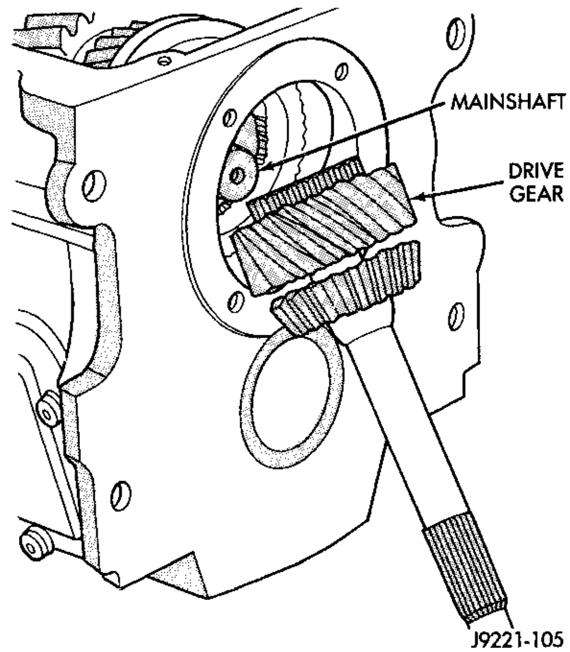

Fig. 41 Drive Gear Removal

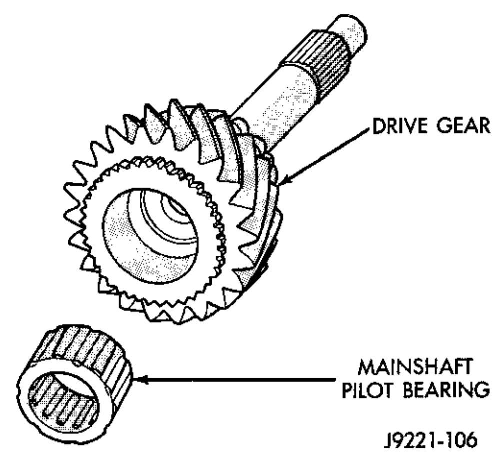

Fig. 42 Pilot Bearing Removal/Installation

(e) Install Puller 6444 on puller rods. Then secure puller to rods with retaining nuts (Fig. 43).

(f) Tighten puller bolt to remove bearing cone from drive gear (Fig. 43).

MAINSHAFT AND GEARTRAIN REMOVAL

(1) Move 1-2 and 3-4 synchro sleeves into Neutral, if necessary.

(2) Remove drive gear thrust bearing from forward end of mainshaft (Fig. 44).

(3) Remove fourth gear clutch gear and synchro stop ring from mainshaft (Fig. 45).

(4) Roll gear case onto left side (Fig. 46).

(5) Remove rear mainshaft rear bearing.

(6) Remove mainshaft assembly as follows (Fig. 46):

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DISASSEMBLY AND ASSEMBLY (Continued)

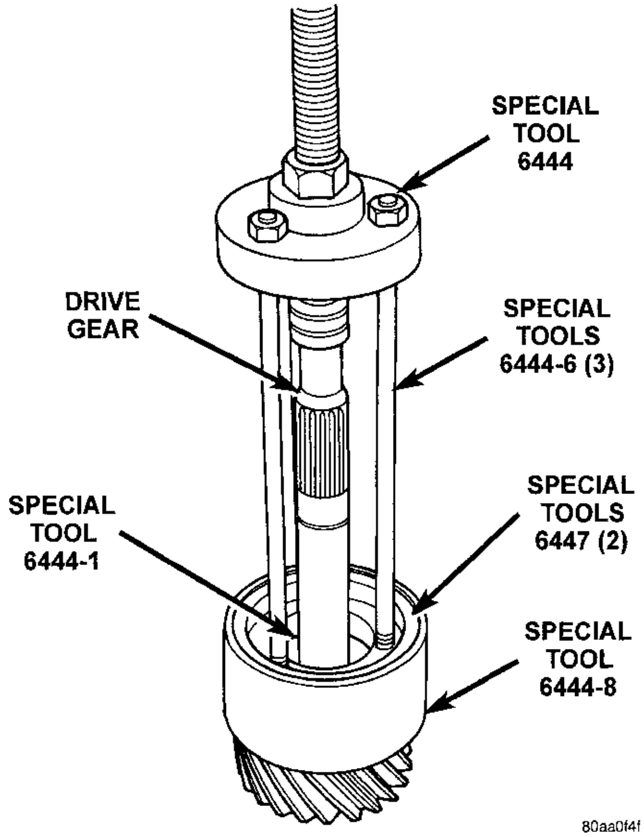

Fig. 43 Removing Front Bearing From Drive Gear

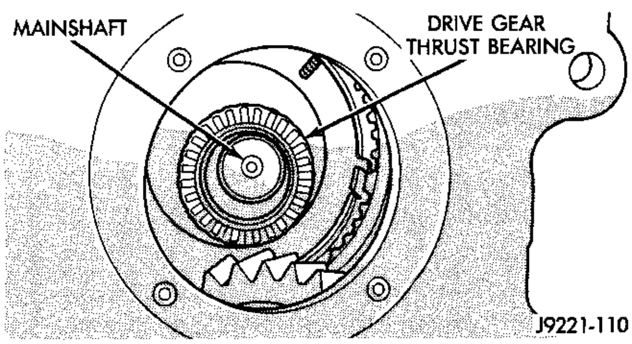

Fig. 44 Drive Gear Thrust Bearing Removal

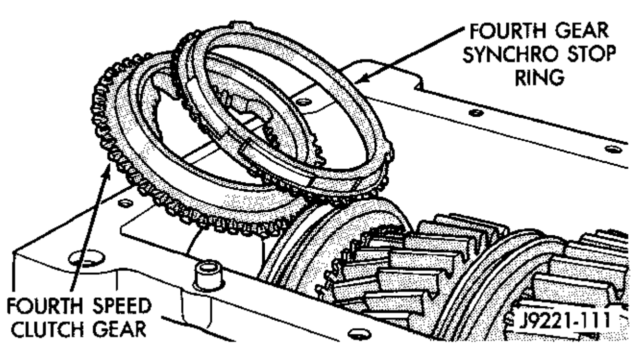

Fig. 45 Fourth Gear Clutch Gear Stop Ring Removal

(a) Lift front end of mainshaft slightly. Use care when handling the mainshaft because the gears will be lose on the mainshaft.

(b) Grasp mainshaft rear splines. Then turn spline end of mainshaft in counterclockwise direction to rotate shaft and geartrain out of case.

(c) Once mainshaft gears roll clear of countershaft gears, shaft and gear assembly can be tilted outward and removed from gear case (Fig. 46).

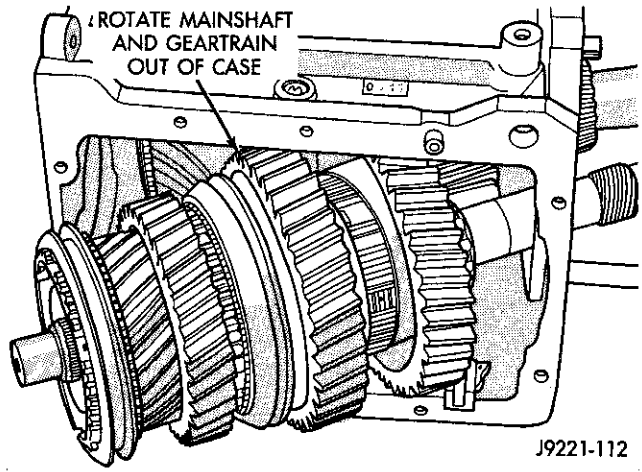

Fig. 46 Mainshaft And Geartrain Removal

REVERSE IDLER AND COUNTERSHAFT REMOVAL

(1) Remove countershaft rear bearing plate (Fig. 47).

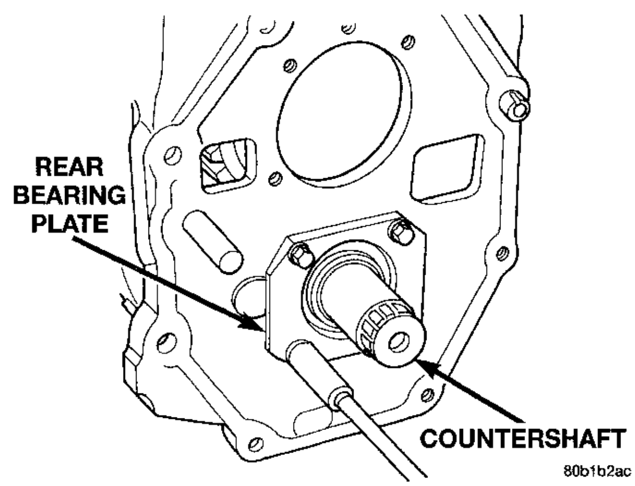

Fig. 47 Removing Countershaft Rear Bearing Plate

DISASSEMBLY AND ASSEMBLY (Continued)

(2) Remove countershaft end play shim and rear bearing cup (Fig. 48).

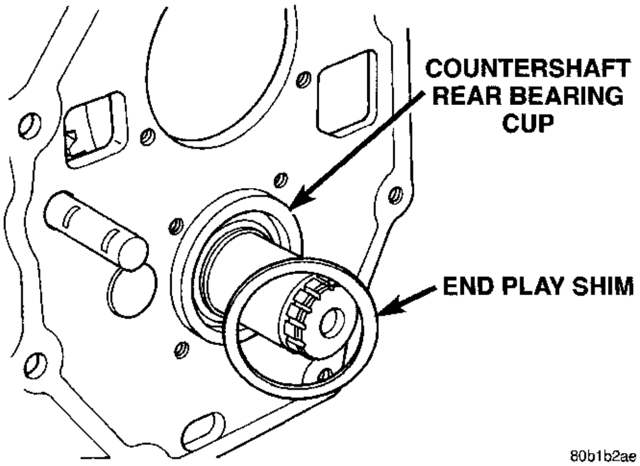

Fig. 48 Countershaft End Play Shim And Rear Bearing Cup Removal

(3) Remove reverse idler shaft (Fig. 49).

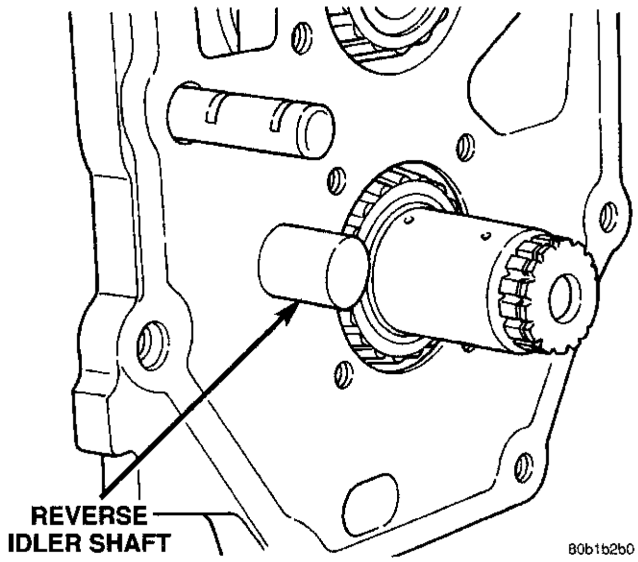

Fig. 49 Removing Reverse Idler Shaft

(4) Rotate countershaft outward and push reverse idler gear away from countershaft and toward front of case (Fig. 50).

(5) Remove idler gear (Fig. 51).

(6) Keep reverse idler gear bearings and spacer together for cleaning and inspection (Fig. 52). Insert idler shaft through gear and bearings to keep them in place.

(7) Remove idler gear thrust washers from gear case. Install washers on idler shaft to keep them together for cleaning and inspection.

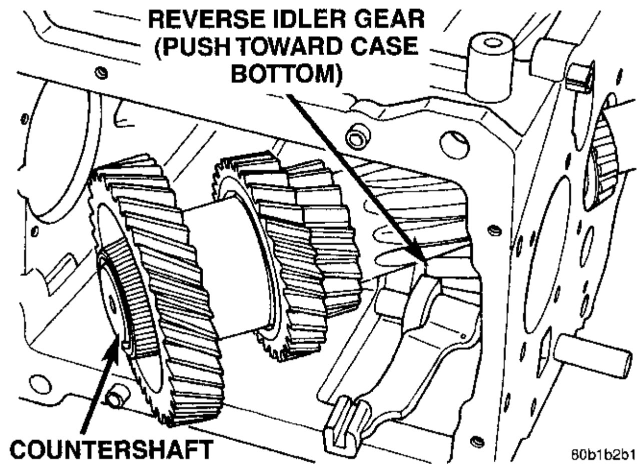

Fig. 50 Idler Gear Moved Away From Countershaft

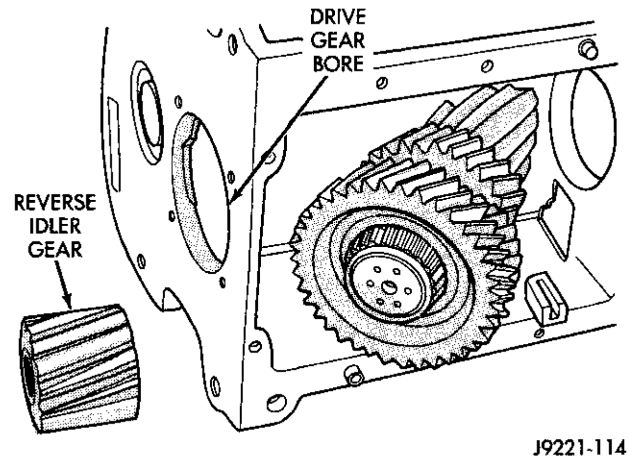

Fig. 51 Reverse Idler Gear Removal

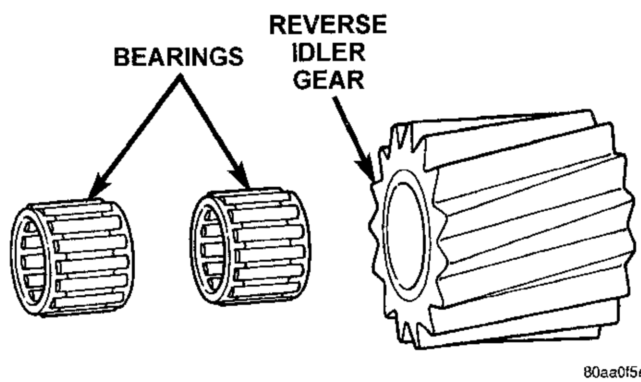

Fig. 52 Reverse Idler Gear Components

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DISASSEMBLY AND ASSEMBLY (Continued)

(8) Remove countershaft rear bearing. Shaft cannot be removed from case until rear bearing has been removed. Bearing removal procedure is as follows:

(a) Assemble Puller Flange 6444-1 and Puller Rods 6444-4 (Fig. 53).

(b) Position first Puller Jaw 6449 on bearing cone (Fig. 53).

(c) Seat puller flange in notch of puller jaw just installed on bearing cone (Fig. 53).

(d) Install second Puller Jaw 6449 on bearing and in notch of puller flange (Fig. 53).

(e) Slide Retaining Collar 6444-8 over puller jaws to hold them in place (Fig. 53). Note that retaining collar has small lip on one end and only fits one way over jaws.

(f) Install Puller 6444 on puller rods. Then secure puller to rods with retaining nuts (Fig. 53).

(g) Tighten puller bolt to remove bearing from shaft (Fig. 53). If bearing is exceptionally tight, tap end of puller bolt with copper mallet to help loosen bearing.

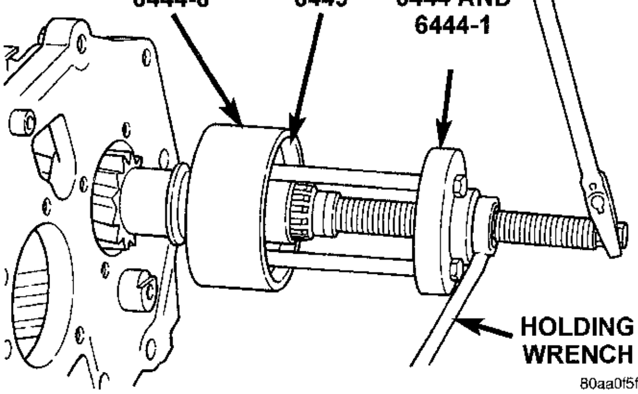

Fig. 53 Removing Countershaft Rear Bearing

(9) Remove bearing puller tools.

(10) Rotate countershaft out of gear case (Fig. 54).

(11) Remove countershaft front bearing as follows:

(a) Assemble Puller Flange 6444-1 and Puller Bolts 6444-4 (Fig. 55).

(b) Position first Puller Jaw 6451 on bearing.

(c) Seat puller flange in notch of puller jaw.

(d) Install second Puller Jaw 6451 on bearing and in notch of puller flange.

(e) Slide Retaining Collar 6444-8 over puller jaws to hold them in place (Fig. 55). Note that retaining collar has small lip on one end and only fits one way over jaws.

(f) Install Puller Bridge And Bolt Assembly 6444 on puller bolts. Then secure bridge to bolts with retaining nuts (Fig. 55).

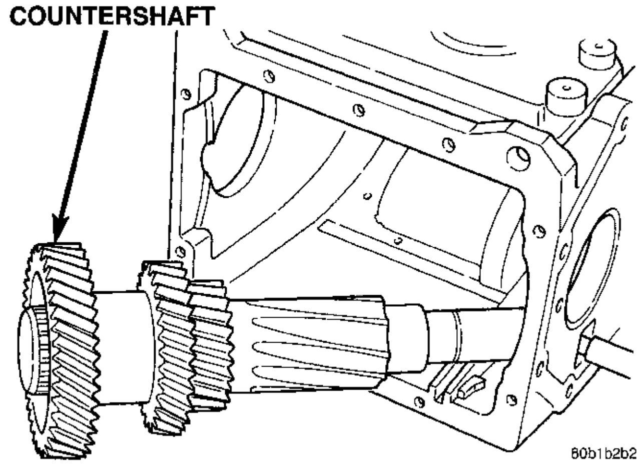

Fig. 54 Removing Countershaft From Gear Case

(g) Tighten puller bolt to remove bearing from shaft (Fig. 55). If bearing is exceptionally tight, tap end of puller bolt with mallet to help loosen bearing.

(12) Remove bearing puller tools.

(13) Set countershaft and idler gear aside for cleaning and inspection.

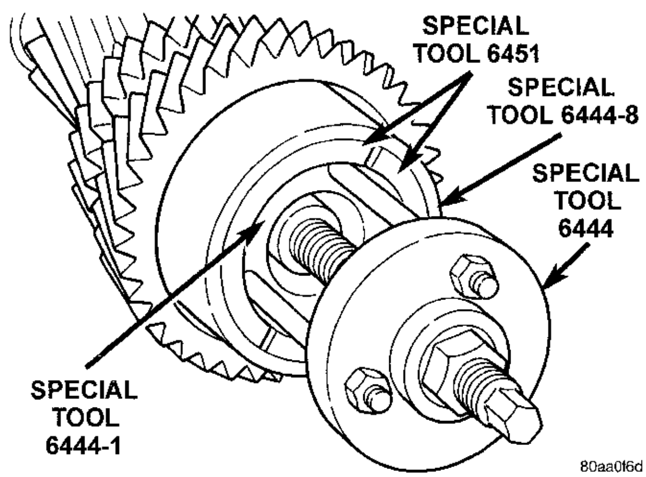

Fig. 55 Removing Countershaft Front Bearing

GEAR CASE DISASSEMBLY

(1) Remove countershaft front bearing cap. Use mallet or hammer to remove cap from inside case (Fig. 56).

(2) Remove countershaft front bearing cup with Remover Tool 6454 and Tool Handle C-4171 (Fig. 57).

(3) Remove roll pin that secures shift lug on shift rail in case (Fig. 58). A small pin punch can be modified by putting a slight bend in it to drive pin completely out of shift rail (Fig. 58).

(4) Remove shift lug rail.

DISASSEMBLY AND ASSEMBLY (Continued)

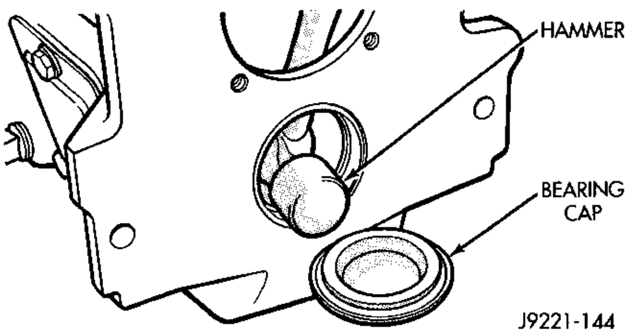

Fig. 56 Countershaft Front Bearing Cap Removal

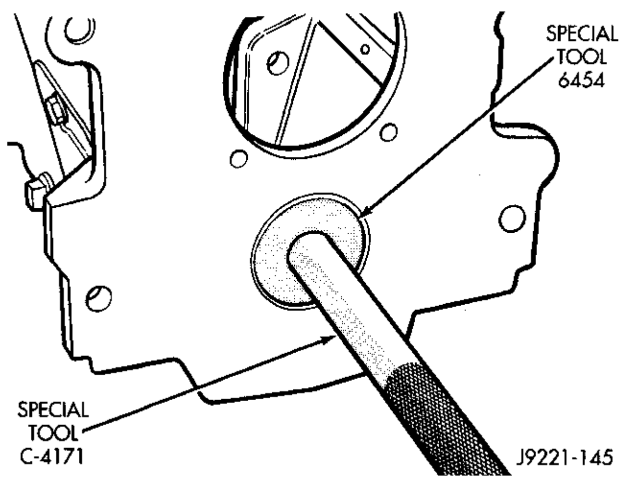

Fig. 57 Countershaft Front Bearing Cup Removal

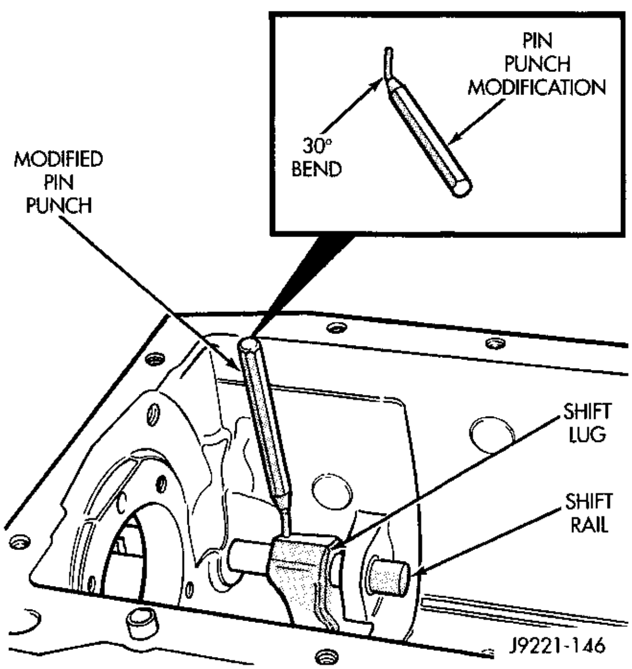

Fig. 58 Removing Shift Lug Roll Pin

MAINSHAFT DISASSEMBLY

NOTE: Not all of the mainshaft gear and synchro components are a one-way fit. Some gear and synchro components can be installed backwards. To avoid reassembly problems, mark the gear gears, clutch gears, synchro hubs, and sleeves for reference during teardown. Use paint or a scriber for marking purposes. Then stack the geartrain parts in order of removal. This practice will help avoid incorrect assembly and lost time.

(1) Remove drive gear thrust bearing from end of mainshaft, if not previously removed.

(2) Remove 3-4 synchro hub, third gear stop ring and third gear as an assembly (Fig. 59). It is not necessary to diassemble the synchronizer components unless worn or damaged.

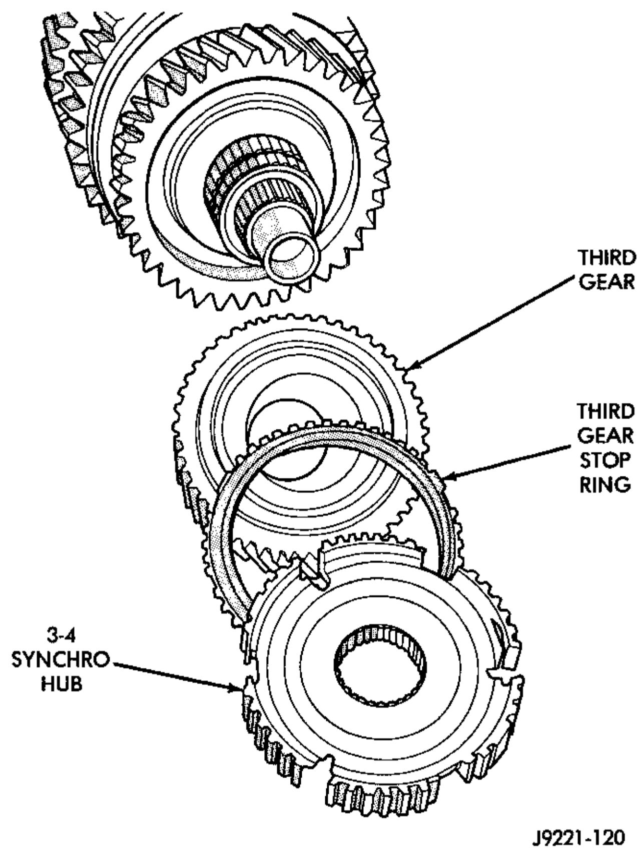

Fig. 59 Third Gear, Stop Ring, And 3-4 Hub Removal

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DISASSEMBLY AND ASSEMBLY (Continued)

(3) Remove third gear bearing from mainshaft (Fig. 60).

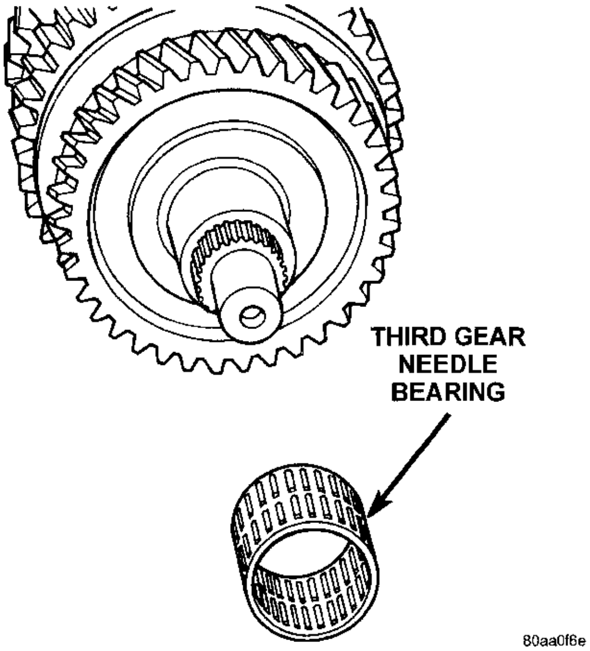

Fig. 60 Third Gear Needle Bearing Removal

(4) Remove third gear bearing spacer (Fig. 61).

(5) Remove snap ring that retains second gear thrust washer on mainshaft (Fig. 61).

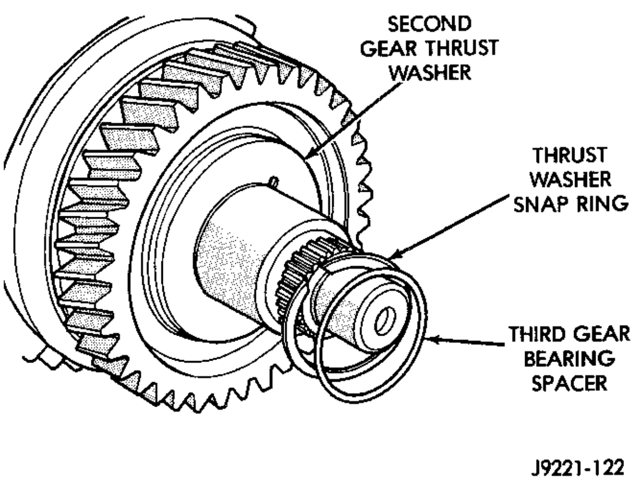

Fig. 61 Bearing Spacer And Snap Ring Location

(6) Remove second gear thrust washer (Fig. 62). Note that washer is notched for locating pin.

(7) Remove thrust washer locating pin (Fig. 63). Use needle nose pliers to grip and remove pin.

(8) Remove second gear (Fig. 64).

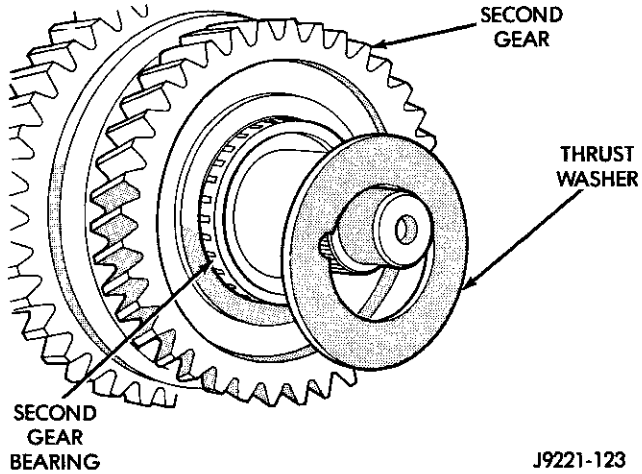

Fig. 62 Second Gear Thrust Washer Removal

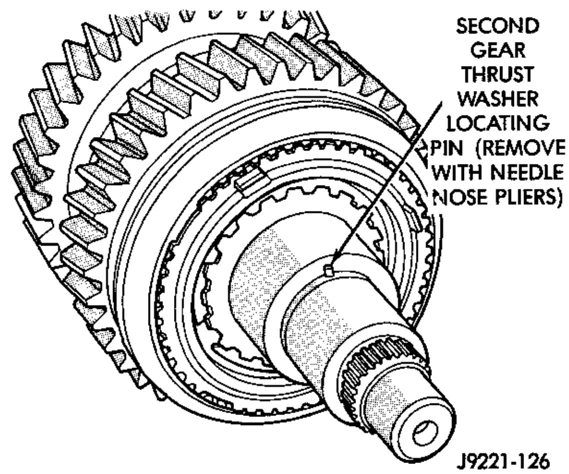

Fig. 63 Thrust Washer Locating Pin Removal

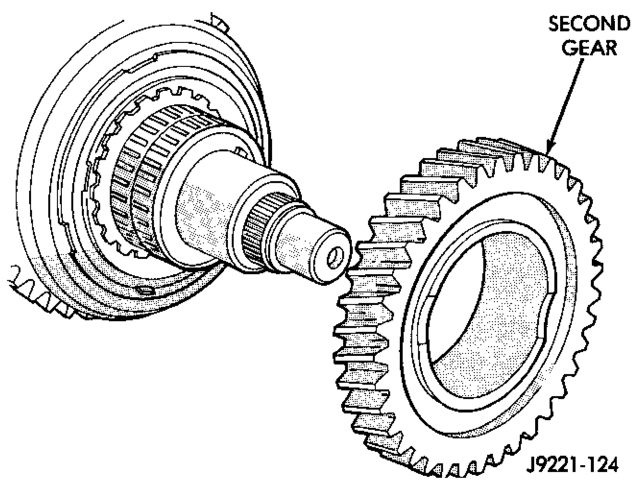

Fig. 64 Second Gear Removal

DISASSEMBLY AND ASSEMBLY (Continued)

(9) Remove second gear bearing (Fig. 65).

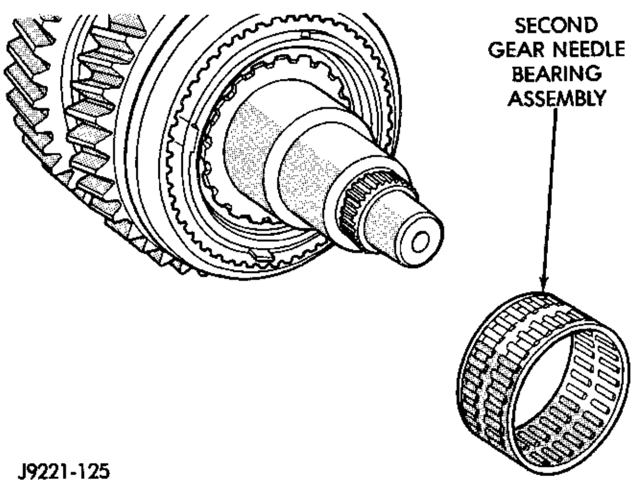

Fig. 65 Second Gear Bearing Removal

(10) Remove snap ring that retains second gear clutch cone (Fig. 66). Snap ring is seated in mainshaft synchro hub groove.

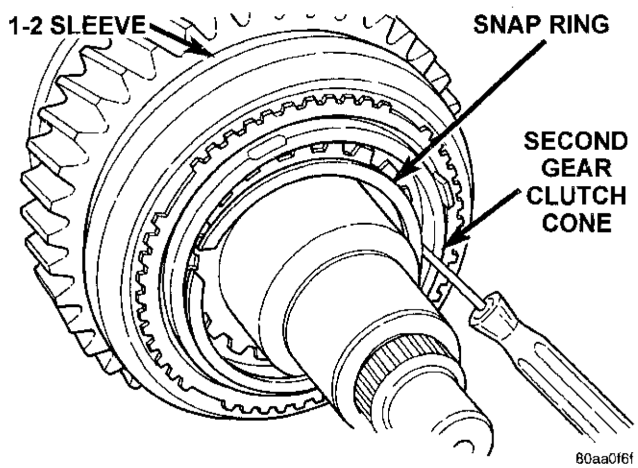

Fig. 66 Removing Second Gear Clutch Cone Snap Ring

(11) Remove second gear clutch cone, synchro clutch ring and synchro stop ring (Fig. 67).

(12) Remove 1-2 synchro hub snap ring (Fig. 68).

(13) Remove 1-2 synchro sleeve, hub, struts and springs as an assembly (Fig. 69). Note that tapered side of sleeve also goes toward front. It is not necessary to disassemble synchro components unless worn, or damaged.

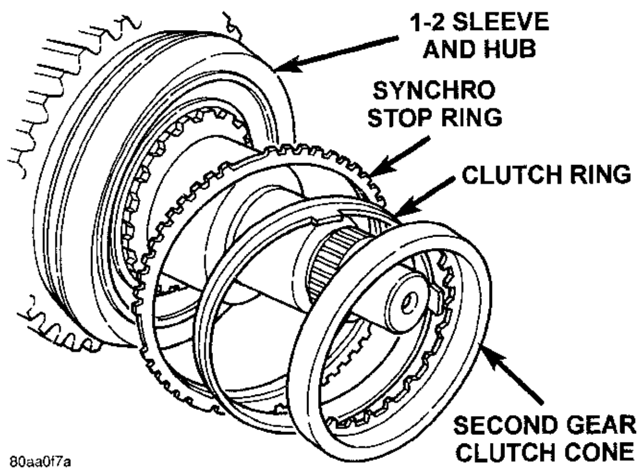

Fig. 67 Second Gear Clutch Cone, Clutch Ring, And Stop Ring Removal

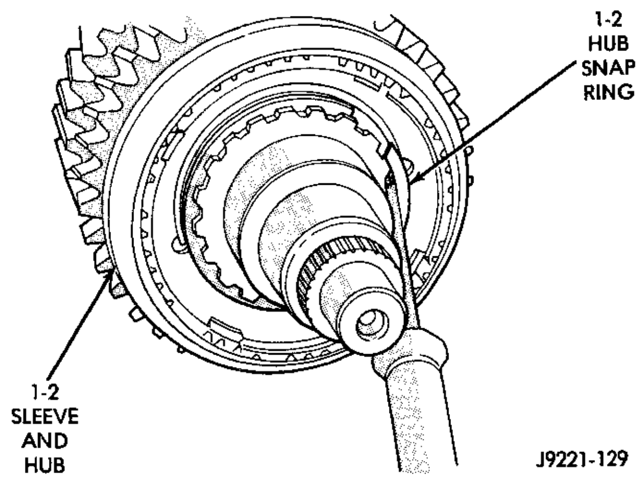

Fig. 68 Removing 1-2 Sleeve And Hub Snap Ring

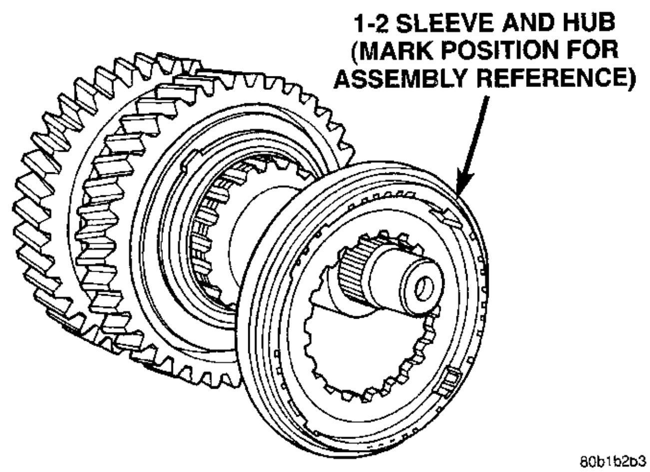

Fig. 69 Removing 1-2 Synchro Sleeve And Hub

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DISASSEMBLY AND ASSEMBLY (Continued)

(14) Remove first gear synchro stop ring and clutch ring (Fig. 70).

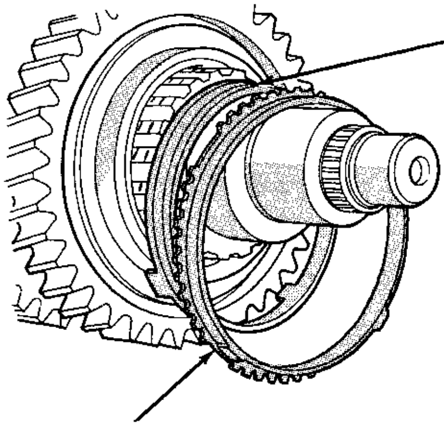

Fig. 70 First Gear Stop And Clutch Ring Removal

(15) Remove first gear clutch cone front snap ring from mainshaft hub (Fig. 71).

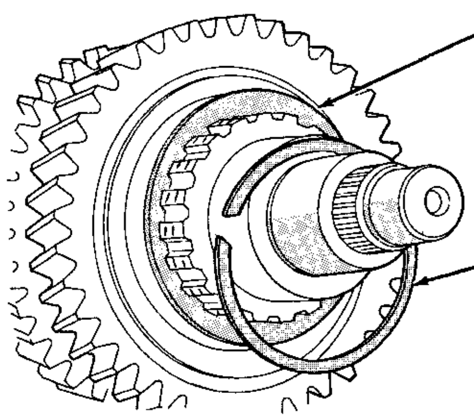

Fig. 71 First Gear Clutch Gear Front Snap Ring Removal

(16) Remove first gear clutch cone (Fig. 72).

(17) Remove first gear clutch gear rear snap ring from mainshaft hub (Fig. 72). It is not really necessary to remove this snap ring unless it, or the mainshaft is to be replaced.

(18) Remove reverse gear thrust washer (Fig. 73).

(19) Remove reverse gear and synchro components as assembly (Fig. 74). It is not necessary to remove or disassemble synchro components unless they are damaged and need to be replaced. If synchro sleeve or struts require service, mark position of sleeve on hub before removal. Correct sleeve position is important as sleeve can be installed backwards causing shift problems.

(20) Remove reverse gear bearing assembly from mainshaft (Fig. 74).

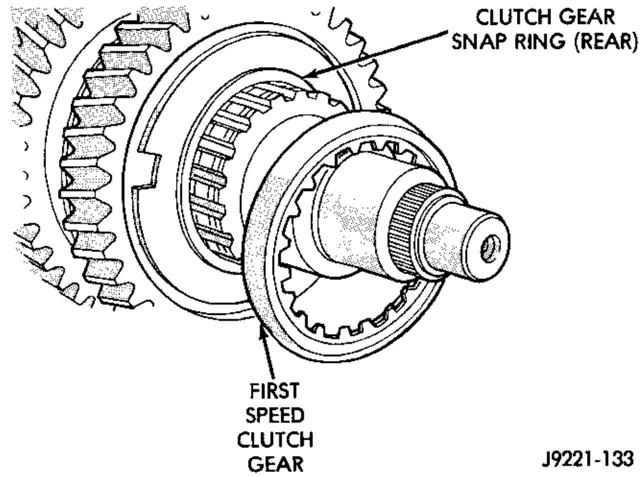

Fig. 72 First Gear Clutch Gear Removal

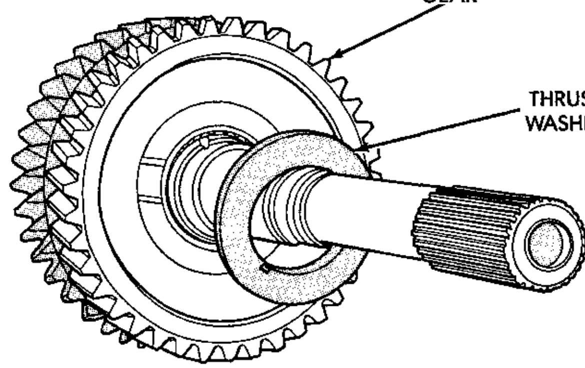

Fig. 73 Reverse Gear Thrust Washer Removal

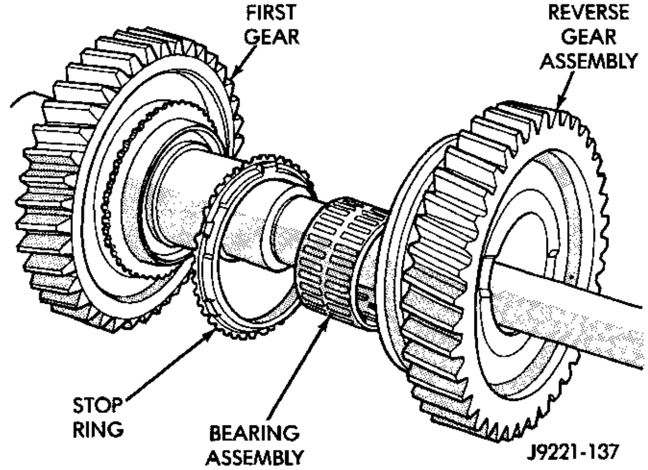

Fig. 74 Reverse Gear, Bearing, And Stop Ring Removal

AUTHENTIC RESTORATION PRODUCTS

DISASSEMBLY AND ASSEMBLY (Continued)

(21) Remove reverse gear bearing spacer from mainshaft (Fig. 75).

(22) Remove reverse clutch gear snap ring (Fig. 75). Tension of this snap ring is considerable. Heavy duty snap ring pliers will be required to spread the ring far enough to remove it.

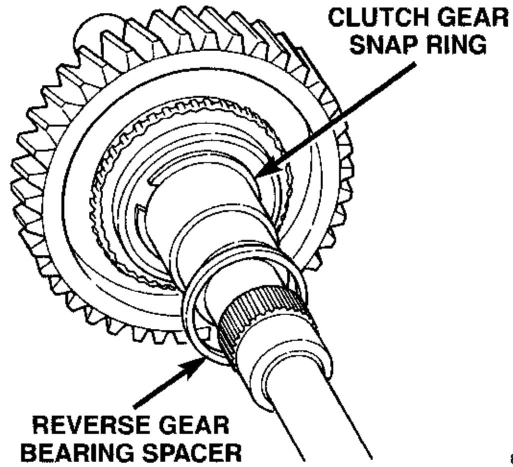

Fig. 75 Reverse Gear Bearing Spacer And First Gear Snap Ring Removal

(23) Remove reverse clutch gear (Fig. 76).

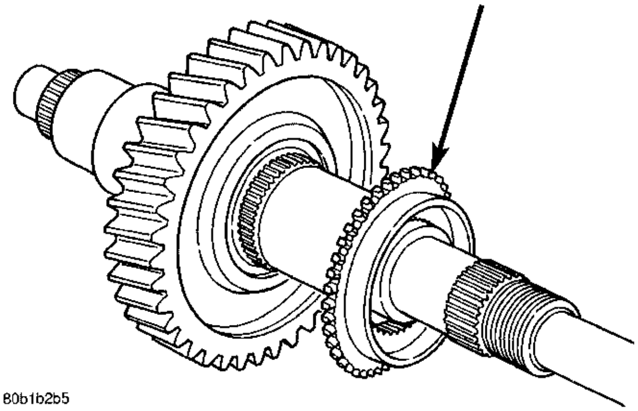

Fig. 76 Removing Reverse Clutch Gear

(24) Remove first gear from bearing and mainshaft (Fig. 77).

(25) Remove first gear bearing from mainshaft (Fig. 78).

ASSEMBLY

NOTE: Gaskets are not used in the NV4500 transmission. Use Mopar® Gasket Maker, or equivalent, on all gear case and extension housing sealing surfaces.

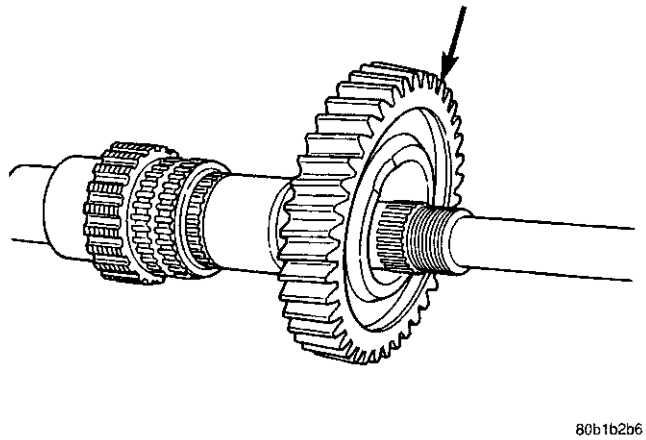

Fig. 77 Removing First Gear

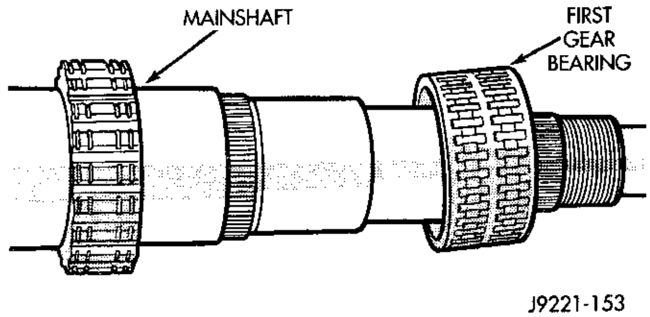

Fig. 78 Removing First Gear Bearing

GEAR CASE ASSEMBLY

(1) Install countershaft front bearing cup in case with Tool Handle C-4171 and Installer Tool 6061-1.

COUNTERSHAFT AND REVERSE IDLER GEAR INSTALLATION

(1) Install front bearing on countershaft with Installer Tool C-4340 (Fig. 79).

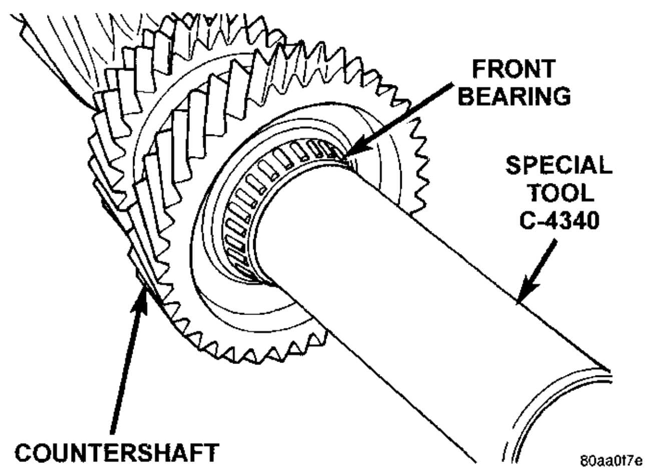

Fig. 79 Countershaft Front Bearing Installation

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DISASSEMBLY AND ASSEMBLY (Continued)

(2) Lubricate countershaft front bearing cup and cone with petroleum jelly.

(3) Position gear case on end with rear of case facing up (Fig. 80).

(4) Install countershaft in gear case (Fig. 80). Do not install rear countershaft bearing on countershaft at this time.

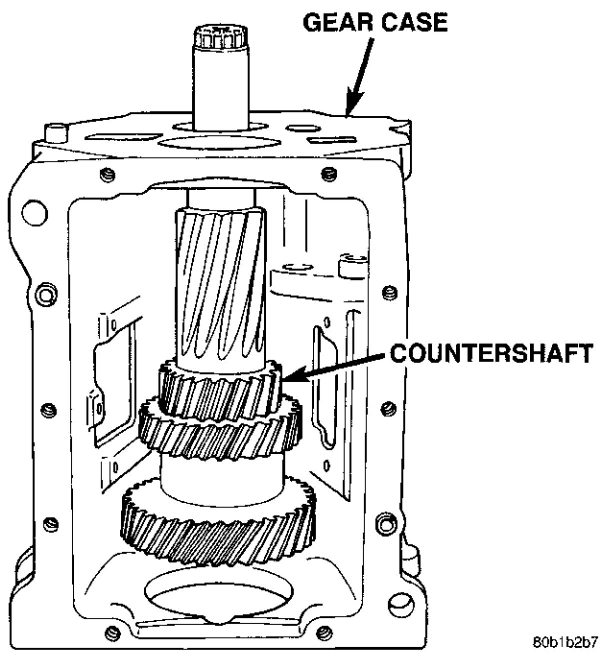

Fig. 80 Positioning Countershaft In Gear Case

(5) Lubricate reverse idler gear bearings with petroleum jelly and install first bearing and second bearing (Fig. 81).

(6) Install idler gear front thrust washer on boss in gear case (Fig. 81). Coat thrust washer with liberal quantity of petroleum jelly to hold it in place.

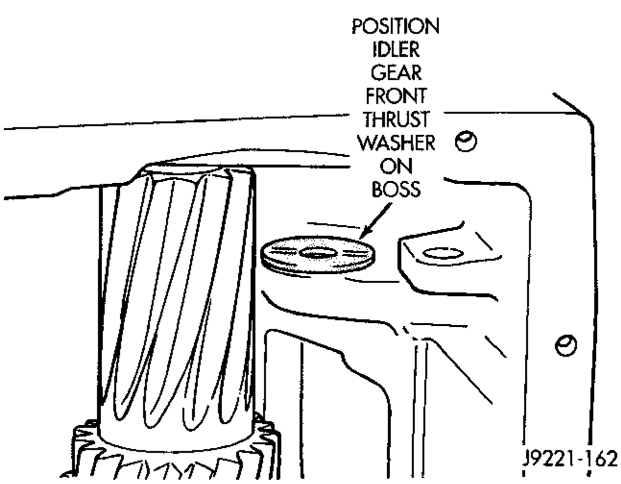

Fig. 81 Positioning Idler Gear Front Thrust Washer In Case

(7) Install reverse idler gear in case (Fig. 82).

(8) Install idler gear rear thrust washer between idler gear and case boss (Fig. 82).

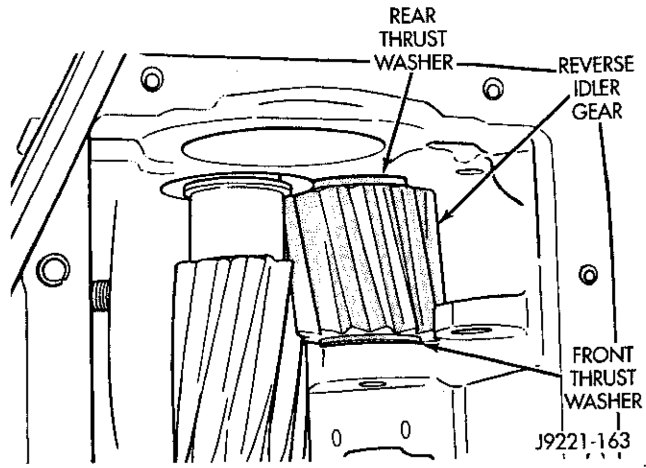

Fig. 82 Idler Gear And Thrust Washer Installation

(9) Align idler gear bearings and thrust washers with drift.

(10) Install reverse idler shaft (Fig. 83). Be sure notched end of shaft is facing countershaft as shown.

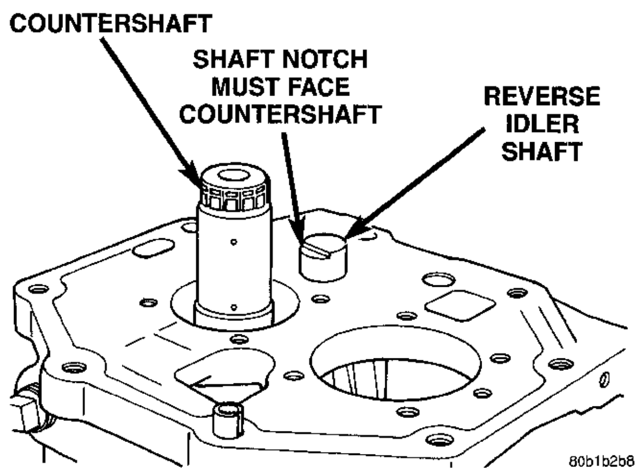

Fig. 83 Reverse Idler Shaft Installation

DISASSEMBLY AND ASSEMBLY (Continued)

(11) Lift countershaft upward and position wood block between front of shaft and case (Fig. 84).

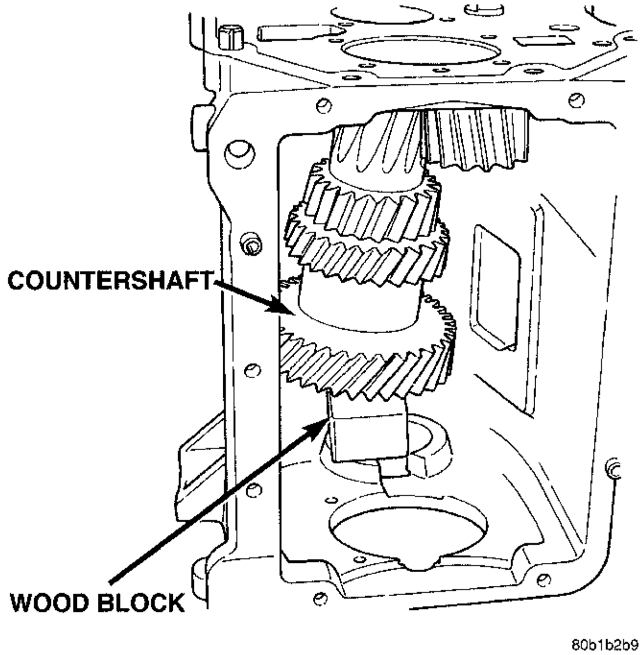

Fig. 84 Supporting Countershaft With Wood Block

(12) Install rear bearing cone on countershaft with Installer Tool C-4040 (Fig. 85).

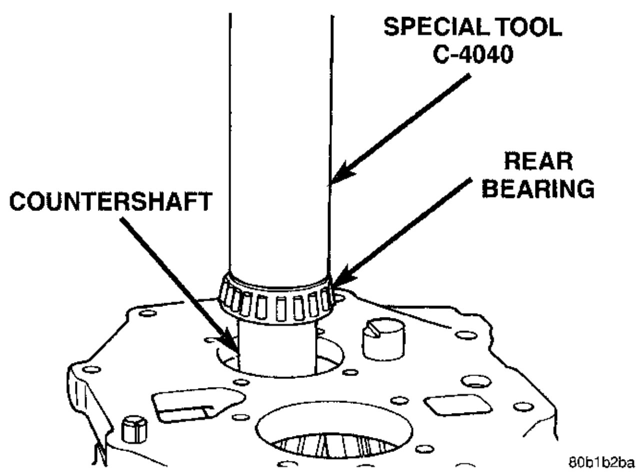

Fig. 85 Installing Countershaft Rear Bearing

(13) Remove wood block from under countershaft and lower countershaft front bearing into front bearing cup.

(14) Lubricate countershaft rear bearing cup and cone with petroleum jelly.

(15) Install countershaft rear bearing cup in gear case and over rear bearing (Fig. 86). Tap cup into place with plastic mallet if necessary.

(16) Install countershaft rear bearing plate (Fig. 88). Be sure plate is seated in notch in reverse idler shaft before tightening bearing plate bolts.

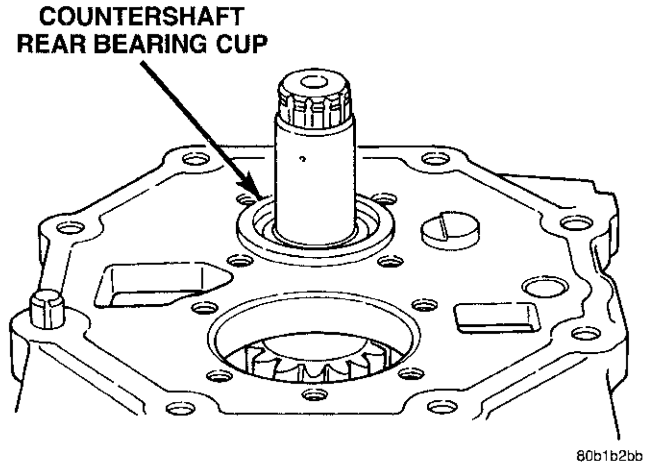

Fig. 86 Countershaft Rear Bearing Cup Installation

(17) Apply Mopar® silicone adhesive/sealer to flange and lip of new cap. Install new front bearing cap in gear case (Fig. 87) with Handle C-4171 and Installer C-3972-A.

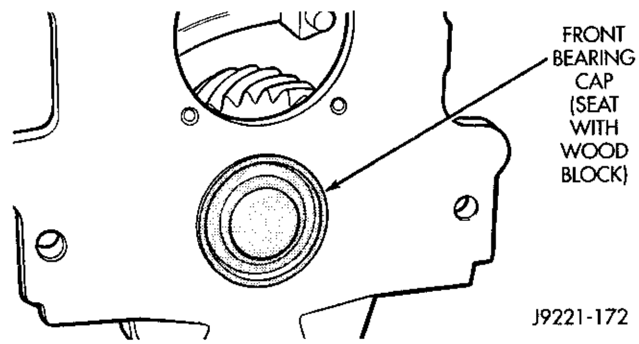

Fig. 87 Countershaft Front Bearing Cap Installation

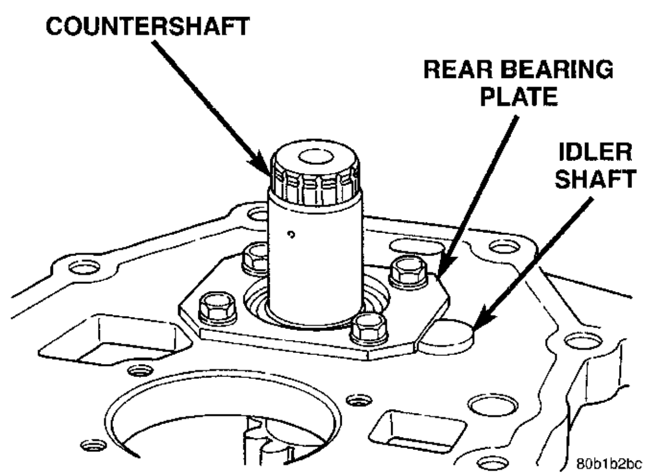

Fig. 88 Countershaft Rear Bearing Plate Installation

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DISASSEMBLY AND ASSEMBLY (Continued)

ADJUSTING COUNTERSHAFT END PLAY

(1) Rotate countershaft 4-5 times to seat bearings.

(2) Mount dial indicator on case. Then position indicator plunger on end of countershaft and zero indicator dial needle (Fig. 89).

(3) Raise countershaft with screwdriver and note end play reading on dial indicator. End play should be 0.051 - 0.15 mm (0.002 - 0.006 in.).

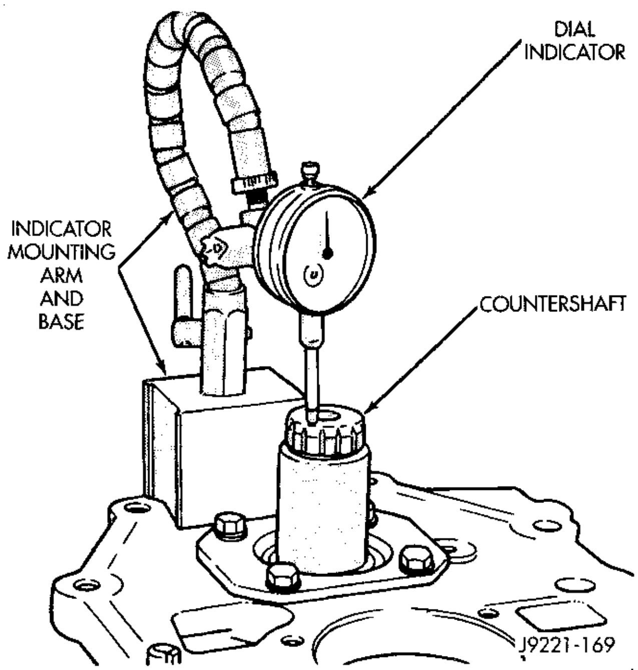

Fig. 89 Measuring Countershaft End Play

(4) Remove countershaft rear bearing plate.

(5) Select and install end play shim that will provide minimum countershaft end play. Position shim on rear bearing cup (Fig. 90).

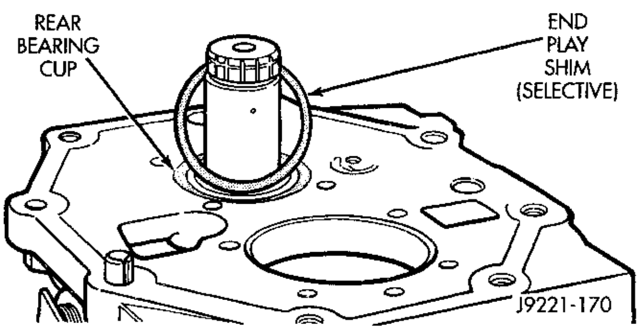

Fig. 90 Installing Countershaft End Play Shim

(6) Reinstall countershaft rear bearing plate (Fig. 88). Be sure plate is seated in reverse idler shaft notch before installing bolts. Also be sure end play shims are still in position before tightening bearing plate bolts.

(7) Apply 1-2 drops Mopar® Loc N' Seal, or equivalent, to threads of rear bearing plate bolts. Then install and tighten bearing plate bolts to 23 N·m (200 in. lbs.) torque.

SHIFT LUG AND RAIL INSTALLATION

(1) Lubricate shift lug and rail with Castrol Syntorq.

(2) Insert shift lug rail part way into case.

(3) Install shift lug on rail.

(4) Position shift rail so roll pin notches are toward outside of case (Fig. 91).

(5) Install roll pin that secures lug to rail (Fig. 91).

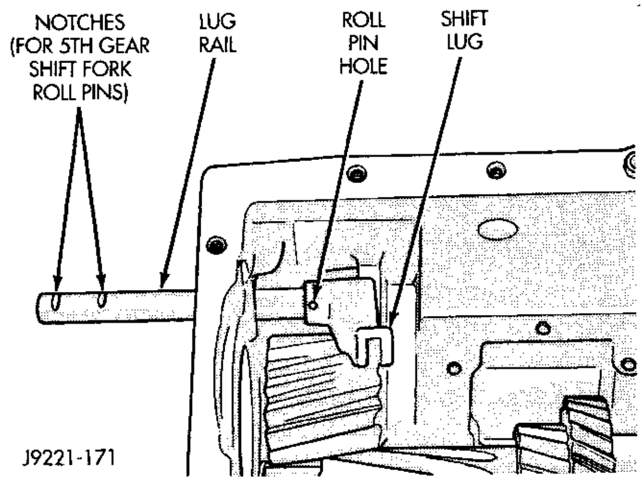

Fig. 91 Shift Lug And Rail Installation

MAINSHAFT AND GEARTRAIN ASSEMBLY

CAUTION: The reverse, 1-2 and 3-4 synchro components can be assembled and installed incorrectly if care is not exercised. Some components can be installed backwards resulting in shift problems. Refer to the assembly procedures for component identification and location.

Lubricate mainshaft bearing surfaces and all bearing assemblies with Castrol Syntorq or with petroleum jelly.

(1) Install first snap ring in rearmost groove of mainshaft hub (Fig. 92). This snap ring locates first gear clutch gear on shaft. A total of four of these snap rings are used to secure various components on the mainshaft 1-2 synchro hub. The snap rings are all the same size and are interchangeable.

(2) Install first gear clutch cone on mainshaft 1-2 synchro hub (Fig. 93). Recessed side of cone faces front. Be sure cone is seated against snap ring previously installed on hub.

(3) Install snap ring on mainshaft 1-2 synchro hub to secure clutch cone (Fig. 94). Be sure snap ring is fully seated in hub groove and against clutch cone. Note that this is second of four snap rings used to secure synchro components on shaft hub.

DISASSEMBLY AND ASSEMBLY (Continued)

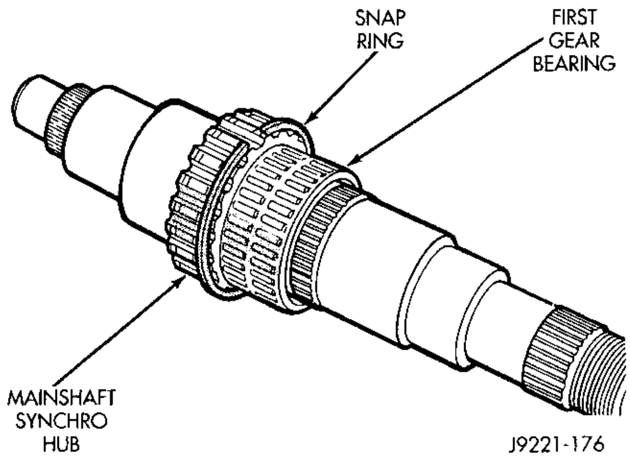

Fig. 92 First Gear Bearing and Snap Ring Installation

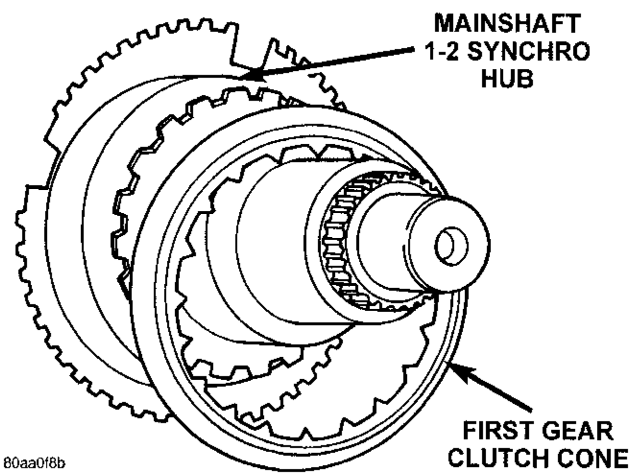

Fig. 93 Installing First Gear Clutch Cone

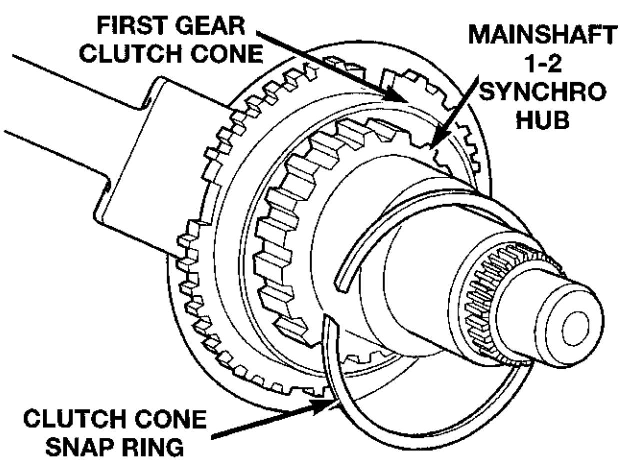

Fig. 94 Installing First Gear Clutch Cone Snap Ring

(4) Support mainshaft in upright position. Remaining gears, snap rings and synchro components are easier to install with shaft in upright position. Shaft can be supported in gear case, or hole can be cut in workbench to support shaft.

(5) If 1-2 synchro hub and sleeve were disassembled for service, reassemble hub, sleeve, struts and springs as follows:

(a) Align and install sleeve on hub. Rotate sleeve until it slides onto hub. Sleeve only fits one way and will easily slide onto hub when long slot in sleeve, aligns with long shoulder on hub (Fig. 95).

(b) Place wood blocks under hub that will raise hub about 3.5 cm (1.375 in.) above surface of workbench. Then allow sleeve to drop down on hub (Fig. 96).

(c) Install springs and struts in hub (Fig. 96). Use lots of petroleum jelly to hold them in place. Then compress struts with your fingers and move sleeve upward until struts are started in sleeve. Verify that struts are engaged in sleeve before proceeding.

(d) Turn synchro assembly upright. Then move sleeve into neutral position on hub and work struts into sleeve at same time. Be sure struts are seated and springs are not displaced during assembly.

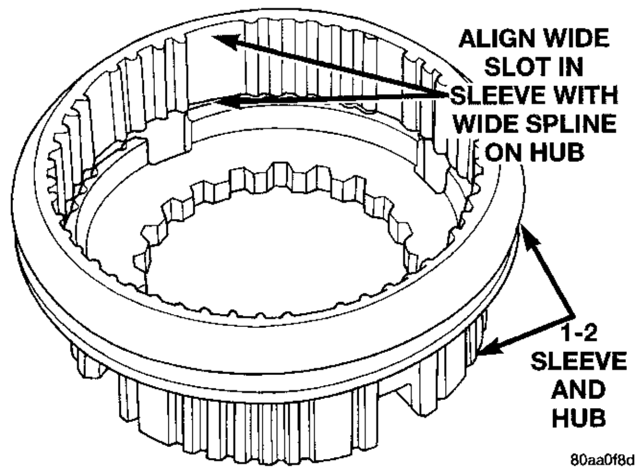

Fig. 95 Installing 1-2 Synchro Sleeve On Hub

(6) Install first gear stop ring in 1-2 synchro hub and sleeve (Fig. 97). Be sure stop ring is fully seated and engaged in hub and sleeve.

(7) Install 1-2 synchro assembly and stop ring on mainshaft. Ensure that the taper on the sleeve is facing forward. Then seat assembly on shaft (Fig. 98).

(8) Install snap ring that secures 1-2 synchro on mainshaft hub (Fig. 99). Be sure snap ring is fully seated in ring groove in mainshaft hub.

(9) Assemble second gear clutch cone, clutch ring and stop ring (Fig. 100).

(10) Install assembled second gear clutch cone and rings on mainshaft and in 1-2 synchro hub (Fig. 101).

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DISASSEMBLY AND ASSEMBLY (Continued)

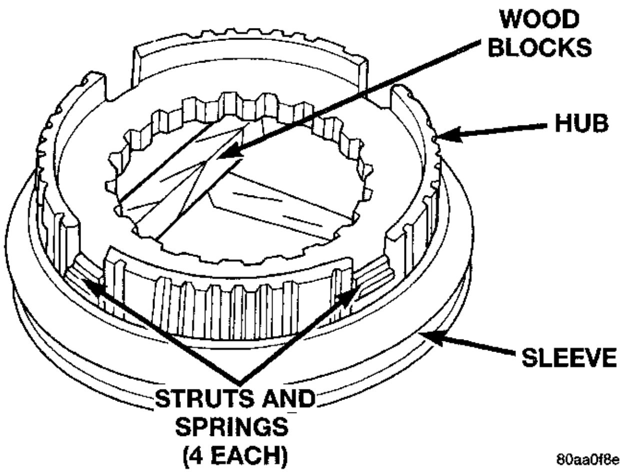

Fig. 96 Installing 1-2 Synchro Struts And Springs

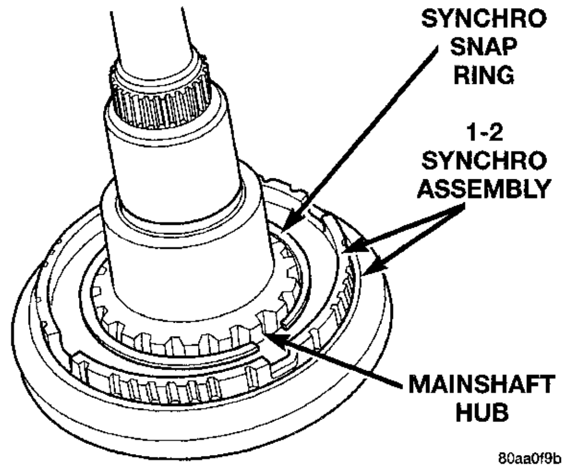

Fig. 99 Installing 1-2 Synchro Snap Ring

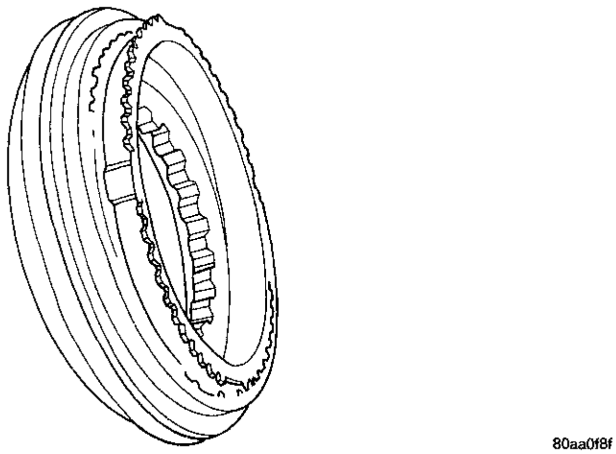

Fig. 97 Installing First Gear Stop Ring In Synchro Hub

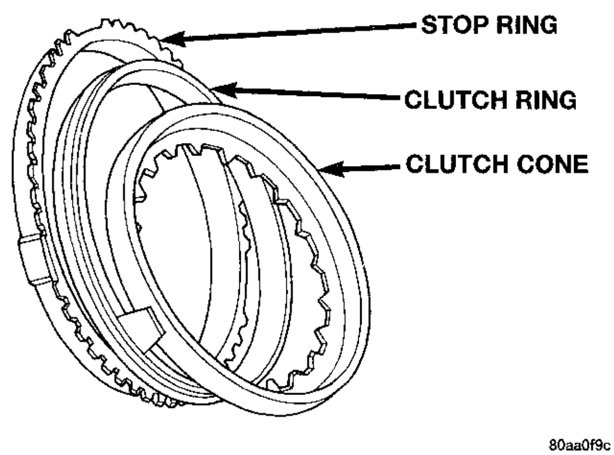

Fig. 100 Assembling Second Gear Clutch Cone, Clutch Ring, And Stop Ring

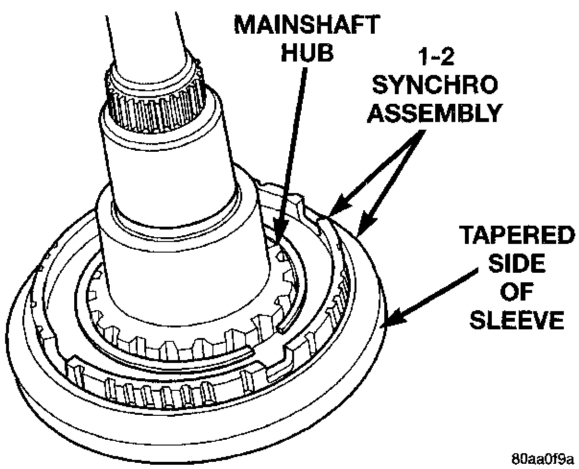

Fig. 98 1-2 Synchro Installation

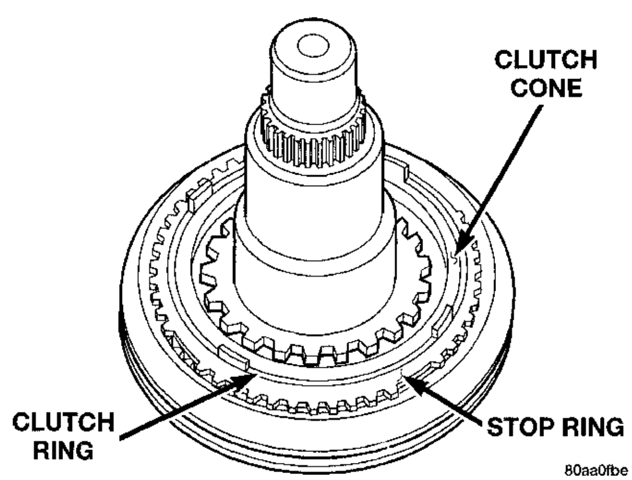

Fig. 101 Second Gear Clutch Cone, Clutch Ring, And Stop Ring Installation

DISASSEMBLY AND ASSEMBLY (Continued)

(11) Install snap ring that secures second gear clutch cone on mainshaft (Fig. 102). Use narrow blade screwdriver to work snap ring into hub groove as shown. **Be sure snap ring is fully engaged in mainshaft groove before proceeding. If snap ring will not fit in groove, clutch cone is slightly misaligned.**

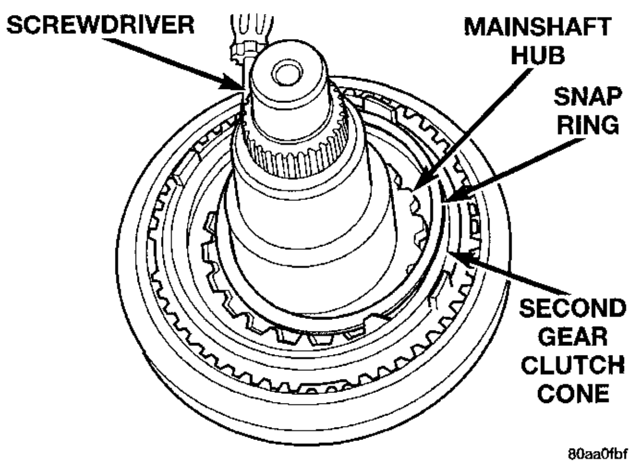

Fig. 102 Installing Second Gear Clutch Cone Snap Ring

(12) Install second gear bearing on mainshaft (Fig. 103).

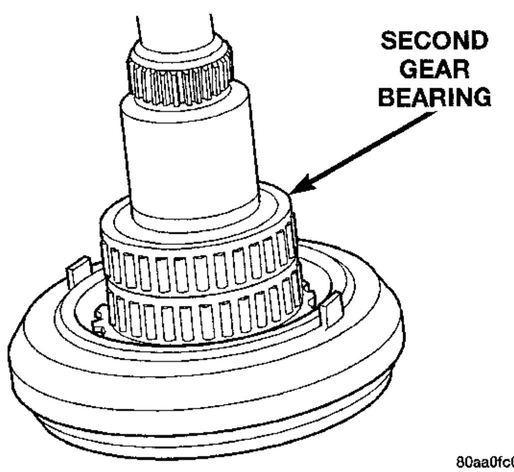

Fig. 103 Second Gear Bearing Installation

(13) Install second gear on mainshaft and bearing. Rotate gear until tabs of second gear clutch ring are fully seated in tab slots in gear (Fig. 104).

(14) Install thrust washer pin in shaft (Fig. 105).

(15) Install second gear thrust washer. Be sure washer is seated on gear and pin (Fig. 106).

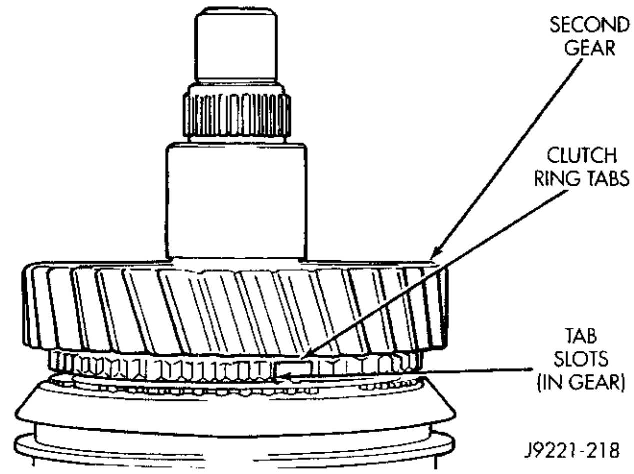

Fig. 104 Second Gear Installation

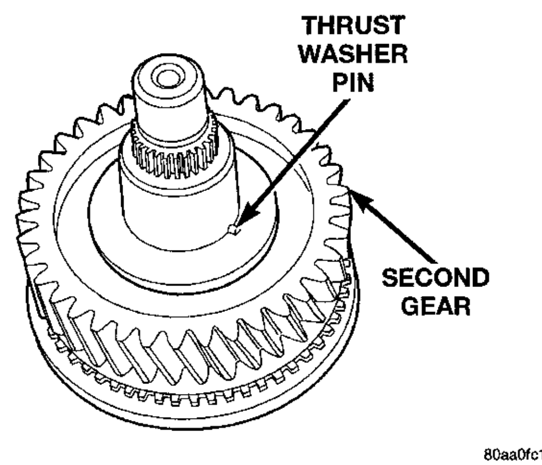

Fig. 105 Thrust Washer Pin Installation

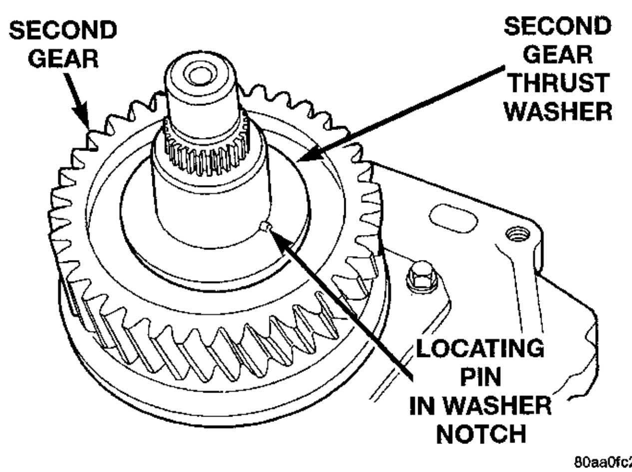

Fig. 106 Second Gear Thrust Washer Installation

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DISASSEMBLY AND ASSEMBLY (Continued)

(16) Install second gear thrust washer snap ring (Fig. 107). Be sure snap ring is fully seated in mainshaft groove.

(17) Install third gear bearing spacer on shaft and seat it against thrust washer snap ring (Fig. 107).

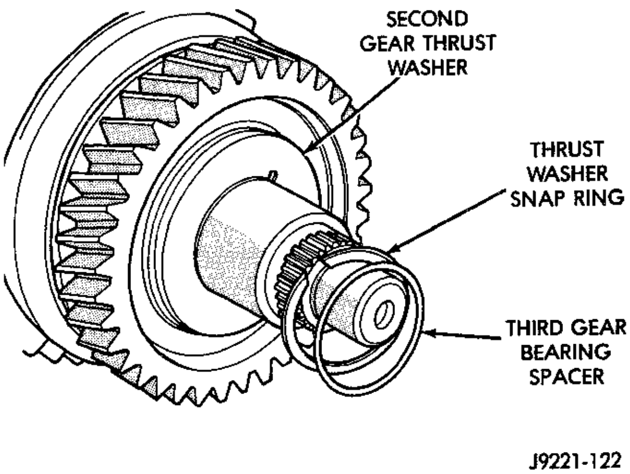

Fig. 107 Installing Snap Ring And Third Gear Bearing Spacer

(18) Install third gear bearing on mainshaft (Fig. 108). Bearing should be flush with mainshaft hub. If bearing is not flush with hub, either bearing spacer or snap ring was not installed. Check and correct if necessary.

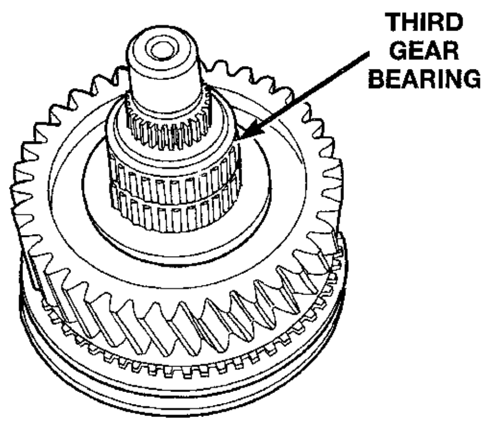

Fig. 108 Third Gear Bearing Installation

(19) Install third gear over bearing and onto mainshaft (Fig. 109).

(20) Install synchro stop ring on third gear (Fig. 110). Be sure stop ring is fully seated on cone taper.

(21) If 3-4 synchro was disassembled for service, reassemble synchro components as follows:

(a) Align and install synchro sleeve on hub (Fig. 111). **Front side of hub has a narrow groove machined in it.**

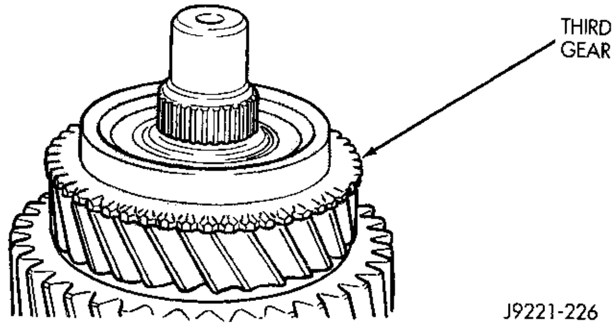

Fig. 109 Third Gear Installation

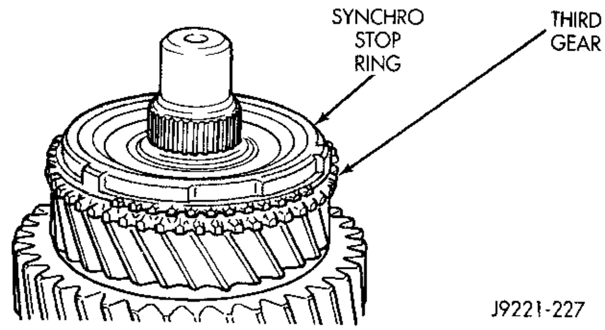

Fig. 110 Third Gear Stop Ring Installation

(b) Insert all three synchro struts in slots machined in sleeve and hub (Fig. 111).

(c) Install and seat synchro springs (Fig. 111). Use flat blade or Phillips screwdriver to compress springs and seat them in struts and hub as shown.

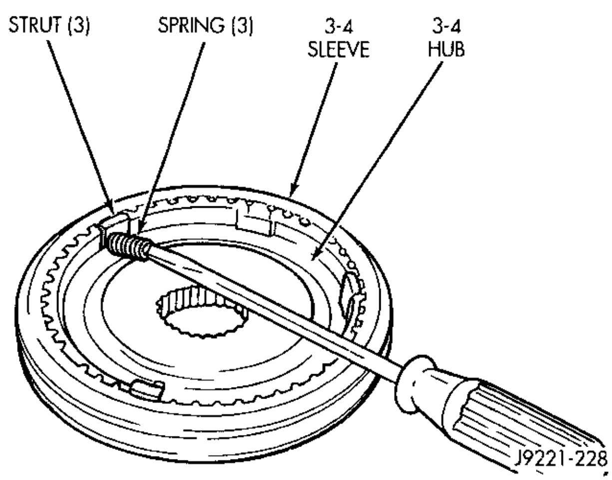

Fig. 111 Synchro Assembly (3-4)

DISASSEMBLY AND ASSEMBLY (Continued)

(22) Start 3-4 synchro assembly on mainshaft. Ensure that the hub groove and the sleeve groove both face forward. Tap assembly onto shaft splines until hub is about 3 mm (0.125 in.) away from third gear stop ring. Then align stop ring with synchro sleeve and hub and seat synchro assembly with Tool C-4040 (Fig. 112).

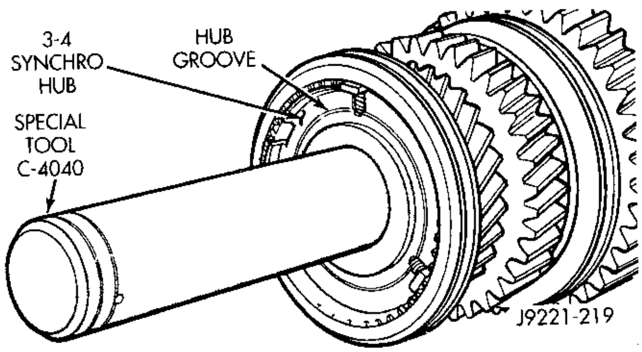

Fig. 112 Seating 3-4 Synchro Assembly On Mainshaft

(23) Verify that 3-4 synchro hub is fully seated on shaft. Approximately 3 mm (0.125 in.) of shaft spline should be visible. If hub is not seated, stop ring lugs are misaligned. Rotate ring until lugs are fully engaged in 3-4 hub slots.

(24) Verify that second and third gear rotate freely at this point. If not, determine the cause and correct.

(25) Invert mainshaft in case or bench. Reverse gear components are easier to install with shaft upright.

(26) Install first gear bearing on mainshaft.

(27) Install first gear on shaft (Fig. 113). Clutch hub side of gear faces front of shaft. Be sure tabs on clutch ring are aligned and seated in first gear hub. 1-2 synchro hub will not seat properly if clutch ring tabs are misaligned.

(28) Install reverse clutch gear on first gear (Fig. 113). Be sure clutch gear is seated on shaft splines.

(29) Install reverse clutch gear snap ring (Fig. 113). Use heavy duty snap ring pliers to install this snap ring as ring tension is considerable. Do not overspread snap ring and make sure it is fully seated in groove. Reverse gear will not fit properly if snap ring is not fully seated.

(30) Install stop ring on clutch cone (Fig. 114). Be sure stop ring is fully seated on cone taper.

(31) Install reverse gear bearing spacer on mainshaft (Fig. 115). Bearing spacer seats against reverse clutch gear snap ring.

(32) Install reverse gear bearing on mainshaft (Fig. 115).

CAUTION: The reverse sleeve will fit either way on the hub. This means the sleeve can be installed backwards if care is not exercised. Be sure the tapered side of the sleeve faces rearward after installation.

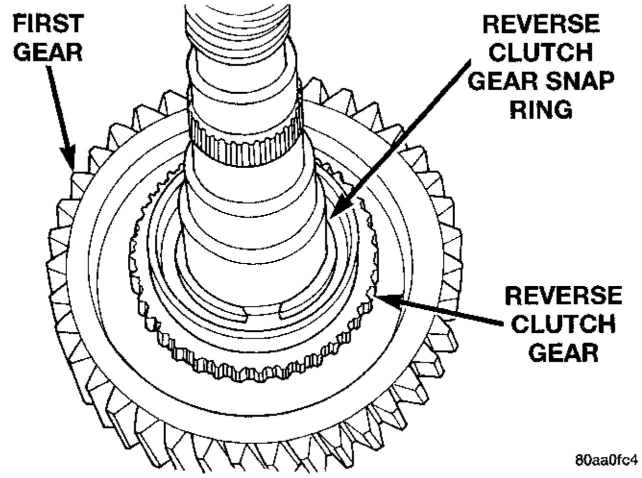

Fig. 113 First Gear, Clutch Gear, And Snap Ring Installation

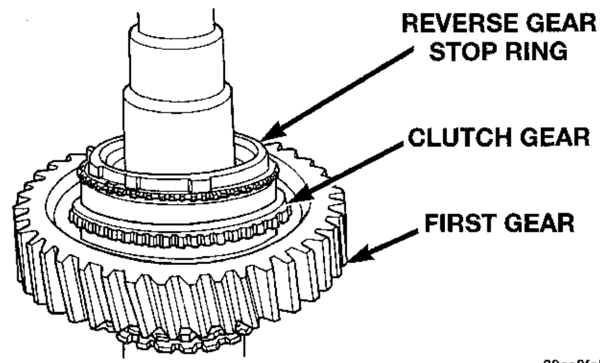

Fig. 114 Clutch Gear Stop Ring Installation

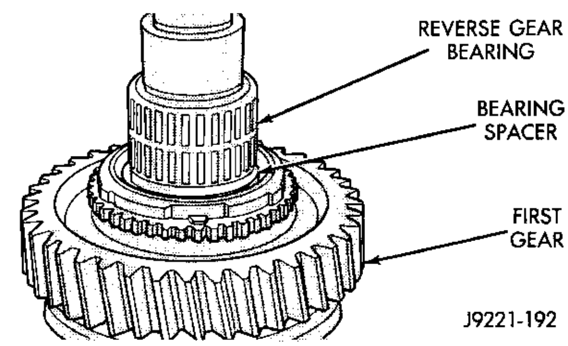

Fig. 115 Reverse Gear Bearing And Spacer Installation

(33) If reverse gear sleeve and struts were disassembled for service, reassemble sleeve, struts and springs as follows:

(a) Position sleeve on hub so tapered side of sleeve faces rearward. Sleeve will fit either way

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DISASSEMBLY AND ASSEMBLY (Continued)

but will cause shift problems if installed backwards (Fig. 116).

(b) Rotate sleeve to align teeth on sleeve and hub. Sleeve will slide easily into place on hub when properly aligned.

(c) Install springs in gear hub (Fig. 116). Use petroleum jelly to hold springs in place if desired.

(d) Compress first spring with flat blade screwdriver and slide strut into position in hub slot. Then work spring into seat in strut with small hooked tool, or screwdriver.

(e) Install second and third struts in same manner as described in step (d).

(f) Work sleeve upward on hub until struts are centered and seated in sleeve. Sleeve should be in neutral position after seating struts.

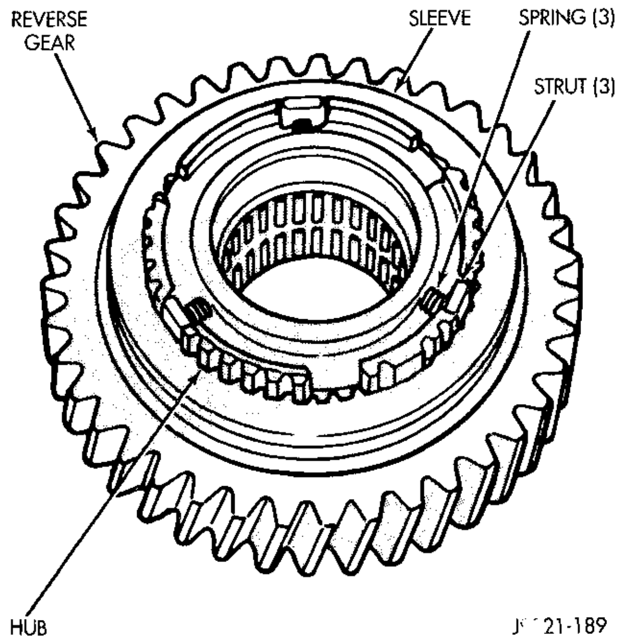


Fig. 116 Reverse Gear Synchro Assembly

(34) Install reverse gear and synchro assembly on mainshaft (Fig. 117). Rotate assembly until stop ring lugs engage in hub slots and gear drops into fully seated position.

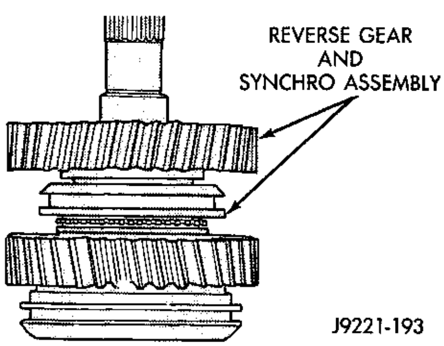


Fig. 117 Reverse Gear Installation

(35) Install reverse gear thrust washer (Fig. 118).

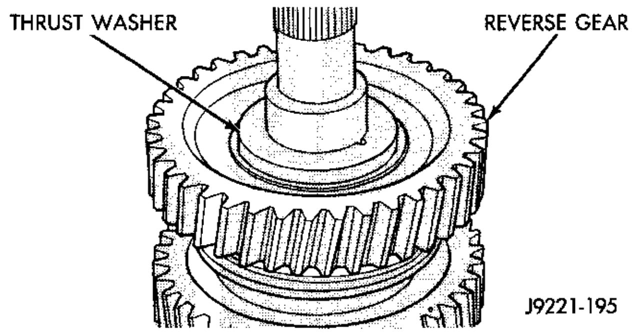


Fig. 118 Reverse Gear Thrust Washer Installation

(36) Install rear bearing on mainshaft.

(37) Install fourth gear stop ring in 3-4 synchro sleeve (Fig. 119).

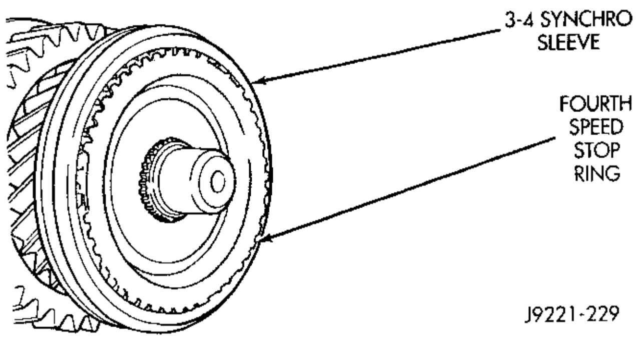


Fig. 119 Fourth gear Stop Ring Installation

(38) Install fourth gear clutch gear in stop ring (Fig. 120).

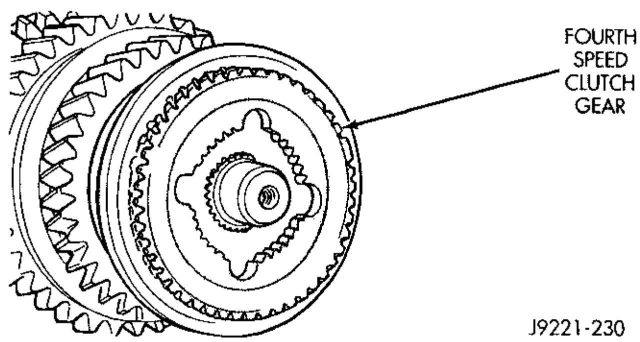


Fig. 120 Fourth gear Clutch Gear Installation

MAINSHAFT AND GEARTRAIN INSTALLATION

(1) Roll gear case onto its left side.

(2) Grip mainshaft at pilot bearing hub and just behind reverse gear. Then lift assembly and guide rear of shaft through bearing bore at rear of case.

(3) Continue holding front of shaft but switch grip at rear to shaft output splines. Lift mainshaft assembly slightly, align gears and seat assembly in case.

(4) Set transmission case upright (Fig. 121).

DISASSEMBLY AND ASSEMBLY (Continued)

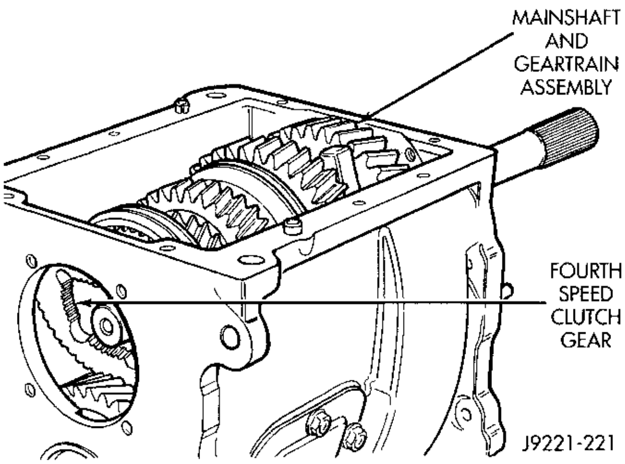


Fig. 121 Mainshaft And Geartrain Installed In Case

(5) Install drive gear thrust bearing on mainshaft (Fig. 122). Use plenty of petroleum jelly to hold bearing in place.

(6) Check alignment and mesh of mainshaft gears. If gears are not aligned, roll case on side and realign shaft and gears in case.

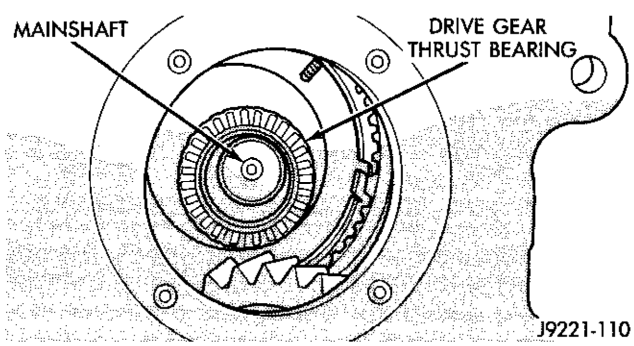


Fig. 122 Drive Gear Thrust Bearing Installation

DRIVE GEAR AND RETAINER INSTALLATION

(1) Install bearing on drive gear with Installer Tool 6448 (Fig. 123).

(2) Lubricate pilot bearing with petroleum jelly and install it in drive gear bore.

(3) Install drive gear on mainshaft. Work gear rearward until mainshaft hub is fully seated in pilot bearing.

(4) Install bearing cup in front retainer with Driver Handle C-4171 and Installer C-4308 (Fig. 124).

(5) Install new oil seal in front bearing retainer with Tool 6052 (Fig. 125). Use one or two wood blocks to support retainer as shown. Lubricate seal lip with petroleum jelly after installation.

(6) Clean contact surfaces of gear case and front bearing retainer with a wax and grease remover.

(7) Apply Mopar® Gasket Maker to flange surface of front bearing retainer (Fig. 126).

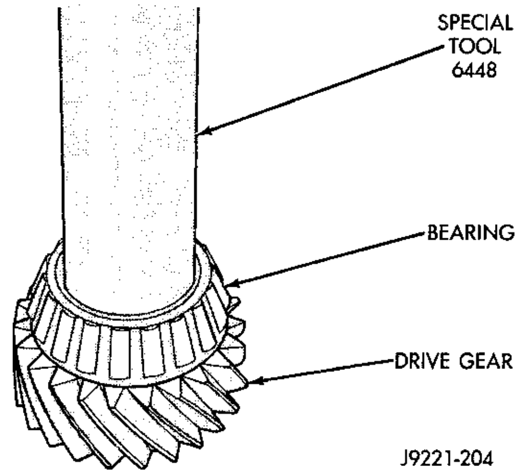


Fig. 123 Installing Front Bearing On Drive Gear

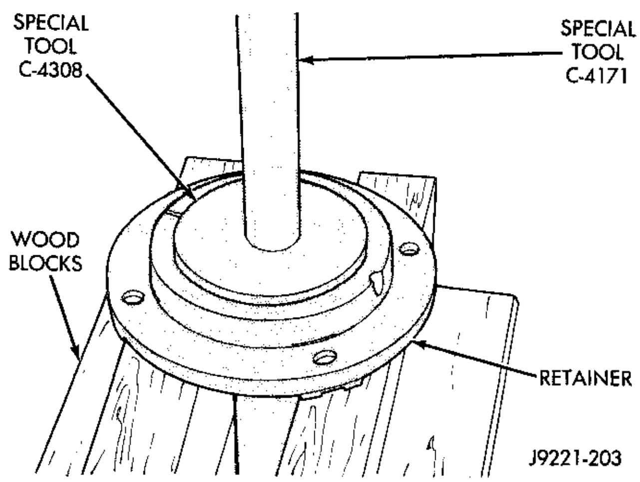


Fig. 124 Installing Front Bearing Cup In Retainer

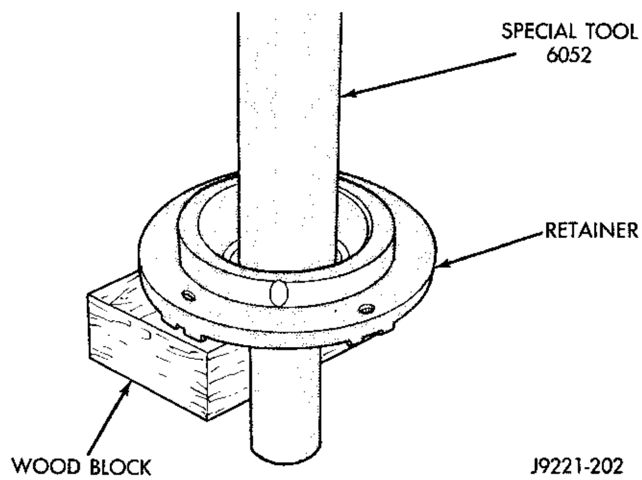


Fig. 125 Installing Bearing Retainer Oil Seal

(8) Install front bearing retainer over drive gear and start it into case.

DISASSEMBLY AND ASSEMBLY (Continued)

(9) Start front bearing retainer in gear case. Verify that retainer lube channel is at top-center (12 O'clock) position (Fig. 126). Adjust retainer position before proceeding, if necessary.

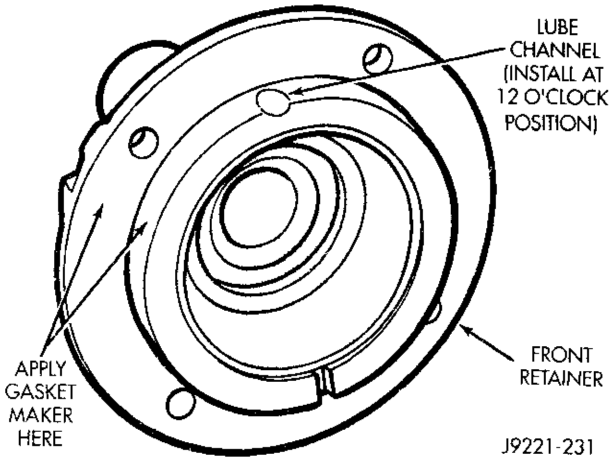


Fig. 126 Location Of Front Retainer Lube Channel

(10) Align front bearing retainer bolt holes and tap retainer into place with plastic mallet. Install and tighten retainer bolts to 30 N·m (265 in. lbs.) torque (Fig. 127). **Use new retainer bolts. Do not reuse the old ones.**

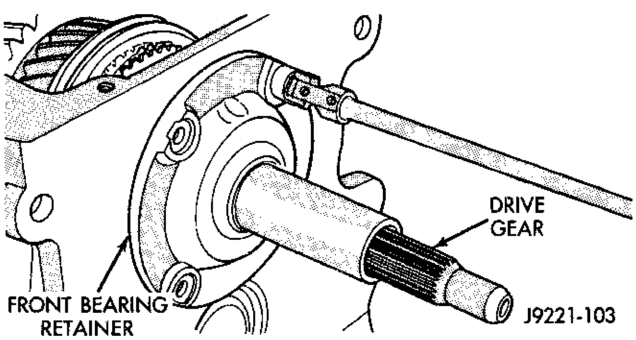


Fig. 127 Installing Front Bearing Retainer

MAINSHAFT END PLAY ADJUSTMENT

(1) Install mainshaft rear bearing.

(2) Install mainshaft rear bearing cup in case and over bearing. Tap bearing cup into place with plastic mallet.

(3) Install rear bearing plate to hold mainshaft and rear bearing in position (Fig. 128). Do not install any end play shims at this time.

(4) Tighten rear bearing plate bolts securely.

(5) Place gear case in upright position on bench. Either cut hole in bench to accept drive gear and front retainer, or use C-clamps to secure transmission on bench. Do not leave transmission unsupported.

(6) Install Extension Rod 8161 into a suitable threaded hole in rear of case.

(7) Mount dial indicator on extension rod and position indicator plunger against end of mainshaft.

(8) Move mainshaft forward to remove all play. Then zero dial indicator.

(9) Move mainshaft upward and observe dial indicator reading. Move mainshaft with pry tool positioned between drive gear and case.

(10) End play should be 0.051-0.15 mm (0.002-0.006 in.). Select fit shims are available to adjust end play, if necessary.

(11) If end play adjustment is required, remove bearing plate and install necessary shim.

(12) Reinstall rear bearing plate (Fig. 128).

(13) Apply Mopar® Lock N' Seal, or equivalent, bearing plate bolt threads. Then install and tighten bolts to 23 N·m (200 in. lbs.) torque. Be sure oil hole in bearing plate is at top as shown.

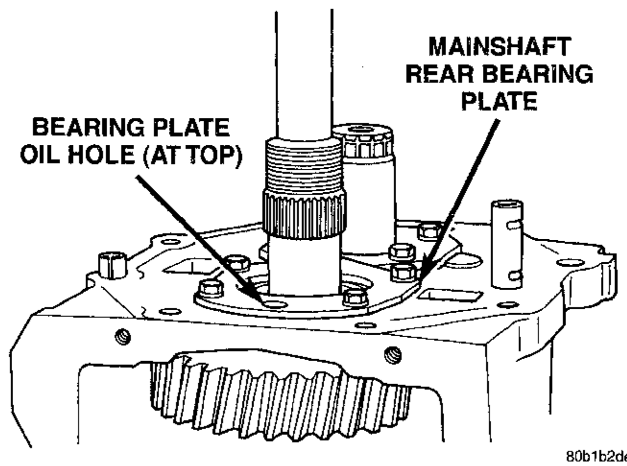


Fig. 128 Rear Bearing Plate Installation

COUNTERSHAFT FIFTH GEAR SYNCHRO INSTALLATION

(1) Install thrust washer pin in countershaft (Fig. 129).

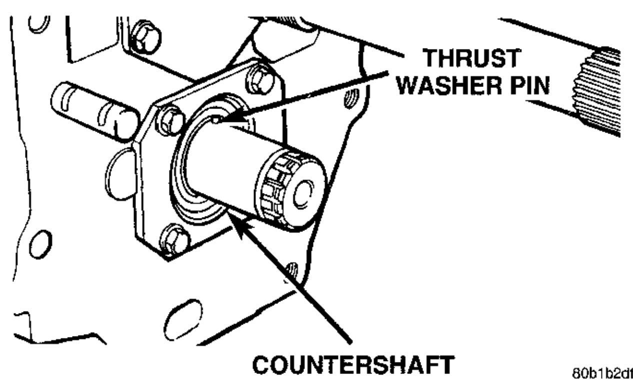


Fig. 129 Installing Fifth Gear Thrust Washer Pin

DISASSEMBLY AND ASSEMBLY (Continued)

(2) Install thrust washer on countershaft. Turn washer until pin engages in washer notch (Fig. 130). Flat side of washer faces rear and cone side to front as shown.

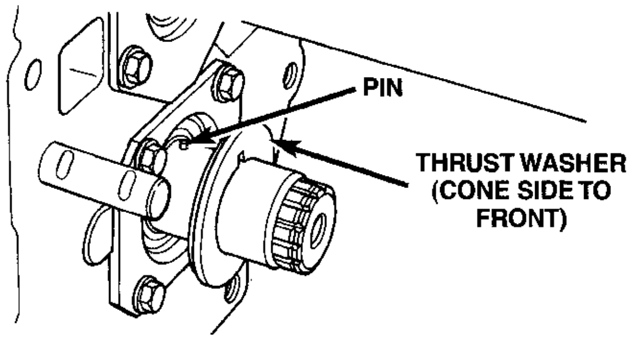


Fig. 130 Installing Fifth Gear Thrust Washer

(3) Lubricate and install fifth gear bearing on countershaft (Fig. 131).

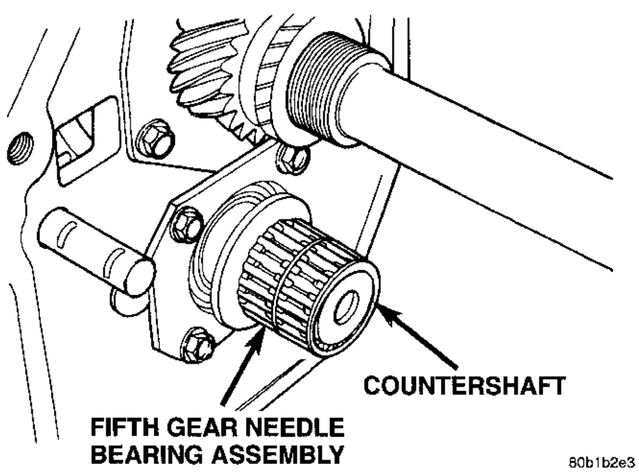


Fig. 131 Countershaft Fifth Gear Bearing Installation

(4) Install synchro sleeve on hub of countershaft fifth gear. Tapered side of sleeve faces front and flat side faces rear (Fig. 132).

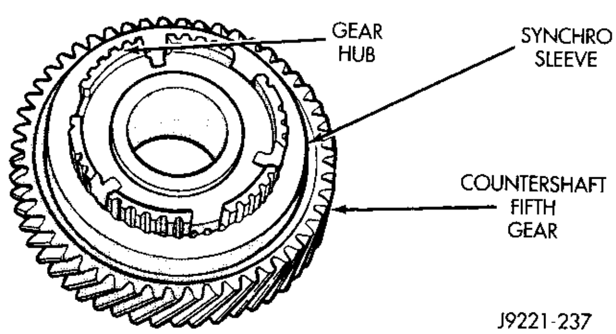


Fig. 132 Installing Synchro Sleeve On Countershaft Fifth Gear Hub

(5) Install shift fork in synchro sleeve (Fig. 133).

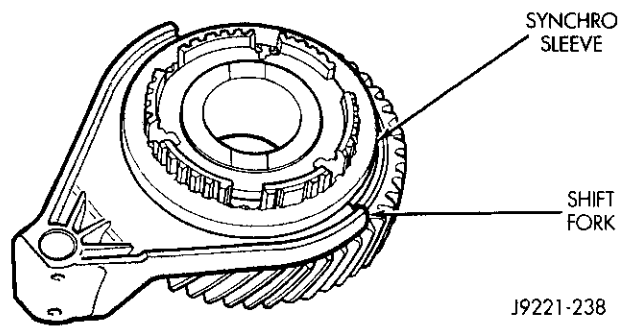


Fig. 133 Installing Fifth Gear Shift Fork In Synchro Sleeve

(6) Install assembled fifth gear, synchro sleeve and shift fork (Fig. 134). Align fork with shift lug rail and align gear with bearings and countershaft. Start components onto shaft and rail. Then tap gear and fork into place with plastic or rawhide mallet.

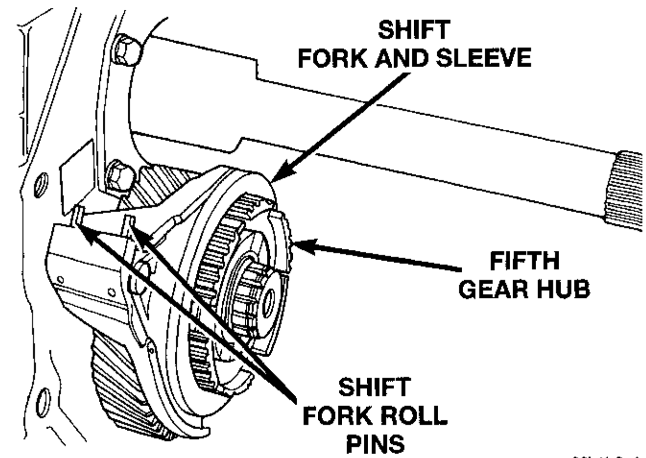


Fig. 134 Installing Assembled Countershaft Fifth Gear, Shift Fork And Synchro Sleeve

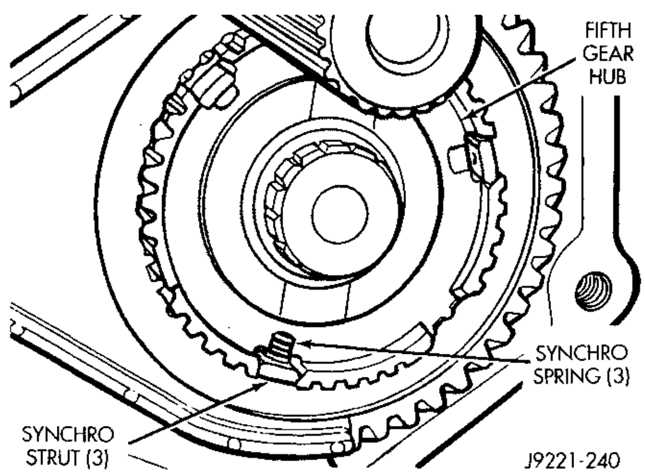


Fig. 135 Installing Fifth Gear Synchro Struts And Springs

DISASSEMBLY AND ASSEMBLY (Continued)

(7) Assemble and install fifth synchro clutch gear and stop ring in fifth gear hub (Fig. 136). Make sure both parts are seated in fifth gear hub.

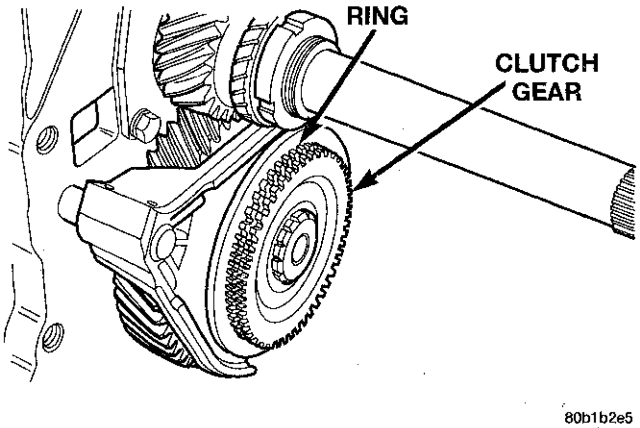


Fig. 136 Fifth Synchro Clutch Gear And Stop Ring Installation

(8) Install clutch gear snap ring (Fig. 137).

(9) Align roll pin holes in shift fork with notches in shift lug rail. Then install roll pins from top side of fork (Fig. 134). Note that roll pins are one way fit due to small shoulder at one end of each pin.

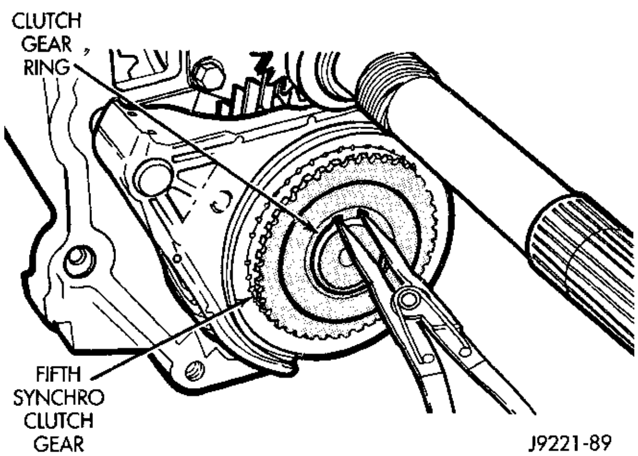


Fig. 137 Installing Fifth Synchro Clutch Snap Ring

MAINSHAFT FIFTH GEAR INSTALLATION

(1) Install mainshaft fifth gear. Use Installer Tool 6446 to seat gear on shaft (Fig. 138). Gear is seated when it contacts rear bearing.

(2) Install new fifth gear nut on mainshaft (Fig. 139).

(3) There are four splined sockets available to retain the mainshaft while installing the fifth gear nut.

- Socket 6441 fits light duty 4X2 mainshafts.
- Socket 6442 fits light duty 4X4 mainshafts.
- Socket 6993 fits heavy duty 4X2 mainshafts.

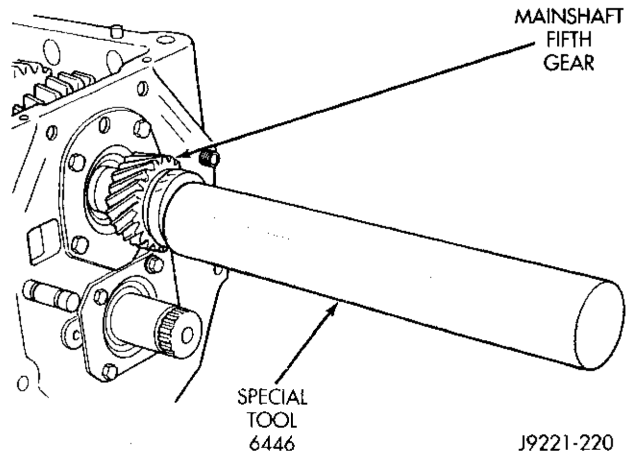


Fig. 138 Installing Mainshaft Fifth Gear

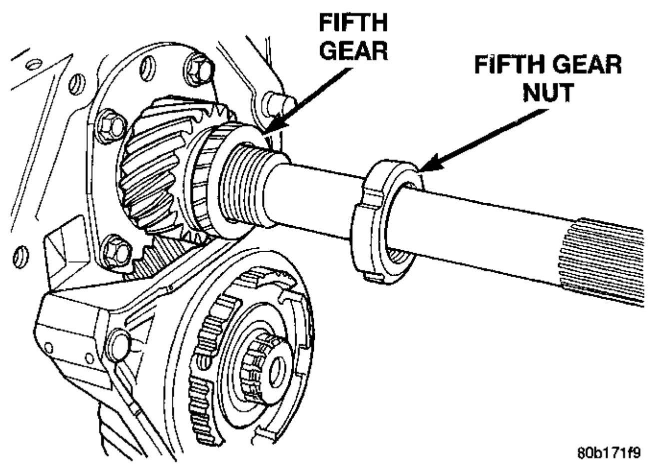


Fig. 139 Installing Fifth Gear Nut

- Socket 6984 fits heavy duty 4X4 mainshafts.

(4) Tighten fifth gear nut as much as possible with Nut Wrench 6443 or 6743, long handle ratchet, breaker bar and applicable socket wrench (Fig. 140).

(5) Lock mainshaft gears by shifting all synchro sleeves into engaged position.

(6) Tighten fifth gear nut with Nut Wrench 6443 or 6743 and high capacity torque wrench. Required torque on nut is 339-475 N·m (250-350 ft. lbs.). Have helper hold transmission steady if necessary.

(7) Use Staking Tool 8213 to stake the fifth gear nut to the mainshaft. The tool is designed to function on both the light duty and heavy duty versions of the NV4500. Ensure that the tool is configured properly for the transmission being serviced.

NOTE: It may be necessary to remove the fifth gear fork and countershaft fifth gear components in order to install the Staking Tool 8213 onto the fifth gear nut.

DISASSEMBLY AND ASSEMBLY (Continued)

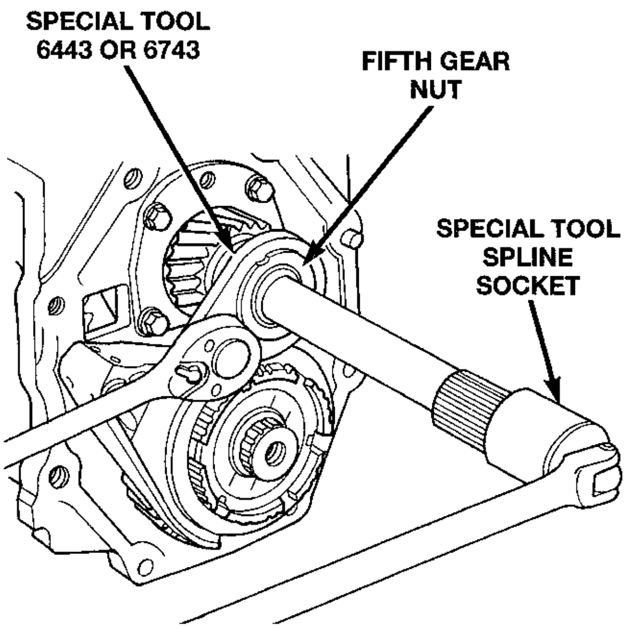


Fig. 140 Fifth Gear Nut Installation

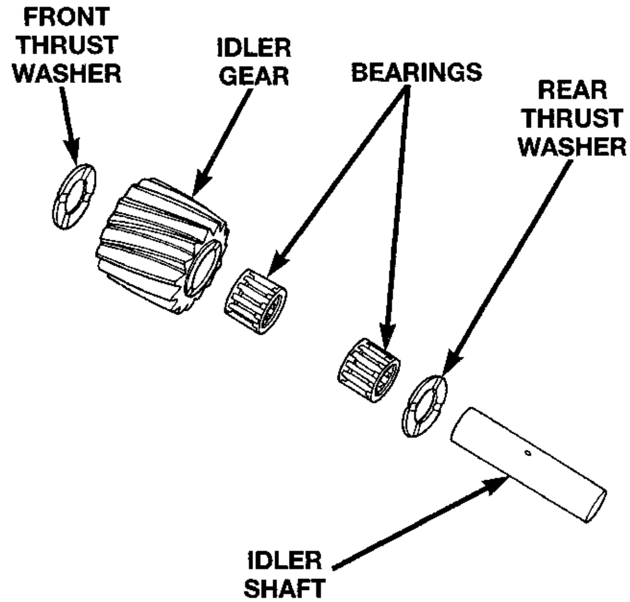


Fig. 141 Reverse Idler Components

CLEANING AND INSPECTION

SHIFT COVER INSPECTION

Inspect the cover and shift components whenever the cover is removed from the gear case or whenever diagnosis indicates inspection is necessary.

Check the forks for wear, distortion, cracks, or being loose on the shift rails. Also check fit of the shift rails in the cover. Replace the cover assembly if the rails are loose in the cover bores.

Inspect and replace the pads on the fifth–reverse shift fork if worn. The expansion plugs at the rear of the cover can be replaced if loose or leaking.

A gasket is not used between the shift cover and gear case. Use Mopar® Gasket Maker, or equivalent, to seal the cover.

TRANSMISSION

Clean the gears, bearings shafts, extension/adapter housing and gear case with solvent. Dry all parts except the bearings with compressed air. Allow the bearings to either air dry or wipe them dry with clean shop towels.

Inspect the reverse idler gear, bearings, shaft and thrust washers (Fig. 141). Replace the bearings if the rollers are worn, chipped, cracked, flat-spotted, or brinnelled. Or if the bearing cage is damaged or distorted. Replace the thrust washers if cracked, chipped, or worn. Replace the gear if the teeth are chipped, cracked or worn thin.

Inspect the drive gear and bearings (Fig. 142). Minor scratches and burrs on the gear surfaces can be reduced with an oil stone and 400 grit paper wetted with oil. Replace either bearing if worn, or damaged. Replace the gear if any teeth, splines, or bearing surfaces are also worn or damaged.

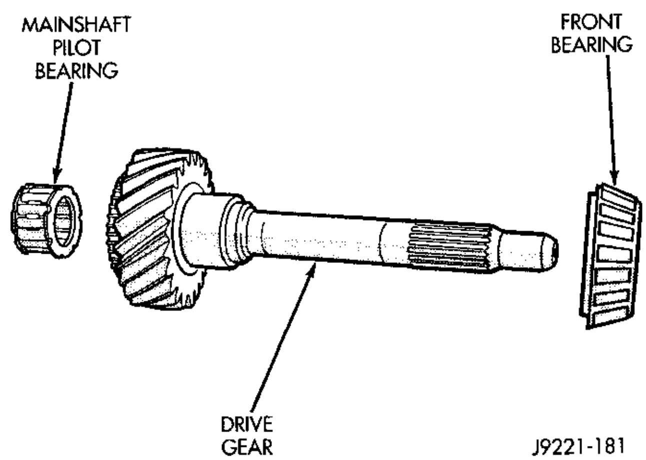


Fig. 142 Drive Gear Components

Inspect the front bearing retainer and bearing cup (Fig. 143). Replace the bearing cup if scored, cracked, brinnelled, or rough. Check the release bearing slide surface of the retainer carefully. Minor corrosion, nicks, or pitting can be smoothed with 400 grit emery and polished out with crocus cloth. Wet the abrasive paper and crocus cloth with oil when smoothing/polishing. Replace the retainer if worn or damaged in any way. Do not reuse the original retainer bolts. Install new bolts during assembly.

Inspect the countershaft and bearings (Fig. 144). Replace the bearings if worn, rough, flat spotted, or

CLEANING AND INSPECTION (Continued)

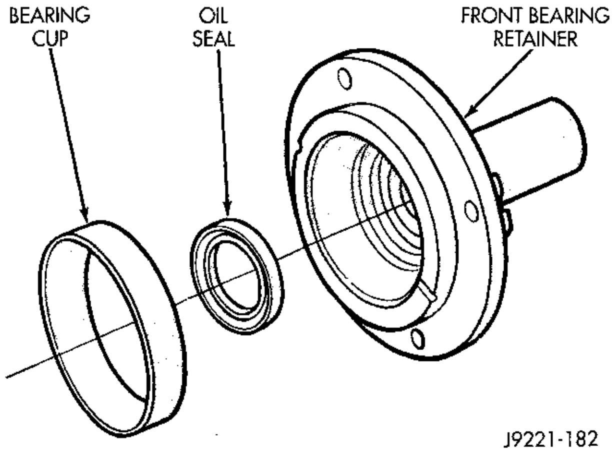


Fig. 143 Front Bearing Retainer Components

heat checked. Check the countershaft gear teeth carefully. Small nicks, scratches, or burrs can be removed with an oil stone and 400 grit paper wetted with oil. Replace the shaft if any of the teeth are worn, cracked, broken, or severely chipped.

Be sure to check condition of the countershaft bearing cups. Replace either bearings cup if worn, or damaged.

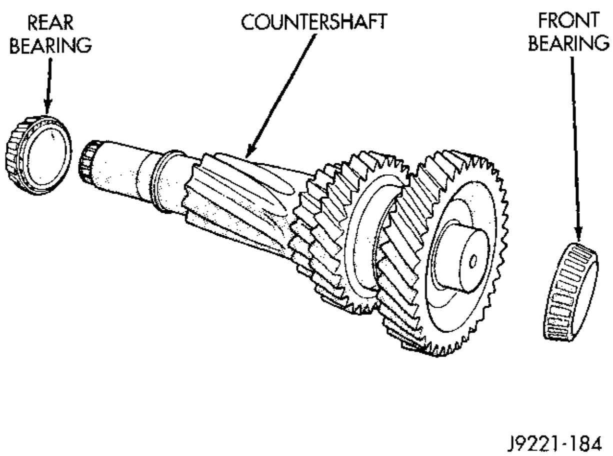


Fig. 144 Countershaft And Bearings

Check condition of the mainshaft. Inspect all the bearing surfaces, splines and threads. Also check condition of the snap ring grooves in the hub area and the speedometer drive gear teeth (Fig. 145). Minor scratches or burrs can be removed with an oil stone and polished with crocus cloth. However, replace the shaft if any surfaces exhibit considerable wear or damage.

Check condition of the gear case and extension or adapter housing. Be sure the alignment dowels in the case top surface and in the housing/adapter are tight and in good condition.

Run a tap through the gear case bolt holes if the threads need minor cleanup. Helicoil inserts can be

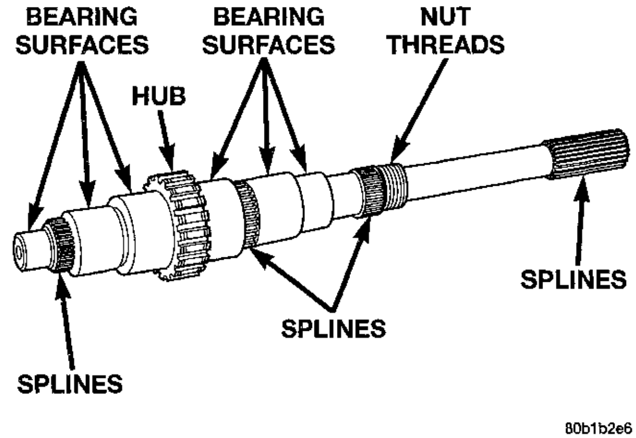


Fig. 145 Mainshaft Bearing And Spline Surfaces

used to repair seriously damaged threaded holes if necessary.

Be sure all case and housing/adapter sealing and mating surfaces are free of burrs and nicks. This is especially important as gaskets are not used in the NV4500. Minor nicks and scratches on the sealing surfaces can be dressed off with a fine tooth file or oil stone.

Replace the gear case or housing/adapter if cracked or broken. Do not attempt to repair this type of damage by welding or brazing.

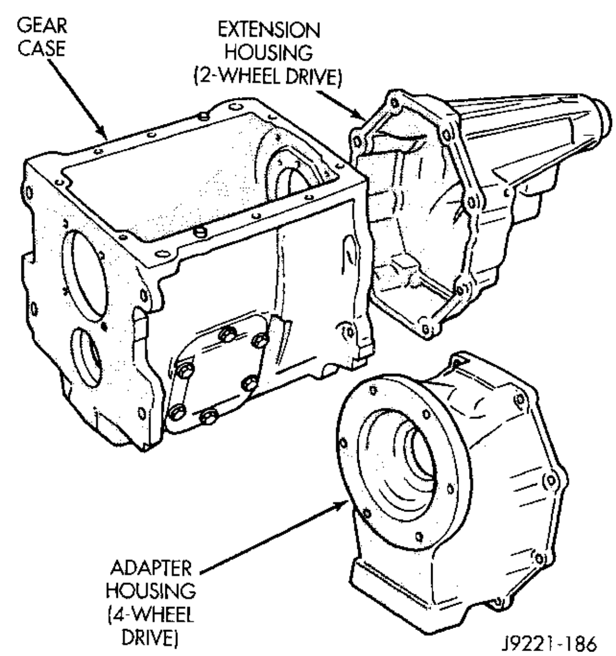


Fig. 146 Gear Case And Extension/Adapter Housings

Check condition of the countershaft fifth gear components (Fig. 147). This includes the shift lug and rail located in the gear case and the rail bushings.

CLEANING AND INSPECTION (Continued)

Inspect the gear and hub assembly. Minor burrs can be cleaned up with an oil stone. However, the gear and hub assembly should be replaced if the teeth or splines are excessively worn, or damaged. The synchro sleeve should also be replaced if worn or damaged in any way. Do not reuse synchro struts that are worn, or springs that are collapsed or severely distorted. Replace worn distorted synchro parts to avoid shift problems after assembly and installation.

The shift fork should be inspected for evidence of wear and distortion. Check fit of the sleeve in the fork to be sure the two parts fit and work smoothly. Replace the fork if the roll pin holes are worn oversize or damaged. Do not attempt to salvage a worn fork. It will cause shift problems later on. Replace the shift fork roll pins if necessary, or if doubt exists about their condition.

The bearings should be examined carefully for wear, roughness, flat spots, pitting, or other damage. Replace the bearings if necessary.

Inspect the stop ring and clutch gear. replace either part if worn or damaged in any way. Also be sure replacement parts fit properly before proceeding with assembly.

Examine the 1–2 synchro hub and sleeve for wear or damage. Replace the sleeve and hub if the splines are worn, chipped or damaged.

Replace the synchro struts if worn, or chipped. Also replace the springs if collapsed, distorted, or broken.

Inspect the mainshaft geartrain components. Check the teeth on all gears, hubs, clutch gears, stop rings and clutch rings. The teeth must be in good condition and not worn, cracked, or chipped. Replace any component that exhibits wear or damage.

Examine the synchro stop rings, clutch rings and clutch gears. Replace any part that exhibits wear, distortion, or damage. Replace the clutch rings if the friction material is burned, flaking off, or worn.

Inspect all of the thrust washers and locating pins. Replace the pins if bent, or worn. Replace the washers if worn, or the locating pin notches are distorted.

Check condition of the synchro struts and springs. Replace these parts if worn, cracked, or distorted.

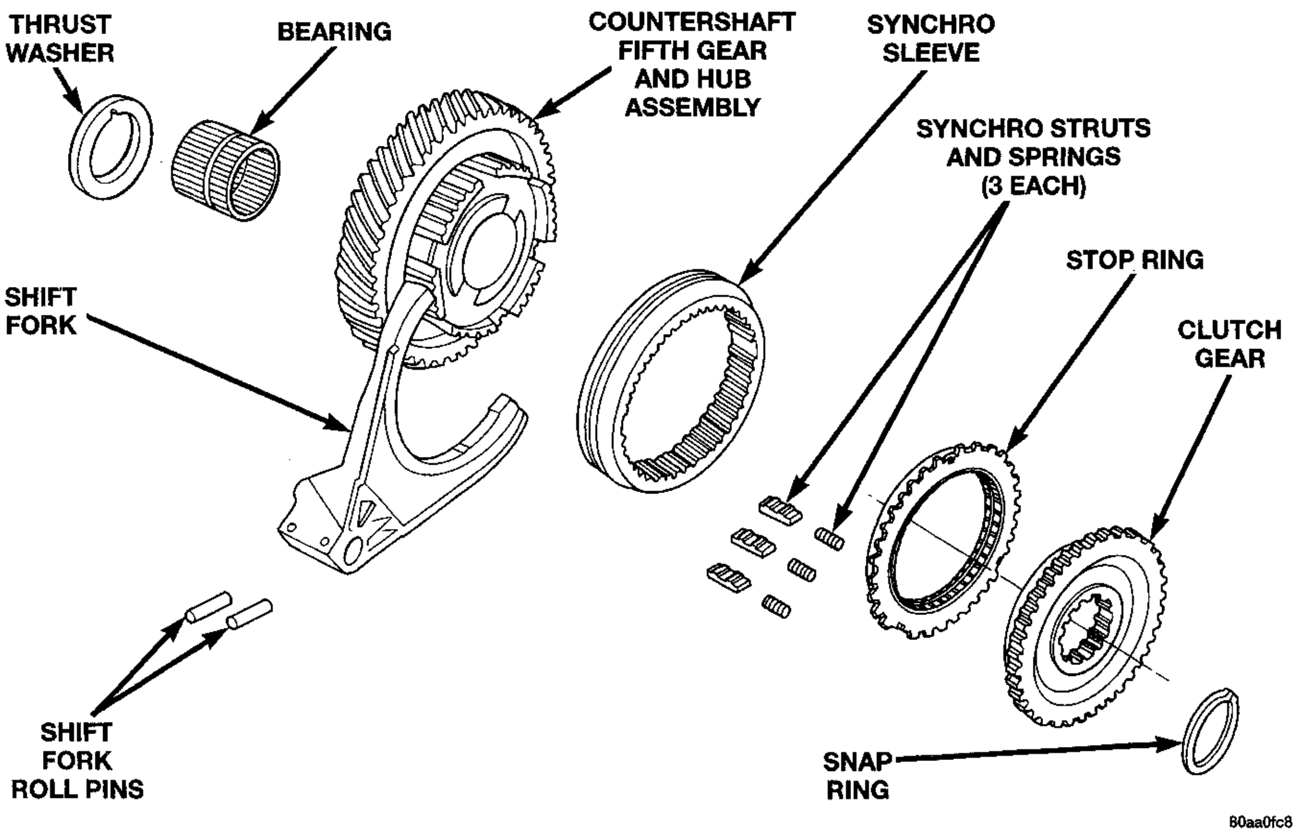


Fig. 147 Countershaft Fifth Gear Components

SPECIFICATIONS

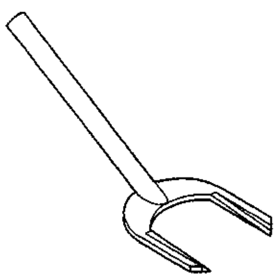
TORQUE

DESCRIPTION	TORQUE
Backup Light Switch	22-34 N·m (193-300 in. lbs.)
Countershaft Bearing Plate Bolts	19-26 N·m (170-230 in. lbs.)
Fifth Gear Nut	339-475 N·m (250-350 ft. lbs.)
Drain and Fill Plugs	34-47 N·m (25-35 ft. lbs.)
Front Bearing Retainer Bolts	27-34 N·m (235-305 in. lbs.)
Mainshaft Bearing Plate Bolts	19-26 N·m (170-230 in. lbs.)
PTO Cover Bolts	27-54 N·m (20-40 ft. lbs.)
Extension/Adapter Housing Bolts	41-68 N·m (30-50 ft. lbs.)
Reverse Inhibitor Screws	8-14 N·m (75-115 in. lbs.)
Shift Cover Bolts	27-31 N·m (216-276 in. lbs.)

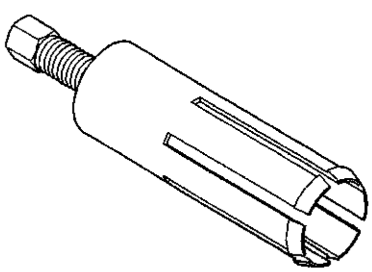
J9221-12

SPECIAL TOOLS

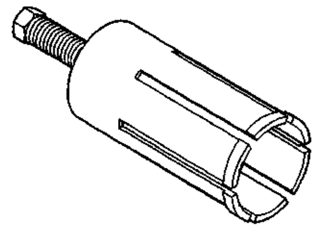
NV4500 MANUAL TRANSMISSION



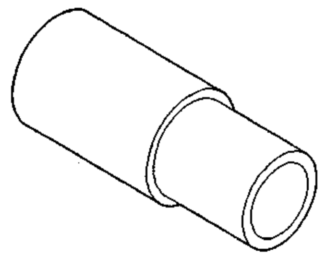
Remover, Seal—C-3985-B



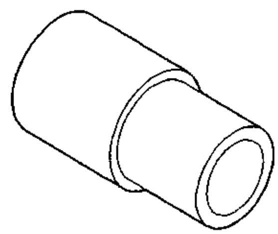
Remover, Bushing—6957



Remover, Bushing—8155

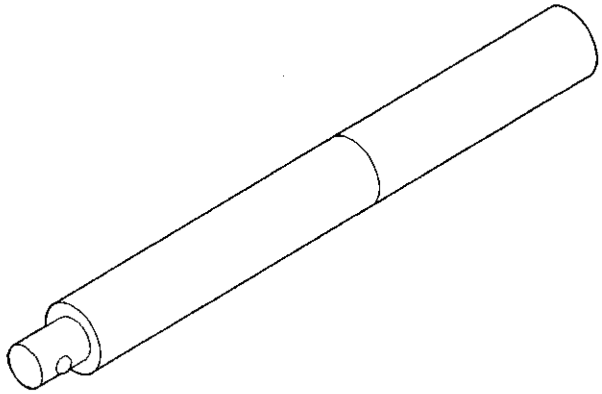


Installer, Bushing—6951

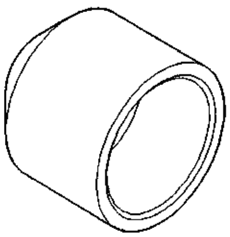


Installer, Bushing—8156

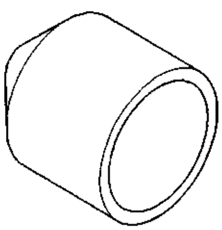
SPECIAL TOOLS (Continued)



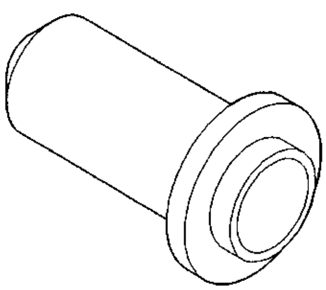
Handle Universal—C-4171



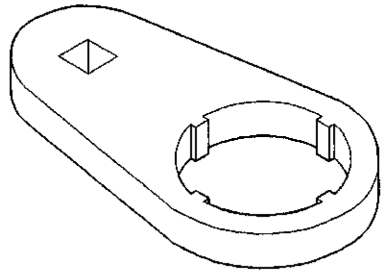
Installer, Seal—C-3972-A



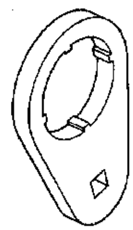
Installer, Seal—8154



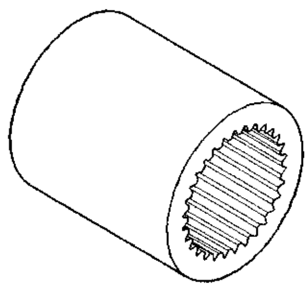
Installer, Seal—C-3860-A



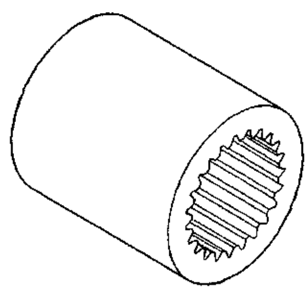
Wrench, 5th Gear Nut—6443



Wrench, Fifth Gear Nut—6743



Wrench, Splined Socket—6441



Wrench, Splined Socket—6442

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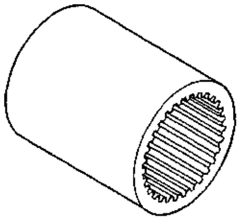
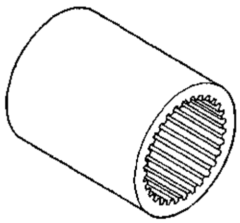
SPECIAL TOOLS (Continued)



Wrench, Splined Socket—6993



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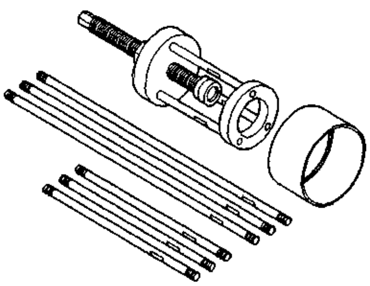
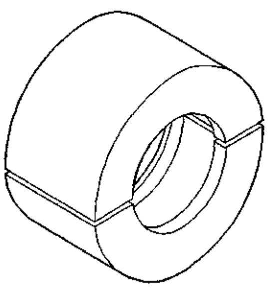
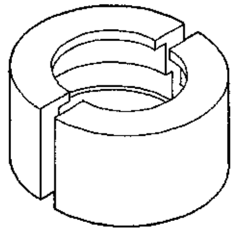


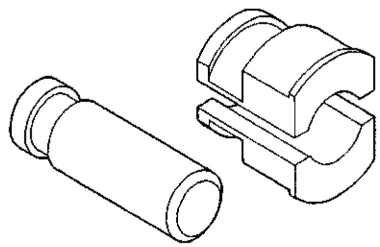
Puller, Bearing and Gear—6444



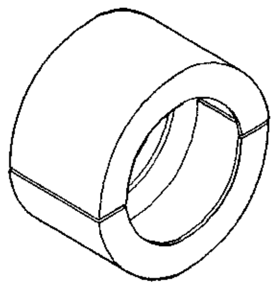
Jaws, 5th Gear (For Puller 6444)—6459



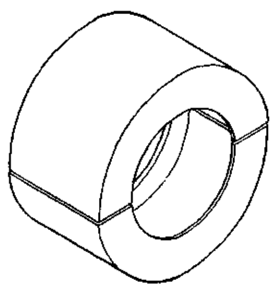
Jaws, Sprocket Remover (Use With 6444)—6820



Jaws and Insert, Sprocket Remover—6453

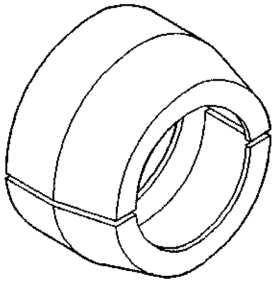


Jaws, Bearing Cone (For Puller 6444)—6447

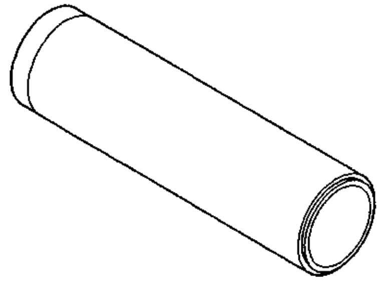


Jaws, Bearing Cone (For Puller 6444)—6449

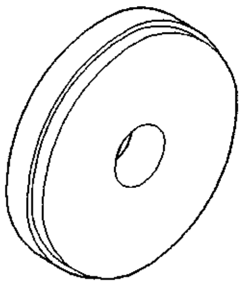
SPECIAL TOOLS (Continued)



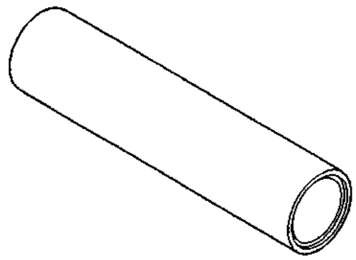
Jaws, Bearing Cone (For Puller 6444)—6451



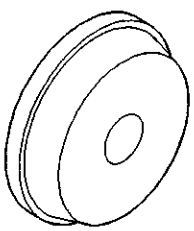
Installer—C-4040



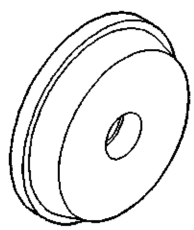
Remover, Countershaft Bearing Cup—6454



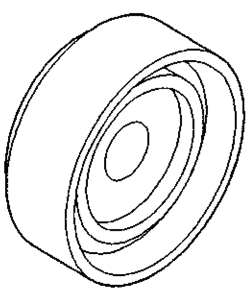
Installer, Bearing Cone—6448



Installer—6061



Installer, Bearing Cup—C-4308



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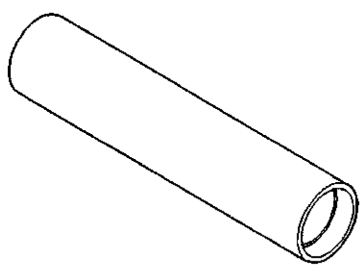
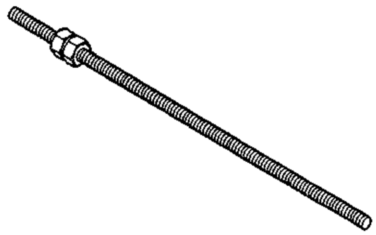
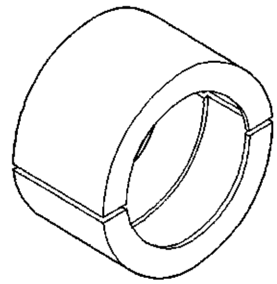


Installer, Bearing Cone—6052

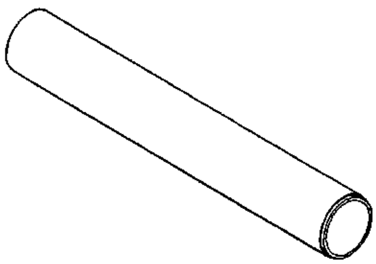
SPECIAL TOOLS (Continued)



Rod, Extension—8161



Jaws, Bearing Cone (For Puller 6444)—6445



Installer, Bearing Cone & 5th Gear—6446

AUTOMATIC TRANSMISSION—42RE

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GENERAL INFORMATION

42RE TRANSMISSION

The 42RE is a four speed fully automatic transmission (Fig. 1) with an electronic governor. First through third gear ranges are provided by the clutches, bands, overrunning clutch, and planetary gear sets in the transmission. Fourth gear range is provided by the overdrive unit that contains an overdrive clutch, direct clutch, planetary gear set, and overrunning clutch. The overdrive clutch is applied in fourth gear only. The direct clutch is applied in all ranges except fourth gear. The 42RE is equipped with a lock-up clutch in the torque converter. The torque converter clutch is controlled by the Powertrain Control Module (PCM). The torque converter clutch is hydraulically applied and is released when fluid is vented from the hydraulic circuit by the torque converter control (TCC) solenoid on the valve body. The torque converter clutch engages in fourth gear, and in third gear when the O/D switch is OFF. Engagement occurs when the vehicle is cruising on a level plane after the vehicle has warmed up. The torque converter clutch disengages when the accelerator is applied. The torque converter clutch feature increases fuel economy and reduces the transmission fluid temperature. The 42RE transmission is cooled by an integral fluid cooler inside the radiator.

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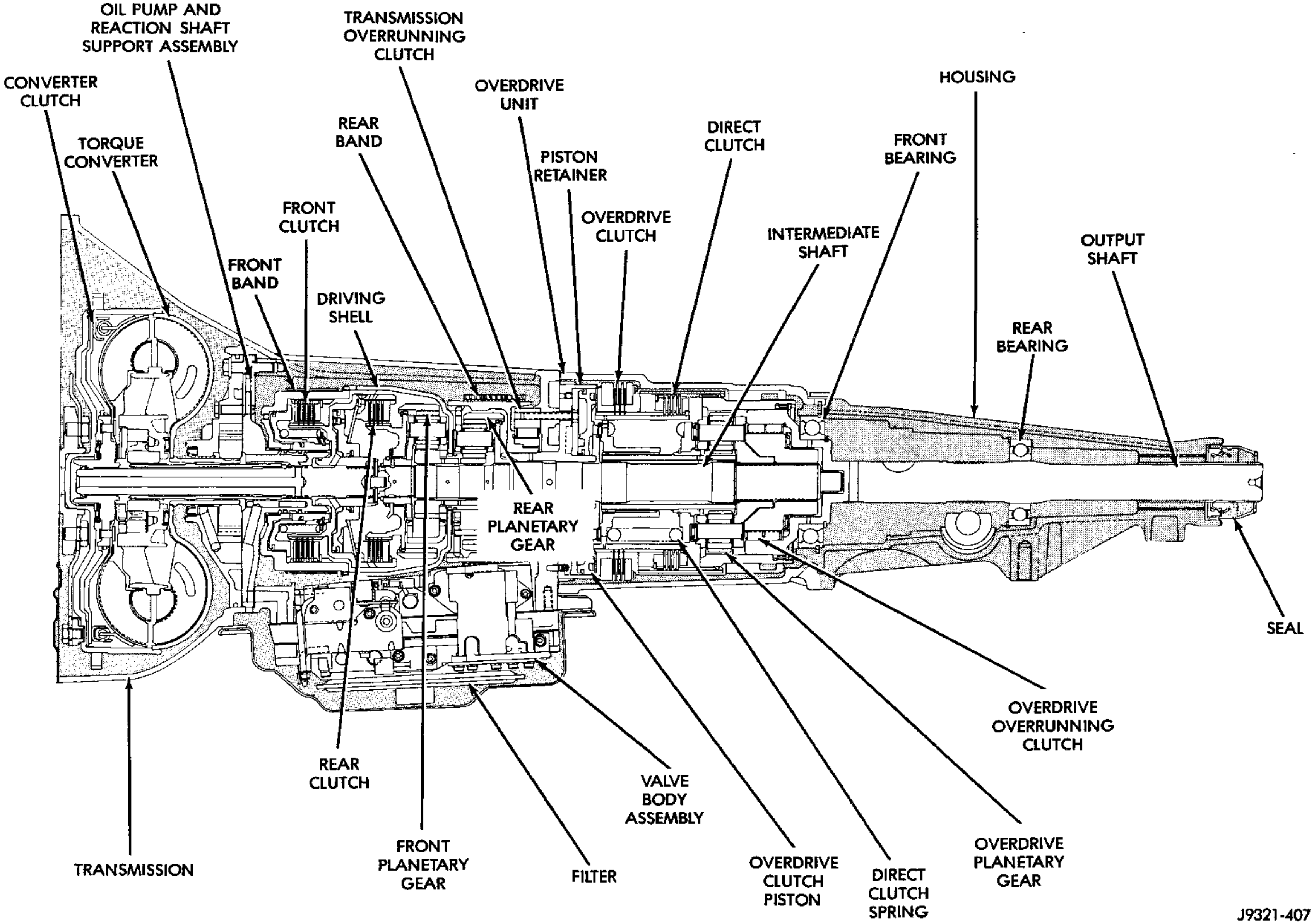

Fig. 1 42RE Transmission

GENERAL INFORMATION (Continued)

TRANSMISSION IDENTIFICATION

Transmission identification numbers are stamped on the left side of the case just above the oil pan gasket surface (Fig. 2). Refer to this information when ordering replacement parts.

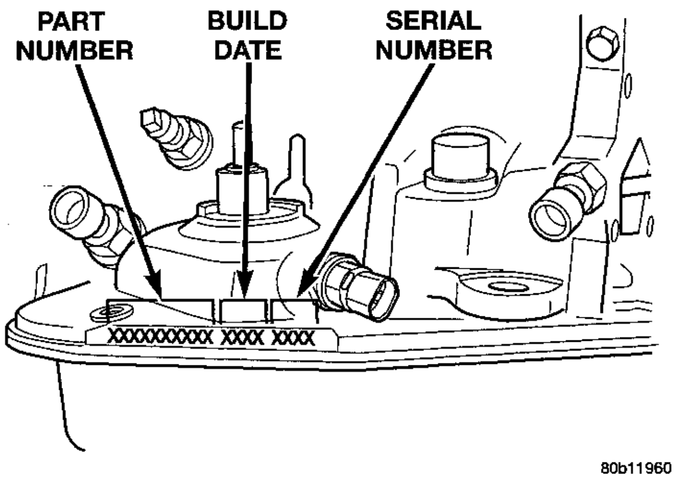

Fig. 2 Transmission Part And Serial Number Location

RECOMMENDED FLUID

Mopar® ATF Plus 3, Type 7176 automatic transmission fluid is the recommended fluid for Chrysler automatic transmissions.

Dexron II fluid IS NOT recommended. Clutch chatter can result from the use of improper fluid.

EFFECTS OF INCORRECT FLUID LEVEL

A low fluid level allows the pump to take in air along with the fluid. Air in the fluid will cause fluid pressures to be low and develop slower than normal. If the transmission is overfilled, the gears churn the fluid into foam. This aerates the fluid and causing the same conditions occurring with a low level. In either case, air bubbles cause fluid overheating, oxidation and varnish buildup which interferes with valve, clutch and servo operation. Foaming also causes fluid expansion which can result in fluid overflow from the transmission vent or fill tube. Fluid overflow can easily be mistaken for a leak if inspection is not careful.

CAUSES OF BURNT FLUID

Burnt, discolored fluid is a result of overheating which has two primary causes.

(1) A result of restricted fluid flow through the main and/or auxiliary cooler. This condition is usually the result of a faulty or improperly installed drainback valve, a damaged main cooler, or severe restrictions in the coolers and lines caused by debris or kinked lines.

(2) Heavy duty operation with a vehicle not properly equipped for this type of operation. Trailer towing or similar high load operation will overheat the transmission fluid if the vehicle is improperly equipped. Such vehicles should have an auxiliary transmission fluid cooler, a heavy duty cooling system, and the engine/axle ratio combination needed to handle heavy loads.

FLUID CONTAMINATION

Transmission fluid contamination is generally a result of:

- adding incorrect fluid
- failure to clean dipstick and fill tube when checking level
- engine coolant entering the fluid
- internal failure that generates debris
- overheat that generates sludge (fluid breakdown)
- failure to reverse flush cooler and lines after repair
- failure to replace contaminated converter after repair

The use of non recommended fluids can result in transmission failure. The usual results are erratic shifts, slippage, abnormal wear and eventual failure due to fluid breakdown and sludge formation. Avoid this condition by using recommended fluids only.

The dipstick cap and fill tube should be wiped clean before checking fluid level. Dirt, grease and other foreign material on the cap and tube could fall into the tube if not removed beforehand. Take the time to wipe the cap and tube clean before withdrawing the dipstick.

Engine coolant in the transmission fluid is generally caused by a cooler malfunction. The only remedy is to replace the radiator as the cooler in the radiator is not a serviceable part. If coolant has circulated through the transmission for some time, an overhaul may also be necessary; especially if shift problems had developed.

The transmission cooler and lines should be reverse flushed whenever a malfunction generates sludge and/or debris. The torque converter should also be replaced at the same time.

Failure to flush the cooler and lines will result in recontamination. Flushing applies to auxiliary coolers as well. The torque converter should also be replaced whenever a failure generates sludge and debris. This is necessary because normal converter flushing procedures will not remove all contaminants.

ELECTRONIC LOCK-UP TORQUE CONVERTER

The torque converter is a hydraulic device that couples the engine crankshaft to the transmission.

GENERAL INFORMATION (Continued)

The torque converter consists of an outer shell with an internal turbine, a stator, an overrunning clutch, an impeller, and an electronically applied converter clutch. Torque multiplication is created when the stator directs the hydraulic flow from the turbine to rotate the impeller in the direction the engine crankshaft is turning. The turbine transfers power to the planetary gear sets in the transmission. The transfer of power into the impeller assists torque multiplication. At low vehicle-speed, the overrunning clutch holds the stator stationary (during torque multiplication) and allows the stator to freewheel at high vehicle speed. The converter clutch engagement reduces engine speed. Clutch engagement also provides reduced transmission fluid temperatures. The torque converter hub drives the transmission oil (fluid) pump.

The torque converter is a sealed, welded unit that is not repairable and is serviced as an assembly.

CAUTION: The torque converter must be replaced if a transmission failure results in large amounts of metal or fiber contamination in the fluid.

TRANSMISSION GEAR RATIOS

Gear ratios are:

- **1st** 2.74:1
- **2nd** 1.54:1
- **3rd** 1.00:1
- **4th** 0.69:1
- **Rev.** 2.21

GEARSHIFT MECHANISM

The gear shift mechanism provides six shift positions which are:

- park (P)
- reverse (R)
- neutral (N)
- drive (D)
- manual second (2)
- manual low (1)

Manual low (1) range provides first gear only. Overrun braking is also provided in this range. Manual second (2) range provides first and second gear only.

Drive range provides first, second third and overdrive fourth gear ranges. The shift into overdrive fourth gear range occurs only after the transmission has completed the shift into D third gear range. No further movement of the shift mechanism is required to complete the 3-4 shift.

The fourth gear upshift occurs automatically when the overdrive selector switch is in the ON position.

DESCRIPTION AND OPERATION

ELECTRONIC GOVERNOR

Governor pressure is controlled electronically. Components used for governor pressure control include:

- Governor body
- Valve body transfer plate
- Governor pressure solenoid valve
- Governor pressure sensor
- Fluid temperature thermistor
- Throttle position sensor (TPS)
- Transmission speed sensor
- Powertrain control module (PCM)

GOVERNOR PRESSURE SOLENOID VALVE

The solenoid valve is a duty-cycle solenoid which regulates the governor pressure needed for upshifts and downshifts. It is an electro-hydraulic device located in the governor body on the valve body transfer plate (Fig. 3).

The inlet side of the solenoid valve is exposed to normal transmission line pressure. The outlet side of the valve leads to the valve body governor circuit.

The solenoid valve regulates line pressure to produce governor pressure. The average current supplied to the solenoid controls governor pressure. One amp current produces zero kPa/psi governor pressure. Zero amps sets the maximum governor pressure.

The powertrain control module (PCM) turns on the trans control relay which supplies electrical power to the solenoid valve. Operating voltage is 12 volts (DC). The PCM controls the ground side of the solenoid using the governor pressure solenoid control circuit.

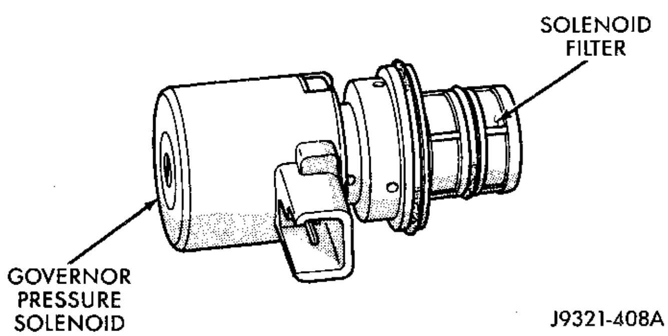

Fig. 3 Governor Pressure Solenoid Valve

GOVERNOR PRESSURE SENSOR

The governor pressure sensor measures output pressure of the governor pressure solenoid valve (Fig. 4).

The sensor output signal provides the necessary feedback to the PCM. This feedback is needed to adequately control governor pressure.

DESCRIPTION AND OPERATION (Continued)

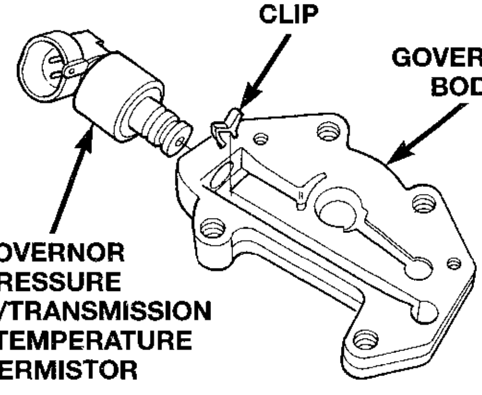

Fig. 4 Governor Pressure Sensor

GOVERNOR BODY AND TRANSFER PLATE

The transfer plate is designed to supply transmission line pressure to the governor pressure solenoid valve and to return governor pressure.

The governor pressure solenoid valve is mounted in the governor body. The body is bolted to the lower side of the transfer plate (Fig. 4). The transfer plate channels line pressure to the solenoid valve through the governor body. It also channels governor pressure from the solenoid valve to the governor circuit. It is the solenoid valve that develops the necessary governor pressure.

TRANSMISSION FLUID TEMPERATURE THERMISTOR

Transmission fluid temperature readings are supplied to the transmission control module by the thermistor. The temperature readings are used to control engagement of the fourth gear overdrive clutch, the converter clutch, and governor pressure. Normal resistance value for the thermistor at room temperature is approximately 1000 ohms.

The PCM prevents engagement of the converter clutch and overdrive clutch, when fluid temperature is below approximately 10°C (50°F).

If fluid temperature exceeds 126°C (260°F), the PCM causes a 4-3 downshift and engage the converter clutch. Engagement is according to the third gear converter clutch engagement schedule.

The overdrive OFF lamp in the instrument panel illuminates when the shift back to third occurs. The transmission will not allow fourth gear operation until fluid temperature decreases to approximately 110°C (230°F).

The thermistor is part of the governor pressure sensor assembly and is immersed in transmission fluid at all times.

TRANSMISSION SPEED SENSOR

The speed sensor (Fig. 5) is located in the overdrive gear case. The sensor is positioned over the park gear and monitors transmission output shaft rotating speed. Speed sensor signals are triggered by the park gear lugs as they rotate past the sensor pickup face. Input signals from the sensor are sent to the transmission control module for processing. The vehicle speed sensor also serves as a backup for the transmission speed sensor. Signals from this sensor are shared with the powertrain control module.

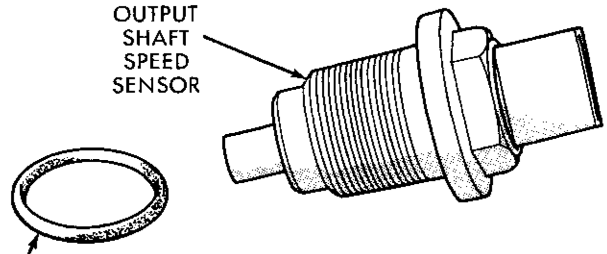

Fig. 5 Transmission Output Speed Sensor

THROTTLE POSITION SENSOR (TPS)

The TPS provides throttle position input signals to the PCM. This input signal is used to determine overdrive and converter clutch shift schedule and to select the proper governor curve.

POWERTRAIN CONTROL MODULE (PCM)

The PCM controls operation of the converter clutch, overdrive clutch, and governor pressure solenoid.

The control module determines transmission shift points based on input signals from the transmission thermistor, transmission output shaft speed sensor, crankshaft position sensor, vehicle speed sensor, throttle position sensor, and battery temperature sensor.

GOVERNOR PRESSURE CURVES

There are four governor pressure curves programmed into the transmission control module. The different curves allow the control module to adjust governor pressure for varying conditions. One curve is used for operation when fluid temperature is at, or below, 1°C (30°F). A second curve is used when fluid temperature is at, or above, 10°C (50°F) during normal city or highway driving. A third curve is used during wide-open throttle operation. The fourth curve is used when driving with the transfer case in low range.

DESCRIPTION AND OPERATION (Continued)

SHIFT VALVE OPERATION

The shift valves are moved by a combination of throttle and governor pressure. The governor pressure is generated by electrical components.

The conditions under which a shift to fourth will not occur are:

- Overdrive switch is Off
- Transmission fluid temperature is below 10° C (50° F) or above 121° C (250° F)
- Shift to third not yet completed
- Vehicle speed too low for 3-4 shift to occur
- Battery temperature below –5° F.

HYDRAULIC CONTROL SYSTEM

The hydraulic control system provides fully automatic operation. The system performs five basic functions which are: pressure supply, pressure regulation, flow control, clutch/band application, and lubrication.

PRESSURE REGULATION

The pressure regulator valve maintains line pressure. The amount of pressure developed is controlled by throttle pressure which is dependent on the degree of throttle opening. The regulator valve is located in the valve body.

The throttle valve determines line pressure and shift speed. Governor pressure increases in proportion to vehicle speed. The throttle valve controls upshift and downshift speeds by regulating pressure according to throttle position.

Shift Valve Flow Control

The manual valve is operated by the gearshift linkage and provides the operating range selected by the driver.

The 1-2 shift valve provides 1-2 or 2-1 shifts and the 2-3 shift valve provides 2-3 or 3-2 shifts.

The kickdown valve provides forced 3-2 or 3-1 downshifts depending on vehicle speed. Downshifts occur when the throttle is opened beyond downshift detent position. Detent is reached just before wide open throttle position.

The 2-3 valve throttle pressure plug provides 3-2 downshifts at varying throttle openings depending on vehicle speed.

The 1-2 shift control valve transmits 1-2 shift pressure to the accumulator piston. This controls kickdown band capacity on 1-2 upshifts and 3-2 downshifts.

The 3-4 shift, quick fill, and timing valves plus the 3-4 accumulator, are only actuated when the overdrive solenoid is energized. The solenoid contains a check ball that controls a vent port to the 3-4 valves. The check ball either diverts line pressure away from or directly to the 3-4 valves.

The limit valve determines maximum speed at which a 3-2 part throttle kickdown can be made. On transmissions without a limit valve, maximum speed for a 3-2 kickdown is at detent position.

The 2-3 shuttle valve has two functions. The first is fast front band release and smooth engagement during lift-foot 2-3 upshifts. The second is to regulate front clutch and band application during 3-2 downshifts.

The 3-4 timing valve is moved by line pressure coming through the 3-4 shift valve. The timing valve holds the 2-3 shift valve in an upshift position. The purpose is to prevent the 2-3 valve from up or downshifting before the 3-4 valve.

The 3-4 accumulator is mounted on the overdrive housing and performs the same function as the 2-3 accumulator; it is used to smooth engagement during a 3-4 shift.

The switch valve directs fluid apply pressure to the converter clutch in one position and releases it in the opposite position. It also directs oil to the cooling and lube circuits. The switch valve regulates oil pressure to the torque converter by limiting maximum oil pressure to 130 psi.

OVERDRIVE OFF SWITCH

The overdrive OFF (control) switch is located in the shift lever arm. The switch is a momentary contact device that signals the PCM to toggle current status of the overdrive function. At key-on, overdrive operation is allowed. Pressing the switch once causes the overdrive OFF mode to be entered and the overdrive OFF switch lamp to be illuminated. Pressing the switch a second time causes normal overdrive operation to be restored and the overdrive lamp to be turned off. The overdrive OFF mode defaults to ON after the ignition switch is cycled OFF and ON. The normal position for the control switch is the ON position. The switch must be in this position to energize the solenoid and allow a 3-4 upshift. The control switch indicator light illuminates only when the overdrive switch is turned to the OFF position, or when illuminated by the transmission control module.

3-4 SHIFT SEQUENCE

The overdrive clutch is applied in fourth gear only. The direct clutch is applied in all ranges except fourth gear. Fourth gear overdrive range is electronically controlled and hydraulically activated. Various sensor inputs are supplied to the powertrain control module to operate the overdrive solenoid on the valve body. The solenoid contains a check ball that opens and closes a vent port in the 3-4 shift valve feed passage. The overdrive solenoid (and check ball) are not energized in first, second, third, or reverse gear. The vent port remains open, diverting line pressure from the 2-3 shift valve away from the 3-4 shift valve. The overdrive control switch must be in the ON position

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DESCRIPTION AND OPERATION (Continued)

to transmit overdrive status to the PCM. A 3-4 upshift occurs only when the overdrive solenoid is energized by the PCM. The PCM energizes the overdrive solenoid during the 3-4 upshift. This causes the solenoid check ball to close the vent port allowing line pressure from the 2-3 shift valve to act directly on the 3-4 upshift valve. Line pressure on the 3-4 shift valve overcomes valve spring pressure moving the valve to the upshift position. This action exposes the feed passages to the 3-4 timing valve, 3-4 quick fill valve, 3-4 accumulator, and ultimately to the overdrive piston. Line pressure through the timing valve moves the overdrive piston into contact with the overdrive clutch. The direct clutch is disengaged before the overdrive clutch is engaged. The boost valve provides increased fluid apply pressure to the overdrive clutch during 3-4 upshifts, and when accelerating in fourth gear. The 3-4 accumulator cushions overdrive clutch engagement to smooth 3-4 upshifts. The accumulator is charged at the same time as apply pressure acts against the overdrive piston.

CONVERTER CLUTCH ENGAGEMENT

Converter clutch engagement in third or fourth gear range is controlled by sensor inputs to the powertrain control module. Inputs that determine clutch engagement are: coolant temperature, engine rpm, vehicle speed, throttle position, and manifold vacuum. The torque converter clutch is engaged by the clutch solenoid on the valve body. The clutch can be engaged in third and fourth gear ranges depending on overdrive control switch position. If the overdrive control switch is in the normal ON position, the clutch will engage after the shift to fourth gear, and above approximately 72 km/h (45 mph). If the control switch is in the OFF position, the clutch will engage after the shift to third gear, at approximately 56 km/h (35 mph) at light throttle.

QUICK FILL VALVE

The 3-4 quick fill valve provides faster engagement of the overdrive clutch during 3-4 upshifts. The valve temporarily bypasses the clutch piston feed orifice at the start of a 3-4 upshift. This exposes a larger passage into the piston retainer resulting in a much faster clutch fill and apply sequence. The quick fill valve does not bypass the regular clutch feed orifice throughout the 3-4 upshift. Instead, once a predetermined pressure develops within the clutch, the valve closes the bypass. Clutch fill is then completed through the regular feed orifice.

CONVERTER DRAINBACK VALVE

The drainback valve is located in the transmission cooler outlet (pressure) line. The valve prevents fluid from draining from the converter into the cooler and lines when the vehicle is shut down for lengthy periods. Production valves have a hose nipple at one end, while the opposite end is threaded for a flare fitting. All valves have an arrow (or similar mark) to indicate direction of flow through the valve.

DIAGNOSIS AND TESTING

AUTOMATIC TRANSMISSION DIAGNOSIS

Automatic transmission problems can be a result of poor engine performance, incorrect fluid level, incorrect linkage or cable adjustment, band or hydraulic control pressure adjustments, hydraulic system malfunctions or electrical/mechanical component malfunctions. Begin diagnosis by checking the easily accessible items such as: fluid level and condition, linkage adjustments and electrical connections. A road test will determine if further diagnosis is necessary.

PRELIMINARY DIAGNOSIS

Two basic procedures are required. One procedure for vehicles that are drivable and an alternate procedure for disabled vehicles (will not back up or move forward).

VEHICLE IS DRIVEABLE

(1) Check for transmission fault codes using DRB scan tool.

(2) Check fluid level and condition.

(3) Adjust throttle and gearshift linkage if complaint was based on delayed, erratic, or harsh shifts.

(4) Road test and note how transmission upshifts, downshifts, and engages.

(5) Perform stall test if complaint is based on sluggish acceleration. Or, if abnormal throttle opening is needed to maintain normal speeds with a properly tuned engine.

(6) Perform hydraulic pressure test if shift problems were noted during road test.

(7) Perform air-pressure test to check clutch-band operation.

VEHICLE IS DISABLED

(1) Check fluid level and condition.

(2) Check for broken or disconnected gearshift or throttle linkage.

(3) Check for cracked, leaking cooler lines, or loose or missing pressure-port plugs.

(4) Raise and support vehicle on safety stands, start engine, shift transmission into gear, and note following:

(a) If propeller shaft turns but wheels do not, problem is with differential or axle shafts.

(b) If propeller shaft does not turn and transmission is noisy, stop engine. Remove oil pan, and

DIAGNOSIS AND TESTING (Continued)

check for debris. If pan is clear, remove transmission and check for damaged drive plate, converter, oil pump, or input shaft.

(c) If propeller shaft does not turn and transmission is not noisy, perform hydraulic-pressure test to determine if problem is hydraulic or mechanical.

PARK/NEUTRAL POSITION SWITCH

The center terminal of the park/neutral position switch is the starter-circuit terminal. It provides the ground for the starter solenoid circuit through the selector lever in PARK and NEUTRAL positions only. The outer terminals on the switch are for the backup lamp circuit.

SWITCH TEST

To test the switch, remove the wiring connector. Test for continuity between the center terminal and the transmission case. Continuity should exist only when the transmission is in PARK or NEUTRAL.

Shift the transmission into REVERSE and test continuity at the switch outer terminals. Continuity should exist only when the transmission is in REVERSE. Continuity should not exist between the outer terminals and the case.

Check gearshift linkage adjustment before replacing a switch that tests faulty.

OVERDRIVE ELECTRICAL CONTROLS

The overdrive off switch, valve body solenoid, case connectors and related wiring can all be tested with a 12 volt test lamp or a volt/ohmmeter. Check continuity of each component when diagnosis indicates this is necessary. Refer to Group 8W, Wiring Diagrams, for component locations and circuit information.

Switch and solenoid continuity should be checked whenever the transmission fails to shift into fourth gear range.

GEARSHIFT LINKAGE AND THROTTLE CABLE

GEARSHIFT LINKAGE

Gearshift linkage adjustment is important because it positions the valve body manual valve. Incorrect adjustment will cause creeping in Neutral, premature clutch wear, delayed engagement in any gear, or a no-start in Park or Neutral position.

Proper operation of the park/neutral position switch will provide a quick check of linkage adjustment.

THROTTLE VALVE CABLE ADJUSTMENT

Throttle valve cable adjustment is important to proper operation. This adjustment positions the throttle valve which controls shift speed, quality and part throttle downshift sensitivity.

If cable setting is too short, early shifts and slippage between shifts may occur. If the setting is too long, shifts may be delayed and part throttle downshifts may be very sensitive.

ROAD TESTING

Before road testing, be sure the fluid level and control cable adjustments have been checked and adjusted if necessary. Verify that diagnostic trouble codes have been resolved.

Observe engine performance during the road test. A poorly tuned engine will not allow accurate analysis of transmission operation.

Operate the transmission in all gear ranges. Check for shift variations and engine flare which indicates slippage. Note if shifts are harsh, spongy, delayed, early, or if part throttle downshifts are sensitive.

Slippage indicated by engine flare, usually means clutch, band or overrunning clutch problems. If the condition is advanced, an overhaul will be necessary to restore normal operation.

A slipping clutch or band can often be determined by comparing which internal units are applied in the various gear ranges. The Clutch and Band Application chart provides a basis for analyzing road test results.

ANALYZING ROAD TEST

Refer to the Clutch and Band Application chart and note which elements are in use in the various gear ranges.

Note that the rear clutch is applied in all forward ranges (D, 2, 1). The transmission overrunning clutch is applied in first gear (D, 2 and 1 ranges) only. The rear band is applied in 1 and R range only.

Note that the overdrive clutch is applied only in fourth gear and the overdrive direct clutch and overrunning clutch are applied in all ranges except fourth gear.

For example: If slippage occurs in first gear in D and 2 range but not in 1 range, the transmission overrunning clutch is faulty. Similarly, if slippage occurs in any two forward gears, the rear clutch is slipping.

Applying the same method of analysis, note that the front and rear clutches are applied simultaneously only in D range third and fourth gear. If the transmission slips in third gear, either the front clutch or the rear clutch is slipping.

If the transmission slips in fourth gear but not in third gear, the overdrive clutch is slipping. By selecting another gear which does not use these clutches, the slipping unit can be determined. For example, if the transmission also slips in Reverse, the front clutch is slipping. If the transmission does not slip in Reverse, the rear clutch is slipping.

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DIAGNOSIS AND TESTING (Continued)

SHIFT LEVER POSITION	TRANSMISSION CLUTCHES AND BANDS					OVERDRIVE CLUTCHES		
	FRONT CLUTCH	FRONT BAND	REAR CLUTCH	REAR BAND	OVERRUN. CLUTCH	OVERDRIVE CLUTCH	DIRECT CLUTCH	OVERRUN. CLUTCH
Reverse	X			X			X	
Drive Range								
First			X		X		X	X
Second		X	X				X	X
Third	X		X				X	X
Fourth	X		X			X		
2-Range (Manual) Second)		X	X		X		X	X
1-Range (Manual Low)			X	X	X		X	X

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Clutch And Band Application Chart

If slippage occurs during the 3-4 shift or only in fourth gear, the overdrive clutch is slipping. Similarly, if the direct clutch were to fail, the transmission would lose both reverse gear and overrun braking in 2 position (manual second gear).

If the transmission will not shift to fourth gear, the control switch, overdrive solenoid or related wiring may also be the problem cause.

This process of elimination can be used to identify a slipping unit and check operation. Proper use of the Clutch and Band Application Chart is the key.

Although road test analysis will help determine the slipping unit, the actual cause of a malfunction usually cannot be determined until hydraulic and air pressure tests are performed. Practically any condition can be caused by leaking hydraulic circuits or sticking valves.

Unless a malfunction is obvious, such as no drive in D range first gear, do not disassemble the transmission. Perform the hydraulic and air pressure tests to help determine the probable cause.

HYDRAULIC PRESSURE TEST

Hydraulic test pressures range from a low of one psi (6.895 kPa) governor pressure, to 300 psi (2068 kPa) at the rear servo pressure port in reverse.

An accurate tachometer and pressure test gauges are required. Test Gauge C-3292 has a 100 psi range and is used at the accumulator, governor, and front servo ports. Test Gauge C-3293-SP has a 300 psi range and is used at the rear servo and overdrive ports where pressures exceed 100 psi.

Pressure Test Port Locations

Test ports are located at both sides of the transmission case (Fig. 6).

Line pressure is checked at the accumulator port on the right side of the case. The front servo pressure port is at the right side of the case just behind the filler tube opening.

The rear servo and governor pressure ports are at the right rear of the transmission case. The overdrive clutch pressure port is at the left rear of the case.

Test One - Transmission In Manual Low

NOTE: This test checks pump output, pressure regulation, and condition of the rear clutch and servo circuit. Both test gauges are required for this test.

(1) Connect tachometer to engine. Position tachometer so it can be observed from driver seat if helper will be operating engine. Raise vehicle on hoist that will allow rear wheels to rotate freely.

(2) Connect 100 psi Gauge C-3292 to accumulator port. Then connect 300 psi Gauge C-3293-SP to rear servo port.

(3) Disconnect throttle and gearshift cables from levers on transmission valve body manual shaft.

(4) Have helper start and run engine at 1000 rpm.

(5) Move transmission shift lever fully forward into 1 range.

(6) Gradually move transmission throttle lever from full forward to full rearward position and note pressures on both gauges:

DIAGNOSIS AND TESTING (Continued)

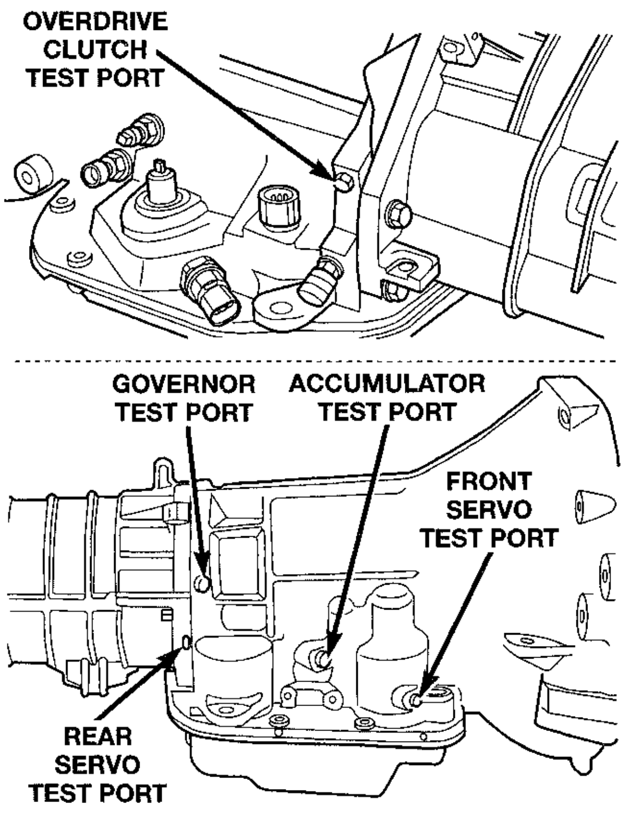

Fig. 6 Pressure Test Port Locations

- Line pressure at accumulator port should be 54-60 psi (372-414 kPa) with throttle lever forward and gradually increase to 90-96 psi (621-662 kPa) as throttle lever is moved rearward.
- Rear servo pressure should be same as line pressure within 3 psi (20.68 kPa).

Test Two—Transmission In 2 Range

NOTE: This test checks pump output, line pressure and pressure regulation. Use 100 psi Test Gauge C-3292 for this test.

(1) Leave vehicle in place on hoist and leave Test Gauge C-3292 connected to accumulator port.
(2) Have helper start and run engine at 1000 rpm.
(3) Move transmission shift lever one detent rearward from full forward position. This is 2 range.
(4) Move transmission throttle lever from full forward to full rearward position and read pressure on gauge.
(5) Line pressure should be 54-60 psi (372-414 kPa) with throttle lever forward and gradually increase to 90-96 psi (621-662 kPa) as lever is moved rearward.

Test Three—Transmission In D Range Third Gear

NOTE: This test checks pressure regulation and condition of the clutch circuits. Both test gauges are required for this test.

(1) Turn OD switch off.
(2) Leave vehicle on hoist and leave Gauge C-3292 in place at accumulator port.
(3) Move Gauge C-3293-SP over to front servo port for this test.
(4) Have helper start and run engine at 1600 rpm for this test.
(5) Move transmission shift lever two detents rearward from full forward position. This is D range.
(6) Read pressures on both gauges as transmission throttle lever is gradually moved from full forward to full rearward position:

- Line pressure at accumulator in D range third gear, should be 54-60 psi (372-414 kPa) with throttle lever forward and increase as lever is moved rearward.
- Front servo pressure in D range third gear, should be within 3 psi (21 kPa) of line pressure up to kickdown point.

Test Four—Transmission In Reverse

NOTE: This test checks pump output, pressure regulation and the front clutch and rear servo circuits. Use 300 psi Test Gauge C-3293-SP for this test.

(1) Leave vehicle on hoist and leave gauge C3292 in place at accumulator port.
(2) Move 300 psi Gauge C-3293-SP back to rear servo port.
(3) Have helper start and run engine at 1600 rpm for test.
(4) Move transmission shift lever four detents rearward from full forward position. This is Reverse range.
(5) Move transmission throttle lever fully forward then fully rearward and note reading at Gauge C-3293-SP.
(6) Pressure should be 145 - 175 psi (1000-1207 kPa) with throttle lever forward and increase to 230 - 280 psi (1586-1931 kPa) as lever is gradually moved rearward.

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DIAGNOSIS AND TESTING (Continued)

Test Five—Governor Pressure

NOTE: This test checks governor operation by measuring governor pressure response to changes in vehicle speed. It is usually not necessary to check governor operation unless shift speeds are incorrect or if the transmission will not downshift. The test should be performed on the road or on a hoist that will allow the rear wheels to rotate freely.

(1) Move 100 psi Test Gauge C-3292 to governor pressure port.

(2) Move transmission shift lever two detents rearward from full forward position. This is D range.

(3) Have helper start and run engine at curb idle speed. Then firmly apply service brakes so wheels will not rotate.

(4) Note governor pressure:

• Governor pressure should be no more than 20.6 kPa (3 psi) at curb idle speed and wheels not rotating.

• If pressure exceeds 20.6 kPa (3 psi), a fault exists in governor pressure control system.

(5) Release brakes, slowly increase engine speed, and observe speedometer and pressure test gauge (do not exceed 30 mph on speedometer). Governor pressure should increase in proportion to vehicle speed. Or approximately 6.89 kPa (1 psi) for every 1 mph.

(6) Governor pressure rise should be smooth and drop back to no more than 20.6 kPa (3 psi), after engine returns to curb idle and brakes are applied to prevent wheels from rotating.

(7) Compare results of pressure test with analysis chart.

Test Six—Transmission In Overdrive Fourth Gear

NOTE: This test checks line pressure at the overdrive clutch in fourth gear range. Use 300 psi Test Gauge C-3292 for this test. The test should be performed on the road or on a chassis dyno.

(1) Remove tachometer; it is not needed for this test.

(2) Move 300 psi Gauge to overdrive clutch pressure test port. Then remove other gauge and reinstall test port plug.

(3) Lower vehicle.

(4) Turn OD switch on.

(5) Secure test gauge so it can be viewed from drivers seat.

(6) Start engine and shift into D range.

(7) Increase vehicle speed gradually until 3-4 shift occurs and note gauge pressure.

(8) Pressure should be 469-496 kPa (68-72 psi) with closed throttle and increase to 620-827 kPa (90-120 psi) at 1/2 to 3/4 throttle. Note that pressure can increase to around 896 kPa (130 psi) at full throttle.

(9) Return to shop or move vehicle off chassis dyno.

PRESSURE TEST ANALYSIS CHART

TEST CONDITION	INDICATION
Line pressure OK during any one test	Pump and regulator valve OK
Line pressure OK in R but low in D, 2, 1	Leakage in rear clutch area (seal rings, clutch seals)
Pressure low in D Fourth Gear Range	Overdrive clutch piston seal, or check ball problem
Pressure OK in 1, 2 but low in D3 and R	Leakage in front clutch area
Pressure OK in 2 but low in R and 1	Leakage in rear servo
Front servo pressure low in 2	Leakage in servo; broken servo ring or cracked servo piston
Pressure low in all positions	Clogged filter, stuck regulator valve, worn or faulty pump, low oil level
Governor pressure too high at idle speed	Governor pressure solenoid valve system fault. Refer to diagnostic book.
Governor pressure low at all mph figures	Faulty governor pressure solenoid, transmission control module, or governor pressure sensor
Lubrication pressure low at all throttle positions	Clogged fluid cooler or lines, seal rings leaking, worn pump bushings, pump, clutch retainer, or clogged filter.
Line pressure high	Output shaft plugged, sticky regulator valve
Line pressure low	Sticky regulator valve, clogged filter, worn pump

CONVERTER STALL TEST

Stall testing involves determining maximum engine speed obtainable at full throttle with the rear wheels locked and the transmission in D range. This test checks the holding ability of the converter overrunning and transmission clutches.

WARNING: NEVER ALLOW ANYONE TO STAND DIRECTLY IN LINE WITH THE VEHICLE FRONT OR REAR DURING A STALL TEST. ALWAYS BLOCK THE WHEELS AND FULLY APPLY THE SERVICE AND PARKING BRAKES DURING THE TEST.

DIAGNOSIS AND TESTING (Continued)

STALL TEST PROCEDURE

(1) Connect tachometer to engine. Position tachometer so it can be viewed from driver's seat.

(2) Drive vehicle to bring transmission fluid up to normal operating temperature. Vehicle can be driven on road or on chassis dynamometer, if available.

(3) Check transmission fluid level. Add fluid if necessary.

(4) Block front wheels.

(5) Fully apply service and parking brakes.

(6) Open throttle completely and record maximum engine speed registered on tachometer. It takes 4-10 seconds to reach max rpm. **Once max rpm has been achieved, do not hold wide open throttle for more than 4-5 seconds.**

CAUTION: Stalling the converter causes a rapid increase in fluid temperature. To avoid fluid overheating, hold the engine at maximum rpm for no more than 5 seconds. If engine exceeds 2500 rpm during the test, release the accelerator pedal immediately; transmission clutch slippage is occurring.

(7) If a second stall test is required, cool down fluid before proceeding. Shift into NEUTRAL and run engine at 1000 rpm for 20-30 seconds to cool fluid.

STALL TEST ANALYSIS

Stall Speed Too High

If the stall speed exceeds 2500 rpm, transmission clutch slippage is indicated.

Stall Speed Low

Low stall speed with a properly tuned engine indicate a torque converter overrunning clutch problem. The condition should be confirmed by road testing. A stall speed 250-350 rpm below normal indicates the converter overrunning clutch is slipping. The vehicle also exhibits poor acceleration but operates normally once highway cruise speeds are reached. Torque converter replacement will be necessary.

Stall Speed Normal But Acceleration Poor

If stall speeds are normal (1800-2300 rpm) but abnormal throttle opening is required for acceleration, or to maintain cruise speed, the converter overrunning clutch is seized. The torque converter will have to be replaced.

Converter Noise During Test

A whining noise caused by fluid flow is normal during a stall test. However, loud metallic noises indicate a damaged converter. To confirm that the noise is originating from the converter, operate the vehicle at light throttle in DRIVE and NEUTRAL on a hoist and listen for noise coming from the converter housing.

AIR TESTING TRANSMISSION CLUTCH AND BAND OPERATION

Air-pressure testing can be used to check transmission front/rear clutch and band operation. The test can be conducted with the transmission either in the vehicle or on the work bench, as a final check, after overhaul.

Air-pressure testing requires that the oil pan and valve body be removed from the transmission. The servo and clutch apply passages are shown (Fig. 7).

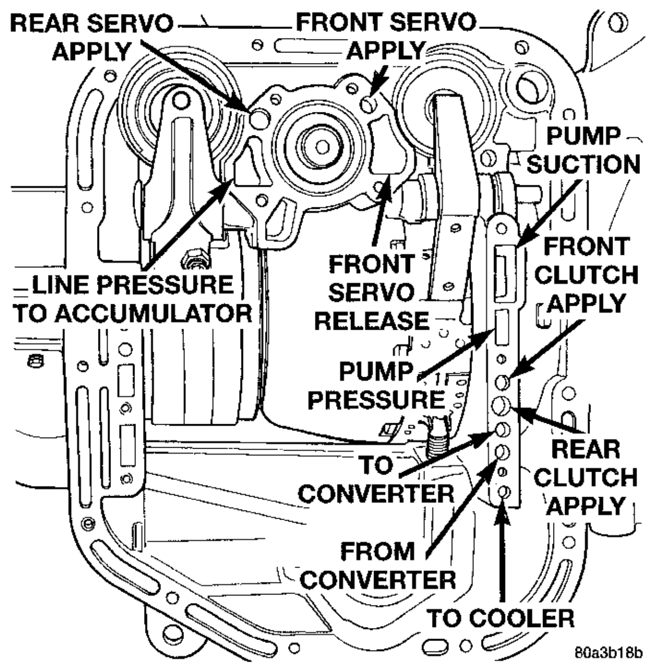

Fig. 7 Air Pressure Test Passages

Front Clutch Air Test

Place one or two fingers on the clutch housing and apply air pressure through front clutch apply passage. Piston movement can be felt and a soft thump heard as the clutch applies.

Rear Clutch Air Test

Place one or two fingers on the clutch housing and apply air pressure through rear clutch apply passage. Piston movement can be felt and a soft thump heard as the clutch applies.

Front Servo Apply Air Test

Apply air pressure to the front servo apply passage. The servo rod should extend and cause the band to tighten around the drum. Spring pressure should release the servo when air pressure is removed.

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DIAGNOSIS AND TESTING (Continued)

Rear Servo Air Test

Apply air pressure to the rear servo apply passage. The servo rod should extend and cause the band to tighten around the drum. Spring pressure should release the servo when air pressure is removed.

CONVERTER HOUSING FLUID LEAK DIAGNOSIS

When diagnosing converter housing fluid leaks, two items must be established before repair.

(1) Verify that a leak condition actually exists.

(2) Determined the true source of the leak.

Some suspected converter housing fluid leaks may not be leaks at all. They may only be the result of residual fluid in the converter housing, or excess fluid spilled during factory fill or fill after repair. Converter housing leaks have several potential sources. Through careful observation, a leak source can be identified before removing the transmission for repair. Pump seal leaks tend to move along the drive hub and onto the rear of the converter. Pump O-ring or pump body leaks follow the same path as a seal leak (Fig. 8). Pump vent or pump attaching bolt leaks are generally deposited on the inside of the converter housing and not on the converter itself (Fig. 8). Pump seal or gasket leaks usually travel down the inside of the converter housing. Front band lever pin plug leaks are generally deposited on the housing and not on the converter.

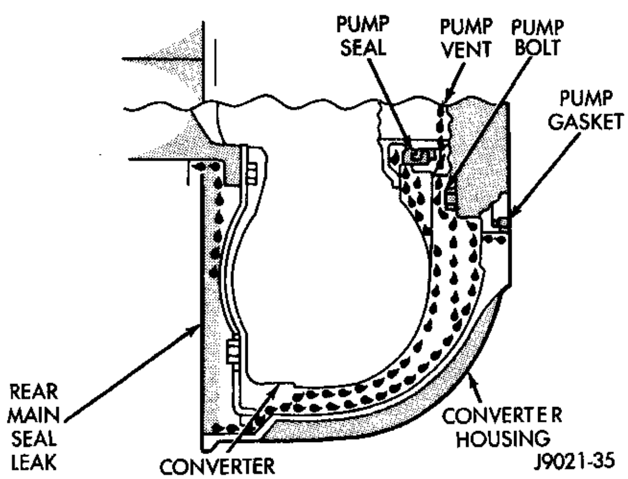

Fig. 8 Converter Housing Leak Paths

TORQUE CONVERTER LEAK POINTS

Possible sources of converter leaks are:

(1) Leaks at the weld joint around the outside diameter weld (Fig. 9).

(2) Leaks at the converter hub weld (Fig. 9).

CONVERTER HOUSING AREA LEAK CORRECTION

(1) Remove converter.

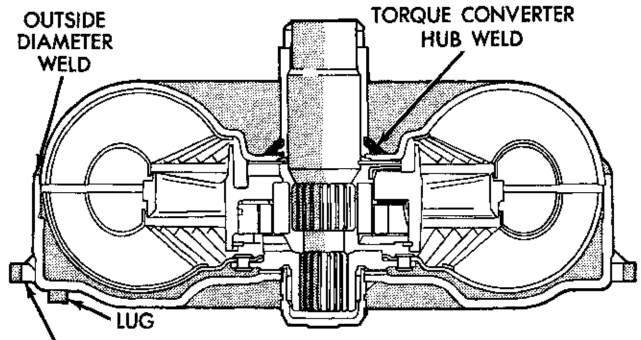

Fig. 9 Converter Leak Points—Typical

(2) Tighten front band adjusting screw until band is tight around front clutch retainer. This prevents front/rear clutches from coming out when oil pump is removed.

(3) Remove oil pump and remove pump seal. Inspect pump housing drainback and vent holes for obstructions. Clear holes with solvent and wire.

(4) Inspect pump bushing and converter hub. If bushing is scored, replace it. If converter hub is scored, either polish it with crocus cloth or replace converter.

(5) Install new pump seal, O-ring, and gasket. Replace oil pump if cracked, porous or damaged in any way. Be sure to loosen the front band before installing the oil pump, damage to the oil pump seal may occur if the band is still tightened to the front clutch retainer.

(6) Loosen kickdown lever pin access plug three turns. Apply Loctite 592, or Permatex No. 2 to plug threads and tighten plug to 17 N·m (150 in. lbs.) torque.

(7) Adjust front band.

(8) Lubricate pump seal and converter hub with transmission fluid or petroleum jelly and install converter.

(9) Install transmission and converter housing dust shield.

(10) Lower vehicle.

DIAGNOSIS TABLES AND CHARTS—RE TRANSMISSION

The diagnosis charts provide additional reference when diagnosing a transmission fault. The charts provide general information on a variety of transmission, overdrive unit and converter clutch fault conditions.

The hydraulic flow charts in the Schematics and Diagrams section of this group, outline fluid flow and hydraulic circuitry. Circuit operation is provided for neutral, third, fourth and reverse gear ranges. Normal working pressures are also supplied for each of the gear ranges.

DIAGNOSIS AND TESTING (Continued)

DIAGNOSIS CHARTS

CONDITION	POSSIBLE CAUSES	CORRECTION
HARSH ENGAGEMENT (FROM NEUTRAL TO DRIVE OR REVERSE)	1. Fluid Level Low	1. Add Fluid
	2. Throttle Linkage Misadjusted	2. Adjust linkage - setting may be too long.
	3. Mount and Driveline Bolts Loose	3. Check engine mount, transmission mount, propeller shaft, rear spring to body bolts, rear control arms, crossmember and axle bolt torque. Tighten loose bolts and replace missing bolts.
	4. U-Joint Worn/Broken	4. Remove propeller shaft and replace U-Joint.
	5. Axle Backlash Incorrect	5. Check per Service Manual. Correct as needed.
	6. Hydraulic Pressure Incorrect	6. Check pressure. Remove, overhaul or adjust valve body as needed.
	7. Band Misadjusted.	7. Adjust rear band.
	8. Valve Body Check Balls Missing.	8. Inspect valve body for proper check ball installation.
	9. Axle Pinion Flange Loose.	9. Replace nut and check pinion threads before installing new nut. Replace pinion gear if threads are damaged.
	10. Clutch, band or planetary component damaged.	10. Remove, disassemble and repair transmission as necessary.
	11. Converter Clutch Faulty.	11. Replace converter and flush cooler and line before installing new converter.

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DIAGNOSIS AND TESTING (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
DELAYED ENGAGEMENT (FROM NEUTRAL TO DRIVE OR REVERSE)	1. Fluid Level Low.	1. Correct level and check for leaks.
	2. Filter Clogged.	2. Change filter.
	3. Gearshift Linkage Misadjusted.	3. Adjust linkage and repair linkage if worn or damaged.
	4. Torque Converter Drain Back (Oil drains from torque converter into transmission sump)	4. If vehicle moves normally after 5 seconds after shifting into gear, no repair is necessary. If longer, inspect pump bushing for wear. Replace pump house.
	5. Rear Band Misadjusted.	5. Adjust band.
	6. Valve Body Filter Plugged.	6. Replace fluid and filter. If oil pan and old fluid were full of clutch disc material and/or metal particles, overhaul will be necessary.
	7. Oil Pump Gears Worn/Damaged.	7. Remove transmission and replace oil pump.
	8. Governor Circuit and Solenoid Valve Electrical Fault.	8. Test with DRB scan tool and repair as required.
	9. Hydraulic Pressure Incorrect.	9. Perform pressure test, remove transmission and repair as needed.
	10. Reaction Shaft Seal Rings Worn/Broken.	10. Remove transmission, remove oil pump and replace seal rings.
	11. Rear Clutch/Input Shaft, Rear Clutch Seal Rings Damaged.	11. Remove and disassemble transmission and repair as necessary.
	12. Regulator Valve Stuck.	12. Clean.
	13. Cooler Plugged.	13. Transfer case failure can plug cooler.
NO DRIVE RANGE (REVERSE OK)	1. Fluid Level Low.	1. Add fluid and check for leaks if drive is restored.
	2. Gearshift Linkage/Cable Loose/Misadjusted.	2. Repair or replace linkage components.
	3. Rear Clutch Burnt.	3. Remove and disassemble transmission and rear clutch and seals. Repair/replace worn or damaged parts as needed.
	4. Valve Body Malfunction.	4. Remove and disassemble valve body. Replace assembly if any valves or bores are damaged.
	5. Transmission Overrunning Clutch Broken.	5. Remove and disassemble transmission. Replace overrunning clutch.
	6. Input Shaft Seal Rings Worn/Damaged.	6. Remove and disassemble transmission. Replace seal rings and any other worn or damaged parts.
	7. Front Planetary Failed Broken.	7. Remove and repair.

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DIAGNOSIS AND TESTING (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
NO DRIVE OR REVERSE (VEHICLE WILL NOT MOVE)	1. Fluid Level Low.	1. Add fluid and check for leaks if drive is restored.
	2. Gearshift Linkage/Cable Loose/Misadjusted.	2. Inspect, adjust and reassemble linkage as needed. Replace worn/damaged parts.
	3. U-Joint/Axle/Transfer Case Broken.	3. Perform preliminary inspection procedure for vehicle that will not move. Refer to procedure in diagnosis section.
	4. Filter Plugged.	4. Remove and disassemble transmission. Repair or replace failed components as needed. Replace filter. If filter and fluid contained clutch material or metal particles, an overhaul may be necessary. Perform lube flow test. Flush oil. Replace cooler as necessary.
	5. Oil Pump Damaged.	5. Perform pressure test to confirm low pressure. Replace pump body assembly if necessary.
	6. Valve Body Malfunctioned.	6. Check and inspect valve body. Replace valve body (as assembly) if any valve or bore is damaged. Clean and reassemble correctly if all parts are in good condition.
	7. Transmission Internal Component Damaged.	7. Remove and disassemble transmission. Repair or replace failed components as needed.
	8. Park Sprag not Releasing - Check Stall Speed, Worn/Damaged/ Stuck.	8. Remove, disassemble, repair.
	9. Torque Converter Damage.	9. Inspect and replace as required.

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DIAGNOSIS AND TESTING (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
SHIFTS DELAYED OR ERRATIC (SHIFTS ALSO HARSH AT TIMES)	1. Fluid Level Low/High.	1. Correct fluid level and check for leaks if low.
	2. Fluid Filter Clogged.	2. Replace filter. If filter and fluid contained clutch material or metal particles, an overhaul may be necessary. Perform lube flow test.
	3. Throttle Linkage Misadjusted.	3. Adjust linkage as described in service section.
	4. Throttle Linkage Binding.	4. Check cable for binding. Check for return to closed throttle at transmission.
	5. Gearshift Linkage/Cable Misadjusted.	5. Adjust linkage/cable as described in service section.
	6. Clutch or Servo Failure.	6. Remove valve body and air test clutch, and band servo operation. Disassemble and repair transmission as needed.
	7. Governor Circuit Electrical Fault.	7. Test using DRB scan tool and repair as required.
	8. Front Band Misadjusted.	8. Adjust band.
	9. Pump Suction Passage Leak.	9. Check for excessive foam on dipstick after normal driving. Check for loose pump bolts, defective gasket. Replace pump assembly if needed.
NO REVERSE (D RANGES OK)	1. Gearshift Linkage/Cable Misadjusted/Damaged.	1. Repair or replace linkage parts as needed.
	2. Park Sprag Sticking.	2. Replace overdrive annulus gear.
	3. Rear Band Misadjusted/Worn.	3. Adjust band; replace.
	4. Valve Body Malfunction.	4. Remove and service valve body. Replace valve body if any valves or valve bores are worn or damaged.
	5. Rear Servo Malfunction.	5. Remove and disassemble transmission. Replace worn/ damaged servo parts as necessary.
	6. Direct Clutch in Overdrive Worn	6. Disassemble overdrive. Replace worn or damaged parts.
	7. Front Clutch Burnt.	7. Remove and disassemble transmission. Replace worn, damaged clutch parts as required.
HAS FIRST/REVERSE ONLY (NO 1-2 OR 2-3 UPSHIFT)	1. Governor Circuit Electrical Fault.	1. Test using DRB scan tool and repair as required.
	2. Valve Body Malfunction.	2. Repair stuck 1-2 shift valve or governor plug.
	3. Front Servo/Kickdown Band Damaged/Burned.	3. Repair/replace.

DIAGNOSIS AND TESTING (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
MOVES IN 2ND OR 3RD GEAR, ABRUPTLY DOWNSHIFTS TO LOW	1. Valve Body Malfunction.	1. Remove, clean and inspect. Look for stuck 1-2 valve or governor plug.
	2. Governor Valve Sticking.	2. Remove, clean and inspect. Replace faulty parts.
NO LOW GEAR (MOVES IN 2ND OR 3RD GEAR ONLY)	1. Governor Valve Sticking.	1. Remove governor, clean, inspect and repair as required.
	2. Governor Circuit Electrical Fault.	2. Test with DRB scan tool and repair as required.
	3. Valve Body Malfunction.	3. Remove, clean and inspect. Look for sticking 1-2 shift valve, 2-3 shift valve, governor plug or broken springs.
	4. Front Servo Piston Cocked in Bore.	4. Inspect servo and repair as required.
	5. Front Band Linkage Malfunction	5. Inspect linkage and look for bind in linkage.
NO KICKDOWN OR NORMAL DOWNSHIFT	1. Throttle Linkage Misadjusted.	1. Adjust linkage.
	2. Accelerator Pedal Travel Restricted.	2. Verify floor mat is not under pedal, repair worn accelerator cable or bent brackets.
	3. Valve Body Hydraulic Pressures Too High or Too Low Due to Valve Body Malfunction or Incorrect Hydraulic Control Pressure Adjustments.	3. Perform hydraulic pressure tests to determine cause and repair as required. Correct valve body pressure adjustments as required.
	4. Governor Circuit Electrical Fault.	4. Test with DRB scan tool and repair as required.
	5. Valve Body Malfunction.	5. Perform hydraulic pressure tests to determine cause and repair as required. Correct valve body pressure adjustments as required.
	6. TPS Malfunction.	6. Replace sensor, check with DRB scan tool.
	7. PCM Malfunction.	7. Check with DRB scan tool and replace if required.
	8. Valve Body Malfunction.	8. Repair sticking 1-2, 2-3 shift valves, governor plugs, 3-4 solenoid, 3-4 shift valve, 3-4 timing valve.

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DIAGNOSIS AND TESTING (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
STUCK IN LOW GEAR (WILL NOT UPSHIFT)	1. Throttle Linkage Misadjusted/ Stuck.	1. Adjust linkage and repair linkage if worn or damaged. Check for binding cable or missing return spring.
	2. Gearshift Linkage Misadjusted.	2. Adjust linkage and repair linkage if worn or damaged.
	3. Governor Component Electrical Fault.	3. Check operating pressures and test with DRB scan tool, repair faulty component.
	4. Front Band Out of Adjustment.	4. Adjust Band.
	5. Clutch or Servo Malfunction.	5. Air pressure check operation of clutches and bands. Repair faulty component.
CREEPS IN NEUTRAL	1. Gearshift Linkage Misadjusted.	1. Adjust linkage.
	2. Rear Clutch Dragging/Warped.	2. Disassemble and repair.
	3. Valve Body Malfunction.	3. Perform hydraulic pressure test to determine cause and repair as required.
BUZZING NOISE	1. Fluid Level Low	1. Add fluid and check for leaks.
	2. Shift Cable Misassembled.	2. Route cable away from engine and bell housing.
	3. Valve Body Misassembled.	3. Remove, disassemble, inspect valve body. Reassemble correctly if necessary. Replace assembly if valves or springs are damaged. Check for loose bolts or screws.
	4. Pump Passages Leaking	4. Check pump for porous casting, scores on mating surfaces and excess rotor clearance. Repair as required. Loose pump bolts.
	5. Cooling System Cooler Plugged.	5. Flow check cooler circuit. Repair as needed.
	6. Overrunning Clutch Damaged.	6. Replace clutch.
SLIPS IN REVERSE ONLY	1. Fluid Level Low.	1. Add fluid and check for leaks.
	2. Gearshift Linkage Misadjusted.	2. Adjust linkage.
	3. Rear Band Misadjusted.	3. Adjust band.
	4. Rear Band Worn.	4. Replace as required.
	5. Overdrive Direct Clutch Worn.	5. Disassemble overdrive. Repair as needed.
	6. Hydraulic Pressure Too Low.	6. Perform hydraulic pressure tests to determine cause.
	7. Rear Servo Leaking.	7. Air pressure check clutch-servo operation and repair as required.
	8. Band Linkage Binding.	8. Inspect and repair as required.

DIAGNOSIS AND TESTING (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
SLIPS IN FORWARD DRIVE RANGES	1. Fluid Level Low.	1. Add fluid and check for leaks.
	2. Fluid Foaming.	2. Check for high oil level, bad pump gasket or seals, dirt between pump halves and loose pump bolts. Replace pump if necessary.
	3. Throttle Linkage Misadjusted.	3. Adjust linkage.
	4. Gearshift Linkage Misadjusted.	4. Adjust linkage.
	5. Rear Clutch Worn.	5. Inspect and replace as needed.
	6. Low Hydraulic Pressure Due to Worn Pump, Incorrect Control Pressure Adjustments, Valve Body Warpage or Malfunction, Sticking, Leaking Seal Rings, Clutch Seals Leaking, Servo Leaks, Clogged Filter or Cooler Lines	6. Perform hydraulic and air pressure tests to determine cause.
	7. Rear Clutch Malfunction, Leaking Seals or Worn Plates.	7. Air pressure check clutch-servo operation and repair as required.
	8. Overrunning Clutch Worn, Not Holding (Slips in 1 Only).	8. Replace Clutch.
SLIPS IN LOW GEAR "D" ONLY, BUT NO IN 1 POSITION	Overrunning Clutch Faulty.	Replace overrunning clutch.
GROWLING, GRATING OR SCRAPING NOISES	1. Drive Plate Broken.	1. Replace.
	2. Torque Converter Bolts Hitting Dust Shield.	2. Dust shield bent. Replace or repair.
	3. Planetary Gear Set Broken/ Seized.	3. Check for debris in oil pan and repair as required.
	4. Overrunning Clutch Worn/Broken.	4. Inspect and check for debris in oil pan. Repair as required.
	5. Oil Pump Components Scored/ Binding.	5. Remove, inspect and repair as required.
	6. Output Shaft Bearing or Bushing Damaged.	6. Remove, inspect and repair as required.
	7. Clutch Operation Faulty.	7. Perform air pressure check and repair as required.
	8. Front and Rear Bands Misadjusted.	8. Adjust bands.

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DIAGNOSIS AND TESTING (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
DRAGS OR LOCKS UP	1. Fluid Level Low.	1. Check and adjust level.
	2. Clutch Dragging/Failed	2. Air pressure check clutch operation and repair as required.
	3. Front or Rear Band Misadjusted.	3. Adjust bands.
	4. Case Leaks Internally.	4. Check for leakage between passages in case.
	5. Servo Band or Linkage Malfunction.	5. Air pressure check servo operation and repair as required.
	6. Overrunning Clutch Worn.	6. Remove and inspect clutch. Repair as required.
	7. Planetary Gears Broken.	7. Remove, inspect and repair as required (look for debris in oil pan).
	8. Converter Clutch Dragging.	8. Check for plugged cooler. Perform flow check. Inspect pump for excessive side clearance. Replace pump as required.
NO 4-3 DOWNSHIFT	1. Circuit Wiring and/or Connectors Shorted.	1. Test wiring and connectors with test lamp and volt/ohmmeter. Repair wiring as necessary. Replace connectors and/or harnesses as required.
	2. PCM Malfunction.	2. Check PCM operation with DRB scan tool. Replace PCM only if faulty.
	3. TPS Malfunction	3. Check TPS with DRB scan tool at PCM.
	4. Lockup Solenoid Not Venting.	4. Remove valve body and replace solenoid assembly if plugged or shorted.
	5. Overdrive Solenoid Not Venting.	5. Remove valve body and replace solenoid if plugged or shorted.
	6. Valve Body Valve Sticking.	6. Repair stuck 3-4 shift valve or lockup timing valve.
NO 4-3 DOWNSHIFT WHEN CONTROL SWITCH IS TURNED OFF	1. Control Switch Open/Shorted.	1. Test and replace switch if faulty.
	2. Overdrive Solenoid Connector Shorted.	2. Test solenoids and replace if seized or shorted.
	3. PCM Malfunction.	3. Test with DRB scan tool. Replace PCM if faulty.
	4. Valve Body Stuck Valves.	4. Repair stuck 3-4, lockup or lockup timing valve.

DIAGNOSIS AND TESTING (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
CLUNK NOISE FROM DRIVELINE ON CLOSED THROTTLE 4-3 DOWNSHIFT	1. Transmission Fluid Low.	1. Add Fluid.
	2. Throttle Cable Misadjusted.	2. Adjust cable.
	3. Overdrive Clutch Select Spacer Wrong Spacer.	3. Replace overdrive piston thrust plate spacer.
3-4 UPSHIFT OCCURS IMMEDIATELY AFTER 2-3 SHIFT	1. Overdrive Solenoid Connector or Wiring Shorted.	1. Test connector and wiring for loose connections, shorts or ground and repair as needed.
	2. TPS Malfunction.	2. Test TPS and replace as necessary. Check with DRB scan tool.
	3. PCM Malfunction.	3. Test PCM with DRB scan tool and replace controller if faulty.
	4. Overdrive Solenoid Malfunction.	4. Replace solenoid.
	5. Valve Body Malfunction.	5. Remove, disassemble, clean and inspect valve body components. Make sure all valves and plugs slide freely in bores. Polish valves with crocus cloth if needed.
WHINE/NOISE RELATED TO ENGINE SPEED	1. Fluid Level Low.	1. Add fluid and check for leaks.
	2. Shift Cable Incorrect Routing.	2. Check shift cable for correct routing. Should not touch engine or bell housing.

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DIAGNOSIS AND TESTING (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
NO 3-4 UPSHIFT	1. Dash O/D Switch In OFF Position.	1. Turn control switch to ON position.
	2. Overdrive Circuit Fuse Blown.	2. Replace fuse. Determine why fuse failed and repair as necessary (i.e., shorts or grounds in circuit).
	3. O/D Switch Wire Shorted/Open Cut.	3. Check wires/connections with 12V test lamp and voltmeter. Repair damaged or loose wire/connection as necessary.
	4. Distance or Coolant Sensor Malfunction.	4. Check with DRB scan tool and repair or replace as necessary.
	5. TPS Malfunction.	5. Check with DRB scan tool and replace if necessary.
	6. Neutral Switch to PCM Wire Shorted/Cut.	6. Test switch as described in service section and replace if necessary. Engine no start.
	7. PCM Malfunction.	7. Check with DRB scan tool and replace if necessary.
	8. Overdrive Solenoid Shorted/ Open.	8. Replace solenoid if shorted or open and repair loose or damaged wires (DRB scan tool).
	9. Solenoid Feed Orifice in Valve Body Blocked.	9. Remove, disassemble, and clean valve body thoroughly. Check feed orifice.
	10. Overdrive Clutch Failed.	10. Disassemble overdrive and repair as needed.
	11. Hydraulic Pressure Low.	11. Pressure test transmission to determine cause.
	12. Valve Body Valve Stuck.	12. Repair stuck 3-4 shift valve, 3-4 timing valve.
	13. O/D Piston Incorrect Spacer.	13. Remove unit, check end play and install correct spacer.
	14. Overdrive Piston Seal Failure.	14. Replace both seals.
	15. O/D Check Valve/Orifice Failed.	15. Check for free movement and secure assembly (in piston retainer). Check ball bleed orifice.

DIAGNOSIS AND TESTING (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
SLIPS IN OVERDRIVE FOURTH GEAR	1. Fluid Level Low.	1. Add fluid and check for leaks.
	2. Overdrive Clutch Pack Worn.	2. Remove overdrive unit and rebuild clutch pack.
	3. Overdrive Piston Retainer Bleed Orifice Blown Out.	3. Disassemble transmission, remove retainer and replace orifice.
	4. Overdrive Piston or Seal Malfunction.	4. Remove overdrive unit. Replace seals if worn. Replace piston if damaged. If piston retainer is damaged, remove and disassemble the transmission.
	5. 3-4 Shift Valve, Timing Valve or Accumulator Malfunction.	5. Remove and overhaul valve body. Replace accumulator seals. Make sure all valves operate freely in bores and do not bind or stick. Make sure valve body screws are correctly tightened and separator plates are properly positioned.
	6. Overdrive Unit Thrust Bearing Failure.	6. Disassemble overdrive unit and replace thrust bearing (NO. 1 thrust bearing is between overdrive piston and clutch hub; NO. 2 thrust bearing is between the planetary gear and the direct clutch spring plate; NO. 3 thrust bearing is between overrunning clutch hub and output shaft).
	7. O/D Check Valve/Bleed Orifice Failure.	7. Check for function/secure orifice insert in O/D piston retainer.
DELAYED 3-4 UPSHIFT (SLOW TO ENGAGE)	1. Fluid Level Low.	1. Add fluid and check for leaks.
	2. Throttle Valve Cable Misadjusted.	2. Adjust throttle valve cable.
	3. Overdrive Clutch Pack Worn/ Burnt.	3. Remove unit and rebuild clutch pack.
	4. TPS Faulty.	4. Test with DRB scan tool and replace as necessary
	5. Overdrive Clutch Bleed Orifice Plugged.	5. Disassemble transmission and replace orifice.
	6. Overdrive Solenoid or Wiring Shorted/Open.	6. Test solenoid and check wiring for loose/corroded connections or shorts/grounds. Replace solenoid if faulty and repair wiring if necessary.
	7. Overdrive Excess Clearance	7. Remove unit. Measure end play and select proper spacer.
	8. O/D Check Valve Missing or Stuck.	8. Check for presence of check valve. Repair or replace as required.

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DIAGNOSIS AND TESTING (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
TORQUE CONVERTER LOCKS UP IN SECOND AND/OR THIRD GEAR	Lockup Solenoid, Relay or Wiring Shorted/Open.	Test solenoid, relay and wiring for continuity, shorts or grounds. Replace solenoid and relay if faulty. Repair wiring and connectors as necessary.
HARSH 1-2, 2-3, 3-4 OR 3-2 SHIFTS	Lockup Solenoid Malfunction.	Remove valve body and replace solenoid assembly.
NO START IN PARK OR NEUTRAL	1. Gearshift Linkage/Cable Misadjusted.	1. Adjust linkage/cable.
	2. Neutral Switch Wire Open/Cut.	2. Check continuity with test lamp. Repair as required.
	3. Neutral Switch Faulty.	3. Refer to service section for test and replacement procedure.
	4. Neutral Switch Connect Faulty.	4. Connectors spread open. Repair.
	5. Valve Body Manual Lever Assembly Bent/Worn/Broken.	5. Inspect lever assembly and replace if damaged.
NO REVERSE (OR SLIPS IN REVERSE)	1. Direct Clutch Pack (front clutch) Worn.	1. Disassemble unit and rebuild clutch pack.
	2. Rear Band Misadjusted.	2. Adjust band.
	3. Front Clutch Malfunctioned/ Burned.	3. Air-pressure test clutch operation. Remove and rebuild if necessary.
	4. Overdrive Thrust Bearing Failure.	4. Disassemble geartrain and replace bearings.
	5. Direct Clutch Spring Collapsed/ Broken.	5. Remove and disassemble unit. Check clutch position and replace spring.

DIAGNOSIS AND TESTING (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
OIL LEAKS.	1. Fluid Lines and Fittings Loose/Leaks/Damaged.	1. Tighten fittings. If leaks persist, replace fittings and lines if necessary.
	2. Fill Tube (where tube enters case) Leaks/Damaged.	2. Replace tube seal. Inspect tube for cracks in fill tube.
	3. Pressure Port Plug Loose Loose/Damaged.	3. Tighten to correct torque. Replace plug or reseal if leak persists.
	4. Pan Gasket Leaks.	4. Tighten pan screws (150 in. lbs.). If leaks persist, replace gasket.
	5. Valve Body Manual Lever Shaft Seal Leaks/Worn.	5. Replace shaft seal.
	6. Rear Bearing Access Plate Leaks.	6. Replace gasket. Tighten screws.
	7. Gasket Damaged or Bolts are Loose.	7. Replace bolts or gasket or tighten both.
	8. Adapter/Extension Gasket Damaged Leaks/Damaged.	8. Replace gasket.
	9. Neutral Switch Leaks/Damaged.	9. Replace switch and gasket.
	10. Converter Housing Area Leaks.	10. Check for leaks at seal caused by worn seal or burr on converter hub (cutting seal), worn bushing, missing oil return, oil in front pump housing or hole plugged. Check for leaks past O-ring seal on pump or past pump-to-case bolts; pump housing porous, oil coming out vent due to overfill or leak past front band shaft access plug.
	11. Pump Seal Leaks/Worn/ Damaged.	11. Replace seal.
	12. Torque Converter Weld Leak/Cracked Hub.	12. Replace converter.
	13. Case Porosity Leaks.	13. Replace case.
NOISY OPERATION IN FOURTH GEAR ONLY	1. Overdrive Clutch Discs, Plates or Snap Rings Damaged.	1. Remove unit and rebuild clutch pack.
	2. Overdrive Piston or Planetary Thrust Bearing Damaged.	2. Remove and disassemble unit. Replace either thrust bearing if damaged.
	3. Output Shaft Bearings Scored/ Damaged.	3. Remove and disassemble unit. Replace either bearing if damaged.
	4. Planetary Gears Worn/Chipped.	4. Remove and overhaul overdrive unit.
	5. Overdrive Unit Overrunning Clutch Rollers Worn/Scored.	5. Remove and overhaul overdrive unit.

SERVICE PROCEDURES

FLUID LEVEL CHECK

Transmission fluid level should be checked monthly under normal operation. If the vehicle is used for trailer towing or similar heavy load hauling, check fluid level and condition weekly. Fluid level is checked with the engine running at curb idle speed, the transmission in NEUTRAL and the transmission fluid at normal operating temperature.

FLUID LEVEL CHECK PROCEDURE

(1) Transmission fluid must be at normal operating temperature for accurate fluid level check. Drive vehicle if necessary to bring fluid temperature up to normal hot operating temperature of 82°C (180°F).

(2) Position vehicle on level surface.

(3) Start and run engine at curb idle speed.

(4) Apply parking brakes.

(5) Shift transmission momentarily into all gear ranges. Then shift transmission back to Neutral.

(6) Clean top of filler tube and dipstick to keep dirt from entering tube.

(7) Remove dipstick (Fig. 10) and check fluid level as follows:

(a) Correct acceptable level is in crosshatch area.

(b) Correct maximum level is to MAX arrow mark.

(c) Incorrect level is at or below MIN line.

(d) If fluid is low, add only enough Mopar® ATF Plus 3 to restore correct level. Do not overfill.

CAUTION: Do not overfill the transmission. Overfilling may cause leakage out the pump vent which can be mistaken for a pump seal leak. Overfilling will also cause fluid aeration and foaming as the excess fluid is picked up and churned by the gear train. This will significantly reduce fluid life.

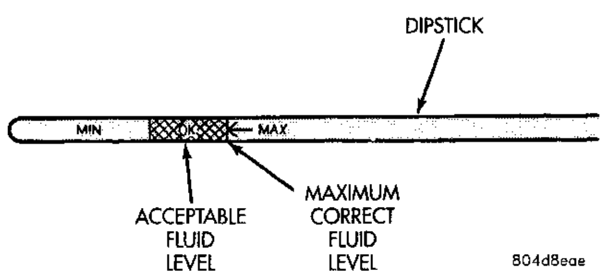

Fig. 10 Dipstick Fluid Level Marks—Typical

FLUID AND FILTER REPLACEMENT

Refer to the Maintenance Schedules in Group 0, Lubrication and Maintenance, for proper service intervals. The service fluid fill after a filter change is approximately 3.8 liters (4.0 quarts).

REMOVAL

(1) Hoist and support vehicle on safety stands.

(2) Place a large diameter shallow drain pan beneath the transmission pan.

(3) Remove bolts holding front and sides of pan to transmission (Fig. 11).

(4) Loosen bolts holding rear of pan to transmission.

(5) Slowly separate front of pan away from transmission allowing the fluid to drain into drain pan.

(6) Hold up pan and remove remaining bolt holding pan to transmission.

(7) While holding pan level, lower pan away from transmission.

(8) Pour remaining fluid in pan into drain pan.

(9) Remove screws holding filter to valve body (Fig. 12).

(10) Separate filter from valve body and pour fluid in filter into drain pan.

(11) Dispose of used trans fluid and filter properly.

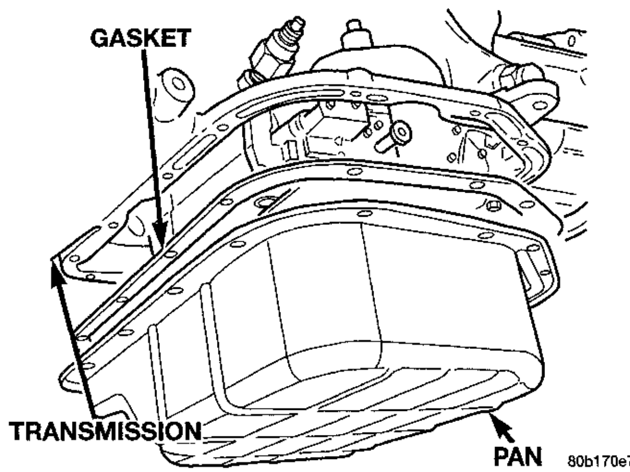

Fig. 11 Transmission Pan—Typical

INSPECTION

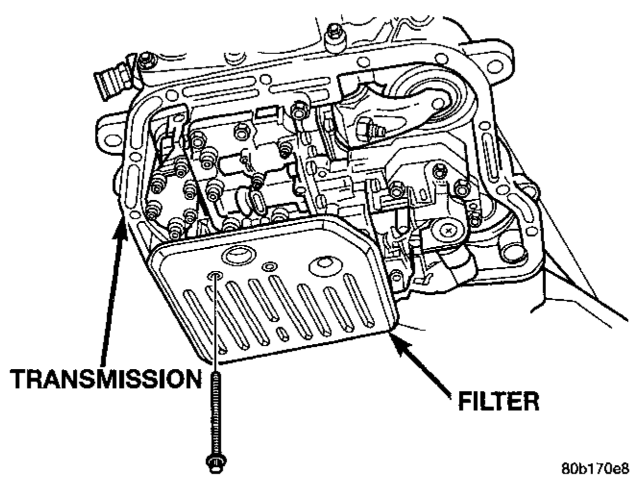

Fig. 12 Transmission Filter—Typical

Inspect bottom of pan and magnet for excessive amounts of metal. A light coating of clutch or band

SERVICE PROCEDURES (Continued)

material on the bottom of the pan does not indicate a problem unless accompanied by slipping condition or shift lag. If fluid and pan are contaminated with excessive amounts or debris, refer to the diagnosis section of this group.

Check the adjustment of the front and rear bands, adjust if necessary.

CLEANING

(1) Using a suitable solvent, clean pan and magnet.

(2) Using a suitable gasket scraper, clean gasket material from gasket surface of transmission case and the gasket flange around the pan.

INSTALLATION

(1) Place replacement filter in position on valve body.

(2) Install screws to hold filter to valve body (Fig. 12). Tighten screws to 4 N·m (35 in. lbs.) torque.

(3) Place new gasket in position on pan and install pan on transmission.

(4) Place pan in position on transmission.

(5) Install screws to hold pan to transmission (Fig. 11). Tighten bolts to 17 N·m (150 in. lbs.) torque.

(6) Lower vehicle and fill transmission with Mopar® ATF Plus 3, type 7176 fluid.

TRANSMISSION FILL PROCEDURE

To avoid overfilling transmission after a fluid change or overhaul, perform the following procedure:

(1) Remove dipstick and insert clean funnel in transmission fill tube.

(2) Add following initial quantity of Mopar® ATF Plus 3 to transmission:

(a) If only fluid and filter were changed, add **3 pints (1-1/2 quarts)** of ATF Plus 3 to transmission.

(b) If transmission was completely overhauled, torque converter was replaced or drained, and cooler was flushed, add **12 pints (6 quarts)** of ATF Plus 3 to transmission.

(3) Apply parking brakes.

(4) Start and run engine at normal curb idle speed.

(5) Apply service brakes, shift transmission through all gear ranges then back to NEUTRAL, set parking brake, and leave engine running at curb idle speed.

(6) Remove funnel, insert dipstick and check fluid level. If level is low, **add fluid to bring level to MIN mark on dipstick.** Check to see if the oil level is equal on both sides of the dipstick. If one side is noticably higher than the other, the dipstick has picked up some oil from the dipstick tube. Allow the oil to drain down the dipstick tube and re-check.

(7) Drive vehicle until transmission fluid is at normal operating temperature.

(8) With the engine running at curb idle speed, the gear selector in NEUTRAL, and the parking brake applied, check the transmission fluid level.

CAUTION: Do not overfill transmission, fluid foaming and shifting problems can result.

(9) Add fluid to bring level up to MAX arrow mark.

When fluid level is correct, shut engine off, release park brake, remove funnel, and install dipstick in fill tube.

CONVERTER DRAINBACK CHECK VALVE SERVICE

The converter drainback check valve is located in the cooler outlet (pressure) line near the radiator lower tank. The valve prevents fluid drainback when the vehicle is parked for lengthy periods. The valve check ball is spring loaded and has an opening pressure of approximately 2 psi.

The valve is serviced as an assembly; it is not repairable. Do not clean the valve if restricted, or contaminated by sludge, or debris. If the valve fails, or if a transmission malfunction occurs that generates sludge and/or clutch particles and metal shavings, the valve must be replaced.

The valve must be removed whenever the cooler and lines are reverse flushed. The valve can be flow tested when necessary. The procedure is exactly the same as for flow testing a cooler.

If the valve is restricted, installed backwards, or in the wrong line, it will cause an overheating condition and possible transmission failure.

CAUTION: The drainback valve is a one-way flow device. It must be properly oriented in terms of flow direction for the cooler to function properly. The valve must be installed in the pressure line. Otherwise flow will be blocked and would cause an overheating condition and eventual transmission failure.

OIL PUMP VOLUME CHECK

After the new or repaired transmission has been installed, fill to the proper level with Mopar® ATF PLUS 3 (Type 7176) automatic transmission fluid. The volume should be checked using the following procedure:

(1) Disconnect the **From cooler** line at the transmission and place a collecting container under the disconnected line.

CAUTION: With the fluid set at the proper level, fluid collection should not exceed (1) quart or internal damage to the transmission may occur.

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SERVICE PROCEDURES (Continued)

(2) Run the engine **at curb idle speed**, with the shift selector in neutral.

(3) If fluid flow is intermittent or it takes more than 20 seconds to collect one quart of ATF PLUS 3, disconnect the **To Cooler** line at the transaxle.

(4) Refill the transaxle to proper level and recheck pump volume.

(5) If flow is found to be within acceptable limits, replace the cooler. Then fill transmission to the proper level, using Mopar® ATF PLUS 3 (Type 7176) automatic transmission fluid.

(6) If fluid flow is still found to be inadequate, check the line pressure using the Transaxle Hydraulic Pressure Test procedure.

FLUSHING COOLERS AND TUBES

When a transmission failure has contaminated the fluid, the oil cooler(s) must be flushed. The cooler bypass valve in the transmission must be replaced also. The torque converter must also be replaced. This will insure that metal particles or sludged oil are not later transferred back into the reconditioned (or replaced) transmission.

The only recommended procedure for flushing coolers and lines is to use Tool 6906 Cooler Flusher.

WARNING: WEAR PROTECTIVE EYEWEAR THAT MEETS THE REQUIREMENTS OF OSHA AND ANSI Z87.1–1968. WEAR STANDARD INDUSTRIAL RUBBER GLOVES.

KEEP LIGHTED CIGARETTES, SPARKS, FLAMES, AND OTHER IGNITION SOURCES AWAY FROM THE AREA TO PREVENT THE IGNITION OF COMBUSTIBLE LIQUIDS AND GASES. KEEP A CLASS (B) FIRE EXTINGUISHER IN THE AREA WHERE THE FLUSHER WILL BE USED.

KEEP THE AREA WELL VENTILATED.

DO NOT LET FLUSHING SOLVENT COME IN CONTACT WITH YOUR EYES OR SKIN: IF EYE CONTAMINATION OCCURS, FLUSH EYES WITH WATER FOR 15 TO 20 SECONDS. REMOVE CONTAMINATED CLOTHING AND WASH AFFECTED SKIN WITH SOAP AND WATER. SEEK MEDICAL ATTENTION.

COOLER FLUSH USING TOOL 6906

(1) Remove cover plate filler plug on Tool 6906. Fill reservoir 1/2 to 3/4 full of fresh flushing solution. Flushing solvents are petroleum based solutions generally used to clean automatic transmission components. **DO NOT** use solvents containing acids, water, gasoline, or any other corrosive liquids.

(2) Reinstall filler plug on Tool 6906.

(3) Verify pump power switch is turned OFF. Connect red alligator clip to positive (+) battery post. Connect black (-) alligator clip to a good ground.

(4) Disconnect the cooler lines at the transmission.

NOTE: When flushing transmission cooler and lines, ALWAYS reverse flush.

(5) Connect the BLUE pressure line to the OUTLET (From) cooler line.

(6) Connect the CLEAR return line to the INLET (To) cooler line

(7) Turn pump ON for two to three minutes to flush cooler(s) and lines. Monitor pressure readings and clear return lines. Pressure readings should stabilize below 20 psi. for vehicles equipped with a single cooler and 30 psi. for vehicles equipped with dual coolers. If flow is intermittent or exceeds these pressures, replace cooler.

(8) Turn pump OFF.

(9) Disconnect CLEAR suction line from reservoir at cover plate. Disconnect CLEAR return line at cover plate, and place it in a drain pan.

(10) Turn pump ON for 30 seconds to purge flushing solution from cooler and lines. Turn pump OFF.

(11) Place CLEAR suction line into a one quart container of Mopar® ATF Plus 3, type 7176 automatic transmission fluid.

(12) Turn pump ON until all transmission fluid is removed from the one quart container and lines. This purges any residual cleaning solvent from the transmission cooler and lines. Turn pump OFF.

(13) Disconnect alligator clips from battery. Reconnect flusher lines to cover plate, and remove flushing adapters from cooler lines.

ALUMINUM THREAD REPAIR

Damaged or worn threads in the aluminum transaxle case and valve body can be repaired by the use of Heli-Coils, or equivalent. This repair consists of drilling out the worn-out damaged threads. Then tap the hole with a special Heli-Coil tap, or equivalent, and installing a Heli-Coil insert, or equivalent, into the hole. This brings the hole back to its original thread size.

Heli-Coil, or equivalent, tools and inserts are readily available from most automotive parts suppliers.

REMOVAL AND INSTALLATION

TRANSMISSION

The overdrive unit can be removed and serviced separately. It is not necessary to remove the entire transmission assembly to perform overdrive unit repairs.

If only the overdrive unit requires service, refer to the overdrive unit removal and installation procedures.

REMOVAL AND INSTALLATION (Continued)

CAUTION: The transmission and torque converter must be removed as an assembly to avoid component damage. The converter drive plate, pump bushing, or oil seal can be damaged if the converter is left attached to the driveplate during removal. Be sure to remove the transmission and converter as an assembly.

REMOVAL

(1) Disconnect battery negative cable.

(2) Disconnect and lower or remove necessary exhaust components.

(3) Remove engine-to-transmission struts, if equipped (Fig. 13).

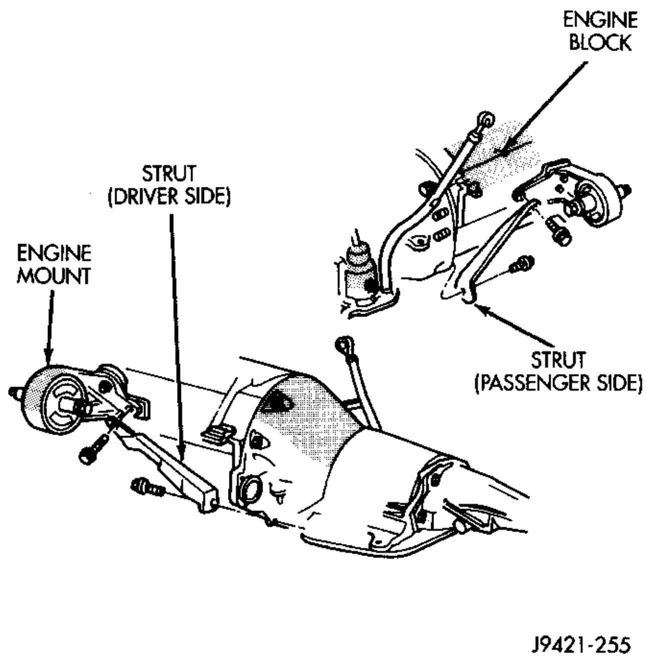

Fig. 13 Transmission-To-Engine Strut Attachment

(4) Disconnect fluid cooler lines at transmission.

(5) Remove starter motor.

(6) Disconnect and remove the crankshaft position sensor. Retain the sensor attaching bolts.

(7) Remove torque converter access cover.

(8) If transmission is being removed for overhaul, remove transmission oil pan, drain fluid and reinstall pan.

(9) Remove fill tube bracket bolts and pull tube out of transmission. Retain fill tube seal (Fig. 13). On 4 x 4 models, it will also be necessary to remove bolt attaching transfer case vent tube to converter housing (Fig. 14).

(10) Mark torque converter and drive plate for assembly alignment. Note that bolt holes in crankshaft flange, drive plate and torque converter all have one offset hole.

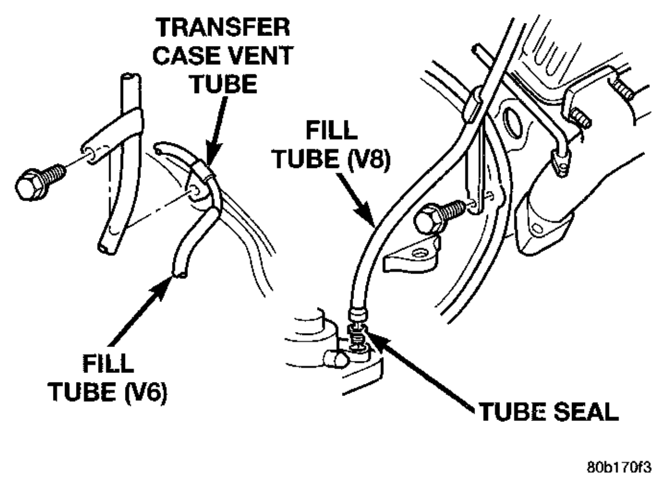

Fig. 14 Fill Tube Attachment

(11) Rotate crankshaft in clockwise direction until converter bolts are accessible. Then remove bolts one at a time. Rotate crankshaft with socket wrench on dampener bolt.

(12) Mark propeller shaft and axle yokes for assembly alignment. Then disconnect and remove propeller shaft. On 4 x 4 models, remove both propeller shafts.

(13) Disconnect wires from park/neutral position switch and transmission solenoid.

(14) Disconnect gearshift rod and torque shaft assembly from transmission.

(15) Disconnect throttle valve cable from transmission bracket and throttle valve lever.

(16) On 4 x 4 models, disconnect shift rod from transfer case shift lever.

(17) Support rear of engine with safety stand or jack.

(18) Raise transmission slightly with service jack to relieve load on crossmember and supports.

(19) Remove bolts securing rear support and cushion to transmission and crossmember. Raise transmission slightly, slide exhaust hanger arm from bracket (Fig. 15) and remove rear support.

(20) Remove bolts attaching crossmember to frame and remove crossmember.

(21) On 4 x 4 models, remove transfer case with transmission jack or aid of helper.

(22) Remove all converter housing bolts.

(23) Carefully work transmission and torque converter assembly rearward off engine block dowels.

(24) Lower transmission and remove assembly from under the vehicle.

(25) To remove torque converter, remove C-clamp from edge of bell housing and carefully slide torque converter out of the transmission.

REMOVAL AND INSTALLATION (Continued)

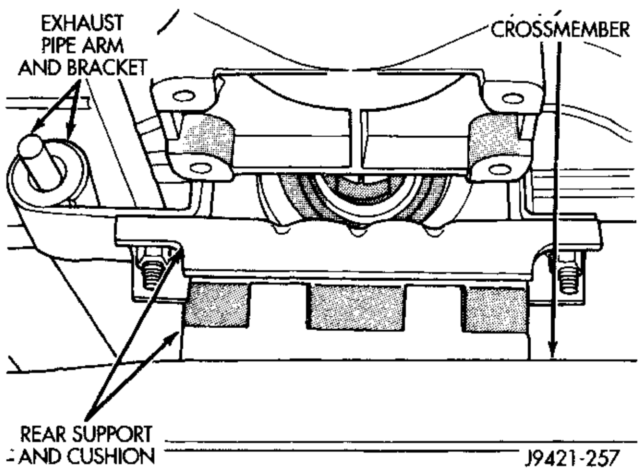

Fig. 15 Rear Support Cushion

INSTALLATION

(1) Check torque converter hub and hub drive notches for sharp edges burrs, scratches, or nicks. Polish the hub and notches with 320/400 grit paper and crocus cloth if necessary. The hub must be smooth to avoid damaging pump seal at installation.

(2) Lubricate converter drive hub and oil pump seal lip with transmission fluid.

(3) Lubricate converter pilot hub with transmission fluid.

(4) Align and install converter in oil pump.

(5) Carefully insert converter in oil pump. Then rotate converter back and forth until fully seated in pump gears.

(6) Check converter seating with steel scale and straightedge (Fig. 16). Surface of converter lugs should be 1/2 in. to rear of straightedge when converter is fully seated.

(7) Temporarily secure converter with C-clamp.

(8) Position transmission on jack and secure it with chains.

(9) Check condition of converter driveplate. Replace the plate if cracked, distorted or damaged. **Also be sure transmission dowel pins are seated in engine block and protrude far enough to hold transmission in alignment.**

(10) Raise transmission and align converter with drive plate and converter housing with engine block.

(11) Move transmission forward. Then raise, lower or tilt transmission to align converter housing with engine block dowels.

(12) Rotate converter so alignment marks scribed on converter are aligned with mark on driveplate.

(13) Carefully work transmission forward and over engine block dowels until converter hub is seated in crankshaft.

(14) Install bolts attaching converter housing to engine.

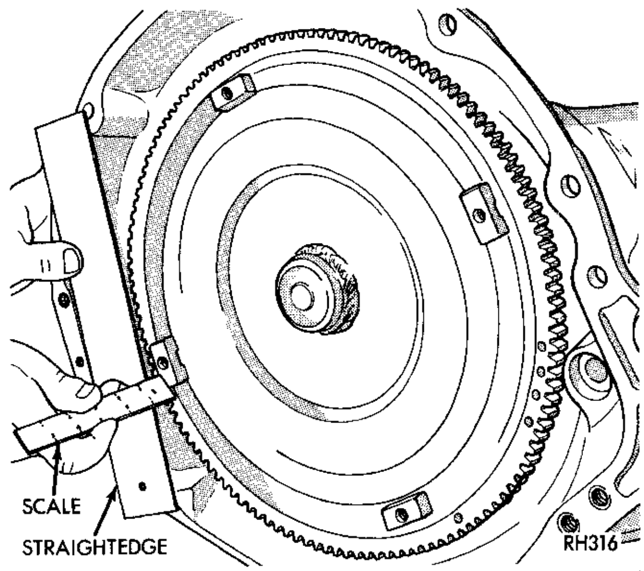

Fig. 16 Typical Method Of Checking Converter Seating

(15) Install rear support. Then lower transmission onto crossmember and install bolts attaching transmission mount to crossmember.

(16) Remove engine support fixture.

(17) Install crankshaft position sensor.

(18) Install new plastic retainer grommet on any shift linkage rod or lever that was disconnected. Grommets should not be reused. Use pry tool to remove rod from grommet and cut away old grommet. Use pliers to snap new grommet into lever and to snap rod into grommet at assembly.

(19) Connect gearshift and throttle cable to transmission.

(20) Connect wires to park/neutral position switch, transmission solenoid(s) and oxygen sensor. Be sure transmission harnesses are properly routed.

CAUTION: It is essential that correct length bolts be used to attach the converter to the driveplate. Bolts that are too long will damage the clutch surface inside the converter.

(21) Install torque converter-to-driveplate bolts. On models with 10.75 in. converter, tighten bolts to 31 N·m (270 in. lbs.). On models with 12.2 in. converter, tighten bolts to 47 N·m (35 ft. lbs.).

(22) Install converter housing access cover.

(23) Install starter motor and cooler line bracket.

(24) Connect cooler lines to transmission.

(25) Install transmission fill tube. Install new seal on tube before installation.

(26) Install exhaust components.

(27) Align and connect propeller shaft.

(28) Adjust gearshift linkage and throttle valve cable if necessary.

REMOVAL AND INSTALLATION (Continued)

(29) Lower vehicle.

(30) Fill transmission with Mopar® ATF Plus 3, Type 7176 fluid.

TORQUE CONVERTER

REMOVAL

(1) Remove transmission and torque converter from vehicle.

(2) Place a suitable drain pan under the converter housing end of the transmission.

CAUTION: Verify that transmission is secure on the lifting device or work surface, the center of gravity of the transmission will shift when the torque converter is removed creating an unstable condition.

The torque converter is a heavy unit. Use caution when separating the torque converter from the transmission.

(3) Pull the torque converter forward until the center hub clears the oil pump seal.

(4) Separate the torque converter from the transmission.

INSTALLATION

Check converter hub and drive notches for sharp edges, burrs, scratches, or nicks. Polish the hub and notches with 320/400 grit paper or crocus cloth if necessary. The hub must be smooth to avoid damaging the pump seal at installation.

(1) Lubricate converter hub and oil pump seal lip with transmission fluid.

(2) Place torque converter in position on transmission.

CAUTION: Do not damage oil pump seal or bushing while inserting torque converter into the front of the transmission.

(3) Align torque converter to oil pump seal opening.

(4) Insert torque converter hub into oil pump.

(5) While pushing torque converter inward, rotate converter until converter is fully seated in the oil pump gears.

(6) Check converter seating with a scale and straightedge (Fig. 17). Surface of converter lugs should be 1/2 in. to rear of straightedge when converter is fully seated.

(7) If necessary, temporarily secure converter with C-clamp attached to the converter housing.

(8) Install the transmission in the vehicle.

(9) Fill the transmission with the recommended fluid.

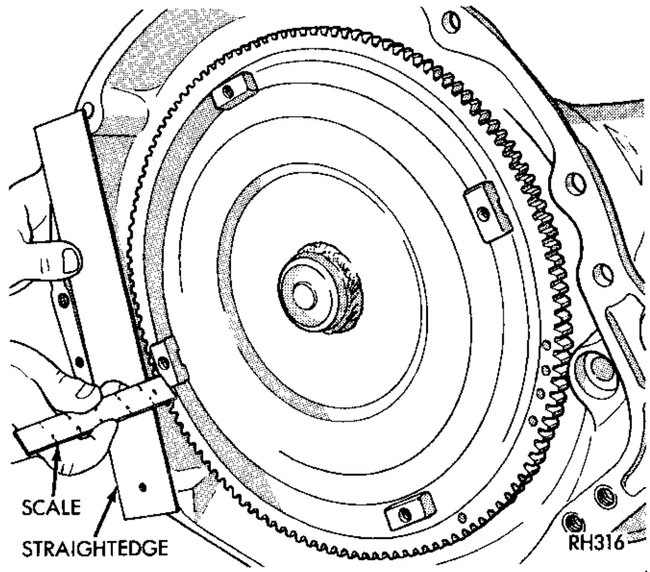

Fig. 17 Checking Torque Converter Seating

YOKE SEAL REPLACEMENT

REMOVAL

(1) Raise vehicle.

(2) Mark propeller shaft and axle yoke for alignment reference.

(3) Disconnect and remove propeller shaft.

(4) Remove old seal with Seal Remover C-3985-B (Fig. 18) from overdrive housing.

INSTALLATION

(1) Place seal in position on overdrive housing.

(2) Drive seal into overdrive housing with Seal Installer C-3995-A (Fig. 19).

(3) Carefully guide propeller shaft slip yoke into housing and onto output shaft splines. Align marks made at removal and connect propeller shaft to rear axle pinion yoke.

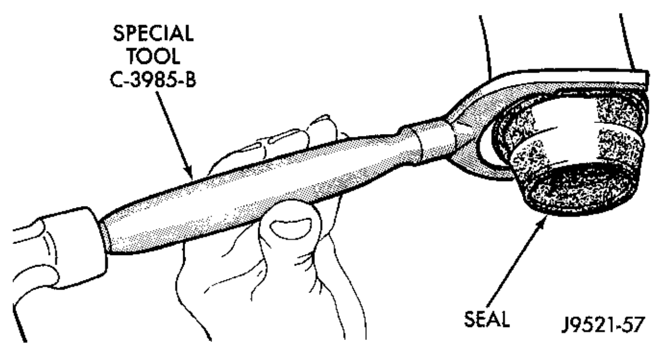

Fig. 18 Removing Overdrive Housing Yoke Seal

PARK/NEUTRAL POSITION SWITCH

REMOVAL

(1) Raise vehicle and position drain pan under switch.

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REMOVAL AND INSTALLATION (Continued)

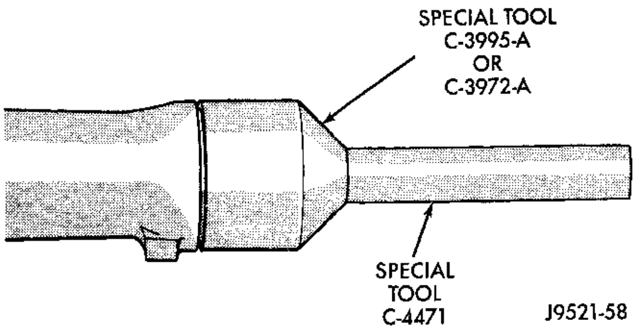

Fig. 19 Installing Overdrive Housing Yoke Seal

(2) Disconnect switch wires.

(3) Remove switch from case.

INSTALLATION

(1) Move shift lever to Park and Neutral positions. Verify that switch operating lever fingers are centered in switch opening in case (Fig. 20).

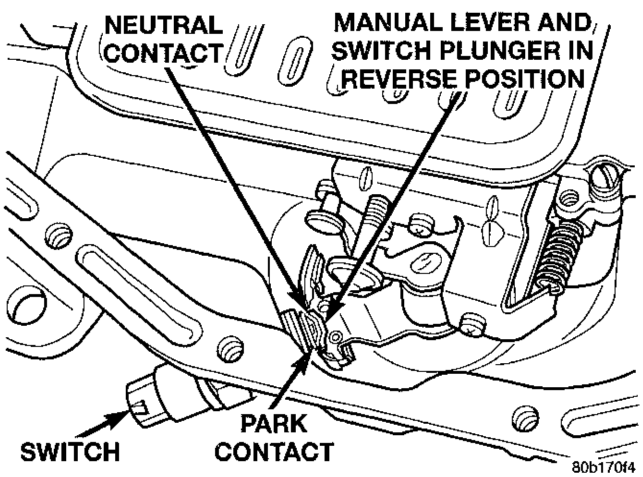

Fig. 20 Park/Neutral Position Switch

(2) Install new seal on switch and install switch in case. Tighten switch to 34 N·m (25 ft. lbs.) torque.

(3) Test continuity of new switch with 12V test lamp.

(4) Connect switch wires and lower vehicle.

(5) Top off transmission fluid level.

GOVERNOR SOLENOID AND PRESSURE SENSOR

REMOVAL

(1) Hoist and support vehicle on safety stands.

(2) Remove transmission fluid pan and filter.

(3) Disengage wire connectors from pressure sensor and solenoid (Fig. 21).

(4) Remove screws holding pressure solenoid retainer to governor body.

(5) Separate solenoid retainer from governor (Fig. 22).

(6) Pull solenoid from governor body (Fig. 23).

(7) Remove bolts holding governor body to valve body.

(8) Separate governor body from valve body (Fig. 24).

(9) Remove governor body gasket.

(10) Remove retainer holding pressure sensor to governor body.

(11) Pull pressure sensor from governor body (Fig. 25).

INSTALLATION

Before installing the pressure sensor and solenoid in the governor body, replace O-ring seals, clean the gasket surfaces and replace gasket.

(1) Lubricate O-ring on pressure sensor with transmission fluid.

(2) Align pressure sensor to bore in governor body (Fig. 25).

(3) Push pressure sensor into governor body.

(4) Install retainer to hold pressure sensor to governor body.

(5) Place gasket in position on back of governor body (Fig. 24).

(6) Place governor body in position on valve body.

(7) Install bolts to hold governor body to valve body.

(8) Lubricate O-ring, on pressure solenoid, with transmission fluid.

(9) Align pressure solenoid to bore in governor body (Fig. 23).

(10) Push solenoid into governor body.

(11) Place solenoid retainer in position on governor (Fig. 22).

(12) Install screws to hold pressure solenoid retainer to governor body.

(13) Engage wire connectors into pressure sensor and solenoid (Fig. 21).

(14) Install transmission fluid pan and (new) filter.

(15) Lower vehicle and road test to verify repair.

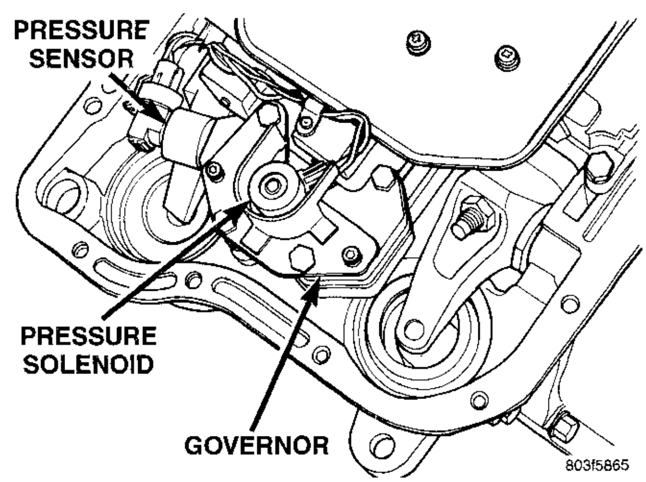

Fig. 21 Governor Solenoid And Pressure Sensor

REMOVAL AND INSTALLATION (Continued)

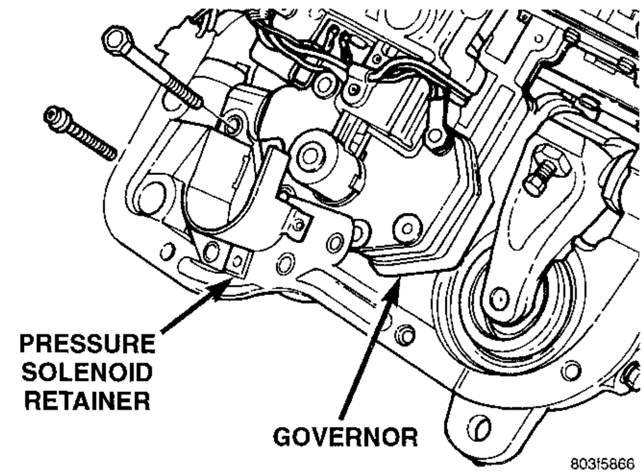

Fig. 22 Pressure Solenoid Retainer

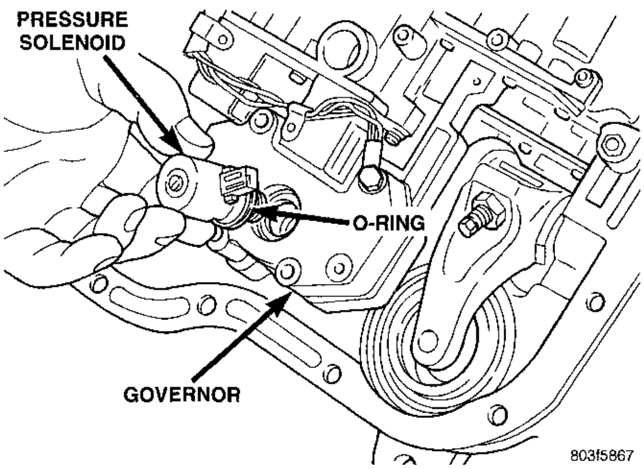

Fig. 23 Pressure Solenoid and O-ring

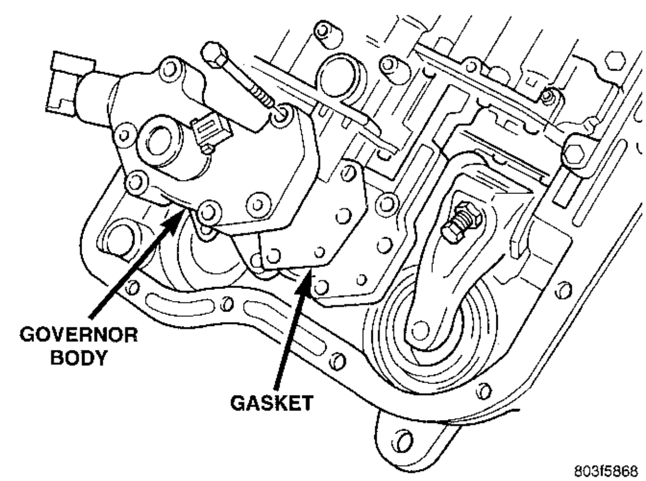

Fig. 24 Governor Body and Gasket

VALVE BODY

The valve body can be removed for service without having to remove the transmission assembly.

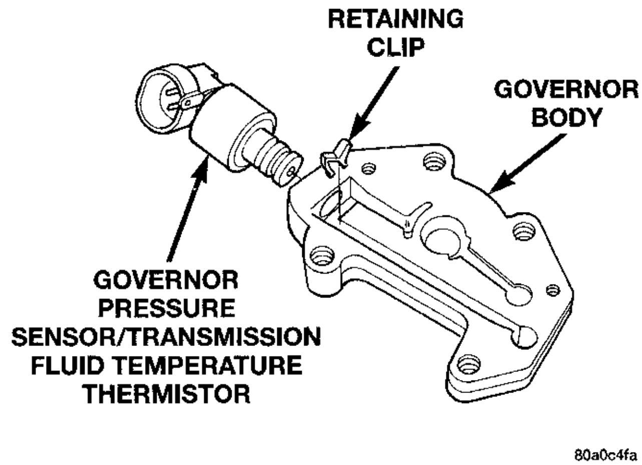

Fig. 25 Pressure Sensor and Retainer

The valve body can be disassembled for cleaning and inspection of the individual components. Refer to Disassembly and Assembly section for proper procedures.

The only replaceable valve body components are:

- Manual lever.
- Manual lever washer, seal, E-clip, and shaft seal.
- Manual lever detent ball.
- Throttle lever.
- Fluid filter.
- Pressure adjusting screw bracket.
- Governor pressure solenoid.
- Governor pressure sensor.
- Converter clutch/overdrive solenoid assembly and harness (includes sump temperature thermistor).
- Governor housing gasket.
- Solenoid case connector O-rings.

The remaining valve body components are serviced only as part of a complete valve body assembly.

REMOVAL

(1) Shift transmission into NEUTRAL.

(2) Raise vehicle.

(3) Remove gearshift and throttle levers from shaft of valve body manual lever.

(4) Disconnect wires at solenoid case connector (Fig. 26).

(5) Position drain pan under transmission oil pan.

(6) Remove transmission oil pan and gasket.

(7) Remove fluid filter from valve body.

(8) Remove bolts attaching valve body to transmission case.

(9) Lower valve body enough to remove accumulator piston and springs.

(10) Work manual lever shaft and electrical connector out of transmission case.

REMOVAL AND INSTALLATION (Continued)

(11) Lower valve body, rotate valve body away from case, pull park rod out of sprag, and remove valve body (Fig. 27).

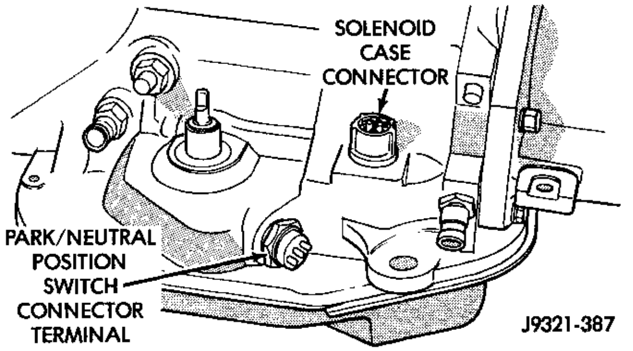

Fig. 26 Transmission Case Connector

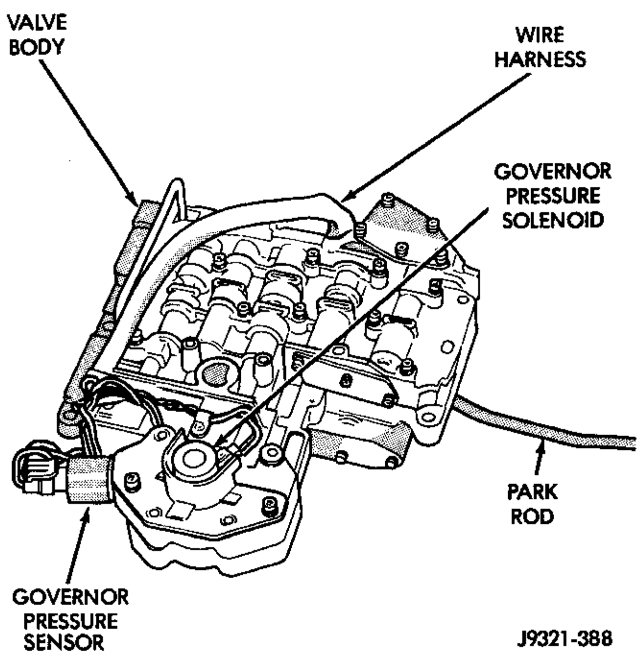

Fig. 27 Valve Body

INSTALLATION

(1) Check condition of O-ring seals on valve body harness connector (Fig. 28). Replace seals on connector body if cut or worn.

(2) Check condition of manual lever shaft seal in transmission case. Replace seal if lip is cut or worn. Install new seal with 15/16 deep well socket (Fig. 29).

(3) Check condition of seals on accumulator piston (Fig. 30). Install new piston seals, if necessary.

(4) Place valve body manual lever in low (1 position) so ball on park lock rod will be easier to install in sprag.

(5) Lubricate shaft of manual lever with petroleum jelly. This will ease inserting shaft through seal in case.

(6) Lubricate seal rings on valve body harness connector with petroleum jelly.

(7) Position valve body in case and work end of park lock rod into and through pawl sprag. Turn propeller shaft to align sprag and park lock teeth if necessary. The rod will click as it enters pawl. Move rod to check engagement.

CAUTION: It is possible for the park rod to displace into a cavity just above the pawl sprag during installation. Make sure the rod is actually engaged in the pawl and has not displaced into this cavity.

(8) Install accumulator springs and piston into case. Then swing valve body over piston and outer spring to hold it in place.

(9) Align accumulator piston and outer spring, manual lever shaft and electrical connector in case.

(10) Then seat valve body in case and install one or two bolts to hold valve body in place.

(11) Tighten valve body bolts alternately and evenly to 11 N·m (100 in. lbs.) torque.

(12) Install new fluid filter on valve body. Tighten filter screws to 4 N·m (35 in. lbs.) torque.

(13) Install throttle and gearshift levers on valve body manual lever shaft.

(14) Check and adjust front and rear bands if necessary.

(15) Connect solenoid case connector wires.

(16) Install oil pan and new gasket. Tighten pan bolts to 17 N·m (13 ft. lbs.) torque.

(17) Lower vehicle and fill transmission with Mopar® ATF Plus 3, type 7176 fluid.

(18) Check and adjust gearshift and throttle valve cables, if necessary.

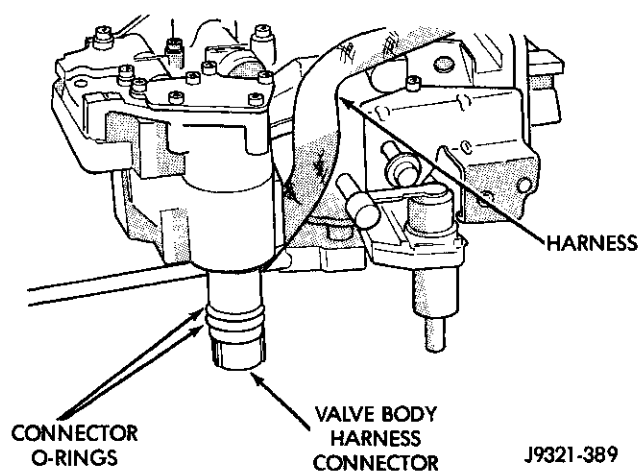

Fig. 28 Valve Body Harness Connector O-Ring Seal

REMOVAL AND INSTALLATION (Continued)

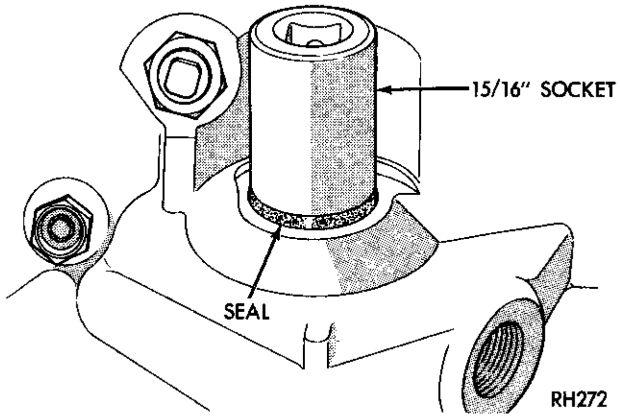

Fig. 29 Manual Lever Shaft Seal

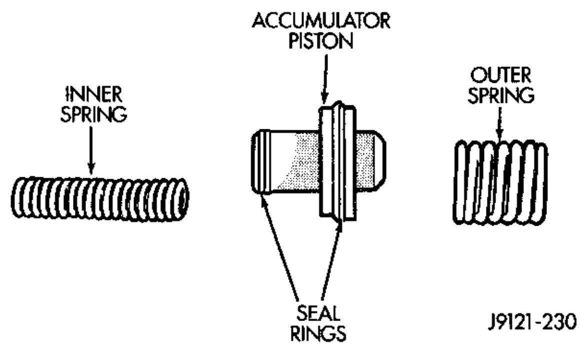

Fig. 30 Accumulator Piston Components

OVERDRIVE UNIT

REMOVAL

(1) Shift transmission into Park.

(2) Raise vehicle.

(3) Mark propeller shaft universal joint(s) and axle pinion yoke for alignment reference at installation.

(4) Disconnect and remove propeller shaft(s).

(5) Remove transmission oil pan, remove gasket, drain oil and reinstall pan.

(6) If overdrive unit had malfunctioned, or if fluid is contaminated, remove entire transmission. If diagnosis indicated overdrive problems only, remove just the overdrive unit.

(7) Support transmission with transmission jack.

(8) Remove bolts attaching overdrive unit to transmission (Fig. 31).

CAUTION: Support the overdrive unit with a jack before moving it rearward. This is necessary to prevent damaging the intermediate shaft. Do not allow the shaft to support the entire weight of the overdrive unit.

(9) Carefully work overdrive unit off intermediate shaft. Do not tilt unit during removal. Keep it as level as possible.

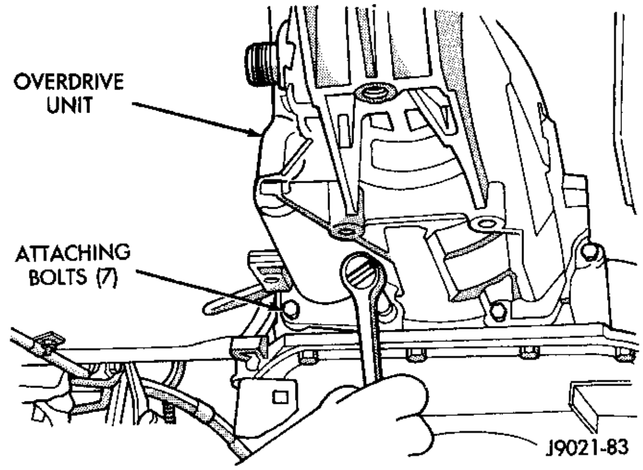

Fig. 31 Overdrive Unit Bolts

(10) If overdrive unit does not require service, immediately insert Alignment Tool 6227-2 in splines of planetary gear and overrunning clutch to prevent splines from rotating out of alignment. If misalignment occurs, overdrive unit will have to be disassembled in order to realign splines.

(11) Remove and retain overdrive piston thrust bearing. Bearing may remain on piston or in clutch hub during removal.

(12) Position drain pan on workbench.

(13) Place overdrive unit over drain pan. Tilt unit to drain residual fluid from case.

(14) Examine fluid for clutch material or metal fragments. If fluid contains these items, overhaul will be necessary.

(15) If overdrive unit does not require any service, leave alignment tool in position. Tool will prevent accidental misalignment of planetary gear and overrunning clutch splines.

INSTALLATION

(1) Be sure overdrive unit Alignment Tool 6227-2 is fully seated before moving unit. If tool is not seated and gear splines rotate out of alignment, overdrive unit will have to be disassembled in order to realign splines.

(2) If overdrive piston retainer was not removed during service and original case gasket is no longer reusable, prepare new gasket by trimming it.

(3) Cut out old case gasket around piston retainer with razor knife (Fig. 32).

(4) Use old gasket as template and trim new gasket to fit.

(5) Position new gasket over piston retainer and on transmission case. Use petroleum jelly to hold gasket in place if necessary. Do not use any type of sealer to secure gasket. Use petroleum jelly only.

REMOVAL AND INSTALLATION (Continued)

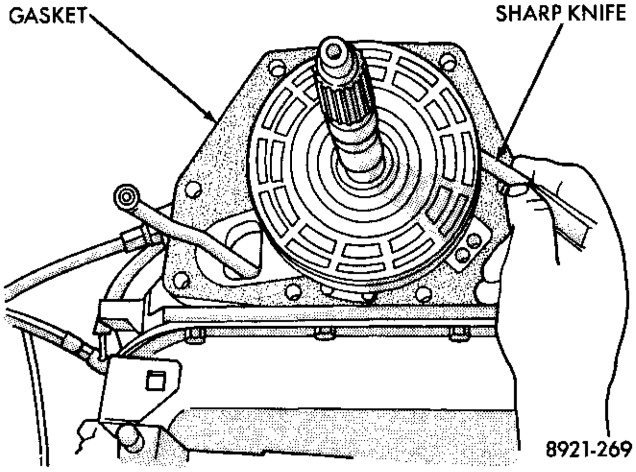

Fig. 32 Trimming Overdrive Case Gasket

(6) Install selective spacer on intermediate shaft, if removed. Spacer goes in groove just rearward of shaft rear splines (Fig. 33).

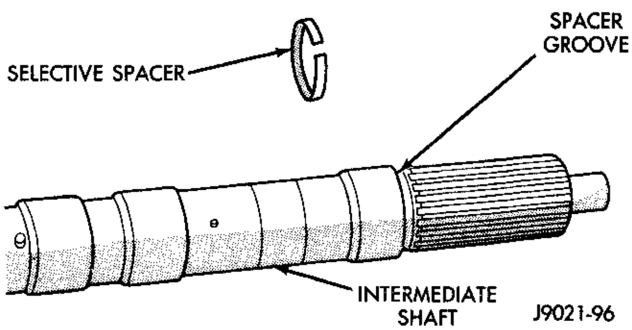

Fig. 33 Intermediate Shaft Selective Spacer Location

(7) Install thrust bearing in overdrive unit sliding hub. Use petroleum jelly to hold bearing in position.

CAUTION: Be sure the shoulder on the inside diameter of the bearing is facing forward.

(8) Verify that splines in overdrive planetary gear and overrunning clutch hub are aligned with Alignment Tool 6227-2. Overdrive unit cannot be installed if splines are not aligned. If splines have rotated out of alignment, unit will have to be disassembled to realign splines.

(9) Carefully slide Alignment Tool 6227-2 out of overdrive planetary gear and overrunning clutch splines.

(10) Raise overdrive unit and carefully slide it straight onto intermediate shaft. Insert park rod into park lock reaction plug at same time. Avoid tilting overdrive during installation as this could cause planetary gear and overrunning clutch splines to rotate out of alignment. If this occurs, it will be necessary to remove and disassemble overdrive unit to realign splines.

(11) Work overdrive unit forward on intermediate shaft until seated against transmission case.

(12) Install bolts attaching overdrive unit to transmission unit. Tighten bolts in diagonal pattern to 34 N·m (25 ft-lbs).

(13) Align and install propeller shaft(s).

OVERDRIVE HOUSING BUSHING

REMOVAL

(1) Remove overdrive housing yoke seal.

(2) Insert Remover 6957 into overdrive housing. Tighten tool to bushing and remove bushing (Fig. 34).

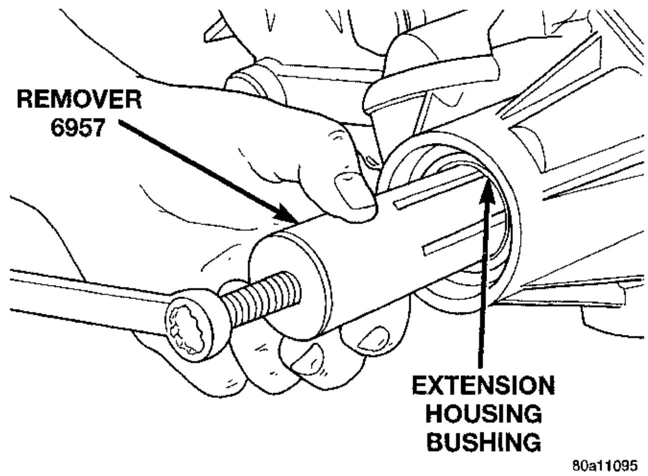

Fig. 34 Bushing Removal—Typical

INSTALLATION

(1) Align bushing oil hole with oil slot in overdrive housing.

(2) Tap bushing into place with Installer 6951 and Handle C-4171.

(3) Install new oil seal in housing using Seal Installer C-3995-A (Fig. 35).

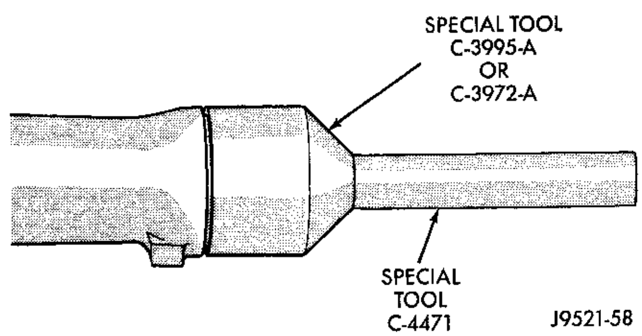

Fig. 35 Overdrive Housing Seal Installation

OUTPUT SHAFT REAR BEARING

REMOVAL

(1) Remove overdrive unit from the vehicle.

(2) Remove overdrive geartrain from housing.

REMOVAL AND INSTALLATION (Continued)

(3) Remove snap ring holding output shaft rear bearing into overdrive housing (Fig. 36).

(4) Using a suitable driver inserted through the rear end of housing, drive bearing from housing.

INSTALLATION

(1) Place replacement bearing in position in housing.

(2) Using a suitable driver, drive bearing into housing until the snap ring groove is visible.

(3) Install snap ring to hold bearing into housing (Fig. 36).

(4) Install overdrive geartrain into housing.

(5) Install overdrive unit in vehicle.

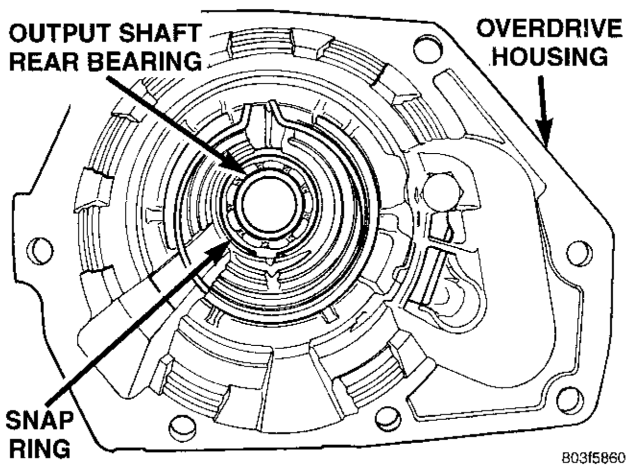

Fig. 36 Output Shaft Rear Bearing

OUTPUT SHAFT FRONT BEARING

REMOVAL

(1) Remove overdrive unit from the vehicle.

(2) Remove overdrive geartrain from housing.

(3) Remove snap ring holding output shaft front bearing to overdrive geartrain. (Fig. 37).

(4) Pull bearing from output shaft.

INSTALLATION

(1) Place replacement bearing in position on geartrain with locating retainer groove toward the rear.

(2) Push bearing onto shaft until the snap ring groove is visible.

(3) Install snap ring to hold bearing onto output shaft (Fig. 37).

(4) Install overdrive geartrain into housing.

(5) Install overdrive unit in vehicle.

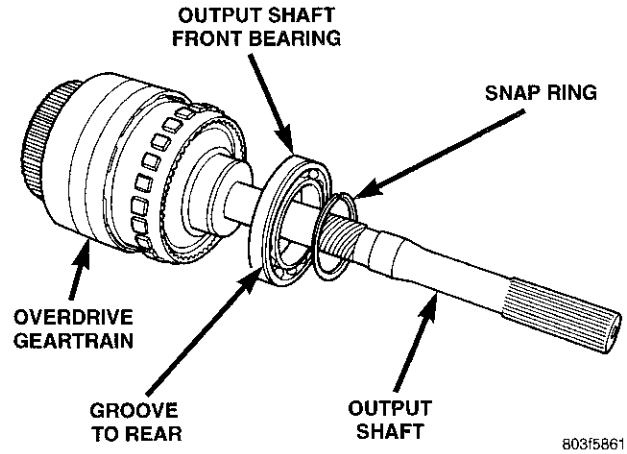

Fig. 37 Output Shaft Front Bearing

DISASSEMBLY AND ASSEMBLY

VALVE BODY

Remove the valve body from the transmission, refer to Removal and Installation procedures section in this group.

DISASSEMBLY

CAUTION: Do not clamp any valve body component in a vise. This practice can damage the component resulting in unsatisfactory operation after assembly and installation. Do not use pliers to remove any of the valves, plugs or springs and do not force any of the components out or into place. The valves and valve body housings will be damaged if force is used. Tag or mark the valve body springs for reference as they are removed. Do not allow them to become intermixed.

(1) Remove fluid filter.

(2) Disconnect wires from governor pressure sensor and solenoid.

(3) Remove screws attaching governor body and retainer plate to transfer plate.

(4) Remove retainer plate, governor body and gasket from transfer plate.

(5) Disconnect wires from governor pressure sensor, if not done previously.

(6) Remove governor pressure sensor from governor body. Sensor is retained in body with M-shaped spring clip. Remove clip with small pointed tool and slide sensor out of body.

(7) Remove governor pressure solenoid by pulling it straight out of bore in governor body. Remove and discard solenoid O-rings if worn, cut, or torn.

(8) Remove small shoulder bolt that secures solenoid harness case connector to 3-4 accumulator housing (Fig. 38). **Retain shoulder bolt. Either tape it**

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DISASSEMBLY AND ASSEMBLY (Continued)

to harness or thread it back into accumulator housing after connector removal.

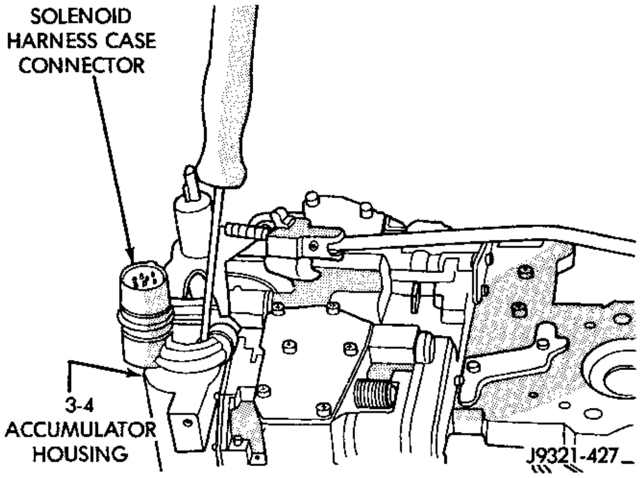

Fig. 38 Solenoid Harness Case Connector Shoulder Bolt

(9) Unhook overdrive/converter solenoid harness from 3-4 accumulator cover plate (Fig. 39).

(10) Turn valve body over and remove screws that attach overdrive/converter solenoid assembly to valve body (Fig. 40).

(11) Remove solenoid and harness assembly from valve body (Fig. 41).

(12) Remove boost valve cover (Fig. 42).

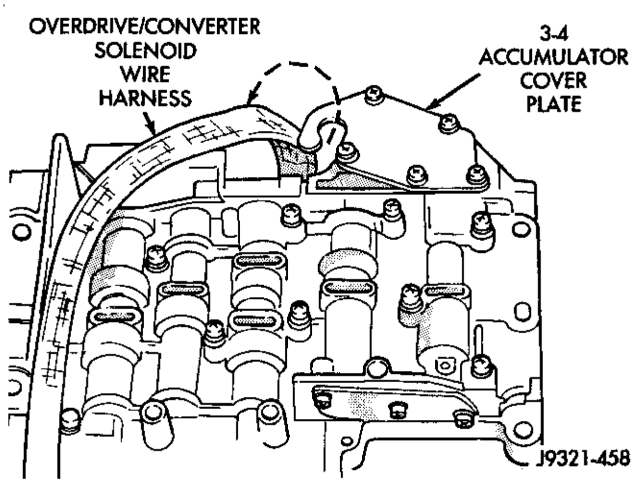

Fig. 39 Unhooking Solenoid Harness From Accumulator Cover Plate

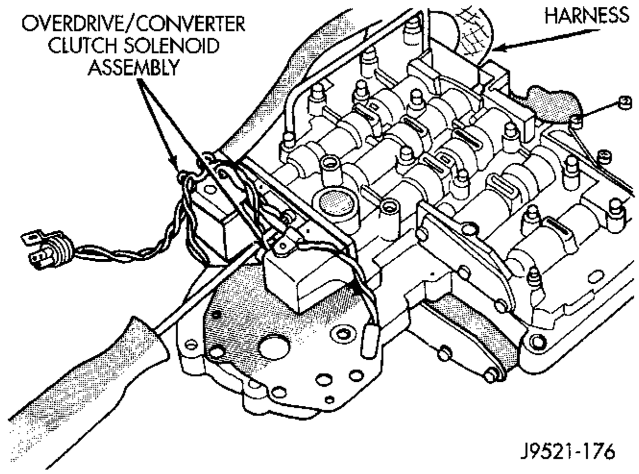

Fig. 40 Solenoid Assembly Screws

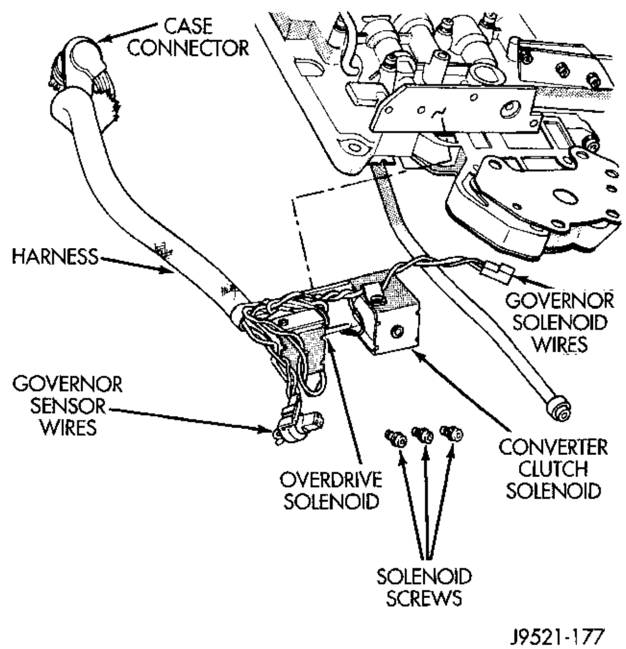

Fig. 41 Solenoid Assembly

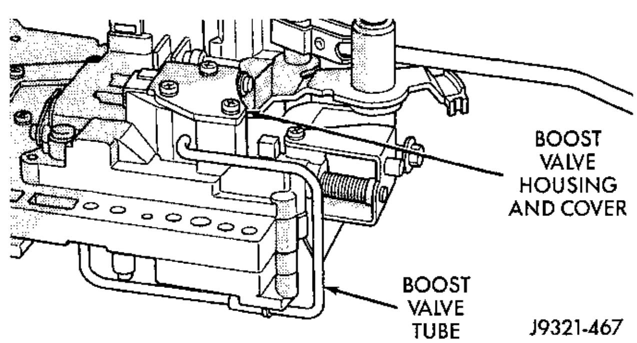

Fig. 42 Boost Valve Cover Location

DISASSEMBLY AND ASSEMBLY (Continued)

(13) Remove boost valve retainer, valve spring and boost valve (Fig. 43).

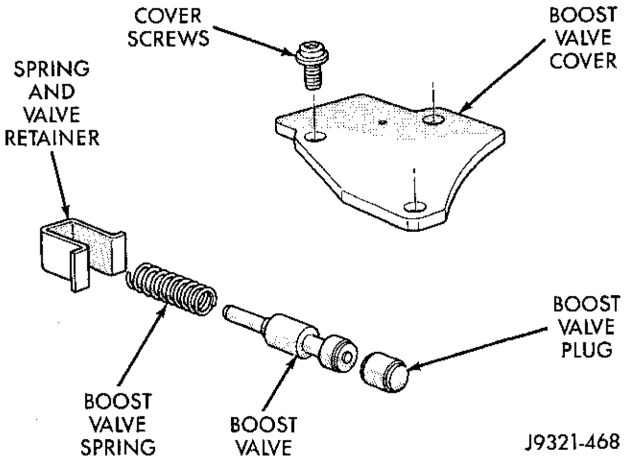

Fig. 43 Boost Valve Components

(14) Secure detent ball and spring with Retainer Tool 6583 (Fig. 44).

(15) Remove park rod E-clip and separate rod from manual lever (Fig. 45).

(16) Remove E-clip and washer that retains throttle lever shaft in manual lever (Fig. 46).

(17) Remove manual lever and throttle lever (Fig. 47). Rotate and lift manual lever off valve body and throttle lever shaft. Then slide throttle lever out of valve body.

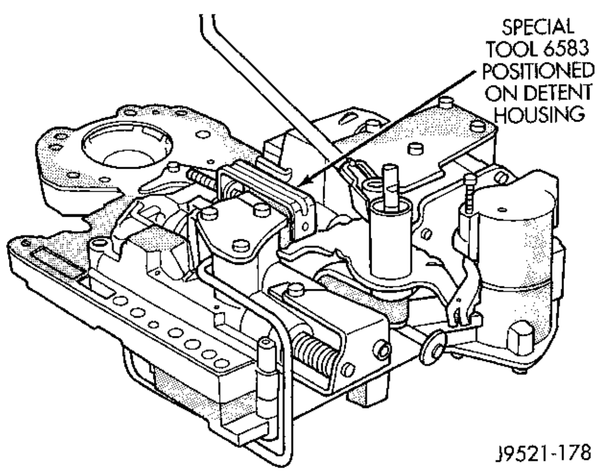

Fig. 44 Detent Ball And Spring

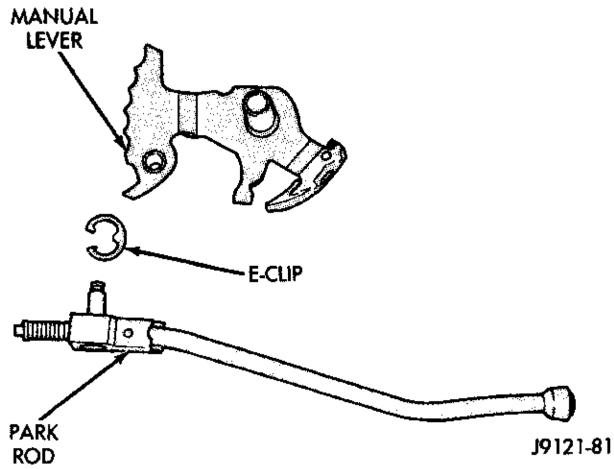

Fig. 45 Park Rod

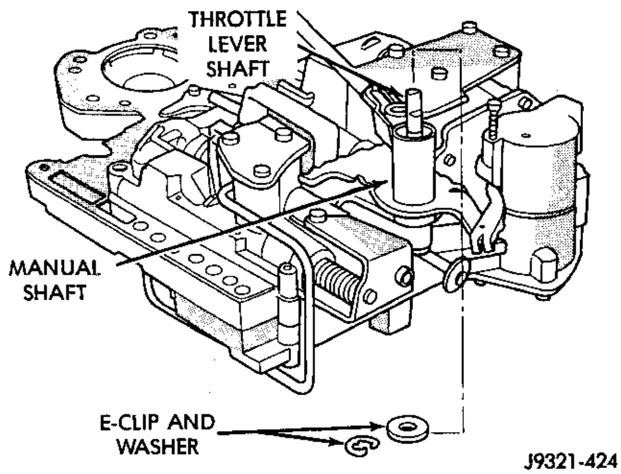

Fig. 46 Throttle Lever E-Clip And Washer

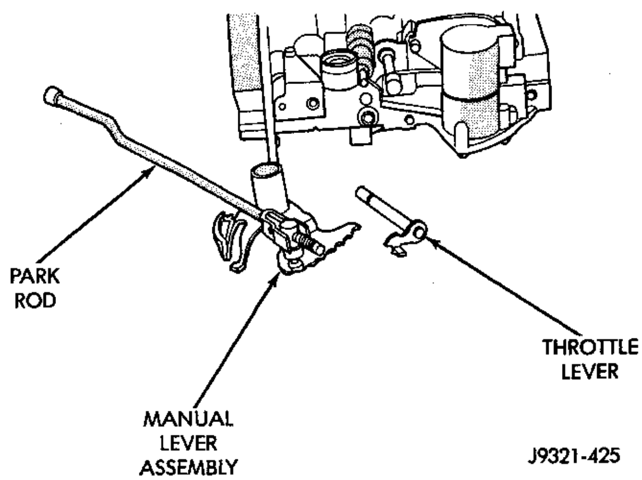

Fig. 47 Manual And Throttle Lever

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DISASSEMBLY AND ASSEMBLY (Continued)

(18) Position pencil magnet next to detent housing to catch detent ball and spring. Then carefully remove Retainer Tool 6583 and remove detent ball and spring (Fig. 48).

(19) Remove screws attaching pressure adjusting screw bracket to valve body and transfer plate (Fig. 49). Hold bracket firmly against spring tension while removing last screw.

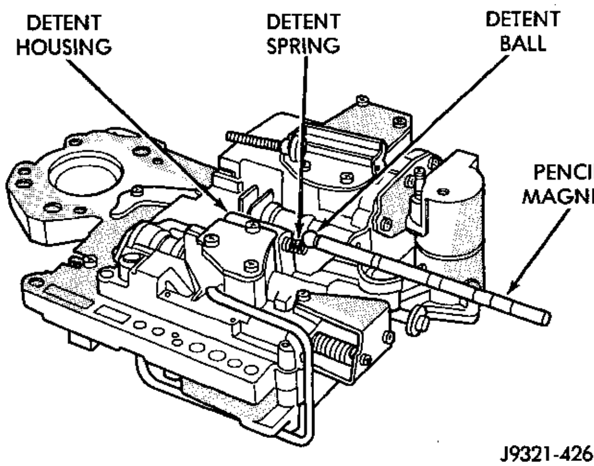

Fig. 48 Detent Ball And Spring

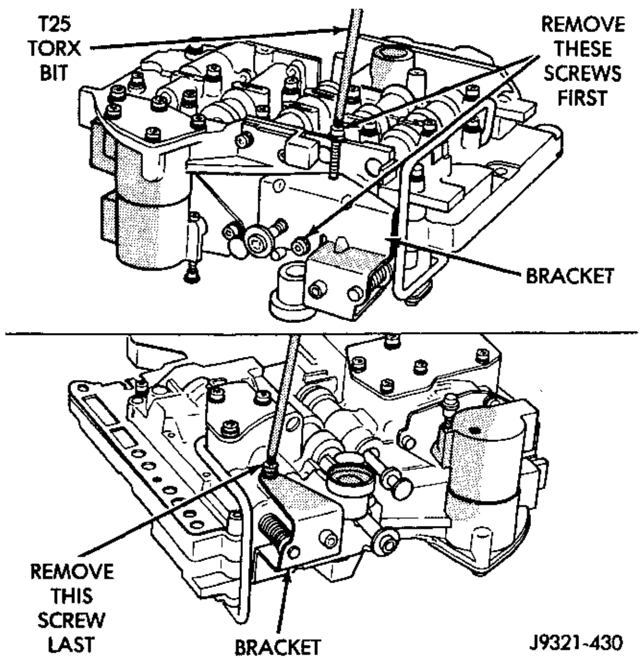

Fig. 49 Adjusting Screw Bracket Fastener

(20) Remove adjusting screw bracket, line pressure adjusting screw, pressure regulator valve spring and switch valve spring (Fig. 50). **Do not remove throttle pressure adjusting screw from bracket and do not disturb setting of either adjusting screw during removal.**

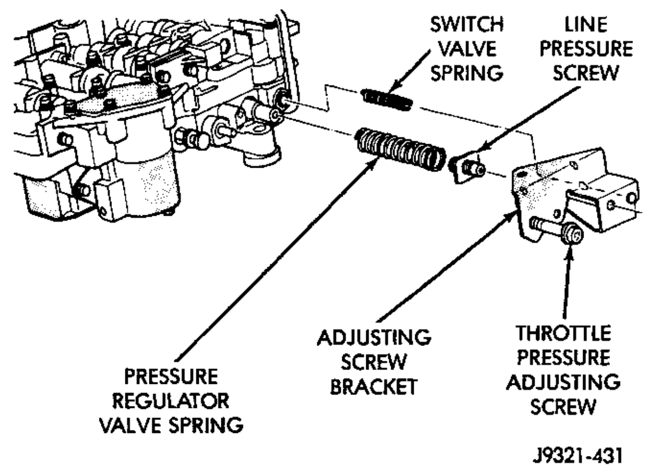

Fig. 50 Adjusting Screw Bracket And Spring

(21) Turn upper housing over and remove switch valve, regulator valve and spring, and manual valve (Fig. 51).

(22) Remove kickdown detent, kickdown valve, and throttle valve and spring (Fig. 51).

(23) Loosen left-side 3-4 accumulator housing attaching screw about 2-3 threads. Then remove center and right-side housing attaching screws (Fig. 52).

(24) Carefully rotate 3-4 accumulator housing upward and remove 3-4 shift valve spring and converter clutch valve plug and spring (Fig. 53).

(25) Remove left-side screw and remove 3-4 accumulator housing from valve body (Fig. 54).

DISASSEMBLY AND ASSEMBLY (Continued)

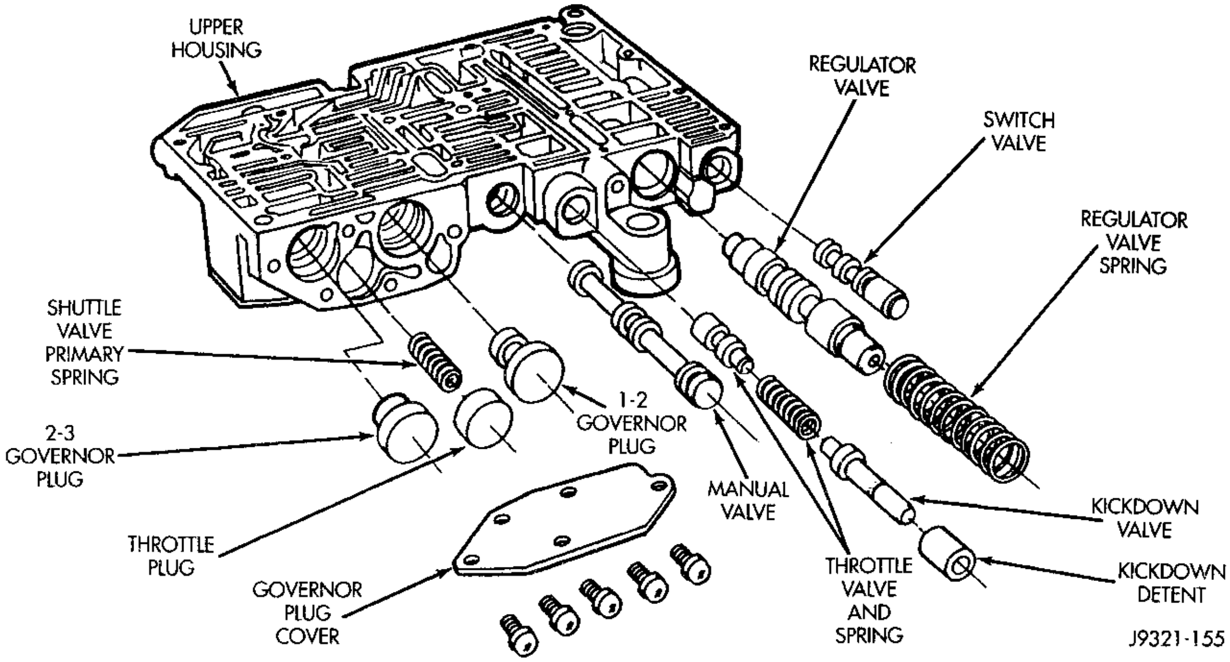

Fig. 51 Upper Housing Control Valve Locations

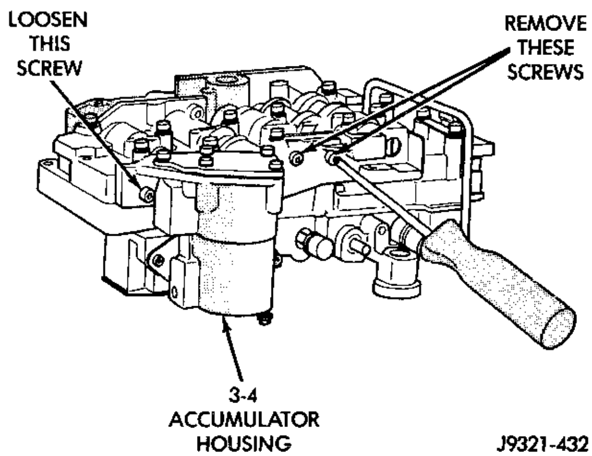

Fig. 52 Accumulator Housing Screw Locations

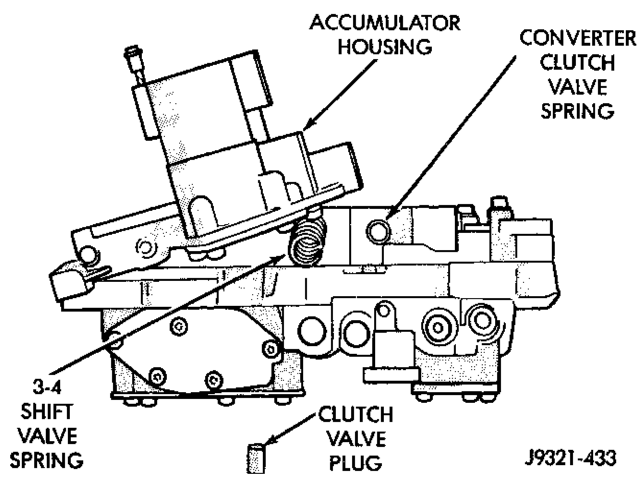

Fig. 53 3-4 Shift And Converter Clutch Valve Springs And Plug

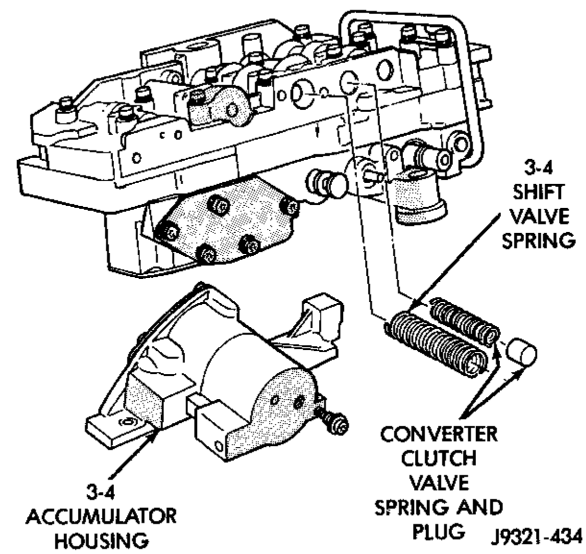

Fig. 54 Accumulator Housing, Valve Springs And Plug

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DISASSEMBLY AND ASSEMBLY (Continued)

(26) Bend back tabs on boost valve tube brace (Fig. 55).

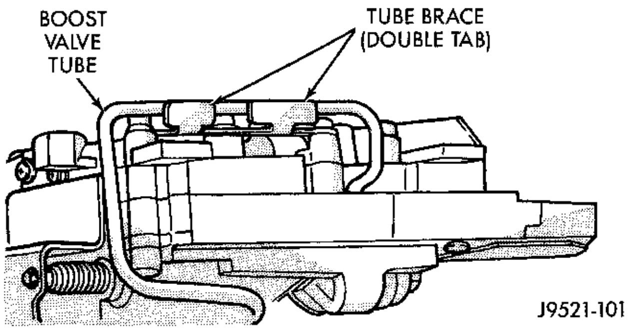

Fig. 55 Boost Valve Tube Brace

(27) Remove boost valve connecting tube (Fig. 56). Disengage tube from upper housing port first. Then rock opposite end of tube back and forth to work it out of lower housing.

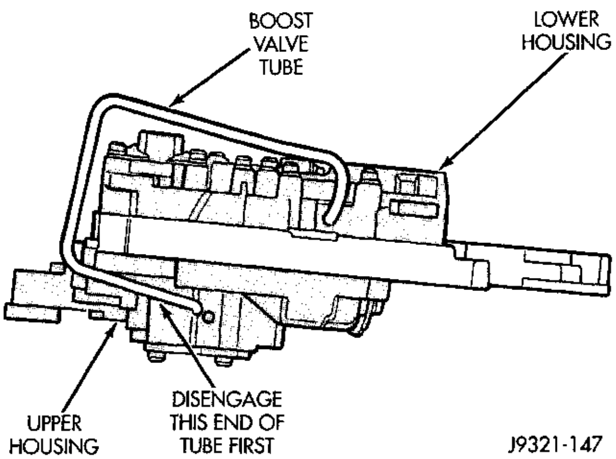

Fig. 56 Boost Valve Tube

CAUTION: Do not use tools to loosen or pry the connecting tube out of the valve body housings. Loosen and remove the tube by hand only.

(28) Turn valve body over so lower housing is facing upward (Fig. 57). In this position, the two check balls in upper housing will remain in place and not fall out when lower housing and separator plate are removed.

(29) Remove screws attaching valve body lower housing to upper housing and transfer plate (Fig. 57). **Note position of boost valve tube brace for assembly reference.**

(30) Remove lower housing and overdrive separator plate from transfer plate (Fig. 57).

(31) Remove the ECE check ball from the transfer plate (Fig. 58). The ECE check ball is approximately 4.8 mm (3/16 in.) in diameter.

(32) Remove transfer plate from upper housing (Fig. 59).

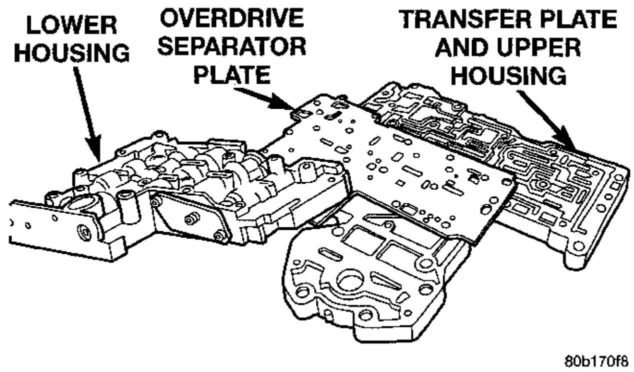

Fig. 57 Lower Housing

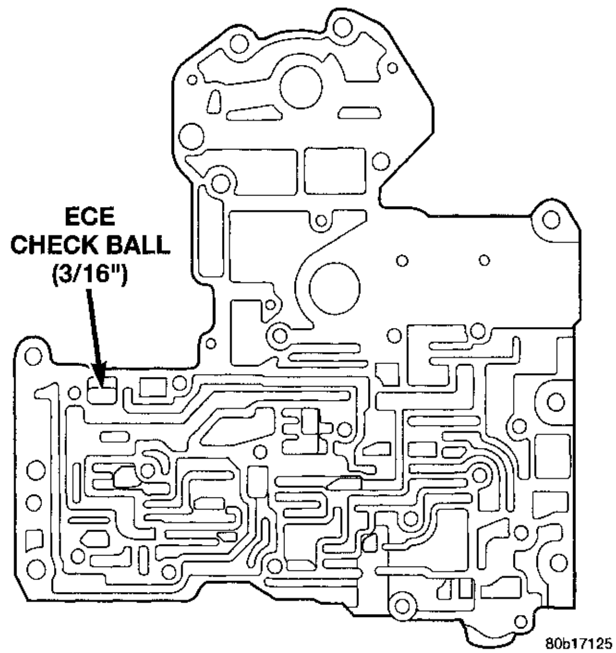

Fig. 58 ECE Check Ball

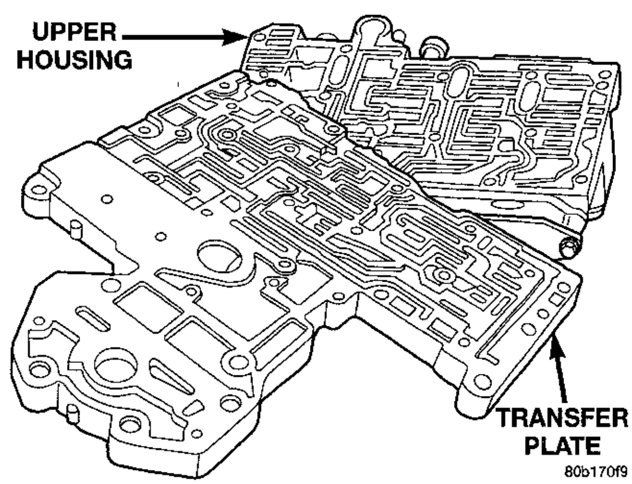

Fig. 59 Transfer Plate

DISASSEMBLY AND ASSEMBLY (Continued)

(33) Turn transfer plate over so upper housing separator plate is facing upward.

(34) Remove upper housing separator plate from transfer plate (Fig. 60). Note position of filter in separator plate for assembly reference.

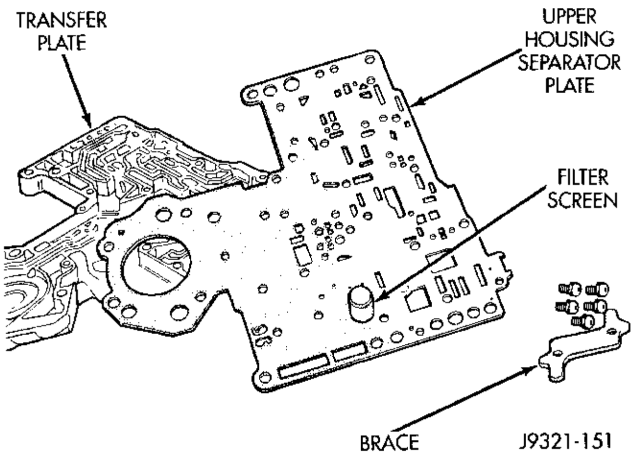

Fig. 60 Upper Housing Separator Plate

(35) Remove rear clutch and rear servo check balls from transfer plate. Note check ball location for assembly reference (Fig. 61).

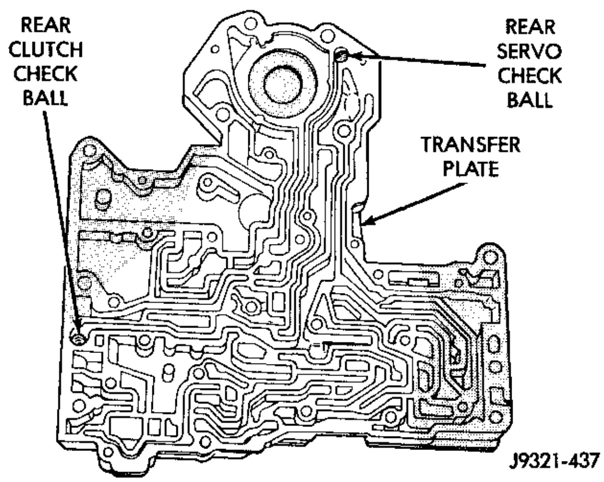

Fig. 61 Rear Clutch And Rear Servo Check Ball Locations

VALVE BODY UPPER HOUSING

(1) Note location of check balls in valve body upper housing (Fig. 62). Then remove the one large diameter and the six smaller diameter check balls.

(2) Remove governor plug and shuttle valve covers (Fig. 64).

(3) Remove E-clip that secures shuttle valve secondary spring on valve stem (Fig. 63).

(4) Remove throttle plug, primary spring, shuttle valve, secondary spring, and spring guides (Fig. 64).

(5) Remove boost valve retainer, spring and valve if not previously removed.

(6) Remove throttle plug and 1-2 and 2-3 governor plugs (Fig. 51).

(7) Turn upper housing around and remove limit valve and shift valve covers (Fig. 65).

(8) Remove limit valve housing. Then remove retainer, spring, limit valve, and 2-3 throttle plug from limit valve housing (Fig. 65).

(9) Remove 1-2 shift control valve and spring (Fig. 65).

(10) Remove 1-2 shift valve and spring (Fig. 65).

(11) Remove 2-3 shift valve and spring from valve body (Fig. 65).

(12) Remove pressure plug cover (Fig. 65).

(13) Remove line pressure plug, sleeve, throttle pressure plug and spring (Fig. 65).

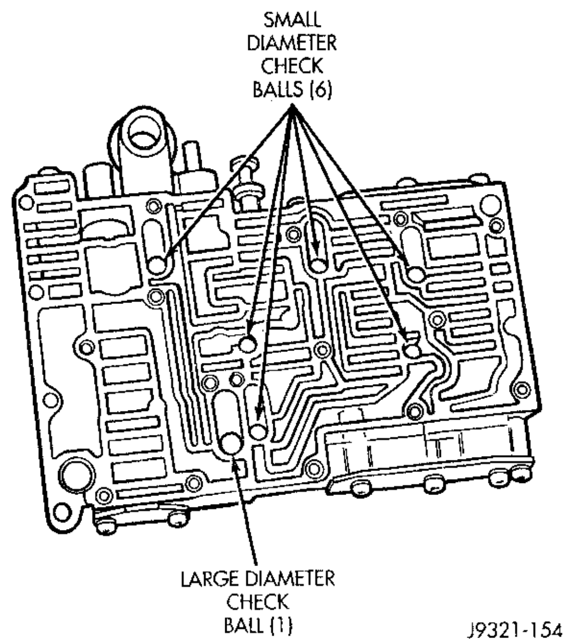

Fig. 62 Check Ball Locations In Upper Housing

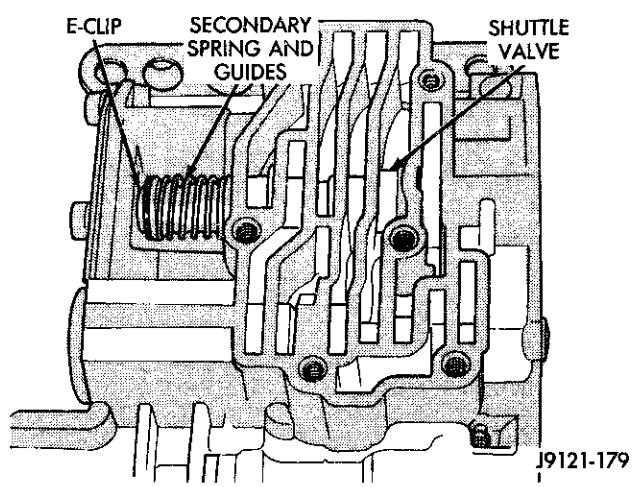

Fig. 63 Shuttle Valve E-Clip And Secondary Spring Location

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DISASSEMBLY AND ASSEMBLY (Continued)

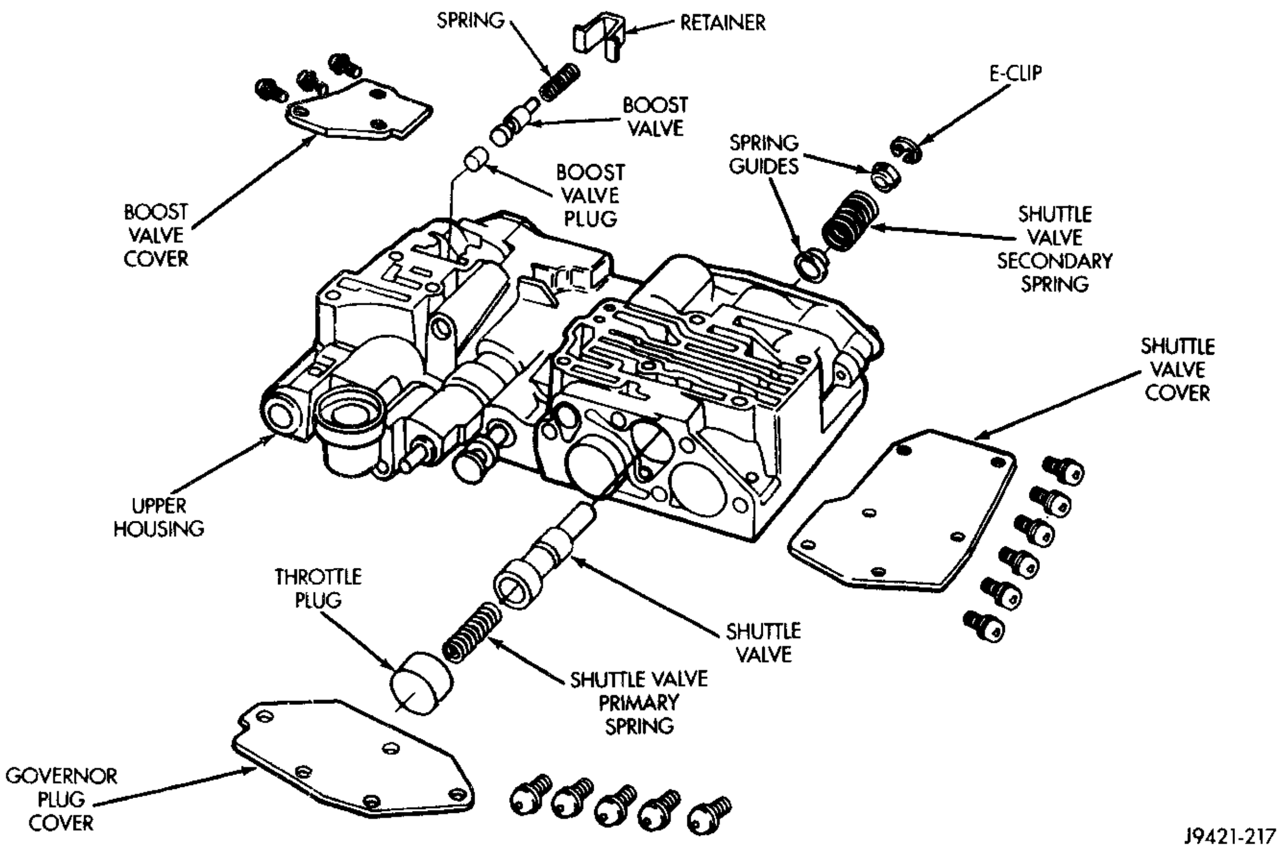

Fig. 64 Shuttle And Boost Valve Components

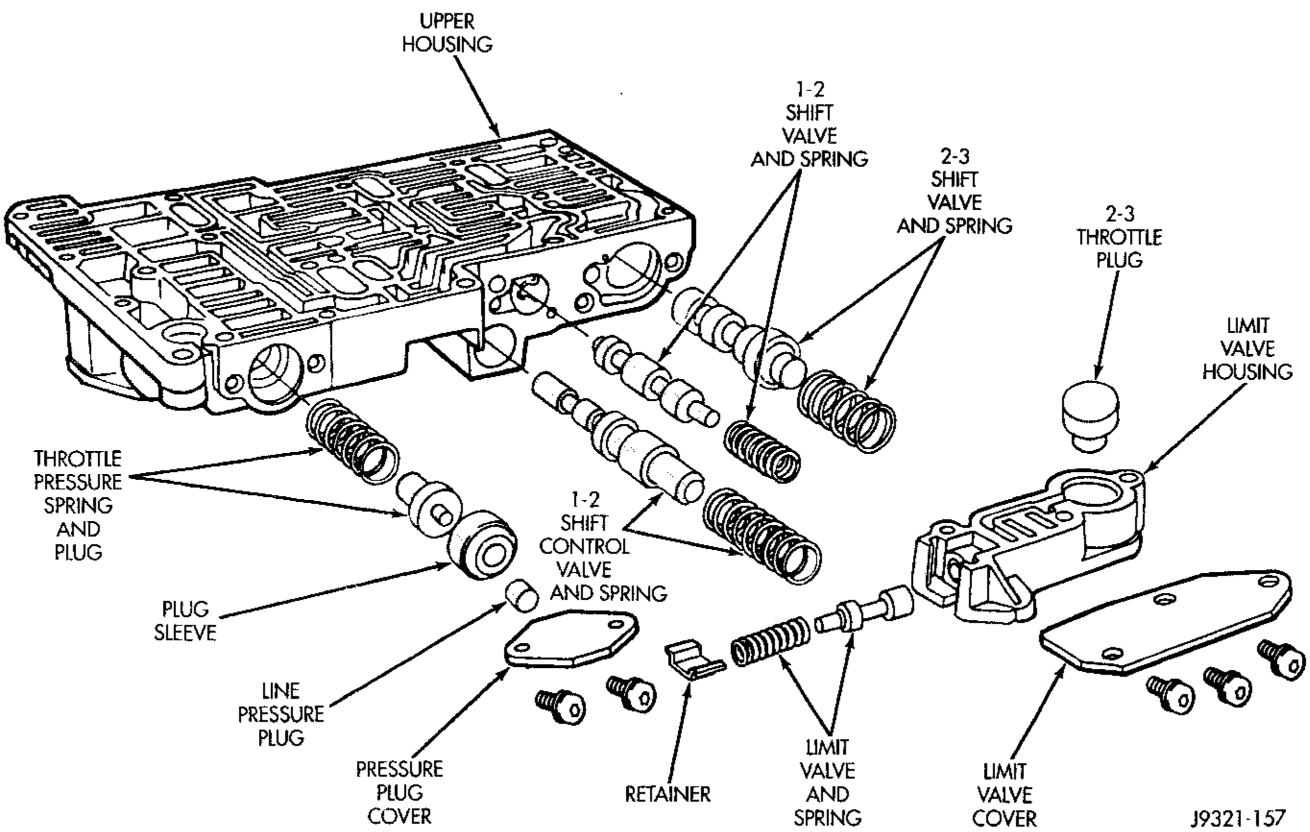

Fig. 65 Upper Housing Shift Valve And Pressure Plug Locations

DISASSEMBLY AND ASSEMBLY (Continued)

VALVE BODY LOWER HOUSING

(1) Remove timing valve cover.
(2) Remove 3-4 timing valve and spring.
(3) Remove 3-4 quick fill valve, spring and plug.
(4) Remove 3-4 shift valve and spring.
(5) Remove converter clutch valve, spring and plug (Fig. 66).
(6) Remove converter clutch timing valve, retainer and valve spring.

3-4 ACCUMULATOR HOUSING

(1) Remove end plate from housing.
(2) Remove piston spring.
(3) Remove piston. Remove and discard piston seals (Fig. 67).

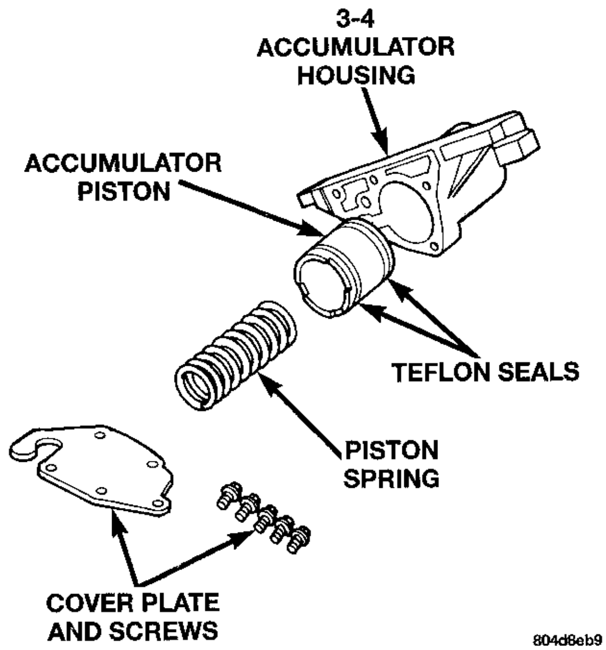

Fig. 67 Accumulator Housing Components

ASSEMBLY

CAUTION: Do not force valves or plugs into place during reassembly. If the valve body bores, valves and plugs are free of distortion or burrs, the valve body components should all slide into place easily. In addition, do not overtighten the transfer plate and valve body screws during reassembly. Overtightening can distort the housings resulting in valve sticking, cross leakage and unsatisfactory operation. Tighten valve body screws to recommended torque only.

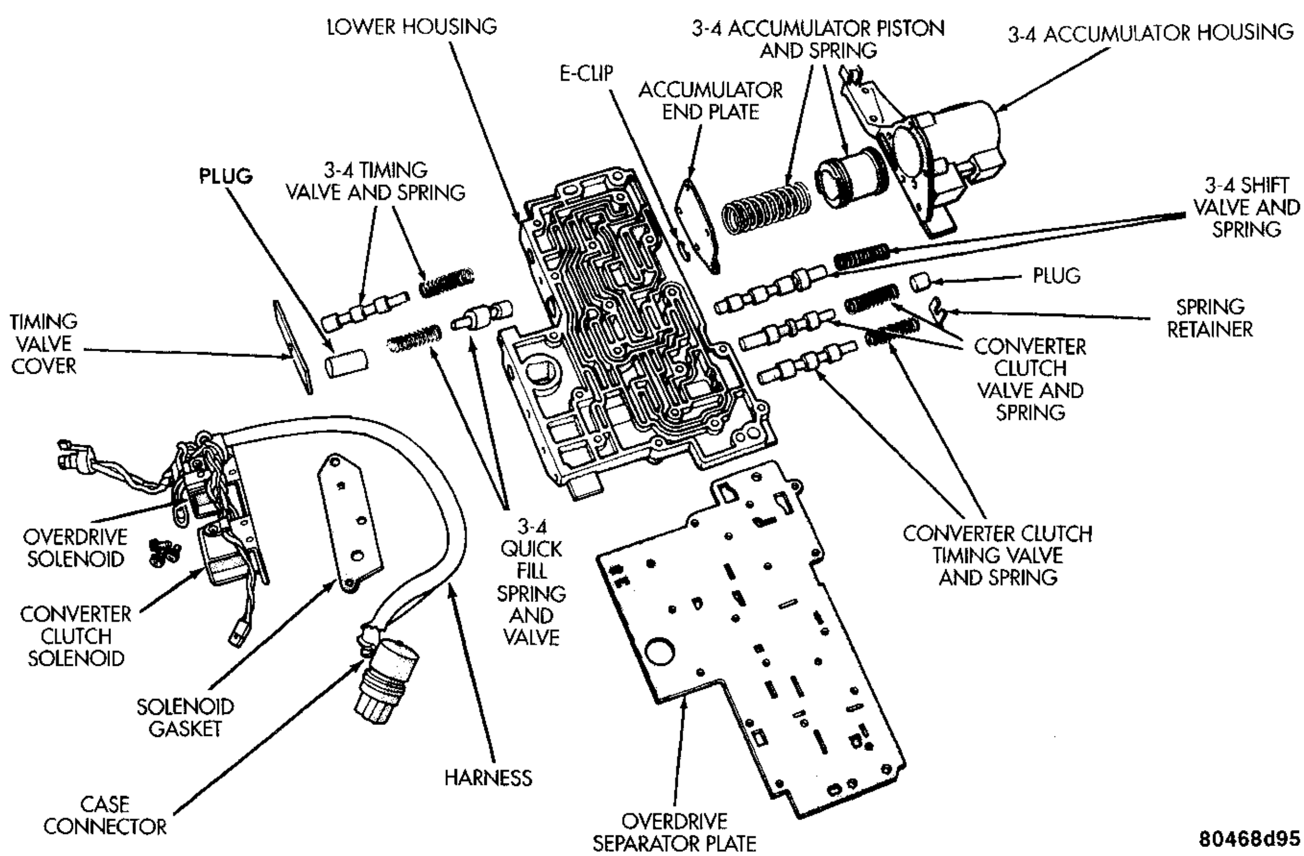

Fig. 66 Lower Housing Shift Valves And Springs

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DISASSEMBLY AND ASSEMBLY (Continued)

LOWER HOUSING

(1) Lubricate valves, springs, and the housing valve and plug bores with clean transmission fluid (Fig. 66).

(2) Install 3-4 timing valve spring and valve in lower housing.

(3) Install 3-4 quick fill valve in lower housing.

(4) Install 3-4 quick fill valve spring and plug in housing.

(5) Install timing valve end plate. Tighten end plate screws to 4 N·m (35 in. lbs.) torque.

3-4 ACCUMULATOR

(1) Lubricate accumulator piston, seals and housing piston bore with clean transmission fluid (Fig. 67).

(2) Install new seal rings on accumulator piston.

(3) Install piston and spring in housing.

(4) Install end plate on housing.

TRANSFER PLATE

(1) Install rear clutch and rear servo check balls in transfer plate (Fig. 68).

(2) Install filter screen in upper housing separator plate (Fig. 69).

(3) Align and position upper housing separator plate on transfer plate (Fig. 70).

(4) Install brace plate (Fig. 70). Tighten brace attaching screws to 4 N·m (35 in. lbs.) torque.

(5) Install remaining separator plate attaching screws. Tighten screws to 4 N·m (35 in. lbs.) torque.

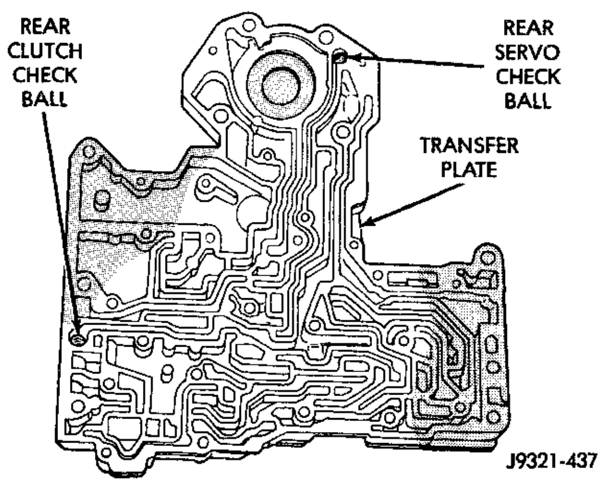

Fig. 68 Rear Clutch And Rear Servo Check Ball Locations

UPPER AND LOWER HOUSING

(1) Position upper housing so internal passages and check ball seats are facing upward. Then install check balls in housing (Fig. 71). Seven check balls are used. The single large check ball is approximately 8.7 mm (11/32 in.) diameter. The single small check ball is approximately 4.8 mm (3/16 in.) in diameter. The remaining 6 check balls are approximately 6.3 mm (1/4 in.) in diameter.

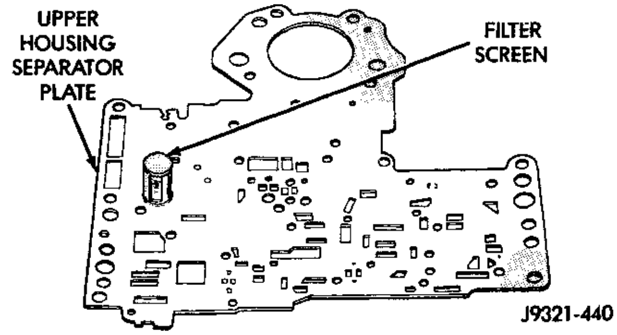

Fig. 69 Separator Plate Filter Screen Installation

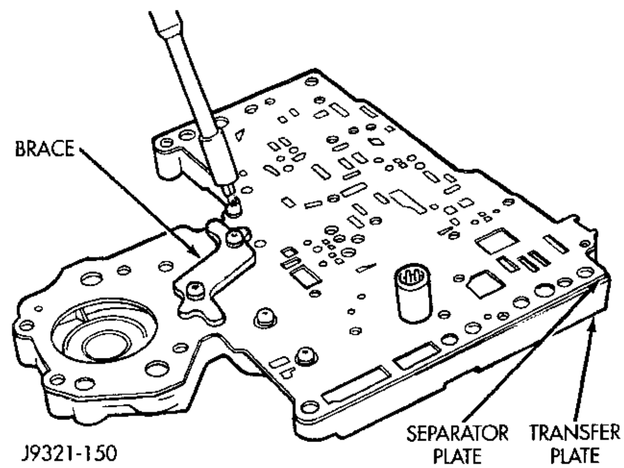

Fig. 70 Brace Plate

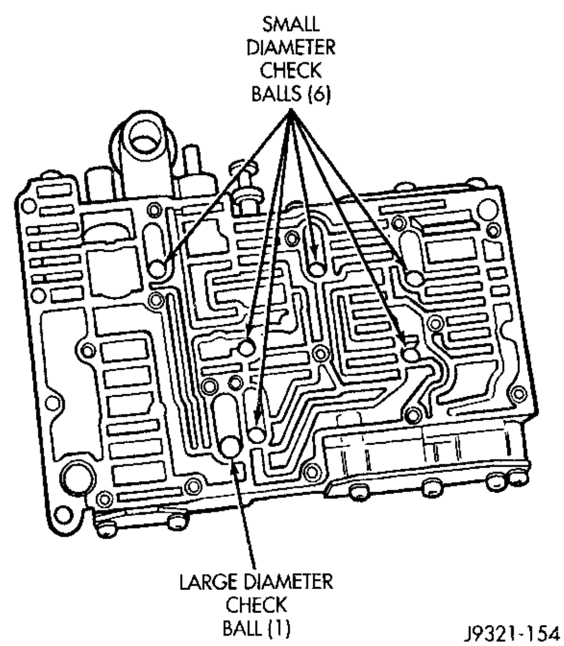

Fig. 71 Check Ball Locations In Upper Housing

DISASSEMBLY AND ASSEMBLY (Continued)

(2) Position assembled transfer plate and upper housing separator plate on upper housing (Fig. 72). Be sure filter screen is seated in proper housing recess.

(3) Install the ECE check ball into the transfer plate (Fig. 58). The ECE check ball is approximately 4.8 mm (3/16 in.) in diameter.

(4) Position lower housing separator plate on transfer plate (Fig. 73).

(5) Install lower housing on assembled transfer plate and upper housing (Fig. 74).

(6) Install and start all valve body screws by hand except for the screws to hold the boost valve tube brace. Save those screws for later installation. Then tighten screws evenly to 4 N·m (35 in. lbs.) torque. Start at center and work out to sides when tightening screws (Fig. 74).

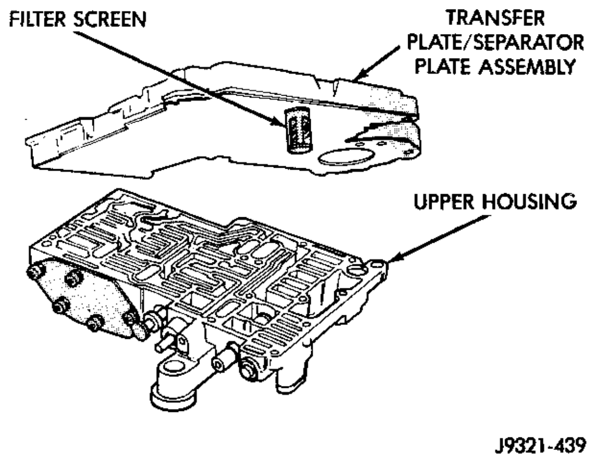

Fig. 72 Installing Transfer Plate On Upper Housing

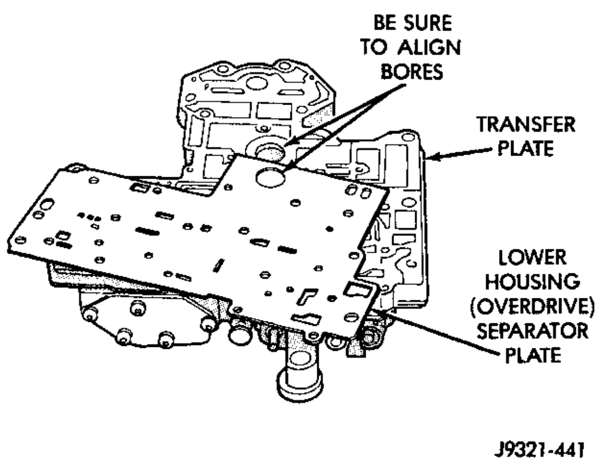

Fig. 73 Lower Housing Separator Plate

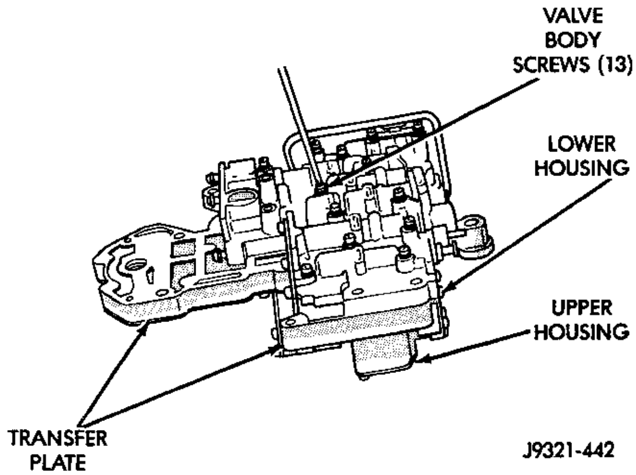

Fig. 74 Installing Lower Housing On Transfer Plate And Upper Housing

UPPER HOUSING VALVE AND PLUG

Refer to (Fig. 75), (Fig. 76) and (Fig. 77) to perform the following steps.

(1) Lubricate valves, plugs, springs with clean transmission fluid.

(2) Assemble regulator valve line pressure plug, sleeve, throttle plug and spring. Insert assembly in upper housing and install cover plate. Tighten cover plate screws to 4 N·m (35 in. lbs.) torque.

(3) Install 1-2 and 2-3 shift valves and springs.

(4) Install 1-2 shift control valve and spring.

(5) Install retainer, spring, limit valve, and 2-3 throttle plug from limit valve housing.

(6) Install limit valve housing and cover plate. Tighten screws to 4 N·m (35 in. lbs.).

(7) Install shuttle valve as follows:

(a) Insert plastic guides in shuttle valve secondary spring and install spring on end of valve.

(b) Install shuttle valve into housing.

(c) Hold shuttle valve in place.

(d) Compress secondary spring and install E-clip in groove at end of shuttle valve.

(e) Verify that spring and E-clip are properly seated before proceeding.

(8) Install shuttle valve cover plate. Tighten cover plate screws to 4 N·m (35 in. lbs.) torque.

(9) Install 1-2 and 2-3 valve governor plugs in valve body.

(10) Install shuttle valve primary spring and throttle plug.

(11) Align and install governor plug cover. Tighten cover screws to 4 N·m (35 in. lbs.) torque.

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DISASSEMBLY AND ASSEMBLY (Continued)

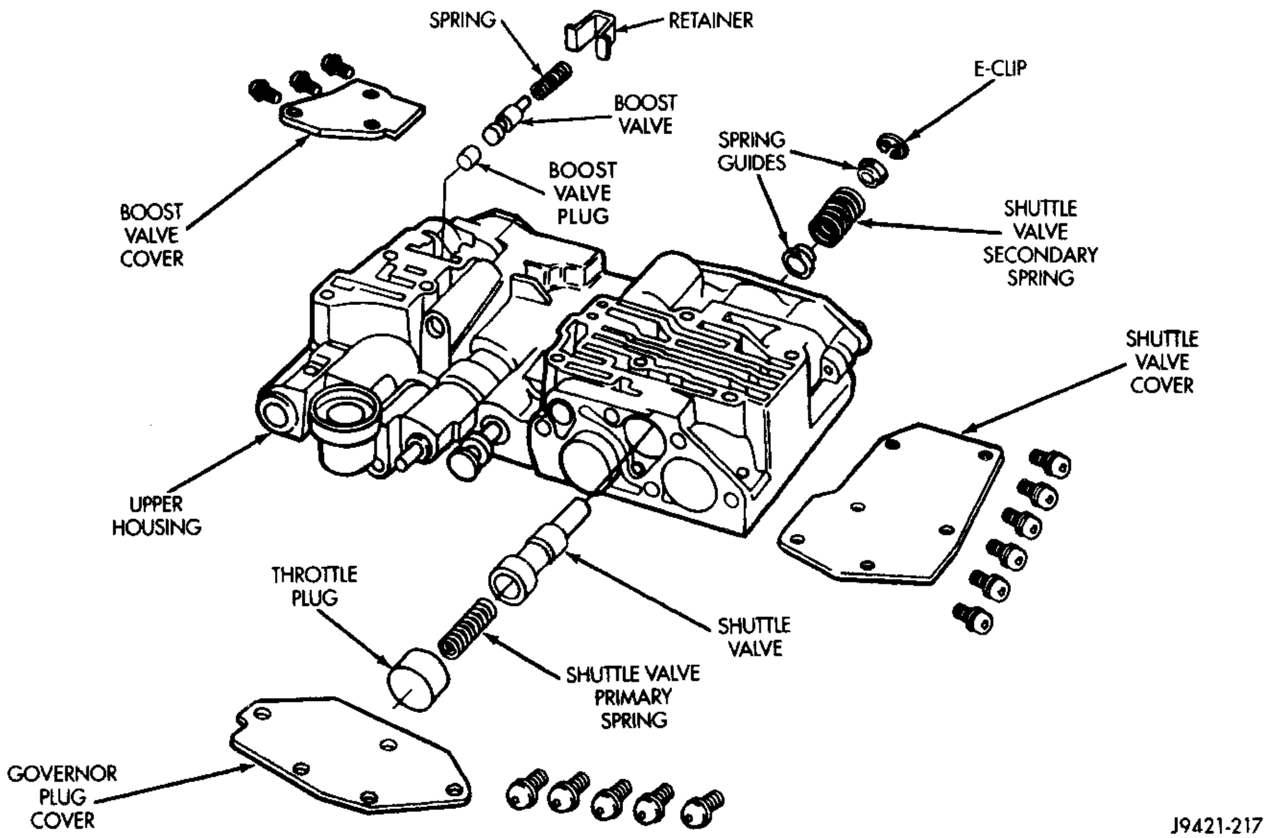

Fig. 75 Shuttle And Boost Valve Components

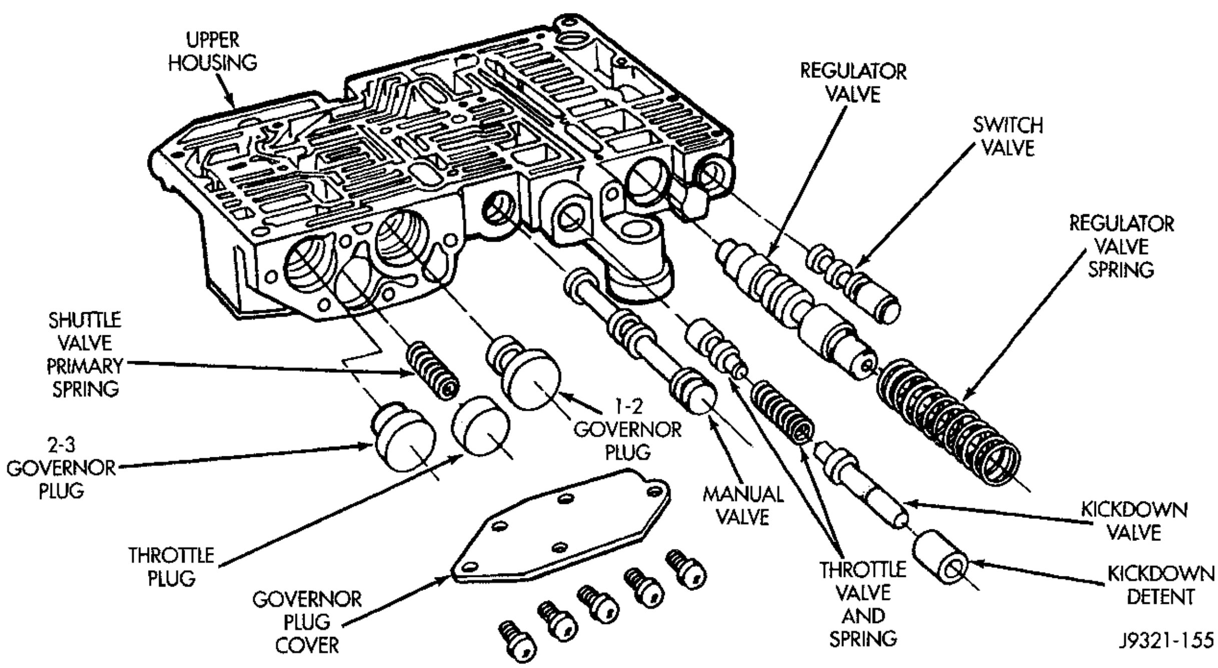

Fig. 76 Upper Housing Control Valve Locations

DISASSEMBLY AND ASSEMBLY (Continued)

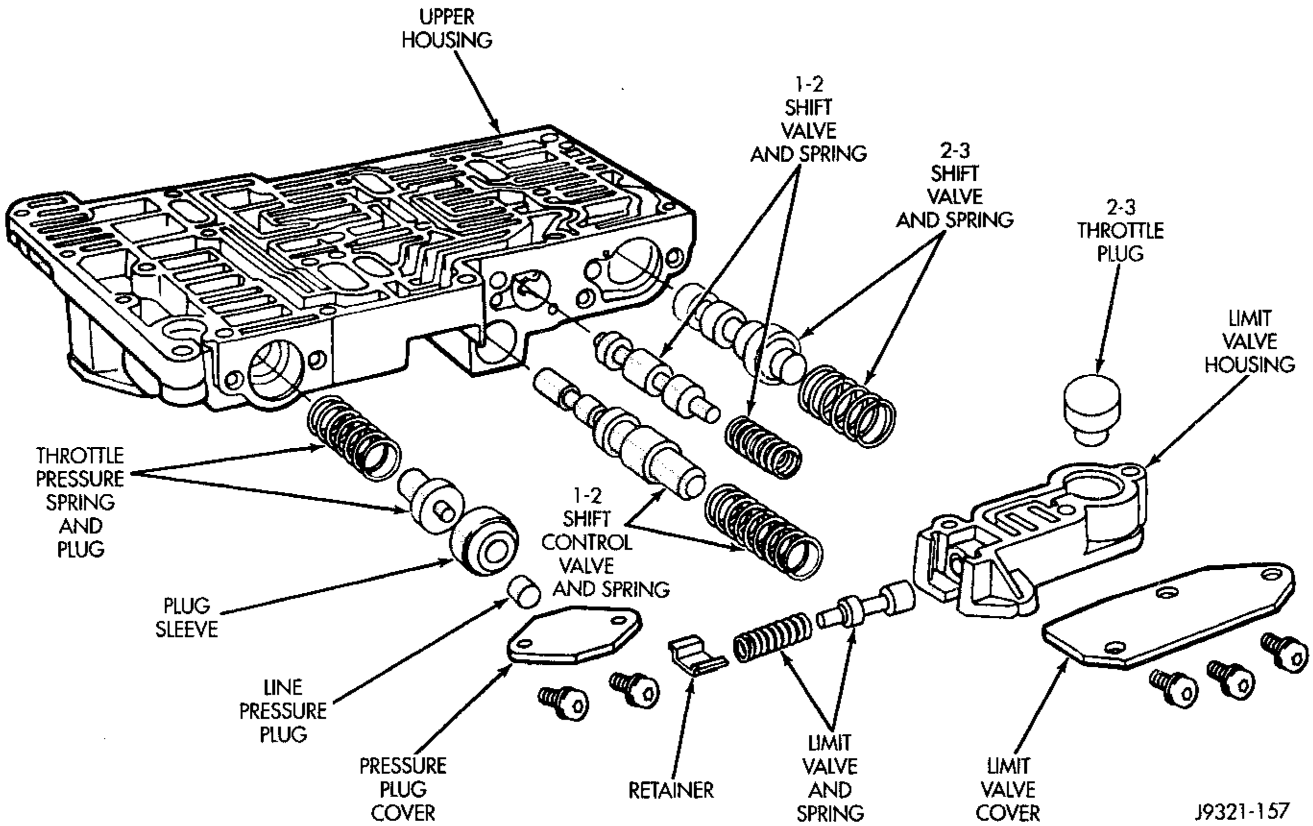

Fig. 77 Upper Housing Shift Valve And Pressure Plug Locations

BOOST VALVE TUBE AND BRACE

(1) Position valve body assembly so lower housing is facing upward (Fig. 78).

(2) Lubricate tube ends and housing ports with transmission fluid or petroleum jelly.

(3) Start tube in lower housing port first. Then swing tube downward and work opposite end of tube into upper housing port (Fig. 78).

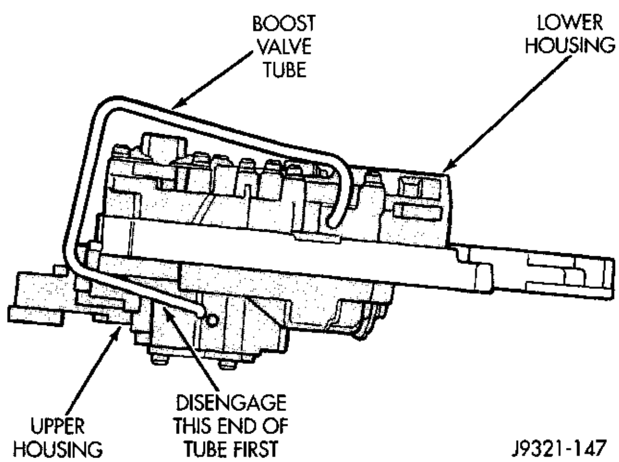

Fig. 78 Boost Valve Tube

(4) Insert and seat each end of tube in housings.

(5) Slide tube brace under tube and into alignment with valve body screw holes (Fig. 79).

(6) Install and finger tighten three screws that secure tube brace to valve body housings (Fig. 79).

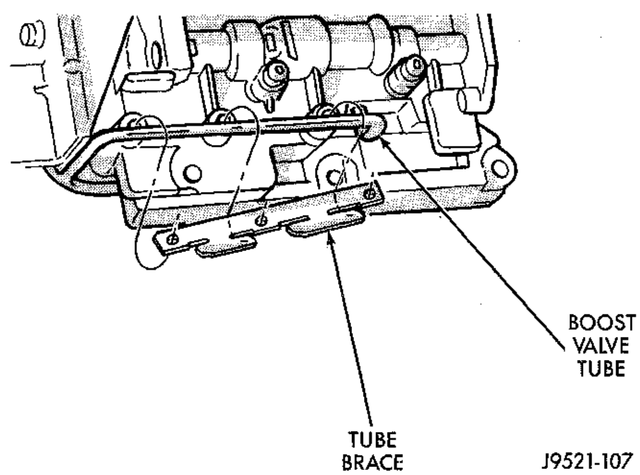

Fig. 79 Boost Valve Tube And Brace

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DISASSEMBLY AND ASSEMBLY (Continued)

(7) Bend tube brace tabs up and against tube to hold it in position (Fig. 80).

(8) Tighten all valve body housing screws to 4 N·m (35 in. lbs.) torque after tube and brace are installed. Tighten screws in diagonal pattern starting at center and working outward.

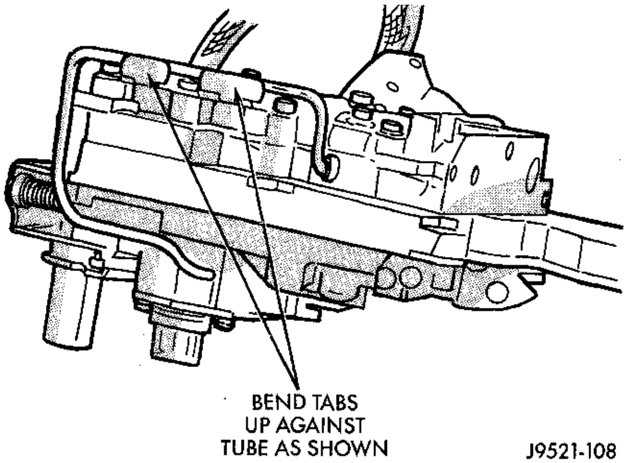

Fig. 80 Securing Boost Valve Tube With Brace Tabs

3-4 ACCUMULATOR

(1) Position converter clutch valve and 3-4 shift valve springs in housing (Fig. 81).

(2) Loosely attach accumulator housing with right-side screw (Fig. 81). Install only one screw at this time as accumulator must be free to pivot upward for ease of installation.

(3) Install 3-4 shift valve and spring.

(4) Install converter clutch timing valve and spring.

(5) Position plug on end of converter clutch valve spring. Then compress and hold springs and plug in place with fingers of one hand.

(6) Swing accumulator housing upward over valve springs and plug.

(7) Hold accumulator housing firmly in place and install remaining two attaching screws. Be sure springs and clutch valve plug are properly seated (Fig. 82). Tighten screws to 4 N·m (35 in. lbs.).

VALVE BODY FINAL

(1) Install boost valve, valve spring, retainer and cover plate. Tighten cover plate screws to 4 N·m (35 in. lbs.) torque.

(2) Insert manual lever detent spring in upper housing.

(3) Position detent ball on end of spring. Then hold detent ball and spring in detent housing with Retainer Tool 6583 (Fig. 83).

(4) Install throttle lever in upper housing. Then install manual lever over throttle lever and start manual lever into housing.

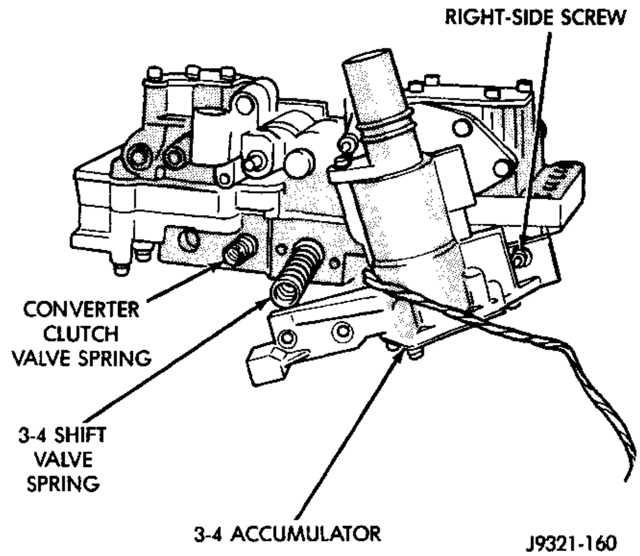

Fig. 81 Converter Clutch And 3-4 Shift Valve Springs

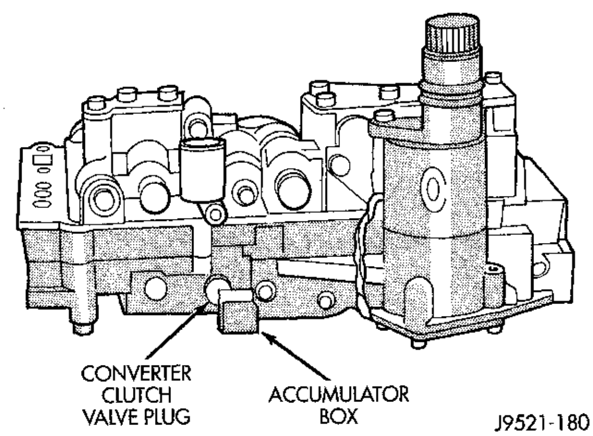

Fig. 82 Seating 3-4 Accumulator On Lower Housing

(5) Align manual lever with detent ball and manual valve. Hold throttle lever upward. Then press down on manual lever until fully seated. Remove detent ball retainer tool after lever is seated.

(6) Then install manual lever seal, washer and E-clip.

(7) Verify that throttle lever is aligned with end of kickdown valve stem and that manual lever arm is engaged in manual valve (Fig. 84).

(8) Position line pressure adjusting screw in adjusting screw bracket.

(9) Install spring on end of line pressure regulator valve.

(10) Install switch valve spring on tang at end of adjusting screw bracket.

(11) Install manual valve.

(12) Install throttle valve and spring.

(13) Install kickdown valve and detent.

DISASSEMBLY AND ASSEMBLY (Continued)

(14) Install pressure regulator valve.

(15) Install switch valve.

(16) Position adjusting screw bracket on valve body. Align valve springs and press bracket into place. Install short, upper bracket screws first and long bottom screw last. Verify that valve springs and bracket are properly aligned. Then tighten all three bracket screws to 4 N·m (35 in. lbs.) torque.

(17) Lubricate solenoid case connector O-rings and shaft of manual lever with light coat of petroleum jelly.

(18) Obtain new fluid filter for valve body but do not install filter at this time.

(19) If line pressure and/or throttle pressure adjustment screw settings were not disturbed, continue with overhaul or reassembly. However, if adjustment screw settings **were** moved or changed, readjust as described in Valve Body Control Pressure Adjustment procedure.

(20) Attach solenoid case connector to 3-4 accumulator with shoulder-type screw. Connector has small locating tang that fits in dimple at top of accumulator housing (Fig. 85). Seat tang in dimple before tightening connector screw.

(21) Install solenoid assembly and gasket. Tighten solenoid attaching screws to 8 N·m (72 in. lbs.) torque.

(22) Verify that solenoid wire harness is properly routed (Fig. 86). **Solenoid harness must be clear of manual lever and park rod and not be pinched between accumulator housing and cover.**

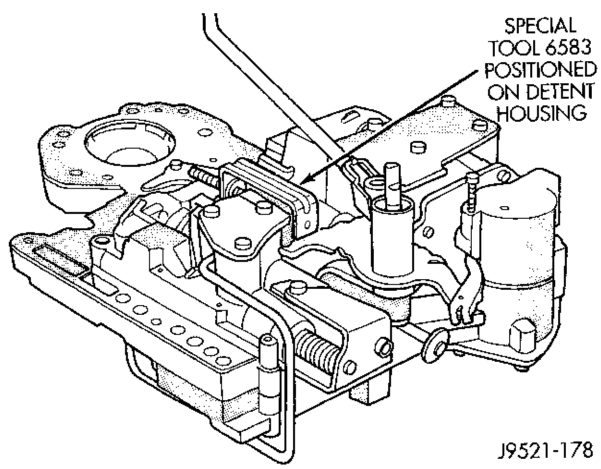

Fig. 83 Detent Ball Spring

GOVERNOR BODY, SENSOR AND SOLENOID

(1) Turn valve body assembly over so accumulator side of transfer plate is facing down.

(2) Install new O-rings on governor pressure solenoid and sensor.

(3) Lubricate solenoid and sensor O-rings with clean transmission fluid.

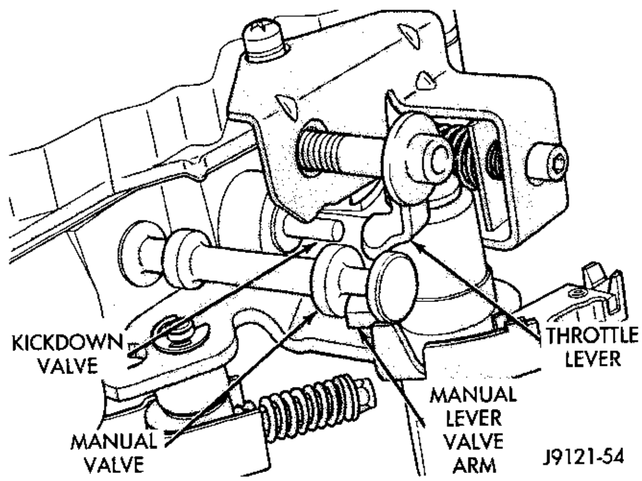

Fig. 84 Manual And Throttle Lever Alignment

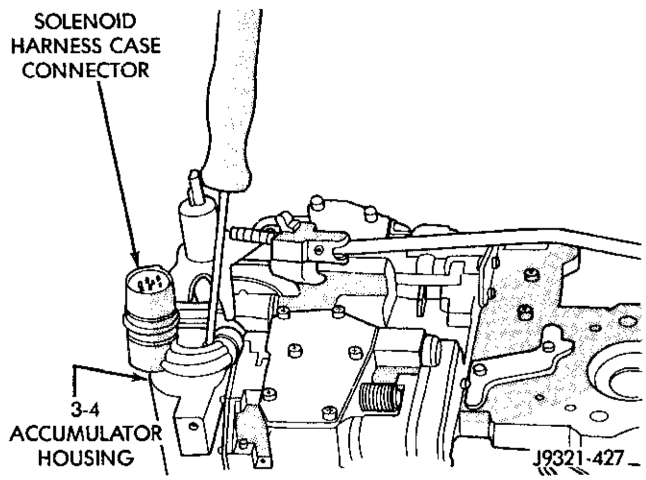

Fig. 85 Solenoid Harness Case Connector Shoulder Bolt

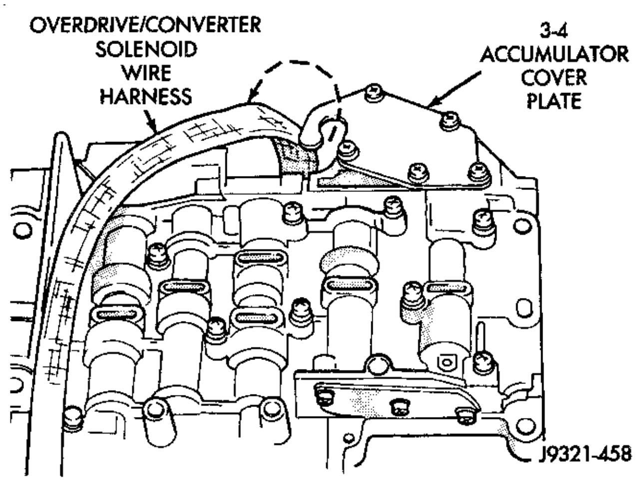

Fig. 86 Solenoid Harness Routing

DISASSEMBLY AND ASSEMBLY (Continued)

(4) Install governor pressure sensor in governor body. Then secure sensor with M-shaped retaining clip.

(5) Install governor pressure solenoid in governor body. Push solenoid in until it snaps into place in body.

(6) Position governor body gasket on transfer plate.

(7) Install retainer plate on governor body and around solenoid. Be sure solenoid connector is positioned in retainer cutout.

(8) Align screw holes in governor body and transfer plate. Then install and tighten governor body screws to 4 N·m (35 in. lbs.) torque.

(9) Connect harness wires to governor pressure solenoid and governor pressure sensor.

(10) Perform Line Pressure and Throttle Pressure adjustments. Refer to adjustment section of this group for proper procedures.

(11) Install fluid filter and pan.

(12) Lower vehicle.

(13) Fill transmission with recommended fluid and road test vehicle to verify repair.

TRANSMISSION

DISASSEMBLY

(1) Clean transmission exterior with steam gun or with solvent. Wear eye protection during cleaning operations.

(2) Place transmission in a vertical position.

(3) Measure and record input shaft end play readings.

(4) Remove shift and throttle levers from valve body manual lever shaft.

(5) Place transmission in horizontal position.

(6) Remove transmission oil pan and gasket.

(7) Remove filter from valve body (Fig. 87). Keep filter screws separate from other valve body screws. Filter screws are longer and should be kept with filter.

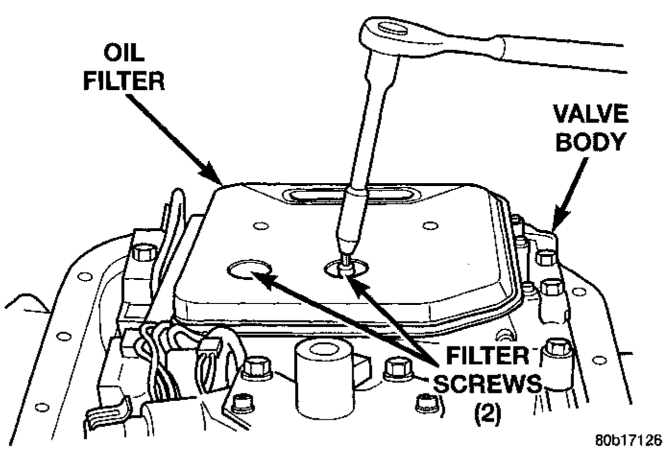

Fig. 87 Oil Filter Removal

(8) Remove park/neutral position switch.

(9) Remove hex head bolts attaching valve body to transmission case (Fig. 88). A total of 10 bolts are used. Note different bolt lengths for assembly reference.

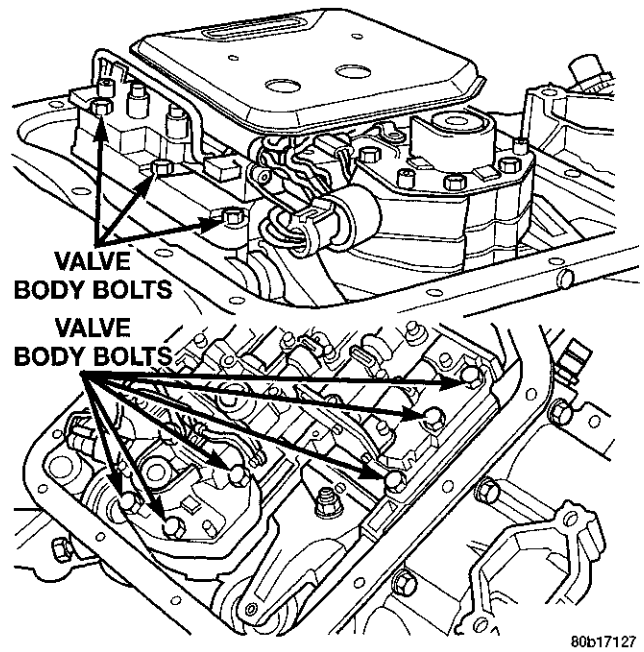

Fig. 88 Valve Body Bolt Locations

(10) Remove valve body assembly. Push valve body harness connector out of case. Then work park rod and valve body out of case (Fig. 89).

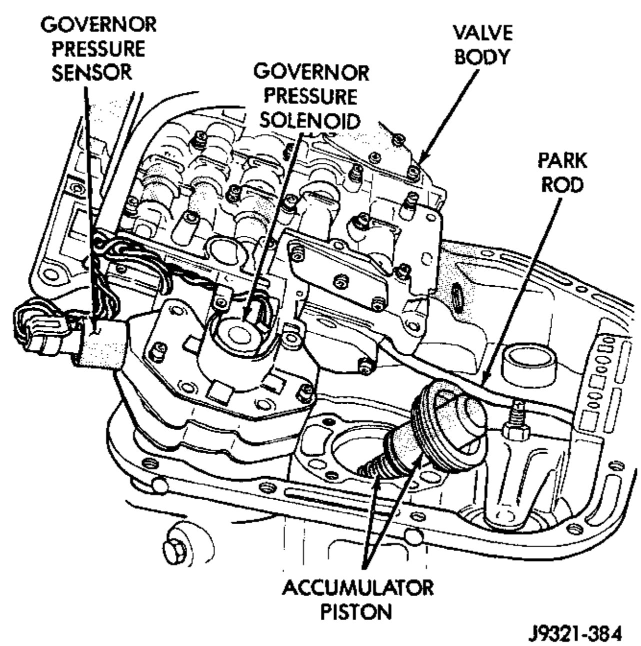

Fig. 89 Valve Body Removal

DISASSEMBLY AND ASSEMBLY (Continued)

(11) Remove accumulator piston and inner and outer springs (Fig. 90).

(12) Remove pump oil seal with suitable pry tool or slide-hammer mounted screw.

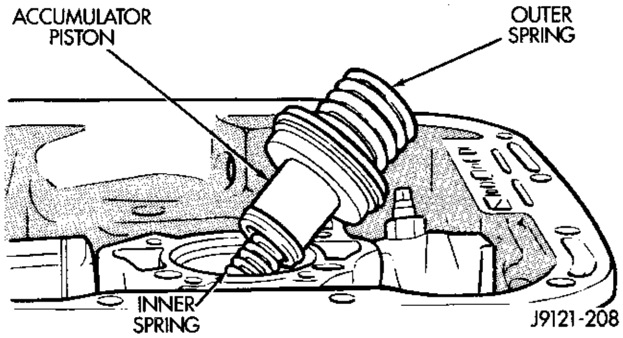

Fig. 90 Accumulator Piston And Springs

(13) Loosen front band adjusting screw locknut 4-5 turns. Then tighten band adjusting screw until band is tight around front clutch retainer. This prevents front/rear clutches from coming out with pump and possibly damaging clutch or pump components.

(14) Remove oil pump bolts.

(15) Thread bolts of Slide Hammer Tools C-3752 into threaded holes in pump body flange (Fig. 91).

(16) Bump slide hammer weights outward to remove pump and reaction shaft support assembly from case (Fig. 91).

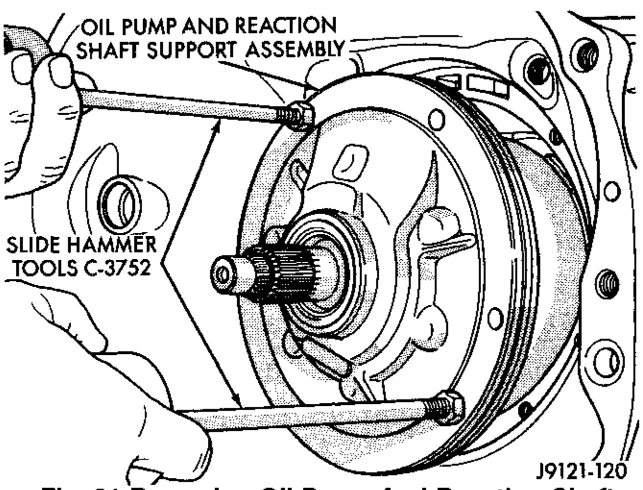

Fig. 91 Removing Oil Pump And Reaction Shaft Support Assembly

(17) Loosen front band adjusting screw until band is completely loose.

(18) Squeeze front band together and remove band strut (Fig. 92).

(19) Remove front band lever (Fig. 93).

(20) Remove front band lever shaft plug, if necessary, from converter housing.

(21) Remove front band lever shaft.

(22) Remove front and rear clutch units as assembly. Grasp input shaft, hold clutch units together and remove them from case (Fig. 94).

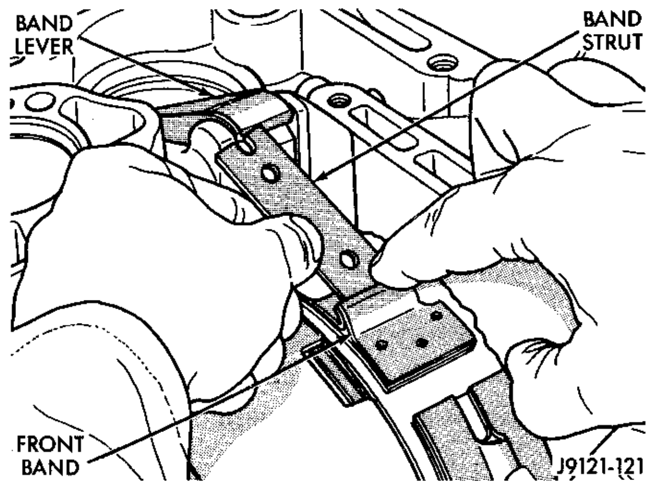

Fig. 92 Removing/Installing Front Band Strut

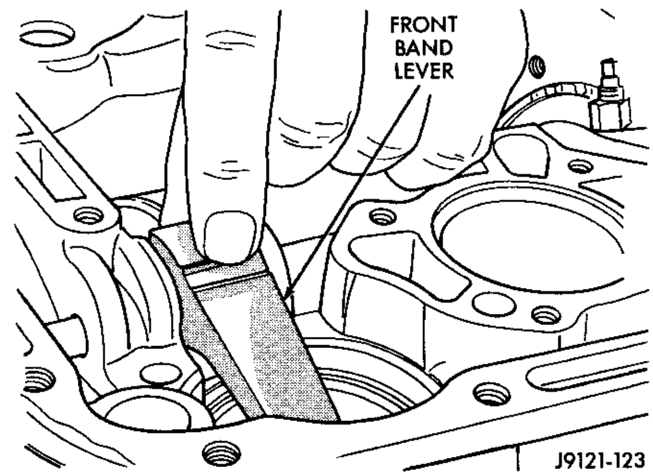

Fig. 93 Removing/Installing Front Band Lever

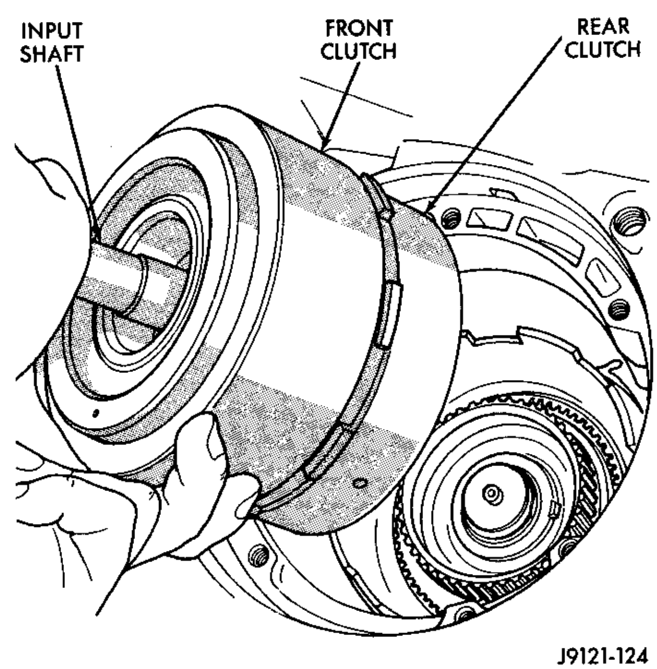

Fig. 94 Removing Front/Rear Clutch Assemblies

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DISASSEMBLY AND ASSEMBLY (Continued)

(23) Lift front clutch off rear clutch (Fig. 95). Set clutch units aside for overhaul.

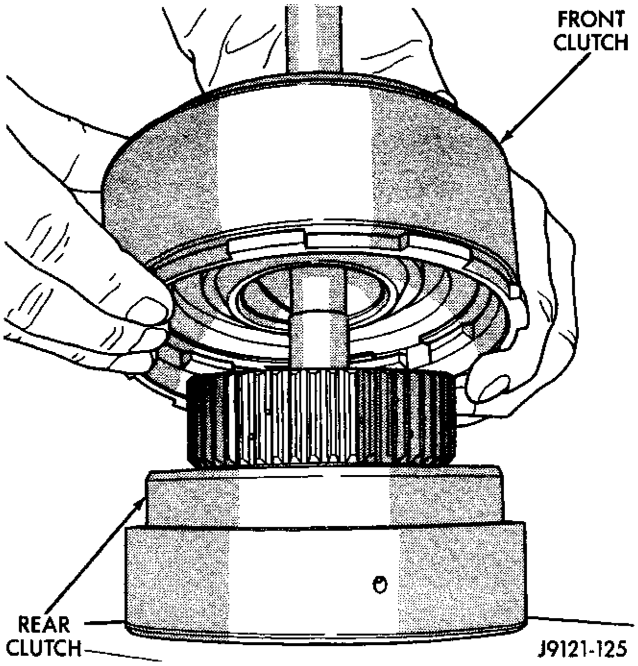

Fig. 95 Separating Front/Rear Clutch Assemblies

(24) Remove intermediate shaft thrust washer from front end of shaft or from rear clutch hub (Fig. 96).

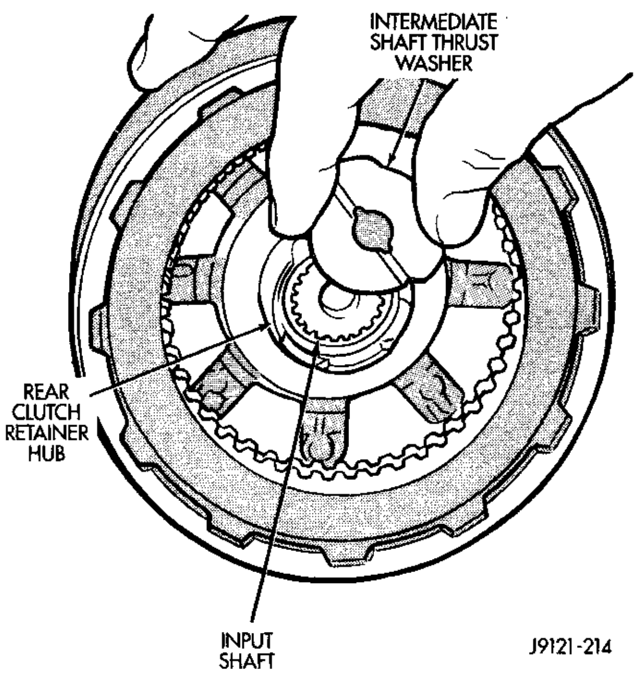

Fig. 96 Removing Intermediate Shaft Thrust Washer

(25) Remove output shaft thrust plate from intermediate shaft hub (Fig. 97).

(26) Slide front band off driving shell (Fig. 98) and remove band from case.

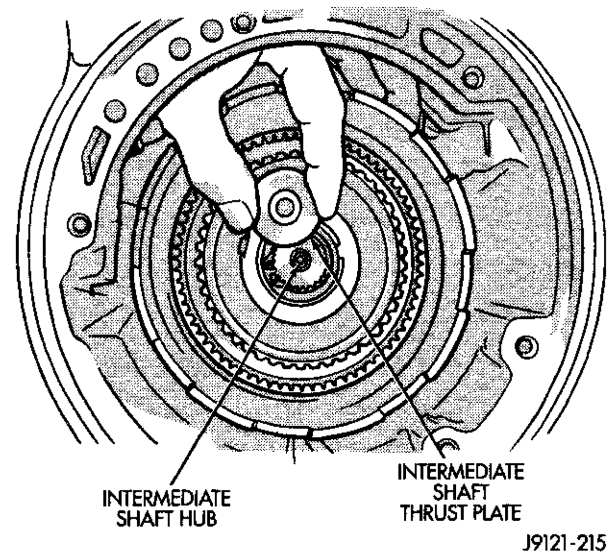

Fig. 97 Removing Intermediate Shaft Thrust Plate

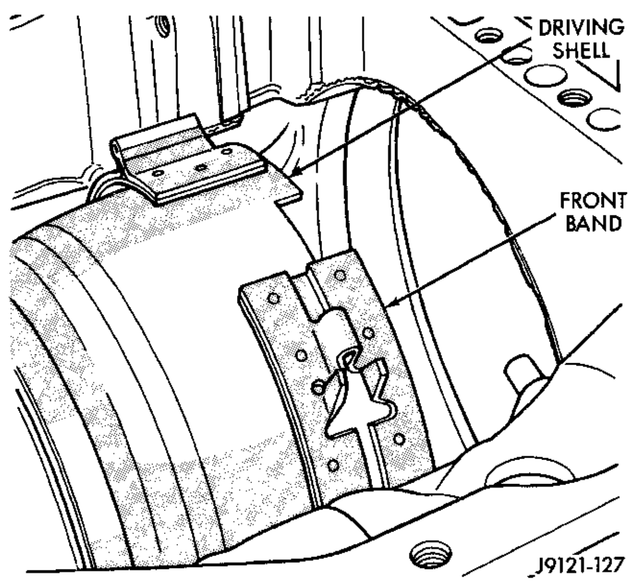

Fig. 98 Front Band Removal/Installation

DISASSEMBLY AND ASSEMBLY (Continued)

(27) Remove planetary geartrain as assembly (Fig. 99). Support geartrain with both hands during removal. Do not allow machined surfaces on intermediate shaft or overdrive piston retainer to become nicked or scratched.

(28) If overdrive unit is not to be serviced, install Alignment Shaft 6227-2 into the overdrive unit to prevent misalignment of the overdrive clutches during service of main transmission components.

(29) Loosen rear band adjusting screw 4-5 turns.

(30) Remove low-reverse drum snap ring (Fig. 100).

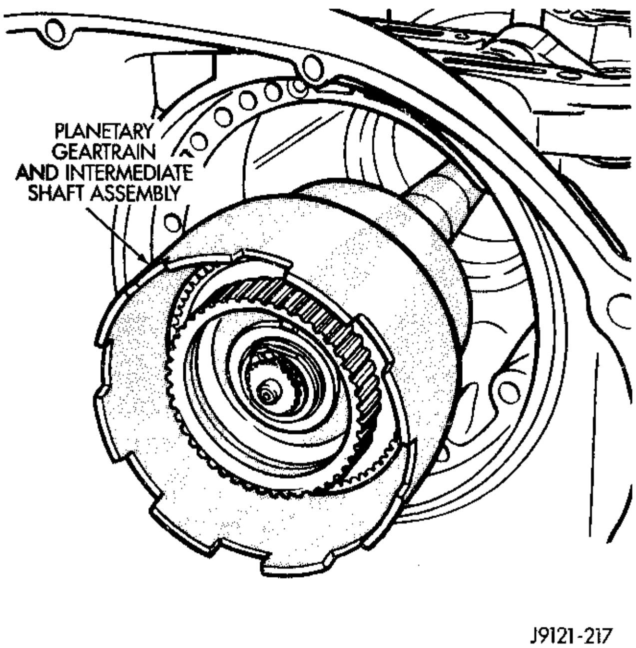

Fig. 99 Removing Planetary Geartrain And Intermediate Shaft Assembly

(31) Remove low-reverse drum and reverse band.

(32) Remove overrunning clutch roller and spring assembly as a unit (Fig. 101).

(33) Compress front servo rod guide about 1/8 inch with Valve Spring Compressor C-3422-B (Fig. 102).

(34) Remove front servo rod guide snap ring. **Exercise caution when removing snap ring. Servo bore can be scratched or nicked if care is not exercised.**

(35) Remove compressor tools and remove front servo rod guide, spring and servo piston.

(36) Compress rear servo spring retainer about 1/16 inch with Valve Spring Compressor C-3422-B (Fig. 103).

(37) Remove rear servo spring retainer snap ring. Then remove compressor tools and remove rear servo spring and piston.

(38) Inspect transmission components.

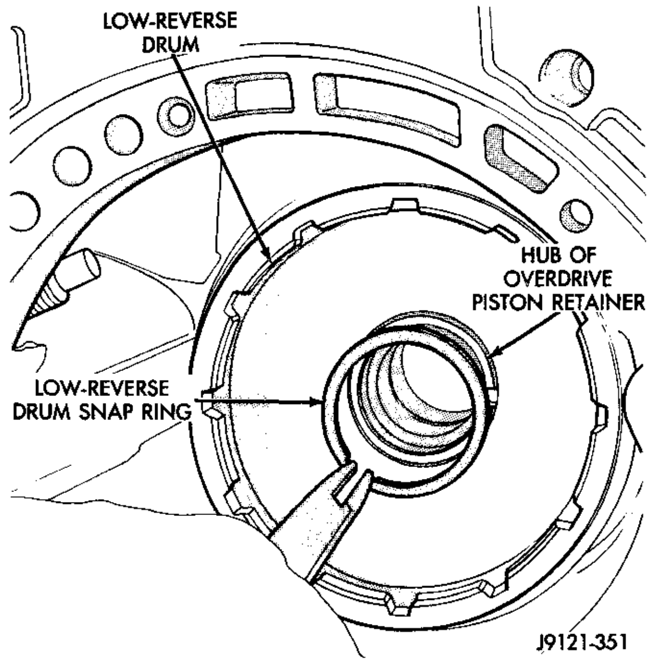

Fig. 100 Removing Low-Reverse Drum Snap Ring

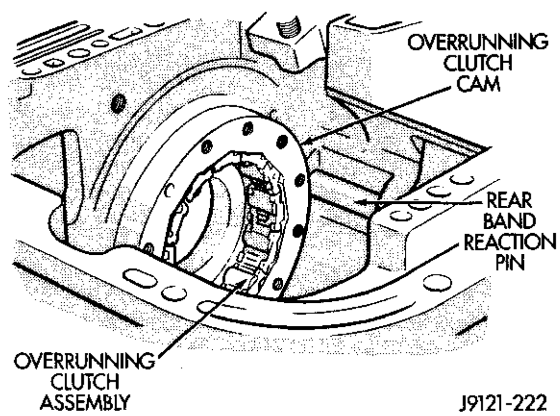

Fig. 101 Overrunning Clutch Assembly Removal

NOTE: TO SERVICE THE OVERRUNNING CLUTCH CAM OR OVERDRIVE PISTON RETAINER, REFER TO OVERRUNNING CLUTCH CAM SERVICE IN THIS SECTION.

ASSEMBLY

Do not allow dirt, grease, or foreign material to enter the case or transmission components during assembly. Keep the transmission case and components clean. Also make sure the tools and workbench area used for assembly operations are equally clean.

Shop towels used for wiping off tools and hands must be made from **lint free** material. Lint will stick to transmission parts and could interfere with valve operation, or even restrict fluid passages.

Lubricate the transmission components with Mopar® transmission fluid during reassembly. Use

DISASSEMBLY AND ASSEMBLY (Continued)

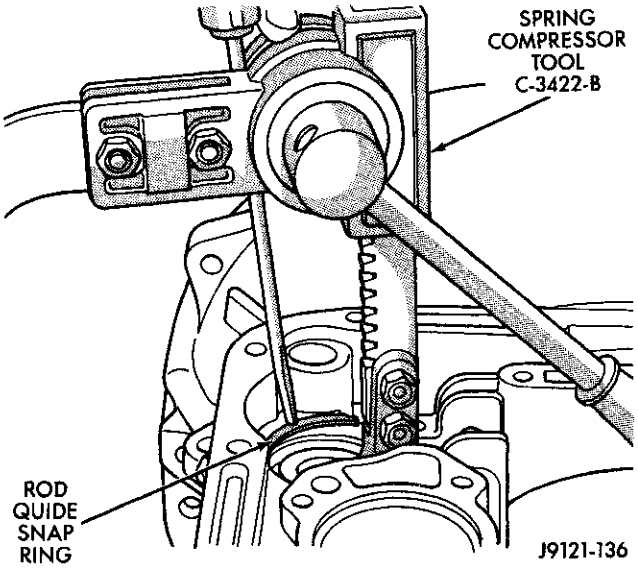

Fig. 102 Compressing Front Servo Rod Guide

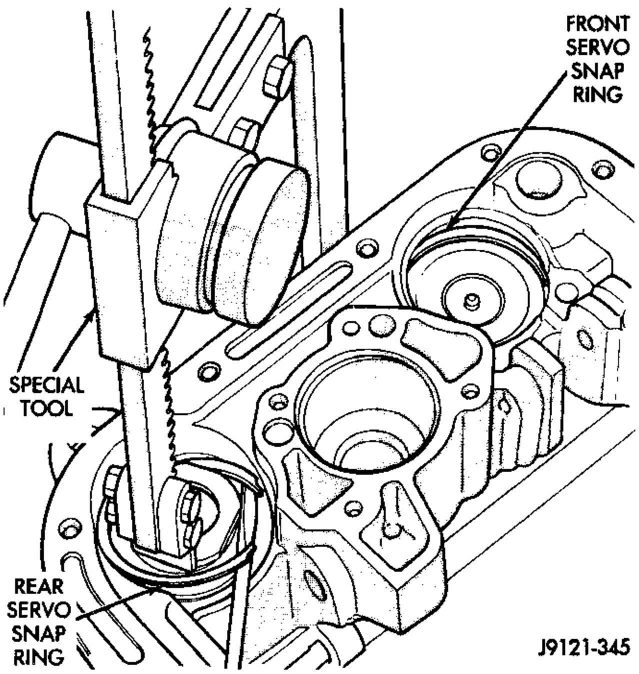

Fig. 103 Compressing Rear Servo Spring

Mopar® Door Ease, or Ru-Glyde on seals and O-rings to ease installation.

Petroleum jelly can also be used to hold thrust washers, thrust plates and gaskets in position during assembly. However, **do not** use chassis grease, bearing grease, white grease, or similar lubricants on any transmission part. These types of lubricants can eventually block or restrict fluid passages and interfere with valve operation. Use petroleum jelly only.

Do not force parts into place. The transmission components and subassemblies are easily installed by hand when properly aligned.

If a part seems extremely difficult to install, it is either misaligned or incorrectly assembled. Also verify that thrust washers, thrust plates and seal rings are correctly positioned before assembly. These parts can interfere with proper assembly if mis-positioned.

The planetary geartrain, front/rear clutch assemblies and oil pump are all much easier to install when the transmission case is upright.

(1) Install rear servo piston, spring and retainer (Fig. 104). Install spring on top of servo piston and install retainer on top of spring.

(2) Install front servo piston assembly, servo spring and rod guide (Fig. 105).

(3) Compress front/rear servo springs with Valve Spring Compressor C-3422-B and install each servo snap ring (Fig. 106).

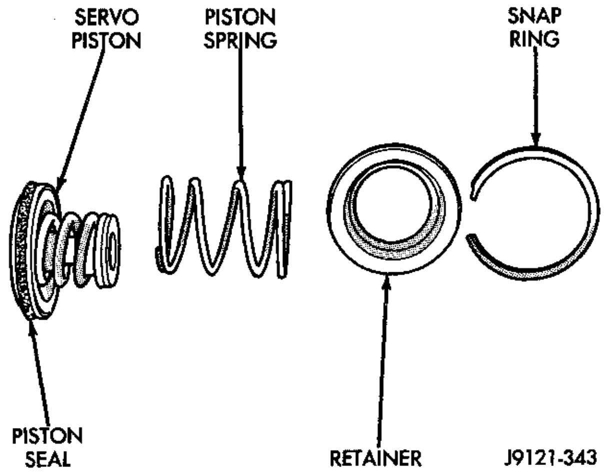

Fig. 104 Rear Servo Components

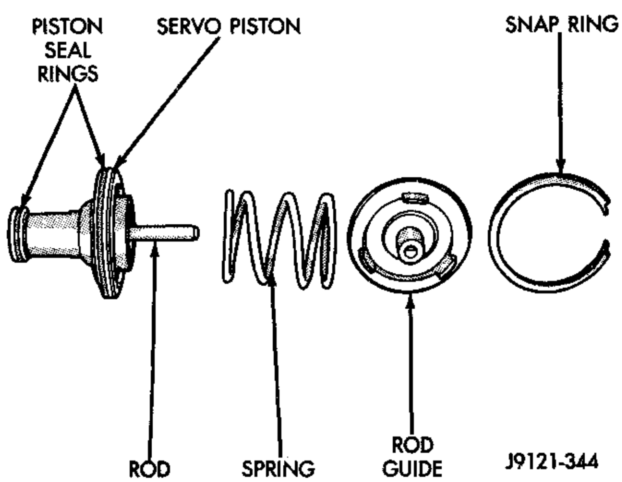

Fig. 105 Front Servo Components

(4) Lubricate clutch cam rollers with transmission fluid.

(5) Install rear band in case (Fig. 107). Be sure twin lugs on band are seated against reaction pin.

DISASSEMBLY AND ASSEMBLY (Continued)

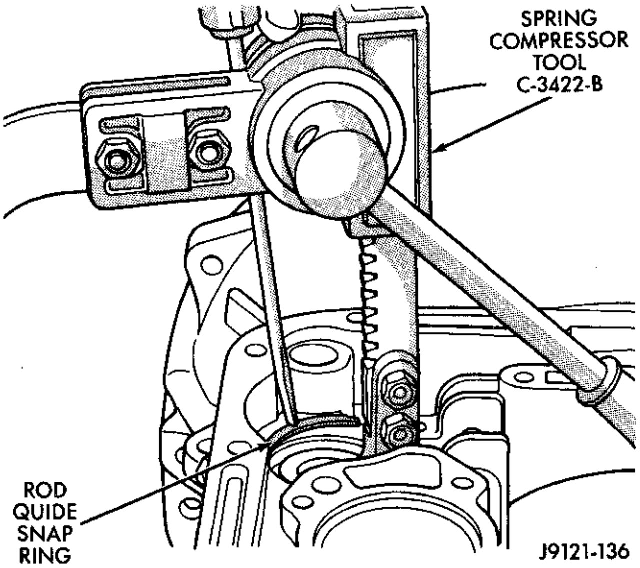

Fig. 106 Compressing Front/Rear Servo Springs

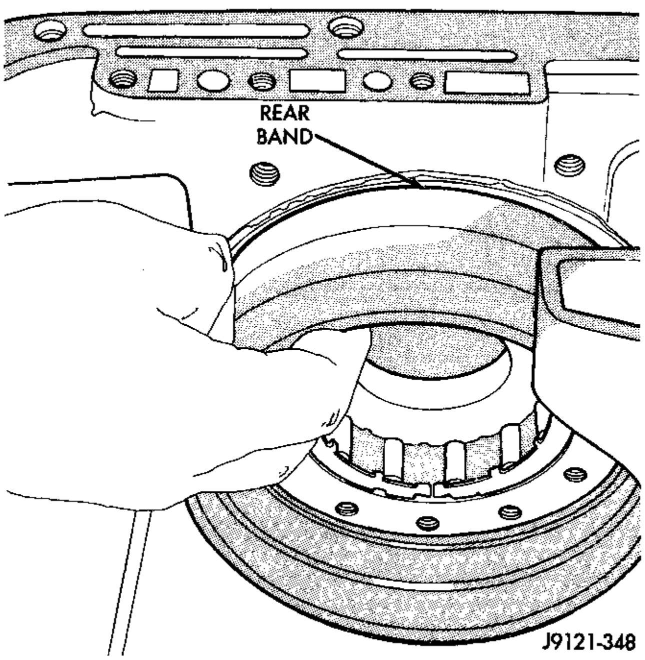

Fig. 107 Rear Band Installation

(6) Install low-reverse drum and check overrunning clutch operation as follows:

(a) Lubricate overrunning clutch race (on drum hub) with transmission fluid.

(b) Guide drum through rear band.

(c) Tilt drum slightly and start race (on drum hub) into overrunning clutch rollers.

(d) Press drum rearward and turn it in clockwise direction until drum seats in overrunning clutch (Fig. 108).

(e) Turn drum back and forth. **Drum should rotate freely in clockwise direction and lock in counterclockwise direction (as viewed from front of case).**

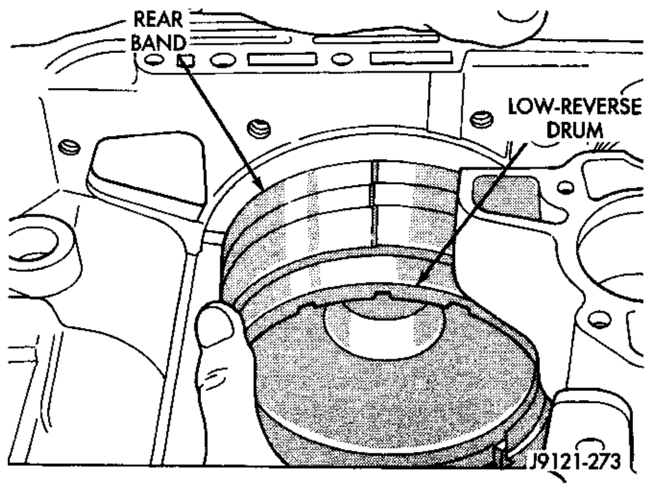

Fig. 108 Installing Low-Reverse Drum

(7) Install snap ring that secures low-reverse drum to hub of overdrive piston retainer (Fig. 109).

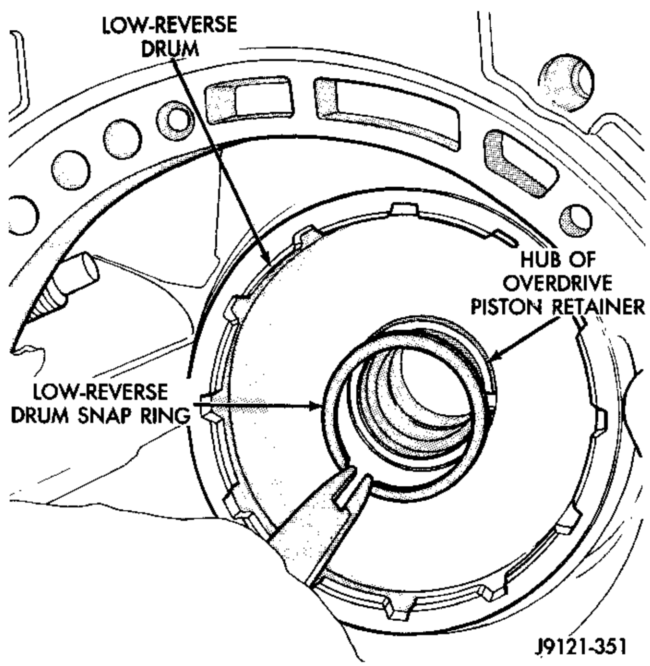

Fig. 109 Installing Low-Reverse Drum Retaining Snap Ring

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DISASSEMBLY AND ASSEMBLY (Continued)

(8) Install rear band lever and pivot pin (Fig. 110). Align lever with pin bores in case and push pivot pin into place.

(9) Install planetary geartrain assembly (Fig. 111).

(10) Install thrust plate on intermediate shaft hub

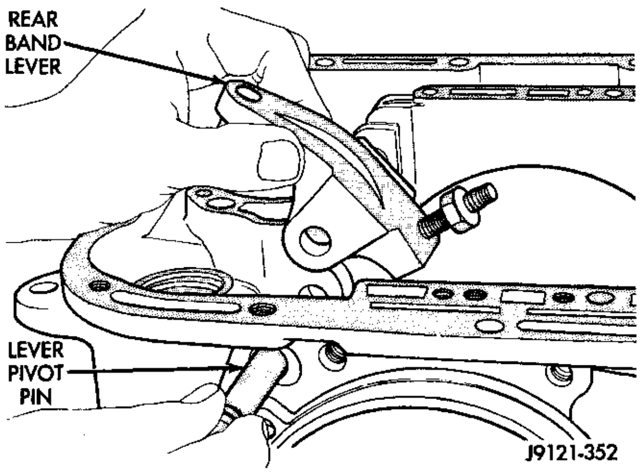

Fig. 110 Rear Band Lever And Pivot Pin Installation

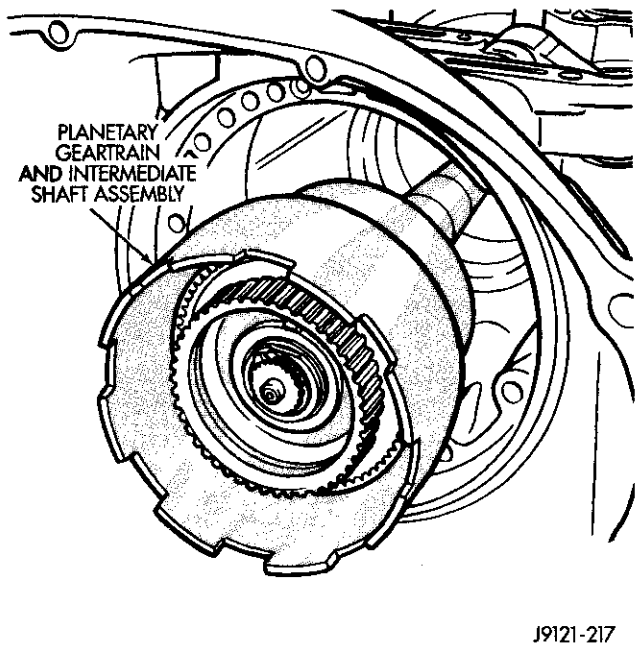

Fig. 111 Installing Planetary Geartrain

(Fig. 112). Use petroleum jelly to hold thrust plate in place.

(11) Check seal ring on rear clutch retainer hub and seal rings on input shaft (Fig. 113). Also verify that shaft seal rings are installed in sequence shown.

(12) Install rear clutch thrust washer (Fig. 114). Use additional petroleum jelly to hold washer in place if necessary.

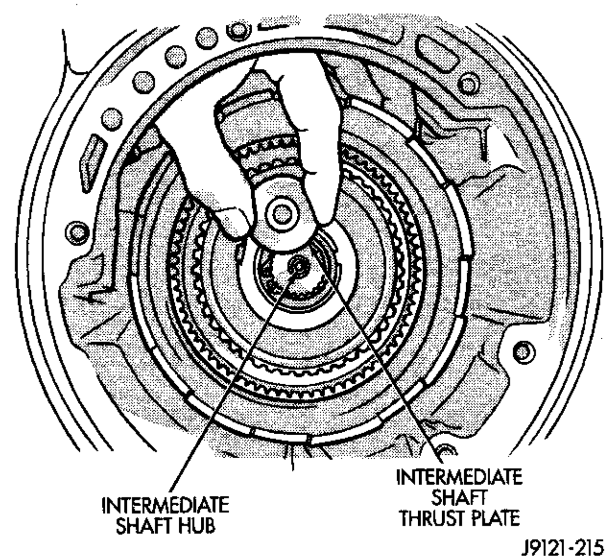

Fig. 112 Installing Intermediate Shaft Thrust Plate

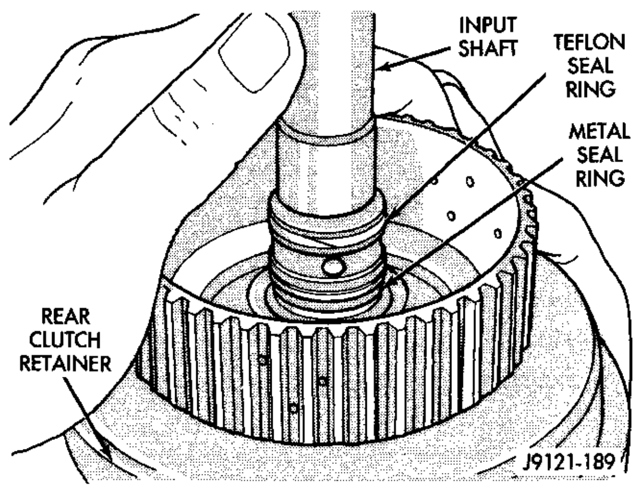

Fig. 113 Input Shaft Seal Ring Location

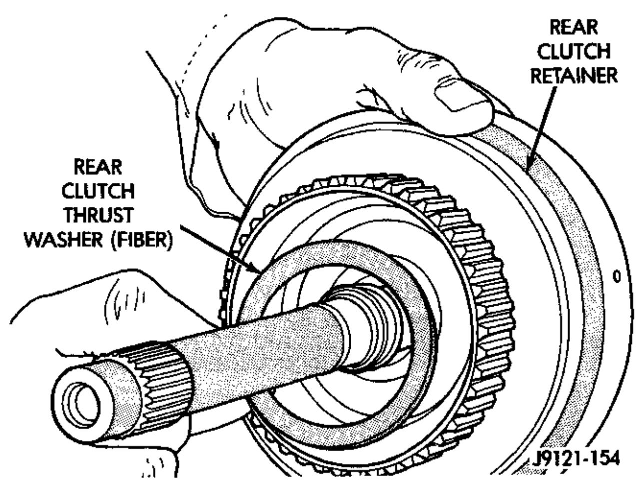

Fig. 114 Installing Rear Clutch Thrust Washer

DISASSEMBLY AND ASSEMBLY (Continued)

(13) Align clutch discs in front clutch and install front clutch on rear clutch (Fig. 115). Rotate front clutch retainer back and forth until completely seated on rear clutch retainer.

(14) Coat intermediate shaft thrust washer with petroleum jelly. Then install washer in rear clutch hub (Fig. 116). Use enough petroleum jelly to hold washer in place. **Be sure grooved side of washer faces rearward (toward output shaft) as shown. Also note that washer only fits one way in clutch hub.** Note thickness of this washer. It is a select fit part and is used to control transmission end play.

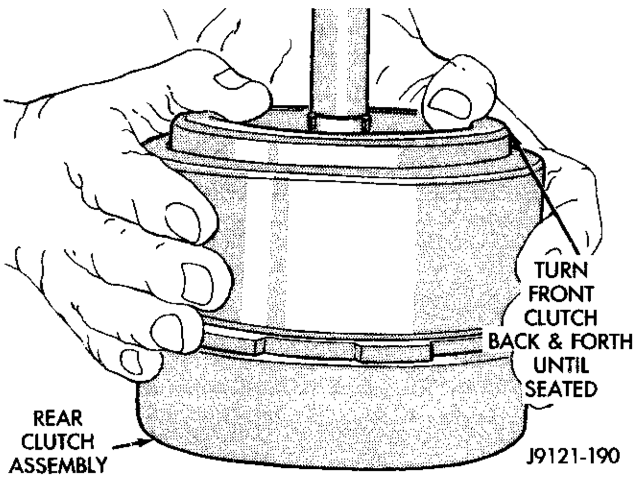

Fig. 115 Assembling Front And Rear Clutch Units

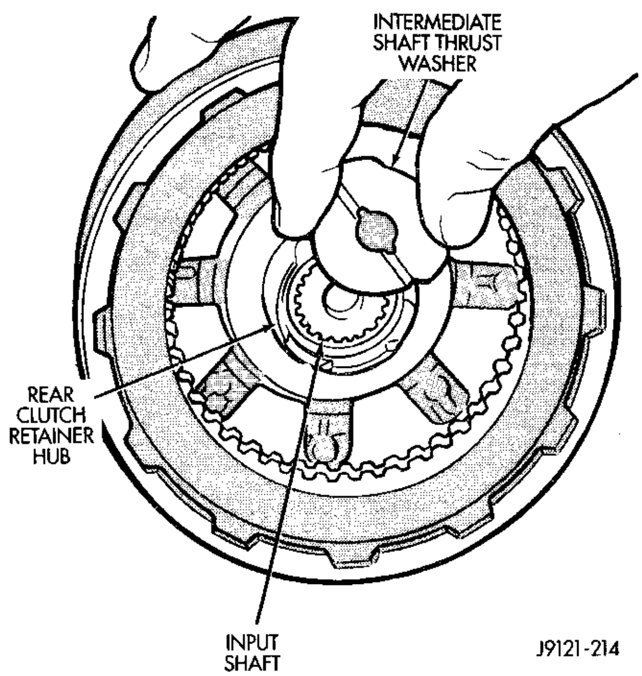

Fig. 116 Installing Intermediate Shaft Thrust Plate

(15) Align drive teeth on rear clutch discs with small screwdriver (Fig. 117). This makes installation on front planetary easier.

(16) Raise front end of transmission upward as far as possible and support case with wood blocks. Front/rear clutch and oil pump assemblies are easier to install if transmission is as close to upright position as possible.

(17) Slide front band into case.

(18) Install front and rear clutch units as assembly (Fig. 118). Align rear clutch with front annulus gear and install assembly in driving shell. **Be sure output shaft thrust washer and thrust plate are not displaced during installation.**

(19) Carefully work assembled clutches back and forth to engage and seat rear clutch discs on front annulus gear. Also be sure front clutch drive lugs are fully engaged in slots of driving shell after installation.

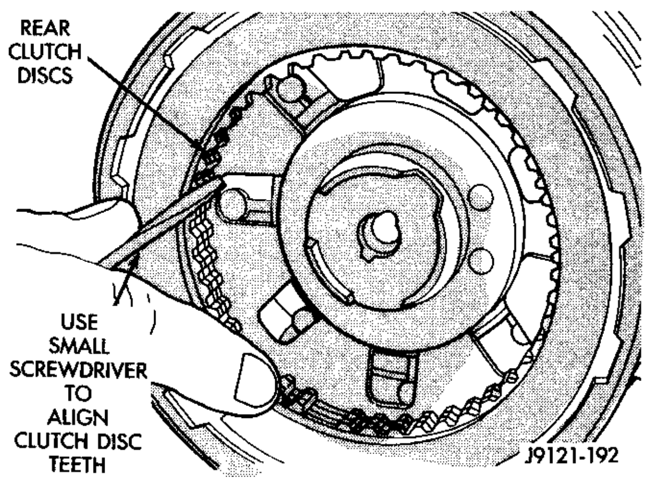

Fig. 117 Aligning Rear Clutch Disc Lugs

DISASSEMBLY AND ASSEMBLY (Continued)

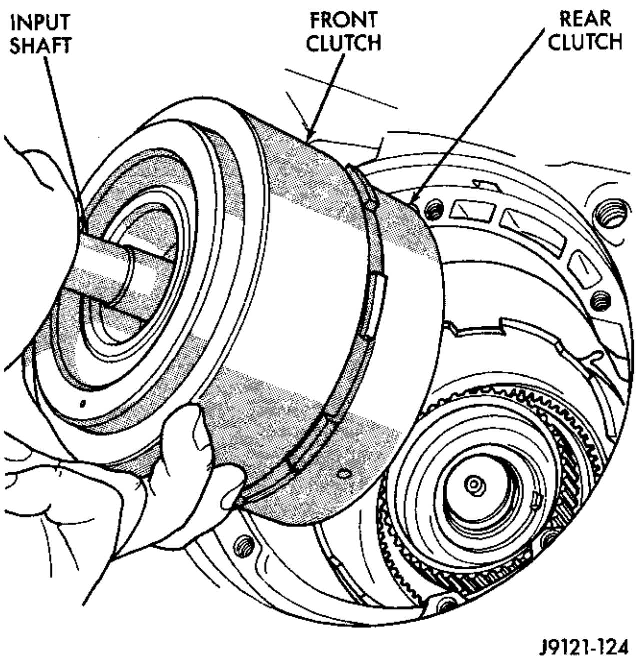

Fig. 118 Installing Front/Rear Clutch Assemblies

(20) Assemble front band strut.

(21) Install front band adjuster, strut and adjusting screw (Fig. 119).

(22) Tighten band adjusting screw until band just grips clutch retainer. Verify that front/rear clutches are still seated before continuing.

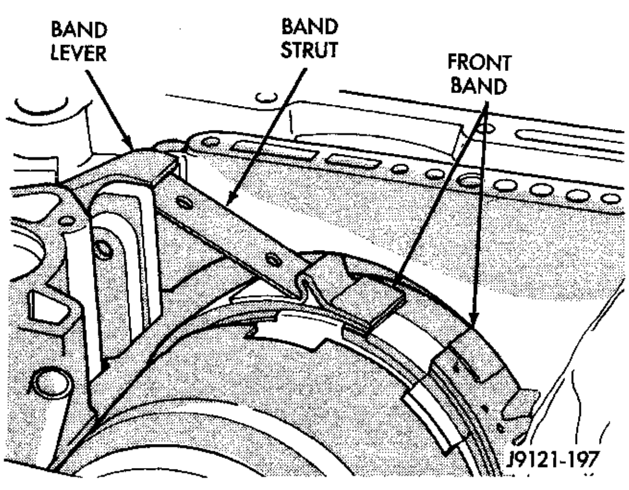

Fig. 119 Front Band Linkage Installation

(23) Check seal rings on reaction shaft support hub. Verify that seal rings are hooked together and that front clutch thrust washer is properly positioned (Fig. 120). Use petroleum jelly to hold thrust washer in place if necessary.

(24) Lubricate oil pump body seal with petroleum jelly. Lubricate pump shaft seal lip with petroleum jelly.

(25) Thread two Pilot Stud Tools C-3288-B into bolt holes in oil pump bore flange (Fig. 121).

(26) Align and install oil pump gasket (Fig. 121).

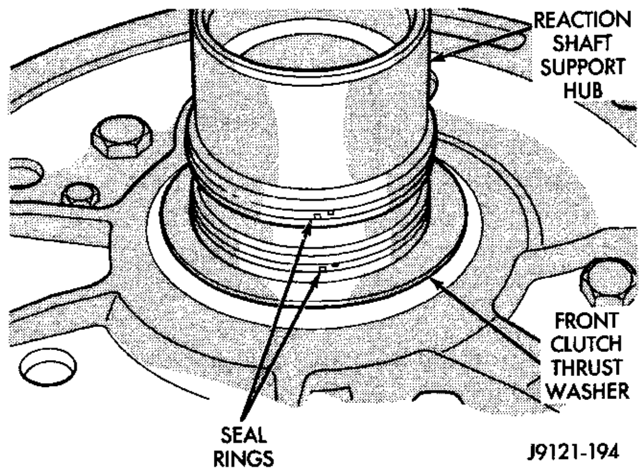

Fig. 120 Reaction Shaft Support Seal Rings And Front Clutch Thrust Washer

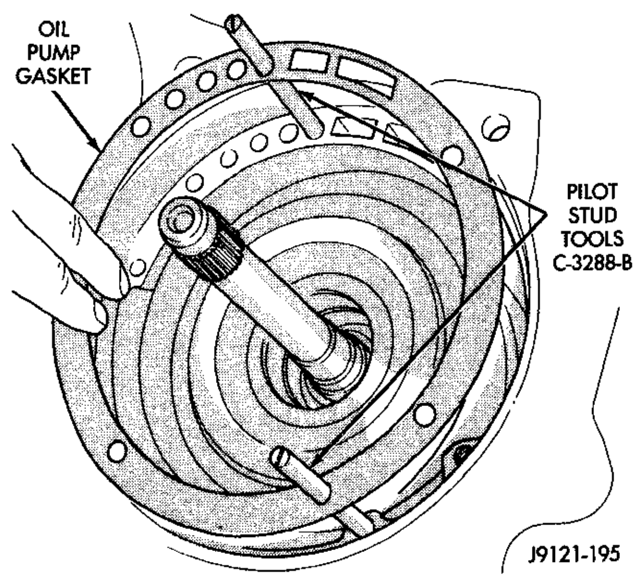

Fig. 121 Installing Pilot Studs And Oil Pump Gasket

DISASSEMBLY AND ASSEMBLY (Continued)

(27) Install oil pump (Fig. 122). Align and position pump on pilot studs. Slide pump down studs and work it into front clutch hub and case by hand. Then install 2 or 3 pump bolts to hold pump in place.

(28) Remove pilot stud tools and install remaining oil pump bolts. Tighten bolts alternately in diagonal pattern to 20 N·m (15 ft. lbs.).

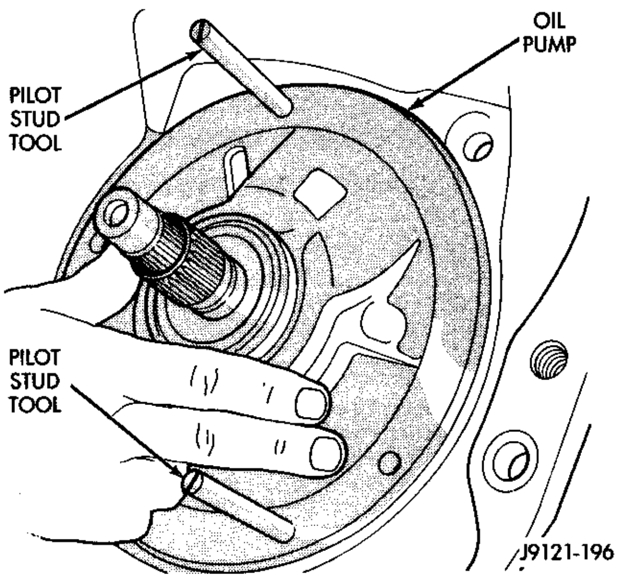

Fig. 122 Installing Oil Pump Assembly In Case

(29) Measure and if necessary, correct input shaft end play as follows (Fig. 123):

(a) Attach dial indicator to converter housing.

(b) Position indicator plunger against input shaft and zero indicator.

(c) Move input shaft in and out and record reading. End play should be 0.56 - 2.31 mm (0.022 - 0.091 in.). Proceed to next step if end play is not within specified limits.

(d) Intermediate shaft thrust washer (in hub of rear clutch retainer) controls end play. Washer is a select fit part and can be changed to adjust end play. If end play turns out to be incorrect, remove oil pump, and clutches. Then install thinner/thicker thrust washer as necessary.

(30) Install accumulator piston and inner and outer springs (Fig. 124).

(31) Verify that valve body solenoid harness is secured in 3-4 accumulator housing cover plate.

(32) Install valve body as follows:

(a) Align and carefully insert park rod into pawl. Rod will make click noise as it enters pawl. Move rod slightly to check engagement.

(b) Align and seat valve body on case. Be sure manual lever shaft and overdrive connector are fully seated in case. Also be sure valve body wiring is not pinched or kinked.

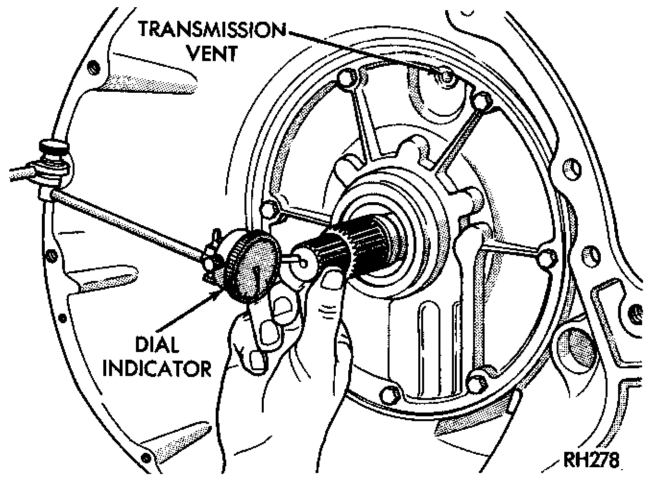

Fig. 123 Measuring Input Shaft End Play

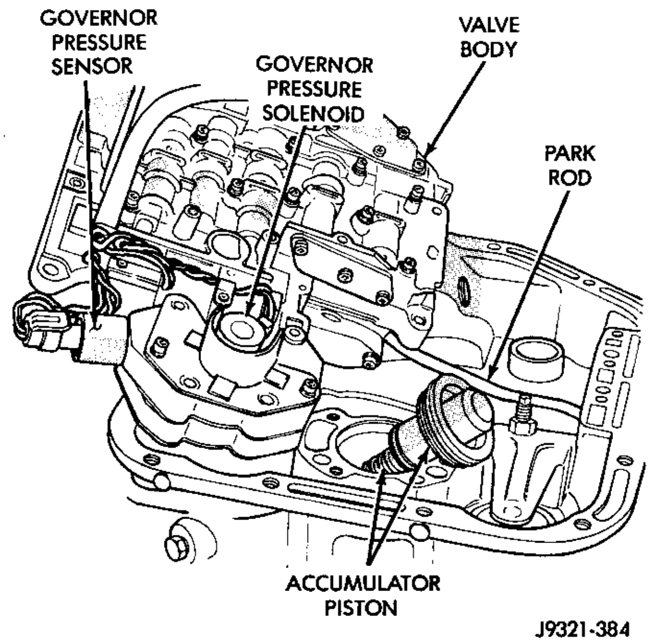

Fig. 124 Accumulator Piston And Springs

(c) Install and start all valve body attaching bolts by hand. Then tighten bolts evenly, in a diagonal pattern to 12 N·m (105 in. lbs.) torque. **Do not overtighten valve body bolts. This could result in distortion and cross leakage after installation..**

CAUTION: It is possible for the park rod to displace into a cavity just above the pawl sprag during installation. Make sure the rod is actually engaged in the pawl and has not displaced into the cavity.

(33) Install new filter on valve body. Tighten filter screws to 4 N·m (35 in. lbs.).

(34) Adjust front and rear bands.

DISASSEMBLY AND ASSEMBLY (Continued)

(35) Install seal on park/neutral position switch (Fig. 125). Then install and tighten switch to 34 N·m (25 ft. lbs.).

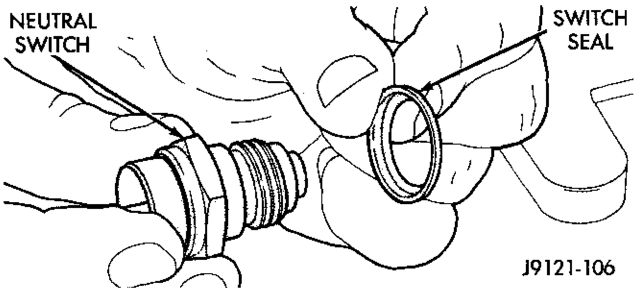

Fig. 125 Park/Neutral Position Switch Seal Position

(36) Install magnet in oil pan. Magnet goes on small protrusion at corner of pan.

(37) Position new oil pan gasket on case and install oil pan. Tighten pan bolts to 17 N·m (13 ft. lbs.).

(38) Install new valve body manual shaft seal in case (Fig. 126). Lubricate seal lip and manual shaft with petroleum jelly. Start seal over shaft and into case. Seat seal with 15/16 inch, deep well socket.

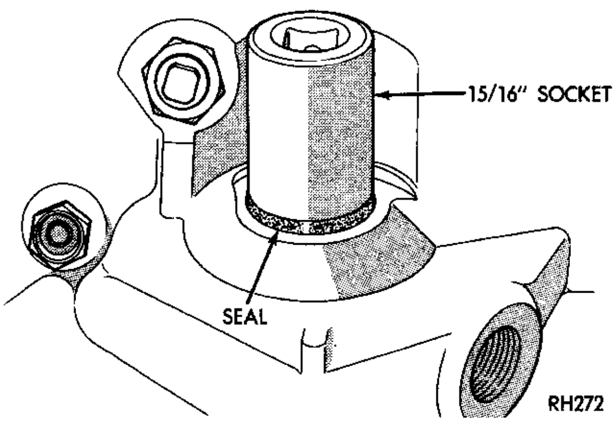

Fig. 126 Installing Manual Lever Shaft Seal

(39) Install throttle valve and shift selector levers on valve body manual lever shaft.

OVERRUNNING CLUTCH CAM/OVERDRIVE PISTON RETAINER

DISASSEMBLY

NOTE: TO SERVICE THE OVERRUNNING CLUTCH CAM AND THE OVERDRIVE PISTON RETAINER, THE TRANSMISSION GEARTRAIN AND OVERDRIVE UNIT MUST BE REMOVED FROM THE TRANSMISSION.

(1) Remove the overdrive piston (Fig. 127).
(2) Remove the overdrive piston retainer bolts.
(3) Remove overdrive piston retainer.
(4) Remove case gasket.
(5) Mark the position of the overrunning clutch cam in the case (Fig. 128).
(6) Remove the overrunning clutch cam bolts.
(7) Remove the overrunning clutch cam.

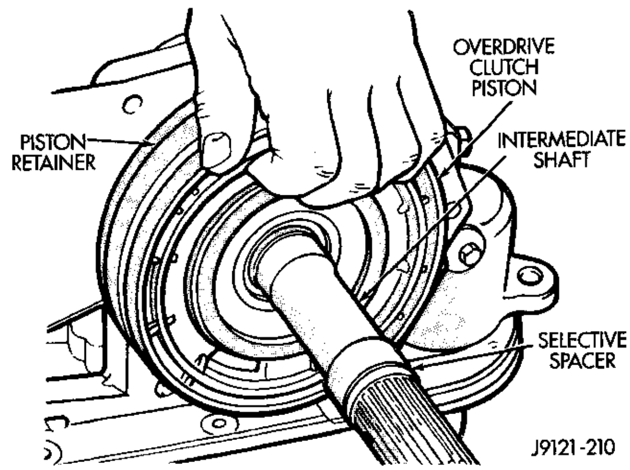

Fig. 127 Overdrive Piston Removal

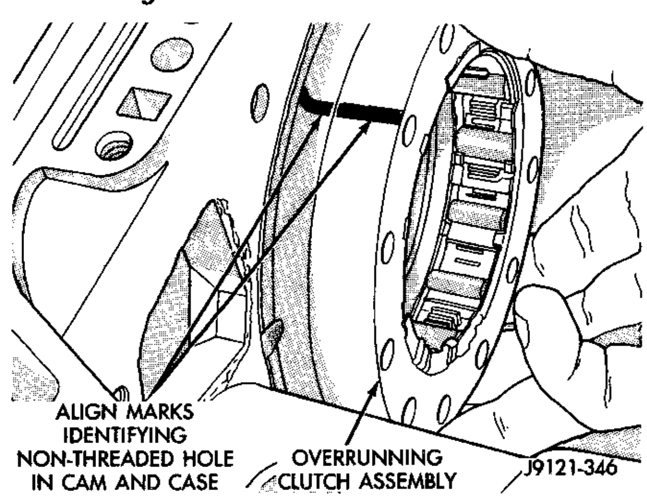

Fig. 128 Overrunning Clutch Cam Removal

DISASSEMBLY AND ASSEMBLY (Continued)

ASSEMBLY

(1) Examine bolt holes in overrunning clutch cam. Note that one hole is **not threaded** (Fig. 129). This hole must align with blank area in clutch cam bolt circle (Fig. 130). Mark hole location on clutch cam and blank area in case with grease pencil, paint stripe, or scribe mark for assembly reference.

(2) Mark location of non-threaded hole in clutch cam and blank area in bolt circle with grease pencil.

(3) Align and install overrunning clutch and cam in case (Fig. 131). **Be sure cam is correctly installed. Bolt holes in cam are slightly countersunk on one side. Be sure this side of cam faces rearward (toward piston retainer).**

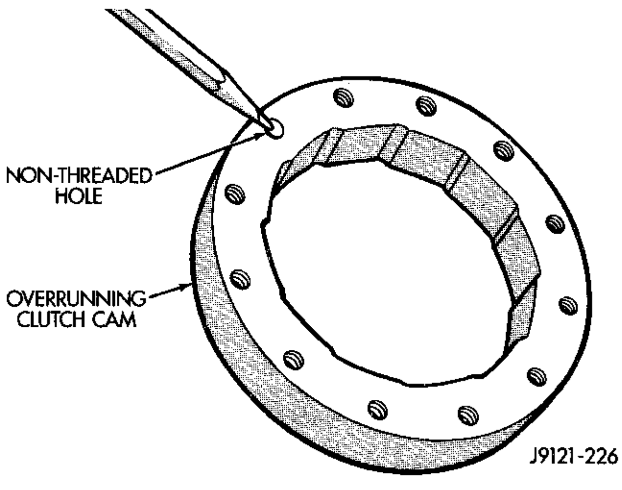

Fig. 129 Location Of Non-Threaded Hole In Clutch Cam

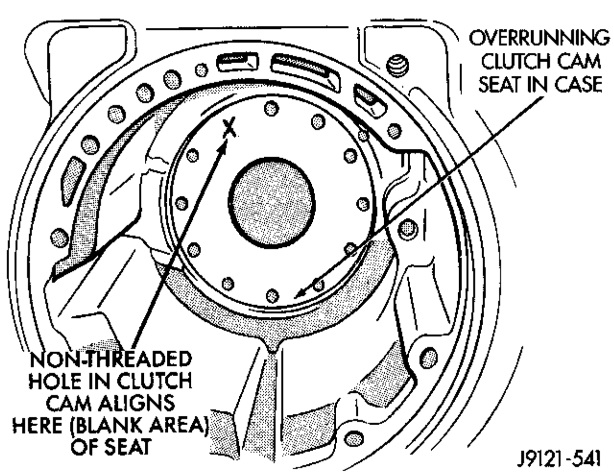

Fig. 130 Location Of Blank Area In Clutch Cam Bolt Circle

(4) Verify that non-threaded hole in clutch cam is properly aligned. Check alignment by threading a bolt into each bolt hole. Adjust clutch cam position if necessary.

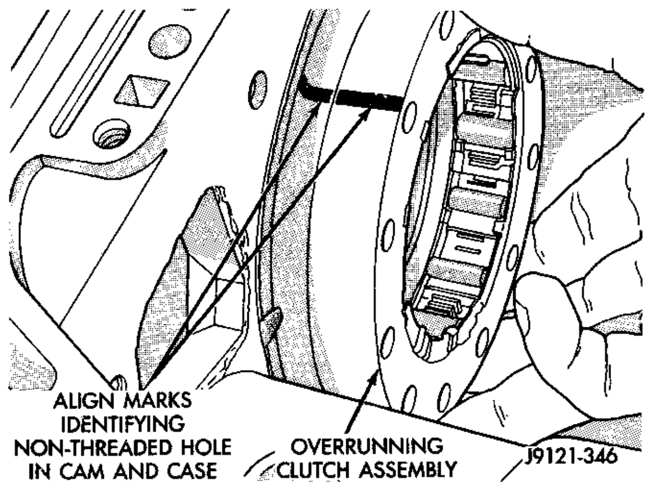

Fig. 131 Overrunning Clutch Installation

(5) Install and tighten overrunning clutch cam bolts to 17 N·m (13 ft. lbs.) torque. Note that clutch cam bolts are shorter than piston retainer bolts.

(6) Install new gasket at rear of transmission case. Use petroleum jelly to hold gasket in place. Be sure to align governor feed holes in gasket with feed passages in case (Fig. 132). Also install gasket before overdrive piston retainer. Center hole in gasket is smaller than retainer and cannot be installed over retainer.

(7) Position overdrive piston retainer on transmission case and align bolt holes in retainer, gasket and case (Fig. 133). Then install and tighten retainer bolts to 17 N·m (13 ft. lbs.) torque.

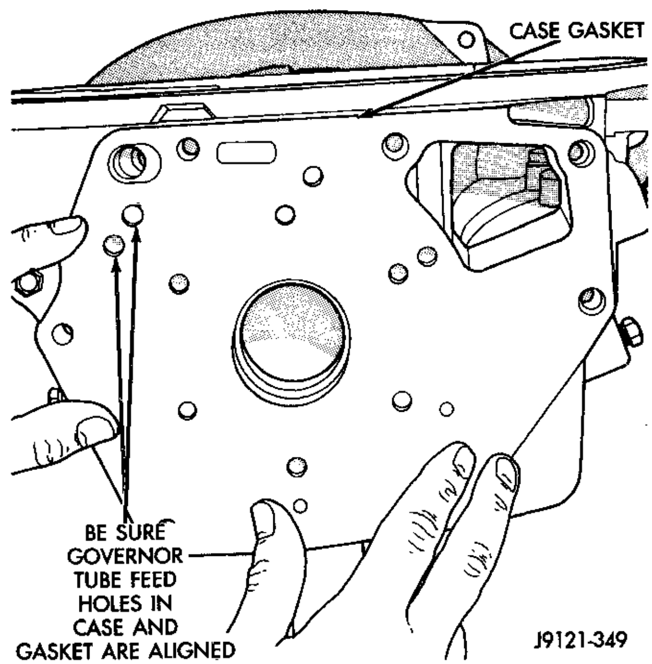

Fig. 132 Installing/Aligning Case Gasket

(8) Install new seals on over drive piston.

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DISASSEMBLY AND ASSEMBLY (Continued)

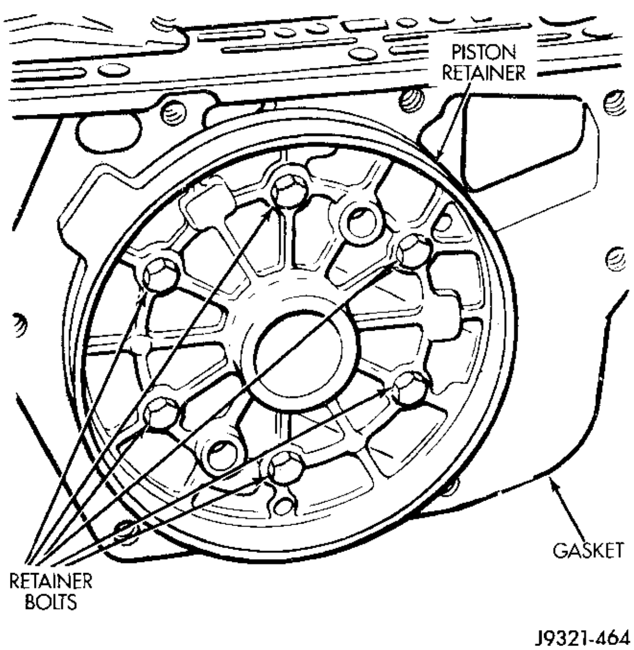

Fig. 133 Aligning Overdrive Piston Retainer

(9) Stand transmission case upright on bellhousing.

(10) Position Guide Ring 8114-1 on outer edge of overdrive piston retainer.

(11) Position Seal Guide 8114-2 on inner edge of overdrive piston retainer.

(12) Install overdrive piston in overdrive piston retainer by: aligning locating lugs on overdrive piston to the two mating holes in retainer.

(a) Aligning locating lugs on overdrive piston to the two mating holes in retainer.

(b) Lubricate overdrive piston seals with Mopar® Door Ease, or equivalent.

(c) Install piston over Seal Guide 8114–2 and inside Guide Ring 8114–1.

(d) Push overdrive piston into position in retainer.

(e) Verify that the locating lugs entered the lug bores in the retainer.

NOTE: INSTALL THE REMAINING TRANSMISSION COMPONENTS AND OVERDRIVE UNIT.

FRONT SERVO PISTON

DISASSEMBLY

(1) Remove seal ring from rod guide (Fig. 134).

(2) Remove small snap ring from servo piston rod. Then remove piston rod, spring and washer from piston.

(3) Remove and discard servo component O-ring and seal rings.

ASSEMBLY

Clean and inspect front servo components.

(1) Lubricate new O-ring and seal rings with petroleum jelly and install them on piston, guide and rod.

(2) Install rod in piston. Install spring and washer on rod. Compress spring and install snap ring (Fig. 134).

(3) Set servo components aside for installation during transmission reassembly.

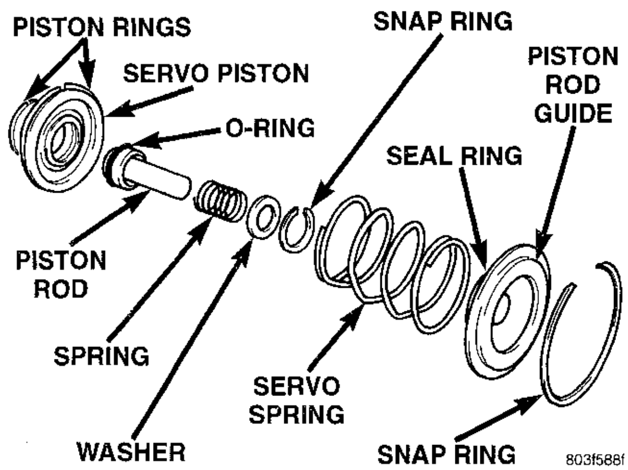

Fig. 134 Front Servo

REAR SERVO PISTON

DISASSEMBLY

(1) Remove small snap ring and remove plug and spring from servo piston (Fig. 135).

(2) Remove and discard servo piston seal ring.

ASSEMBLY

(1) Lubricate piston and guide seals with petroleum jelly. Lubricate other servo parts with Mopar® ATF Plus 3, Type 7176, transmission fluid.

(2) Install new seal ring on servo piston.

(3) Assemble piston, plug, spring and new snap ring.

(4) Lubricate piston seal lip with petroleum jelly.

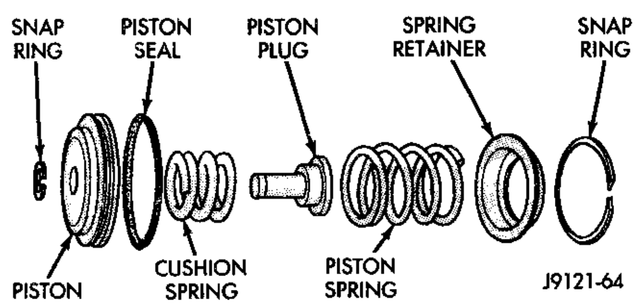

Fig. 135 Rear Servo Components

DISASSEMBLY AND ASSEMBLY (Continued)

OIL PUMP AND REACTION SHAFT SUPPORT

DISASSEMBLY

(1) Remove seal ring from housing and reaction shaft support (Fig. 136).

(2) Mark pump housing and support assembly for alignment reference.

(3) Remove bolts attaching pump body to support (Fig. 137).

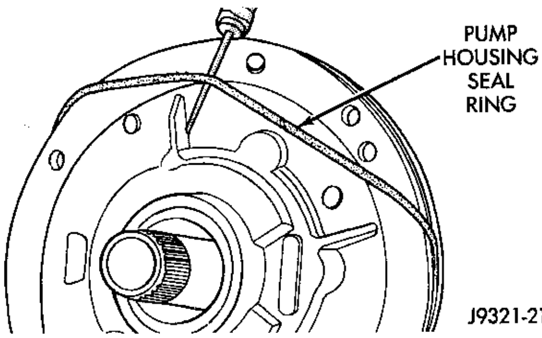

Fig. 136 Removing Pump Seal Ring

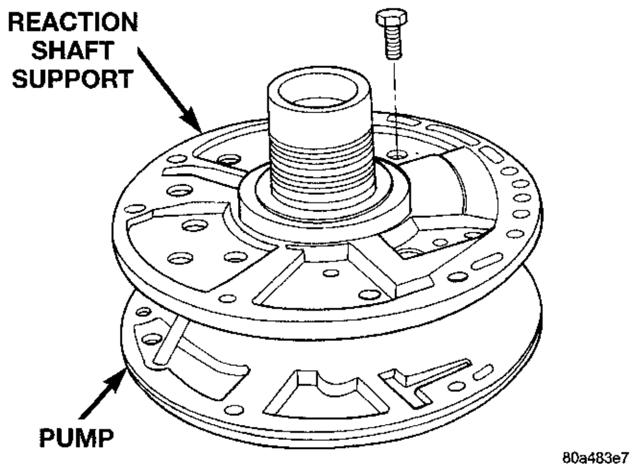

Fig. 137 Pump Support Bolts

(4) Separate support from pump housing (Fig. 138).

(5) Remove inner and outer gears from reaction shaft support (Fig. 139).

(6) If pump seal was not removed during transmission disassembly, remove seal with punch and hammer.

(7) Remove front clutch thrust washer from support hub (Fig. 140).

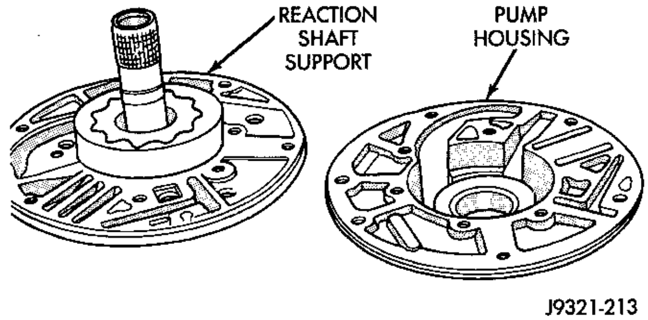

Fig. 138 Separating Pump Housing From Reaction Shaft Support

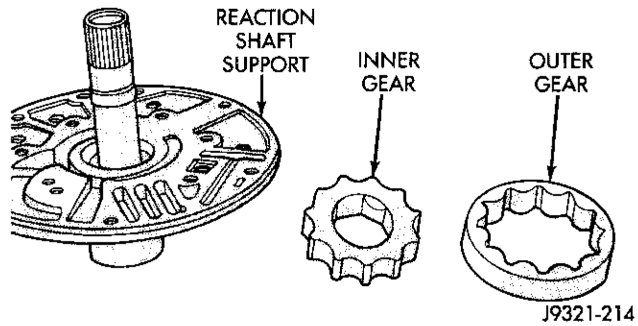

Fig. 139 Pump Gear Removal

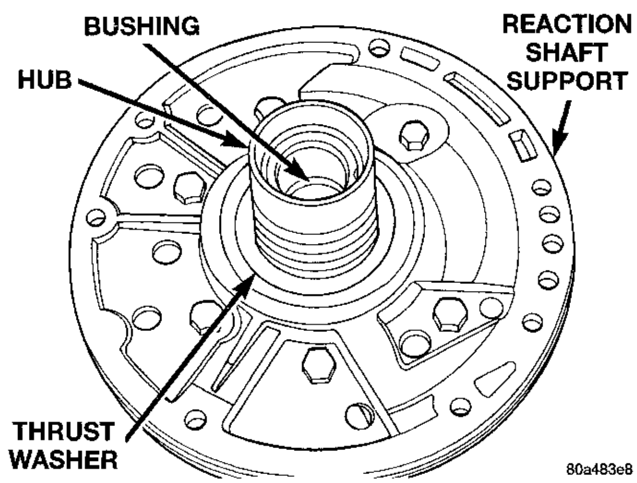

Fig. 140 Support Hub Thrust Washer

DISASSEMBLY AND ASSEMBLY (Continued)

OIL PUMP BUSHING REPLACEMENT

(1) Remove pump bushing with Tool Handle C-4171 and Bushing Remover SP-3551 from Tool Set C-3887-J (Fig. 141).

(2) Install new pump bushing with Tool Handle C-4171 and Bushing Installer SP-5117 (Fig. 141). Bushing should be flush with pump housing bore.

(3) Stake new pump bushing in two places with blunt punch (Fig. 142). Remove burrs from stake points with knife blade afterward.

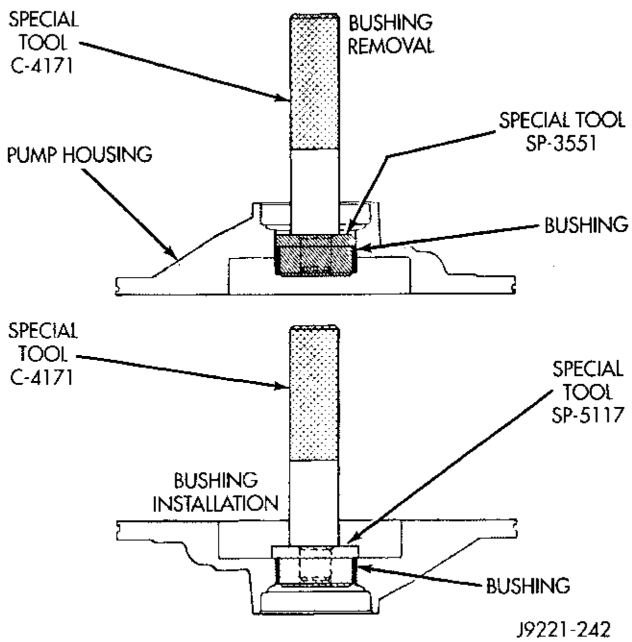

Fig. 141 Removing Oil Pump Bushing

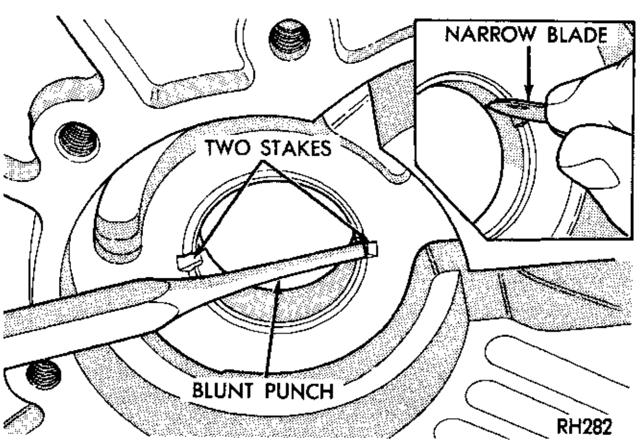

Fig. 142 Staking Oil Pump Bushing

REACTION SHAFT SUPPORT BUSHING REMOVAL

(1) Assemble Bushing Remover Tools SP-1191, 3633 and 5324 (Fig. 143). **Do not clamp any part of reaction shaft or support in vise.**

(2) Hold Cup Tool SP-3633 firmly against reaction shaft and thread remover SP-5324 into bushing as far as possible by hand. Then thread remover tool 3-4 additional turns into bushing with a wrench.

(3) Turn remover tool hex nut down against remover cup to pull bushing from shaft. Clean all chips from shaft after bushing removal.

(4) Lightly grip old bushing in vise or with pliers and back remover tool out of bushing.

(5) Assemble Bushing Installer Tools C-4171 and SP-5325 (Fig. 143).

(6) Slide new bushing onto Installer Tool SP-5325.

(7) Position reaction shaft support upright on a clean smooth surface.

(8) Align bushing in bore. Then tap bushing into place until Bushing Installer SP-5325 bottoms.

(9) Clean reaction shaft support thoroughly after installing bushing.

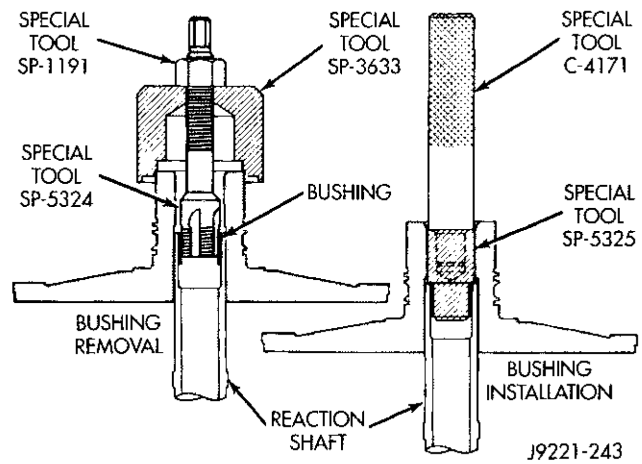

Fig. 143 Replacing Reaction Shaft Support Bushing

ASSEMBLY

(1) Lubricate gear bore in pump housing with transmission fluid.

(2) Lubricate pump gears with transmission fluid.

(3) Support pump housing on wood blocks (Fig. 144).

(4) Install outer gear in pump housing (Fig. 144). Gear can be installed either way (it is not a one-way fit).

(5) Install pump inner gear (Fig. 145).

CAUTION: The pump inner gear is a one way fit. The bore on one side of the gear inside diameter (I.D.) is chamfered. Be sure the chamfered side faces forward (to front of pump).

(6) Install new thrust washer on hub of reaction shaft support. Lubricate washer with transmission fluid or petroleum jelly.

(7) If reaction shaft seal rings are being replaced, install new seal rings on support hub (Fig. 146). Lubricate seal rings with transmission fluid or petro-

DISASSEMBLY AND ASSEMBLY (Continued)

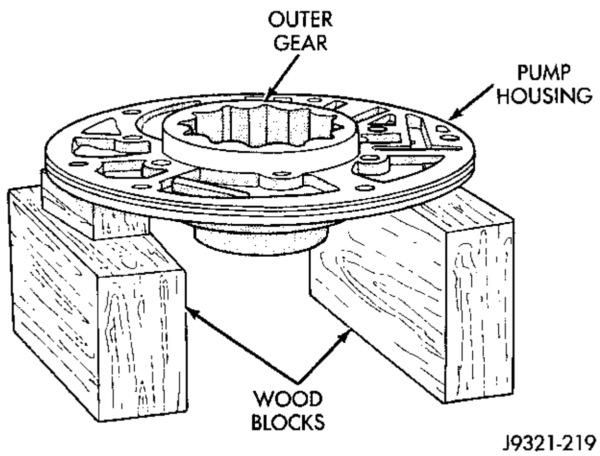

Fig. 144 Supporting Pump And Installing Outer Gear

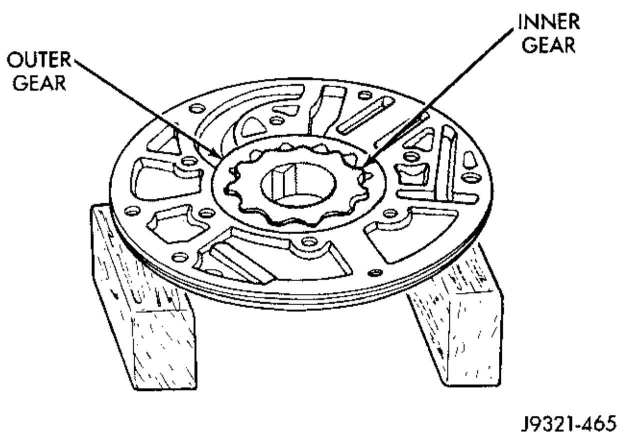

Fig. 145 Pump Inner Gear Installation

leum jelly after installation. Squeeze each ring until ring ends are securely hooked together.

CAUTION: The reaction shaft support seal rings will break if overspread, or twisted. If new rings are being installed, spread them only enough for installation. Also be very sure the ring ends are securely hooked together after installation. Otherwise, the rings will either prevent pump installation, or break during installation.

(8) Install reaction shaft support on pump housing (Fig. 147).

(9) Align reaction support on pump housing. Use alignment marks made at disassembly. Or, rotate support until bolt holes in support and pump housing are all aligned (holes are offset for one-way fit).

(10) Install all bolts that attach support to pump housing. Then tighten bolts finger tight.

(11) Tighten support-to-pump bolts to required torque as follows:

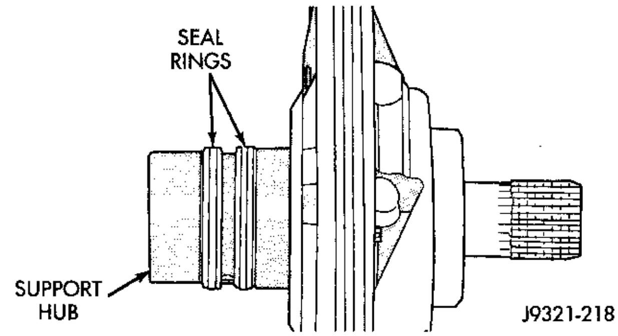

Fig. 146 Hub Seal Ring Position

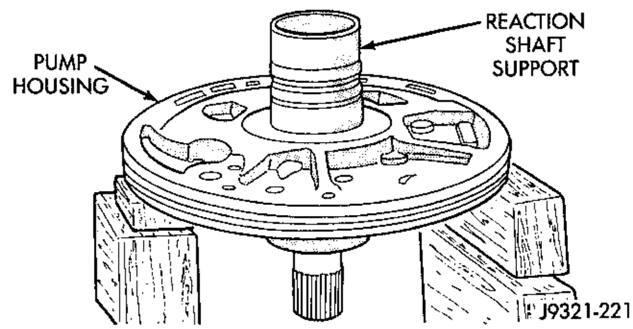

Fig. 147 Assembling Reaction Shaft Support And Pump Housing

(a) Reverse pump assembly and install it in transmission case. Position pump so bolts are facing out and are accessible.

(b) Secure pump assembly in case with 2 or 3 bolts, or with pilot studs.

(c) Tighten support-to-pump bolts to 20 N·m (15 ft. lbs.).

(d) Remove pump assembly from transmission case.

(12) Install new oil seal in pump with Special Tool C-4193 and Tool Handle C-4171 (Fig. 148). Be sure seal lip faces inward.

(13) Install new seal ring around pump housing. Be sure seal is properly seated in groove.

(14) Lubricate lip of pump oil seal and O-ring seal with transmission fluid.

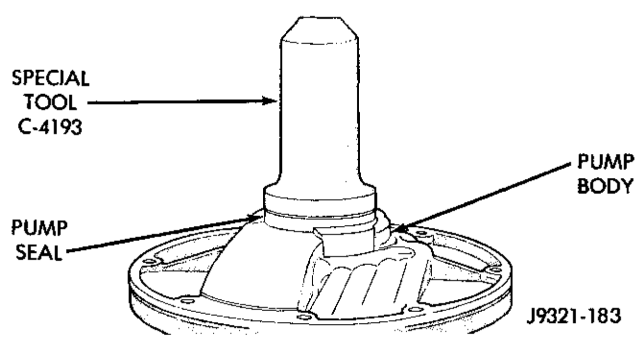

Fig. 148 Pump Oil Seal Installation

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DISASSEMBLY AND ASSEMBLY (Continued)

FRONT CLUTCH

NOTE: The 42RE transmission uses four plates and discs for the front clutch.

DISASSEMBLY

(1) Remove waved snap ring and remove pressure plate, clutch plates and clutch discs (Fig. 149).

(2) Compress clutch piston spring with Compressor Tool C-3575-A (Fig. 150). Be sure legs of tool are seated squarely on spring retainer before compressing spring.

(3) Remove retainer snap ring and remove compressor tool.

(4) Remove spring retainer and clutch spring. Note position of retainer on spring for assembly reference.

(5) Remove clutch piston from clutch retainer. Remove piston by rotating it up and out of retainer.

(6) Remove seals from clutch piston and clutch retainer hub. Discard both seals as they are not reusable.

ASSEMBLY

(1) Soak clutch discs in transmission fluid while assembling other clutch parts.

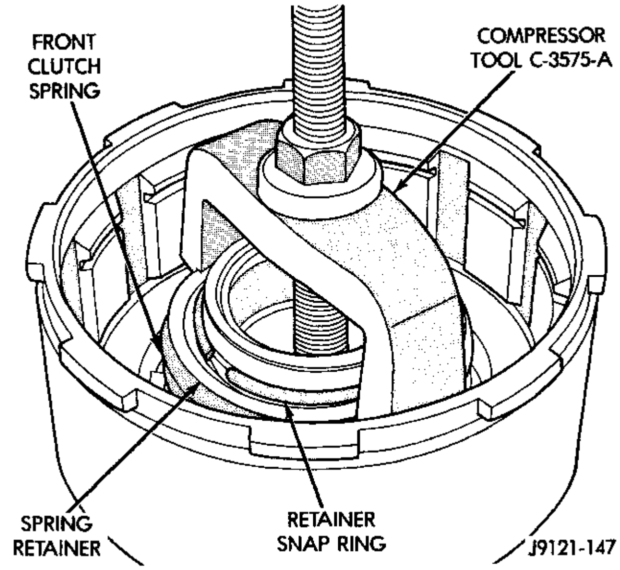

Fig. 150 Compressing Front Clutch Piston Spring

(2) Install new seals on piston and in hub of retainer. Be sure lip of each seal faces interior of clutch retainer.

(3) Lubricate lips of piston and retainer seals with liberal quantity of Mopar® Door Ease. Then lubricate

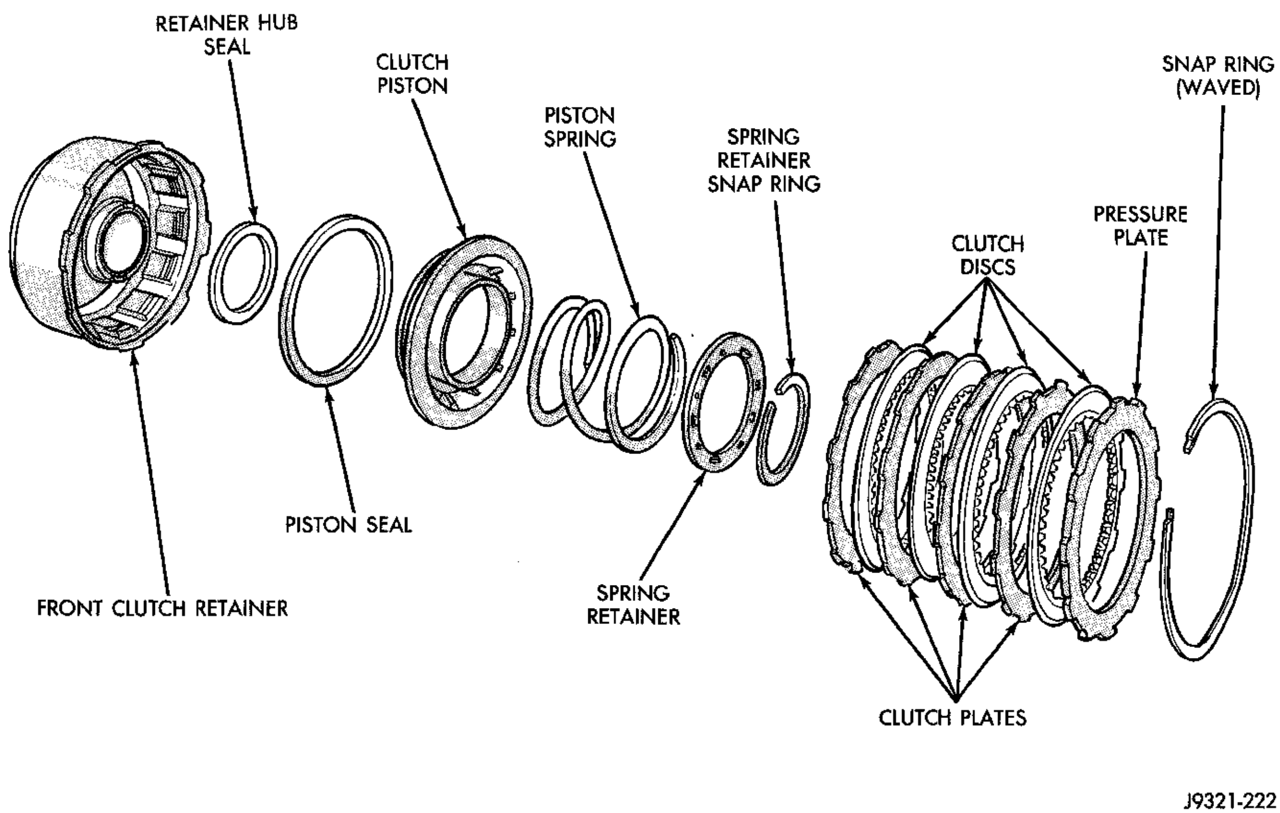

Fig. 149 42RE Front Clutch Components

DISASSEMBLY AND ASSEMBLY (Continued)

retainer hub, bore and piston with light coat of transmission fluid.

(4) Install clutch piston in retainer (Fig. 151). Use twisting motion to seat piston in bottom of retainer.

CAUTION: Never push the clutch piston straight in. This will fold the seals over causing leakage and clutch slip.

(5) Position spring in clutch piston (Fig. 152).

(6) Position spring retainer on top of piston spring (Fig. 153). **Make sure retainer is properly installed. Small raised tabs should be facing upward. Semicircular lugs on underside of retainer are for positioning retainer in spring.**

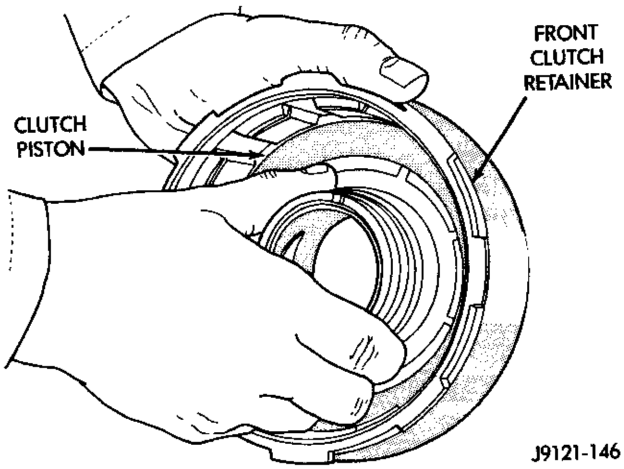

Fig. 151 Front Clutch Piston Installation

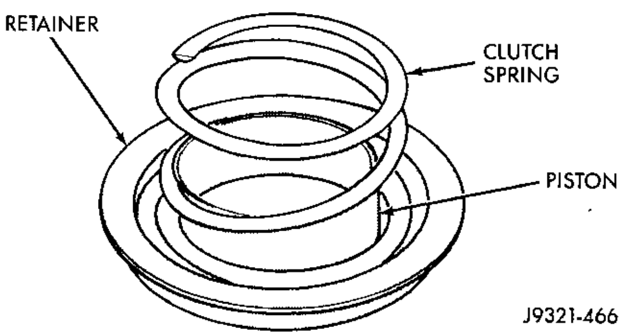

Fig. 152 Clutch Piston Spring Installation

(7) Compress piston spring and retainer with Compressor Tool C-3575-A (Fig. 150). Then install new snap ring to secure spring retainer and spring.

(8) Install clutch plates and discs (Fig. 149). Install steel plate then disc until all plates and discs are installed. The front clutch uses 4 clutch discs and plates in a 42RE transmission.

(9) Install pressure plate and waved snap ring (Fig. 149).

Clearance should be 1.70 to 3.40 mm (0.067 to 0.134 in.). If clearance is incorrect, clutch discs, plates, pressure plates and snap ring may have to be changed.

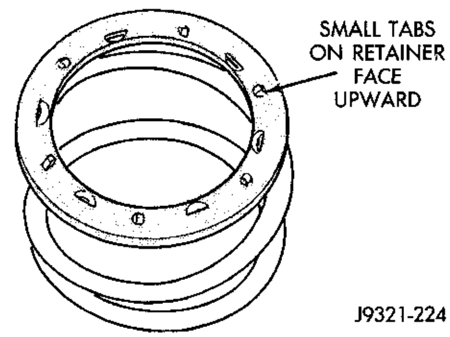

Fig. 153 Correct Spring Retainer Installed Position

REAR CLUTCH

DISASSEMBLY

(1) Remove fiber thrust washer from forward side of clutch retainer.

(2) Remove input shaft front/rear seal rings.

(3) Remove selective clutch pack snap ring (Fig. 154).

(4) Remove top pressure plate, clutch discs, steel plates, bottom pressure plate and wave snap ring and wave spring (Fig. 154).

(5) Remove clutch piston with rotating motion.

(6) Remove and discard piston seals.

(7) Remove input shaft snap-ring (Fig. 155). It may be necessary to press the input shaft in slightly to relieve tension on the snap-ring

(8) Press input shaft out of retainer with shop press and suitable size press tool. Use a suitably sized press tool to support the retainer as close to the input shaft as possible.

ASSEMBLY

(1) Soak clutch discs in transmission fluid while assembling other clutch parts.

(2) Install new seal rings on clutch retainer hub and input shaft if necessary (Fig. 156).

(a) Be sure clutch hub seal ring is fully seated in groove and is not twisted.

(3) Lubricate splined end of input shaft and clutch retainer with transmission fluid. Then press input shaft into retainer. Use a suitably sized press tool to support retainer as close to input shaft as possible.

(4) Install input shaft snap-ring (Fig. 155).

(5) Invert retainer and press input shaft in opposite direction until snap-ring is seated.

(6) Install new seals on clutch piston. Be sure lip of each seal faces interior of clutch retainer.

(7) Lubricate lip of piston seals with generous quantity of Mopar® Door Ease. Then lubricate retainer hub and bore with light coat of transmission fluid.

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DISASSEMBLY AND ASSEMBLY (Continued)

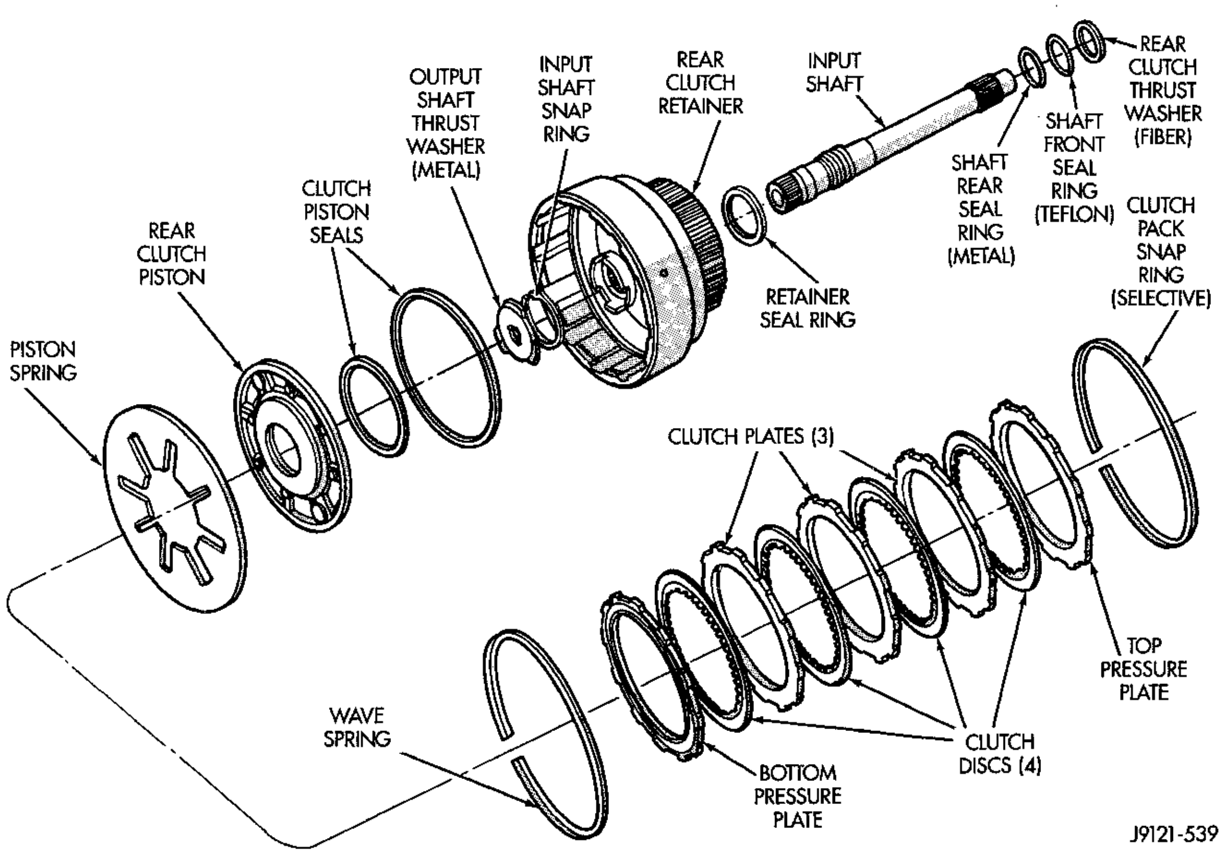

Fig. 154 Rear Clutch Components

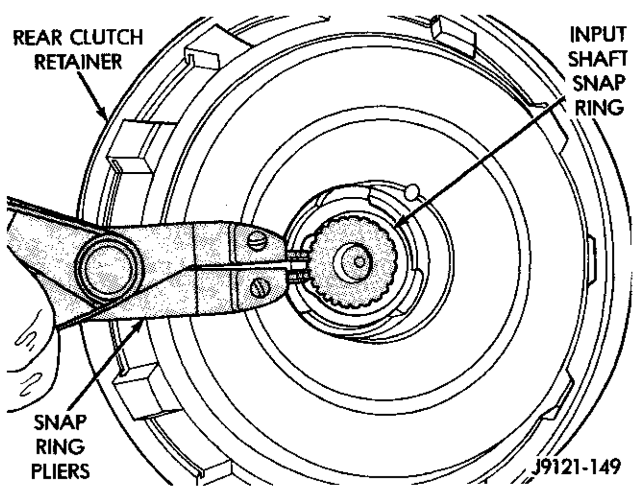

Fig. 155 Removing/Installing Input Shaft Snap-Ring

(8) Install clutch piston in retainer. Use twisting motion to seat piston in bottom of retainer. A thin strip of plastic (about 0.020" thick), can be used to guide seals into place if necessary.

CAUTION: Never push the clutch piston straight in. This will fold the seals over causing leakage and clutch slip. In addition, never use any type of metal tool to help ease the piston seals into place. Metal tools will cut, shave, or score the seals.

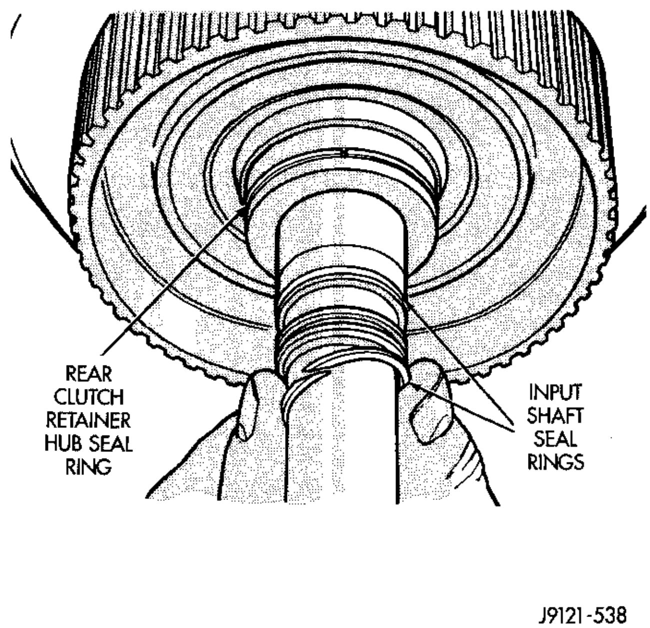

Fig. 156 Rear Clutch Retainer And Input Shaft Seal Ring Installation

DISASSEMBLY AND ASSEMBLY (Continued)

(9) Install piston spring in retainer and on top of piston (Fig. 159). Concave side of spring faces downward (toward piston).

(10) Install wave spring in retainer (Fig. 159). Be sure spring is completely seated in retainer groove.

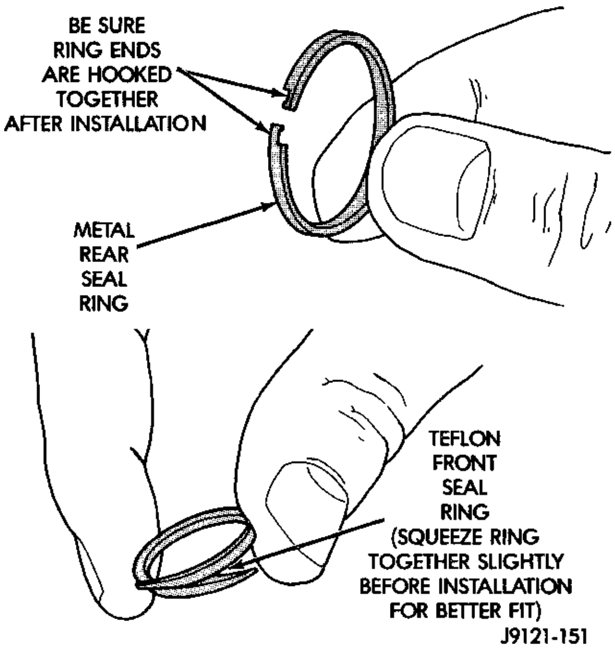

Fig. 157 Input Shaft Seal Ring Identification

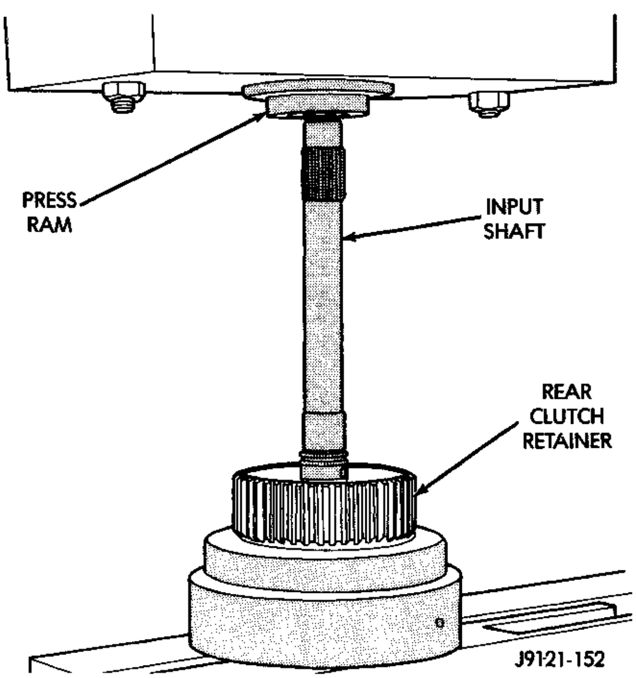

Fig. 158 Pressing Input Shaft Into Rear Clutch Retainer

(11) Install bottom pressure plate (Fig. 154). Ridged side of plate faces downward (toward piston) and flat side toward clutch pack.

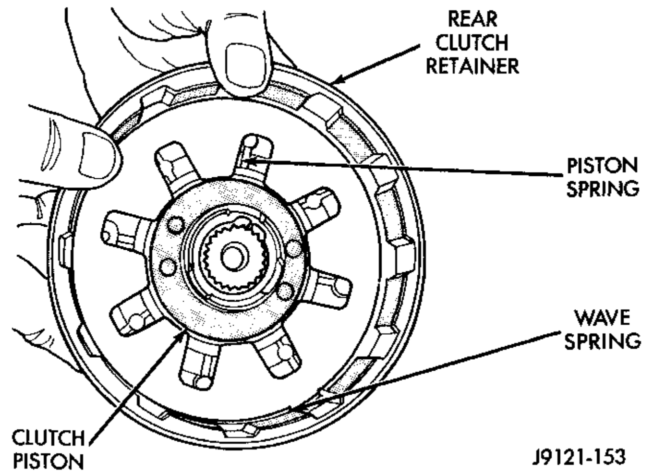

Fig. 159 Piston Spring/Wave Spring Position

(12) Install first clutch disc in retainer on top of bottom pressure plate. Then install a clutch plate followed by a clutch disc until entire clutch pack is installed (4 discs and 3 plates are required) (Fig. 154).

(13) Install top pressure plate.

(14) Install selective snap ring. Be sure snap ring is fully seated in retainer groove.

(15) Using a suitable gauge bar and dial indicator, measure clutch pack clearance (Fig. 160).

(a) Position gauge bar across the clutch drum with the dial indicator pointer on the pressure plate (Fig. 160).

(b) Using two small screw drivers, lift the pressure plate and release it.

(c) Zero the dial indicator.

(d) Lift the pressure plate until it contacts the snap-ring and record the dial indicator reading.

Clearance should be 0.64 - 1.14 mm (0.025 - 0.045 in.). If clearance is incorrect, steel plates, discs, selective snap ring and pressure plates may have to be changed.

The selective snap ring thicknesses are:
- .107–.109 in.
- .098–.100 in.
- .095–.097 in.
- .083–.085 in.
- .076–.078 in.
- .071–.073 in.
- .060–.062 in.

(16) Coat rear clutch thrust washer with petroleum jelly and install washer over input shaft and into clutch retainer (Fig. 161). Use enough petroleum jelly to hold washer in place.

(17) Set rear clutch aside for installation during final assembly.

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DISASSEMBLY AND ASSEMBLY (Continued)

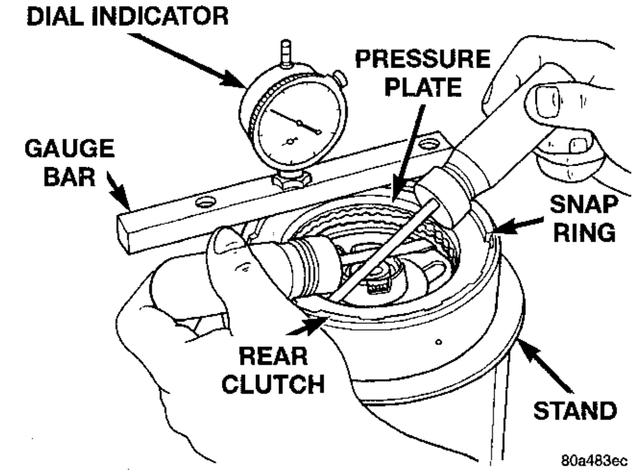

Fig. 160 Checking Rear Clutch Pack Clearance

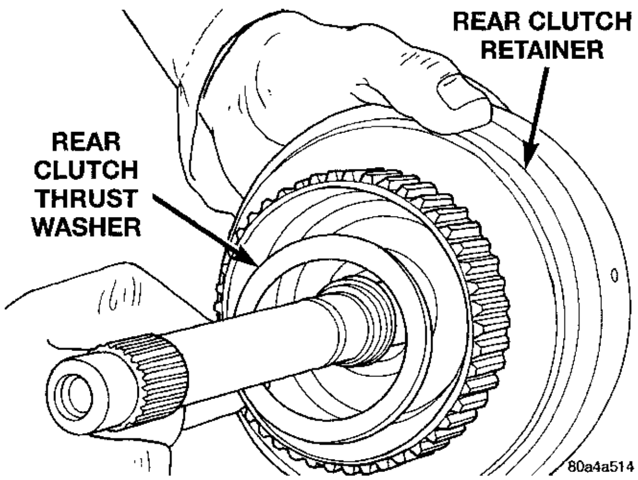

Fig. 161 Installing Rear Clutch Thrust Washer

PLANETARY GEARTRAIN/OUTPUT SHAFT

DISASSEMBLY

(1) Remove planetary snap ring (Fig. 162).

(2) Remove front annulus and planetary assembly from driving shell (Fig. 162).

(3) Remove snap ring that retains front planetary gear in annulus gear (Fig. 163).

(4) Remove tabbed thrust washer and tabbed thrust plate from hub of front annulus (Fig. 164).

(5) Separate front annulus and planetary gears (Fig. 164).

(6) Remove front planetary gear front thrust washer from annulus gear hub.

(7) Separate and remove driving shell, rear planetary and rear annulus from output shaft (Fig. 165).

(8) Remove front planetary rear thrust washer from driving shell.

(9) Remove tabbed thrust washers from rear planetary gear.

(10) Remove lock ring that retains sun gear in driving shell. Then remove sun gear, spacer and thrust plates.

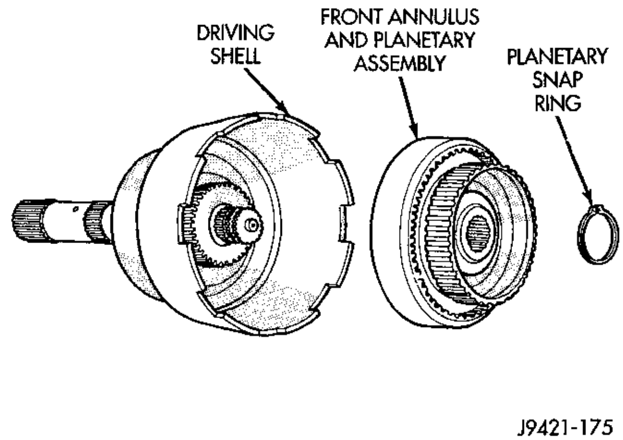

Fig. 162 Front Annulus And Planetary Assembly Removal

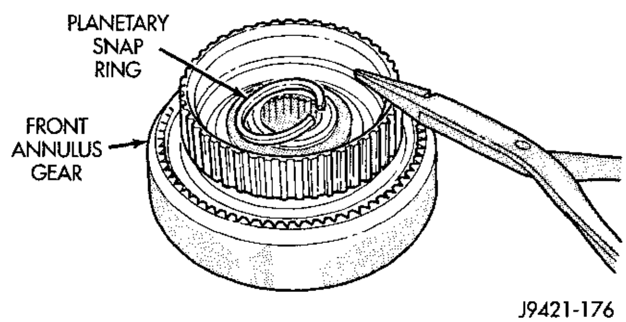

Fig. 163 Front Planetary Snap Ring Removal

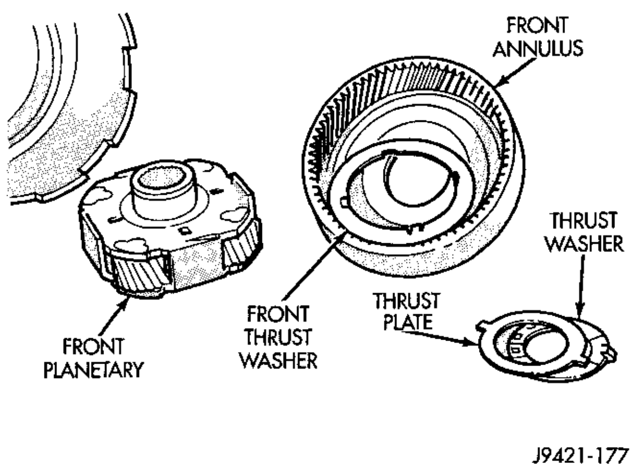

Fig. 164 Front Planetary And Annulus Gear Disassembly

ASSEMBLY

(1) Lubricate output shaft and planetary components with transmission fluid. Use petroleum jelly to

DISASSEMBLY AND ASSEMBLY (Continued)

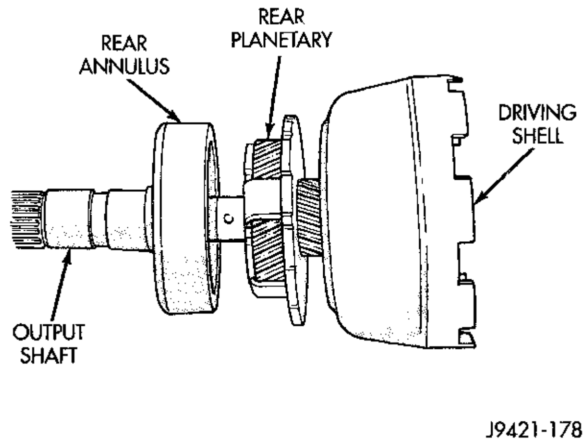

Fig. 165 Removing Driving Shell, Rear Planetary And Rear Annulus

lubricate and hold thrust washers and plates in position.

(2) Assemble rear annulus gear and support if disassembled. Be sure support snap ring is seated and that shoulder-side of support faces rearward (Fig. 166).

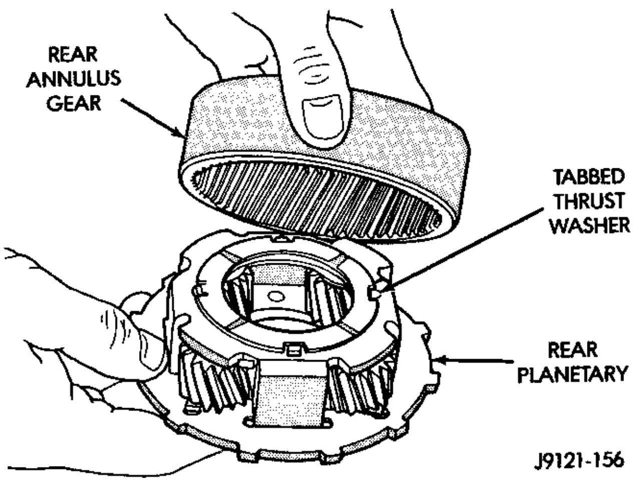

Fig. 166 Assembling Rear Annulus And Planetary Gear

(3) Install rear thrust washer on rear planetary gear. Use enough petroleum jelly to hold washer in place. Also be sure all four washer tabs are properly engaged in gear slots.

(4) Install rear annulus over and onto rear planetary gear (Fig. 166).

(5) Install assembled rear planetary and annulus gear on output shaft (Fig. 167). Verify that assembly is fully seated on shaft.

(6) Install front thrust washer on rear planetary gear (Fig. 168). Use enough petroleum jelly to hold washer on gear. Be sure all four washer tabs are seated in slots.

(7) Install spacer on sun gear (Fig. 169).

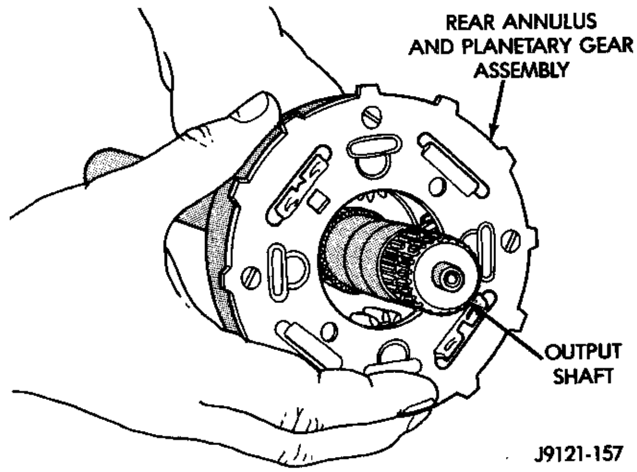

Fig. 167 Installing Rear Annulus And Planetary On Output Shaft

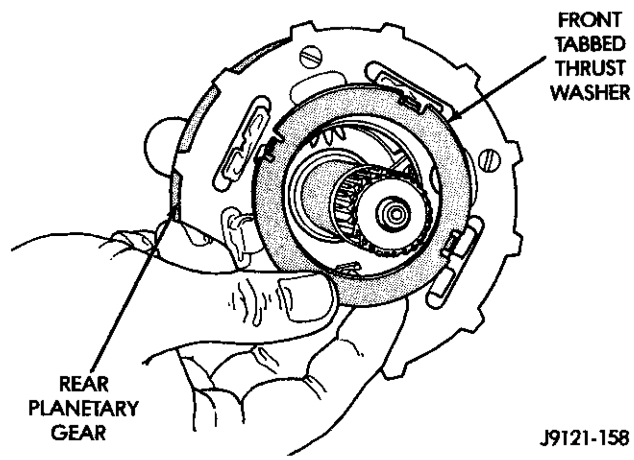

Fig. 168 Installing Rear Planetary Front Thrust Washer

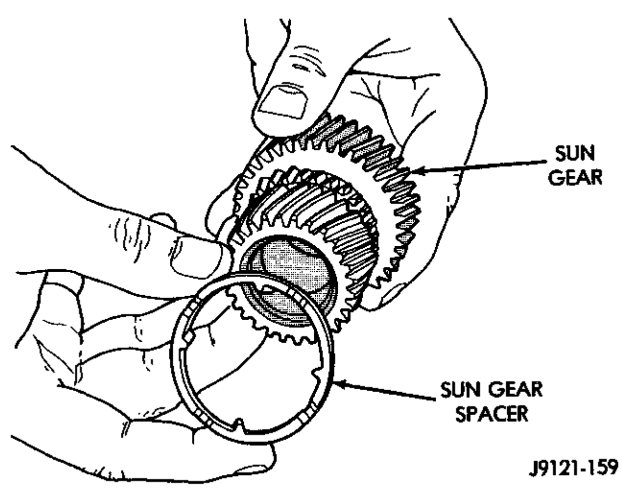

Fig. 169 Installing Spacer On Sun Gear

DISASSEMBLY AND ASSEMBLY (Continued)

(8) Install thrust plate on sun gear (Fig. 170). Note that driving shell thrust plates are interchangeable. Use either plate on sun gear and at front/rear of shell.

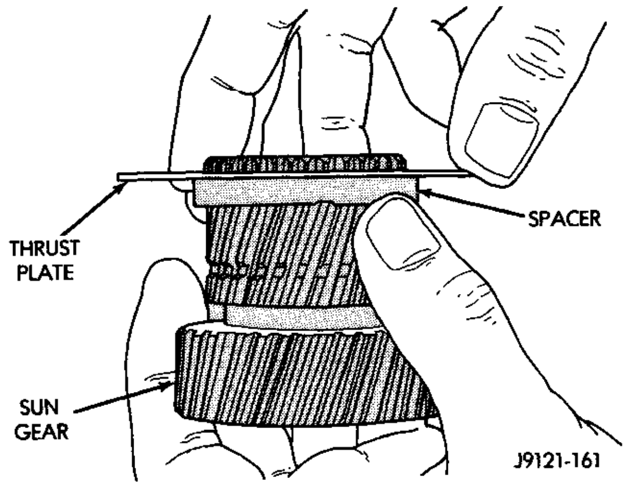

Fig. 170 Installing Driving Shell Front Thrust Plate On Sun Gear

(9) Hold sun gear in place and install thrust plate over sun gear at rear of driving shell (Fig. 171).

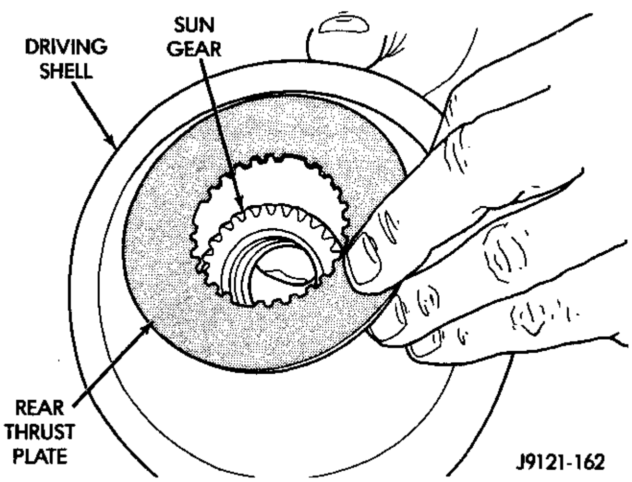

Fig. 171 Installing Driving Shell Rear Thrust Plate

(10) Position wood block on bench and support sun gear on block (Fig. 172). This makes it easier to align and install sun gear lock ring. Keep wood block handy as it will also be used for geartrain end play check.

(11) Align rear thrust plate on driving shell and install sun gear lock ring. Be sure ring is fully seated in sun gear ring groove (Fig. 173).

(12) Install assembled driving shell and sun gear on output shaft (Fig. 174).

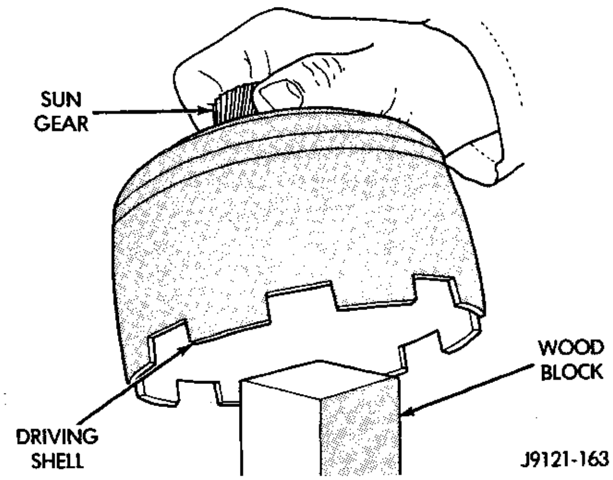

Fig. 172 Supporting Sun Gear On Wood Block

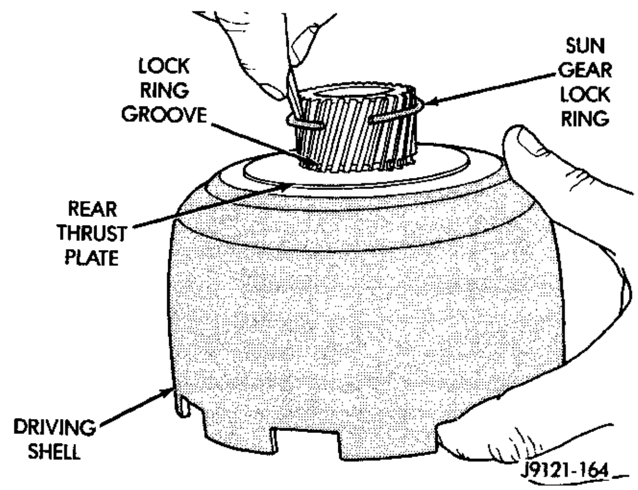

Fig. 173 Installing Sun Gear Lock Ring

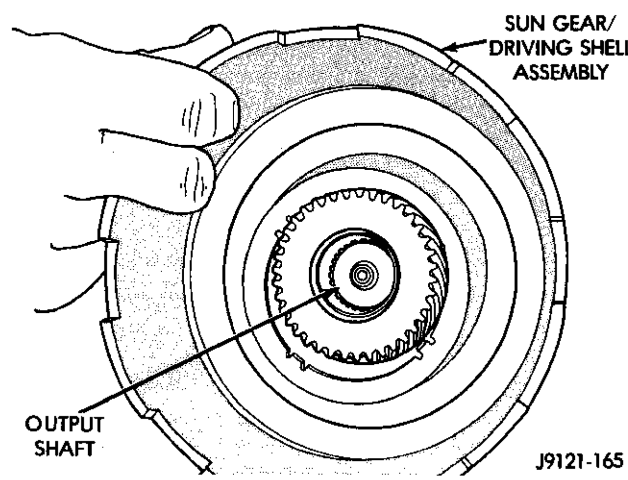

Fig. 174 Installing Assembled Sun Gear And Driving Shell On Output Shaft

DISASSEMBLY AND ASSEMBLY (Continued)

(13) Install rear thrust washer on front planetary gear (Fig. 175). Use enough petroleum jelly to hold washer in place and be sure all four washer tabs are seated.

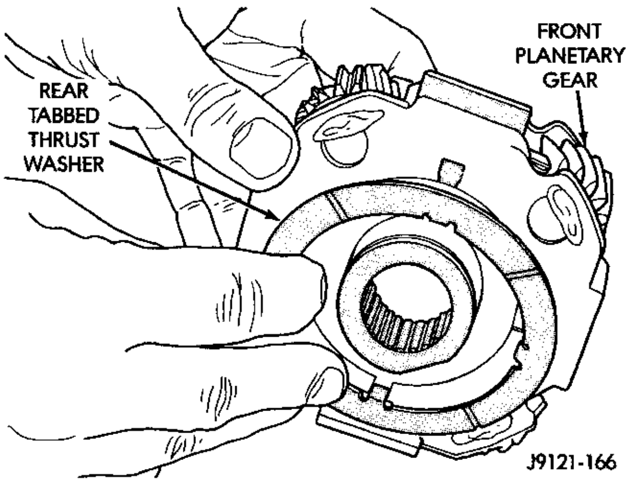

Fig. 175 Installing Rear Thrust Washer On Front Planetary Gear

(14) Install front planetary gear on output shaft and in driving shell (Fig. 176).

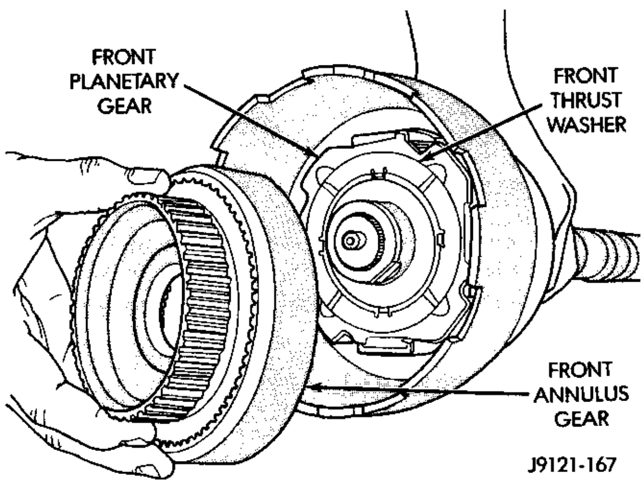

Fig. 176 Installing Front Planetary And Annulus Gears

(15) Install front thrust washer on front planetary gear. Use enough petroleum jelly to hold washer in place and be sure all four washer tabs are seated.

(16) Assemble front annulus gear and support, if necessary. Be sure support snap ring is seated.

(17) Install front annulus on front planetary (Fig. 176).

(18) Position thrust plate on front annulus gear support (Fig. 177). **Note that plate has two tabs on it. These tabs fit in notches of annulus hub.**

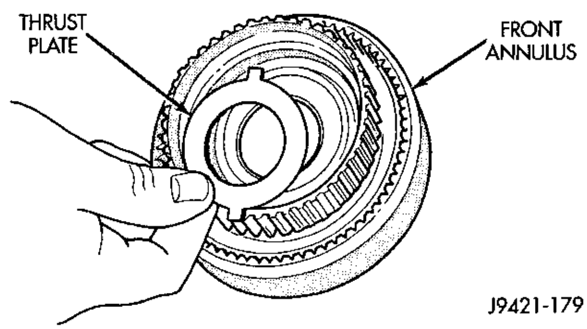

Fig. 177 Positioning Thrust Plate On Front Annulus Support

(19) Install thrust washer in front annulus (Fig. 178). **Align flat on washer with flat on planetary hub. Also be sure washer tab is facing up.**

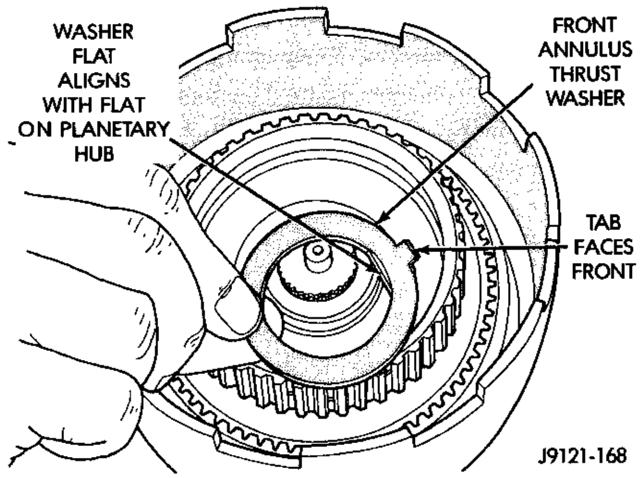

Fig. 178 Installing Front Annulus Thrust Washer

(20) Install front annulus snap ring (Fig. 179). Use snap ring pliers to avoid distorting ring during installation. Also be sure ring is fully seated.

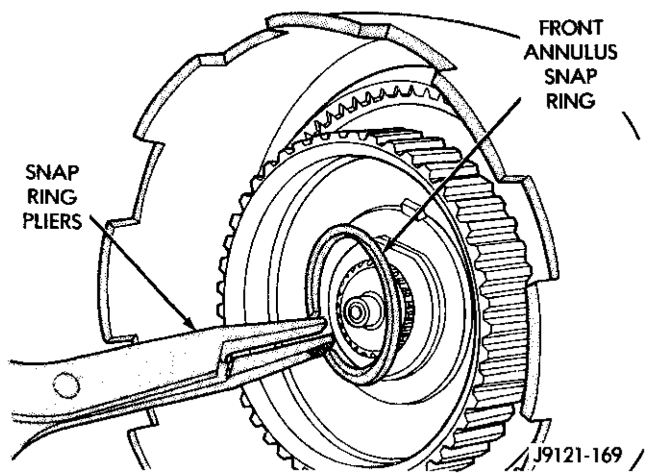

Fig. 179 Installing Front Annulus Snap Ring

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DISASSEMBLY AND ASSEMBLY (Continued)

(21) Install planetary selective snap ring with snap ring pliers (Fig. 180). Be sure ring is fully seated.

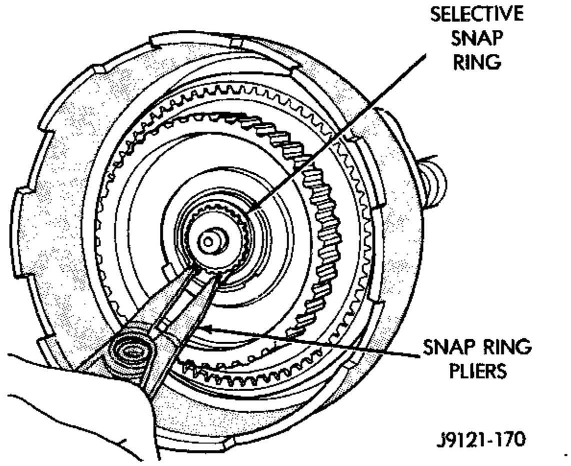

Fig. 180 Installing Planetary Selective Snap Ring

(22) Turn planetary geartrain assembly over so driving shell is facing workbench. Then support geartrain on wood block positioned under forward end of output shaft. This allows geartrain components to move forward for accurate end play check.

(23) Check planetary geartrain end play with feeler gauge (Fig. 181). Gauge goes between shoulder on output shaft and end of rear annulus support.

(24) Geartrain end play should be 0.12 to 1.22 mm (0.005 to 0.048 in.). If end play is incorrect, snap ring (or thrust washers) may have to be replaced. Snap ring is available in three different thicknesses for adjustment purposes.

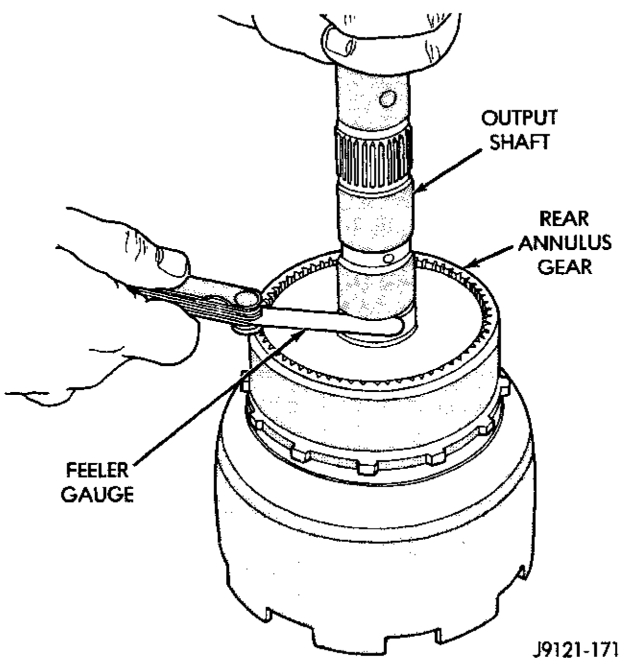

Fig. 181 Checking Planetary Geartrain End Play

OVERDRIVE UNIT

DISASSEMBLY

(1) Remove transmission speed sensor and O-ring seal from overdrive case (Fig. 182).

(2) Remove overdrive piston thrust bearing (Fig. 183).

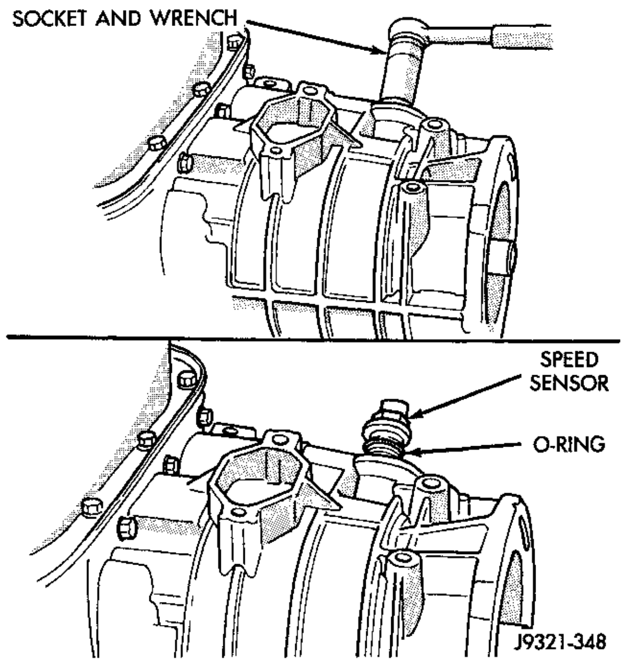

Fig. 182 Transmission Speed Sensor Removal/ Installation

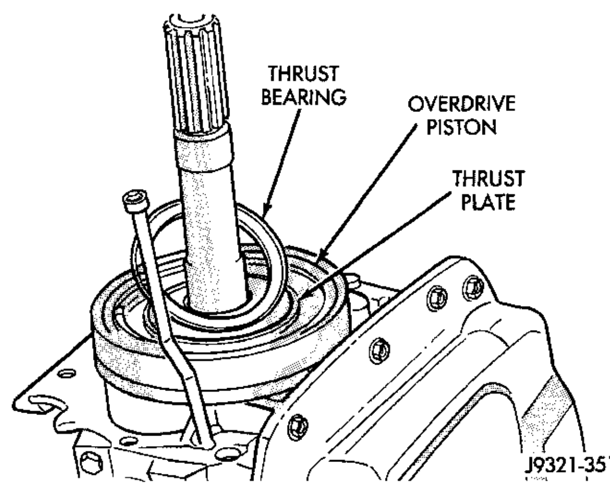

Fig. 183 Overdrive Piston Thrust Bearing Removal/ Installation

DISASSEMBLY AND ASSEMBLY (Continued)

OVERDRIVE PISTON DISASSEMBLY

(1) Remove overdrive piston thrust plate (Fig. 184). Retain thrust plate. It is a select fit part and may possibly be reused.

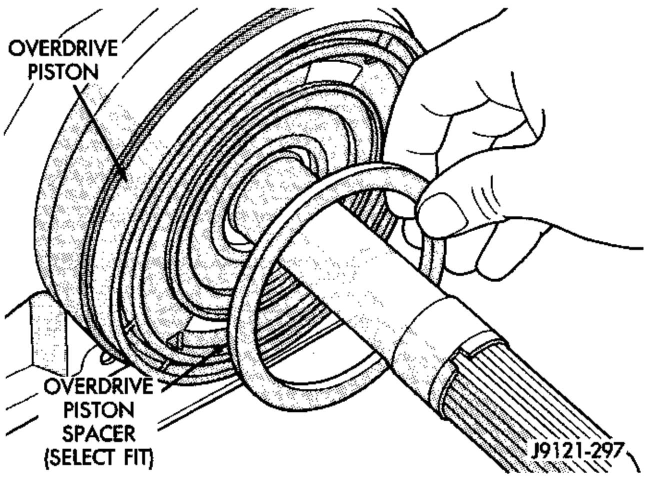

Fig. 184 Overdrive Piston Thrust Plate Removal/ Installation

(2) Remove intermediate shaft spacer (Fig. 185). Retain spacer. It is a select fit part and may possibly be reused.

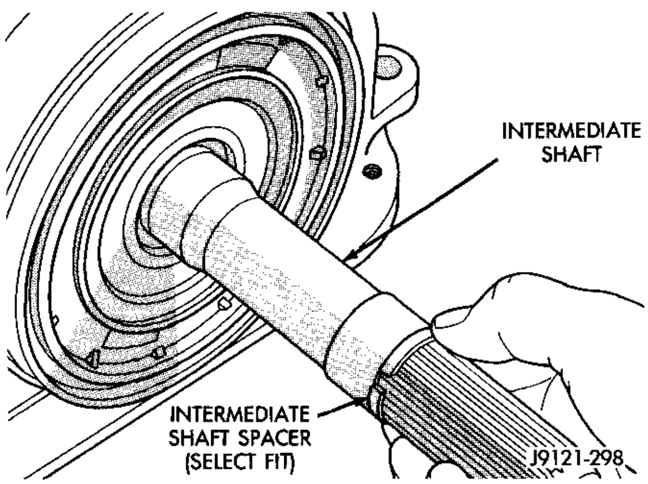

Fig. 185 Intermediate Shaft Spacer Location

(3) Remove overdrive piston from retainer (Fig. 186).

OVERDRIVE CLUTCH PACK DISASSEMBLY

(1) Remove overdrive clutch pack wire retaining ring (Fig. 187).

(2) Remove overdrive clutch pack (Fig. 188).

NOTE: The 42RE transmission has three clutch discs and two clutch plates.

(3) Note position of clutch pack components for assembly reference (Fig. 189).

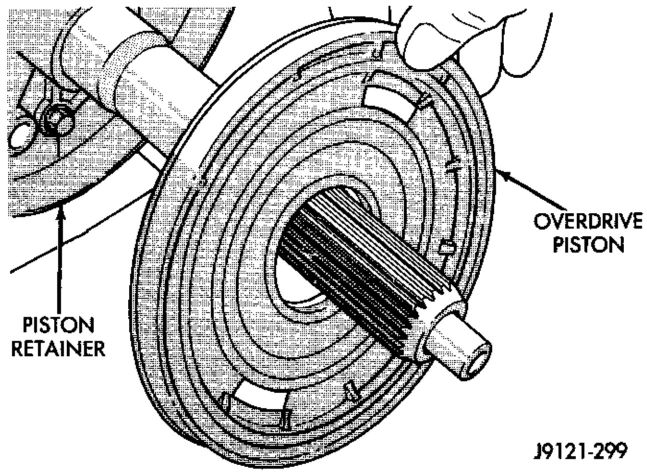

Fig. 186 Overdrive Piston Removal

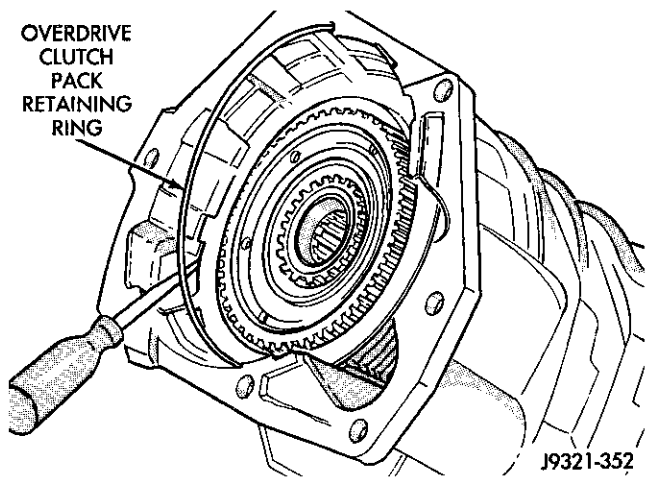

Fig. 187 Removing Overdrive Clutch Pack Retaining Ring

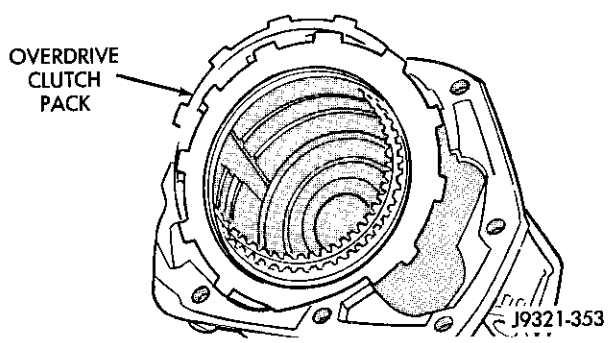

Fig. 188 Overdrive Clutch Pack Removal

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DISASSEMBLY AND ASSEMBLY (Continued)

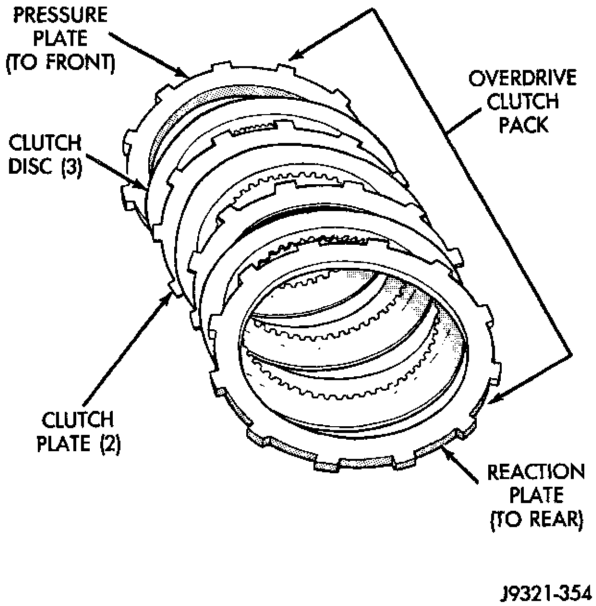

Fig. 189 42RE Overdrive Clutch Component Position

OVERDRIVE GEARTRAIN DISASSEMBLY

(1) Remove overdrive clutch wave spring (Fig. 190).

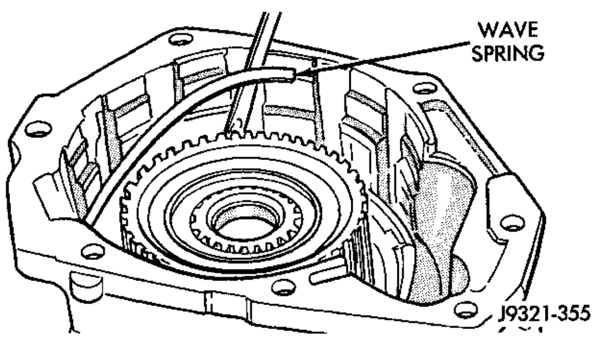

Fig. 190 Overdrive Clutch Wave Spring Removal/ Installation

(2) Remove overdrive clutch reaction snap ring (Fig. 191). Note that snap ring is located in same groove as wave spring.

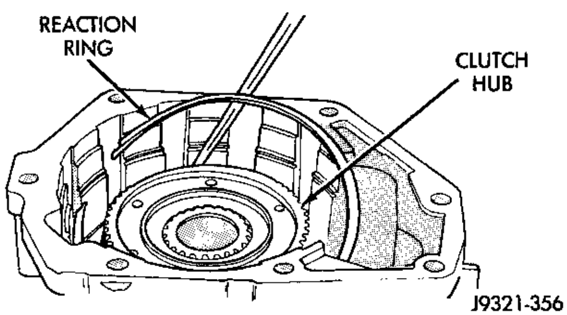

Fig. 191 Overdrive Clutch Reaction Snap Ring Removal/Installation

(3) Remove Torx head screws that attach access cover and gasket to overdrive case (Fig. 192).

(4) Remove access cover and gasket (Fig. 193).

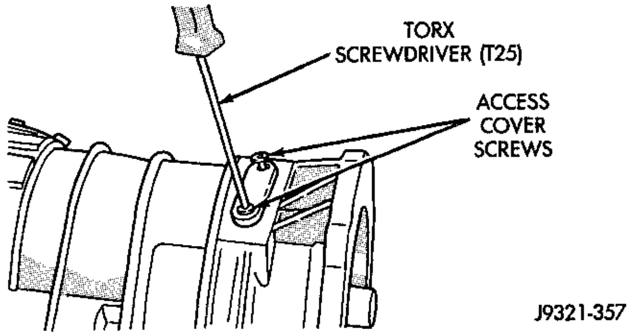

Fig. 192 Access Cover Screw Removal/Installation

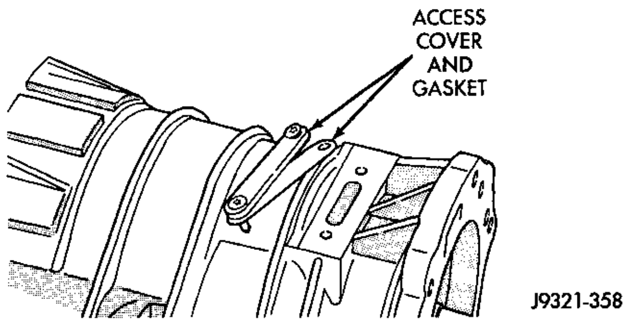

Fig. 193 Access Cover And Gasket Removal/ Installation

(5) Expand output shaft bearing snap ring with expanding-type snap ring pliers. Then push output shaft forward to release shaft bearing from locating ring (Fig. 194).

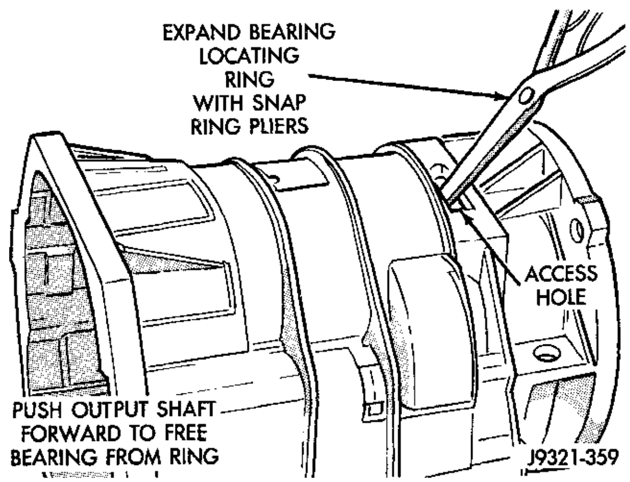

Fig. 194 Releasing Bearing From Locating Ring

DISASSEMBLY AND ASSEMBLY (Continued)

(6) Lift gear case up and off geartrain assembly (Fig. 195).

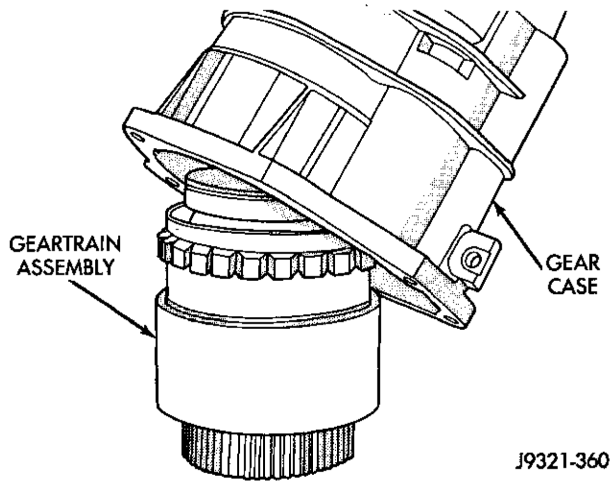

Fig. 195 Removing Gear Case From Geartrain Assembly

(7) Remove snap ring that retains rear bearing on output shaft.

(8) Remove rear bearing from output shaft (Fig. 196).

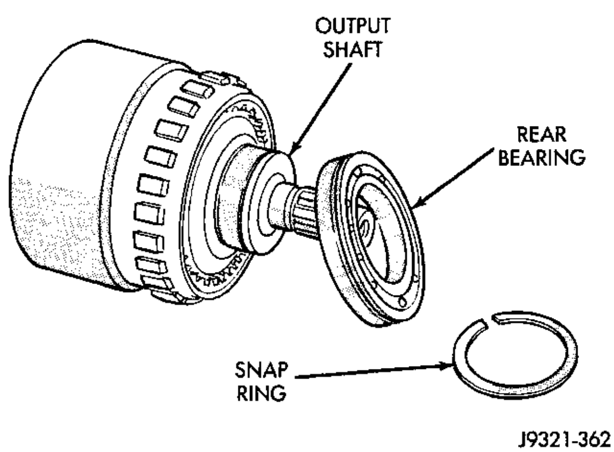

Fig. 196 Rear Bearing Removal

DIRECT CLUTCH, HUB AND SPRING DISASSEMBLY

WARNING: THE NEXT STEP IN DISASSEMBLY INVOLVES COMPRESSING THE DIRECT CLUTCH SPRING. IT IS EXTREMELY IMPORTANT THAT PROPER EQUIPMENT BE USED TO COMPRESS THE SPRING AS SPRING FORCE IS APPROXIMATELY 830 POUNDS. USE SPRING COMPRESSOR TOOL 6227-1 AND A HYDRAULIC SHOP PRESS WITH A MINIMUM RAM TRAVEL OF 5-6 INCHES. THE PRESS MUST ALSO HAVE A BED THAT CAN BE ADJUSTED UP OR DOWN AS REQUIRED. RELEASE CLUTCH SPRING TENSION SLOWLY AND COMPLETELY TO AVOID PERSONAL INJURY.

(1) Mount geartrain assembly in shop press (Fig. 197).

(2) Position Compressor Tool 6227-1 on clutch hub (Fig. 197). Support output shaft flange with steel press plates as shown and center assembly under press ram.

(3) Apply press pressure slowly. Compress hub and spring far enough to expose clutch hub retaining ring and relieve spring pressure on clutch pack snap ring (Fig. 197).

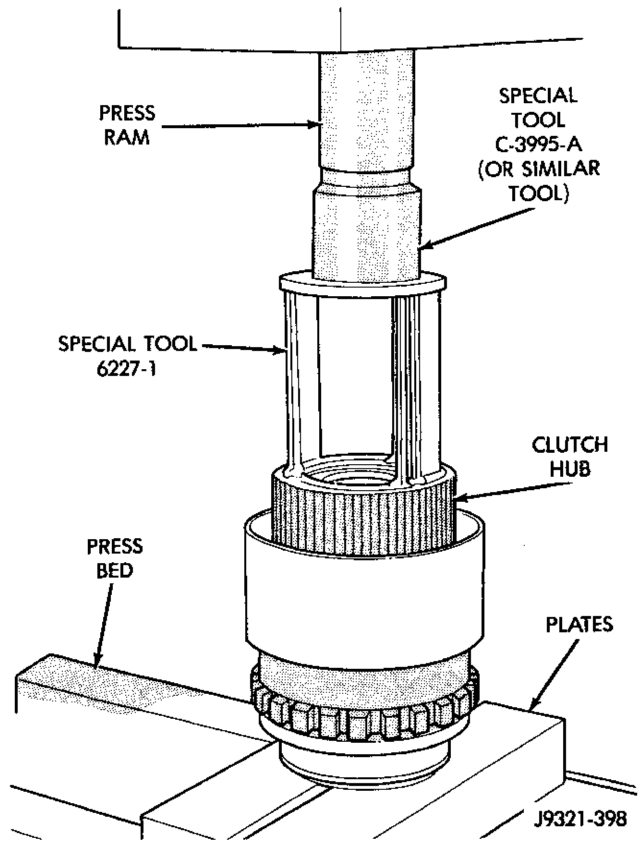

Fig. 197 Geartrain Mounted In Shop Press

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DISASSEMBLY AND ASSEMBLY (Continued)

(4) Remove direct clutch pack snap ring (Fig. 198).

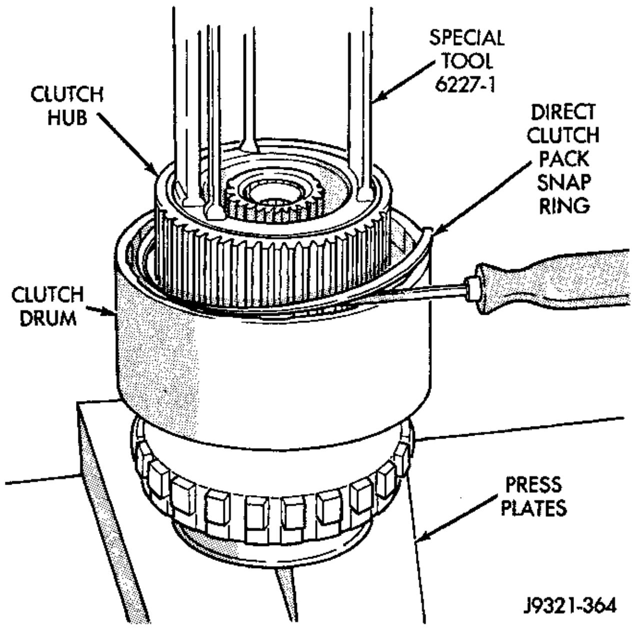

Fig. 198 Direct Clutch Pack Snap Ring Removal

(5) Remove direct clutch hub retaining ring (Fig. 199).

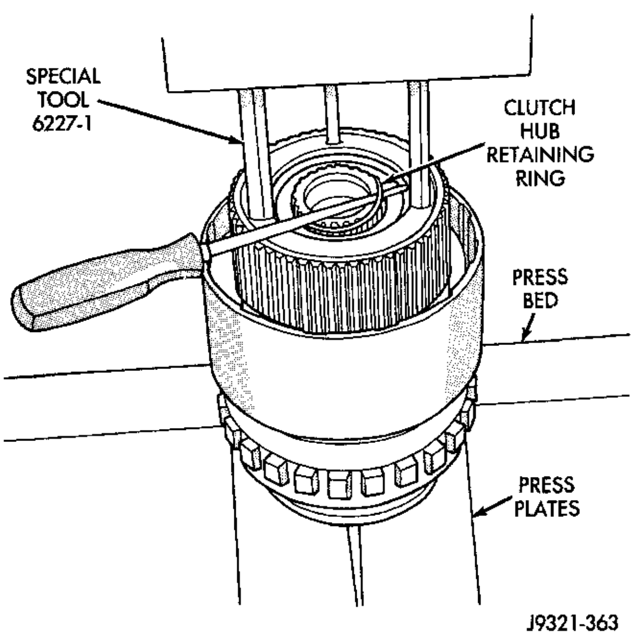

Fig. 199 Direct Clutch Hub Retaining Ring Removal

(6) Release press load slowly and completely (Fig. 200).

(7) Remove Special Tool 6227-1. Then remove clutch pack from hub (Fig. 200).

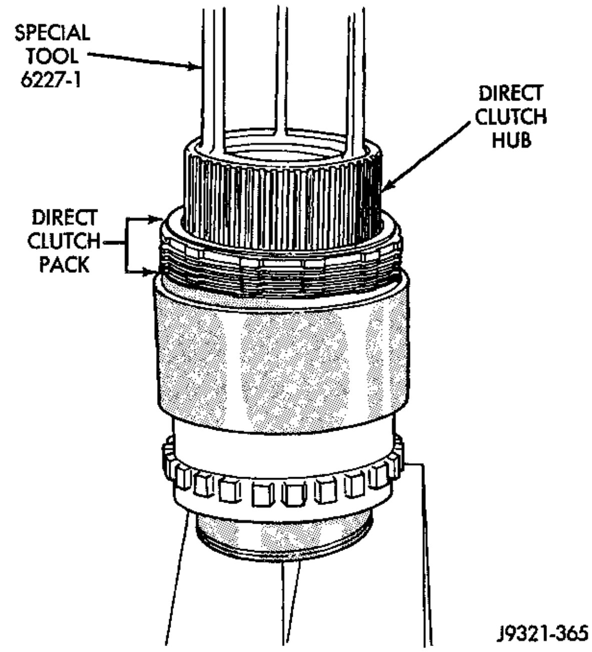

Fig. 200 Direct Clutch Pack Removal

Geartrain Disassembly

(1) Remove direct clutch hub and spring (Fig. 201).

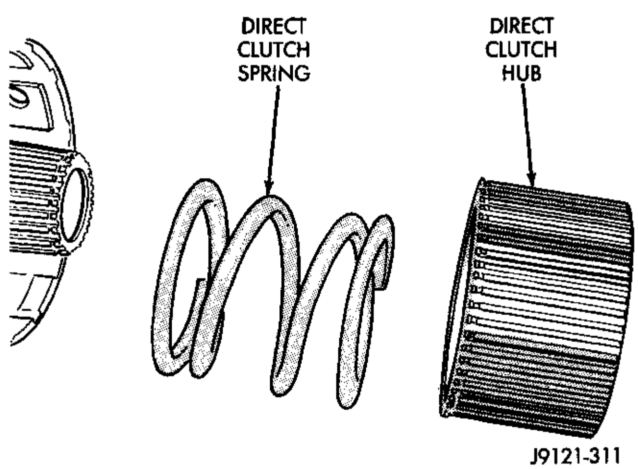

Fig. 201 Direct Clutch Hub And Spring Removal

DISASSEMBLY AND ASSEMBLY (Continued)

(2) Remove sun gear and spring plate. Then remove planetary thrust bearing and planetary gear (Fig. 202).

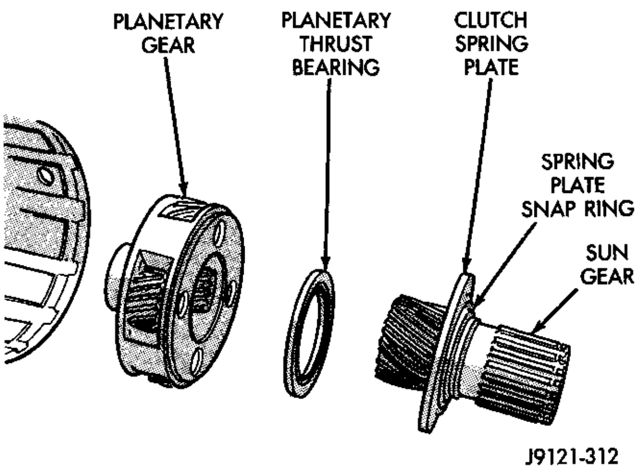

Fig. 202 Removing Sun Gear, Thrust Bearing And Planetary Gear

(3) Remove overrunning clutch assembly with expanding type snap ring pliers (Fig. 203). Insert pliers into clutch hub. Expand pliers to grip hub splines and remove clutch with counterclockwise, twisting motion.

(4) Remove thrust bearing from overrunning clutch hub.

(5) Remove overrunning clutch from hub.

(6) Mark position of annulus gear and direct clutch drum for assembly alignment reference (Fig. 204). Use small center punch or scriber to make alignment marks.

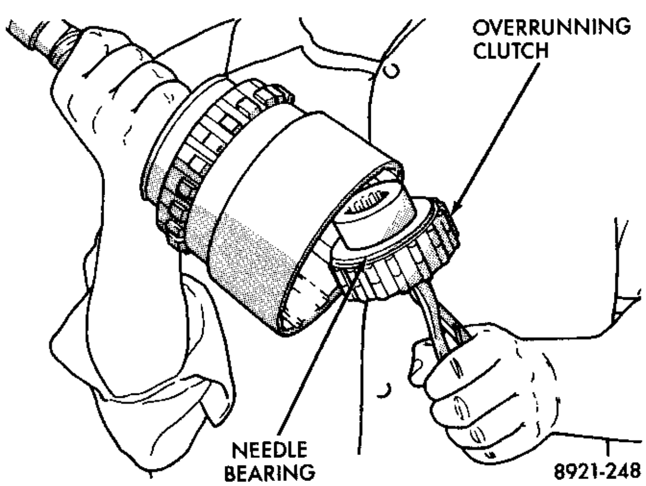

Fig. 203 Overrunning Clutch Assembly Removal/ Installation

(7) Remove direct clutch drum rear retaining ring (Fig. 205).

(8) Remove direct clutch drum outer retaining ring (Fig. 206).

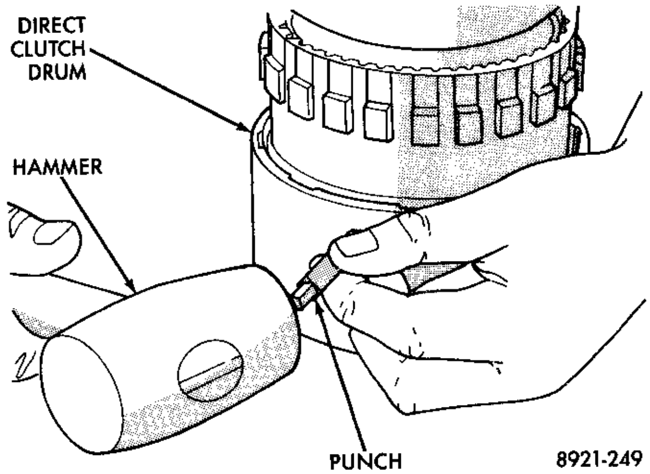

Fig. 204 Marking Direct Clutch Drum And Annulus Gear For Assembly Alignment

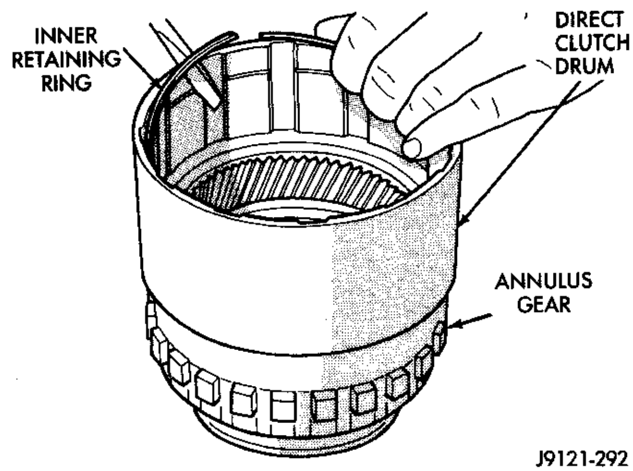

Fig. 205 Clutch Drum Inner Retaining Ring Removal

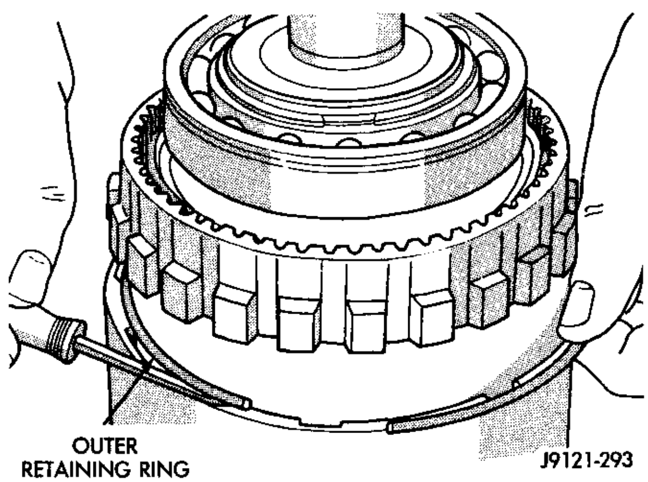

Fig. 206 Clutch Drum Outer Retaining Ring Removal

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DISASSEMBLY AND ASSEMBLY (Continued)

(9) Mark annulus gear and output shaft for assembly alignment reference (Fig. 207). Use punch or scriber to mark gear and shaft.

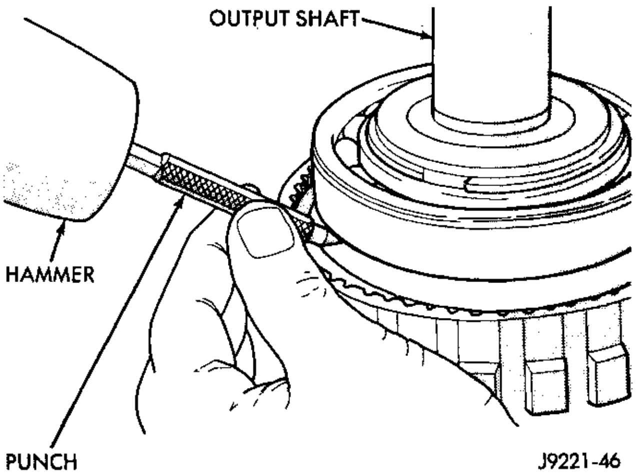

Fig. 207 Marking Annulus Gear And Output Shaft For Assembly Alignment

(10) Remove snap ring that secures annulus gear on output shaft (Fig. 208). Use two screwdrivers to unseat and work snap ring out of groove as shown.

(11) Remove annulus gear from output shaft (Fig. 209). Use rawhide or plastic mallet to tap gear off shaft.

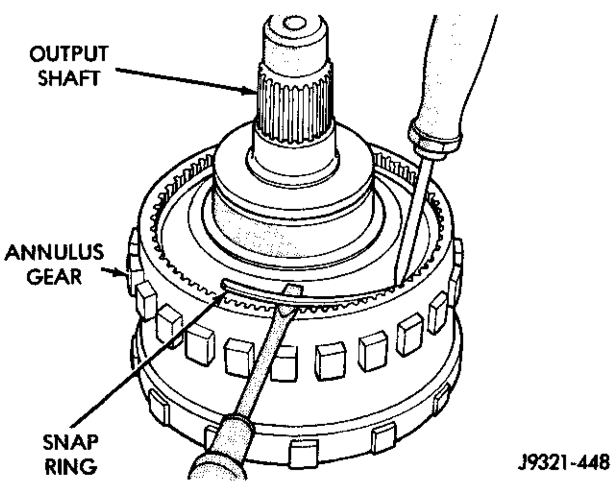

Fig. 208 Annulus Gear Snap Ring Removal

GEAR CASE AND PARK LOCK DISASSEMBLY

(1) Remove locating ring from gear case.

(2) Remove park pawl shaft retaining bolt and remove shaft, pawl and spring.

(3) Remove reaction plug snap ring and remove reaction plug.

(4) Remove output shaft seal.

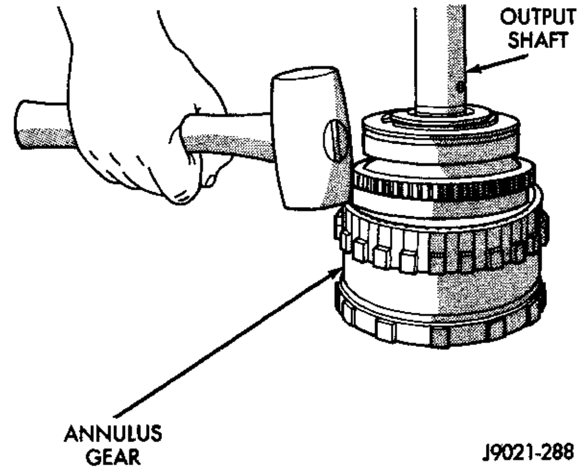

Fig. 209 Annulus Gear Removal

ASSEMBLY

GEARTRAIN AND DIRECT CLUTCH ASSEMBLY

(1) Soak direct clutch and overdrive clutch discs in Mopar® ATF Plus 3, type 7176, transmission fluid. Allow discs to soak for 10-20 minutes.

(2) Install new pilot bushing and clutch hub bushing in output shaft if necessary (Fig. 210). Lubricate bushings with petroleum jelly, or transmission fluid.

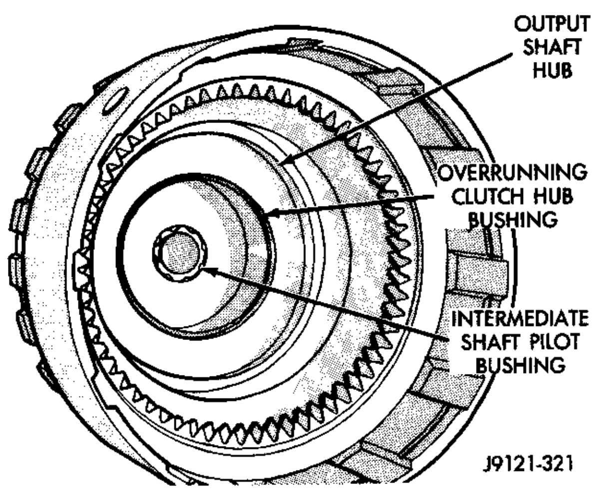

Fig. 210 Output Shaft Pilot Bushing

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DISASSEMBLY AND ASSEMBLY (Continued)

(3) Install annulus gear on output shaft, if removed. Then install annulus gear retaining snap ring (Fig. 211).

(4) Align and install clutch drum on annulus gear (Fig. 212). Be sure drum is engaged in annulus gear lugs.

(5) Install clutch drum outer retaining ring (Fig. 212).

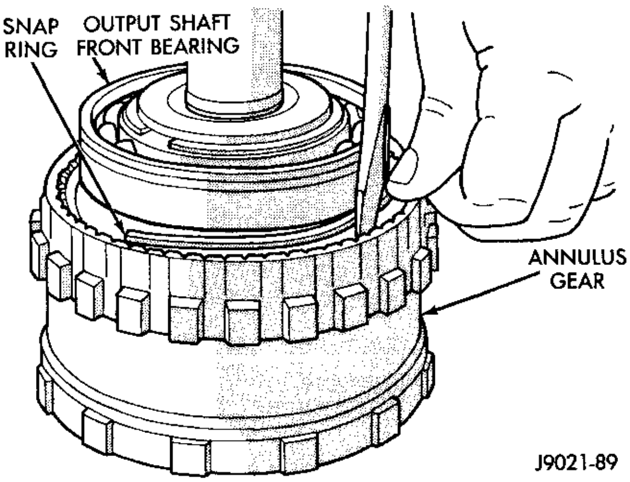

Fig. 211 Annulus Gear Installation

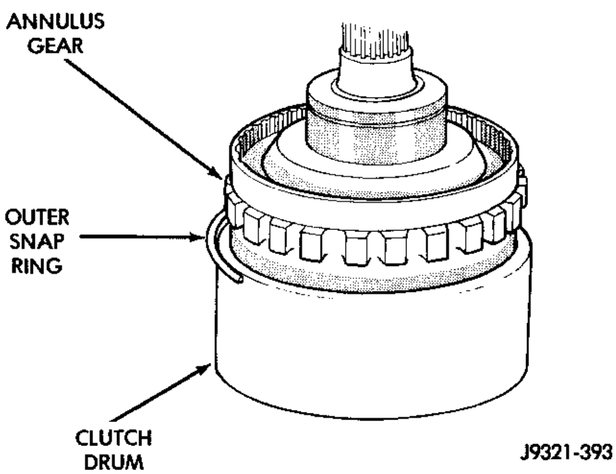

Fig. 212 Clutch Drum And Outer Retaining Ring Installation

(6) Slide clutch drum forward and install inner retaining ring (Fig. 213).

(7) Install rear bearing and snap ring on output shaft (Fig. 214). Be sure locating ring groove in bearing is toward rear.

(8) Install overrunning clutch on hub (Fig. 215). **Note that clutch only fits one way. Shoulder on clutch should seat in small recess at edge of hub.**

(9) Install thrust bearing on overrunning clutch hub. Use generous amount of petroleum jelly to hold bearing in place for installation. **Bearing fits one way only. Be sure bearing is seated squarely against hub. Reinstall bearing if it does not seat squarely.**

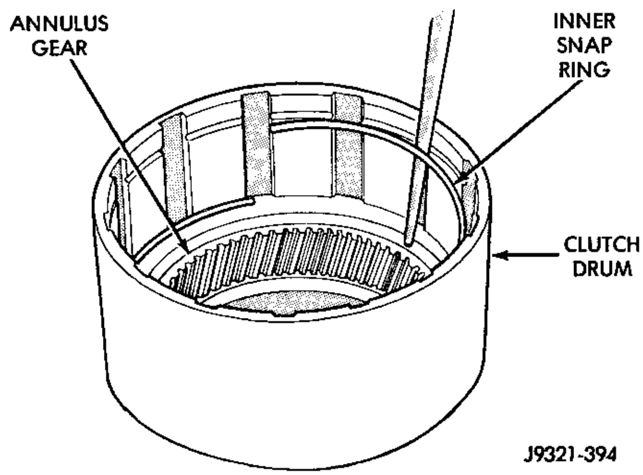

Fig. 213 Clutch Drum Inner Retaining Ring Installation

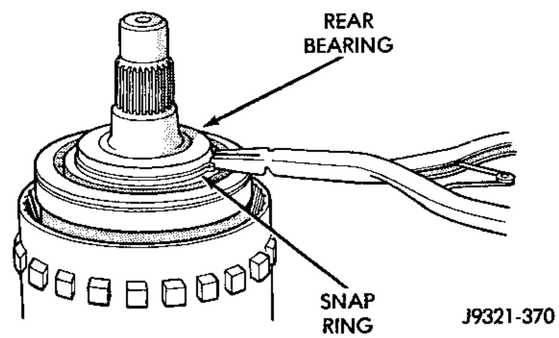

Fig. 214 Rear Bearing And Snap Ring Installation

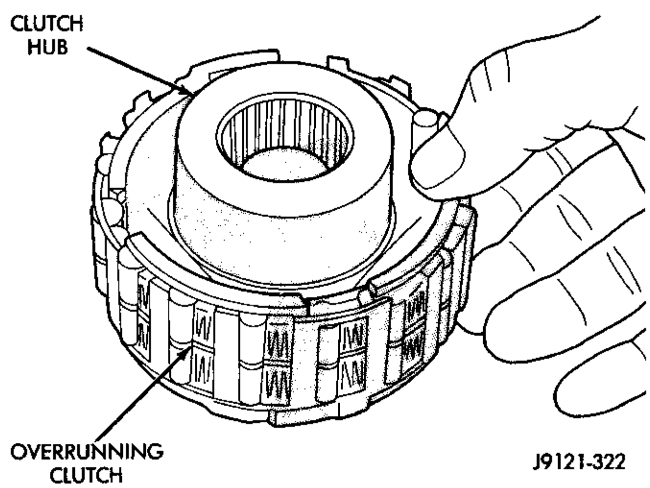

Fig. 215 Assembling Overrunning Clutch And Hub

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DISASSEMBLY AND ASSEMBLY (Continued)

(10) Install overrunning clutch in output shaft (Fig. 216). Insert snap ring pliers in hub splines. Expand pliers to grip hub. Then install assembly with counterclockwise, twisting motion.

(11) Install planetary gear in annulus gear (Fig. 217). **Be sure planetary pinions are fully seated in annulus gear before proceeding.**

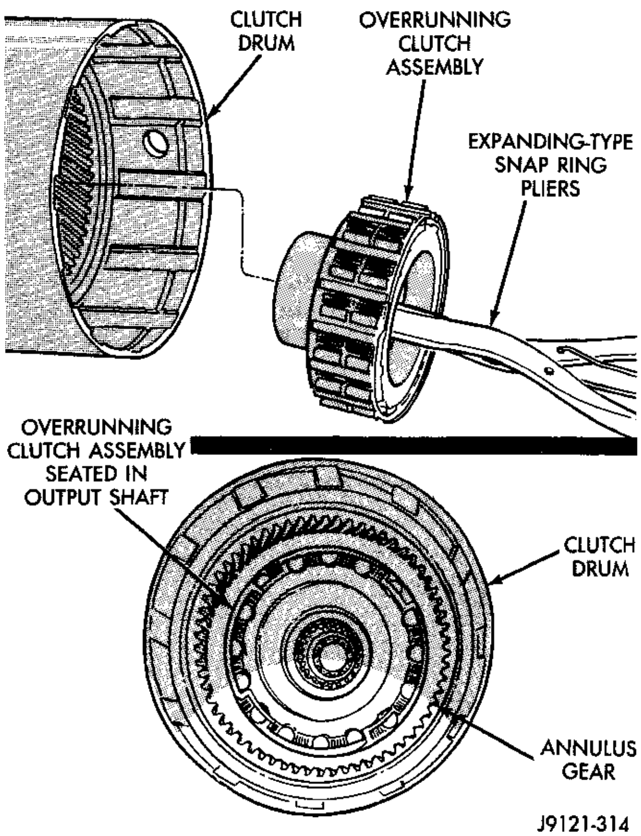

Fig. 216 Overrunning Clutch Installation

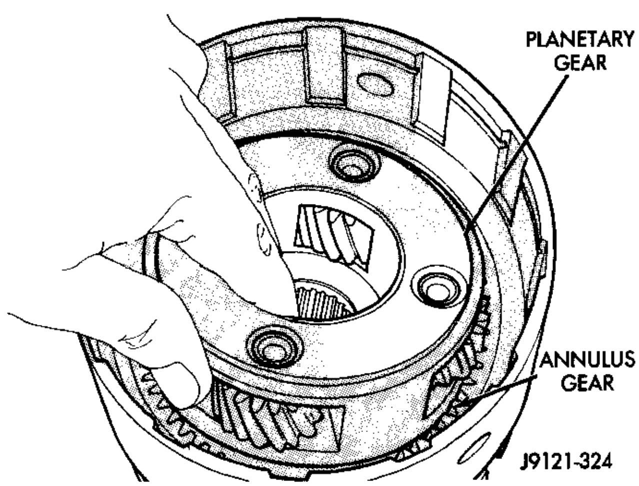

Fig. 217 Planetary Gear Installation

(12) Coat planetary thrust bearing and bearing contact surface of spring plate with generous amount of petroleum jelly. This will help hold bearing in place during installation.

(13) Install planetary thrust bearing on sun gear (Fig. 218). Slide bearing onto gear and seat it against spring plate as shown. **Bearing fits one way only. If it does not seat squarely against spring plate, remove and reposition bearing.**

(14) Install assembled sun gear, spring plate and thrust bearing (Fig. 219). Be sure sun gear and thrust bearing are fully seated before proceeding.

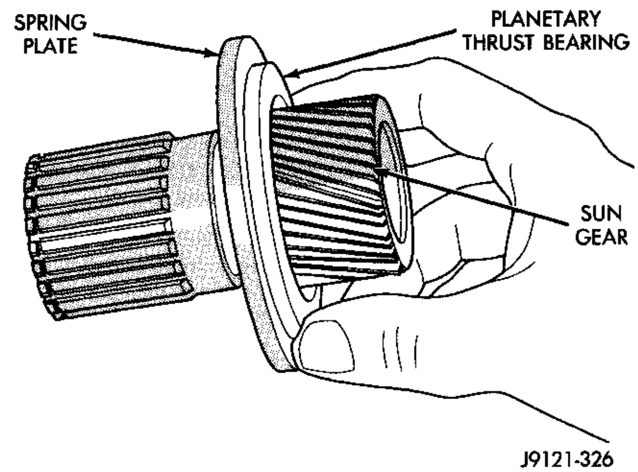

Fig. 218 Planetary Thrust Bearing Installation

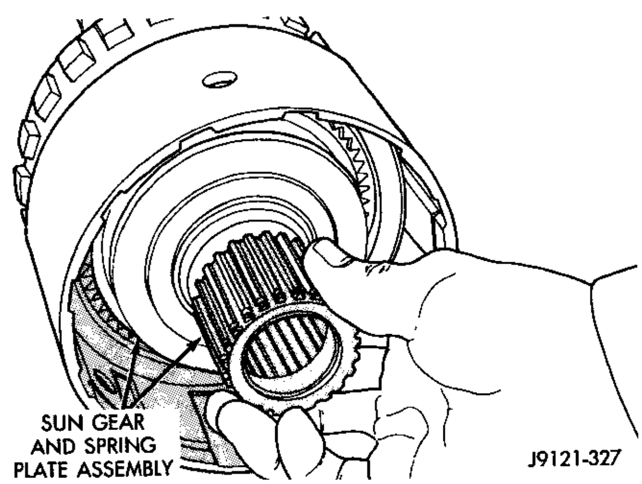

Fig. 219 Sun Gear Installation

(15) Mount assembled output shaft, annulus gear, and clutch drum in shop press. Direct clutch spring, hub and clutch pack are easier to install with assembly mounted in press.

(16) Align splines in hubs of planetary gear and overrunning clutch with Alignment tool 6227-2 (Fig. 220). Insert tool through sun gear and into splines of both hubs. Be sure alignment tool is fully seated before proceeding.

(17) Install direct clutch spring (Fig. 221). Be sure spring is properly seated on spring plate.

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DISASSEMBLY AND ASSEMBLY (Continued)

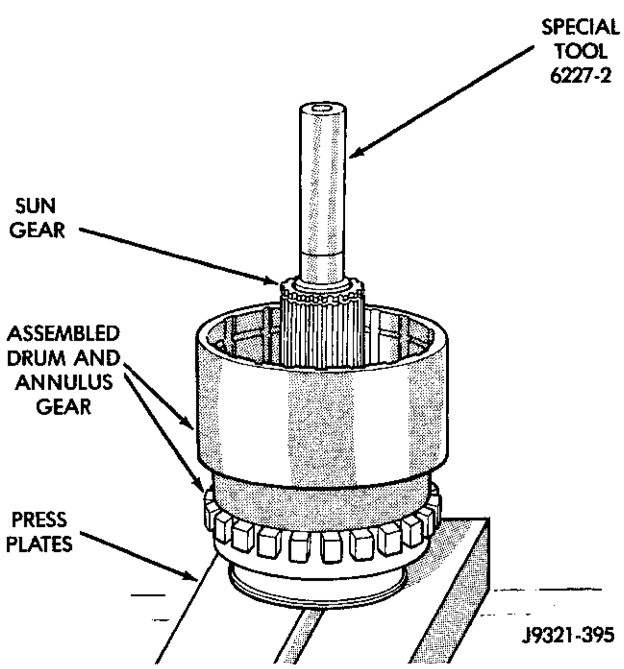

Fig. 220 Alignment Tool Installation

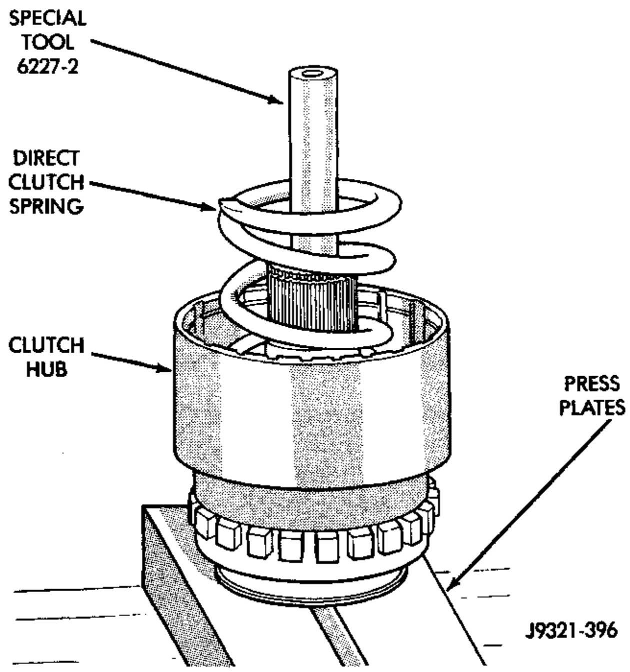

Fig. 221 Direct Clutch Spring Installation

NOTE: The 42RE transmission has 6 direct clutch discs and 5 clutch plates.

(18) Assemble and install direct clutch pack on hub as follows:

(a) Assemble clutch pack components (Fig. 222).

(b) Install direct clutch reaction plate on clutch hub first. **Note that one side of reaction plate is counterbored. Be sure this side faces rearward. Splines at rear of hub are raised slightly. Counterbore in plate fits over raised splines. Plate should be flush with this end of hub (Fig. 223).**

(c) Install first clutch disc followed by a steel plate until all discs and plates have been installed.

(d) Install pressure plate. This is last clutch pack item to be installed. **Be sure plate is**

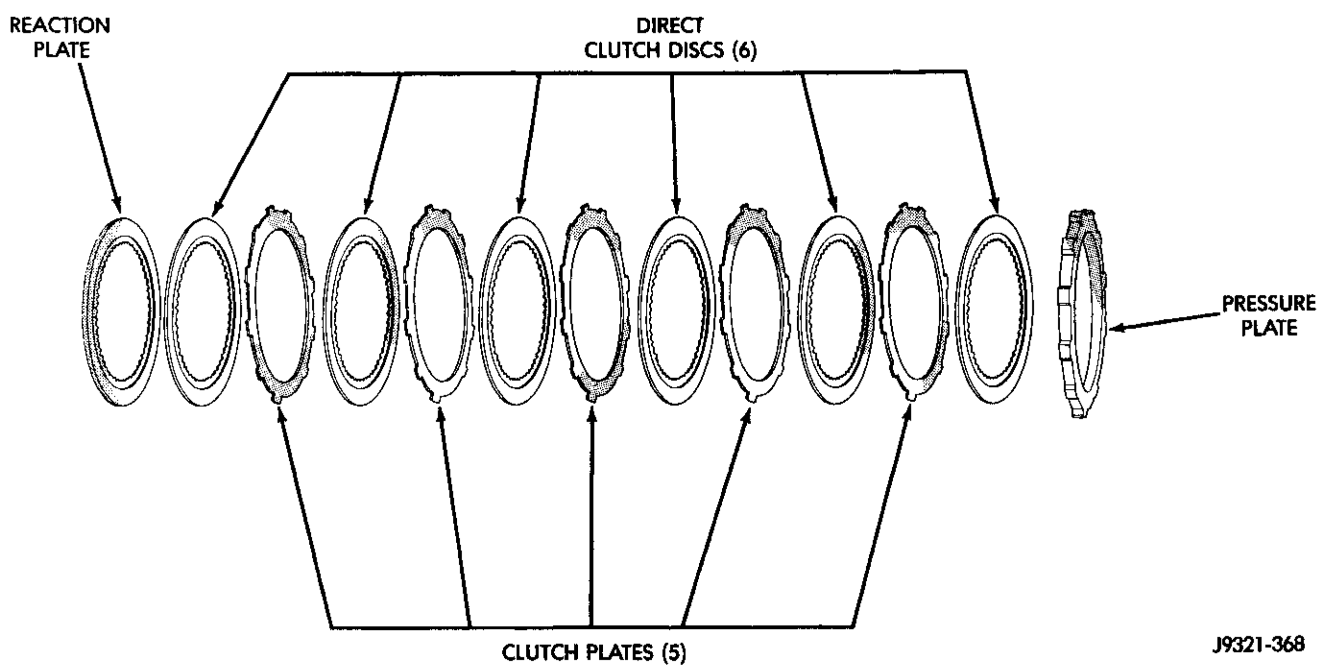

Fig. 222 42RE Direct Clutch Pack Components

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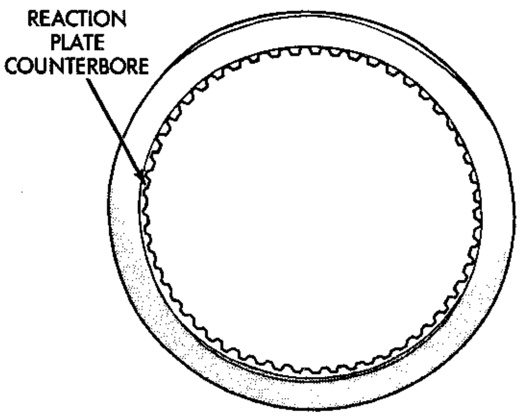
DISASSEMBLY AND ASSEMBLY (Continued)

installed with shoulder side facing upward (Fig. 224).

(19) Install clutch hub and clutch pack on direct clutch spring (Fig. 225). **Be sure hub is started on sun gear splines before proceeding.**



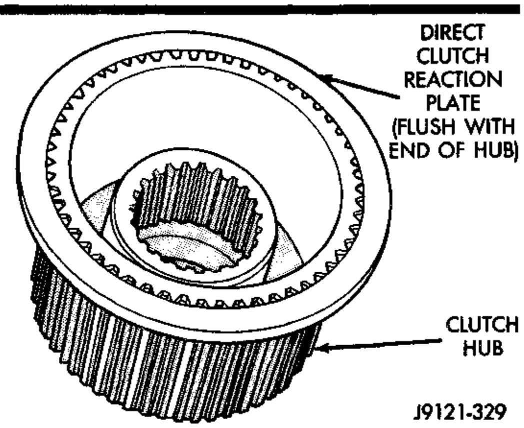


Fig. 223 Correct Position Of Direct Clutch Reaction Plate

WARNING: THE NEXT STEP IN GEARTRAIN ASSEMBLY INVOLVES COMPRESSING THE DIRECT CLUTCH HUB AND SPRING. IT IS EXTREMELY IMPORTANT THAT PROPER EQUIPMENT BE USED TO COMPRESS THE SPRING AS SPRING FORCE IS APPROXIMATELY 830 POUNDS. USE COMPRESSOR TOOL C-6227-1 AND A HYDRAULIC-TYPE SHOP PRESS WITH A MINIMUM RAM TRAVEL OF 6 INCHES. THE PRESS MUST ALSO HAVE A BED THAT CAN BE ADJUSTED UP OR DOWN AS REQUIRED. RELEASE CLUTCH SPRING TENSION SLOWLY AND COMPLETELY TO AVOID PERSONAL INJURY.

(20) Position Compressor Tool 6227-1 on clutch hub.

(21) Compress clutch hub and spring just enough to place tension on hub and hold it in place.

(22) Slowly compress clutch hub and spring. Compress spring and hub only enough to expose ring

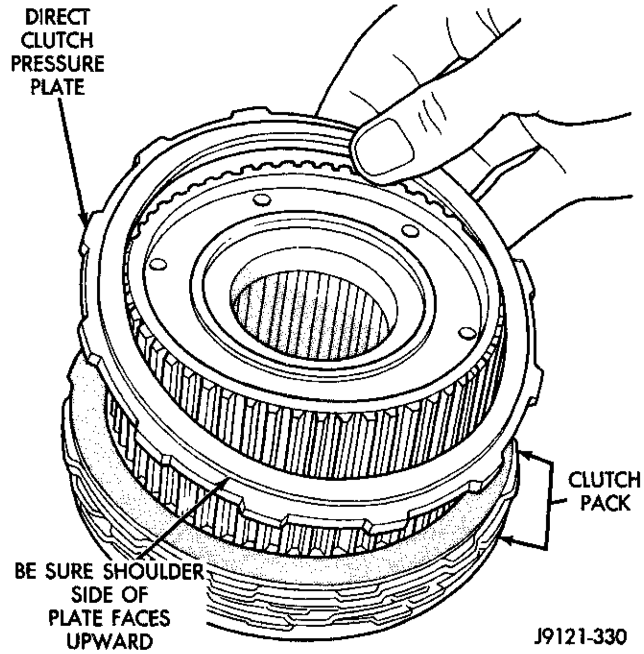


Fig. 224 Correct Position Of Direct Clutch Pressure Plate

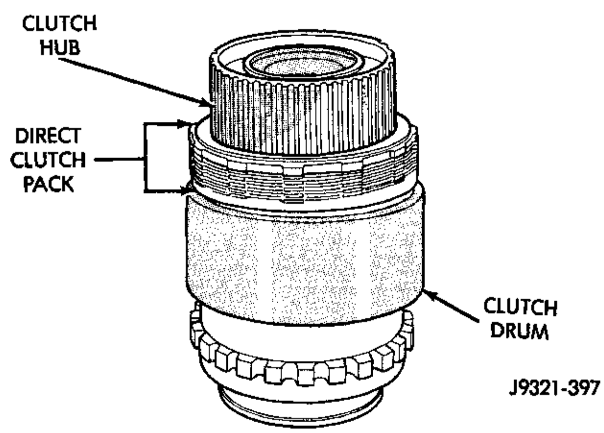


Fig. 225 Direct Clutch Pack And Clutch Hub Installation

grooves for clutch pack snap ring and clutch hub retaining ring.

(23) Realign clutch pack on hub and seat clutch discs and plates in clutch drum.

(24) Install direct clutch pack snap ring (Fig. 226). **Be very sure snap ring is fully seated in clutch drum ring groove.**

(25) Install clutch hub retaining ring (Fig. 227). **Be very sure retaining ring is fully seated in sun gear ring groove.**

(26) Slowly release press ram, remove compressor tools and remove geartrain assembly.

DISASSEMBLY AND ASSEMBLY (Continued)

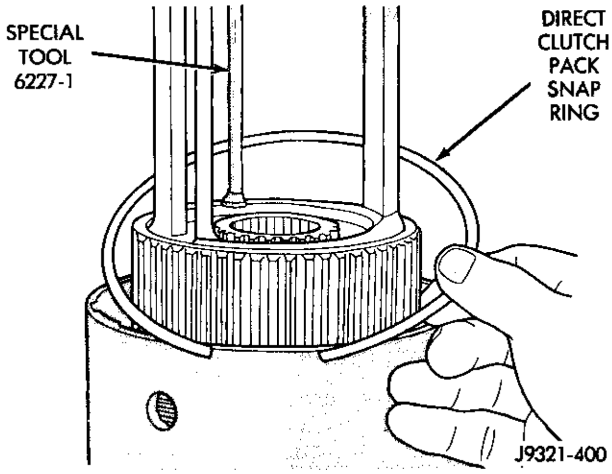


Fig. 226 Direct Clutch Pack Snap Ring Installation

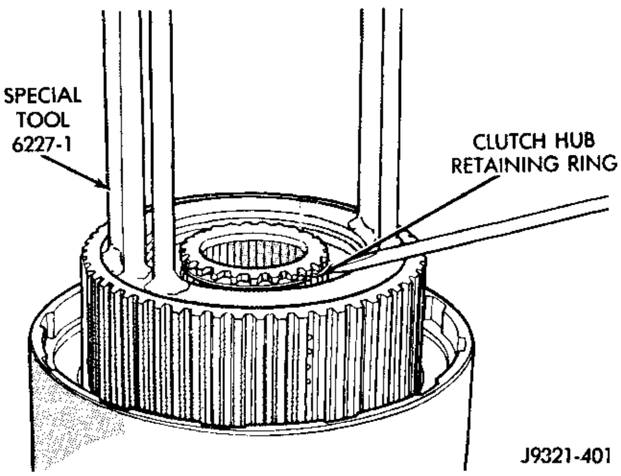


Fig. 227 Clutch Hub Retaining Ring Installation

GEAR CASE ASSEMBLY

(1) Position park pawl and spring in case and install park pawl shaft. Verify that end of spring with 90° bend is hooked to pawl and straight end of spring is seated against case.

(2) Install pawl shaft retaining bolt. Tighten bolt to 27 N·m (20 ft. lbs.) torque.

(3) Install park lock reaction plug. **Note that plug has locating pin at rear (Fig. 228). Be sure pin is seated in hole in case before installing snap ring.**

(4) Install reaction plug snap-ring (Fig. 229). **Compress snap ring only enough for installation; do not distort it.**

(5) Install new seal in gear case. On 4x4 gear case, use Tool Handle C-4171 and Installer C-3860-A to seat seal in case. On 4 x 2 gear case, use same Handle C-4171 and Installer C-3995-A to seat seal in case.

(6) Verify that tab ends of rear bearing locating ring extend into access hole in gear case (Fig. 230).

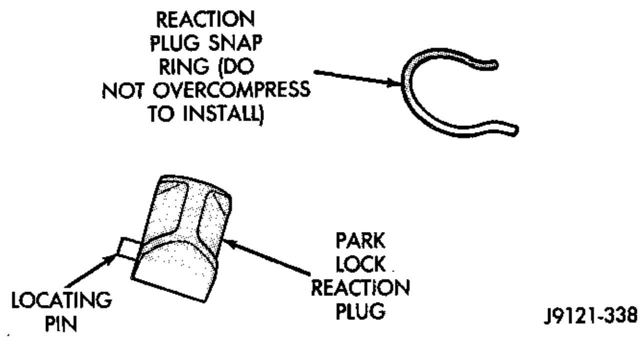


Fig. 228 Reaction Plug Locating Pin And Snap-Ring

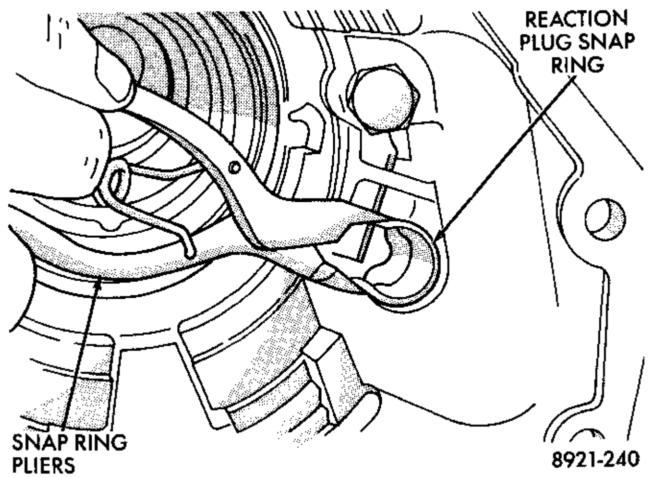


Fig. 229 Reaction Plug And Snap-Ring Installation

(7) Support geartrain on Tool 6227-1 (Fig. 231). Be sure tool is securely seated in clutch hub.

(8) Install overdrive gear case on geartrain (Fig. 231).

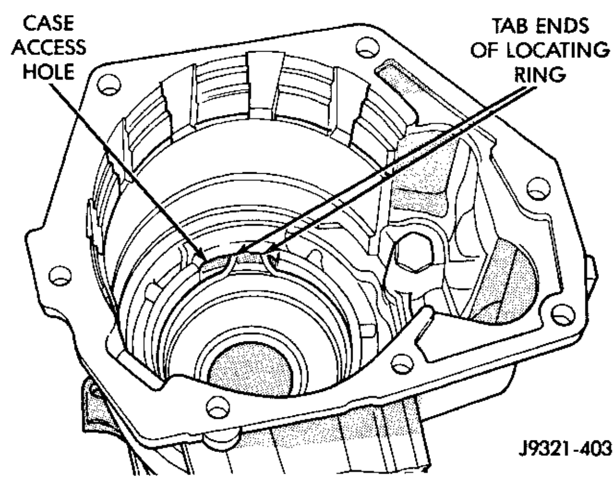


Fig. 230 Correct Rear Bearing Locating Ring Position

(9) Expand front bearing locating ring with snap ring pliers (Fig. 232). Then slide case downward until

DISASSEMBLY AND ASSEMBLY (Continued)

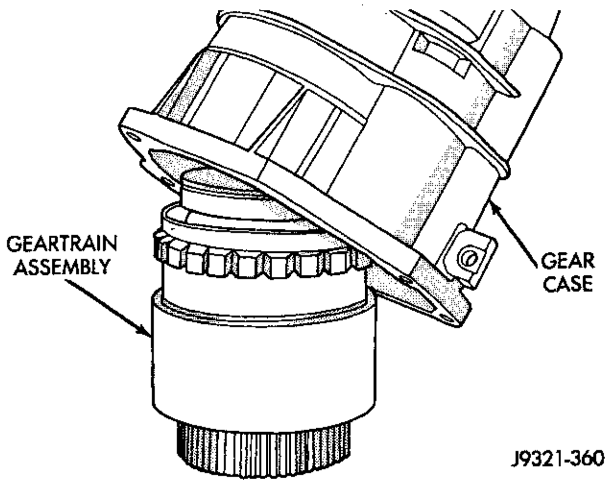


Fig. 231 Overdrive Gear Case Installation

locating ring locks in bearing groove and release snap ring.

(10) Install locating ring access cover and gasket in overdrive unit case (Fig. 233).

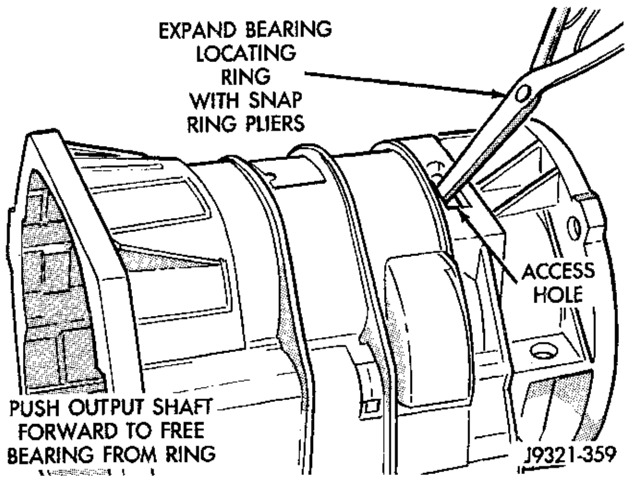


Fig. 232 Seating Locating Ring In Rear Bearing

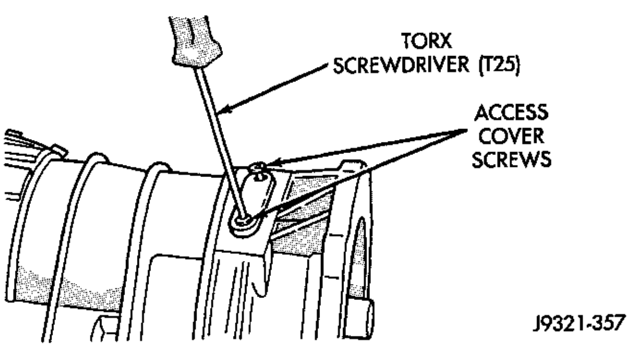


Fig. 233 Locating Ring Access Cover And Gasket Installation

OVERDRIVE CLUTCH ASSEMBLY

(1) Install overdrive clutch reaction ring first. Reaction ring is flat with notched ends (Fig. 234).

(2) Install wave spring on top of reaction ring (Fig. 235). **Reaction ring and wave ring both fit in same ring groove.** Use screwdriver to seat each ring securely in groove. Also ensure that the ends of the two rings are offset from each other.

NOTE: The 42RE transmission has 3 overdrive clutch discs and 2 plates.

(3) Assemble overdrive clutch pack (Fig. 236).

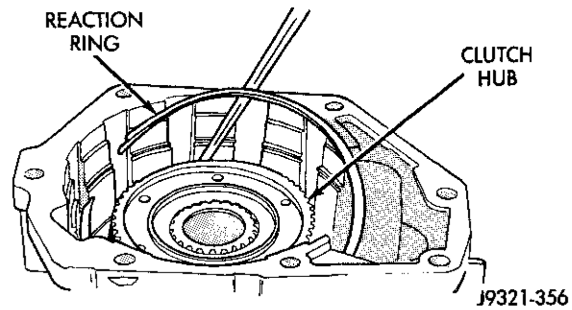


Fig. 234 Overdrive Clutch Reaction Ring Installation

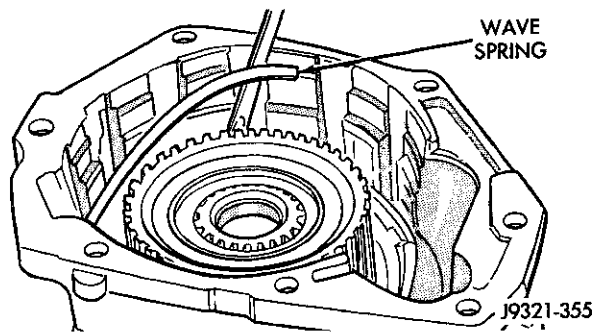


Fig. 235 Overdrive Clutch Wave Spring Installation

(4) Install overdrive clutch reaction plate first.

(5) Install first clutch disc followed by first clutch plate. Then install remaining clutch discs and plates in same order.

(6) Install clutch pack pressure plate.

(7) Install clutch pack wire-type retaining ring (Fig. 237).

INTERMEDIATE SHAFT SPACER SELECTION

(1) Place overdrive unit in vertical position. Mount it on blocks, or in workbench with appropriate size mounting hole cut into it. Be sure unit is facing upward for access to direct clutch hub. Also be sure output shaft is not loaded and internal components are moved rearward for accurate measurement.

(2) Determine correct thickness intermediate shaft spacer as follows:

(a) Insert Special Tool 6312 through sun gear, planetary gear and into pilot bushing in output shaft. Be sure tool bottoms against planetary shoulder.

DISASSEMBLY AND ASSEMBLY (Continued)

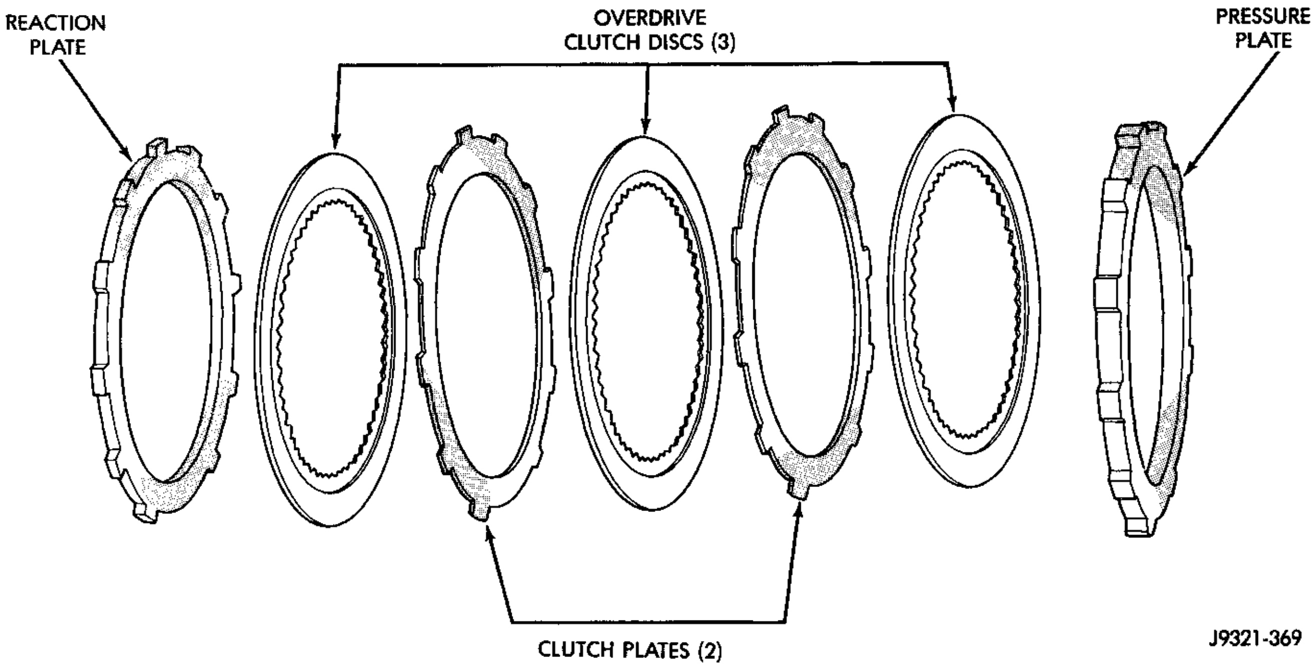


Fig. 236 42RE Overdrive Clutch Components

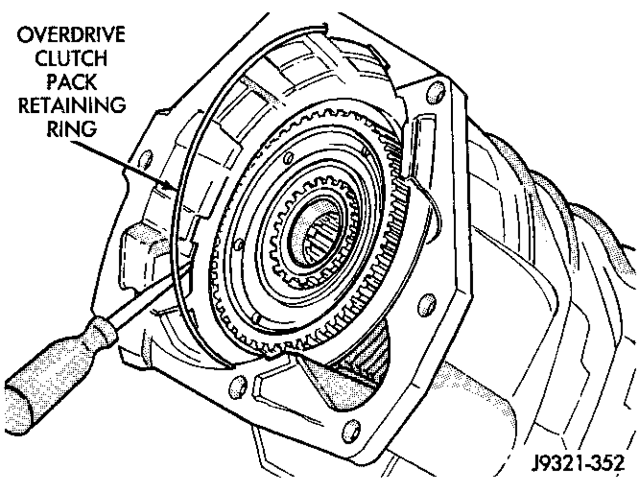


Fig. 237 Overdrive Clutch Pack Retaining Ring Installation

(b) Position Gauge Tool 6311 across face of overdrive case (Fig. 238). Then position Dial Caliper C-4962 over gauge tool.

(c) Extend sliding scale of dial caliper downward through gauge tool slot until scale contacts end of Gauge Alignment Tool 6312. Lock scale in place. Remove dial caliper tool and note distance measured (Fig. 238).

(d) Select proper thickness end play spacer from spacer chart based on distance measured (Fig. 239).

(e) Remove Gauge Alignment Tool 6312.

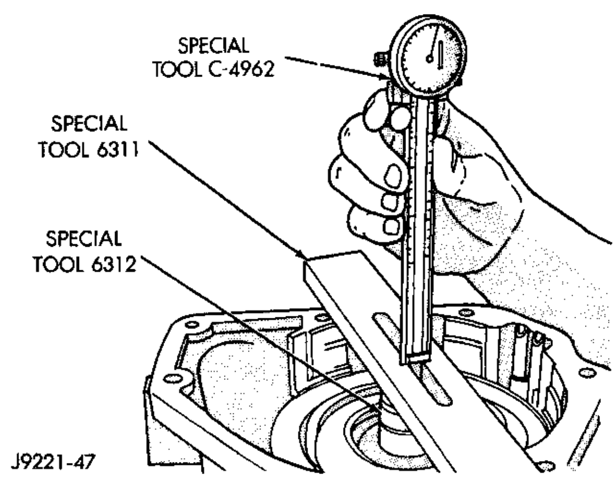


Fig. 238 Shaft End Play Measurement

End Play Measurement (Inches)	Spacer Thickness (Inches)
.7336 - .7505	.158 - .159
.7506 - .7675	.175 - .176
.7676 - .7855	.193 - .194
.7856 - .8011	.211 - .212

J9121-341

Fig. 239 Intermediate Shaft End Play Spacer Selection

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DISASSEMBLY AND ASSEMBLY (Continued)

OD THRUST PLATE SELECTION

(1) Place overdrive unit in vertical position. Mount it on blocks, or in workbench with appropriate size mounting hole cut into it. Be sure unit is facing upward for access to direct clutch hub. Also be sure output shaft is not loaded and internal components are moved rearward for accurate measurement.

(2) Determine correct thickness overdrive piston thrust plate as follows:

(a) Position Gauge Tool 6311 across face of overdrive case. Then position Dial Caliper C-4962 over gauge tool (Fig. 240).

(b) Measure distance to clutch hub thrust bearing seat at four points 90° apart. Then average measurements by adding them and dividing by 4.

(c) Select and install required thrust plate from information in thrust plate chart (Fig. 241).

(3) Leave Alignment Tool 6227-2 in place. Tool will keep planetary and clutch hub splines in alignment until overdrive unit is ready for installation on transmission.

(4) Transmission speed sensor can be installed at this time if desired. However, it is recommended that sensor not be installed until after overdrive unit is secured to transmission.

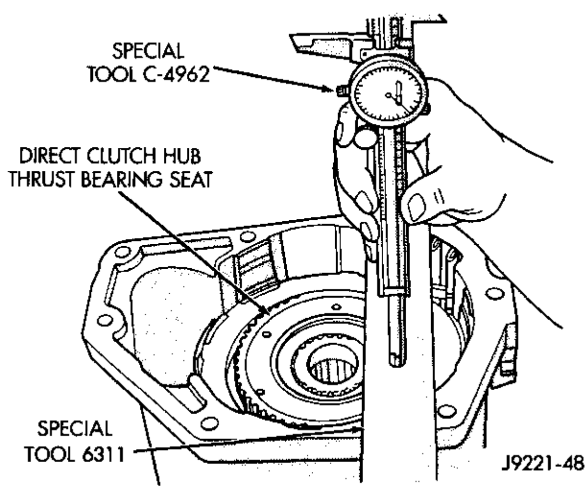

Fig. 240 Overdrive Piston Thrust Plate Measurement

OVERDRIVE PISTON ASSEMBLY

(1) Install new seals on over drive piston.

(2) Stand transmission case upright on bellhousing.

(3) Position Guide Ring 8114-1 on outer edge of overdrive piston retainer.

(4) Position Seal Guide 8114-2 on inner edge of overdrive piston retainer.

(5) Install overdrive piston in overdrive piston retainer by: aligning locating lugs on overdrive piston to the two mating holes in retainer.

(a) Aligning locating lugs on overdrive piston to the two mating holes in retainer.

End Play Measurement (Inches)	Spacer Thickness (Inches)
1.7500 - 1.7649	.108 - .110
1.7650 - 1.7799	.123 - .125
1.7800 - 1.7949	.138 - .140
1.7950 - 1.8099	.153 - .155
1.8100 - 1.8249	.168 - .170
1.8250 - 1.8399	.183 - .185
1.8400 - 1.8549	.198 - .200
1.8550 - 1.8699	.213 - .215
1.8700 - 1.8849	.228 - .230
1.8850 - 1.8999	.243 - .245

J9121-342

Fig. 241 Overdrive Piston Thrust Plate Selection

(b) Lubricate overdrive piston seals with Mopar® Door Ease, or equivalent.

(c) Install piston over Seal Guide 8114–2 and inside Guide Ring 8114–1.

(d) Push overdrive piston into position in retainer.

(e) Verify that the locating lugs entered the lug bores in the retainer.

(6) Install intermediate shaft spacer on intermediate shaft.

(7) Install overdrive piston thrust plate on overdrive piston.

(8) Install overdrive piston thrust bearing on overdrive piston.

(9) Install transmission speed sensor and O-ring seal in overdrive case (Fig. 182).

CLEANING AND INSPECTION

VALVE BODY

Clean the valve housings, valves, plugs, springs, and separator plates with a standard parts cleaning solution only. Do not use gasoline, kerosene, or any type of caustic solution.

Do not immerse any of the electrical components in cleaning solution. Clean the governor solenoid and sensor and the dual solenoid and harness assembly by wiping them off with dry shop towels only.

Dry all except the electrical parts with compressed air. Make sure all passages are clean and free from obstructions. **Do not use rags or shop towels to dry or wipe off valve body components. Lint from these materials can stick to valve body parts, interfere with valve operation, and clog filters and fluid passages.**

Wipe the governor pressure sensor and solenoid valve with dry, lint free shop towels only. The O-rings on the sensor and solenoid valve are the only service-

CLEANING AND INSPECTION (Continued)

able components. Be sure the vent ports in the solenoid valve are open and not blocked by dirt or debris. Replace the valve and/or sensor only when DRB scan tool diagnosis indicates this is necessary. Or, if either part has sustained physical damage (dented, deformed, broken, etc.).

CAUTION: Do not turn the small screw at the end of the solenoid valve for any reason. Turning the screw in either direction will ruin solenoid calibration and result in solenoid failure. In addition, the filter on the solenoid valve is NOT serviceable. Do not try to remove the filter as this will damage the valve housing.

Inspect the throttle and manual valve levers and shafts. Do not attempt to straighten a bent shaft or correct a loose lever. Replace these components if worn, bent, loose or damaged in any way.

Inspect all of the valve body mating surfaces for scratches, nicks, burrs, or distortion. Use a straightedge to check surface flatness. Minor scratches may be removed with crocus cloth using only very light pressure.

Minor distortion of a valve body mating surface may be corrected by smoothing the surface with a sheet of crocus cloth. Position the crocus cloth on a surface plate, sheet of plate glass or equally flat surface. If distortion is severe or any surfaces are heavily scored, the valve body will have to be replaced.

CAUTION: Many of the valves and plugs, such as the throttle valve, shuttle valve plug, 1-2 shift valve and 1-2 governor plug, are made of coated aluminum. Aluminum components are identified by the dark color of the special coating applied to the surface (or by testing with a magnet). Do not sand aluminum valves or plugs under any circumstances. This practice could damage the special coating causing the valves/plugs to stick and bind.

Inspect the valves and plugs for scratches, burrs, nicks, or scores. Minor surface scratches on steel valves and plugs can be removed with crocus cloth but **do not round off the edges of the valve or plug lands.** Maintaining sharpness of these edges is vitally important. The edges prevent foreign matter from lodging between the valves and plugs and the bore.

Inspect all the valve and plug bores in the valve body. Use a penlight to view the bore interiors. Replace the valve body if any bores are distorted or scored. Inspect all of the valve body springs. The springs must be free of distortion, warpage or broken coils.

Check the two separator plates for distortion or damage of any kind. Inspect the upper housing, lower housing, 3-4 accumulator housing, and transfer plate carefully. Be sure all fluid passages are clean and clear. Check condition of the upper housing and transfer plate check balls as well. The check balls and ball seats must not be worn or damaged.

Trial fit each valve and plug in its bore to check freedom of operation. When clean and dry, the valves and plugs should drop freely into the bores.

Valve body bores do not change dimensionally with use. If the valve body functioned correctly when new, it will continue to operate properly after cleaning and inspection. It should not be necessary to replace a valve body assembly unless it is damaged in handling.

The only serviceable valve body components are listed below. The remaining valve body components are serviced only as part of a complete valve body assembly. Serviceable parts are:

- dual solenoid and harness assembly
- solenoid gasket
- solenoid case connector O-rings and shoulder bolt
- switch valve and spring
- pressure adjusting screw and bracket assembly
- throttle lever
- manual lever and shaft seal
- throttle lever shaft seal, washer, and E-clip
- fluid filter and screws
- detent ball and spring
- valve body screws
- governor pressure solenoid
- governor pressure sensor and retaining clip
- park lock rod and E-clip

TRANSMISSION

GENERAL INFORMATION

Inspect the transmission bushings during overhaul. Bushing condition is important as worn, scored bushings contribute to low pressures, clutch slip and accelerated wear of other components. However, do not replace bushings as a matter of course. Replace bushings only when they are actually worn, or scored.

Use recommended tools to replace bushings. The tools are sized and designed to remove, install, and seat bushings correctly. The bushing replacement tools are included in Bushing Tool Set C-3887-B.

Pre-sized service bushings are available for replacement purposes. Only the sun gear bushings are not serviced. Low cost of the sun gear assembly makes it easier to simply replace the gear and bushings as an assembly.

Heli-Coil inserts can be used to repair damaged, stripped or worn threads in aluminum parts. These

CLEANING AND INSPECTION (Continued)

inserts are available from most automotive parts suppliers. Stainless steel inserts are recommended.

The use of crocus cloth is permissible where necessary, providing it is used carefully. When used on shafts, or valves, use extreme care to avoid rounding off sharp edges. Sharp edges are vital as they prevent foreign matter from getting between the valve and valve bore.

Do not reuse oil seals, gaskets, seal rings, or O-rings during overhaul. Replace these parts as a matter of course. Also do not reuse snap rings or E-clips that are bent or distorted. Replace these parts as well.

Lubricate transmission parts with Mopar® ATF Plus, Type 7176, transmission fluid during overhaul and assembly. Use petroleum jelly, Mopar® Door Ease, or Ru-Glyde to prelubricate seals, O-rings, and thrust washers. Petroleum jelly can also be used to hold parts in place during reassembly.

TRANSMISSION CASE CLEANING AND INSPECTION

Clean the case in a solvent tank. Flush the case bores and fluid passages thoroughly with solvent. Dry the case and all fluid passages with compressed air. Be sure all solvent is removed from the case and that all fluid passages are clear.

NOTE: Do not use shop towels or rags to dry the case (or any other transmission component) unless they are made from lint-free materials. Lint will stick to case surfaces and transmission components and circulate throughout the transmission after assembly. A sufficient quantity of lint can block fluid passages and interfere with valve body operation.

Inspect the case for cracks, porous spots, worn bores, or damaged threads. Damaged threads can be repaired with Helicoil thread inserts. However, the case will have to be replaced if it exhibits any type of damage or wear.

Lubricate the front band adjusting screw threads with petroleum jelly and thread the screw part-way into the case. Be sure the screw turns freely.

OVERRUNNING CLUTCH/LOW-REVERSE DRUM/OVERDRIVE PISTON RETAINER

Clean the overrunning clutch assembly, clutch cam, low-reverse drum, and overdrive piston retainer in solvent. Dry them with compressed air after cleaning.

Inspect condition of each clutch part after cleaning. Replace the overrunning clutch roller and spring assembly if any rollers or springs are worn or damaged, or if the roller cage is distorted, or damaged. Replace the cam if worn, cracked or damaged.

Replace the low-reverse drum if the clutch race, roller surface or inside diameter is scored, worn or damaged. **Do not remove the clutch race from the low-reverse drum under any circumstances. Replace the drum and race as an assembly if either component is damaged.**

Examine the overdrive piston retainer carefully for wear, cracks, scoring or other damage. Be sure the retainer hub is a snug fit in the case and drum. Replace the retainer if worn or damaged.

ACCUMULATOR

Inspect the accumulator piston and seal rings (Fig. 242). Replace the seal rings if worn or cut. Replace the piston if chipped or cracked.

Check condition of the accumulator inner and outer springs (Fig. 242). Replace the springs if the coils are cracked, distorted or collapsed.

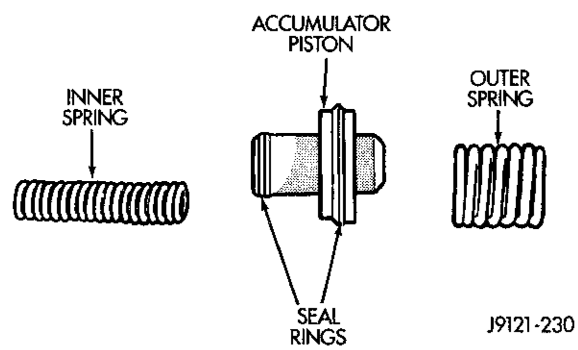

Fig. 242 Accumulator Components

FRONT SERVO

Clean the servo piston components with solvent and dry them with compressed air. Wipe the band clean with lint free shop towels.

Replace the front band if distorted, lining is burned, flaking off, or worn to the point where the grooves in the lining material are no longer visible.

Inspect the servo components. Replace the springs if collapsed, distorted or broken. Replace the guide, rod and piston if cracked, bent, or worn. Discard the servo snap ring if distorted or warped.

Check the servo piston bore for wear. If the bore is severely scored, or damaged, it will be necessary to replace the case.

Replace any servo component if doubt exists about condition. Do not reuse suspect parts.

REAR SERVO

Remove and discard the servo piston seal ring (Fig. 243). Then clean the servo components with solvent and dry with compressed air. Replace either spring if collapsed, distorted or broken. Replace the plug and piston if cracked, bent, or worn. Discard the servo snap rings and use a new ones at assembly.

CLEANING AND INSPECTION (Continued)

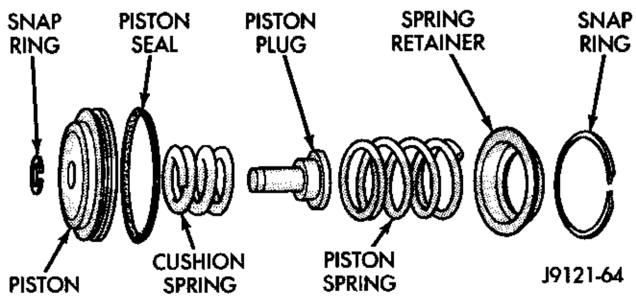

Fig. 243 Rear Servo Components

OIL PUMP AND REACTION SHAFT SUPPORT

(1) Clean pump and support components with solvent and dry them with compressed air.

(2) Check condition of the seal rings and thrust washer on the reaction shaft support. The seal rings do not need to be replaced unless cracked, broken, or severely worn.

(3) Inspect the pump and support components. Replace the pump or support if the seal ring grooves or machined surfaces are worn, scored, pitted, or damaged. Replace the pump gears if pitted, worn chipped, or damaged.

(4) Inspect the pump bushing. Then check the reaction shaft support bushing. Replace either bushing only if heavily worn, scored or damaged. It is not necessary to replace the bushings unless they are actually damaged.

(5) Install the gears in the pump body and measure pump component clearances as follows:

(a) Clearance between outer gear and reaction shaft housing should be 0.010 to 0.063 mm (0.0004 to 0.0025 in.). Clearance between inner gear and reaction shaft housing should be 0.010 to 0.063 mm (0.0004 to 0.0025 in.). Both clearances can be measured at the same time by:

(I) Installing the pump gears in the pump housing.

(II) Position an appropriate piece of Plastigage® across both gears.

(III) Align the plastigage to a flat area on the reaction shaft housing.

(IV) Install the reaction shaft to the pump housing.

(V) Separate the reaction shaft housing from the pump housing and measure the Plastigage® following the instructions supplied with it.

(b) Clearance between inner gear tooth and outer gear should be 0.08 to 0.19 mm (0.0035 to 0.0075 in.). Measure clearance with an appropriate feeler gauge.

(c) Clearance between outer gear and pump housing should also be 0.010 to 0.19 mm (0.0035 to 0.0075 in.). Measure clearance with an appropriate feeler gauge.

FRONT CLUTCH

Clean and inspect the front clutch components. Replace the clutch discs if warped, worn, scored, burned or charred, or if the facing is flaking off. Replace the steel plates if heavily scored, warped, or broken. Be sure the driving lugs on the plates are in good condition. The lugs must not be bent, cracked or damaged in any way.

Replace the clutch spring and spring retainer if either is distorted, warped or broken.

Check the lug grooves in the clutch retainer. The steel plates should slide freely in the slots. Replace the retainer if the grooves are worn or damaged.

Check action of the check ball in the retainer (Fig. 244). The ball must move freely and not stick.

NOTE: Inspect the clutch retainer bushings carefully (Fig. 245). The retainer bushings are NOT serviceable. It will be necessary to replace the retainer if either bushing is scored, or worn.

Inspect the piston and retainer seal surfaces for nicks or scratches. Minor scratches can be removed with crocus cloth. However, replace the piston and/or retainer if the seal surfaces are seriously scored.

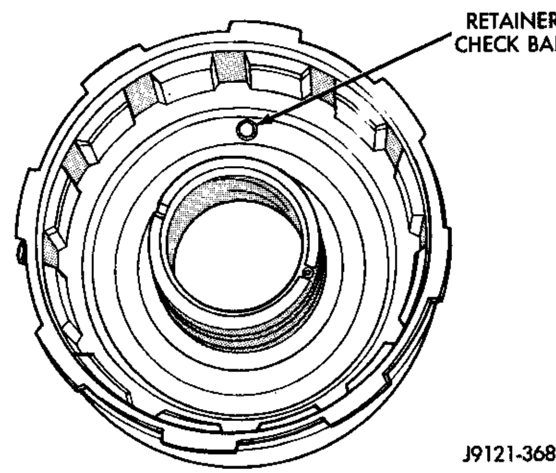

Fig. 244 Front Clutch Piston Retainer Check Ball Location

REAR CLUTCH

Clean the clutch components with solvent and dry them with compressed air. Do not use rags or shop towels to dry any of the clutch parts. Lint from such materials will adhere to component surfaces and could restrict or block fluid passages after assembly.

Replace the clutch discs if warped, worn, scored, burned/charred, the lugs are damaged, or if the facing is flaking off. Replace the top and bottom pressure plates if scored, warped, or cracked. Be sure the driving lugs on the pressure and clutch plates are also in good condition. The lugs must not be bent, cracked or damaged in any way.

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CLEANING AND INSPECTION (Continued)

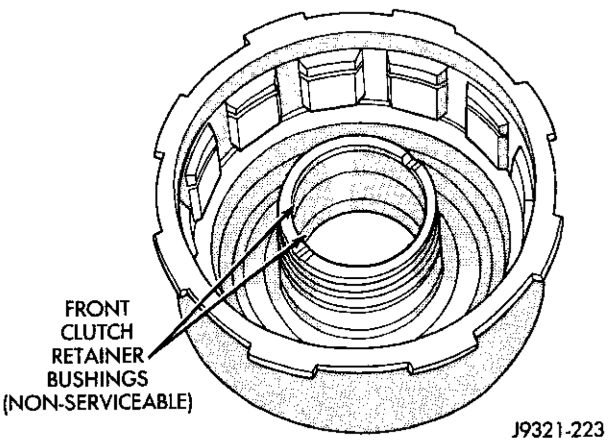

Fig. 245 Retainer Bushing Location/Inspection

Replace the piston spring and wave spring if either part is distorted, warped or broken.

Check the lug grooves in the clutch retainer. The clutch and pressure plates should slide freely in the slots. Replace the retainer if the grooves are worn or damaged. Also check action of the check balls in the retainer and piston. Each check ball must move freely and not stick.

Replace the retainer bushing if worn, scored, or doubt exists about bushing condition.

Inspect the piston and retainer seal surfaces for nicks or scratches. Minor scratches can be removed with crocus cloth. However, replace the piston and/or retainer if the seal surfaces are seriously scored.

Check condition of the fiber thrust washer and metal output shaft thrust washer. Replace either washer if worn or damaged.

Check condition of the seal rings on the input shaft and clutch retainer hub. Replace the seal rings only if worn, distorted, or damaged. The input shaft front seal ring is teflon with chamfered ends. The rear ring is metal with interlocking ends.

Check the input shaft for wear, or damage. Replace the shaft if worn, scored or damaged in any way.

PLANETARY GEARTRAIN

Clean the planetary components in solvent and dry them with compressed air.

Check sun gear and driving shell condition. Replace the gear if damaged or if the bushings are scored or worn. The bushings are not serviceable. Replace the driving shell if worn, cracked or damaged.

Replace planetary gear sets if gears, pinion pins, or carrier are damaged in any way. Replace the annulus gears and supports if either component is worn or damaged.

Inspect the geartrain spacers, thrust plates, snap rings, and thrust washers. Replace any of these parts that are worn, distorted or damaged. Do not attempt to reuse these parts.

The planetary gear thrust washers are different sizes. The large diameter washers go on the front planetary and the smaller washers go on the rear planetary. All the washers have four locating tabs on them. These tabs fit in the holes or slots provided in each planetary gear.

Inspect the output shaft carefully. Pay particular attention to the machined bushing/bearing surfaces on the shaft and the governor valve shaft bore at the shaft rear.

Replace the output shaft if the machined surfaces are scored, pitted, or damaged in any way. Also replace the shaft if the splines are damaged, or exhibits cracks at any location (especially at the governor valve shaft bore).

The annulus gears can be removed from their supports if necessary. Just remove the snap rings and separate the two parts when replacement is necessary. In addition, the annulus gear bushings can be replaced if severely worn, or scored. However it is not necessary to replace the bushings if they only exhibit normal wear. Check bushing fit on the output shaft to be sure.

OVERDRIVE UNIT

Clean the geartrain and case components with solvent. Dry all parts except the bearings with compressed air. Allow bearings to air dry.

Do not use shop towels for wiping parts dry unless the towels are made from a lint-free material. A sufficient quantity of lint (from shop towels, cloths, rags, etc.) could plug the transmission filter and fluid passages.

Discard the old case gasket and seals. Do not attempt to salvage these parts. They are not reusable. Replace any of the overdrive unit snap rings if distorted or damaged.

Minor nicks or scratches on components can be smoothed with crocus cloth. However, do not attempt to reduce severe scoring on any components with abrasive materials. Replace severely scored components; do not try to salvage them.

Check condition of the park lock components and the overdrive case.

Replace the case if cracked, scored, or damaged. Replace the park lock pawl, plug, or spring if worn or damaged. Be sure the bullet at the end of the park lock rod is in good condition. Replace the rod if the bullet is worn or the rod itself is bent or distorted. Do not attempt to straighten the rod.

Check the bushings in the overdrive case. Replace the bushings if severely scored or worn. Also replace the case seal if loose, distorted, or damaged.

CLEANING AND INSPECTION (Continued)

Examine the overdrive and direct clutch discs and plates. Replace the discs if the facing is worn, severely scored, or burned and flaking off. Replace the clutch plates if worn, heavily scored, or cracked. Check the lugs on the clutch plates for wear. The plates should slide freely in the drum. Replace the plates or drum if binding occurs.

Check condition of the annulus gear, direct clutch hub, clutch drum and clutch spring. Replace the gear, hub and drum if worn or damaged. Replace the spring if collapsed, distorted, or cracked.

Be sure the splines and lugs on the gear, drum and hub are in good condition. The clutch plates and discs should slide freely in these components.

Inspect the thrust bearings and spring plate. Replace the plate if worn or scored. Replace the bearings if rough, noisy, brinnelled, or worn.

Inspect the planetary gear assembly and the sun gear and bushings. If either the sun gear or the bushings are damaged, replace the gear and bushings as an assembly. The gear and bushings are not serviced separately.

The planetary carrier and pinions must be in good condition. Also be sure the pinion pins are secure and in good condition. Replace the carrier if worn or damaged.

Inspect the overrunning clutch and race. The race surface should be smooth and free of scores. Replace the overrunning clutch assembly or the race if either assembly is worn or damaged in any way.

Inspect the output shaft and governor components. Replace the shaft pilot bushing and inner bushing if damaged. Replace either shaft bearing if rough or noisy. Replace the bearing snap rings if distorted or cracked.

Check the machined surfaces on the output shaft. These surfaces should clean and smooth. Very minor nicks or scratches can be smoothed with crocus cloth. Replace the shaft if worn, scored or damaged in any way.

Inspect the output shaft bushings. The small bushing is the intermediate shaft pilot bushing. The large bushing is the overrunning clutch hub bushing. Replace either bushing if scored, pitted, cracked, or worn.

ADJUSTMENTS

TRANSMISSION THROTTLE VALVE CABLE ADJUSTMENT

The transmission throttle valve is operated by a cam on the valve body throttle lever. The throttle lever is actuated by a cable connected to the engine throttle body lever (Fig. 246). A retaining clip at the engine-end of the cable is removed to provide for cable adjustment. The retaining clip is then installed back onto the throttle valve cable to lock in the adjustment.

A correctly adjusted throttle valve cable, will cause the throttle lever on the transmission to move simultaneously with the throttle body lever from the idle position. Proper adjustment allows simultaneous movement without causing the transmission throttle lever to move ahead of, or lag behind the throttle body lever.

THROTTLE VALVE CABLE ADJUSTMENT CHECK

(1) Turn ignition key to OFF position.

(2) Remove air cleaner.

(3) Verify that throttle body lever is at curb idle position. Then verify that transmission throttle lever (Fig. 246) is also at idle (full forward) position.

(4) Slide cable off attachment stud on throttle body lever (Fig. 246).

(5) Compare position of cable end to attachment stud on throttle body lever:

(a) Cable end and attachment stud should be aligned (or centered on one another) to within 1 mm (0.039 in.) in either direction.

(b) If cable end and attachment stud are misaligned (off center), cable will have to be adjusted as described in following procedure.

(6) Reconnect cable end to attachment stud. Then with aid of a helper, observe movement of transmission throttle lever and lever on throttle body.

(a) If both levers move simultaneously from idle to half-throttle and back to idle position, adjustment is correct.

(b) If transmission throttle lever moves ahead of, or lags behind throttle body lever, cable adjustment will be necessary. Or, if throttle body lever prevents transmission lever from returning to closed position, cable adjustment will be necessary.

THROTTLE VALVE CABLE ADJUSTMENT PROCEDURE

(1) Turn ignition switch to OFF position and shift into Park.

(2) Remove air cleaner.

(3) Disconnect cable end from attachment stud on throttle body. **Carefully slide cable off stud. Do not pull or pry cable off.**

(4) Verify that transmission throttle lever is in idle (full forward) position. Then be sure lever on throttle body is at curb idle position.

(5) Insert a small screwdriver under edge of retaining clip and remove retaining clip.

(6) Center cable end on attachment stud to within 1 mm (0.039 in.).

(7) Install retaining clip onto cable housing.

(8) Check cable adjustment. Be sure transmission throttle lever and lever on throttle body move simul-

ADJUSTMENTS (Continued)

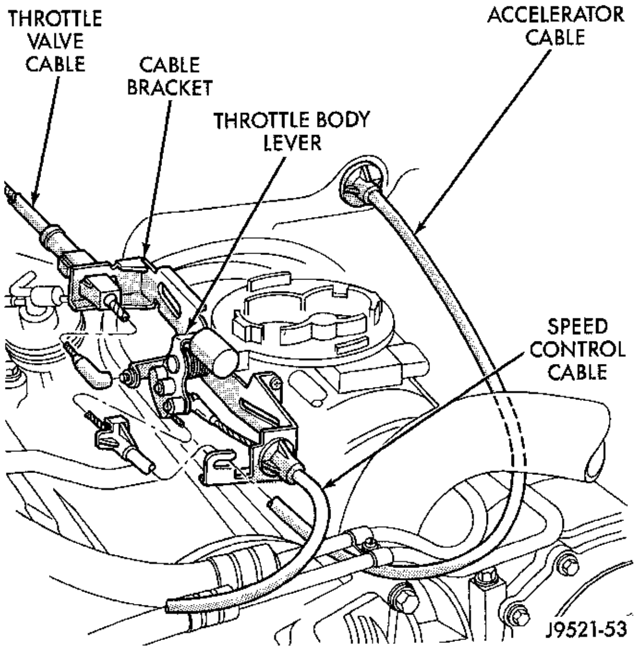

Fig. 246 Throttle Valve Cable Attachment —At Engine

taneously and as described in cable adjustment checking procedure.

GEARSHIFT LINKAGE ADJUSTMENT

Check linkage adjustment by starting engine in Park and Neutral. Adjustment is acceptable if the engine starts in only these two positions. Adjustment is incorrect if the engine starts in one position but not both positions

If the engine starts in any other position, or if the engine will not start in any position, the park/neutral switch is probably faulty.

LINKAGE ADJUSTMENT

Check condition of the shift linkage (Fig. 247). Do not attempt adjustment if any component is loose, worn, or bent. Replace any suspect components.

Replace the grommet securing the shift rod or torque rod in place if either rod was removed from the grommet. Remove the old grommet as necessary and use suitable pliers to install the new grommet.

(1) Shift transmission into Park.

(2) Raise and support vehicle.

(3) Loosen lock bolt in front shift rod adjusting swivel (Fig. 247).

(4) Ensure that the shift rod slides freely in the swivel. Lube rod and swivel as necessary.

(5) Move transmission shift lever fully rearward to the Park detent.

(6) Center adjusting swivel on shift rod.

(7) Tighten swivel lock bolt to 10 N·m (90 in. lbs.).

(8) Lower vehicle and verify proper adjustment.

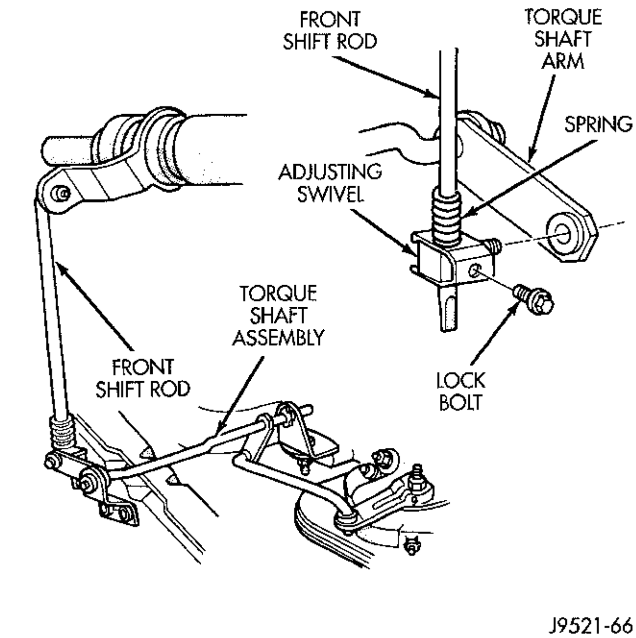

Fig. 247 Linkage Adjustment Components

BAND ADJUSTMENTS

FRONT BAND ADJUSTMENT

The front (kickdown) band adjusting screw is located on the left side of the transmission case above the manual valve and throttle valve levers.

(1) Raise vehicle.

(2) Loosen band adjusting screw locknut (Fig. 248). Then back locknut off 3-5 turns. Be sure adjusting screw turns freely in case. Apply lubricant to screw threads if necessary.

(3) Tighten band adjusting screw to 8 N·m (72 in. lbs.) torque with Inch Pound Torque Wrench C-3380-A, a 3-in. extension and 5/16 socket.

CAUTION: If Adapter C-3705 is needed to reach the adjusting screw (Fig. 249), tighten the screw to only 5 N·m (47-50 in. lbs.) torque.

(4) Back off front band adjusting screw 3-5/8 turns.

(5) Hold adjuster screw in position and tighten locknut to 41 N·m (30 ft. lbs.) torque.

(6) Lower vehicle.

REAR BAND ADJUSTMENT

The transmission oil pan must be removed for access to the rear band adjusting screw.

(1) Raise vehicle.

(2) Remove transmission oil pan and drain fluid.

(3) Loosen band adjusting screw locknut 5-6 turns (Fig. 250). Be sure adjusting screw turns freely in lever.

ADJUSTMENTS (Continued)

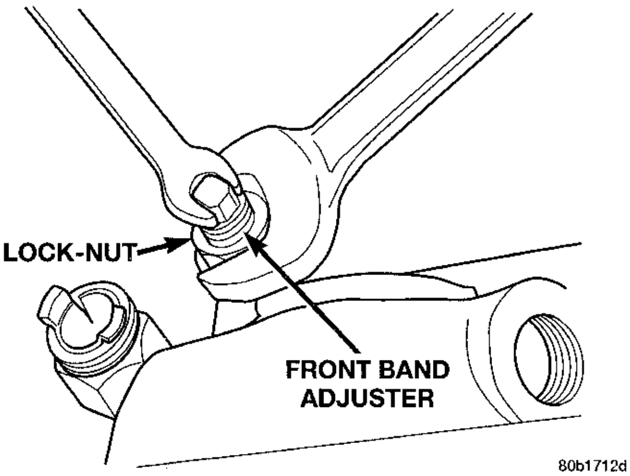

Fig. 248 Front Band Adjustment Screw Location

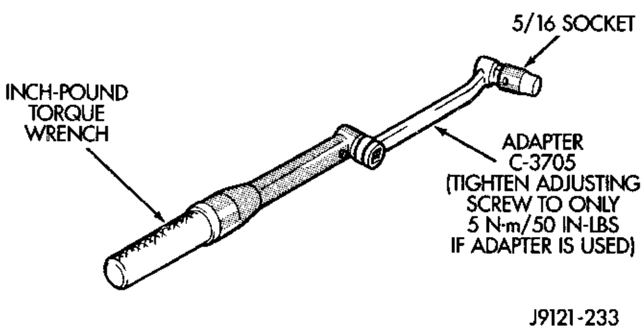

Fig. 249 Band Adjustment Adapter Tool

(4) Tighten adjusting screw to 8 N·m (72 in. lbs.) torque.

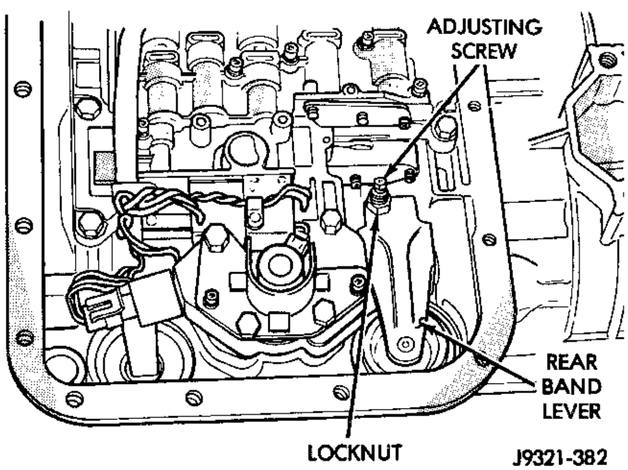

Fig. 250 Rear Band Adjusting Screw Location

(5) Back off adjusting screw 4 turns.

(6) Hold adjusting screw in place and tighten locknut to 34 N·m (25 ft. lbs.) torque.

(7) Position new gasket on oil pan and install pan on transmission. Tighten pan bolts to 17 N·m (13 ft. lbs.) torque.

(8) Lower vehicle and refill transmission with Mopar® ATF Plus 3, Type 7176 fluid.

VALVE BODY

CONTROL PRESSURE ADJUSTMENTS

There are two control pressure adjustments on the valve body;

- Line Pressure
- Throttle Pressure

Line and throttle pressures are interdependent because each affects shift quality and timing. As a result, both adjustments must be performed properly and in the correct sequence. Adjust line pressure first and throttle pressure last.

LINE PRESSURE ADJUSTMENT

Measure distance from the valve body to the inner edge of the adjusting screw with an accurate steel scale (Fig. 251).

Distance should be 33.4 mm (1-5/16 in.).

If adjustment is required, turn the adjusting screw in, or out, to obtain required distance setting.

NOTE: The 33.4 mm (1-5/16 in.) setting is an approximate setting. Manufacturing tolerances may make it necessary to vary from this dimension to obtain desired pressure.

One complete turn of the adjusting screw changes line pressure approximately 1-2/3 psi (9 kPa).

Turning the adjusting screw counterclockwise increases pressure while turning the screw clockwise decreases pressure.

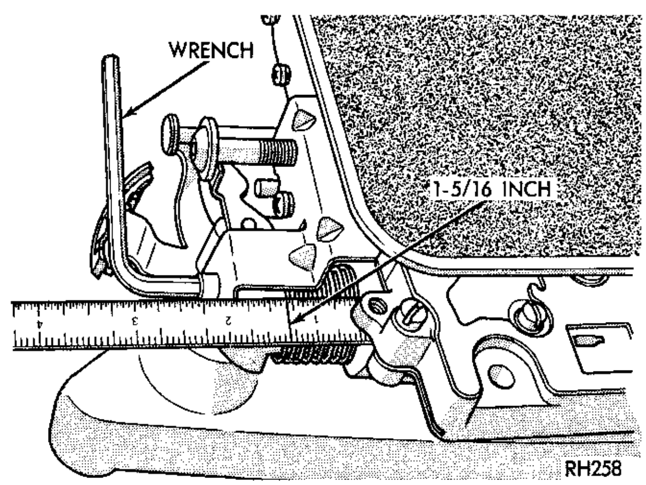

Fig. 251 Line Pressure Adjustment

THROTTLE PRESSURE ADJUSTMENT

Insert Gauge Tool C-3763 between the throttle lever cam and the kickdown valve stem (Fig. 252).

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ADJUSTMENTS (Continued)

Push the gauge tool inward to compress the kickdown valve against the spring and bottom the throttle valve.

Maintain pressure against kickdown valve spring. Turn throttle lever stop screw until the screw head touches throttle lever tang and the throttle lever cam touches gauge tool.

NOTE: The kickdown valve spring must be fully compressed and the kickdown valve completely bottomed to obtain correct adjustment.

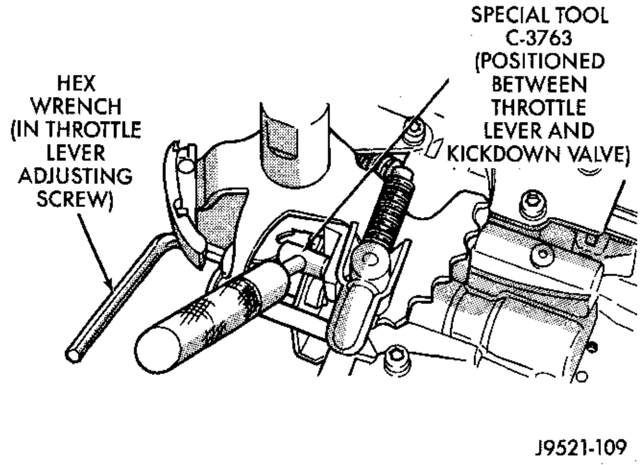

Fig. 252 Throttle Pressure Adjustment

SCHEMATICS AN DIAGRAMS

HYDRAULIC SCHEMATICS

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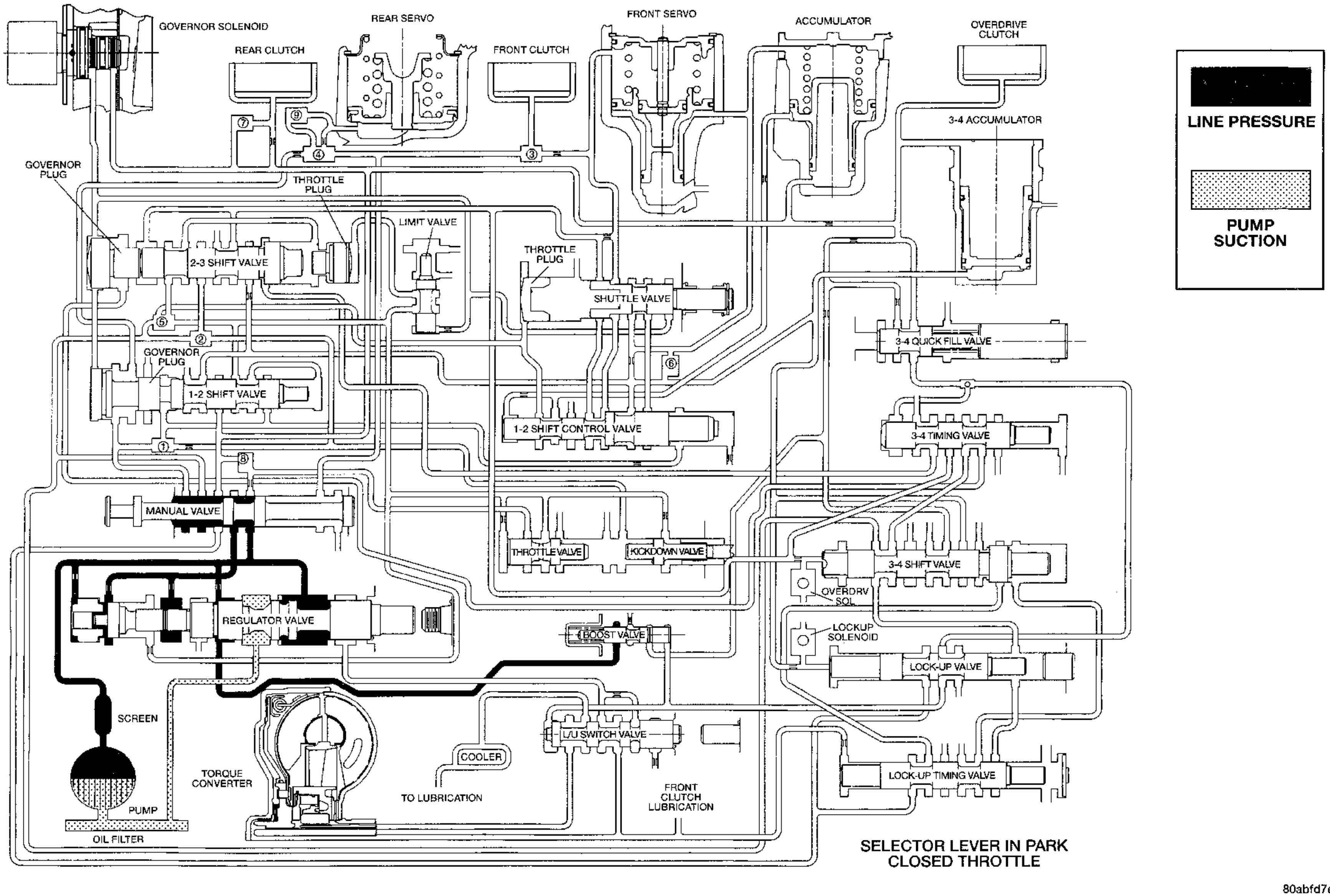

HYDRAULIC FLOW IN PARK

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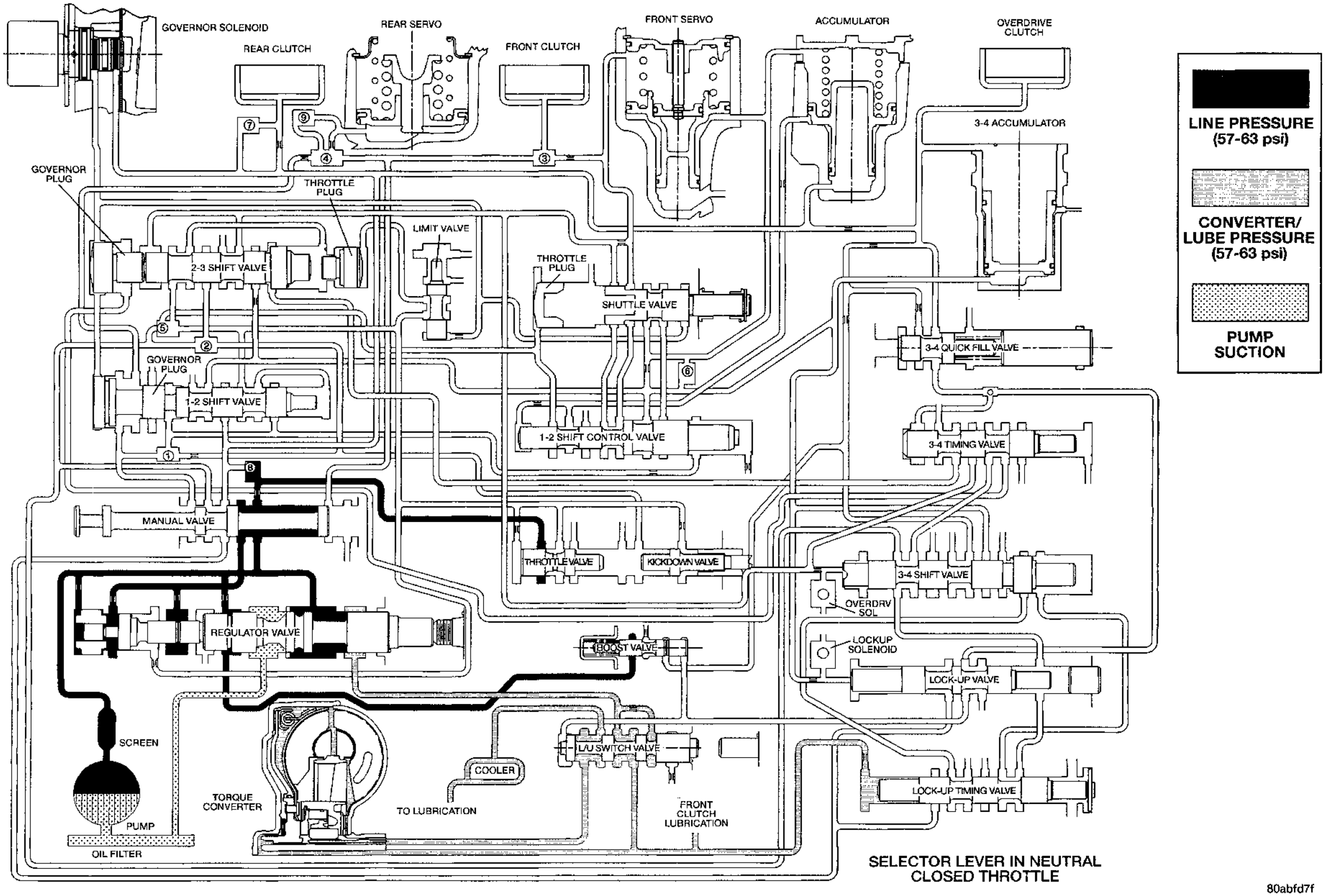
SCHEMATICS AN DIAGRAMS (Continued)



HYDRAULIC FLOW IN NEUTRAL

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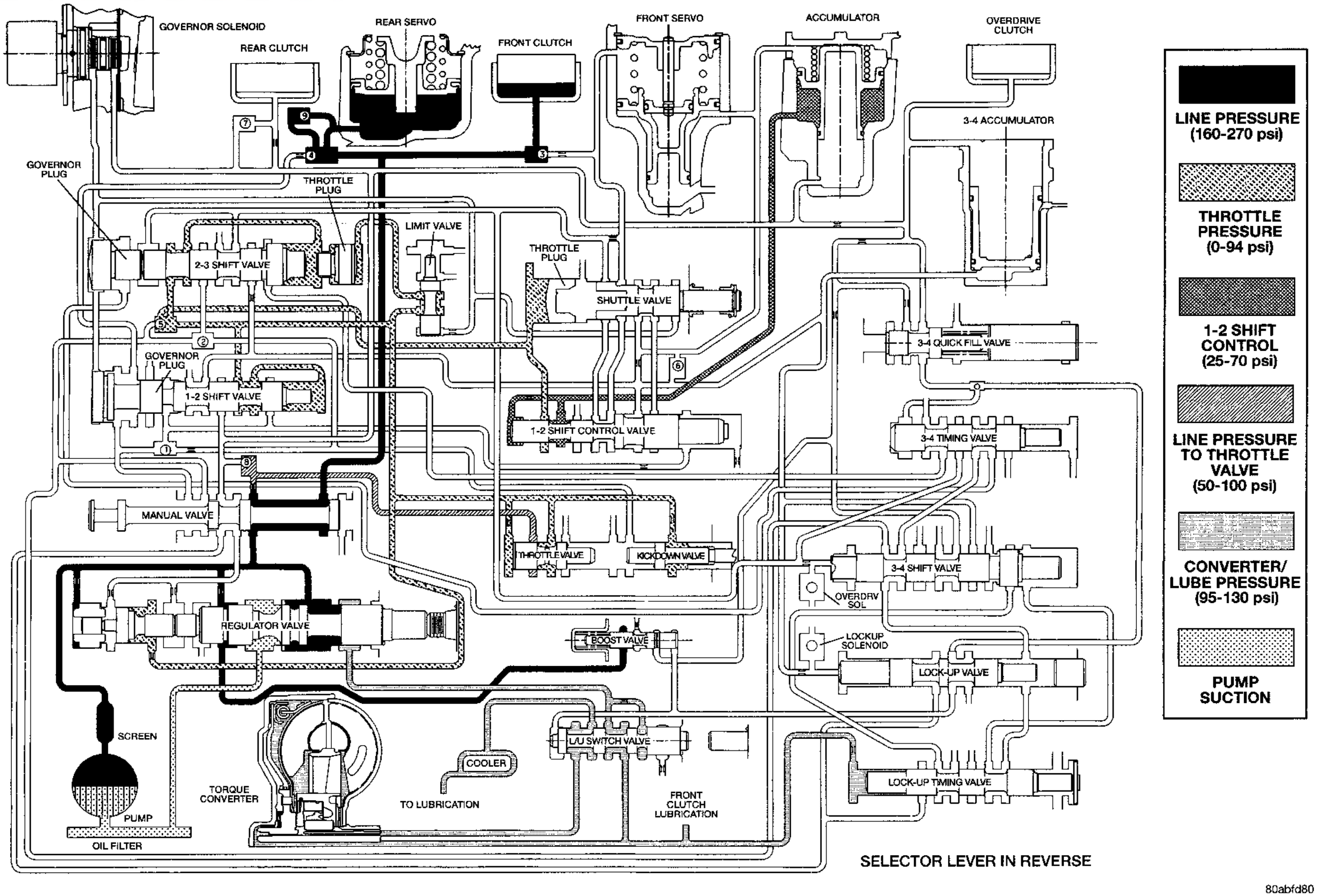

HYDRAULIC FLOW IN REVERSE

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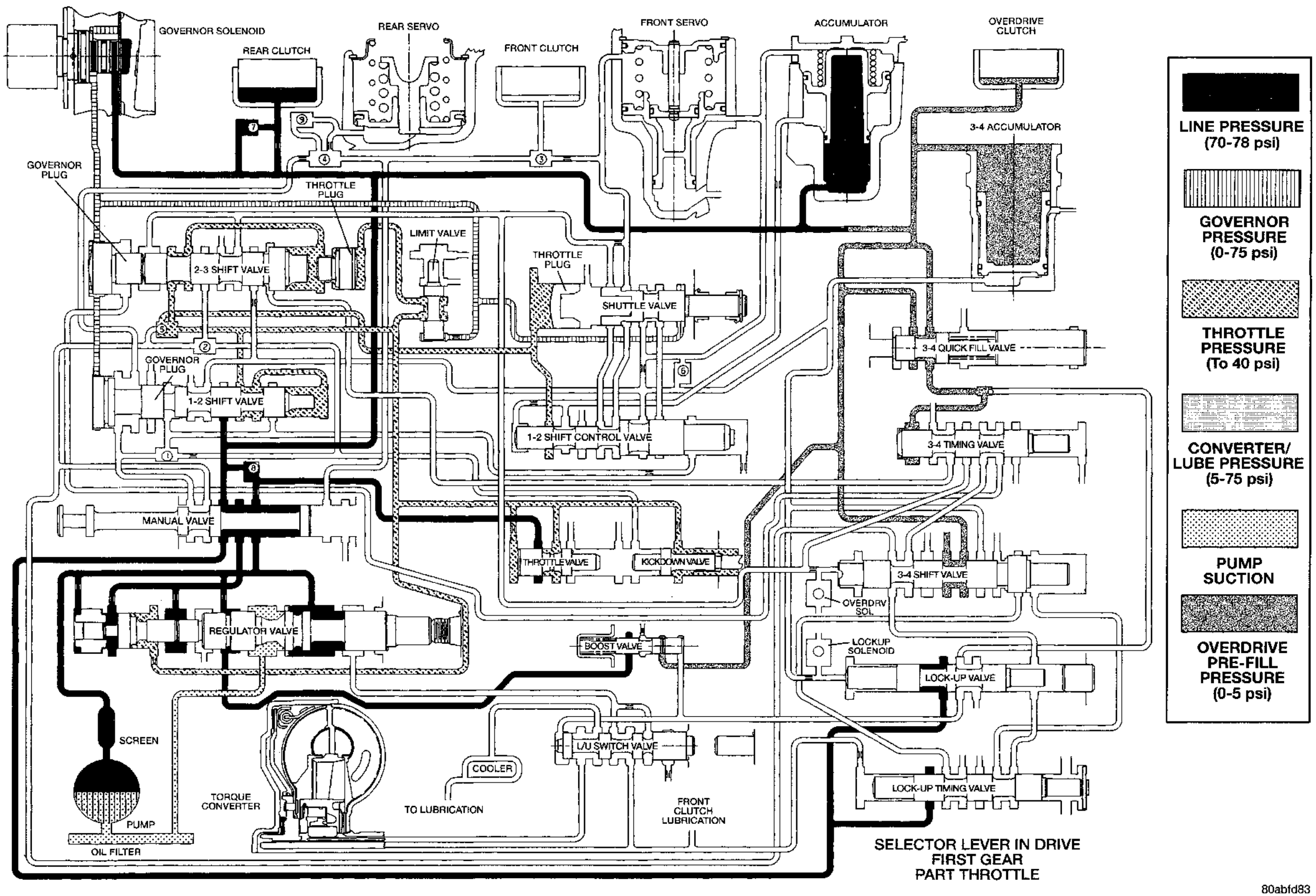

HYDRAULIC FLOW IN DRIVE FIRST GEAR

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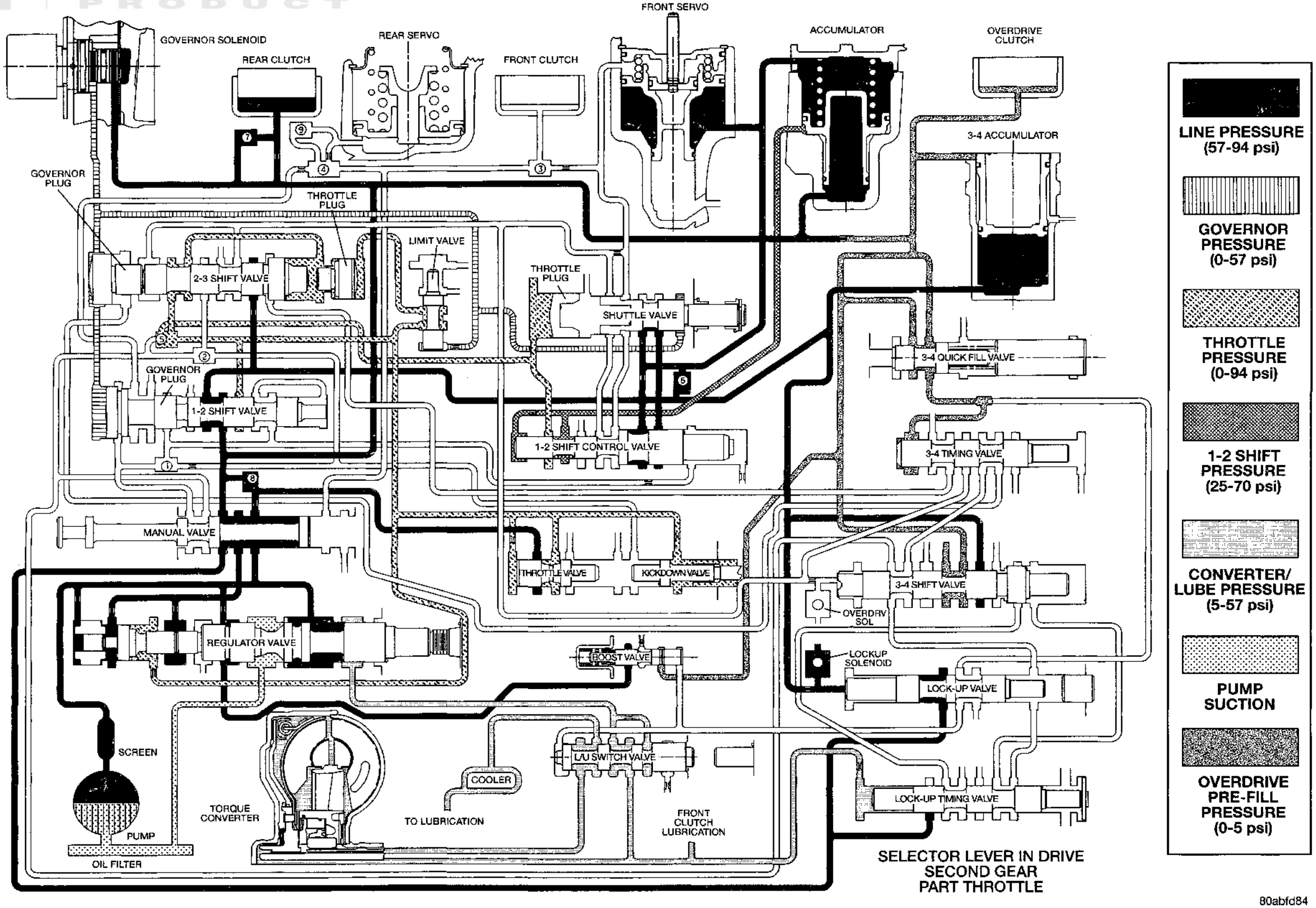

HYDRAULIC FLOW IN DRIVE SECOND GEAR

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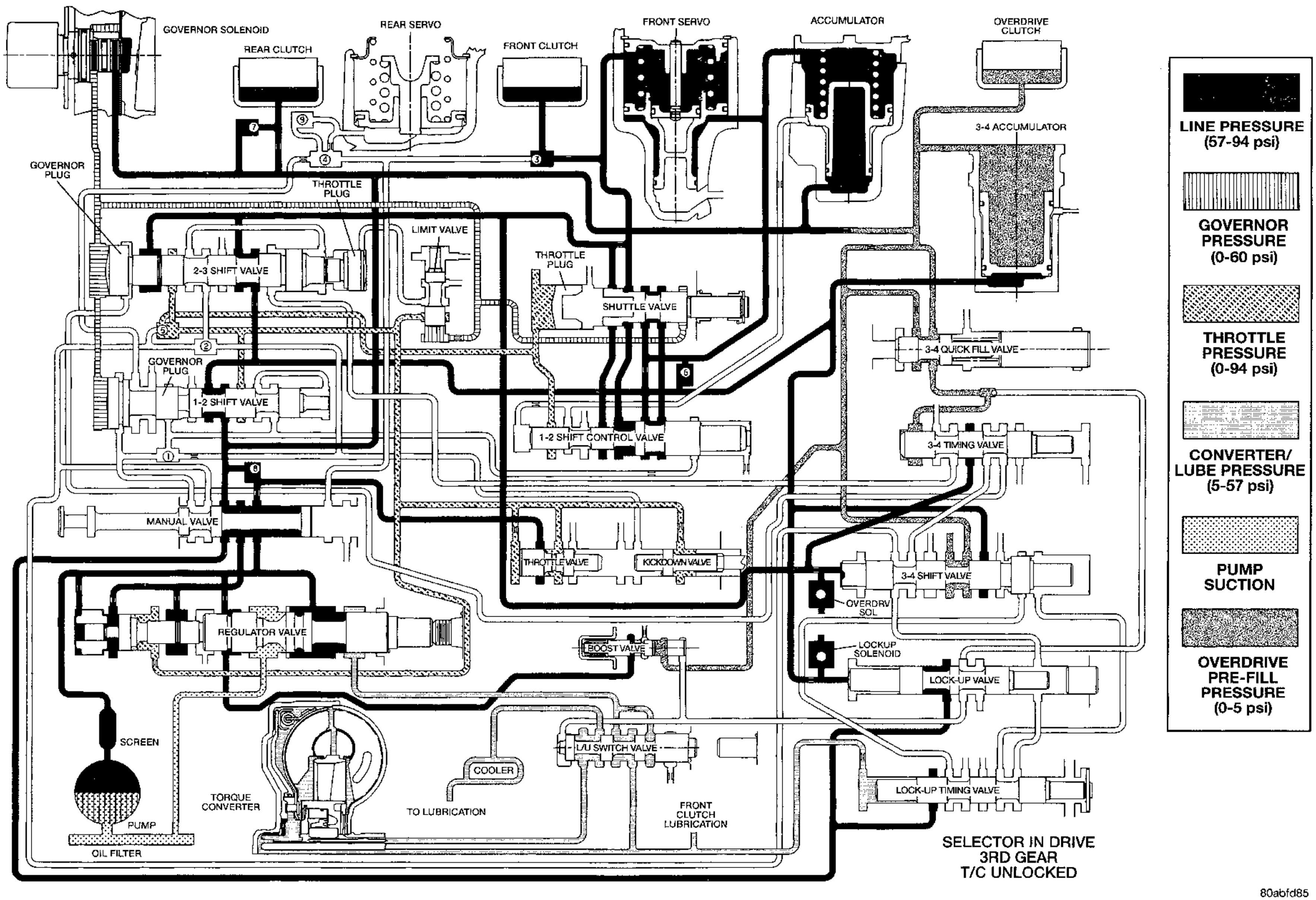

HYDRAULIC FLOW IN DRIVE THIRD GEAR (CONVERTER CLUTCH NOT APPLIED)

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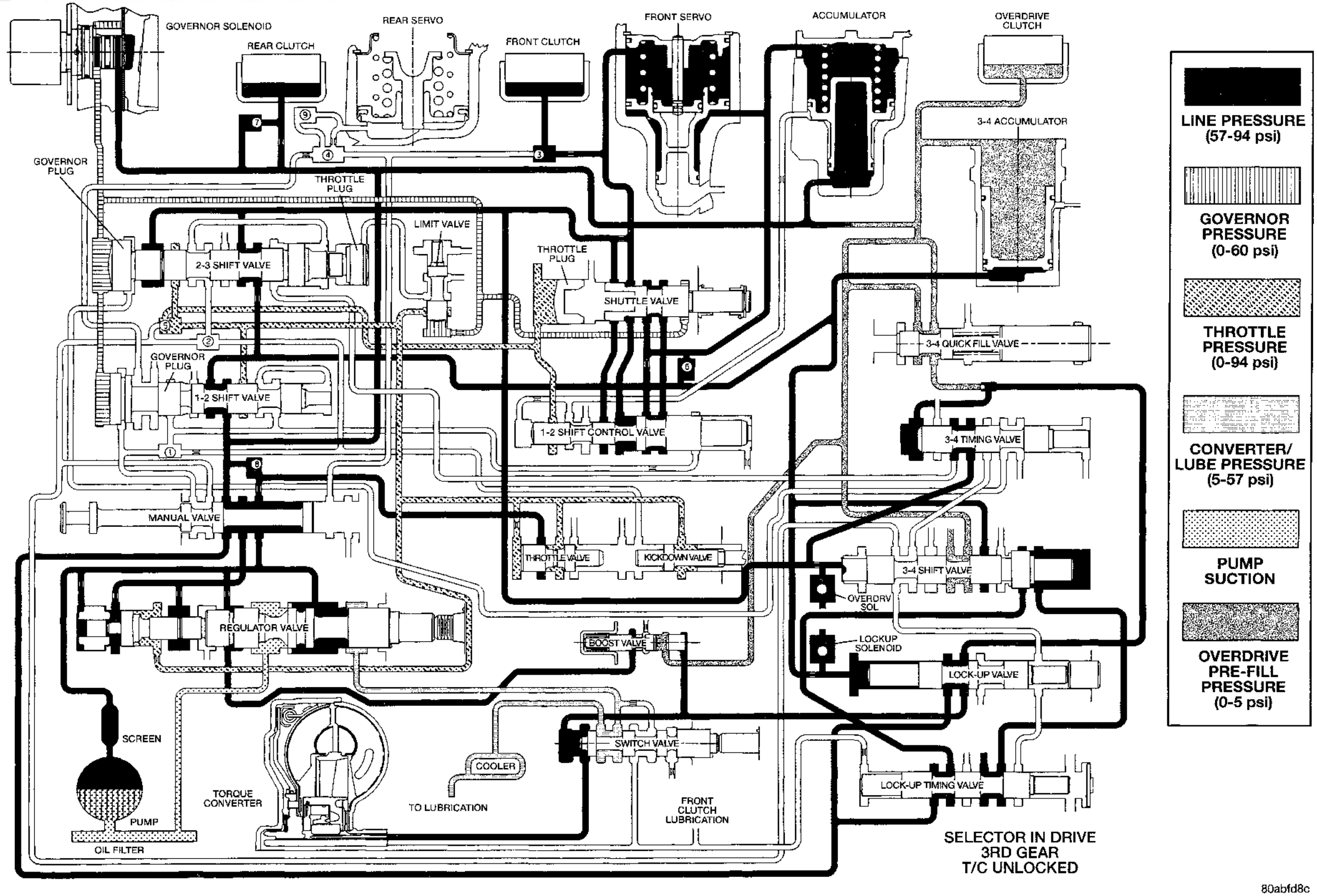

HYDRAULIC FLOW IN DRIVE THIRD GEAR (CONVERTER CLUTCH APPLIED)

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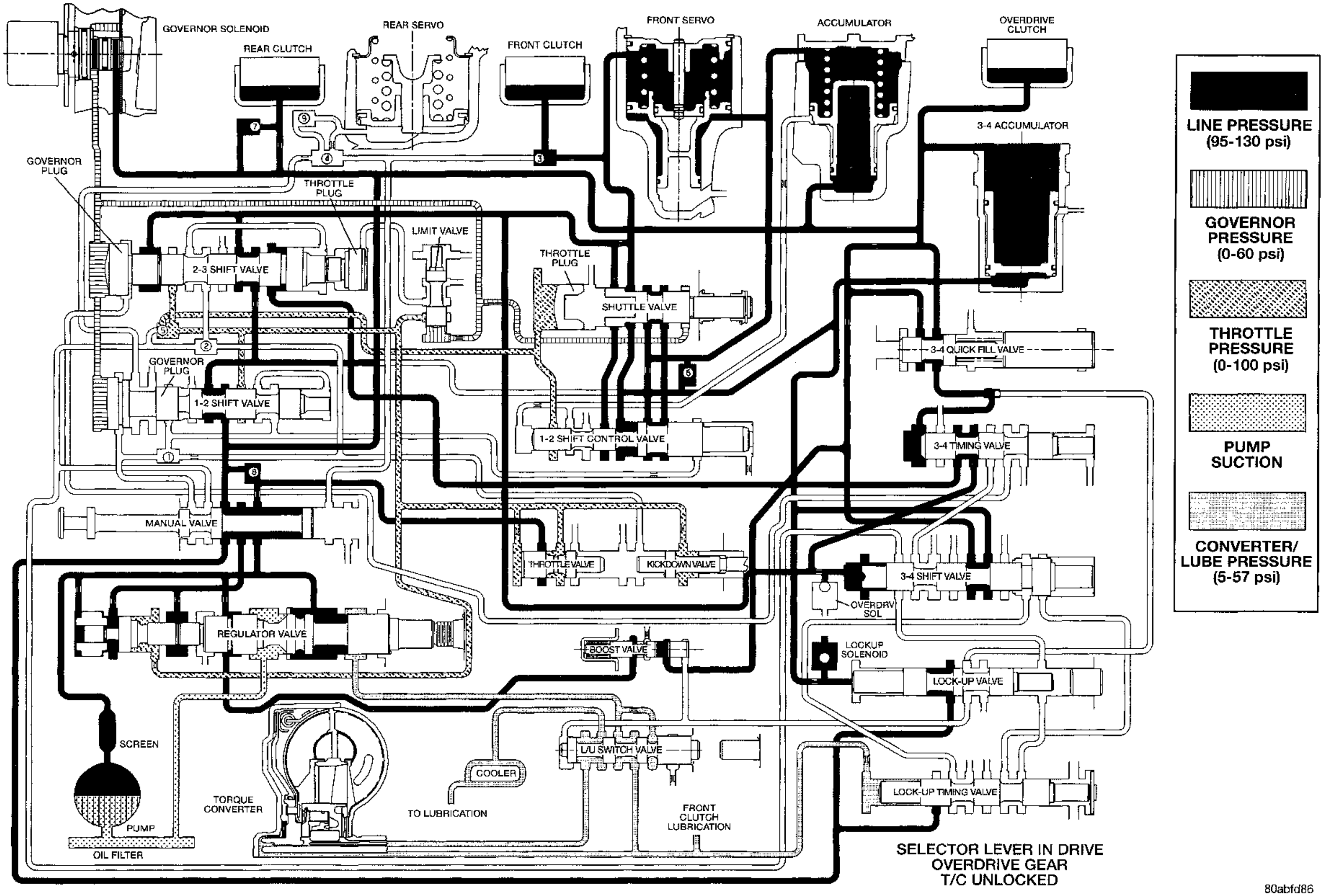

HYDRAULIC FLOW IN DRIVE FOURTH GEAR (CONVERTER CLUTCH NOT APPLIED)

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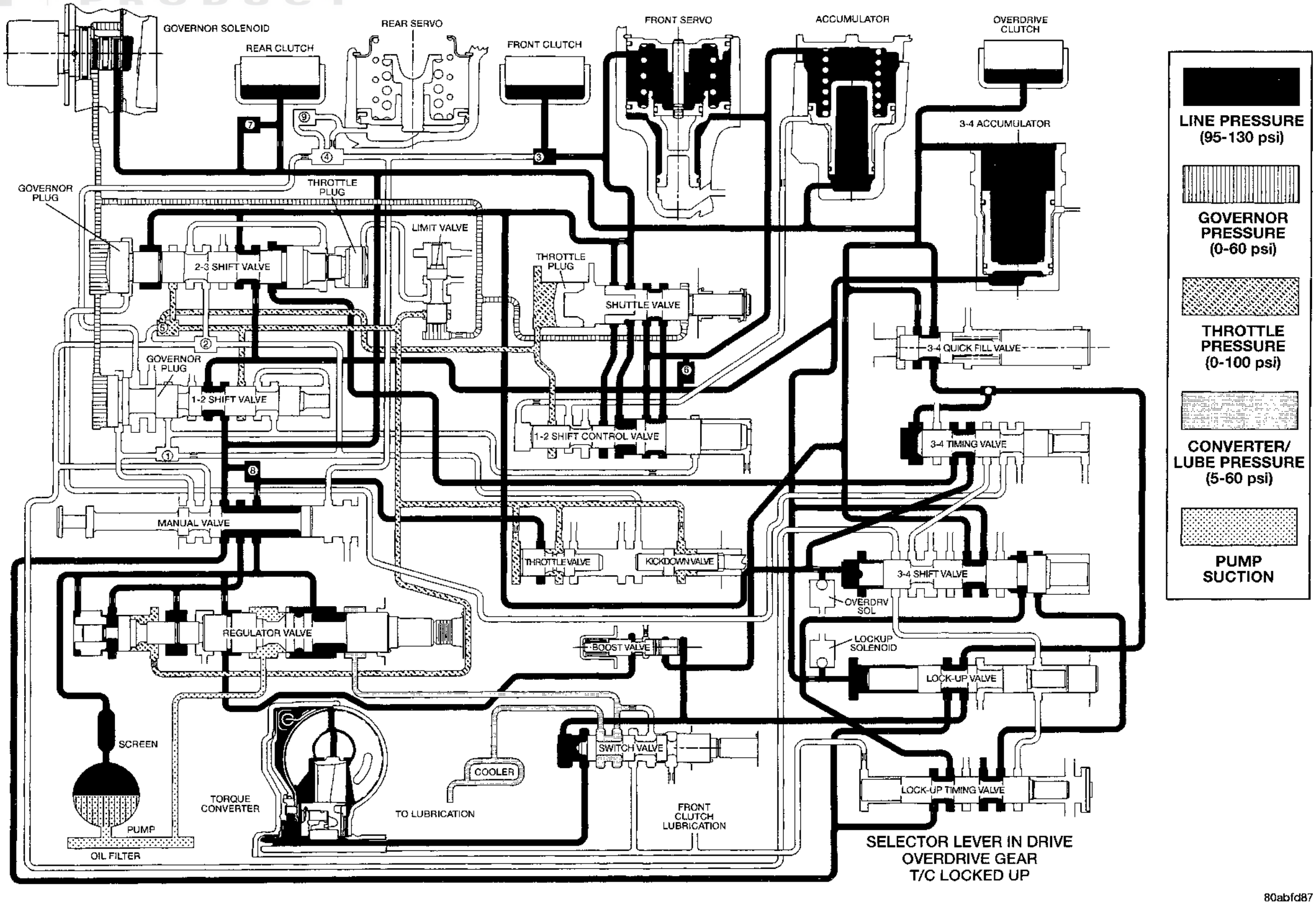
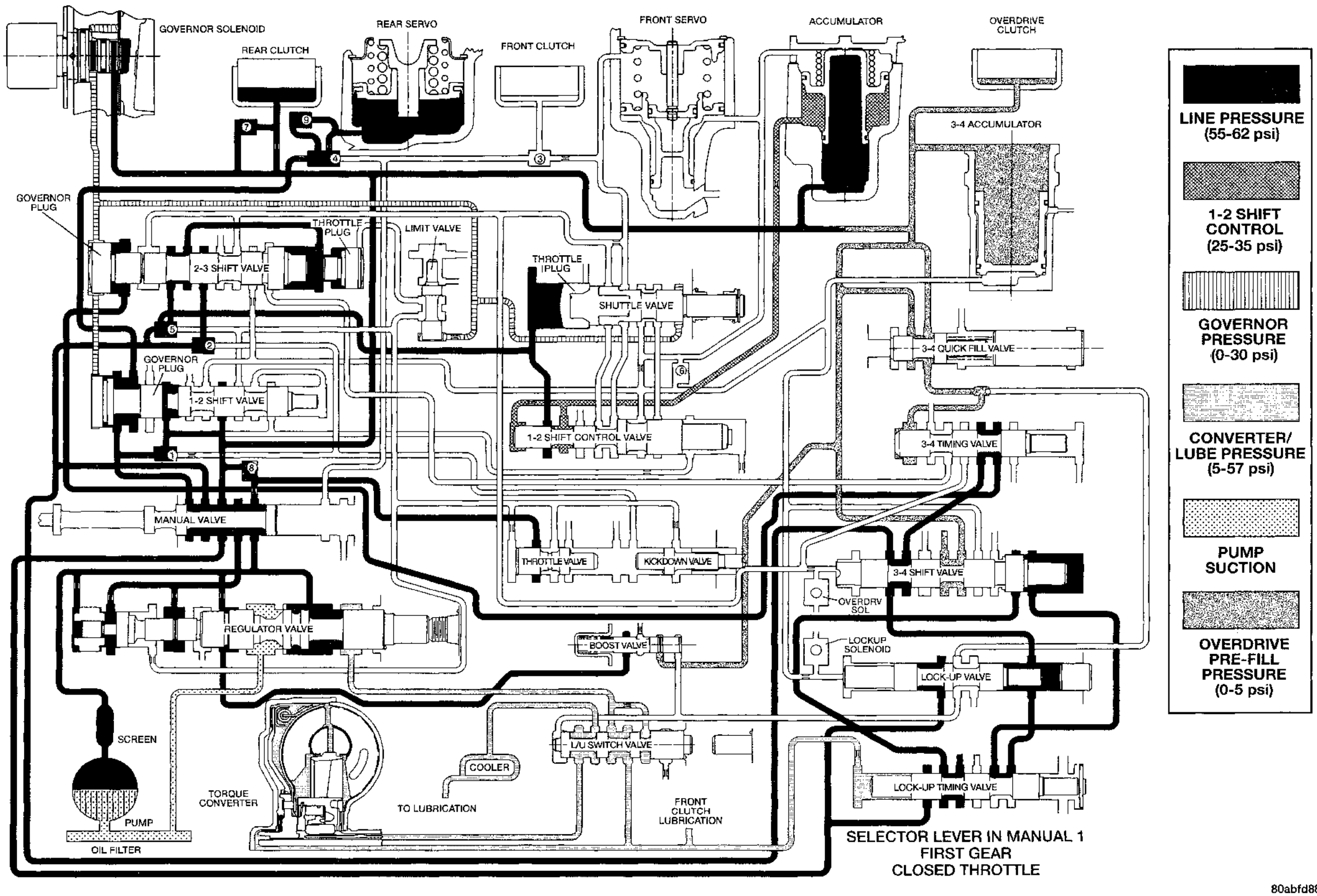


HYDRAULIC FLOW IN DRIVE FOURTH GEAR (CONVERTER CLUTCH APPLIED)

Mopar AUTHENTIC RESTORATION PRODUCT



HYDRAULIC FLOW IN MANUAL LOW (1)

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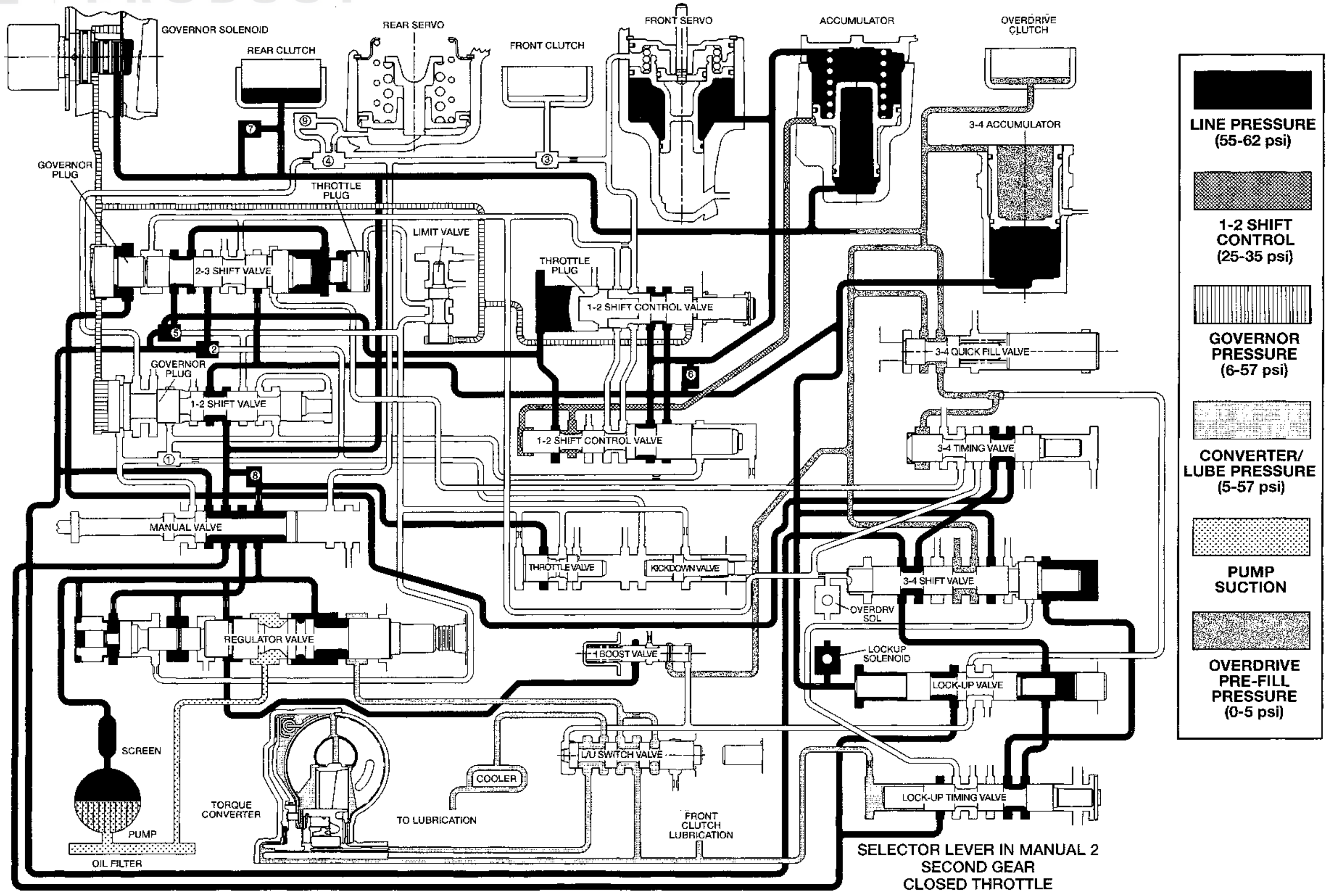

HYDRAULIC FLOW IN MANUAL SECOND (2)

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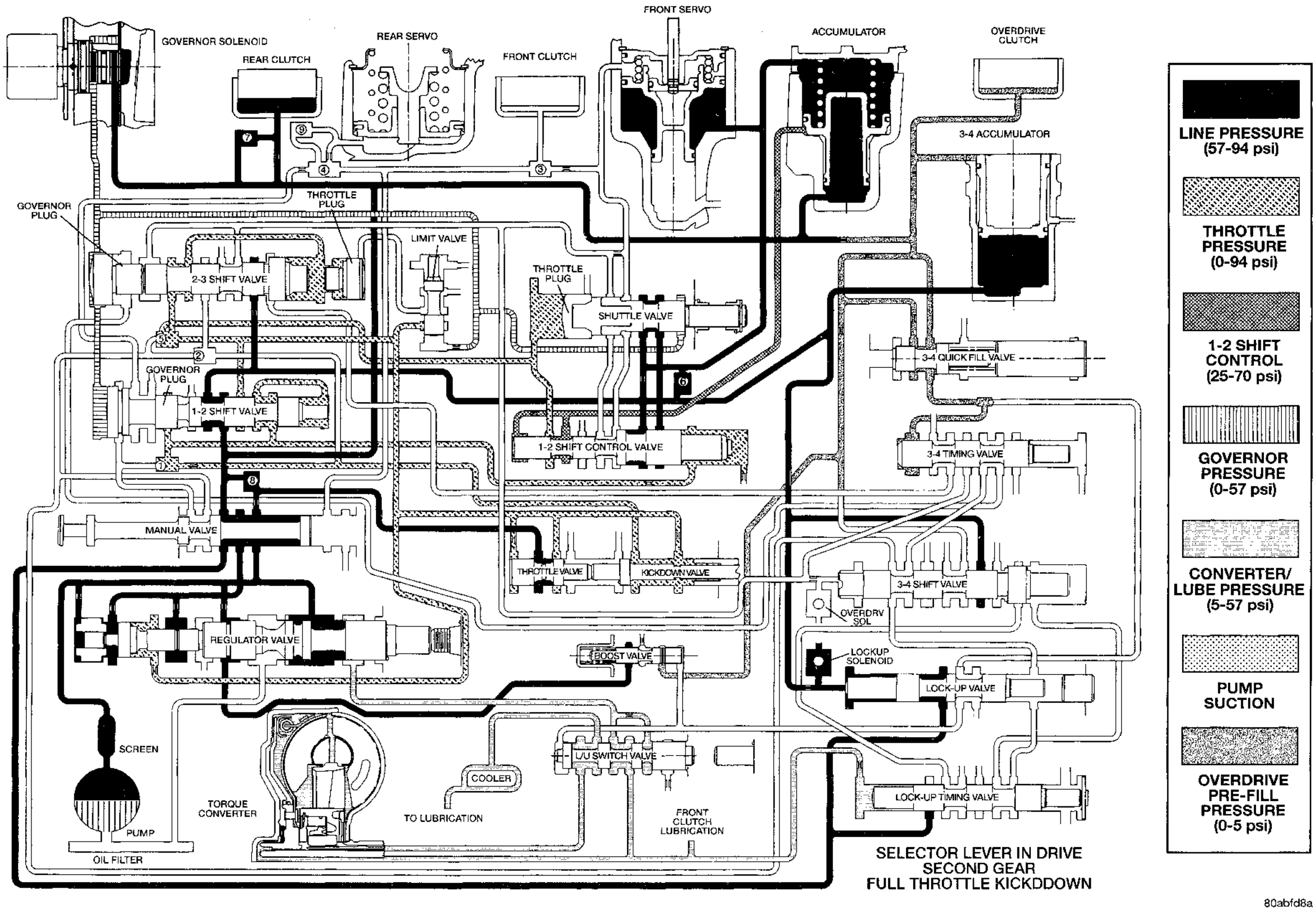

HYDRAULIC FLOW DURING FULL THROTTLE 3–2 DOWNSHIFT (PASSING GEAR)

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SPECIFICATIONS

TRANSMISSION

GENERAL

Component	Metric	Inch
Planetary end play	0.127-1.22 mm	0.005-0.048 in.
Input shaft end play	0.56-2.31 mm	0.022-0.091 in.
Clutch pack clearance/Front.	1.70-3.40mm	0.067-0.134 in.
Clutch pack clearance/Rear.	0.81-1.40 mm	0.022-0.037 in.
Front clutch	4 discs	
Rear clutch	4 discs	
Overdrive clutch	3 discs	
Direct clutch	6 discs	
42RE Band adjustment from 72 in. lbs.		
Front band	Back off 3-5/8 turns	
Rear band	Back off 4 turns	
Recommended fluid	Mopar® ATF Plus 3,type 7176	

GEAR RATIOS

- 1ST GEAR-2.74
- 2ND GEAR-1.54
- 3RD GEAR-1.00
- 4TH GEAR-0.69
- REV.GEAR-2.21

TORQUE

DESCRIPTION	TORQUE
Fitting, cooler line at trans	18 N·m (13 ft. lbs.)
Bolt, torque convertor	31 N·m (23 ft. lbs.)
Bolt/nut, crossmember	68 N·m (50 ft. lbs.)
Bolt, driveplate to crankshaft	75 N·m (55 ft. lbs.)
Plug, front band reaction	17 N·m (13 ft. lbs.)
Locknut, front band adj.	34 N·m (25 ft. lbs.)
Switch, park/neutral	34 N·m (25 ft. lbs.)
Bolt, fluid pan	17 N·m (13 ft. lbs.)
Screws, fluid filter	4 N·m (35 in. lbs.)
Bolt, oil pump	20 N·m (15 ft. lbs.)
Bolt, overrunning clutch cam	17 N·m (13 ft. lbs.)
Bolt, O/D to trans.	34 N·m (25 ft. lbs.)
Bolt, O/D piston retainer	17 N·m (13 ft. lbs.)
Plug, pressure test port	14 N·m (10 ft. lbs.)
Bolt, reaction shaft support	20 N·m (15 ft. lbs.)
Locknut, rear band	41 N·m (30 ft. lbs.)
Bolt. speedometer adapter	11 N·m (8 ft. lbs.)
Bolt, valve body to case	12 N·m (100 in. lbs.)
Sensor, trans speed	27 N·m (20 ft. lbs.)
Screw, solenoid wiring connector	4 N·m (35 in. lbs.)
Screw, solenoid to transfer plate	4 N·m (35 in. lbs.)

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SPECIFICATIONS (Continued)

THRUST WASHER/SPACER/SNAP RING DIMENSIONS

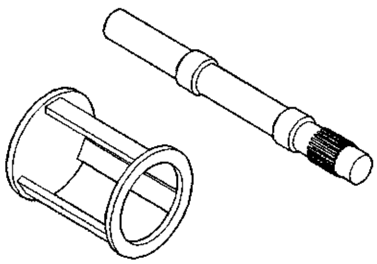
Component	Metric	Inch
Front clutch thrust washer (reaction shaft support hub)	1.55 mm	0.061 in.
Rear clutch thrust washer (clutch retainer)	1.55 mm	0.061 in.
Intermediate shaft thrust plate (shaft hub pilot)	1.5-1.6 mm	0.060-0.063 in.
Output shaft thrust washer (rear clutch hub)	Select fit to set end play	
Rear clutch pack snap ring	1.5 mm	0.060 in.
	1.95 mm	0.076 in.
	2.45 mm	0.098 in.
Planetary geartrain snap ring (at front of output shaft)	Select fit (three thicknesses avalible)	
Overdrive piston thrust plate	Thrust plate and spacer are select fit. Refer to size charts and selection procedures in Overdrive Unit D&A procedures	
Intermiediate shaft spacer		

PRESSURE TEST

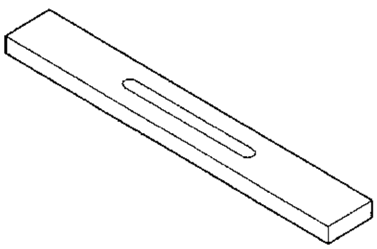
Overdrive clutch	Fourth gear only	Pressure should be 469-496 kPa (68-72 psi) with closed throttle and increase to 620-896 kPa (90-130 psi) at 1/2 to 3/4 throttle.
Line pressure (at accumulator)	Closed throttle	372-414 kPa (54-60 psi).
Front servo	Third gear only	No more than 21 kPa (3 psi) lower than line pressure.
Rear servo	1 range	No more than 21 kPa (3 psi) lower than line pressure.
	R range	1103 kPa (160 psi) at idle, builds to 1862 kPa (270 psi) at 1600 rpm.
Governor	D range closed throttle	Pressure should respond smoothly to changes in mph and return to 0-7 kPa (0-1.5 psi) when stopped with transmission in D, 1, 2. Pressure above 7 kPa (1.5 psi) at stand still will prevent transmission from downshifting.

SPECIAL TOOLS

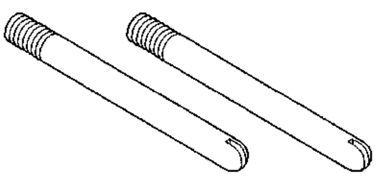
RE TRANSMISSIONS



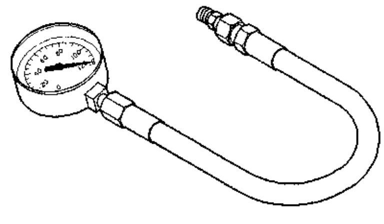
Spring Compressor and Alignment Shaft—6227



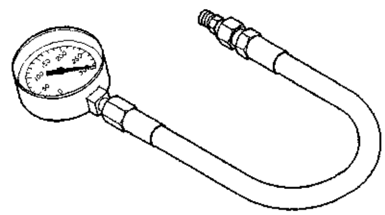
Gauge Bar—6311



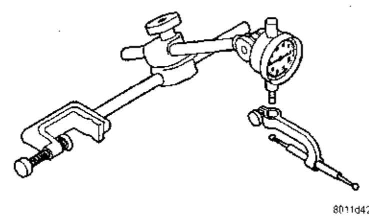
Extension Housing Pilot—C-3288-B



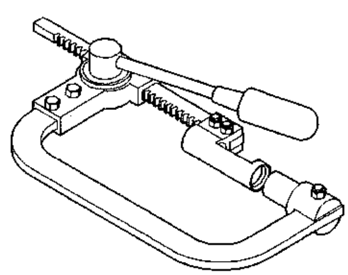
Pressure Gauge—C-3292



Pressure Gauge—C-3293SP

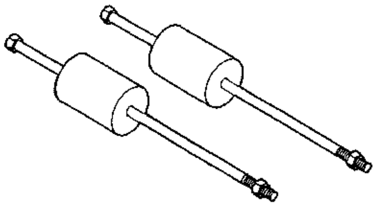


Dial Indicator—C-3339

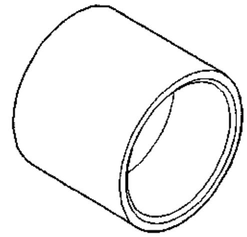


Spring Compressor—C-3422-B

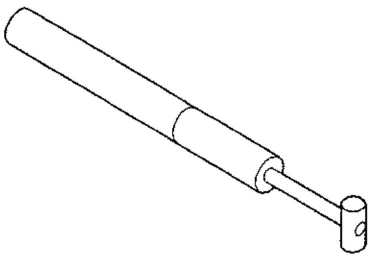
SPECIAL TOOLS (Continued)



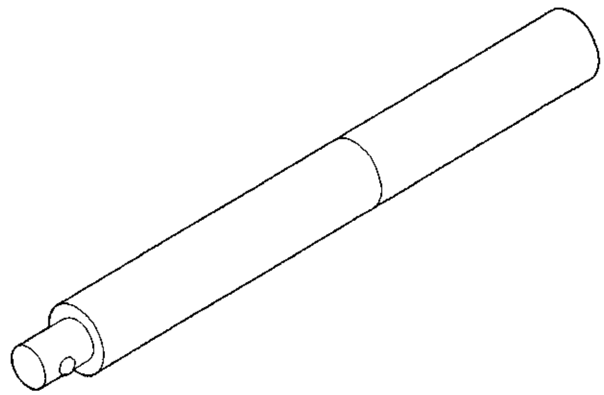
Puller, Slide Hammer—C-3752



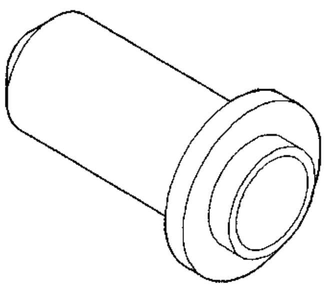
Installer—C-3995-A



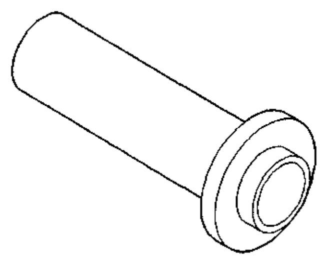
Gauge, Throttle Setting—C-3763



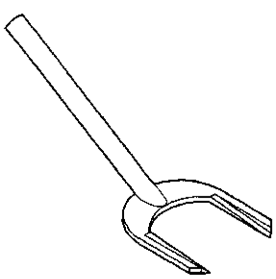
Universal Handle—C-4171



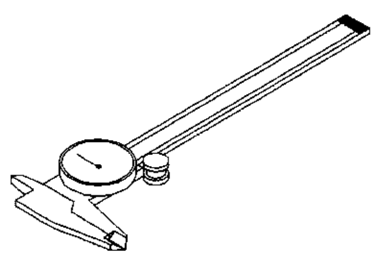
Seal Installer—C-3860–A



Seal Installer—C-4193-A

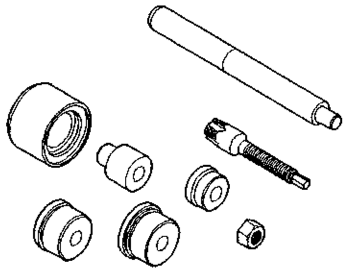


Seal Remover—C-3985-B

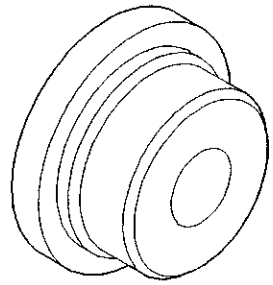


Dial Caliper—C-4962

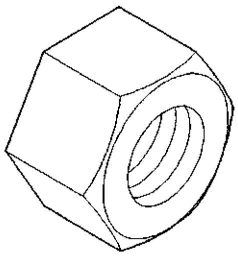
SPECIAL TOOLS (Continued)



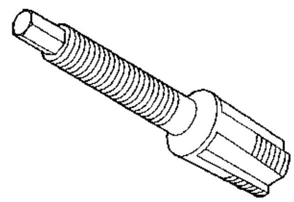
Bushing Remover/Installer Set—C-3887-J



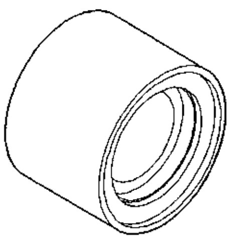
Installer, Bushing—SP-5117



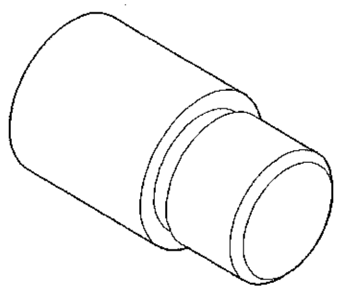
Nut, Bushing Remover—SP-1191, From kit C-3887-J



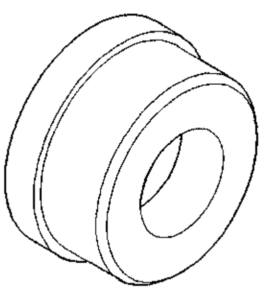
Remover, Bushing—SP-5324



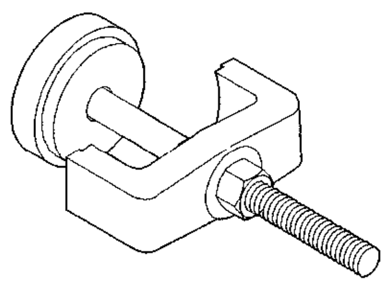
Cup, Bushing Remover—SP-3633, From kit C-3887-J



Installer, Bushing—SP-5325



Remover, Bushing—SP-3551



Compressor, Spring—C-3575-A

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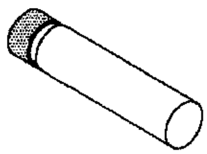
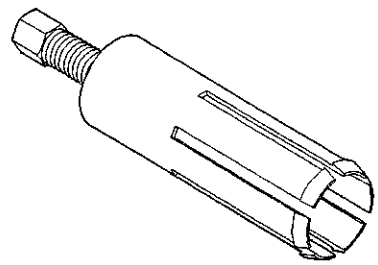
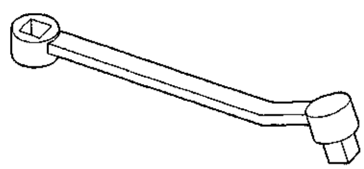
SPECIAL TOOLS (Continued)



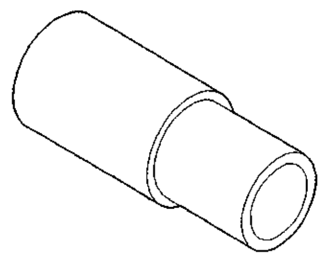
Gauge—6312



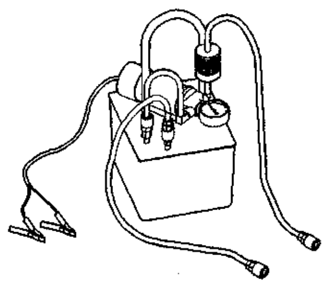
Remover—6957



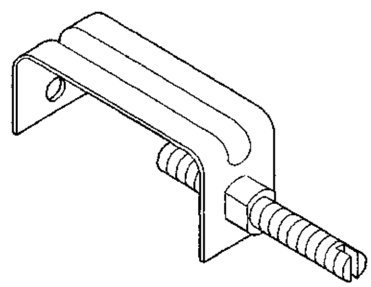
Adapter—C-3705



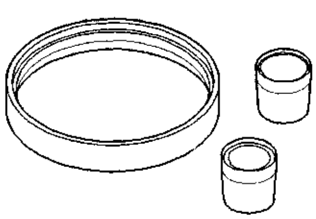
Installer—6951



Flusher—6906



Retainer—6583



Installer—8114

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AUTOMATIC TRANSMISSION—46/47RE

INDEX

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GENERAL INFORMATION

46/47RE TRANSMISSION

The 46/47RE transmissions are four speed fully automatic transmissions with an electronic governor (Fig. 1) and (Fig. 2). First through third gear ranges are provided by the clutches, bands, overrunning clutch, and planetary gear sets in the transmission. Fourth gear range is provided by the overdrive unit that contains an overdrive clutch, direct clutch, planetary gear set, and overrunning clutch. The overdrive clutch is applied in fourth gear only. The direct clutch is applied in all ranges except fourth gear. The transmissions are equipped with a lock-up clutch in the torque converter. The torque converter clutch is controlled by the Powertrain Control Module (PCM). The torque converter clutch is hydraulically applied and is released when fluid is vented from the hydraulic circuit by the torque converter control (TCC) solenoid on the valve body. The torque converter clutch engages in fourth gear, and in third gear when the O/D switch is OFF. Engagement occurs when the vehicle is cruising on a level plane after the vehicle has warmed up. The torque converter clutch disengages when the vehicle begins to go uphill or the accelerator is applied. The torque converter clutch feature increases fuel economy and reduces the transmission fluid temperature. Both transmissions are cooled by an integral fluid cooler inside the radiator.

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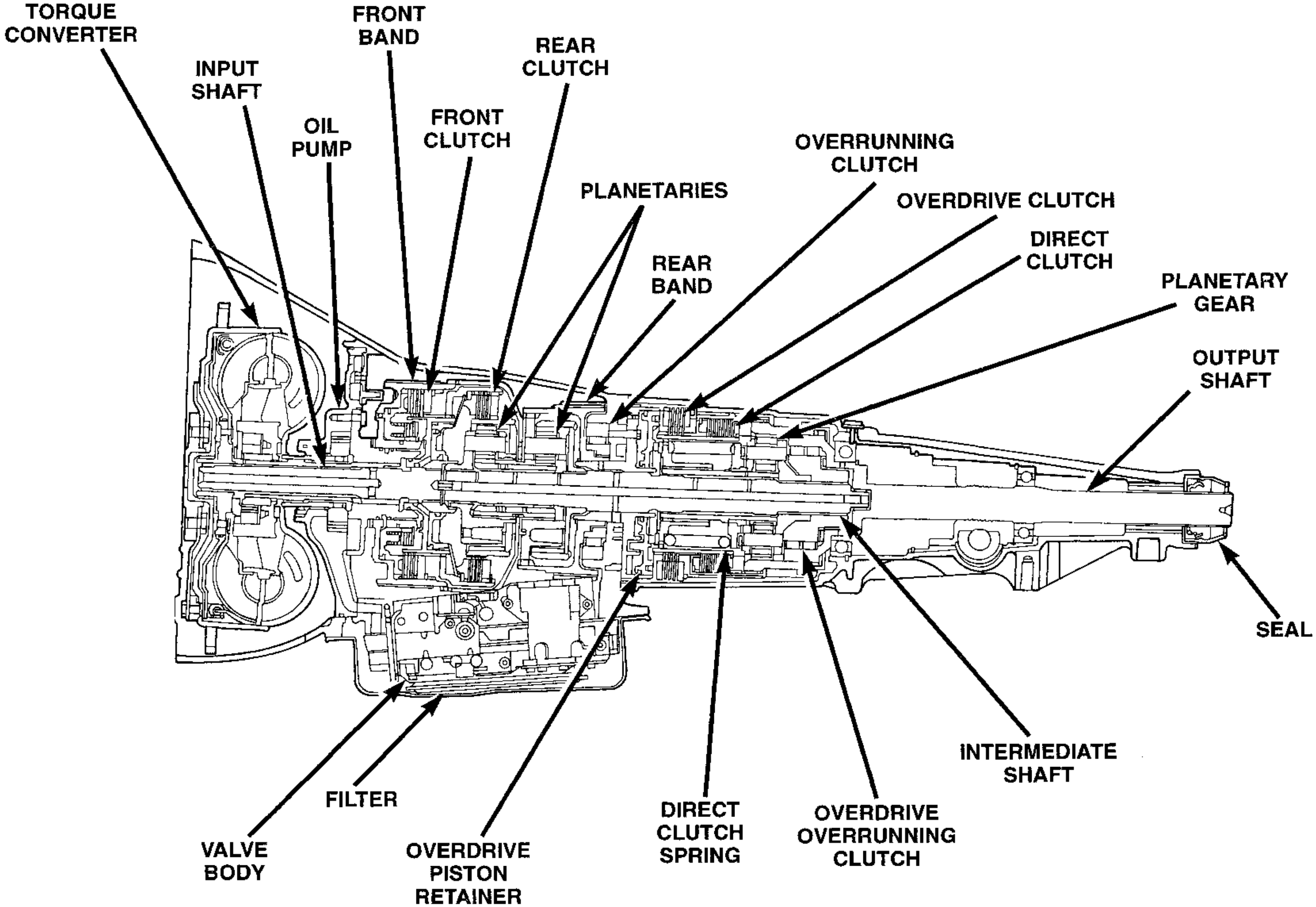

Fig. 1 46RE Transmission

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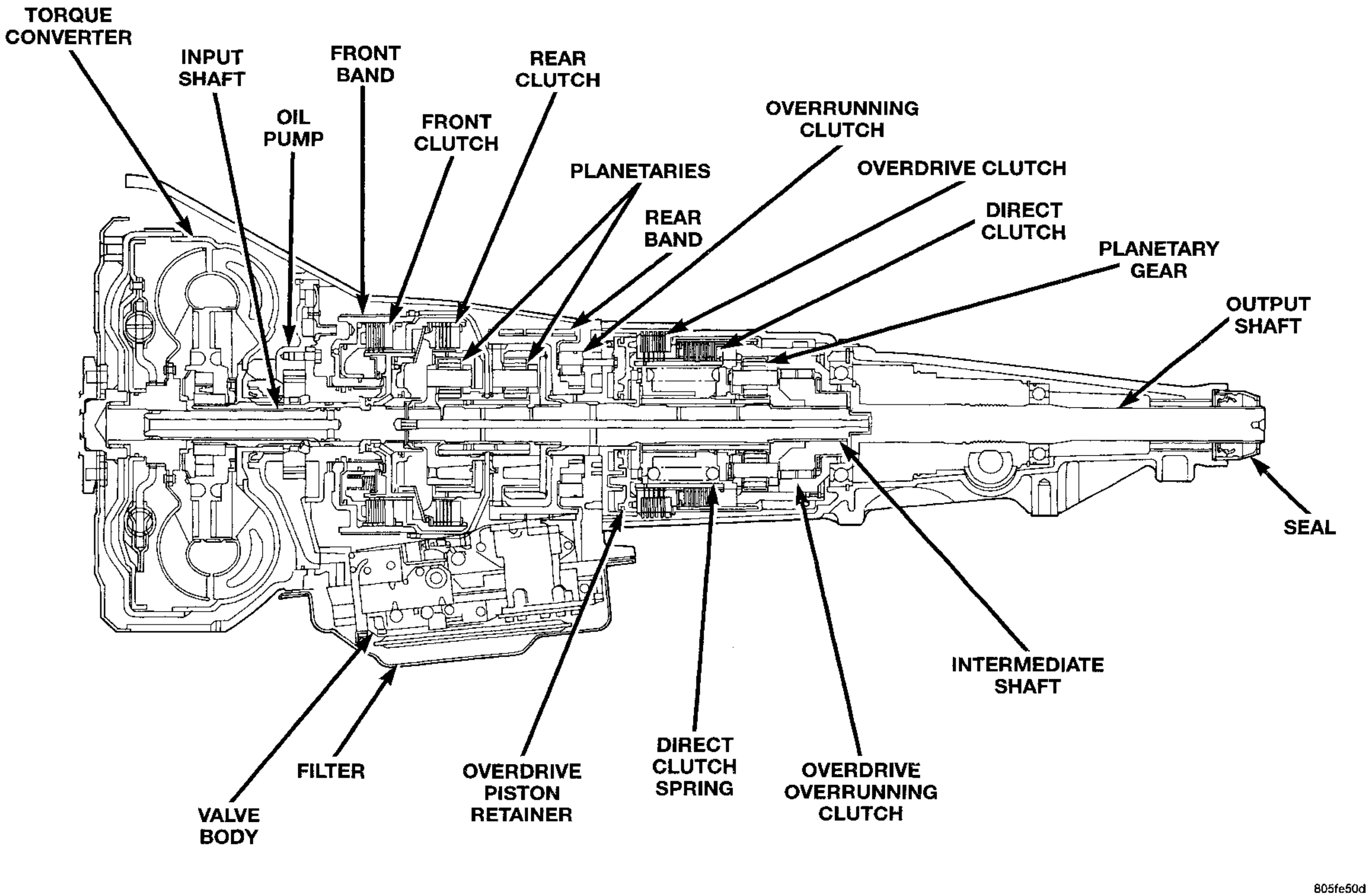

Fig. 2 47RE Transmission

GENERAL INFORMATION (Continued)

TRANSMISSION IDENTIFICATION

Transmission identification numbers are stamped on the left side of the case just above the oil pan gasket surface (Fig. 3). Refer to this information when ordering replacement parts.

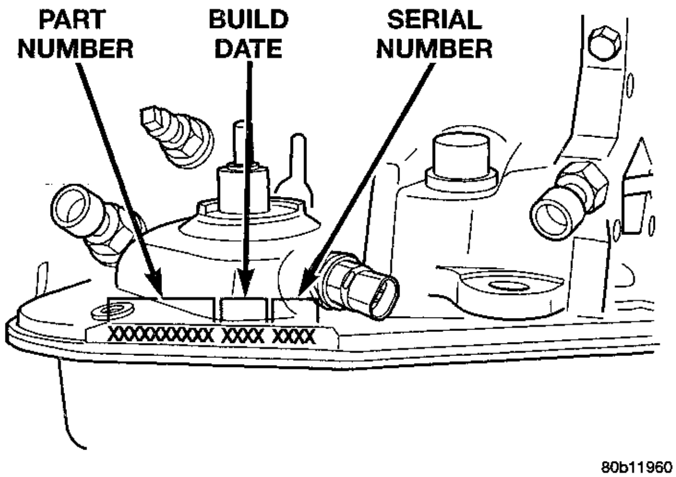

Fig. 3 Transmission Part And Serial Number Location

RECOMMENDED FLUID

Mopar® ATF Plus 3, Type 7176 automatic transmission fluid is the recommended fluid for Chrysler automatic transmissions.

Dexron II fluid IS NOT recommended. Clutch chatter can result from the use of improper fluid.

EFFECTS OF INCORRECT FLUID LEVEL

A low fluid level allows the pump to take in air along with the fluid. Air in the fluid will cause fluid pressures to be low and develop slower than normal. If the transmission is overfilled, the gears churn the fluid into foam. This aerates the fluid and causing the same conditions occurring with a low level. In either case, air bubbles cause fluid overheating, oxidation and varnish buildup which interferes with valve, clutch and servo operation. Foaming also causes fluid expansion which can result in fluid overflow from the transmission vent or fill tube. Fluid overflow can easily be mistaken for a leak if inspection is not careful.

CAUSES OF BURNT FLUID

Burnt, discolored fluid is a result of overheating which has two primary causes.

(1) A result of restricted fluid flow through the main and/or auxiliary cooler. This condition is usually the result of a faulty or improperly installed drainback valve, a damaged main cooler, or severe restrictions in the coolers and lines caused by debris or kinked lines.

(2) Heavy duty operation with a vehicle not properly equipped for this type of operation. Trailer towing or similar high load operation will overheat the transmission fluid if the vehicle is improperly equipped. Such vehicles should have an auxiliary transmission fluid cooler, a heavy duty cooling system, and the engine/axle ratio combination needed to handle heavy loads.

FLUID CONTAMINATION

Transmission fluid contamination is generally a result of:

- adding incorrect fluid
- failure to clean dipstick and fill tube when checking level
- engine coolant entering the fluid
- internal failure that generates debris
- overheat that generates sludge (fluid breakdown)
- failure to reverse flush cooler and lines after repair
- failure to replace contaminated converter after repair

The use of non recommended fluids can result in transmission failure. The usual results are erratic shifts, slippage, abnormal wear and eventual failure due to fluid breakdown and sludge formation. Avoid this condition by using recommended fluids only.

The dipstick cap and fill tube should be wiped clean before checking fluid level. Dirt, grease and other foreign material on the cap and tube could fall into the tube if not removed beforehand. Take the time to wipe the cap and tube clean before withdrawing the dipstick.

Engine coolant in the transmission fluid is generally caused by a cooler malfunction. The only remedy is to replace the radiator as the cooler in the radiator is not a serviceable part. If coolant has circulated through the transmission for some time, an overhaul may also be necessary; especially if shift problems had developed.

The transmission cooler and lines should be reverse flushed whenever a malfunction generates sludge and/or debris. The torque converter should also be replaced at the same time.

Failure to flush the cooler and lines will result in recontamination. Flushing applies to auxiliary coolers as well. The torque converter should also be replaced whenever a failure generates sludge and debris. This is necessary because normal converter flushing procedures will not remove all contaminants.

ELECTRONIC LOCK-UP TORQUE CONVERTER

The torque converter is a hydraulic device that couples the engine crankshaft to the transmission.

GENERAL INFORMATION (Continued)

The torque converter consists of an outer shell with an internal turbine, a stator, an overrunning clutch, an impeller, and an electronically applied converter clutch. Torque multiplication is created when the stator directs the hydraulic flow from the turbine to rotate the impeller in the direction the engine crankshaft is turning. The turbine transfers power to the planetary gear sets in the transmission. The transfer of power into the impeller assists torque multiplication. At low vehicle-speed, the overrunning clutch holds the stator stationary (during torque multiplication) and allows the stator to freewheel at high vehicle speed. The converter clutch engagement reduces engine speed. Clutch engagement also provides reduced transmission fluid temperatures. The torque converter hub drives the transmission oil (fluid) pump.

The torque converter is a sealed, welded unit that is not repairable and is serviced as an assembly.

CAUTION: The torque converter must be replaced if a transmission failure results in large amounts of metal or fiber contamination in the fluid.

TRANSMISSION GEAR RATIOS

46/47RE gear ratios are:

- 2.45:1 (first gear)
- 1.45:1 (second gear)
- 1.00:1 (third gear)
- 0.69:1 (fourth gear)
- 2.21 (reverse)

GEARSHIFT MECHANISM

The gear shift mechanism provides six shift positions which are:

- park (P)
- reverse (R)
- neutral (N)
- drive (D)
- manual second (2)
- manual low (1)

Manual low (1) range provides first gear only. Overrun braking is also provided in this range. Manual second (2) range provides first and second gear only.

Drive range provides first, second third and overdrive fourth gear ranges. The shift into overdrive fourth gear range occurs only after the transmission has completed the shift into D third gear range. No further movement of the shift mechanism is required to complete the 3-4 shift.

The fourth gear upshift occurs automatically when the overdrive selector switch is in the ON position.

DESCRIPTION AND OPERATION

ELECTRONIC GOVERNOR

Governor pressure is controlled electronically. Components used for governor pressure control include:

- Governor body
- Valve body transfer plate
- Governor pressure solenoid valve
- Governor pressure sensor
- Fluid temperature thermistor
- Throttle position sensor (TPS)
- Transmission speed sensor
- Powertrain control module (PCM)

GOVERNOR PRESSURE SOLENOID VALVE

The solenoid valve is a duty-cycle solenoid which regulates the governor pressure needed for upshifts and downshifts. It is an electro-hydraulic device located in the governor body on the valve body transfer plate (Fig. 4).

The inlet side of the solenoid valve is exposed to normal transmission line pressure. The outlet side of the valve leads to the valve body governor circuit.

The solenoid valve regulates line pressure to produce governor pressure. The average current supplied to the solenoid controls governor pressure. One amp current produces zero kPa/psi governor pressure. Zero amps sets the maximum governor pressure.

The powertrain control module (PCM) turns on the trans control relay which supplies electrical power to the solenoid valve. Operating voltage is 12 volts (DC). The PCM controls the ground side of the solenoid using the governor pressure solenoid control circuit.

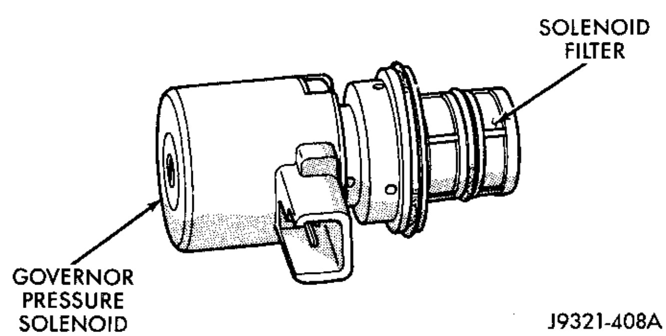

Fig. 4 Governor Pressure Solenoid Valve

GOVERNOR PRESSURE SENSOR

The governor pressure sensor measures output pressure of the governor pressure solenoid valve (Fig. 5).

The sensor output signal provides the necessary feedback to the PCM. This feedback is needed to adequately control governor pressure.

DESCRIPTION AND OPERATION (Continued)

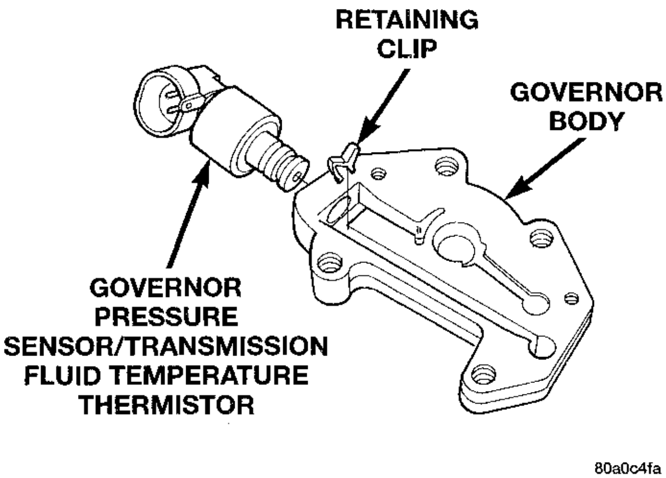

Fig. 5 Governor Pressure Sensor

GOVERNOR BODY AND TRANSFER PLATE

The transfer plate is designed to supply transmission line pressure to the governor pressure solenoid valve and to return governor pressure.

The governor pressure solenoid valve is mounted in the governor body. The body is bolted to the lower side of the transfer plate (Fig. 5). The transfer plate channels line pressure to the solenoid valve through the governor body. It also channels governor pressure from the solenoid valve to the governor circuit. It is the solenoid valve that develops the necessary governor pressure.

TRANSMISSION FLUID TEMPERATURE THERMISTOR

Transmission fluid temperature readings are supplied to the transmission control module by the thermistor. The temperature readings are used to control engagement of the fourth gear overdrive clutch, the converter clutch, and governor pressure. Normal resistance value for the thermistor at room temperature is approximately 1000 ohms.

The PCM prevents engagement of the converter clutch and overdrive clutch, when fluid temperature is below approximately 10°C (50°F).

If fluid temperature exceeds 126°C (260°F), the PCM causes a 4-3 downshift and engage the converter clutch. Engagement is according to the third gear converter clutch engagement schedule.

The overdrive OFF lamp in the instrument panel illuminates when the shift back to third occurs. The transmission will not allow fourth gear operation until fluid temperature decreases to approximately 110°C (230°F).

The thermistor is part of the governor pressure sensor assembly and is immersed in transmission fluid at all times.

TRANSMISSION SPEED SENSOR

The speed sensor (Fig. 6) is located in the overdrive gear case. The sensor is positioned over the park gear and monitors transmission output shaft rotating speed. Speed sensor signals are triggered by the park gear lugs as they rotate past the sensor pickup face. Input signals from the sensor are sent to the transmission control module for processing. The vehicle speed sensor also serves as a backup for the transmission speed sensor. Signals from this sensor are shared with the powertrain control module.

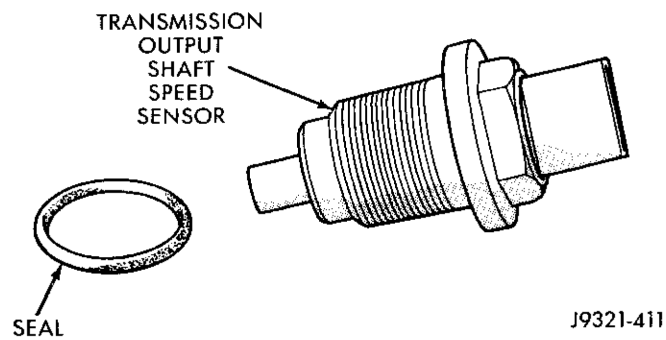

Fig. 6 Transmission Output Speed Sensor

THROTTLE POSITION SENSOR (TPS)

The TPS provides throttle position input signals to the PCM. This input signal is used to determine overdrive and converter clutch shift schedule and to select the proper governor curve.

POWERTRAIN CONTROL MODULE (PCM)

The PCM controls operation of the converter clutch, overdrive clutch, and governor pressure solenoid.

The control module determines transmission shift points based on input signals from the transmission thermistor, transmission output shaft speed sensor, crankshaft position sensor, vehicle speed sensor, throttle position sensor, and battery temperature sensor.

GOVERNOR PRESSURE CURVES

There are four governor pressure curves programmed into the transmission control module. The different curves allow the control module to adjust governor pressure for varying conditions. One curve is used for operation when fluid temperature is at, or below, 1°C (30°F). A second curve is used when fluid temperature is at, or above, 10°C (50°F) during normal city or highway driving. A third curve is used during wide-open throttle operation. The fourth curve is used when driving with the transfer case in low range.

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DESCRIPTION AND OPERATION (Continued)

SHIFT VALVE OPERATION

The shift valves are moved by a combination of throttle and governor pressure. The governor pressure is generated by electrical components.

The conditions under which a shift to fourth will not occur are:

- Overdrive switch is Off
- Transmission fluid temperature is below 10° C (50° F) or above 121° C (250° F)
- Shift to third not yet completed
- Vehicle speed too low for 3-4 shift to occur
- Battery temperature below –5° F.

HYDRAULIC CONTROL SYSTEM

The hydraulic control system provides fully automatic operation. The system performs five basic functions which are: pressure supply, pressure regulation, flow control, clutch/band application, and lubrication.

PRESSURE REGULATION

The pressure regulator valve maintains line pressure. The amount of pressure developed is controlled by throttle pressure which is dependent on the degree of throttle opening. The regulator valve is located in the valve body.

The throttle valve determines line pressure and shift speed. Governor pressure increases in proportion to vehicle speed. The throttle valve controls upshift and downshift speeds by regulating pressure according to throttle position.

Shift Valve Flow Control

The manual valve is operated by the gearshift linkage and provides the operating range selected by the driver.

The 1-2 shift valve provides 1-2 or 2-1 shifts and the 2-3 shift valve provides 2-3 or 3-2 shifts.

The kickdown valve provides forced 3-2 or 3-1 downshifts depending on vehicle speed. Downshifts occur when the throttle is opened beyond downshift detent position. Detent is reached just before wide open throttle position.

The 2-3 valve throttle pressure plug provides 3-2 downshifts at varying throttle openings depending on vehicle speed.

The 1-2 shift control valve transmits 1-2 shift pressure to the accumulator piston. This controls kickdown band capacity on 1-2 upshifts and 3-2 downshifts.

The 3-4 shift, quick fill, and timing valves plus the 3-4 accumulator, are only actuated when the overdrive solenoid is energized. The solenoid contains a check ball that controls a vent port to the 3-4 valves. The check ball either diverts line pressure away from or directly to the 3-4 valves.

The limit valve determines maximum speed at which a 3-2 part throttle kickdown can be made. On transmissions without a limit valve, maximum speed for a 3-2 kickdown is at detent position.

The 2-3 shuttle valve has two functions. The first is fast front band release and smooth engagement during lift-foot 2-3 upshifts. The second is to regulate front clutch and band application during 3-2 downshifts.

The 3-4 timing valve is moved by line pressure coming through the 3-4 shift valve. The timing valve holds the 2-3 shift valve in an upshift position. The purpose is to prevent the 2-3 valve from up or downshifting before the 3-4 valve.

The 3-4 accumulator is mounted on the overdrive housing and performs the same function as the 2-3 accumulator; it is used to smooth engagement during a 3-4 shift.

The switch valve directs fluid apply pressure to the converter clutch in one position and releases it in the opposite position. It also directs oil to the cooling and lube circuits. The switch valve regulates oil pressure to the torque converter by limiting maximum oil pressure to 130 psi.

OVERDRIVE OFF SWITCH

The overdrive OFF (control) switch is located in the instrument panel. The switch is a momentary contact device that signals the PCM to toggle current status of the overdrive function. At key-on, overdrive operation is allowed. Pressing the switch once causes the overdrive OFF mode to be entered and the overdrive OFF switch lamp to be illuminated. Pressing the switch a second time causes normal overdrive operation to be restored and the overdrive lamp to be turned off. The overdrive OFF mode defaults to ON after the ignition switch is cycled OFF and ON. The normal position for the control switch is the ON position. The switch must be in this position to energize the solenoid and allow a 3-4 upshift. The control switch indicator light illuminates only when the overdrive switch is turned to the OFF position, or when illuminated by the transmission control module.

3-4 SHIFT SEQUENCE

The overdrive clutch is applied in fourth gear only. The direct clutch is applied in all ranges except fourth gear. Fourth gear overdrive range is electronically controlled and hydraulically activated. Various sensor inputs are supplied to the powertrain control module to operate the overdrive solenoid on the valve body. The solenoid contains a check ball that opens and closes a vent port in the 3-4 shift valve feed passage. The overdrive solenoid (and check ball) are not energized in first, second, third, or reverse gear. The vent port remains open, diverting line pressure from the 2-3 shift valve away from the 3-4 shift valve. The overdrive control switch must be in the ON position

DESCRIPTION AND OPERATION (Continued)

to transmit overdrive status to the PCM. A 3-4 upshift occurs only when the overdrive solenoid is energized by the PCM. The PCM energizes the overdrive solenoid during the 3-4 upshift. This causes the solenoid check ball to close the vent port allowing line pressure from the 2-3 shift valve to act directly on the 3-4 upshift valve. Line pressure on the 3-4 shift valve overcomes valve spring pressure moving the valve to the upshift position. This action exposes the feed passages to the 3-4 timing valve, 3-4 quick fill valve, 3-4 accumulator, and ultimately to the overdrive piston. Line pressure through the timing valve moves the overdrive piston into contact with the overdrive clutch. The direct clutch is disengaged before the overdrive clutch is engaged. The boost valve provides increased fluid apply pressure to the overdrive clutch during 3-4 upshifts, and when accelerating in fourth gear. The 3-4 accumulator cushions overdrive clutch engagement to smooth 3-4 upshifts. The accumulator is charged at the same time as apply pressure acts against the overdrive piston.

CONVERTER CLUTCH ENGAGEMENT

Converter clutch engagement in third or fourth gear range is controlled by sensor inputs to the powertrain control module. Inputs that determine clutch engagement are: coolant temperature, engine rpm, vehicle speed, throttle position, and manifold vacuum. The torque converter clutch is engaged by the clutch solenoid on the valve body. The clutch can be engaged in third and fourth gear ranges depending on overdrive control switch position. If the overdrive control switch is in the normal ON position, the clutch will engage after the shift to fourth gear, and above approximately 72 km/h (45 mph). If the control switch is in the OFF position, the clutch will engage after the shift to third gear, at approximately 56 km/h (35 mph) at light throttle.

QUICK FILL VALVE

The 3-4 quick fill valve provides faster engagement of the overdrive clutch during 3-4 upshifts. The valve temporarily bypasses the clutch piston feed orifice at the start of a 3-4 upshift. This exposes a larger passage into the piston retainer resulting in a much faster clutch fill and apply sequence. The quick fill valve does not bypass the regular clutch feed orifice throughout the 3-4 upshift. Instead, once a predetermined pressure develops within the clutch, the valve closes the bypass. Clutch fill is then completed through the regular feed orifice.

CONVERTER DRAINBACK VALVE

The drainback valve is located in the transmission cooler outlet (pressure) line. The valve prevents fluid from draining from the converter into the cooler and lines when the vehicle is shut down for lengthy periods. Production valves have a hose nipple at one end, while the opposite end is threaded for a flare fitting. All valves have an arrow (or similar mark) to indicate direction of flow through the valve.

DIAGNOSIS AND TESTING

AUTOMATIC TRANSMISSION DIAGNOSIS

Automatic transmission problems can be a result of poor engine performance, incorrect fluid level, incorrect linkage or cable adjustment, band or hydraulic control pressure adjustments, hydraulic system malfunctions or electrical/mechanical component malfunctions. Begin diagnosis by checking the easily accessible items such as: fluid level and condition, linkage adjustments and electrical connections. A road test will determine if further diagnosis is necessary.

PRELIMINARY DIAGNOSIS

Two basic procedures are required. One procedure for vehicles that are drivable and an alternate procedure for disabled vehicles (will not back up or move forward).

VEHICLE IS DRIVEABLE

(1) Check for transmission fault codes using DRB scan tool.

(2) Check fluid level and condition.

(3) Adjust throttle and gearshift linkage if complaint was based on delayed, erratic, or harsh shifts.

(4) Road test and note how transmission upshifts, downshifts, and engages.

(5) Perform stall test if complaint is based on sluggish acceleration. Or, if abnormal throttle opening is needed to maintain normal speeds with a properly tuned engine.

(6) Perform hydraulic pressure test if shift problems were noted during road test.

(7) Perform air-pressure test to check clutch-band operation.

VEHICLE IS DISABLED

(1) Check fluid level and condition.

(2) Check for broken or disconnected gearshift or throttle linkage.

(3) Check for cracked, leaking cooler lines, or loose or missing pressure-port plugs.

(4) Raise and support vehicle on safety stands, start engine, shift transmission into gear, and note following:

(a) If propeller shaft turns but wheels do not, problem is with differential or axle shafts.

(b) If propeller shaft does not turn and transmission is noisy, stop engine. Remove oil pan, and

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DIAGNOSIS AND TESTING (Continued)

check for debris. If pan is clear, remove transmission and check for damaged drive plate, converter, oil pump, or input shaft.

(c) If propeller shaft does not turn and transmission is not noisy, perform hydraulic-pressure test to determine if problem is hydraulic or mechanical.

PARK/NEUTRAL POSITION SWITCH

The center terminal of the park/neutral position switch is the starter-circuit terminal. It provides the ground for the starter solenoid circuit through the selector lever in PARK and NEUTRAL positions only. The outer terminals on the switch are for the backup lamp circuit.

SWITCH TEST

To test the switch, remove the wiring connector. Test for continuity between the center terminal and the transmission case. Continuity should exist only when the transmission is in PARK or NEUTRAL.

Shift the transmission into REVERSE and test continuity at the switch outer terminals. Continuity should exist only when the transmission is in REVERSE. Continuity should not exist between the outer terminals and the case.

Check gearshift linkage adjustment before replacing a switch that tests faulty.

OVERDRIVE ELECTRICAL CONTROLS

The overdrive off switch, valve body solenoid, case connectors and related wiring can all be tested with a 12 volt test lamp or a volt/ohmmeter. Check continuity of each component when diagnosis indicates this is necessary. Refer to Group 8W, Wiring Diagrams, for component locations and circuit information.

Switch and solenoid continuity should be checked whenever the transmission fails to shift into fourth gear range.

GEARSHIFT LINKAGE AND THROTTLE CABLE

GEARSHIFT LINKAGE

Gearshift linkage adjustment is important because it positions the valve body manual valve. Incorrect adjustment will cause creeping in Neutral, premature clutch wear, delayed engagement in any gear, or a no-start in Park or Neutral position.

Proper operation of the park/neutral position switch will provide a quick check of linkage adjustment.

THROTTLE VALVE CABLE ADJUSTMENT

Throttle valve cable adjustment is important to proper operation. This adjustment positions the throttle valve which controls shift speed, quality and part throttle downshift sensitivity.

If cable setting is too short, early shifts and slippage between shifts may occur. If the setting is too long, shifts may be delayed and part throttle downshifts may be very sensitive.

ROAD TESTING

Before road testing, be sure the fluid level and control cable adjustments have been checked and adjusted if necessary. Verify that diagnostic trouble codes have been resolved.

Observe engine performance during the road test. A poorly tuned engine will not allow accurate analysis of transmission operation.

Operate the transmission in all gear ranges. Check for shift variations and engine flare which indicates slippage. Note if shifts are harsh, spongy, delayed, early, or if part throttle downshifts are sensitive.

Slippage indicated by engine flare, usually means clutch, band or overrunning clutch problems. If the condition is advanced, an overhaul will be necessary to restore normal operation.

A slipping clutch or band can often be determined by comparing which internal units are applied in the various gear ranges. The Clutch and Band Application chart provides a basis for analyzing road test results.

ANALYZING ROAD TEST

Refer to the Clutch and Band Application chart and note which elements are in use in the various gear ranges.

Note that the rear clutch is applied in all forward ranges (D, 2, 1). The transmission overrunning clutch is applied in first gear (D, 2 and 1 ranges) only. The rear band is applied in 1 and R range only.

Note that the overdrive clutch is applied only in fourth gear and the overdrive direct clutch and overrunning clutch are applied in all ranges except fourth gear.

For example: If slippage occurs in first gear in D and 2 range but not in 1 range, the transmission overrunning clutch is faulty. Similarly, if slippage occurs in any two forward gears, the rear clutch is slipping.

Applying the same method of analysis, note that the front and rear clutches are applied simultaneously only in D range third and fourth gear. If the transmission slips in third gear, either the front clutch or the rear clutch is slipping.

If the transmission slips in fourth gear but not in third gear, the overdrive clutch is slipping. By selecting another gear which does not use these clutches, the slipping unit can be determined. For example, if the transmission also slips in Reverse, the front clutch is slipping. If the transmission does not slip in Reverse, the rear clutch is slipping.

DIAGNOSIS AND TESTING (Continued)

SHIFT LEVER POSITION	TRANSMISSION CLUTCHES AND BANDS					OVERDRIVE CLUTCHES		
	FRONT CLUTCH	FRONT BAND	REAR CLUTCH	REAR BAND	OVERRUN. CLUTCH	OVERDRIVE CLUTCH	DIRECT CLUTCH	OVERRUN. CLUTCH
Reverse	X			X			X	
Drive Range								
First			X		X		X	X
Second		X	X				X	X
Third	X		X				X	X
Fourth	X		X			X		
2-Range (Manual) Second)		X	X		X		X	X
1-Range (Manual Low)			X	X	X		X	X

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Clutch And Band Application Chart

If slippage occurs during the 3-4 shift or only in fourth gear, the overdrive clutch is slipping. Similarly, if the direct clutch were to fail, the transmission would lose both reverse gear and overrun braking in 2 position (manual second gear).

If the transmission will not shift to fourth gear, the control switch, overdrive solenoid or related wiring may also be the problem cause.

This process of elimination can be used to identify a slipping unit and check operation. Proper use of the Clutch and Band Application Chart is the key.

Although road test analysis will help determine the slipping unit, the actual cause of a malfunction usually cannot be determined until hydraulic and air pressure tests are performed. Practically any condition can be caused by leaking hydraulic circuits or sticking valves.

Unless a malfunction is obvious, such as no drive in D range first gear, do not disassemble the transmission. Perform the hydraulic and air pressure tests to help determine the probable cause.

HYDRAULIC PRESSURE TEST

Hydraulic test pressures range from a low of one psi (6.895 kPa) governor pressure, to 300 psi (2068 kPa) at the rear servo pressure port in reverse.

An accurate tachometer and pressure test gauges are required. Test Gauge C-3292 has a 100 psi range and is used at the accumulator, governor, and front servo ports. Test Gauge C-3293-SP has a 300 psi range and is used at the rear servo and overdrive ports where pressures exceed 100 psi.

Pressure Test Port Locations

Test ports are located at both sides of the transmission case (Fig. 7).

Line pressure is checked at the accumulator port on the right side of the case. The front servo pressure port is at the right side of the case just behind the filler tube opening.

The rear servo and governor pressure ports are at the right rear of the transmission case. The overdrive clutch pressure port is at the left rear of the case.

Test One - Transmission In Manual Low

NOTE: This test checks pump output, pressure regulation, and condition of the rear clutch and servo circuit. Both test gauges are required for this test.

(1) Connect tachometer to engine. Position tachometer so it can be observed from driver seat if helper will be operating engine. Raise vehicle on hoist that will allow rear wheels to rotate freely.

(2) Connect 100 psi Gauge C-3292 to accumulator port. Then connect 300 psi Gauge C-3293-SP to rear servo port.

(3) Disconnect throttle and gearshift cables from levers on transmission valve body manual shaft.

(4) Have helper start and run engine at 1000 rpm.

(5) Move transmission shift lever fully forward into 1 range.

(6) Gradually move transmission throttle lever from full forward to full rearward position and note pressures on both gauges:

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DIAGNOSIS AND TESTING (Continued)

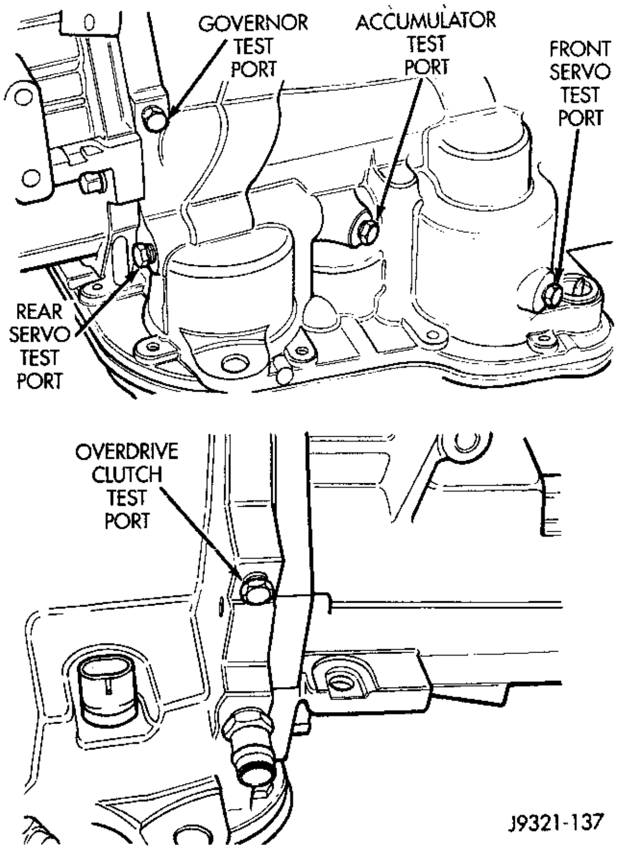

Fig. 7 Pressure Test Port Locations

- Line pressure at accumulator port should be 54-60 psi (372-414 kPa) with throttle lever forward and gradually increase to 90-96 psi (621-662 kPa) as throttle lever is moved rearward.
- Rear servo pressure should be same as line pressure within 3 psi (20.68 kPa).

Test Two—Transmission In 2 Range

NOTE: This test checks pump output, line pressure and pressure regulation. Use 100 psi Test Gauge C-3292 for this test.

(1) Leave vehicle in place on hoist and leave Test Gauge C-3292 connected to accumulator port.
(2) Have helper start and run engine at 1000 rpm.
(3) Move transmission shift lever one detent rearward from full forward position. This is 2 range.
(4) Move transmission throttle lever from full forward to full rearward position and read pressure on gauge.
(5) Line pressure should be 54-60 psi (372-414 kPa) with throttle lever forward and gradually increase to 90-96 psi (621-662 kPa) as lever is moved rearward.

Test Three—Transmission In D Range Third Gear

NOTE: This test checks pressure regulation and condition of the clutch circuits. Both test gauges are required for this test.

(1) Turn OD switch off.
(2) Leave vehicle on hoist and leave Gauge C-3292 in place at accumulator port.
(3) Move Gauge C-3293-SP over to front servo port for this test.
(4) Have helper start and run engine at 1600 rpm for this test.
(5) Move transmission shift lever two detents rearward from full forward position. This is D range.
(6) Read pressures on both gauges as transmission throttle lever is gradually moved from full forward to full rearward position:

- Line pressure at accumulator in D range third gear, should be 54-60 psi (372-414 kPa) with throttle lever forward and increase as lever is moved rearward.
- Front servo pressure in D range third gear, should be within 3 psi (21 kPa) of line pressure up to kickdown point.

Test Four—Transmission In Reverse

NOTE: This test checks pump output, pressure regulation and the front clutch and rear servo circuits. Use 300 psi Test Gauge C-3293-SP for this test.

(1) Leave vehicle on hoist and leave gauge C3292 in place at accumulator port.
(2) Move 300 psi Gauge C-3293-SP back to rear servo port.
(3) Have helper start and run engine at 1600 rpm for test.
(4) Move transmission shift lever four detents rearward from full forward position. This is Reverse range.
(5) Move transmission throttle lever fully forward then fully rearward and note reading at Gauge C-3293-SP.
(6) Pressure should be 145 - 175 psi (1000-1207 kPa) with throttle lever forward and increase to 230 - 280 psi (1586-1931 kPa) as lever is gradually moved rearward.

DIAGNOSIS AND TESTING (Continued)

Test Five—Governor Pressure

NOTE: This test checks governor operation by measuring governor pressure response to changes in vehicle speed. It is usually not necessary to check governor operation unless shift speeds are incorrect or if the transmission will not downshift. The test should be performed on the road or on a hoist that will allow the rear wheels to rotate freely.

(1) Move 100 psi Test Gauge C-3292 to governor pressure port.

(2) Move transmission shift lever two detents rearward from full forward position. This is D range.

(3) Have helper start and run engine at curb idle speed. Then firmly apply service brakes so wheels will not rotate.

(4) Note governor pressure:

- Governor pressure should be no more than 20.6 kPa (3 psi) at curb idle speed and wheels not rotating.
- If pressure exceeds 20.6 kPa (3 psi), a fault exists in governor pressure control system.

(5) Release brakes, slowly increase engine speed, and observe speedometer and pressure test gauge (do not exceed 30 mph on speedometer). Governor pressure should increase in proportion to vehicle speed. Or approximately 6.89 kPa (1 psi) for every 1 mph.

(6) Governor pressure rise should be smooth and drop back to no more than 20.6 kPa (3 psi), after engine returns to curb idle and brakes are applied to prevent wheels from rotating.

(7) Compare results of pressure test with analysis chart.

Test Six—Transmission In Overdrive Fourth Gear

NOTE: This test checks line pressure at the overdrive clutch in fourth gear range. Use 300 psi Test Gauge C-3292 for this test. The test should be performed on the road or on a chassis dyno.

(1) Remove tachometer; it is not needed for this test.

(2) Move 300 psi Gauge to overdrive clutch pressure test port. Then remove other gauge and reinstall test port plug.

(3) Lower vehicle.

(4) Turn OD switch on.

(5) Secure test gauge so it can be viewed from drivers seat.

(6) Start engine and shift into D range.

(7) Increase vehicle speed gradually until 3-4 shift occurs and note gauge pressure.

(8) Pressure should be 469-496 kPa (68-72 psi) with closed throttle and increase to 620-827 kPa (90-120 psi) at 1/2 to 3/4 throttle. Note that pressure can increase to around 896 kPa (130 psi) at full throttle.

(9) Return to shop or move vehicle off chassis dyno.

PRESSURE TEST ANALYSIS CHART

TEST CONDITION	INDICATION
Line pressure OK during any one test	Pump and regulator valve OK
Line pressure OK in R but low in D, 2, 1	Leakage in rear clutch area (seal rings, clutch seals)
Pressure low in D Fourth Gear Range	Overdrive clutch piston seal, or check ball problem
Pressure OK in 1, 2 but low in D3 and R	Leakage in front clutch area
Pressure OK in 2 but low in R and 1	Leakage in rear servo
Front servo pressure low in 2	Leakage in servo; broken servo ring or cracked servo piston
Pressure low in all positions	Clogged filter, stuck regulator valve, worn or faulty pump, low oil level
Governor pressure too high at idle speed	Governor pressure solenoid valve system fault. Refer to diagnostic book.
Governor pressure low at all mph figures	Faulty governor pressure solenoid, transmission control module, or governor pressure sensor
Lubrication pressure low at all throttle positions	Clogged fluid cooler or lines, seal rings leaking, worn pump bushings, pump, clutch retainer, or clogged filter.
Line pressure high	Output shaft plugged, sticky regulator valve
Line pressure low	Sticky regulator valve, clogged filter, worn pump

CONVERTER STALL TEST

Stall testing involves determining maximum engine speed obtainable at full throttle with the rear wheels locked and the transmission in D range. This test checks the holding ability of the converter overrunning and transmission clutches.

WARNING: NEVER ALLOW ANYONE TO STAND DIRECTLY IN LINE WITH THE VEHICLE FRONT OR REAR DURING A STALL TEST. ALWAYS BLOCK THE WHEELS AND FULLY APPLY THE SERVICE AND PARKING BRAKES DURING THE TEST.

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DIAGNOSIS AND TESTING (Continued)

STALL TEST PROCEDURE

(1) Connect tachometer to engine. Position tachometer so it can be viewed from driver's seat.

(2) Drive vehicle to bring transmission fluid up to normal operating temperature. Vehicle can be driven on road or on chassis dynamometer, if available.

(3) Check transmission fluid level. Add fluid if necessary.

(4) Block front wheels.

(5) Fully apply service and parking brakes.

(6) Open throttle completely and record maximum engine speed registered on tachometer. It takes 4-10 seconds to reach max rpm. **Once max rpm has been achieved, do not hold wide open throttle for more than 4-5 seconds.**

CAUTION: Stalling the converter causes a rapid increase in fluid temperature. To avoid fluid overheating, hold the engine at maximum rpm for no more than 5 seconds. If engine exceeds 2500 rpm during the test, release the accelerator pedal immediately; transmission clutch slippage is occurring.

(7) If a second stall test is required, cool down fluid before proceeding. Shift into NEUTRAL and run engine at 1000 rpm for 20-30 seconds to cool fluid.

STALL TEST ANALYSIS

Stall Speed Too High

If the stall speed exceeds 2500 rpm, transmission clutch slippage is indicated.

Stall Speed Low

Low stall speed with a properly tuned engine indicate a torque converter overrunning clutch problem. The condition should be confirmed by road testing. A stall speed 250-350 rpm below normal indicates the converter overrunning clutch is slipping. The vehicle also exhibits poor acceleration but operates normally once highway cruise speeds are reached. Torque converter replacement will be necessary.

Stall Speed Normal But Acceleration Poor

If stall speeds are normal (1800-2300 rpm) but abnormal throttle opening is required for acceleration, or to maintain cruise speed, the converter overrunning clutch is seized. The torque converter will have to be replaced.

Converter Noise During Test

A whining noise caused by fluid flow is normal during a stall test. However, loud metallic noises indicate a damaged converter. To confirm that the noise is originating from the converter, operate the vehicle at light throttle in DRIVE and NEUTRAL on a hoist and listen for noise coming from the converter housing.

AIR TESTING TRANSMISSION CLUTCH AND BAND OPERATION

Air-pressure testing can be used to check transmission front/rear clutch and band operation. The test can be conducted with the transmission either in the vehicle or on the work bench, as a final check, after overhaul.

Air-pressure testing requires that the oil pan and valve body be removed from the transmission. The servo and clutch apply passages are shown (Fig. 8).

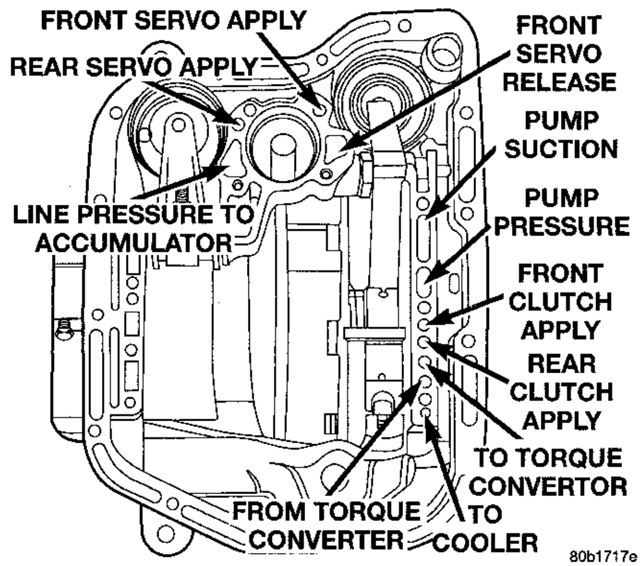

Fig. 8 Air Pressure Test Passages

Front Clutch Air Test

Place one or two fingers on the clutch housing and apply air pressure through front clutch apply passage. Piston movement can be felt and a soft thump heard as the clutch applies.

Rear Clutch Air Test

Place one or two fingers on the clutch housing and apply air pressure through rear clutch apply passage. Piston movement can be felt and a soft thump heard as the clutch applies.

Front Servo Air Test

Apply air pressure to the front servo apply passage. The servo rod should extend and cause the band to tighten around the drum. Spring pressure should release the servo when air pressure is removed.

Rear Servo Air Test

Apply air pressure to the rear servo apply passage. The servo rod should extend and cause the band to

DIAGNOSIS AND TESTING (Continued)

tighten around the drum. Spring pressure should release the servo when air pressure is removed.

CONVERTER HOUSING FLUID LEAK DIAGNOSIS

When diagnosing converter housing fluid leaks, two items must be established before repair.

(1) Verify that a leak condition actually exists.

(2) Determined the true source of the leak.

Some suspected converter housing fluid leaks may not be leaks at all. They may only be the result of residual fluid in the converter housing, or excess fluid spilled during factory fill or fill after repair. Converter housing leaks have several potential sources. Through careful observation, a leak source can be identified before removing the transmission for repair. Pump seal leaks tend to move along the drive hub and onto the rear of the converter. Pump O-ring or pump body leaks follow the same path as a seal leak (Fig. 9). Pump vent or pump attaching bolt leaks are generally deposited on the inside of the converter housing and not on the converter itself (Fig. 9). Pump seal or gasket leaks usually travel down the inside of the converter housing. Front band lever pin plug leaks are generally deposited on the housing and not on the converter.

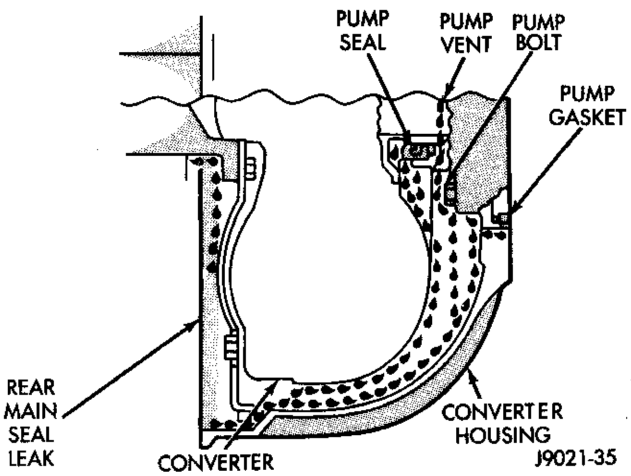

Fig. 9 Converter Housing Leak Paths

TORQUE CONVERTER LEAK POINTS

Possible sources of converter leaks are:

(1) Leaks at the weld joint around the outside diameter weld (Fig. 10).

(2) Leaks at the converter hub weld (Fig. 10).

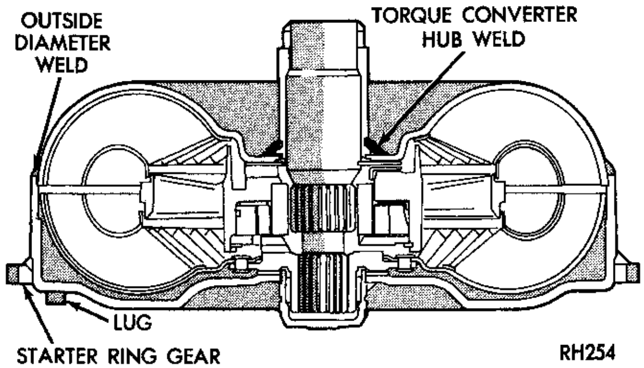

Fig. 10 Converter Leak Points—Typical

CONVERTER HOUSING AREA LEAK CORRECTION

(1) Remove converter.

(2) Tighten front band adjusting screw until band is tight around front clutch retainer. This prevents front/rear clutches from coming out when oil pump is removed.

(3) Remove oil pump and remove pump seal. Inspect pump housing drainback and vent holes for obstructions. Clear holes with solvent and wire.

(4) Inspect pump bushing and converter hub. If bushing is scored, replace it. If converter hub is scored, either polish it with crocus cloth or replace converter.

(5) Install new pump seal, O-ring, and gasket. Replace oil pump if cracked, porous or damaged in any way. Be sure to loosen the front band before installing the oil pump, damage to the oil pump seal may occur if the band is still tightened to the front clutch retainer.

(6) Loosen kickdown lever pin access plug three turns. Apply Loctite 592, or Permatex No. 2 to plug threads and tighten plug to 17 N·m (150 in. lbs.) torque.

(7) Adjust front band.

(8) Lubricate pump seal and converter hub with transmission fluid or petroleum jelly and install converter.

(9) Install transmission and converter housing dust shield.

(10) Lower vehicle.

DIAGNOSIS TABLES AND CHARTS—RE TRANSMISSION

The diagnosis charts provide additional reference when diagnosing a transmission fault. The charts provide general information on a variety of transmission, overdrive unit and converter clutch fault conditions.

The hydraulic flow charts in the Schematics and Diagrams section of this group, outline fluid flow and hydraulic circuitry. Circuit operation is provided for neutral, third, fourth and reverse gear ranges. Normal working pressures are also supplied for each of the gear ranges.

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DIAGNOSIS AND TESTING (Continued)

DIAGNOSIS CHARTS

CONDITION	POSSIBLE CAUSES	CORRECTION
HARSH ENGAGEMENT (FROM NEUTRAL TO DRIVE OR REVERSE)	1. Fluid Level Low	1. Add Fluid
	2. Throttle Linkage Misadjusted	2. Adjust linkage - setting may be too long.
	3. Mount and Driveline Bolts Loose	3. Check engine mount, transmission mount, propeller shaft, rear spring to body bolts, rear control arms, crossmember and axle bolt torque. Tighten loose bolts and replace missing bolts.
	4. U-Joint Worn/Broken	4. Remove propeller shaft and replace U-Joint.
	5. Axle Backlash Incorrect	5. Check per Service Manual. Correct as needed.
	6. Hydraulic Pressure Incorrect	6. Check pressure. Remove, overhaul or adjust valve body as needed.
	7. Band Misadjusted.	7. Adjust rear band.
	8. Valve Body Check Balls Missing.	8. Inspect valve body for proper check ball installation.
	9. Axle Pinion Flange Loose.	9. Replace nut and check pinion threads before installing new nut. Replace pinion gear if threads are damaged.
	10. Clutch, band or planetary component damaged.	10. Remove, disassemble and repair transmission as necessary.
	11. Converter Clutch Faulty.	11. Replace converter and flush cooler and line before installing new converter.

DIAGNOSIS AND TESTING (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
DELAYED ENGAGEMENT (FROM NEUTRAL TO DRIVE OR REVERSE)	1. Fluid Level Low.	1. Correct level and check for leaks.
	2. Filter Clogged.	2. Change filter.
	3. Gearshift Linkage Misadjusted.	3. Adjust linkage and repair linkage if worn or damaged.
	4. Torque Converter Drain Back (Oil drains from torque converter into transmission sump)	4. If vehicle moves normally after 5 seconds after shifting into gear, no repair is necessary. If longer, inspect pump bushing for wear. Replace pump house.
	5. Rear Band Misadjusted.	5. Adjust band.
	6. Valve Body Filter Plugged.	6. Replace fluid and filter. If oil pan and old fluid were full of clutch disc material and/or metal particles, overhaul will be necessary.
	7. Oil Pump Gears Worn/Damaged.	7. Remove transmission and replace oil pump.
	8. Governor Circuit and Solenoid Valve Electrical Fault.	8. Test with DRB scan tool and repair as required.
	9. Hydraulic Pressure Incorrect.	9. Perform pressure test, remove transmission and repair as needed.
	10. Reaction Shaft Seal Rings Worn/Broken.	10. Remove transmission, remove oil pump and replace seal rings.
	11. Rear Clutch/Input Shaft, Rear Clutch Seal Rings Damaged.	11. Remove and disassemble transmission and repair as necessary.
	12. Regulator Valve Stuck.	12. Clean.
	13. Cooler Plugged.	13. Transfer case failure can plug cooler.
NO DRIVE RANGE (REVERSE OK)	1. Fluid Level Low.	1. Add fluid and check for leaks if drive is restored.
	2. Gearshift Linkage/Cable Loose/Misadjusted.	2. Repair or replace linkage components.
	3. Rear Clutch Burnt.	3. Remove and disassemble transmission and rear clutch and seals. Repair/replace worn or damaged parts as needed.
	4. Valve Body Malfunction.	4. Remove and disassemble valve body. Replace assembly if any valves or bores are damaged.
	5. Transmission Overrunning Clutch Broken.	5. Remove and disassemble transmission. Replace overrunning clutch.
	6. Input Shaft Seal Rings Worn/ Damaged.	6. Remove and disassemble transmission. Replace seal rings and any other worn or damaged parts.
	7. Front Planetary Failed Broken.	7. Remove and repair.

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DIAGNOSIS AND TESTING (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
NO DRIVE OR REVERSE (VEHICLE WILL NOT MOVE)	1. Fluid Level Low.	1. Add fluid and check for leaks if drive is restored.
	2. Gearshift Linkage/Cable Loose/Misadjusted.	2. Inspect, adjust and reassemble linkage as needed. Replace worn/damaged parts.
	3. U-Joint/Axle/Transfer Case Broken.	3. Perform preliminary inspection procedure for vehicle that will not move. Refer to procedure in diagnosis section.
	4. Filter Plugged.	4. Remove and disassemble transmission. Repair or replace failed components as needed. Replace filter. If filter and fluid contained clutch material or metal particles, an overhaul may be necessary. Perform lube flow test. Flush oil. Replace cooler as necessary.
	5. Oil Pump Damaged.	5. Perform pressure test to confirm low pressure. Replace pump body assembly if necessary.
	6. Valve Body Malfunctioned.	6. Check and inspect valve body. Replace valve body (as assembly) if any valve or bore is damaged. Clean and reassemble correctly if all parts are in good condition.
	7. Transmission Internal Component Damaged.	7. Remove and disassemble transmission. Repair or replace failed components as needed.
	8. Park Sprag not Releasing - Check Stall Speed, Worn/Damaged/ Stuck.	8. Remove, disassemble, repair.
	9. Torque Converter Damage.	9. Inspect and replace as required.

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DIAGNOSIS AND TESTING (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
SHIFTS DELAYED OR ERRATIC (SHIFTS ALSO HARSH AT TIMES)	1. Fluid Level Low/High.	1. Correct fluid level and check for leaks if low.
	2. Fluid Filter Clogged.	2. Replace filter. If filter and fluid contained clutch material or metal particles, an overhaul may be necessary. Perform lube flow test.
	3. Throttle Linkage Misadjusted.	3. Adjust linkage as described in service section.
	4. Throttle Linkage Binding.	4. Check cable for binding. Check for return to closed throttle at transmission.
	5. Gearshift Linkage/Cable Misadjusted.	5. Adjust linkage/cable as described in service section.
	6. Clutch or Servo Failure.	6. Remove valve body and air test clutch, and band servo operation. Disassemble and repair transmission as needed.
	7. Governor Circuit Electrical Fault.	7. Test using DRB scan tool and repair as required.
	8. Front Band Misadjusted.	8. Adjust band.
	9. Pump Suction Passage Leak.	9. Check for excessive foam on dipstick after normal driving. Check for loose pump bolts, defective gasket. Replace pump assembly if needed.
NO REVERSE (D RANGES OK)	1. Gearshift Linkage/Cable Misadjusted/Damaged.	1. Repair or replace linkage parts as needed.
	2. Park Sprag Sticking.	2. Replace overdrive annulus gear.
	3. Rear Band Misadjusted/Worn.	3. Adjust band; replace.
	4. Valve Body Malfunction.	4. Remove and service valve body. Replace valve body if any valves or valve bores are worn or damaged.
	5. Rear Servo Malfunction.	5. Remove and disassemble transmission. Replace worn/ damaged servo parts as necessary.
	6. Direct Clutch in Overdrive Worn	6. Disassemble overdrive. Replace worn or damaged parts.
	7. Front Clutch Burnt.	7. Remove and disassemble transmission. Replace worn, damaged clutch parts as required.
HAS FIRST/REVERSE ONLY (NO 1-2 OR 2-3 UPSHIFT)	1. Governor Circuit Electrical Fault.	1. Test using DRB scan tool and repair as required.
	2. Valve Body Malfunction.	2. Repair stuck 1-2 shift valve or governor plug.
	3. Front Servo/Kickdown Band Damaged/Burned.	3. Repair/replace.

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DIAGNOSIS AND TESTING (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
MOVES IN 2ND OR 3RD GEAR, ABRUPTLY DOWNSHIFTS TO LOW	1. Valve Body Malfunction.	1. Remove, clean and inspect. Look for stuck 1-2 valve or governor plug.
	2. Governor Valve Sticking.	2. Remove, clean and inspect. Replace faulty parts.
NO LOW GEAR (MOVES IN 2ND OR 3RD GEAR ONLY)	1. Governor Valve Sticking.	1. Remove governor, clean, inspect and repair as required.
	2. Governor Circuit Electrical Fault.	2. Test with DRB scan tool and repair as required.
	3. Valve Body Malfunction.	3. Remove, clean and inspect. Look for sticking 1-2 shift valve, 2-3 shift valve, governor plug or broken springs.
	4. Front Servo Piston Cocked in Bore.	4. Inspect servo and repair as required.
	5. Front Band Linkage Malfunction	5. Inspect linkage and look for bind in linkage.
NO KICKDOWN OR NORMAL DOWNSHIFT	1. Throttle Linkage Misadjusted.	1. Adjust linkage.
	2. Accelerator Pedal Travel Restricted.	2. Verify floor mat is not under pedal, repair worn accelerator cable or bent brackets.
	3. Valve Body Hydraulic Pressures Too High or Too Low Due to Valve Body Malfunction or Incorrect Hydraulic Control Pressure Adjustments.	3. Perform hydraulic pressure tests to determine cause and repair as required. Correct valve body pressure adjustments as required.
	4. Governor Circuit Electrical Fault.	4. Test with DRB scan tool and repair as required.
	5. Valve Body Malfunction.	5. Perform hydraulic pressure tests to determine cause and repair as required. Correct valve body pressure adjustments as required.
	6. TPS Malfunction.	6. Replace sensor, check with DRB scan tool.
	7. PCM Malfunction.	7. Check with DRB scan tool and replace if required.
	8. Valve Body Malfunction.	8. Repair sticking 1-2, 2-3 shift valves, governor plugs, 3-4 solenoid, 3-4 shift valve, 3-4 timing valve.

DIAGNOSIS AND TESTING (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
STUCK IN LOW GEAR (WILL NOT UPSHIFT)	1. Throttle Linkage Misadjusted/ Stuck.	1. Adjust linkage and repair linkage if worn or damaged. Check for binding cable or missing return spring.
	2. Gearshift Linkage Misadjusted.	2. Adjust linkage and repair linkage if worn or damaged.
	3. Governor Component Electrical Fault.	3. Check operating pressures and test with DRB scan tool, repair faulty component.
	4. Front Band Out of Adjustment.	4. Adjust Band.
	5. Clutch or Servo Malfunction.	5. Air pressure check operation of clutches and bands. Repair faulty component.
CREEPS IN NEUTRAL	1. Gearshift Linkage Misadjusted.	1. Adjust linkage.
	2. Rear Clutch Dragging/Warped.	2. Disassemble and repair.
	3. Valve Body Malfunction.	3. Perform hydraulic pressure test to determine cause and repair as required.
BUZZING NOISE	1. Fluid Level Low	1. Add fluid and check for leaks.
	2. Shift Cable Misassembled.	2. Route cable away from engine and bell housing.
	3. Valve Body Misassembled.	3. Remove, disassemble, inspect valve body. Reassemble correctly if necessary. Replace assembly if valves or springs are damaged. Check for loose bolts or screws.
	4. Pump Passages Leaking	4. Check pump for porous casting, scores on mating surfaces and excess rotor clearance. Repair as required. Loose pump bolts.
	5. Cooling System Cooler Plugged.	5. Flow check cooler circuit. Repair as needed.
	6. Overrunning Clutch Damaged.	6. Replace clutch.
SLIPS IN REVERSE ONLY	1. Fluid Level Low.	1. Add fluid and check for leaks.
	2. Gearshift Linkage Misadjusted.	2. Adjust linkage.
	3. Rear Band Misadjusted.	3. Adjust band.
	4. Rear Band Worn.	4. Replace as required.
	5. Overdrive Direct Clutch Worn.	5. Disassemble overdrive. Repair as needed.
	6. Hydraulic Pressure Too Low.	6. Perform hydraulic pressure tests to determine cause.
	7. Rear Servo Leaking.	7. Air pressure check clutch-servo operation and repair as required.
	8. Band Linkage Binding.	8. Inspect and repair as required.

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DIAGNOSIS AND TESTING (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
SLIPS IN FORWARD DRIVE RANGES	1. Fluid Level Low.	1. Add fluid and check for leaks.
	2. Fluid Foaming.	2. Check for high oil level, bad pump gasket or seals, dirt between pump halves and loose pump bolts. Replace pump if necessary.
	3. Throttle Linkage Misadjusted.	3. Adjust linkage.
	4. Gearshift Linkage Misadjusted.	4. Adjust linkage.
	5. Rear Clutch Worn.	5. Inspect and replace as needed.
	6. Low Hydraulic Pressure Due to Worn Pump, Incorrect Control Pressure Adjustments, Valve Body Warpage or Malfunction, Sticking, Leaking Seal Rings, Clutch Seals Leaking, Servo Leaks, Clogged Filter or Cooler Lines	6. Perform hydraulic and air pressure tests to determine cause.
	7. Rear Clutch Malfunction, Leaking Seals or Worn Plates.	7. Air pressure check clutch-servo operation and repair as required.
	8. Overrunning Clutch Worn, Not Holding (Slips in 1 Only).	8. Replace Clutch.
SLIPS IN LOW GEAR "D" ONLY, BUT NO IN 1 POSITION	Overrunning Clutch Faulty.	Replace overrunning clutch.
GROWLING, GRATING OR SCRAPING NOISES	1. Drive Plate Broken.	1. Replace.
	2. Torque Converter Bolts Hitting Dust Shield.	2. Dust shield bent. Replace or repair.
	3. Planetary Gear Set Broken/ Seized.	3. Check for debris in oil pan and repair as required.
	4. Overrunning Clutch Worn/Broken.	4. Inspect and check for debris in oil pan. Repair as required.
	5. Oil Pump Components Scored/ Binding.	5. Remove, inspect and repair as required.
	6. Output Shaft Bearing or Bushing Damaged.	6. Remove, inspect and repair as required.
	7. Clutch Operation Faulty.	7. Perform air pressure check and repair as required.
	8. Front and Rear Bands Misadjusted.	8. Adjust bands.

DIAGNOSIS AND TESTING (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
DRAGS OR LOCKS UP	1. Fluid Level Low.	1. Check and adjust level.
	2. Clutch Dragging/Failed	2. Air pressure check clutch operation and repair as required.
	3. Front or Rear Band Misadjusted.	3. Adjust bands.
	4. Case Leaks Internally.	4. Check for leakage between passages in case.
	5. Servo Band or Linkage Malfunction.	5. Air pressure check servo operation and repair as required.
	6. Overrunning Clutch Worn.	6. Remove and inspect clutch. Repair as required.
	7. Planetary Gears Broken.	7. Remove, inspect and repair as required (look for debris in oil pan).
	8. Converter Clutch Dragging.	8. Check for plugged cooler. Perform flow check. Inspect pump for excessive side clearance. Replace pump as required.
NO 4-3 DOWNSHIFT	1. Circuit Wiring and/or Connectors Shorted.	1. Test wiring and connectors with test lamp and volt/ohmmeter. Repair wiring as necessary. Replace connectors and/or harnesses as required.
	2. PCM Malfunction.	2. Check PCM operation with DRB scan tool. Replace PCM only if faulty.
	3. TPS Malfunction	3. Check TPS with DRB scan tool at PCM.
	4. Lockup Solenoid Not Venting.	4. Remove valve body and replace solenoid assembly if plugged or shorted.
	5. Overdrive Solenoid Not Venting.	5. Remove valve body and replace solenoid if plugged or shorted.
	6. Valve Body Valve Sticking.	6. Repair stuck 3-4 shift valve or lockup timing valve.
NO 4-3 DOWNSHIFT WHEN CONTROL SWITCH IS TURNED OFF	1. Control Switch Open/Shorted.	1. Test and replace switch if faulty.
	2. Overdrive Solenoid Connector Shorted.	2. Test solenoids and replace if seized or shorted.
	3. PCM Malfunction.	3. Test with DRB scan tool. Replace PCM if faulty.
	4. Valve Body Stuck Valves.	4. Repair stuck 3-4, lockup or lockup timing valve.
CLUNK NOISE FROM DRIVELINE ON CLOSED THROTTLE 4-3 DOWNSHIFT	1. Transmission Fluid Low.	1. Add Fluid.
	2. Throttle Cable Misadjusted.	2. Adjust cable.
	3. Overdrive Clutch Select Spacer Wrong Spacer.	3. Replace overdrive piston thrust plate spacer.

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DIAGNOSIS AND TESTING (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
3-4 UPSHIFT OCCURS IMMEDIATELY AFTER 2-3 SHIFT	1. Overdrive Solenoid Connector or Wiring Shorted.	1. Test connector and wiring for loose connections, shorts or ground and repair as needed.
	2. TPS Malfunction.	2. Test TPS and replace as necessary. Check with DRB scan tool.
	3. PCM Malfunction.	3. Test PCM with DRB scan tool and replace controller if faulty.
	4. Overdrive Solenoid Malfunction.	4. Replace solenoid.
	5. Valve Body Malfunction.	5. Remove, disassemble, clean and inspect valve body components. Make sure all valves and plugs slide freely in bores. Polish valves with crocus cloth if needed.
WHINE/NOISE RELATED TO ENGINE SPEED	1. Fluid Level Low.	1. Add fluid and check for leaks.
	2. Shift Cable Incorrect Routing.	2. Check shift cable for correct routing. Should not touch engine or bell housing.

DIAGNOSIS AND TESTING (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
NO 3-4 UPSHIFT	1. Dash O/D Switch In OFF Position.	1. Turn control switch to ON position.
	2. Overdrive Circuit Fuse Blown.	2. Replace fuse. Determine why fuse failed and repair as necessary (i.e., shorts or grounds in circuit).
	3. O/D Switch Wire Shorted/Open Cut.	3. Check wires/connections with 12V test lamp and voltmeter. Repair damaged or loose wire/connection as necessary.
	4. Distance or Coolant Sensor Malfunction.	4. Check with DRB scan tool and repair or replace as necessary.
	5. TPS Malfunction.	5. Check with DRB scan tool and replace if necessary.
	6. Neutral Switch to PCM Wire Shorted/Cut.	6. Test switch as described in service section and replace if necessary. Engine no start.
	7. PCM Malfunction.	7. Check with DRB scan tool and replace if necessary.
	8. Overdrive Solenoid Shorted/ Open.	8. Replace solenoid if shorted or open and repair loose or damaged wires (DRB scan tool).
	9. Solenoid Feed Orifice in Valve Body Blocked.	9. Remove, disassemble, and clean valve body thoroughly. Check feed orifice.
	10. Overdrive Clutch Failed.	10. Disassemble overdrive and repair as needed.
	11. Hydraulic Pressure Low.	11. Pressure test transmission to determine cause.
	12. Valve Body Valve Stuck.	12. Repair stuck 3-4 shift valve, 3-4 timing valve.
	13. O/D Piston Incorrect Spacer.	13. Remove unit, check end play and install correct spacer.
	14. Overdrive Piston Seal Failure.	14. Replace both seals.
	15. O/D Check Valve/Orifice Failed.	15. Check for free movement and secure assembly (in piston retainer). Check ball bleed orifice.

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DIAGNOSIS AND TESTING (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
SLIPS IN OVERDRIVE FOURTH GEAR	1. Fluid Level Low.	1. Add fluid and check for leaks.
	2. Overdrive Clutch Pack Worn.	2. Remove overdrive unit and rebuild clutch pack.
	3. Overdrive Piston Retainer Bleed Orifice Blown Out.	3. Disassemble transmission, remove retainer and replace orifice.
	4. Overdrive Piston or Seal Malfunction.	4. Remove overdrive unit. Replace seals if worn. Replace piston if damaged. If piston retainer is damaged, remove and disassemble the transmission.
	5. 3-4 Shift Valve, Timing Valve or Accumulator Malfunction.	5. Remove and overhaul valve body. Replace accumulator seals. Make sure all valves operate freely in bores and do not bind or stick. Make sure valve body screws are correctly tightened and separator plates are properly positioned.
	6. Overdrive Unit Thrust Bearing Failure.	6. Disassemble overdrive unit and replace thrust bearing (NO. 1 thrust bearing is between overdrive piston and clutch hub; NO. 2 thrust bearing is between the planetary gear and the direct clutch spring plate; NO. 3 thrust bearing is between overrunning clutch hub and output shaft).
	7. O/D Check Valve/Bleed Orifice Failure.	7. Check for function/secure orifice insert in O/D piston retainer.
DELAYED 3-4 UPSHIFT (SLOW TO ENGAGE)	1. Fluid Level Low.	1. Add fluid and check for leaks.
	2. Throttle Valve Cable Misadjusted.	2. Adjust throttle valve cable.
	3. Overdrive Clutch Pack Worn/ Burnt.	3. Remove unit and rebuild clutch pack.
	4. TPS Faulty.	4. Test with DRB scan tool and replace as necessary
	5. Overdrive Clutch Bleed Orifice Plugged.	5. Disassemble transmission and replace orifice.
	6. Overdrive Solenoid or Wiring Shorted/Open.	6. Test solenoid and check wiring for loose/corroded connections or shorts/grounds. Replace solenoid if faulty and repair wiring if necessary.
	7. Overdrive Excess Clearance	7. Remove unit. Measure end play and select proper spacer.
	8. O/D Check Valve Missing or Stuck.	8. Check for presence of check valve. Repair or replace as required.
TORQUE CONVERTER LOCKS UP IN SECOND AND/OR THIRD GEAR	Lockup Solenoid, Relay or Wiring Shorted/Open.	Test solenoid, relay and wiring for continuity, shorts or grounds. Replace solenoid and relay if faulty. Repair wiring and connectors as necessary.

DIAGNOSIS AND TESTING (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
HARSH 1-2, 2-3, 3-4 OR 3-2 SHIFTS	Lockup Solenoid Malfunction.	Remove valve body and replace solenoid assembly.
NO START IN PARK OR NEUTRAL	1. Gearshift Linkage/Cable Misadjusted.	1. Adjust linkage/cable.
	2. Neutral Switch Wire Open/Cut.	2. Check continuity with test lamp. Repair as required.
	3. Neutral Switch Faulty.	3. Refer to service section for test and replacement procedure.
	4. Neutral Switch Connect Faulty.	4. Connectors spread open. Repair.
	5. Valve Body Manual Lever Assembly Bent/Worn/Broken.	5. Inspect lever assembly and replace if damaged.
NO REVERSE (OR SLIPS IN REVERSE)	1. Direct Clutch Pack (front clutch) Worn.	1. Disassemble unit and rebuild clutch pack.
	2. Rear Band Misadjusted.	2. Adjust band.
	3. Front Clutch Malfunctioned/ Burned.	3. Air-pressure test clutch operation. Remove and rebuild if necessary.
	4. Overdrive Thrust Bearing Failure.	4. Disassemble geartrain and replace bearings.
	5. Direct Clutch Spring Collapsed/ Broken.	5. Remove and disassemble unit. Check clutch position and replace spring.

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DIAGNOSIS AND TESTING (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
OIL LEAKS.	1. Fluid Lines and Fittings Loose/Leaks/Damaged.	1. Tighten fittings. If leaks persist, replace fittings and lines if necessary.
	2. Fill Tube (where tube enters case) Leaks/Damaged.	2. Replace tube seal. Inspect tube for cracks in fill tube.
	3. Pressure Port Plug Loose Loose/Damaged.	3. Tighten to correct torque. Replace plug or reseal if leak persists.
	4. Pan Gasket Leaks.	4. Tighten pan screws (150 in. lbs.). If leaks persist, replace gasket.
	5. Valve Body Manual Lever Shaft Seal Leaks/Worn.	5. Replace shaft seal.
	6. Rear Bearing Access Plate Leaks.	6. Replace gasket. Tighten screws.
	7. Gasket Damaged or Bolts are Loose.	7. Replace bolts or gasket or tighten both.
	8. Adapter/Extension Gasket Damaged Leaks/Damaged.	8. Replace gasket.
	9. Neutral Switch Leaks/Damaged.	9. Replace switch and gasket.
	10. Converter Housing Area Leaks.	10. Check for leaks at seal caused by worn seal or burr on converter hub (cutting seal), worn bushing, missing oil return, oil in front pump housing or hole plugged. Check for leaks past O-ring seal on pump or past pump-to-case bolts; pump housing porous, oil coming out vent due to overfill or leak past front band shaft access plug.
	11. Pump Seal Leaks/Worn/ Damaged.	11. Replace seal.
	12. Torque Converter Weld Leak/Cracked Hub.	12. Replace converter.
	13. Case Porosity Leaks.	13. Replace case.
NOISY OPERATION IN FOURTH GEAR ONLY	1. Overdrive Clutch Discs, Plates or Snap Rings Damaged.	1. Remove unit and rebuild clutch pack.
	2. Overdrive Piston or Planetary Thrust Bearing Damaged.	2. Remove and disassemble unit. Replace either thrust bearing if damaged.
	3. Output Shaft Bearings Scored/ Damaged.	3. Remove and disassemble unit. Replace either bearing if damaged.
	4. Planetary Gears Worn/Chipped.	4. Remove and overhaul overdrive unit.
	5. Overdrive Unit Overrunning Clutch Rollers Worn/Scored.	5. Remove and overhaul overdrive unit.

SERVICE PROCEDURES

FLUID LEVEL CHECK

Transmission fluid level should be checked monthly under normal operation. If the vehicle is used for trailer towing or similar heavy load hauling, check fluid level and condition weekly. Fluid level is checked with the engine running at curb idle speed, the transmission in NEUTRAL and the transmission fluid at normal operating temperature.

FLUID LEVEL CHECK PROCEDURE

(1) Transmission fluid must be at normal operating temperature for accurate fluid level check. Drive vehicle if necessary to bring fluid temperature up to normal hot operating temperature of 82°C (180°F).

(2) Position vehicle on level surface.

(3) Start and run engine at curb idle speed.

(4) Apply parking brakes.

(5) Shift transmission momentarily into all gear ranges. Then shift transmission back to Neutral.

(6) Clean top of filler tube and dipstick to keep dirt from entering tube.

(7) Remove dipstick (Fig. 11) and check fluid level as follows:

(a) Correct acceptable level is in crosshatch area.

(b) Correct maximum level is to MAX arrow mark.

(c) Incorrect level is at or below MIN line.

(d) If fluid is low, add only enough Mopar® ATF Plus 3 to restore correct level. Do not overfill.

CAUTION: Do not overfill the transmission. Overfilling may cause leakage out the pump vent which can be mistaken for a pump seal leak. Overfilling will also cause fluid aeration and foaming as the excess fluid is picked up and churned by the gear train. This will significantly reduce fluid life.

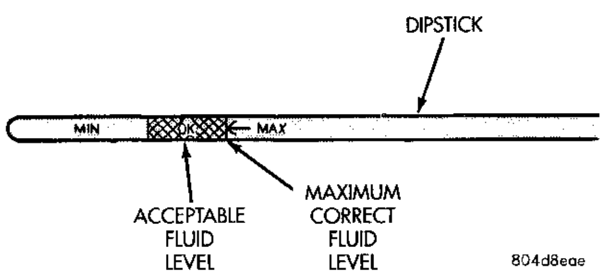

Fig. 11 Dipstick Fluid Level Marks—Typical

FLUID AND FILTER REPLACEMENT

Refer to the Maintenance Schedules in Group 0, Lubrication and Maintenance, for proper service intervals. The service fluid fill after a filter change is approximately 3.8 liters (4.0 quarts).

REMOVAL

(1) Hoist and support vehicle on safety stands.

(2) Place a large diameter shallow drain pan beneath the transmission pan.

(3) Remove bolts holding front and sides of pan to transmission (Fig. 12).

(4) Loosen bolts holding rear of pan to transmission.

(5) Slowly separate front of pan away from transmission allowing the fluid to drain into drain pan.

(6) Hold up pan and remove remaining bolt holding pan to transmission.

(7) While holding pan level, lower pan away from transmission.

(8) Pour remaining fluid in pan into drain pan.

(9) Remove screws holding filter to valve body (Fig. 13).

(10) Separate filter from valve body and pour fluid in filter into drain pan.

(11) Dispose of used trans fluid and filter properly.

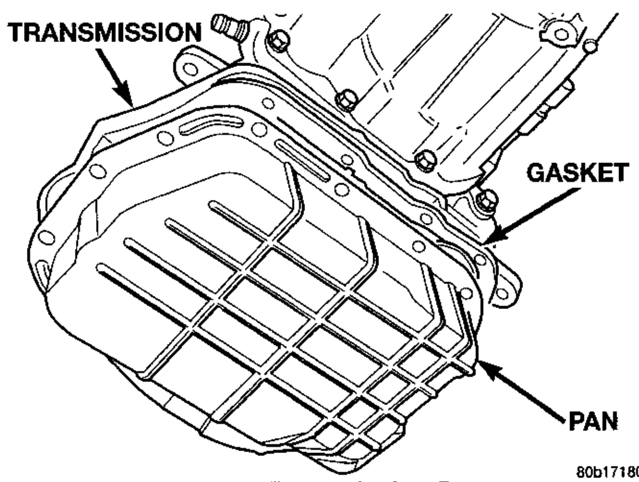

Fig. 12 Transmission Pan

INSPECTION

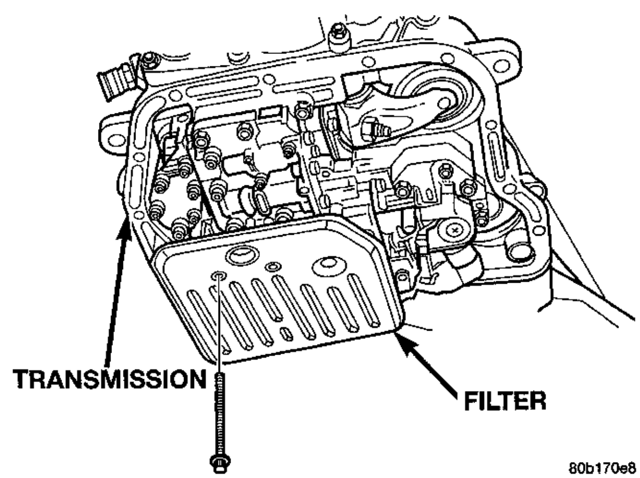

Fig. 13 Transmission Filter

Inspect bottom of pan and magnet for excessive amounts of metal or fiber contamination. A light

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SERVICE PROCEDURES (Continued)

coating of clutch or band material on the bottom of the pan does not indicate a problem unless accompanied by slipping condition or shift lag. If fluid and pan are contaminated with excessive amounts or debris, refer to the diagnosis section of this group.

Check the adjustment of the front and rear bands, adjust if necessary.

CLEANING

(1) Using a suitable solvent, clean pan and magnet.

(2) Using a suitable gasket scraper, clean gasket material from gasket surface of transmission case and the gasket flange around the pan.

INSTALLATION

(1) Place replacement filter in position on valve body.

(2) Install screws to hold filter to valve body (Fig. 13). Tighten screws to 4 N·m (35 in. lbs.) torque.

(3) Place new gasket in position on pan and install pan on transmission.

(4) Place pan in position on transmission.

(5) Install screws to hold pan to transmission (Fig. 12). Tighten bolts to 17 N·m (150 in. lbs.) torque.

(6) Lower vehicle and fill transmission with Mopar® ATF Plus 3, type 7176 fluid.

TRANSMISSION FILL PROCEDURE

To avoid overfilling transmission after a fluid change or overhaul, perform the following procedure:

(1) Remove dipstick and insert clean funnel in transmission fill tube.

(2) Add following initial quantity of Mopar® ATF Plus 3 to transmission:

(a) If only fluid and filter were changed, add **3 pints (1-1/2 quarts)** of ATF Plus 3 to transmission.

(b) If transmission was completely overhauled, torque converter was replaced or drained, and cooler was flushed, add **12 pints (6 quarts)** of ATF Plus 3 to transmission.

(3) Apply parking brakes.

(4) Start and run engine at normal curb idle speed.

(5) Apply service brakes, shift transmission through all gear ranges then back to NEUTRAL, set parking brake, and leave engine running at curb idle speed.

(6) Remove funnel, insert dipstick and check fluid level. If level is low, **add fluid to bring level to MIN mark on dipstick.** Check to see if the oil level is equal on both sides of the dipstick. If one side is noticably higher than the other, the dipstick has picked up some oil from the dipstick tube. Allow the oil to drain down the dipstick tube and re-check.

(7) Drive vehicle until transmission fluid is at normal operating temperature.

(8) With the engine running at curb idle speed, the gear selector in NEUTRAL, and the parking brake applied, check the transmission fluid level.

CAUTION: Do not overfill transmission, fluid foaming and shifting problems can result.

(9) Add fluid to bring level up to MAX arrow mark.

When fluid level is correct, shut engine off, release park brake, remove funnel, and install dipstick in fill tube.

CONVERTER DRAINBACK CHECK VALVE SERVICE

The converter drainback check valve is located in the cooler outlet (pressure) line near the radiator lower tank. The valve prevents fluid drainback when the vehicle is parked for lengthy periods. The valve check ball is spring loaded and has an opening pressure of approximately 2 psi.

The valve is serviced as an assembly; it is not repairable. Do not clean the valve if restricted, or contaminated by sludge, or debris. If the valve fails, or if a transmission malfunction occurs that generates sludge and/or clutch particles and metal shavings, the valve must be replaced.

The valve must be removed whenever the cooler and lines are reverse flushed. The valve can be flow tested when necessary. The procedure is exactly the same as for flow testing a cooler.

If the valve is restricted, installed backwards, or in the wrong line, it will cause an overheating condition and possible transmission failure.

CAUTION: The drainback valve is a one-way flow device. It must be properly oriented in terms of flow direction for the cooler to function properly. The valve must be installed in the pressure line. Otherwise flow will be blocked and would cause an overheating condition and eventual transmission failure.

OIL PUMP VOLUME CHECK

After the new or repaired transmission has been installed, fill to the proper level with Mopar® ATF PLUS 3 (Type 7176) automatic transmission fluid. The volume should be checked using the following procedure:

(1) Disconnect the **From cooler** line at the transmission and place a collecting container under the disconnected line.

CAUTION: With the fluid set at the proper level, fluid collection should not exceed (1) quart or internal damage to the transmission may occur.

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SERVICE PROCEDURES (Continued)

(2) Run the engine **at curb idle speed**, with the shift selector in neutral.

(3) If fluid flow is intermittent or it takes more than 20 seconds to collect one quart of ATF PLUS 3, disconnect the **To Cooler** line at the transaxle.

(4) Refill the transaxle to proper level and recheck pump volume.

(5) If flow is found to be within acceptable limits, replace the cooler. Then fill transmission to the proper level, using Mopar® ATF PLUS 3 (Type 7176) automatic transmission fluid.

(6) If fluid flow is still found to be inadequate, check the line pressure using the Transaxle Hydraulic Pressure Test procedure.

FLUSHING COOLERS AND TUBES

When a transmission failure has contaminated the fluid, the oil cooler(s) must be flushed. The cooler bypass valve in the transmission must be replaced also. The torque converter must also be replaced. This will insure that metal particles or sludged oil are not later transferred back into the reconditioned (or replaced) transmission.

The only recommended procedure for flushing coolers and lines is to use Tool 6906 Cooler Flusher.

WARNING: WEAR PROTECTIVE EYEWEAR THAT MEETS THE REQUIREMENTS OF OSHA AND ANSI Z87.1–1968. WEAR STANDARD INDUSTRIAL RUBBER GLOVES.

KEEP LIGHTED CIGARETTES, SPARKS, FLAMES, AND OTHER IGNITION SOURCES AWAY FROM THE AREA TO PREVENT THE IGNITION OF COMBUSTIBLE LIQUIDS AND GASES. KEEP A CLASS (B) FIRE EXTINGUISHER IN THE AREA WHERE THE FLUSHER WILL BE USED.

KEEP THE AREA WELL VENTILATED.

DO NOT LET FLUSHING SOLVENT COME IN CONTACT WITH YOUR EYES OR SKIN: IF EYE CONTAMINATION OCCURS, FLUSH EYES WITH WATER FOR 15 TO 20 SECONDS. REMOVE CONTAMINATED CLOTHING AND WASH AFFECTED SKIN WITH SOAP AND WATER. SEEK MEDICAL ATTENTION.

COOLER FLUSH USING TOOL 6906

(1) Remove cover plate filler plug on Tool 6906. Fill reservoir 1/2 to 3/4 full of fresh flushing solution. Flushing solvents are petroleum based solutions generally used to clean automatic transmission components. **DO NOT** use solvents containing acids, water, gasoline, or any other corrosive liquids.

(2) Reinstall filler plug on Tool 6906.

(3) Verify pump power switch is turned OFF. Connect red alligator clip to positive (+) battery post. Connect black (-) alligator clip to a good ground.

(4) Disconnect the cooler lines at the transmission.

NOTE: When flushing transmission cooler and lines, ALWAYS reverse flush.

(5) Connect the BLUE pressure line to the OUTLET (From) cooler line.

(6) Connect the CLEAR return line to the INLET (To) cooler line

(7) Turn pump ON for two to three minutes to flush cooler(s) and lines. Monitor pressure readings and clear return lines. Pressure readings should stabilize below 20 psi. for vehicles equipped with a single cooler and 30 psi. for vehicles equipped with dual coolers. If flow is intermittent or exceeds these pressures, replace cooler.

(8) Turn pump OFF.

(9) Disconnect CLEAR suction line from reservoir at cover plate. Disconnect CLEAR return line at cover plate, and place it in a drain pan.

(10) Turn pump ON for 30 seconds to purge flushing solution from cooler and lines. Turn pump OFF.

(11) Place CLEAR suction line into a one quart container of Mopar® ATF Plus 3, type 7176 automatic transmission fluid.

(12) Turn pump ON until all transmission fluid is removed from the one quart container and lines. This purges any residual cleaning solvent from the transmission cooler and lines. Turn pump OFF.

(13) Disconnect alligator clips from battery. Reconnect flusher lines to cover plate, and remove flushing adapters from cooler lines.

ALUMINUM THREAD REPAIR

Damaged or worn threads in the aluminum transaxle case and valve body can be repaired by the use of Heli-Coils, or equivalent. This repair consists of drilling out the worn-out damaged threads. Then tap the hole with a special Heli-Coil tap, or equivalent, and installing a Heli-Coil insert, or equivalent, into the hole. This brings the hole back to its original thread size.

Heli-Coil, or equivalent, tools and inserts are readily available from most automotive parts suppliers.

REMOVAL AND INSTALLATION

TRANSMISSION

The overdrive unit can be removed and serviced separately. It is not necessary to remove the entire transmission assembly to perform overdrive unit repairs.

If only the overdrive unit requires service, refer to the overdrive unit removal and installation procedures.

Mopar AUTHENTIC RESTORATION PRODUCT

REMOVAL AND INSTALLATION (Continued)

CAUTION: The transmission and torque converter must be removed as an assembly to avoid component damage. The converter drive plate, pump bushing, or oil seal can be damaged if the converter is left attached to the driveplate during removal. Be sure to remove the transmission and converter as an assembly.

REMOVAL

(1) Disconnect battery negative cable.

(2) Disconnect and lower or remove necessary exhaust components.

(3) Remove engine-to-transmission struts, if equipped (Fig. 14).

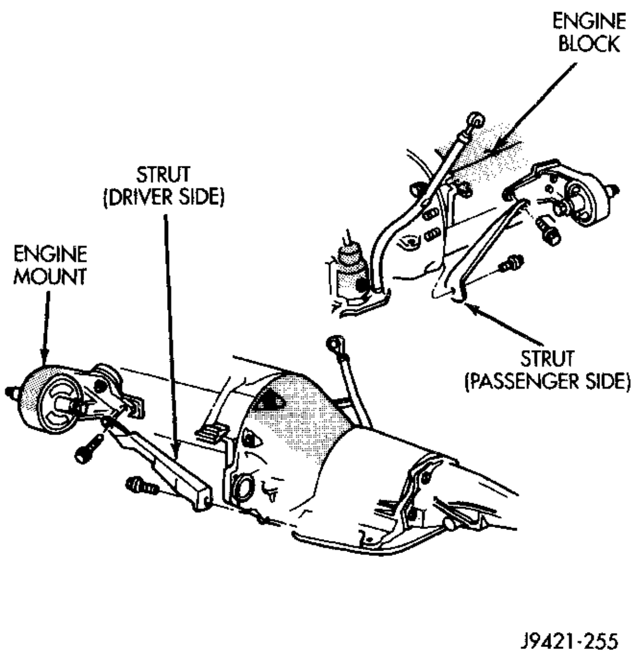

Fig. 14 Transmission-To-Engine Strut Attachment

(4) Disconnect fluid cooler lines at transmission.

(5) Remove starter motor.

(6) Disconnect and remove the crankshaft position sensor. Retain the sensor attaching bolts.

(7) Remove torque converter access cover.

(8) If transmission is being removed for overhaul, remove transmission oil pan, drain fluid and reinstall pan.

(9) Remove fill tube bracket bolts and pull tube out of transmission. Retain fill tube seal (Fig. 14). On 4 x 4 models, it will also be necessary to remove bolt attaching transfer case vent tube to converter housing (Fig. 15).

(10) Mark torque converter and drive plate for assembly alignment. Note that bolt holes in crankshaft flange, drive plate and torque converter all have one offset hole.

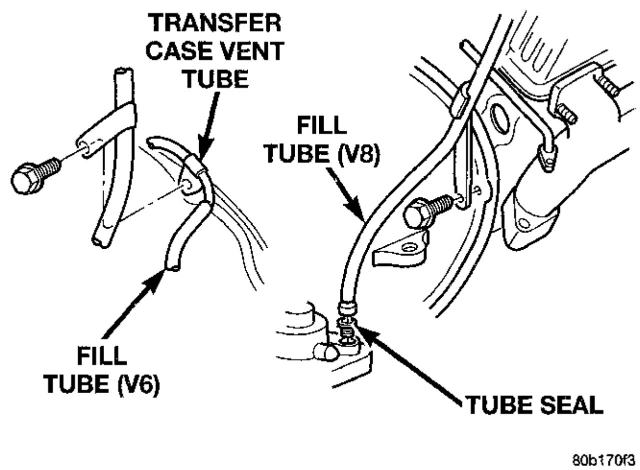

Fig. 15 Fill Tube Attachment

(11) Rotate crankshaft in clockwise direction until converter bolts are accessible. Then remove bolts one at a time. Rotate crankshaft with socket wrench on dampener bolt.

(12) Mark propeller shaft and axle yokes for assembly alignment. Then disconnect and remove propeller shaft. On 4 x 4 models, remove both propeller shafts.

(13) Disconnect wires from park/neutral position switch and transmission solenoid.

(14) Disconnect gearshift rod and torque shaft assembly from transmission.

(15) Disconnect throttle valve cable from transmission bracket and throttle valve lever.

(16) On 4 x 4 models, disconnect shift rod from transfer case shift lever.

(17) Support rear of engine with safety stand or jack.

(18) Raise transmission slightly with service jack to relieve load on crossmember and supports.

(19) Remove bolts securing rear support and cushion to transmission and crossmember. Raise transmission slightly, slide exhaust hanger arm from bracket (Fig. 16) and remove rear support.

(20) Remove bolts attaching crossmember to frame and remove crossmember.

(21) On 4 x 4 models, remove transfer case with transmission jack or aid of helper.

(22) Remove all converter housing bolts.

(23) Carefully work transmission and torque converter assembly rearward off engine block dowels.

(24) Lower transmission and remove assembly from under the vehicle.

(25) To remove torque converter, remove C-clamp from edge of bell housing and carefully slide torque converter out of the transmission.

REMOVAL AND INSTALLATION (Continued)

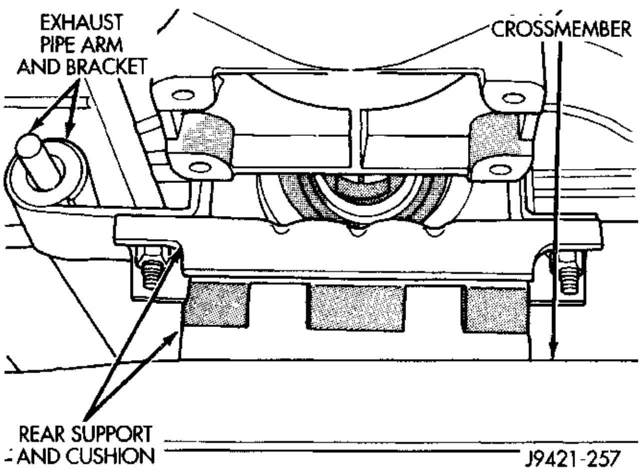

Fig. 16 Rear Support Cushion

INSTALLATION

(1) Check torque converter hub and hub drive notches for sharp edges burrs, scratches, or nicks. Polish the hub and notches with 320/400 grit paper and crocus cloth if necessary. The hub must be smooth to avoid damaging pump seal at installation.

(2) Lubricate converter drive hub and oil pump seal lip with transmission fluid.

(3) Lubricate converter pilot hub with transmission fluid.

(4) Align and install converter in oil pump.

(5) Carefully insert converter in oil pump. Then rotate converter back and forth until fully seated in pump gears.

(6) Check converter seating with steel scale and straightedge (Fig. 17). Surface of converter lugs should be 1/2 in. to rear of straightedge when converter is fully seated.

(7) Temporarily secure converter with C-clamp.

(8) Position transmission on jack and secure it with chains.

(9) Check condition of converter driveplate. Replace the plate if cracked, distorted or damaged. **Also be sure transmission dowel pins are seated in engine block and protrude far enough to hold transmission in alignment.**

(10) Raise transmission and align converter with drive plate and converter housing with engine block.

(11) Move transmission forward. Then raise, lower or tilt transmission to align converter housing with engine block dowels.

(12) Rotate converter so alignment marks scribed on converter are aligned with mark on driveplate.

(13) Carefully work transmission forward and over engine block dowels until converter hub is seated in crankshaft.

(14) Install bolts attaching converter housing to engine.

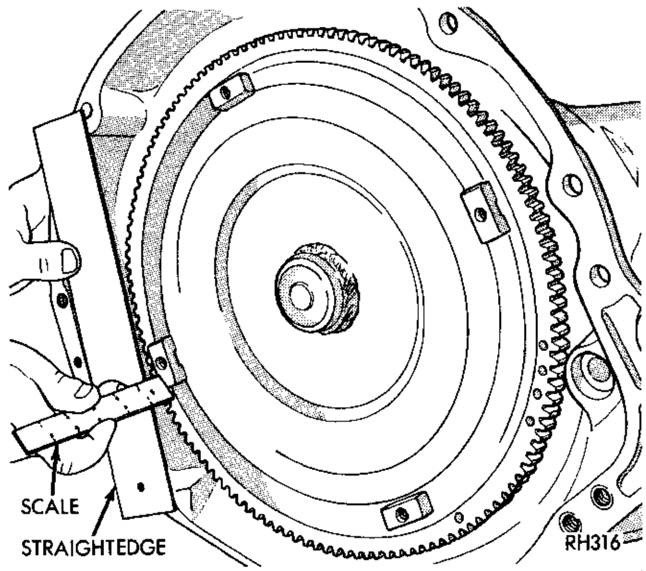

Fig. 17 Typical Method Of Checking Converter Seating

(15) Install rear support. Then lower transmission onto crossmember and install bolts attaching transmission mount to crossmember.

(16) Remove engine support fixture.

(17) Install crankshaft position sensor.

(18) Install new plastic retainer grommet on any shift linkage rod or lever that was disconnected. Grommets should not be reused. Use pry tool to remove rod from grommet and cut away old grommet. Use pliers to snap new grommet into lever and to snap rod into grommet at assembly.

(19) Connect gearshift and throttle cable to transmission.

(20) Connect wires to park/neutral position switch, transmission solenoid(s) and oxygen sensor. Be sure transmission harnesses are properly routed.

CAUTION: It is essential that correct length bolts be used to attach the converter to the driveplate. Bolts that are too long will damage the clutch surface inside the converter.

(21) Install torque converter-to-driveplate bolts. On models with 10.75 in. converter, tighten bolts to 31 N·m (270 in. lbs.). On models with 12.2 in. converter, tighten bolts to 47 N·m (35 ft. lbs.).

(22) Install converter housing access cover.

(23) Install starter motor and cooler line bracket.

(24) Connect cooler lines to transmission.

(25) Install transmission fill tube. Install new seal on tube before installation.

(26) Install exhaust components.

(27) Align and connect propeller shaft.

(28) Adjust gearshift linkage and throttle valve cable if necessary.

REMOVAL AND INSTALLATION (Continued)

(29) Lower vehicle.

(30) Fill transmission with Mopar® ATF Plus 3, Type 7176 fluid.

TORQUE CONVERTER

REMOVAL

(1) Remove transmission and torque converter from vehicle.

(2) Place a suitable drain pan under the converter housing end of the transmission.

CAUTION: Verify that transmission is secure on the lifting device or work surface, the center of gravity of the transmission will shift when the torque converter is removed creating an unstable condition.

The torque converter is a heavy unit. Use caution when separating the torque converter from the transmission.

(3) Pull the torque converter forward until the center hub clears the oil pump seal.

(4) Separate the torque converter from the transmission.

INSTALLATION

Check converter hub and drive notches for sharp edges, burrs, scratches, or nicks. Polish the hub and notches with 320/400 grit paper or crocus cloth if necessary. The hub must be smooth to avoid damaging the pump seal at installation.

(1) Lubricate converter hub and oil pump seal lip with transmission fluid.

(2) Place torque converter in position on transmission.

CAUTION: Do not damage oil pump seal or bushing while inserting torque converter into the front of the transmission.

(3) Align torque converter to oil pump seal opening.

(4) Insert torque converter hub into oil pump.

(5) While pushing torque converter inward, rotate converter until converter is fully seated in the oil pump gears.

(6) Check converter seating with a scale and straightedge (Fig. 18). Surface of converter lugs should be 1/2 in. to rear of straightedge when converter is fully seated.

(7) If necessary, temporarily secure converter with C-clamp attached to the converter housing.

(8) Install the transmission in the vehicle.

(9) Fill the transmission with the recommended fluid.

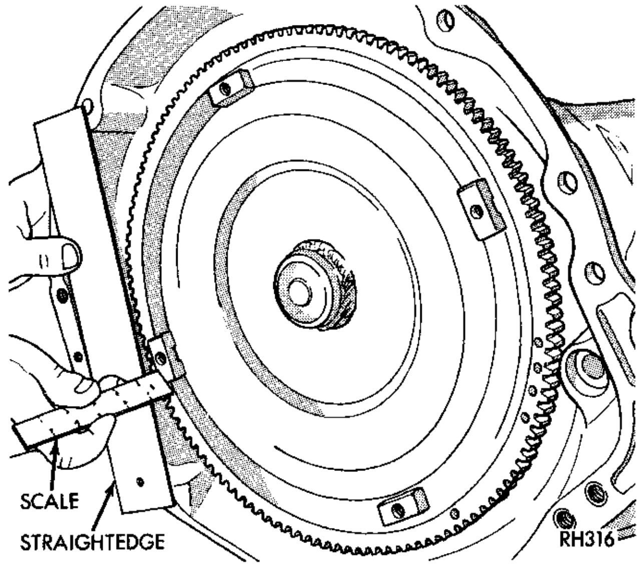

Fig. 18 Checking Torque Converter Seating

YOKE SEAL REPLACEMENT

REMOVAL

(1) Raise vehicle.

(2) Mark propeller shaft and axle yoke for alignment reference.

(3) Disconnect and remove propeller shaft.

(4) Remove old seal with Seal Remover C-3985-B (Fig. 19) from overdrive housing.

INSTALLATION

(1) Place seal in position on overdrive housing.

(2) Drive seal into overdrive housing with Seal Installer C-3995-A (Fig. 20).

(3) Carefully guide propeller shaft slip yoke into housing and onto output shaft splines. Align marks made at removal and connect propeller shaft to rear axle pinion yoke.

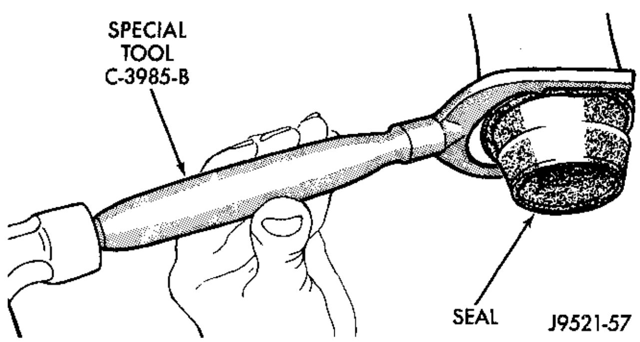

Fig. 19 Removing Overdrive Housing Yoke Seal

PARK/NEUTRAL POSITION SWITCH

REMOVAL

(1) Raise vehicle and position drain pan under switch.

REMOVAL AND INSTALLATION (Continued)

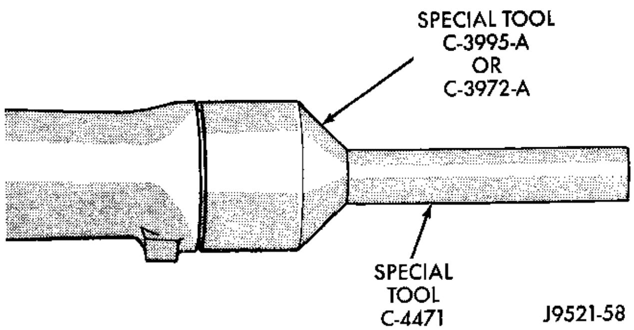

Fig. 20 Installing Overdrive Housing Yoke Seal

(2) Disconnect switch wires.
(3) Remove switch from case.

INSTALLATION

(1) Move shift lever to Park and Neutral positions. Verify that switch operating lever fingers are centered in switch opening in case (Fig. 21).

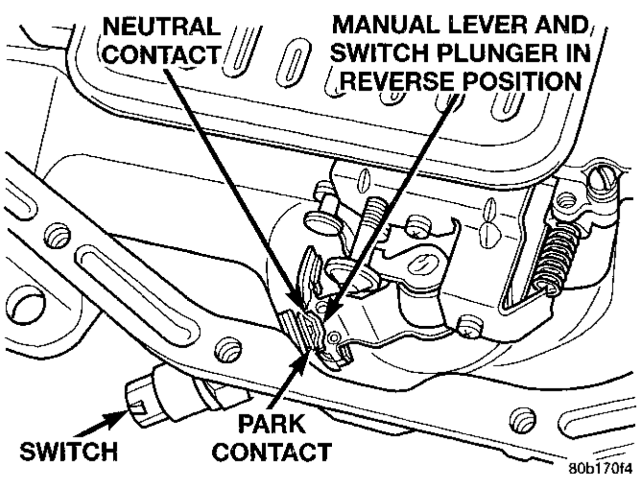

Fig. 21 Park/Neutral Position Switch

(2) Install new seal on switch and install switch in case. Tighten switch to 34 N·m (25 ft. lbs.) torque.
(3) Test continuity of new switch with 12V test lamp.
(4) Connect switch wires and lower vehicle.
(5) Top off transmission fluid level.

GOVERNOR SOLENOID AND PRESSURE SENSOR

REMOVAL

(1) Hoist and support vehicle on safety stands.
(2) Remove transmission fluid pan and filter.
(3) Disengage wire connectors from pressure sensor and solenoid (Fig. 22).
(4) Remove screws holding pressure solenoid retainer to governor body.
(5) Separate solenoid retainer from governor (Fig. 23).
(6) Pull solenoid from governor body (Fig. 24).
(7) Remove bolts holding governor body to valve body.
(8) Separate governor body from valve body (Fig. 25).
(9) Remove governor body gasket.
(10) Remove retainer holding pressure sensor to governor body.
(11) Pull pressure sensor from governor body (Fig. 26).

INSTALLATION

Before installing the pressure sensor and solenoid in the governor body, replace O-ring seals, clean the gasket surfaces and replace gasket.

(1) Lubricate O-ring on pressure sensor with transmission fluid.
(2) Align pressure sensor to bore in governor body (Fig. 26).
(3) Push pressure sensor into governor body.
(4) Install retainer to hold pressure sensor to governor body.
(5) Place gasket in position on back of governor body (Fig. 25).
(6) Place governor body in position on valve body.
(7) Install bolts to hold governor body to valve body.
(8) Lubricate O-ring, on pressure solenoid, with transmission fluid.
(9) Align pressure solenoid to bore in governor body (Fig. 24).
(10) Push solenoid into governor body.
(11) Place solenoid retainer in position on governor (Fig. 23).
(12) Install screws to hold pressure solenoid retainer to governor body.
(13) Engage wire connectors into pressure sensor and solenoid (Fig. 22).
(14) Install transmission fluid pan and (new) filter.
(15) Lower vehicle and road test to verify repair.

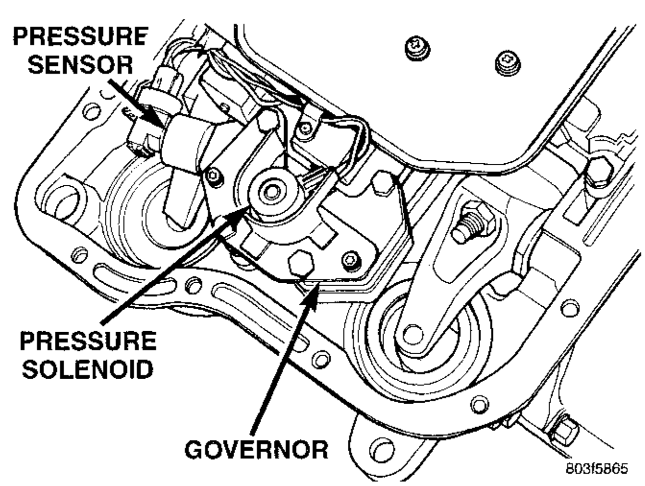

Fig. 22 Governor Solenoid And Pressure Sensor

REMOVAL AND INSTALLATION (Continued)

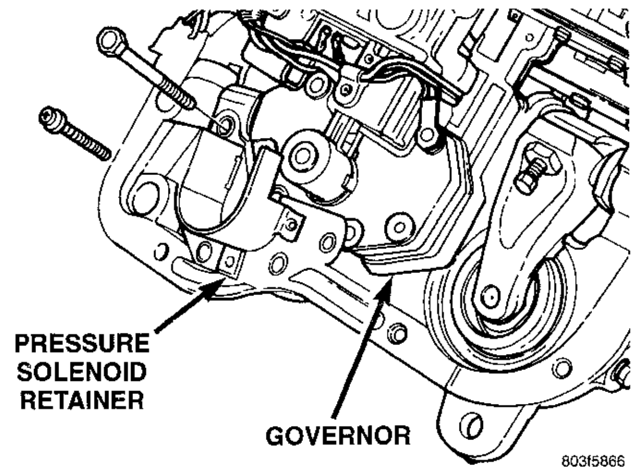

Fig. 23 Pressure Solenoid Retainer

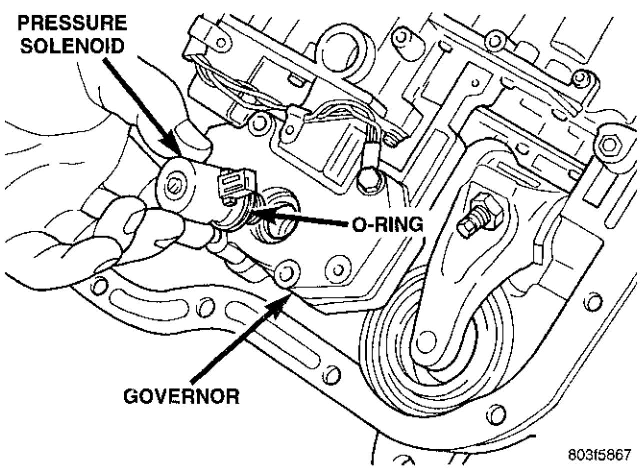

Fig. 24 Pressure Solenoid and O-ring

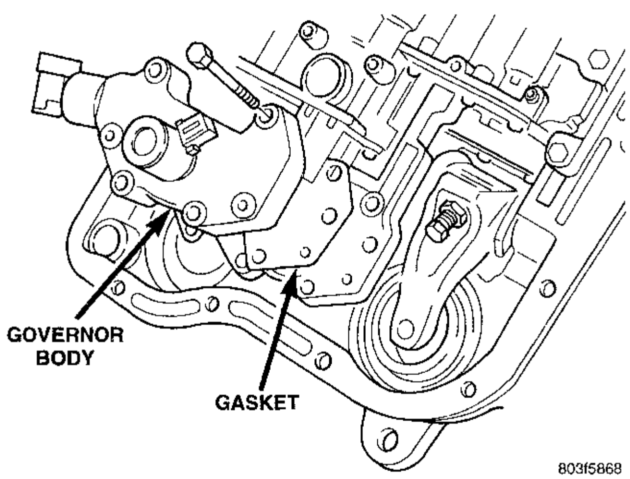

Fig. 25 Governor Body and Gasket

VALVE BODY

The valve body can be removed for service without having to remove the transmission assembly.

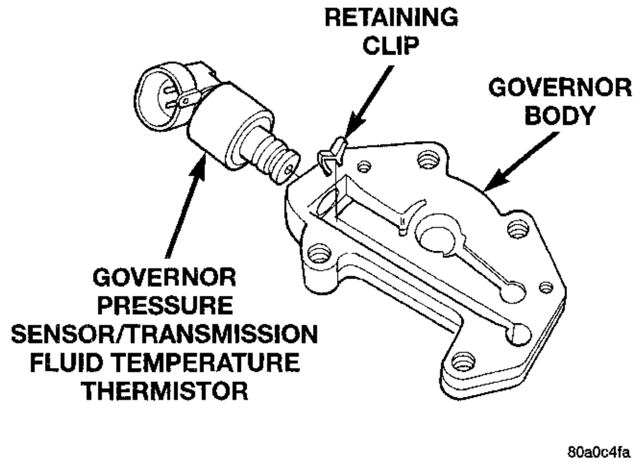

Fig. 26 Pressure Sensor and Retainer

The valve body can be disassembled for cleaning and inspection of the individual components. Refer to Disassembly and Assembly section for proper procedures.

The only replaceable valve body components are:

- Manual lever.
- Manual lever washer, seal, E-clip, and shaft seal.
- Manual lever detent ball.
- Throttle lever.
- Fluid filter.
- Pressure adjusting screw bracket.
- Governor pressure solenoid.
- Governor pressure sensor.
- Converter clutch/overdrive solenoid assembly and harness (includes sump temperature thermistor).
- Governor housing gasket.
- Solenoid case connector O-rings.

The remaining valve body components are serviced only as part of a complete valve body assembly.

REMOVAL

(1) Shift transmission into NEUTRAL.

(2) Raise vehicle.

(3) Remove gearshift and throttle levers from shaft of valve body manual lever.

(4) Disconnect wires at solenoid case connector (Fig. 27).

(5) Position drain pan under transmission oil pan.

(6) Remove transmission oil pan and gasket.

(7) Remove fluid filter from valve body.

(8) Remove bolts attaching valve body to transmission case.

(9) Lower valve body enough to remove accumulator piston and springs.

(10) Work manual lever shaft and electrical connector out of transmission case.

REMOVAL AND INSTALLATION (Continued)

(11) Lower valve body, rotate valve body away from case, pull park rod out of sprag, and remove valve body (Fig. 28).

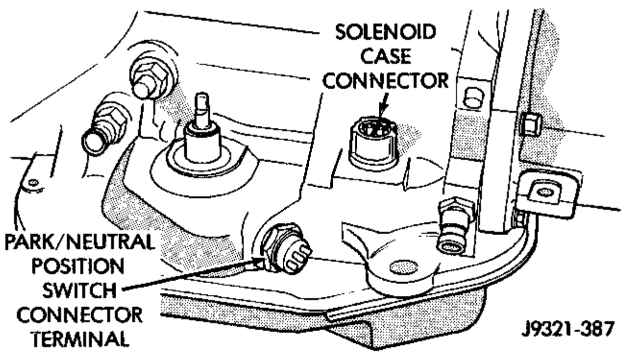

Fig. 27 Transmission Case Connector

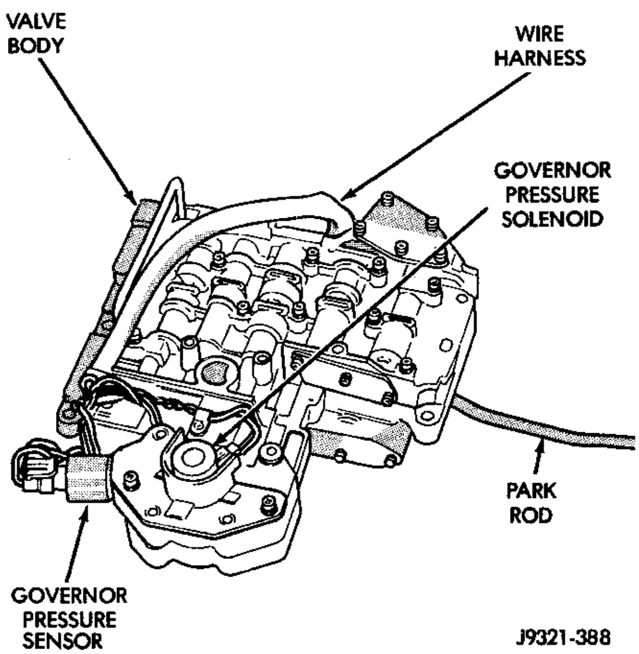

Fig. 28 Valve Body

INSTALLATION

(1) Check condition of O-ring seals on valve body harness connector (Fig. 29). Replace seals on connector body if cut or worn.

(2) Check condition of manual lever shaft seal in transmission case. Replace seal if lip is cut or worn. Install new seal with 15/16 deep well socket (Fig. 30).

(3) Check condition of seals on accumulator piston (Fig. 31). Install new piston seals, if necessary.

(4) Place valve body manual lever in low (1 position) so ball on park lock rod will be easier to install in sprag.

(5) Lubricate shaft of manual lever with petroleum jelly. This will ease inserting shaft through seal in case.

(6) Lubricate seal rings on valve body harness connector with petroleum jelly.

(7) Position valve body in case and work end of park lock rod into and through pawl sprag. Turn propeller shaft to align sprag and park lock teeth if necessary. The rod will click as it enters pawl. Move rod to check engagement.

CAUTION: It is possible for the park rod to displace into a cavity just above the pawl sprag during installation. Make sure the rod is actually engaged in the pawl and has not displaced into this cavity.

(8) Install accumulator springs and piston into case. Then swing valve body over piston and outer spring to hold it in place.

(9) Align accumulator piston and outer spring, manual lever shaft and electrical connector in case.

(10) Then seat valve body in case and install one or two bolts to hold valve body in place.

(11) Tighten valve body bolts alternately and evenly to 11 N·m (100 in. lbs.) torque.

(12) Install new fluid filter on valve body. Tighten filter screws to 4 N·m (35 in. lbs.) torque.

(13) Install throttle and gearshift levers on valve body manual lever shaft.

(14) Check and adjust front and rear bands if necessary.

(15) Connect solenoid case connector wires.

(16) Install oil pan and new gasket. Tighten pan bolts to 17 N·m (13 ft. lbs.) torque.

(17) Lower vehicle and fill transmission with Mopar® ATF Plus 3, type 7176 fluid.

(18) Check and adjust gearshift and throttle valve cables, if necessary.

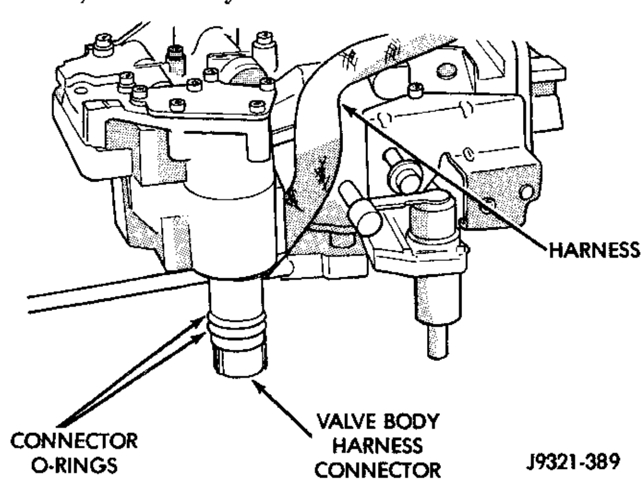

Fig. 29 Valve Body Harness Connector O-Ring Seal

REMOVAL AND INSTALLATION (Continued)

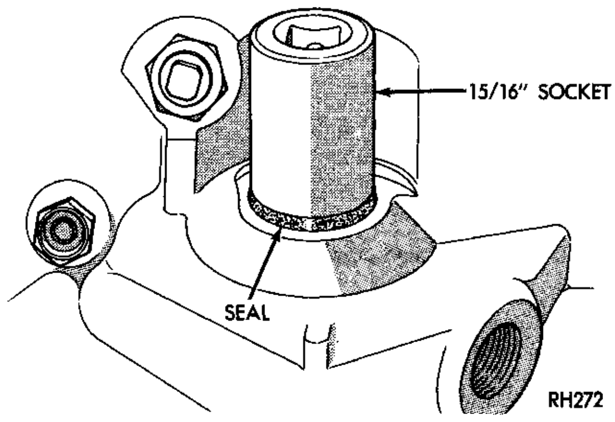

Fig. 30 Manual Lever Shaft Seal

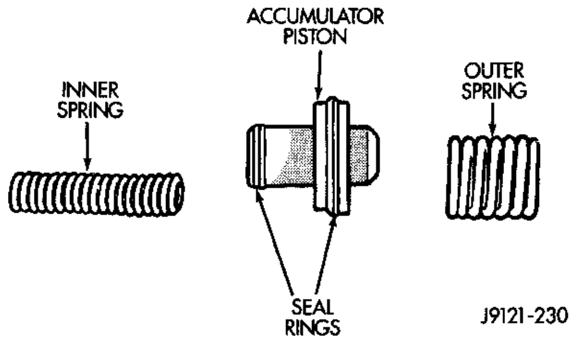

Fig. 31 Accumulator Piston Components

OVERDRIVE UNIT

REMOVAL

(1) Shift transmission into Park.

(2) Raise vehicle.

(3) Mark propeller shaft universal joint(s) and axle pinion yoke for alignment reference at installation.

(4) Disconnect and remove propeller shaft(s).

(5) Remove transmission oil pan, remove gasket, drain oil and reinstall pan.

(6) If overdrive unit had malfunctioned, or if fluid is contaminated, remove entire transmission. If diagnosis indicated overdrive problems only, remove just the overdrive unit.

(7) Support transmission with transmission jack.

(8) Remove vehicle speed sensor and speedometer adapter, if necessary.

(9) Remove bolts attaching overdrive unit to transmission (Fig. 32).

CAUTION: Support the overdrive unit with a jack before moving it rearward. This is necessary to prevent damaging the intermediate shaft. Do not allow the shaft to support the entire weight of the overdrive unit.

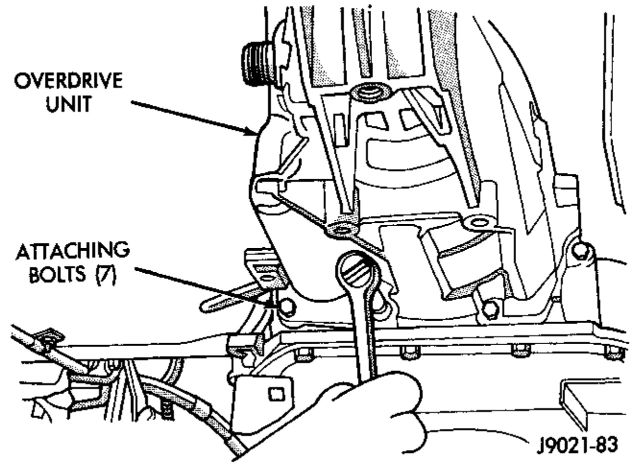

Fig. 32 Overdrive Unit Bolts

(10) Carefully work overdrive unit off intermediate shaft. Do not tilt unit during removal. Keep it as level as possible.

(11) If overdrive unit does not require service, immediately insert Alignment Tool 6227-2 in splines of planetary gear and overrunning clutch to prevent splines from rotating out of alignment. If misalignment occurs, overdrive unit will have to be disassembled in order to realign splines.

(12) Remove and retain overdrive piston thrust bearing. Bearing may remain on piston or in clutch hub during removal.

(13) Position drain pan on workbench.

(14) Place overdrive unit over drain pan. Tilt unit to drain residual fluid from case.

(15) Examine fluid for clutch material or metal fragments. If fluid contains these items, overhaul will be necessary.

(16) If overdrive unit does not require any service, leave alignment tool in position. Tool will prevent accidental misalignment of planetary gear and overrunning clutch splines.

INSTALLATION

(1) Be sure overdrive unit Alignment Tool 6227-2 is fully seated before moving unit. If tool is not seated and gear splines rotate out of alignment, overdrive unit will have to be disassembled in order to realign splines.

(2) If overdrive piston retainer was not removed during service and original case gasket is no longer reusable, prepare new gasket by trimming it.

(3) Cut out old case gasket around piston retainer with razor knife (Fig. 33).

(4) Use old gasket as template and trim new gasket to fit.

(5) Position new gasket over piston retainer and on transmission case. Use petroleum jelly to hold

REMOVAL AND INSTALLATION (Continued)

gasket in place if necessary. Do not use any type of sealer to secure gasket. Use petroleum jelly only.

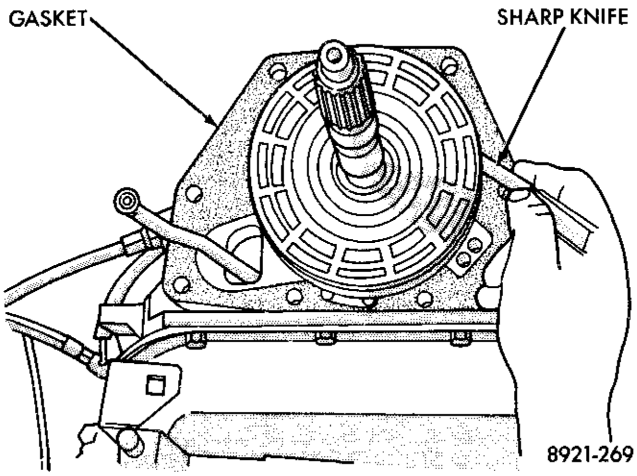

Fig. 33 Trimming Overdrive Case Gasket

(6) Install selective spacer on intermediate shaft, if removed. Spacer goes in groove just rearward of shaft rear splines (Fig. 34).

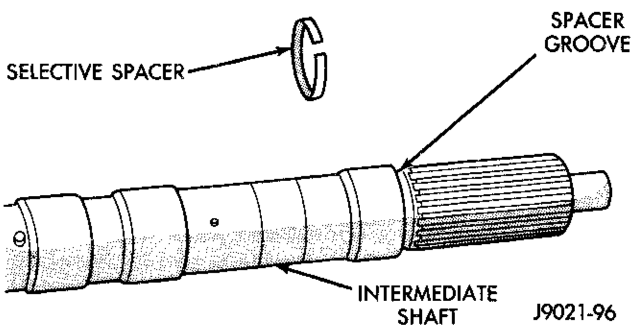

Fig. 34 Intermediate Shaft Selective Spacer Location

(7) Install thrust bearing in overdrive unit sliding hub. Use petroleum jelly to hold bearing in position.

CAUTION: Be sure the shoulder on the inside diameter of the bearing is facing forward.

(8) Verify that splines in overdrive planetary gear and overrunning clutch hub are aligned with Alignment Tool 6227-2. Overdrive unit cannot be installed if splines are not aligned. If splines have rotated out of alignment, unit will have to be disassembled to realign splines.

(9) Carefully slide Alignment Tool 6227-2 out of overdrive planetary gear and overrunning clutch splines.

(10) Raise overdrive unit and carefully slide it straight onto intermediate shaft. Insert park rod into park lock reaction plug at same time. Avoid tilting overdrive during installation as this could cause planetary gear and overrunning clutch splines to rotate out of alignment. If this occurs, it will be necessary to remove and disassemble overdrive unit to realign splines.

(11) Work overdrive unit forward on intermediate shaft until seated against transmission case.

(12) Install bolts attaching overdrive unit to transmission unit. Tighten bolts in diagonal pattern to 34 N·m (25 ft-lbs).

(13) Install speed sensor and speedometer adapter. Be sure to index adapter.

(14) Connect speed sensor and overdrive wires.

(15) Align and install propeller shaft.

OVERDRIVE HOUSING BUSHING

REMOVAL

(1) Remove overdrive housing yoke seal.

(2) Insert Remover 6957 into overdrive housing. Tighten tool to bushing and remove bushing (Fig. 35).

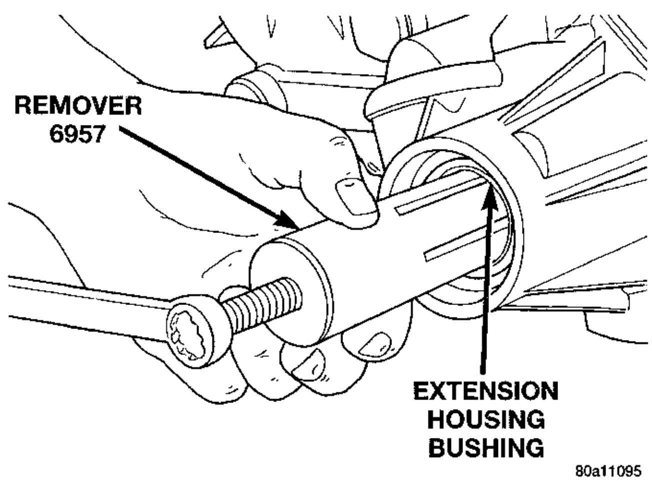

Fig. 35 Bushing Removal—Typical

INSTALLATION

(1) Align bushing oil hole with oil slot in overdrive housing.

(2) Tap bushing into place with Installer 6951 and Handle C-4171.

(3) Install new oil seal in housing using Seal Installer C-3995–A (Fig. 36).

OUTPUT SHAFT REAR BEARING

REMOVAL

(1) Remove overdrive unit from the vehicle.

(2) Remove overdrive geartrain from housing.

(3) Remove snap ring holding output shaft rear bearing into overdrive housing (Fig. 37).

(4) Using a suitable driver inserted through the rear end of housing, drive bearing from housing.

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REMOVAL AND INSTALLATION (Continued)

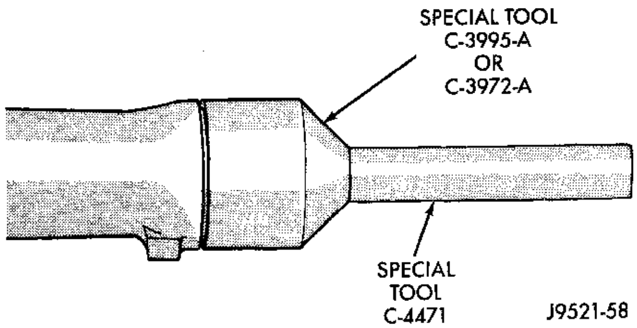

Fig. 36 Overdrive Housing Seal Installation

INSTALLATION

(1) Place replacement bearing in position in housing.
(2) Using a suitable driver, drive bearing into housing until the snap ring groove is visible.
(3) Install snap ring to hold bearing into housing (Fig. 37).
(4) Install overdrive geartrain into housing.
(5) Install overdrive unit in vehicle.

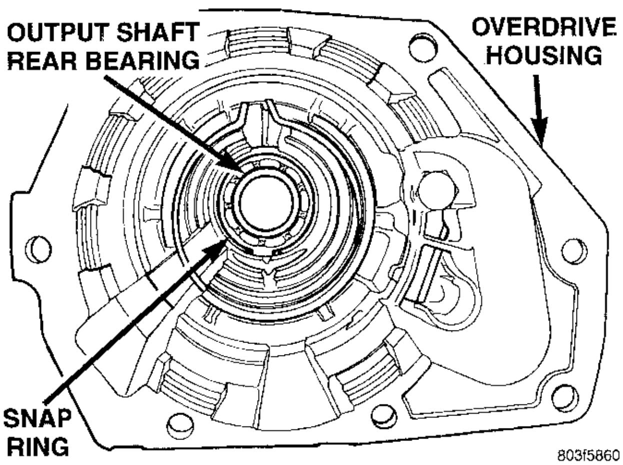

Fig. 37 Output Shaft Rear Bearing

OUTPUT SHAFT FRONT BEARING

REMOVAL

(1) Remove overdrive unit from the vehicle.
(2) Remove overdrive geartrain from housing.
(3) Remove snap ring holding output shaft front bearing to overdrive geartrain. (Fig. 38).
(4) Pull bearing from output shaft.

INSTALLATION

(1) Place replacement bearing in position on geartrain with locating retainer groove toward the rear.
(2) Push bearing onto shaft until the snap ring groove is visible.
(3) Install snap ring to hold bearing onto output shaft (Fig. 38).
(4) Install overdrive geartrain into housing.
(5) Install overdrive unit in vehicle.

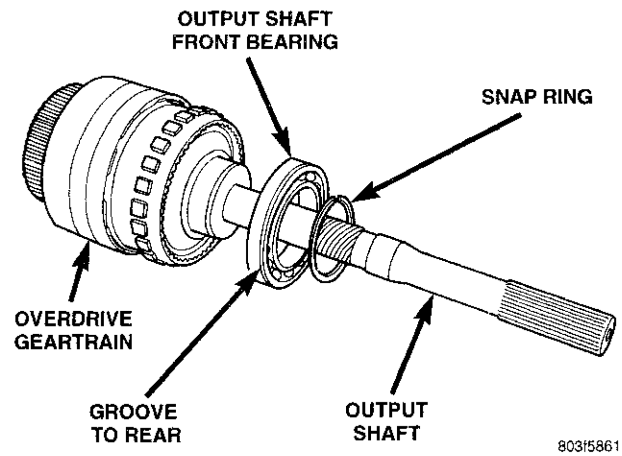

Fig. 38 Output Shaft Front Bearing

DISASSEMBLY AND ASSEMBLY

VALVE BODY

Remove the valve body from the transmission, refer to Removal and Installation procedures section in this group.

DISASSEMBLY

CAUTION: Do not clamp any valve body component in a vise. This practice can damage the component resulting in unsatisfactory operation after assembly and installation. Do not use pliers to remove any of the valves, plugs or springs and do not force any of the components out or into place. The valves and valve body housings will be damaged if force is used. Tag or mark the valve body springs for reference as they are removed. Do not allow them to become intermixed.

(1) Remove fluid filter.
(2) Disconnect wires from governor pressure sensor and solenoid (Fig. 39).

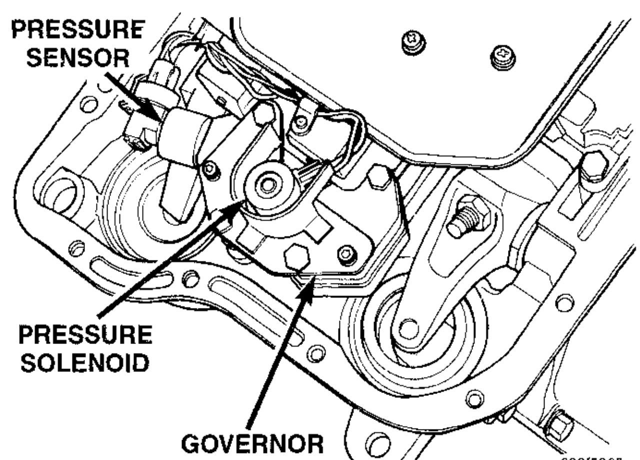

Fig. 39 Governor Pressure Solenoid And Sensor Wire Locations

DISASSEMBLY AND ASSEMBLY (Continued)

(3) Remove screws attaching governor body and retainer plate to transfer plate (Fig. 40).

(4) Remove retainer plate, governor body and gasket from transfer plate (Fig. 41).

(5) Disconnect wires from governor pressure sensor, if not done previously.

(6) Remove governor pressure sensor from governor body. Sensor is retained in body with M-shaped spring clip (Fig. 42). Remove clip with small pointed tool and slide sensor out of body.

(7) Remove governor pressure solenoid by pulling it straight out of bore in governor body (Fig. 43). Remove and discard solenoid O-rings if worn, cut, or torn.

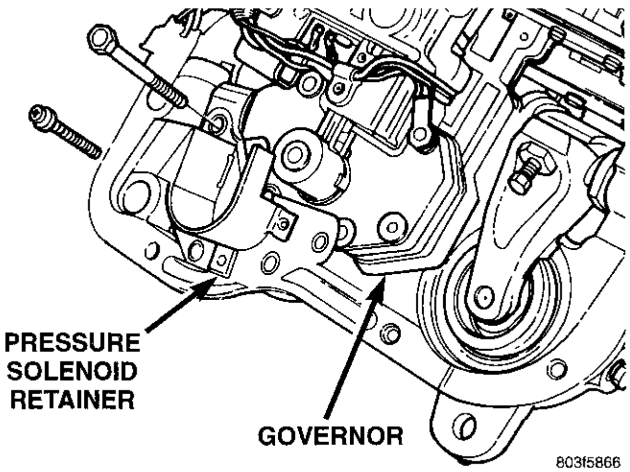

Fig. 40 Governor Body And Retainer Plate Attaching Screw

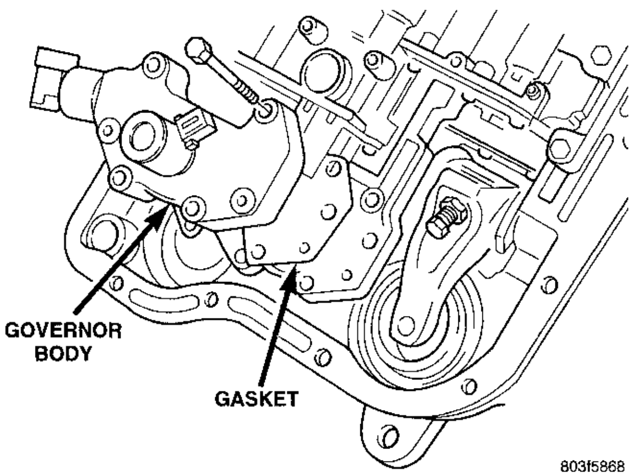

Fig. 41 Governor Body And Gasket

(8) Remove transmission fluid filter.

(9) Remove small shoulder bolt that secures solenoid harness case connector to 3-4 accumulator housing (Fig. 44). **Retain shoulder bolt. Either tape it to harness or thread it back into accumulator housing after connector removal.**

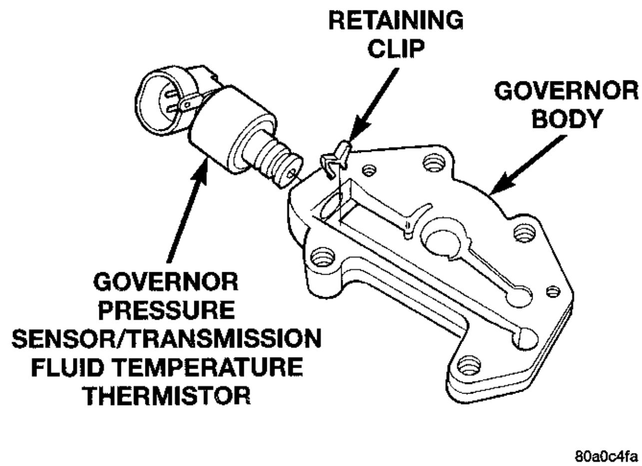

Fig. 42 Governor Pressure Sensor

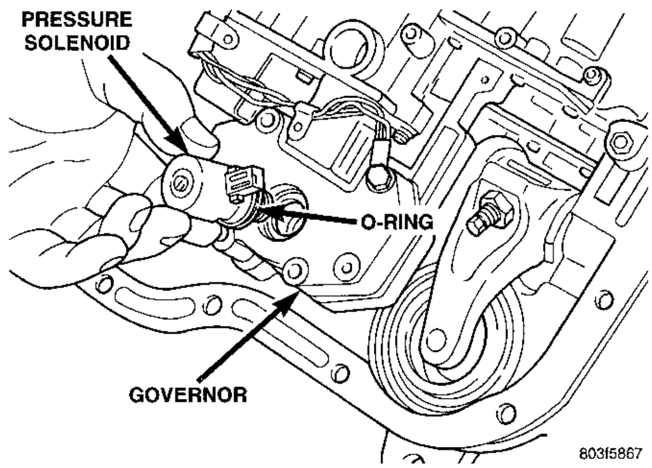

Fig. 43 Governor Pressure Solenoid

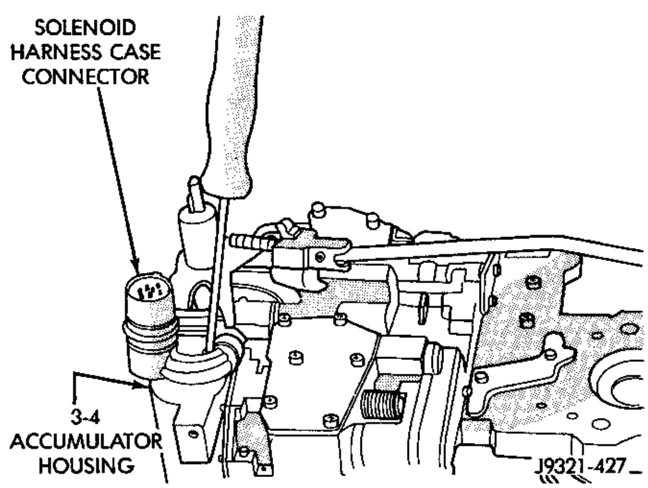

Fig. 44 Solenoid Harness Case Connector Shoulder Bolt

DISASSEMBLY AND ASSEMBLY (Continued)

(10) Unhook overdrive/converter solenoid harness from 3-4 accumulator cover plate (Fig. 45).

(11) Turn valve body over and remove screws that attach overdrive/converter solenoid assembly to valve body (Fig. 46).

(12) Remove solenoid and harness assembly from valve body (Fig. 47).

(13) Remove boost valve cover (Fig. 48).

(14) Remove boost valve retainer, valve spring and boost valve (Fig. 49).

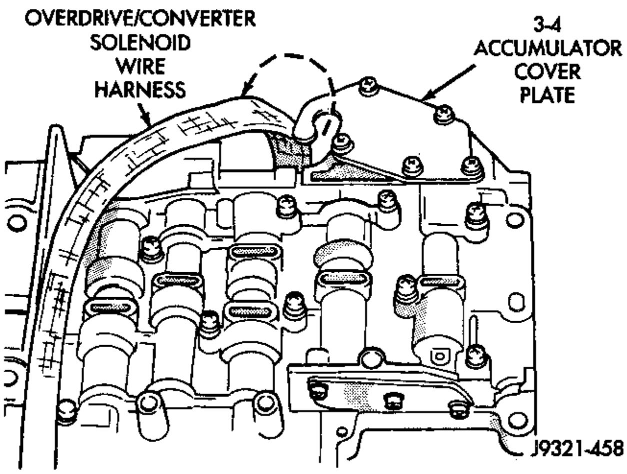

Fig. 45 Unhooking Solenoid Harness From Accumulator Cover Plate

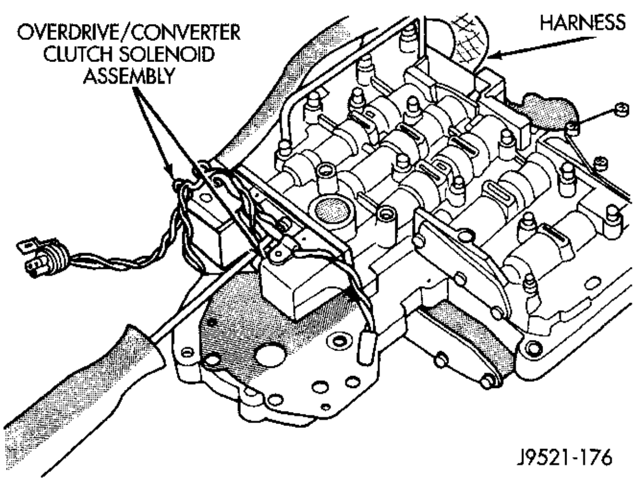

Fig. 46 Solenoid Assembly Screws

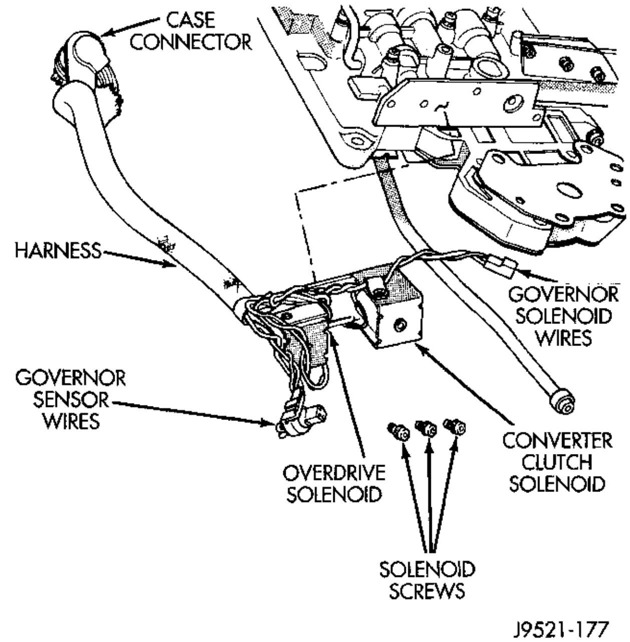

Fig. 47 Solenoid Assembly

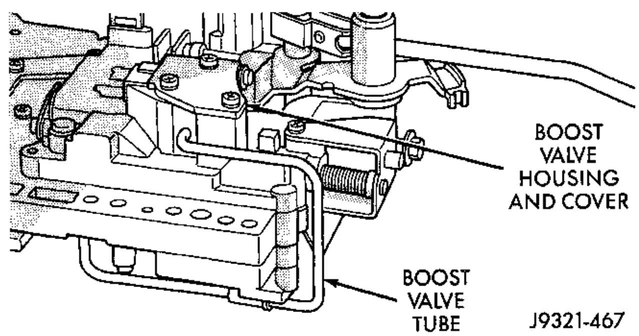

Fig. 48 Boost Valve Cover Location

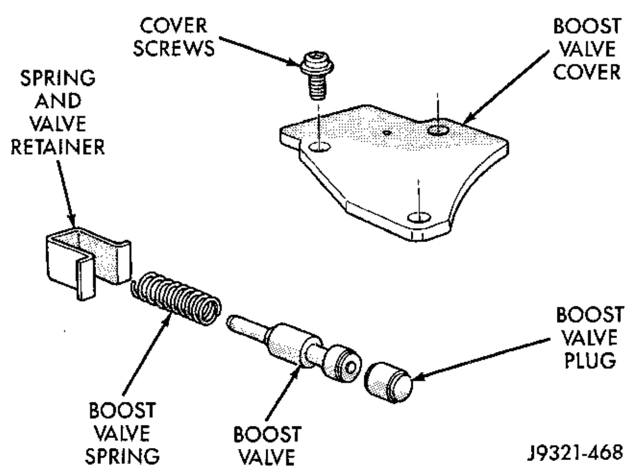

Fig. 49 Boost Valve Components

DISASSEMBLY AND ASSEMBLY (Continued)

(15) Secure detent ball and spring with Retainer Tool 6583 (Fig. 50).

(16) Remove park rod E-clip and separate rod from manual lever (Fig. 51).

(17) Remove E-clip and washer that retains throttle lever shaft in manual lever (Fig. 52).

(18) Remove manual lever and throttle lever (Fig. 53). Rotate and lift manual lever off valve body and throttle lever shaft. Then slide throttle lever out of valve body.

(19) Position pencil magnet next to detent housing to catch detent ball and spring. Then carefully remove Retainer Tool 6583 and remove detent ball and spring (Fig. 54).

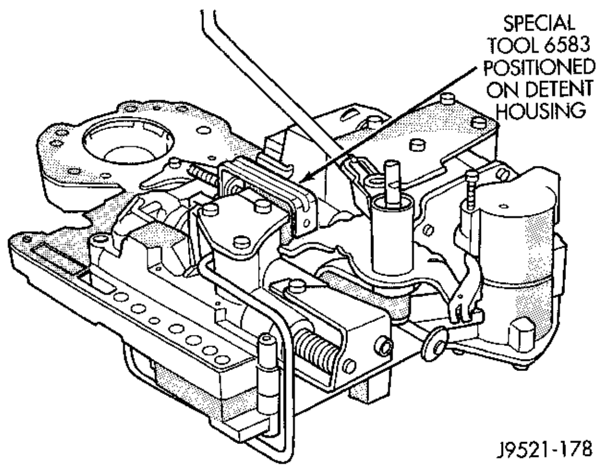

Fig. 50 Detent Ball And Spring

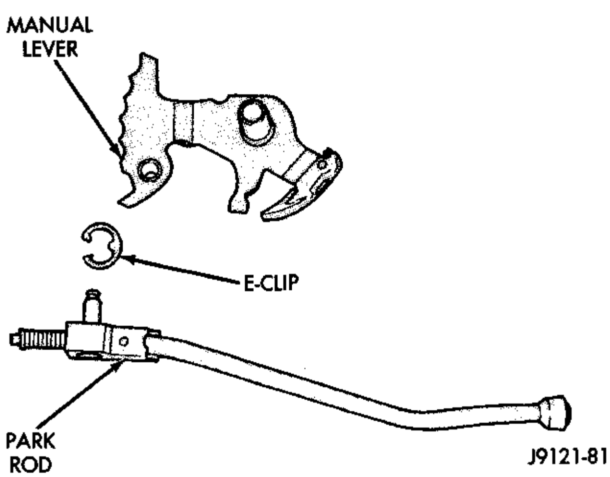

Fig. 51 Park Rod

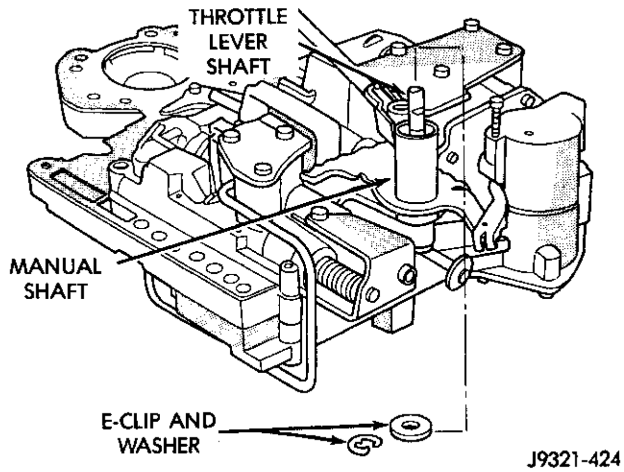

Fig. 52 Throttle Lever E-Clip And Washer

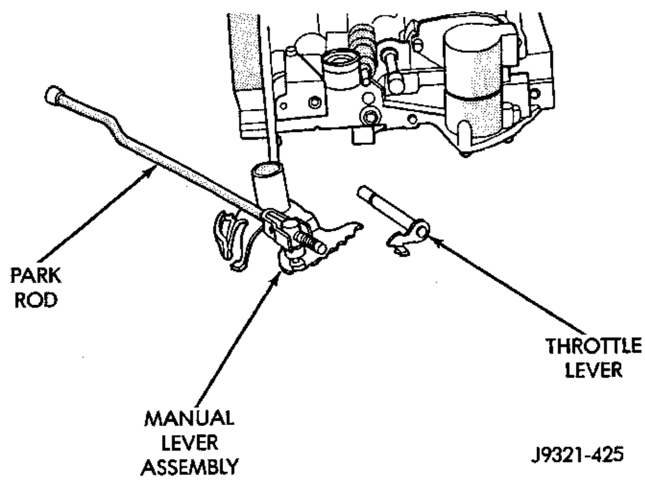

Fig. 53 Manual And Throttle Lever

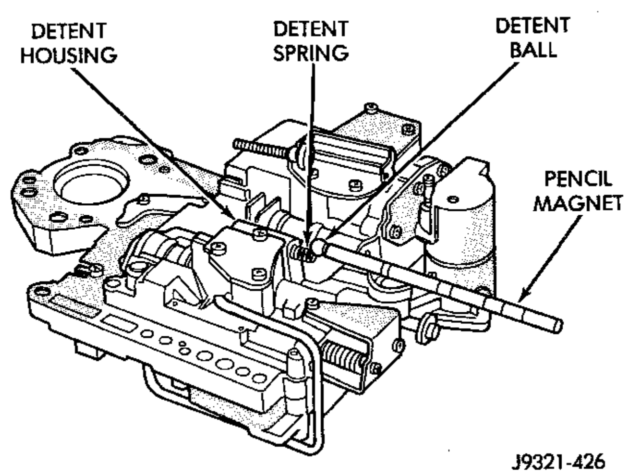

Fig. 54 Detent Ball And Spring

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DISASSEMBLY AND ASSEMBLY (Continued)

(20) Remove screws attaching pressure adjusting screw bracket to valve body and transfer plate (Fig. 55). Hold bracket firmly against spring tension while removing last screw.

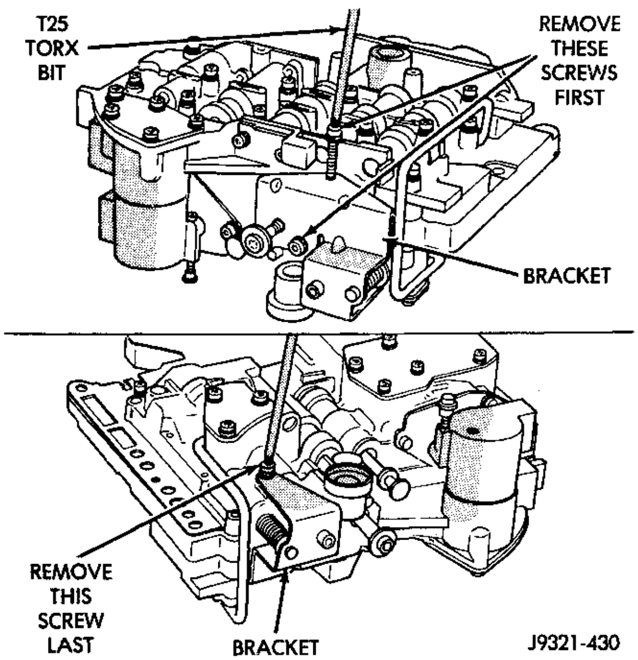

Fig. 55 Adjusting Screw Bracket Fastener

(21) Remove adjusting screw bracket, line pressure adjusting screw, pressure regulator valve spring and switch valve spring (Fig. 56). **Do not remove throttle pressure adjusting screw from bracket and do not disturb setting of either adjusting screw during removal.**

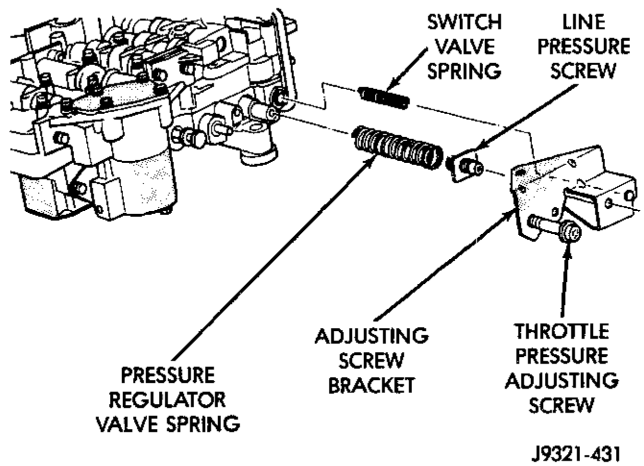

Fig. 56 Adjusting Screw Bracket And Spring

(22) Turn upper housing over and remove switch valve, regulator valve and spring, and manual valve (Fig. 57).

(23) Remove kickdown detent, kickdown valve, and throttle valve and spring (Fig. 57).

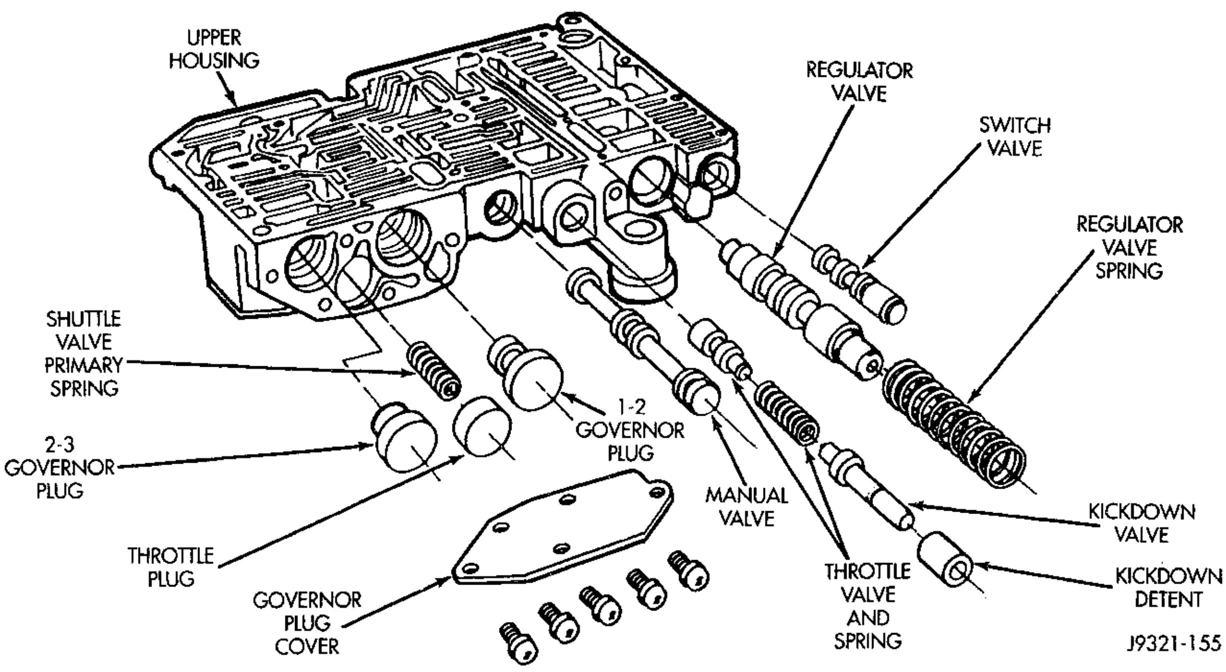

Fig. 57 Upper Housing Control Valve Locations

DISASSEMBLY AND ASSEMBLY (Continued)

(24) Loosen left-side 3-4 accumulator housing attaching screw about 2-3 threads. Then remove center and right-side housing attaching screws (Fig. 58).

(25) Carefully rotate 3-4 accumulator housing upward and remove 3-4 shift valve spring and converter clutch valve plug and spring (Fig. 59).

(26) Remove left-side screw and remove 3-4 accumulator housing from valve body (Fig. 60).

(27) Bend back tabs on boost valve tube brace (Fig. 61).

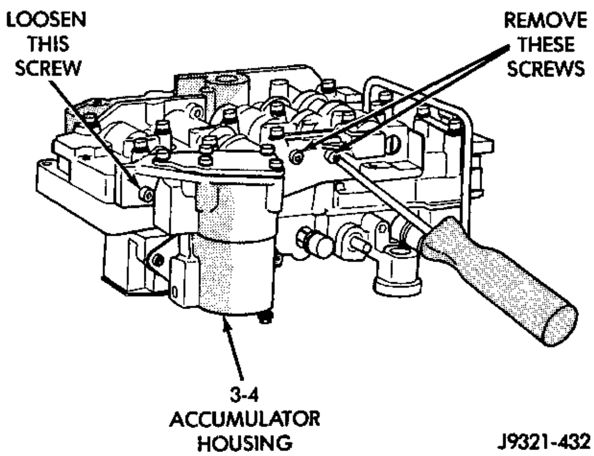

Fig. 58 Accumulator Housing Screw Locations

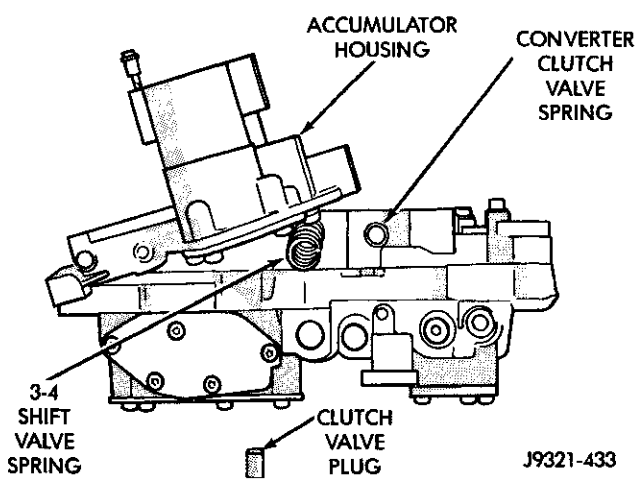

Fig. 59 3-4 Shift And Converter Clutch Valve Springs And Plug

(28) Remove boost valve connecting tube (Fig. 62). Disengage tube from upper housing port first. Then rock opposite end of tube back and forth to work it out of lower housing.

CAUTION: Do not use tools to loosen or pry the connecting tube out of the valve body housings. Loosen and remove the tube by hand only.

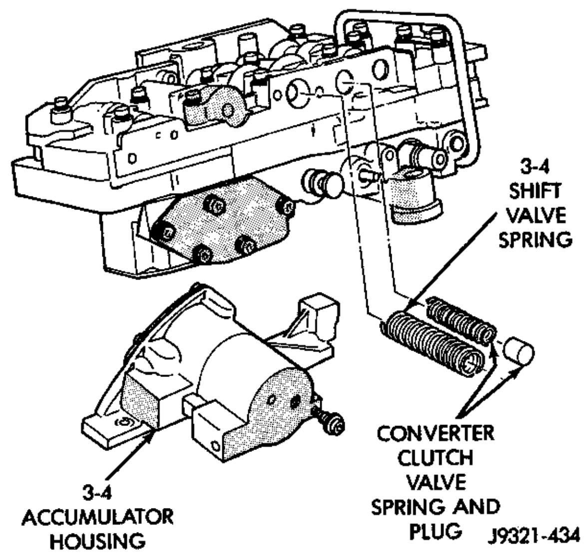

Fig. 60 Accumulator Housing, Valve Springs And Plug

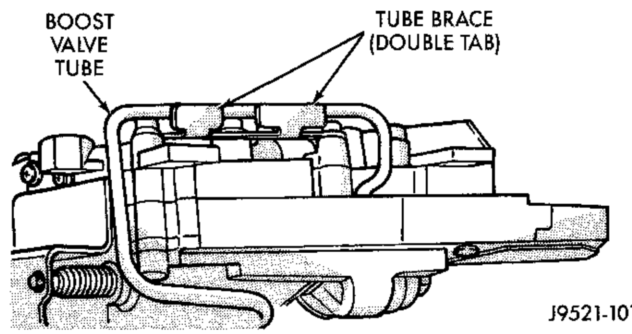

Fig. 61 Boost Valve Tube Brace

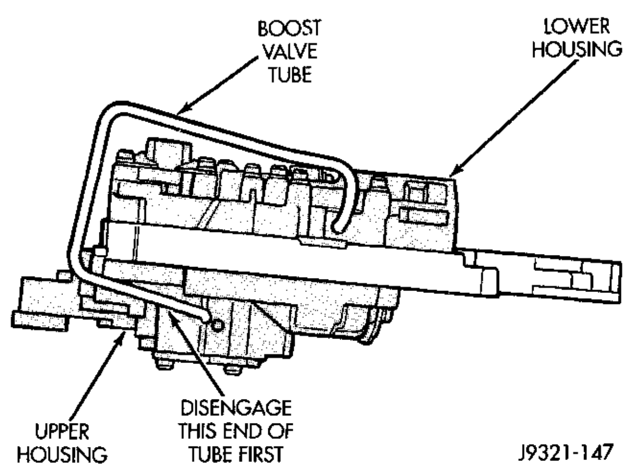

Fig. 62 Boost Valve Tube

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DISASSEMBLY AND ASSEMBLY (Continued)

(29) Turn valve body over so lower housing is facing upward (Fig. 63). In this position, the two check balls in upper housing will remain in place and not fall out when lower housing and separator plate are removed.

(30) Remove screws attaching valve body lower housing to upper housing and transfer plate (Fig. 63). **Note position of boost valve tube brace for assembly reference.**

(31) Remove lower housing and overdrive separator plate from transfer plate (Fig. 63).

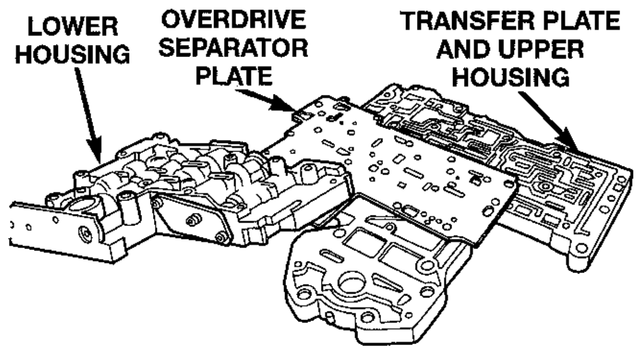

Fig. 63 Lower Housing

(32) Remove the ECE check ball from the transfer plate (Fig. 64). The ECE check ball is approximately 4.8 mm (3/16 in.) in diameter.

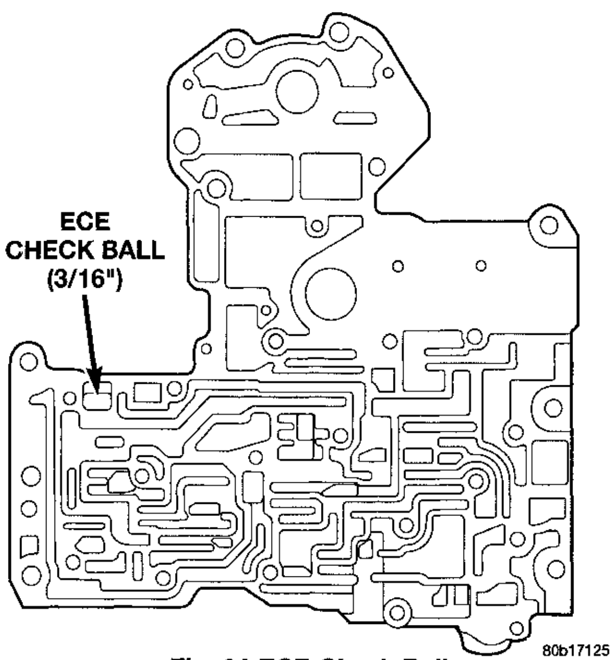

Fig. 64 ECE Check Ball

(33) Remove transfer plate from upper housing (Fig. 65).

(34) Turn transfer plate over so upper housing separator plate is facing upward.

(35) Remove upper housing separator plate from transfer plate (Fig. 66). Note position of filter in separator plate for assembly reference.

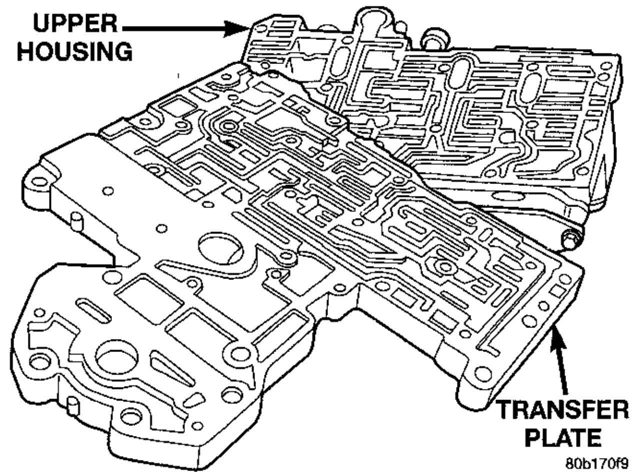

Fig. 65 Transfer Plate

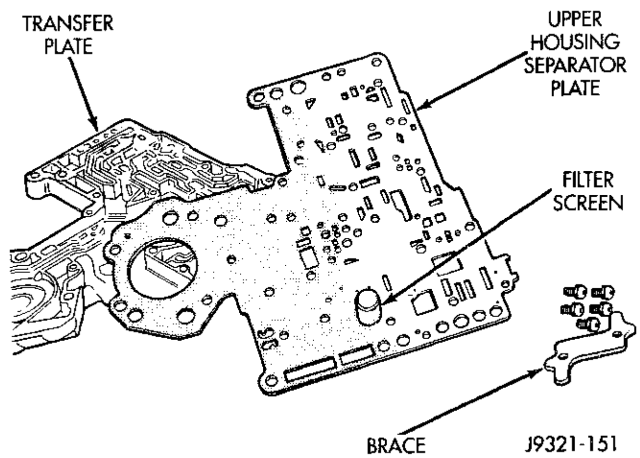

Fig. 66 Upper Housing Separator Plate

(36) Remove rear clutch and rear servo check balls from transfer plate. Note check ball location for assembly reference (Fig. 67).

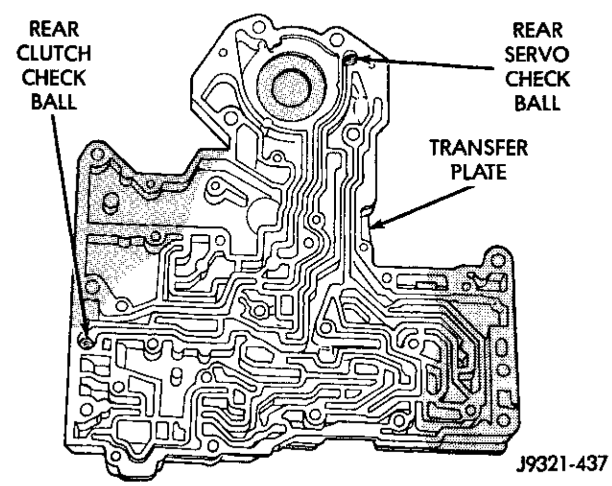

Fig. 67 Rear Clutch And Rear Servo Check Ball Locations

DISASSEMBLY AND ASSEMBLY (Continued)

VALVE BODY UPPER HOUSING

(1) Note location of check balls in valve body upper housing (Fig. 68). Then remove the one large diameter and the six smaller diameter check balls.

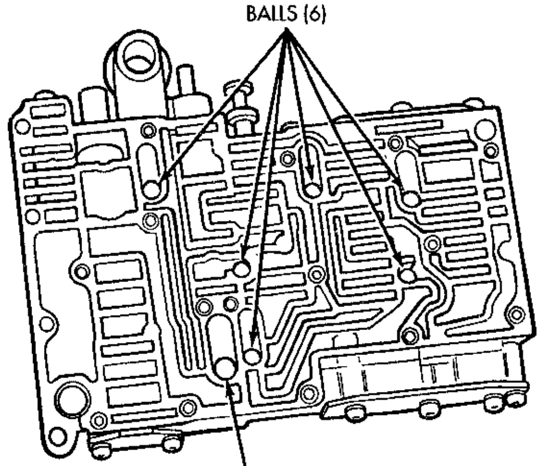

Fig. 68 Check Ball Locations In Upper Housing

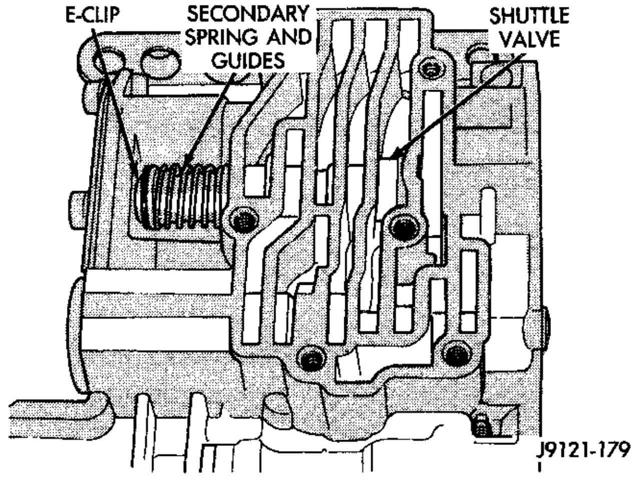

Fig. 69 Shuttle Valve E-Clip And Secondary Spring Location

(2) Remove governor plug and shuttle valve covers (Fig. 70).

(3) Remove E-clip that secures shuttle valve secondary spring on valve stem (Fig. 69).

(4) Remove throttle plug, primary spring, shuttle valve, secondary spring, and spring guides (Fig. 70).

(5) Remove boost valve retainer, spring and valve if not previously removed.

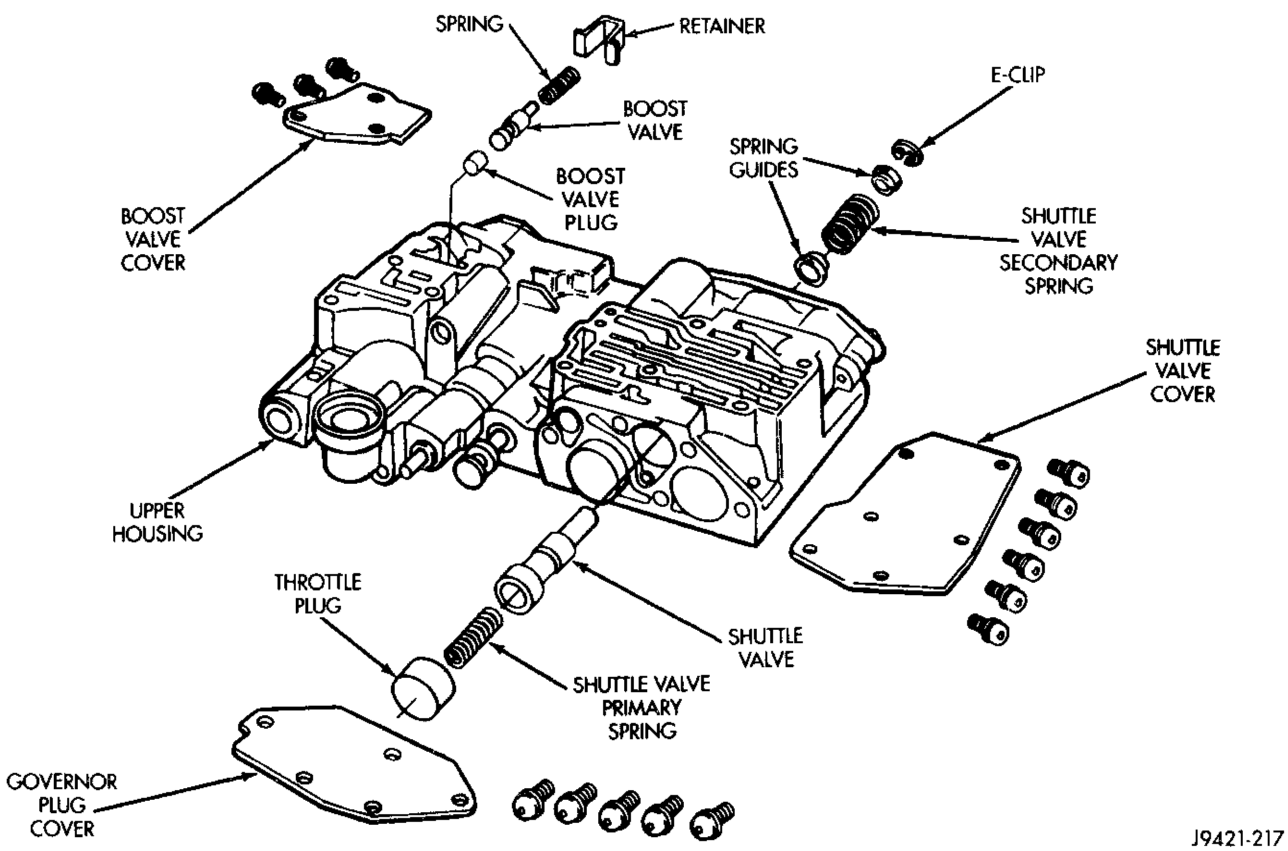

Fig. 70 Shuttle And Boost Valve Components

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DISASSEMBLY AND ASSEMBLY (Continued)

(6) Remove throttle plug and 1-2 and 2-3 governor plugs (Fig. 57).

(7) Turn upper housing around and remove limit valve and shift valve covers (Fig. 71).

(8) Remove limit valve housing. Then remove retainer, spring, limit valve, and 2-3 throttle plug from limit valve housing (Fig. 71).

(9) Remove 1-2 shift control valve and spring (Fig. 71).

(10) Remove 1-2 shift valve and spring (Fig. 71).

(11) Remove 2-3 shift valve and spring from valve body (Fig. 71).

(12) Remove pressure plug cover (Fig. 71).

(13) Remove line pressure plug, sleeve, throttle pressure plug and spring (Fig. 71).

VALVE BODY LOWER HOUSING

(1) Remove timing valve cover.

(2) Remove 3-4 timing valve and spring.

(3) Remove 3-4 quick fill valve, spring and plug.

(4) Remove 3-4 shift valve and spring.

(5) Remove converter clutch valve, spring and plug (Fig. 72).

(6) Remove converter clutch timing valve, retainer and valve spring.

3-4 ACCUMULATOR HOUSING

(1) Remove end plate from housing.

(2) Remove piston spring.

(3) Remove piston. Remove and discard piston seals (Fig. 73).

ASSEMBLY

CAUTION: Do not force valves or plugs into place during reassembly. If the valve body bores, valves and plugs are free of distortion or burrs, the valve body components should all slide into place easily. In addition, do not overtighten the transfer plate and valve body screws during reassembly. Overtightening can distort the housings resulting in valve sticking, cross leakage and unsatisfactory operation. Tighten valve body screws to recommended torque only.

LOWER HOUSING

(1) Lubricate valves, springs, and the housing valve and plug bores with clean transmission fluid (Fig. 72).

(2) Install 3-4 timing valve spring and valve in lower housing.

(3) Install 3-4 quick fill valve in lower housing.

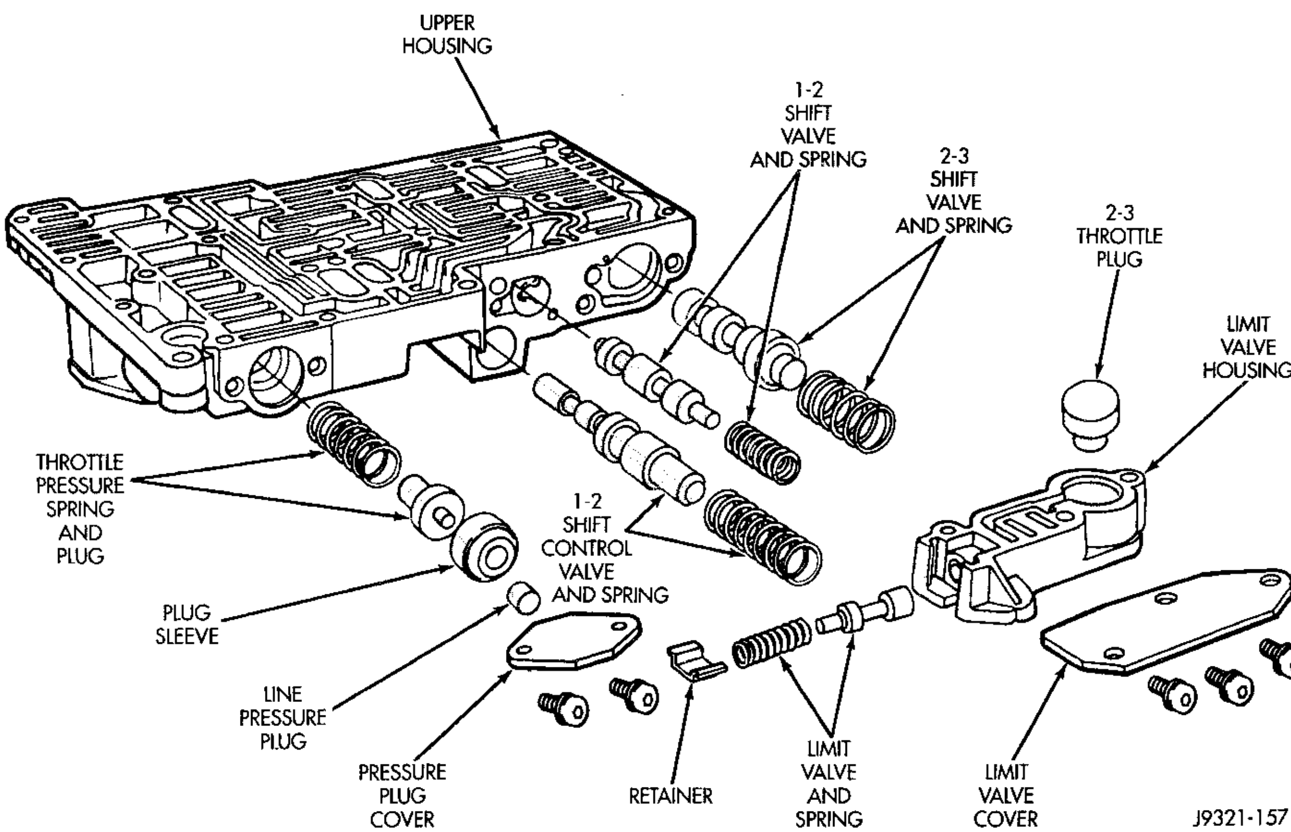

Fig. 71 Upper Housing Shift Valve And Pressure Plug Locations

DISASSEMBLY AND ASSEMBLY (Continued)

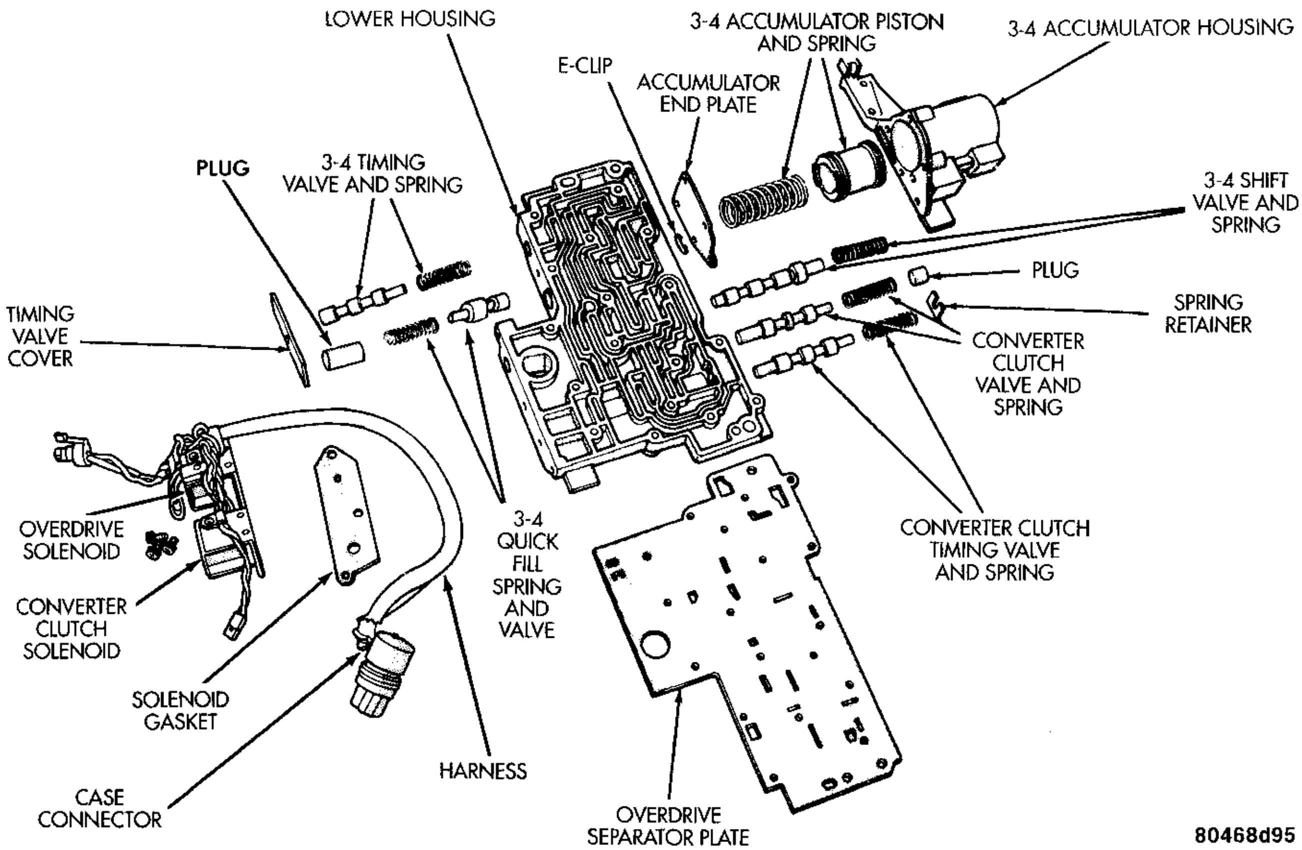

Fig. 72 Lower Housing Shift Valves And Springs

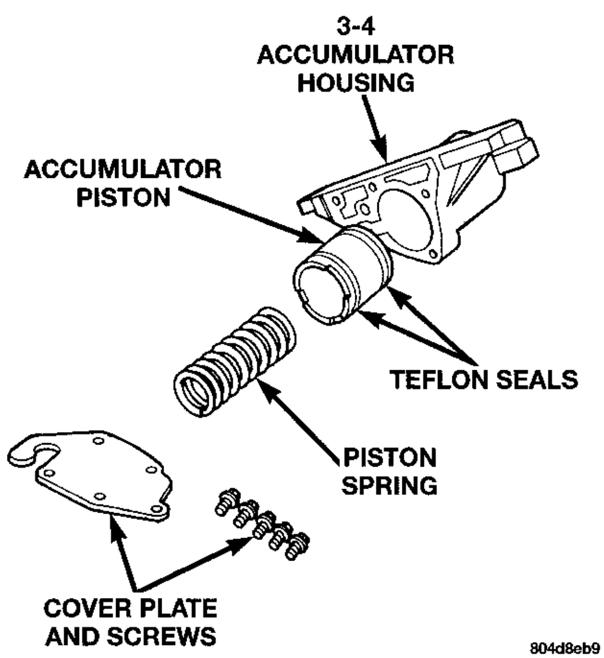

Fig. 73 Accumulator Housing Components

(4) Install 3-4 quick fill valve spring and plug in housing.

(5) Install timing valve end plate. Tighten end plate screws to 4 N·m (35 in. lbs.) torque.

3-4 ACCUMULATOR

(1) Lubricate accumulator piston, seals and housing piston bore with clean transmission fluid (Fig. 73).

(2) Install new seal rings on accumulator piston.

(3) Install piston and spring in housing.

(4) Install end plate on housing.

DISASSEMBLY AND ASSEMBLY (Continued)

TRANSFER PLATE

(1) Install rear clutch and rear servo check balls in transfer plate (Fig. 74).

(2) Install filter screen in upper housing separator plate (Fig. 75).

(3) Align and position upper housing separator plate on transfer plate (Fig. 76).

(4) Install brace plate (Fig. 76). Tighten brace attaching screws to 4 N·m (35 in. lbs.) torque.

(5) Install remaining separator plate attaching screws. Tighten screws to 4 N·m (35 in. lbs.) torque.

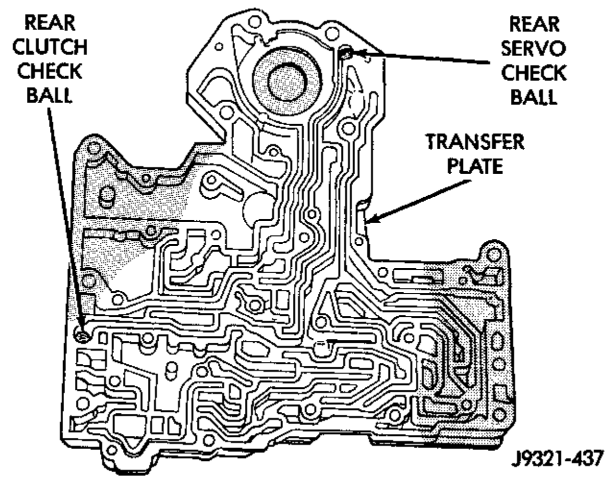

Fig. 74 Rear Clutch And Rear Servo Check Ball Locations

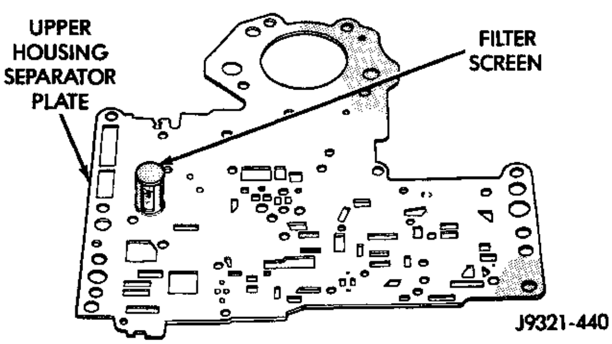

Fig. 75 Separator Plate Filter Screen Installation

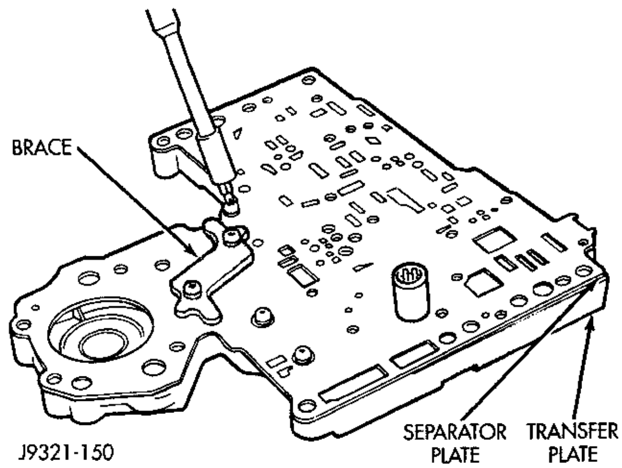

Fig. 76 Brace Plate

UPPER AND LOWER HOUSING

(1) Position upper housing so internal passages and check ball seats are facing upward. Then install check balls in housing (Fig. 77). Eight check balls are used. The single large check ball is approximately 8.7 mm (11/32 in.) diameter. The single small check ball is approximately 4.8 mm (3/16 in.) in diameter. The remaining 6 check balls are approximately 6.3 mm (1/4 in.) in diameter.

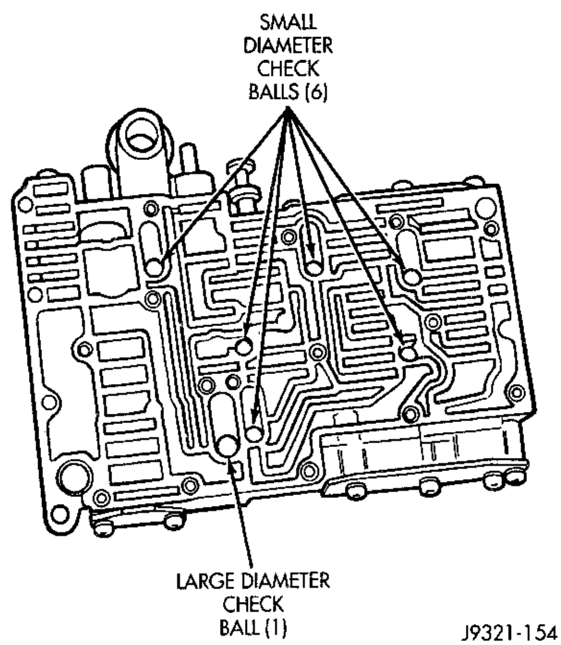

Fig. 77 Check Ball Locations In Upper Housing

DISASSEMBLY AND ASSEMBLY (Continued)

(2) Position assembled transfer plate and upper housing separator plate on upper housing (Fig. 78). Be sure filter screen is seated in proper housing recess.

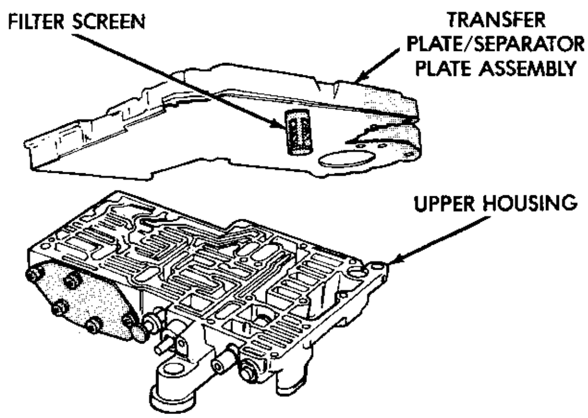

Fig. 78 Installing Transfer Plate On Upper Housing

(3) Install the ECE check ball into the transfer plate (Fig. 64). The ECE check ball is approximately 4.8 mm (3/16 in.) in diameter.

(4) Position lower housing separator plate on transfer plate (Fig. 79).

(5) Install lower housing on assembled transfer plate and upper housing (Fig. 80).

(6) Install and start all valve body screws by hand except for the screws to hold the boost valve tube brace. Save those screws for later installation. Then tighten screws evenly to 4 N·m (35 in. lbs.) torque. Start at center and work out to sides when tightening screws (Fig. 80).

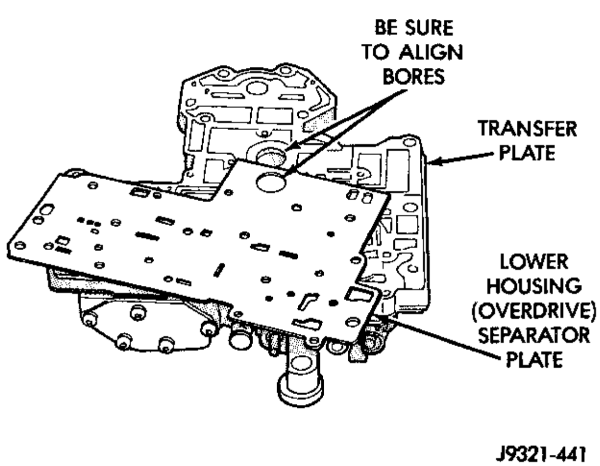

Fig. 79 Lower Housing Separator Plate

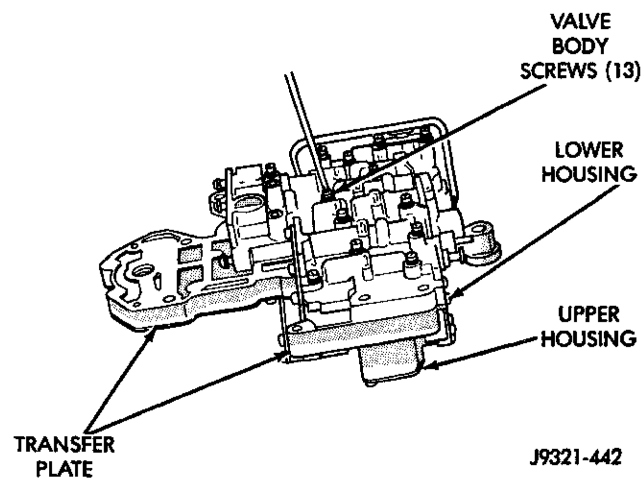

Fig. 80 Installing Lower Housing On Transfer Plate And Upper Housing

UPPER HOUSING VALVE AND PLUG

Refer to (Fig. 81), (Fig. 82) and (Fig. 83) to perform the following steps.

(1) Lubricate valves, plugs, springs with clean transmission fluid.

(2) Assemble regulator valve line pressure plug, sleeve, throttle plug and spring. Insert assembly in upper housing and install cover plate. Tighten cover plate screws to 4 N·m (35 in. lbs.) torque.

(3) Install 1-2 and 2-3 shift valves and springs.

(4) Install 1-2 shift control valve and spring.

(5) Install retainer, spring, limit valve, and 2-3 throttle plug from limit valve housing.

(6) Install limit valve housing and cover plate. Tighten screws to 4 N·m (35 in. lbs.).

(7) Install shuttle valve as follows:

(a) Insert plastic guides in shuttle valve secondary spring and install spring on end of valve.

(b) Install shuttle valve into housing.

(c) Hold shuttle valve in place.

(d) Compress secondary spring and install E-clip in groove at end of shuttle valve.

(e) Verify that spring and E-clip are properly seated before proceeding.

(8) Install shuttle valve cover plate. Tighten cover plate screws to 4 N·m (35 in. lbs.) torque.

(9) Install 1-2 and 2-3 valve governor plugs in valve body.

(10) Install shuttle valve primary spring and throttle plug.

(11) Align and install governor plug cover. Tighten cover screws to 4 N·m (35 in. lbs.) torque.

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DISASSEMBLY AND ASSEMBLY (Continued)

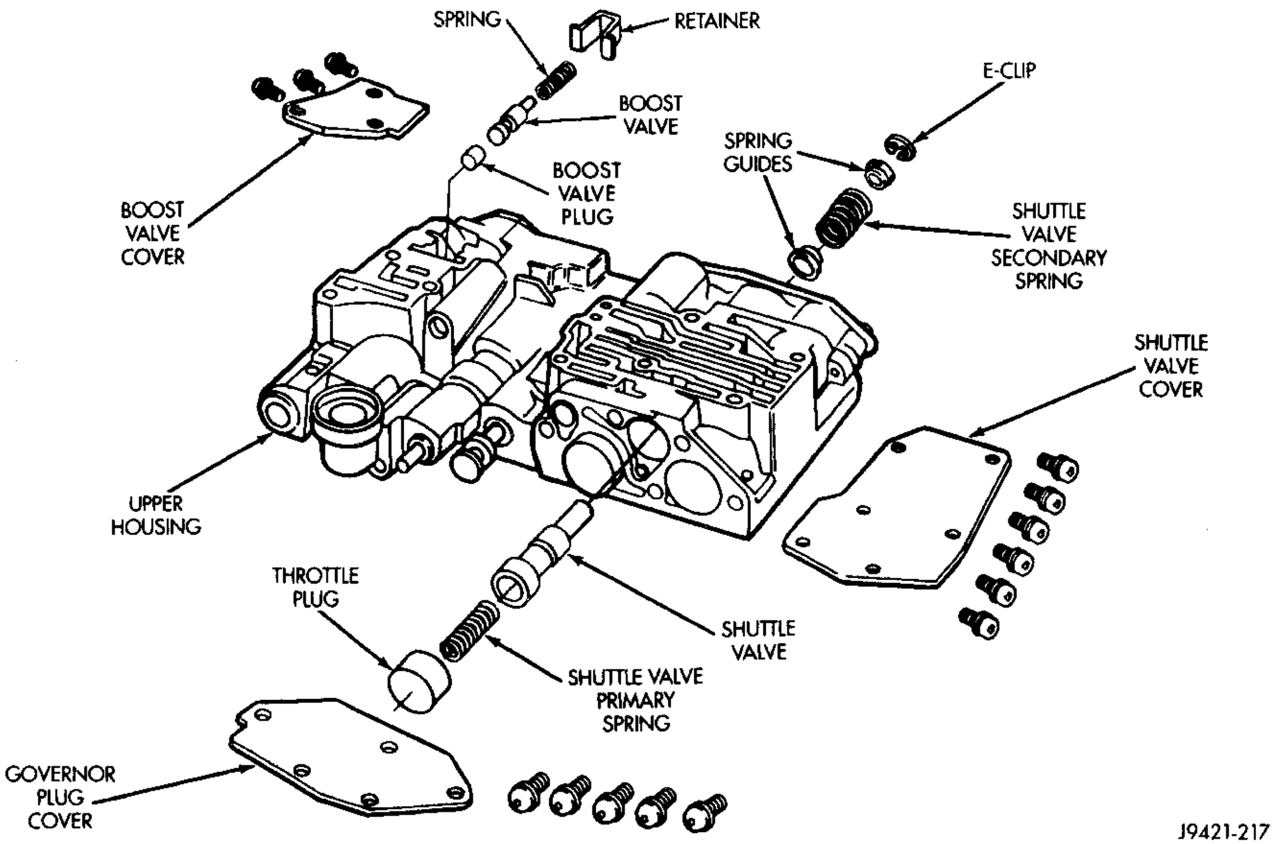

Fig. 81 Shuttle And Boost Valve Components

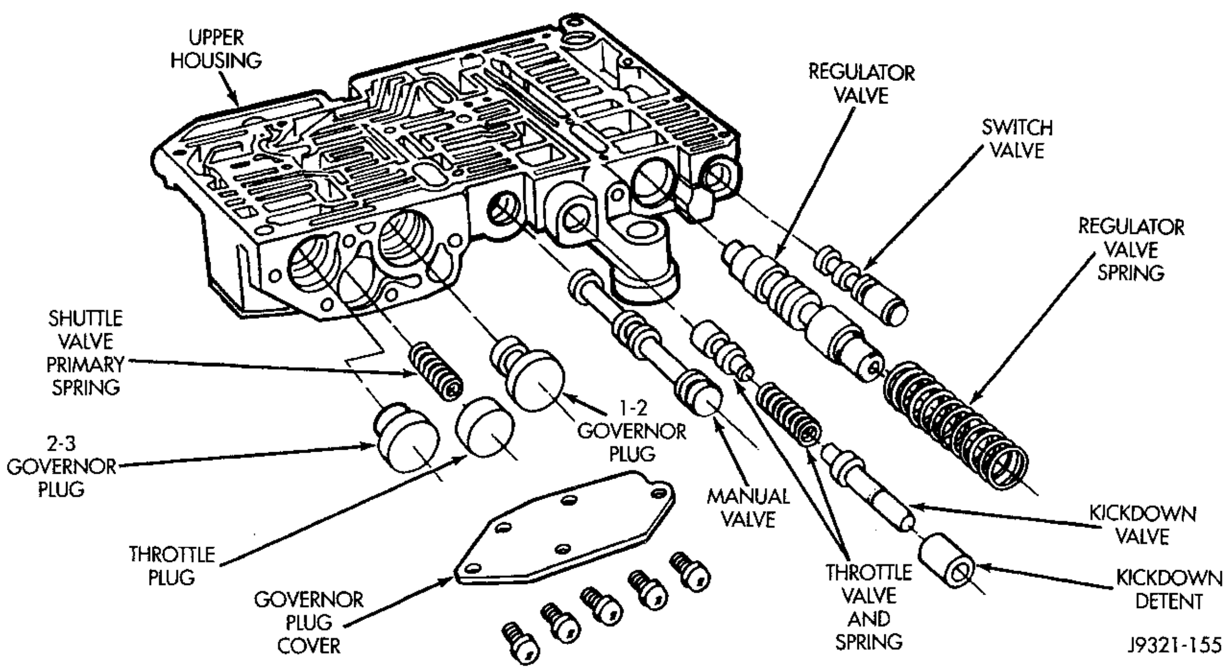

Fig. 82 Upper Housing Control Valve Locations

DISASSEMBLY AND ASSEMBLY (Continued)

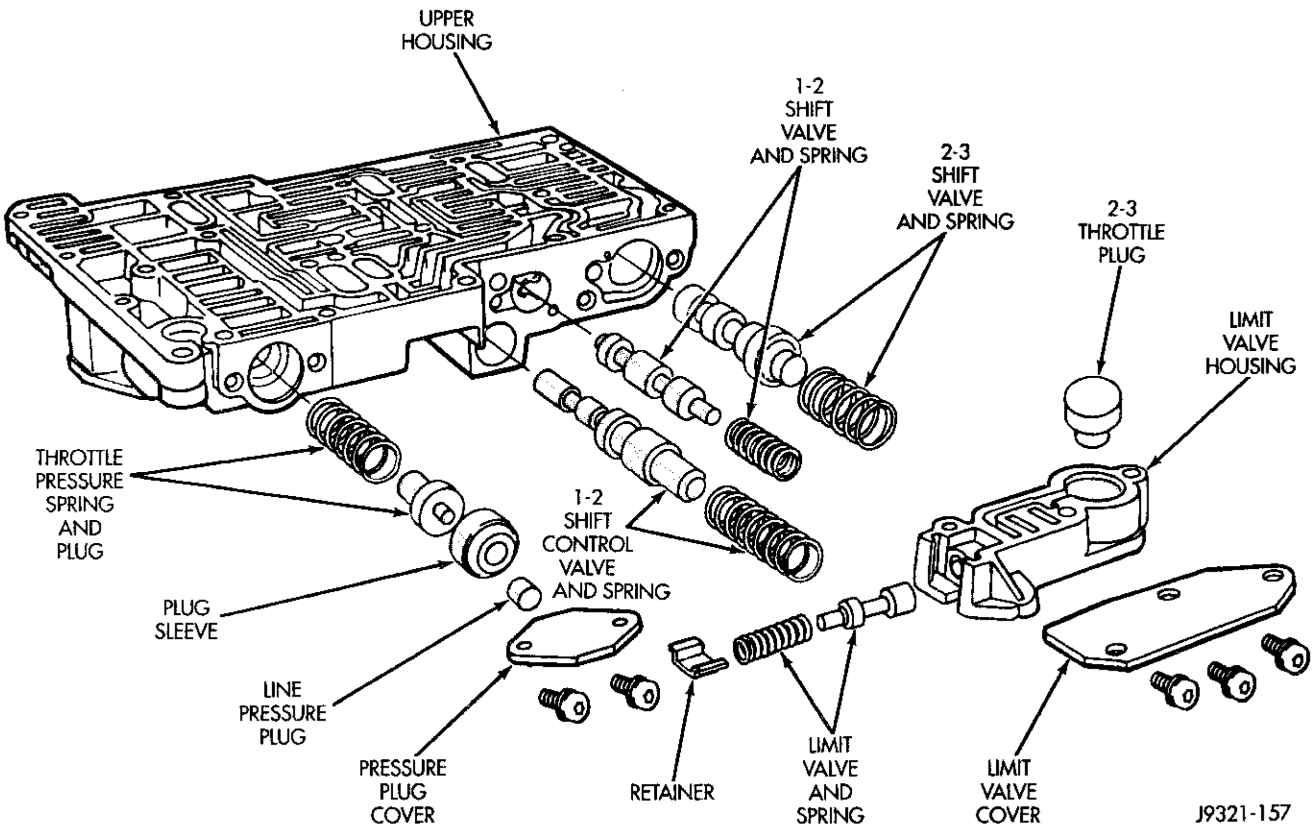

Fig. 83 Upper Housing Shift Valve And Pressure Plug Locations

BOOST VALVE TUBE AND BRACE

(1) Position valve body assembly so lower housing is facing upward (Fig. 84).

(2) Lubricate tube ends and housing ports with transmission fluid or petroleum jelly.

(3) Start tube in lower housing port first. Then swing tube downward and work opposite end of tube into upper housing port (Fig. 84).

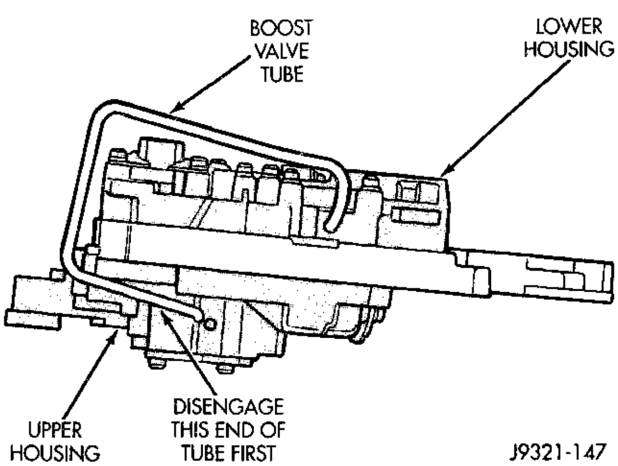

Fig. 84 Boost Valve Tube

(4) Insert and seat each end of tube in housings.

(5) Slide tube brace under tube and into alignment with valve body screw holes (Fig. 85).

(6) Install and finger tighten three screws that secure tube brace to valve body housings (Fig. 85).

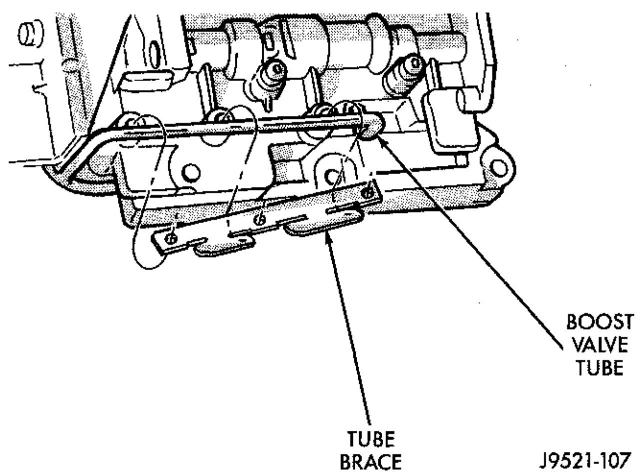

Fig. 85 Boost Valve Tube And Brace

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DISASSEMBLY AND ASSEMBLY (Continued)

(7) Bend tube brace tabs up and against tube to hold it in position (Fig. 86).

(8) Tighten all valve body housing screws to 4 N·m (35 in. lbs.) torque after tube and brace are installed. Tighten screws in diagonal pattern starting at center and working outward.

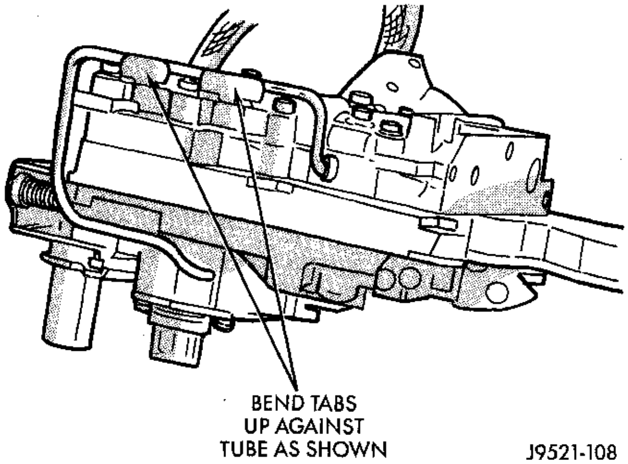

Fig. 86 Securing Boost Valve Tube With Brace Tabs

3-4 ACCUMULATOR

(1) Position converter clutch valve and 3-4 shift valve springs in housing (Fig. 87).

(2) Loosely attach accumulator housing with right-side screw (Fig. 87). Install only one screw at this time as accumulator must be free to pivot upward for ease of installation.

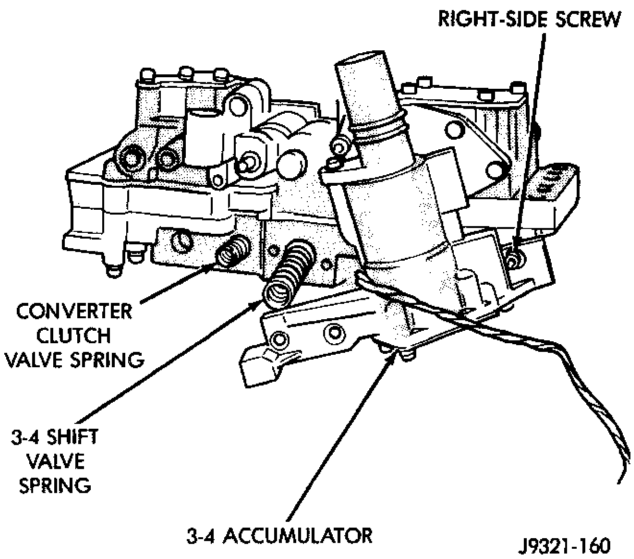

Fig. 87 Converter Clutch And 3-4 Shift Valve Springs

(3) Install 3-4 shift valve and spring.

(4) Install converter clutch timing valve and spring.

(5) Position plug on end of converter clutch valve spring. Then compress and hold springs and plug in place with fingers of one hand.

(6) Swing accumulator housing upward over valve springs and plug.

(7) Hold accumulator housing firmly in place and install remaining two attaching screws. Be sure springs and clutch valve plug are properly seated (Fig. 88). Tighten screws to 4 N·m (35 in. lbs.).

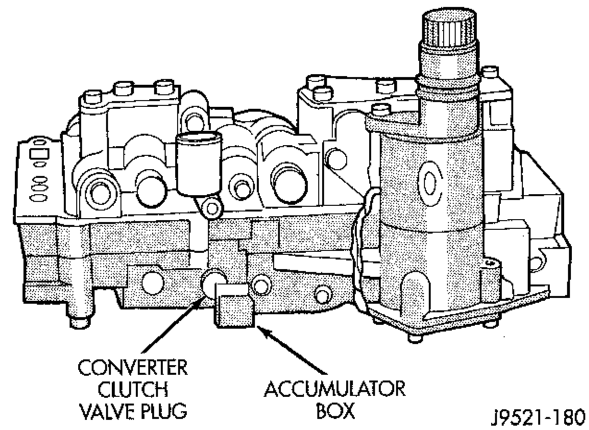

Fig. 88 Seating 3-4 Accumulator On Lower Housing

VALVE BODY FINAL

(1) Install boost valve, valve spring, retainer and cover plate. Tighten cover plate screws to 4 N·m (35 in. lbs.) torque.

(2) Insert manual lever detent spring in upper housing.

(3) Position detent ball on end of spring. Then hold detent ball and spring in detent housing with Retainer Tool 6583 (Fig. 89).

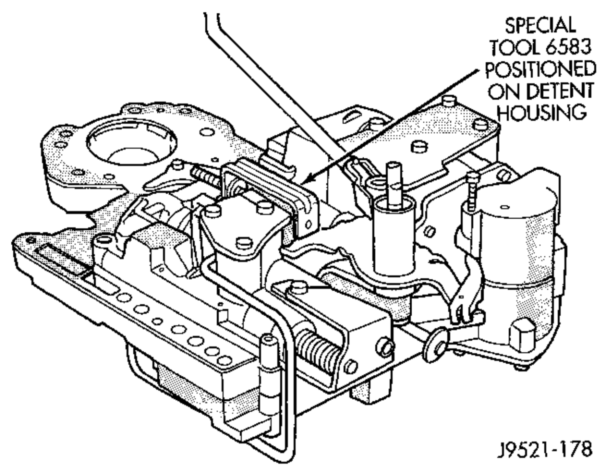

Fig. 89 Detent Ball Spring

(4) Install throttle lever in upper housing. Then install manual lever over throttle lever and start manual lever into housing.

DISASSEMBLY AND ASSEMBLY (Continued)

(5) Align manual lever with detent ball and manual valve. Hold throttle lever upward. Then press down on manual lever until fully seated. Remove detent ball retainer tool after lever is seated.

(6) Then install manual lever seal, washer and E-clip.

(7) Verify that throttle lever is aligned with end of kickdown valve stem and that manual lever arm is engaged in manual valve (Fig. 90).

(8) Position line pressure adjusting screw in adjusting screw bracket.

(9) Install spring on end of line pressure regulator valve.

(10) Install switch valve spring on tang at end of adjusting screw bracket.

(11) Install manual valve.

(12) Install throttle valve and spring.

(13) Install kickdown valve and detent.

(14) Install pressure regulator valve.

(15) Install switch valve.

(16) Position adjusting screw bracket on valve body. Align valve springs and press bracket into place. Install short, upper bracket screws first and long bottom screw last. Verify that valve springs and bracket are properly aligned. Then tighten all three bracket screws to 4 N·m (35 in. lbs.) torque.

(17) Lubricate solenoid case connector O-rings and shaft of manual lever with light coat of petroleum jelly.

(18) Obtain new fluid filter for valve body but do not install filter at this time.

(19) If line pressure and/or throttle pressure adjustment screw settings were not disturbed, continue with overhaul or reassembly. However, if adjustment screw settings **were** moved or changed, readjust as described in Valve Body Control Pressure Adjustment procedure.

(20) Attach solenoid case connector to 3-4 accumulator with shoulder-type screw. Connector has small locating tang that fits in dimple at top of accumulator housing (Fig. 91). Seat tang in dimple before tightening connector screw.

(21) Install solenoid assembly and gasket. Tighten solenoid attaching screws to 8 N·m (72 in. lbs.) torque.

(22) Verify that solenoid wire harness is properly routed (Fig. 92). **Solenoid harness must be clear of manual lever and park rod and not be pinched between accumulator housing and cover.**

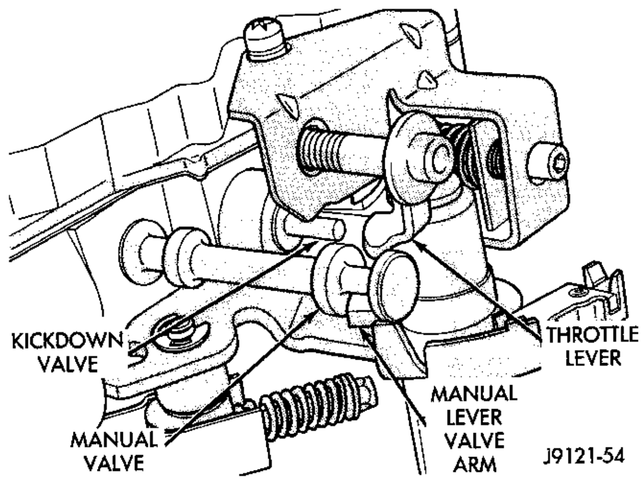

Fig. 90 Manual And Throttle Lever Alignment

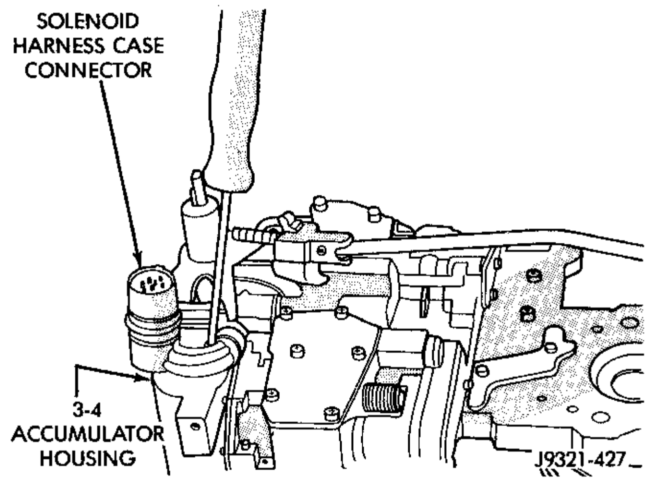

Fig. 91 Solenoid Harness Case Connector Shoulder Bolt

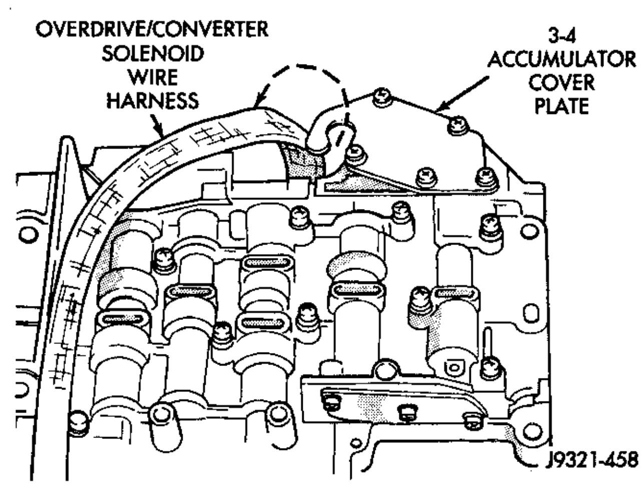

Fig. 92 Solenoid Harness Routing

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DISASSEMBLY AND ASSEMBLY (Continued)

GOVERNOR BODY, SENSOR AND SOLENOID

(1) Turn valve body assembly over so accumulator side of transfer plate is facing down.

(2) Install new O-rings on governor pressure solenoid and sensor (Fig. 93).

(3) Lubricate solenoid and sensor O-rings with clean transmission fluid.

(4) Install governor pressure sensor in governor body. Then secure sensor with M-shaped retaining clip (Fig. 93).

(5) Install governor pressure solenoid in governor body (Fig. 94). Push solenoid in until it snaps into place in body.

(6) Position governor body gasket on transfer plate (Fig. 95).

(7) Install retainer plate on governor body and around solenoid (Fig. 96). Be sure solenoid connector is positioned in retainer cutout.

(8) Align screw holes in governor body and transfer plate. Then install and tighten governor body screws to 4 N·m (35 in. lbs.) torque.

(9) Connect harness wires to governor pressure solenoid and governor pressure sensor (Fig. 97).

(10) Perform Line Pressure and Throttle Pressure adjustments, refer to adjustment section of this group for proper procedures.

(11) Install fluid filter and pan.

(12) Lower vehicle.

(13) Fill transmission with recommended fluid and road test vehicle to verify repair.

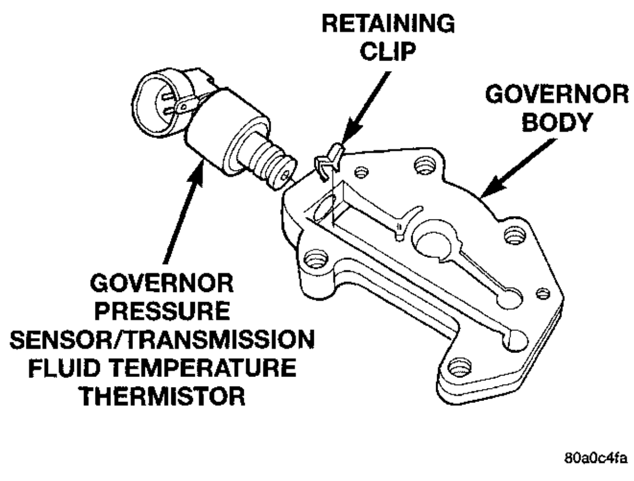

Fig. 93 Governor Pressure Sensor

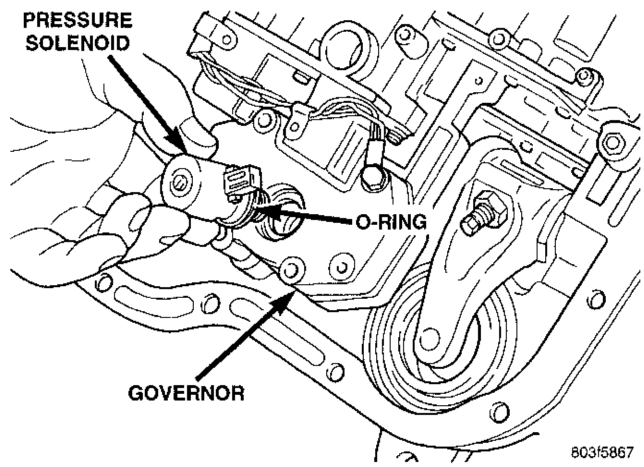

Fig. 94 Governor Pressure Solenoid

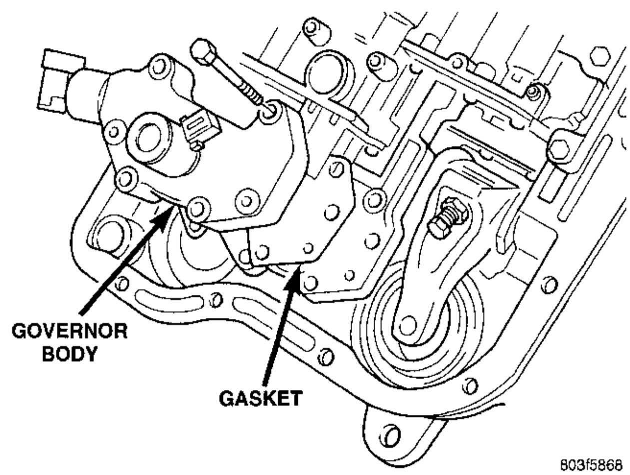

Fig. 95 Governor Body And Gasket

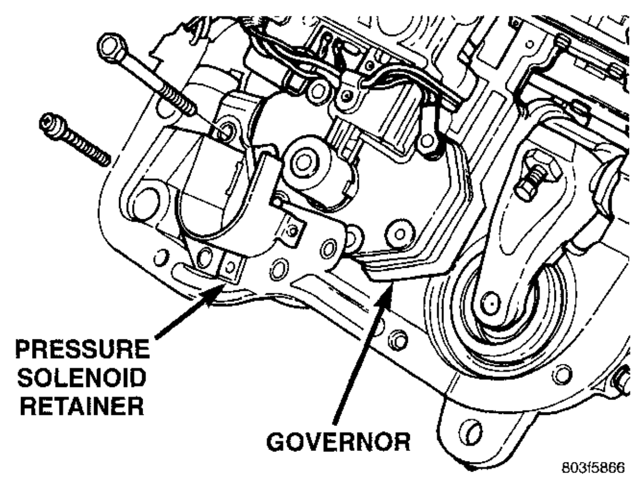

Fig. 96 Pressure Solenoid Retainer

DISASSEMBLY AND ASSEMBLY (Continued)

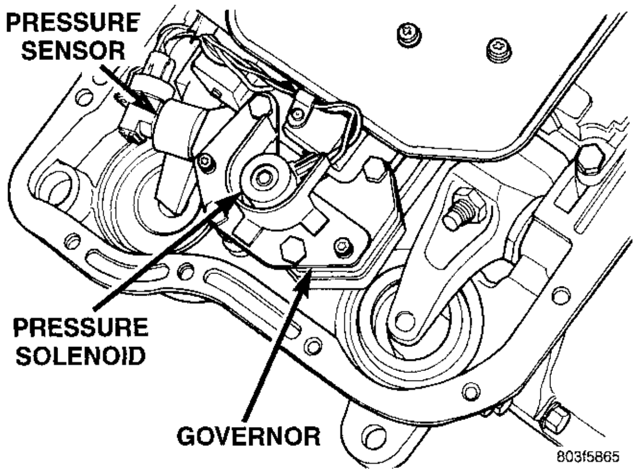

Fig. 97 Governor Pressure Sensor And Solenoid Connectors

TRANSMISSION

DISASSEMBLY

(1) Drain fluid from transmission.

(2) Clean exterior of transmission with suitable solvent or pressure washer.

(3) Remove torque converter from front of transmission.

(4) Remove throttle and shift levers from valve body manual shaft and throttle lever shaft.

(5) Place transmission in vertical position.

(6) Measure and record the input shaft end-play measurement.

(7) Mount transmission in repair stand C-3750-B or similar type stand (Fig. 98).

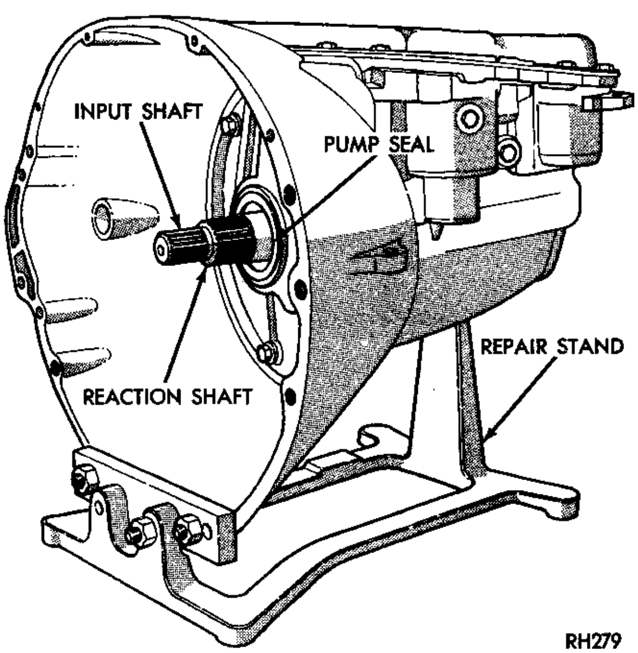

Fig. 98 Repair Stand

(8) Remove fluid pan and filter.

(9) Remove park/neutral position switch and seal (Fig. 99).

(10) Remove valve body and electronic governor.

(11) Remove accumulator outer spring, piston and inner spring (Fig. 100). Note position of piston and springs for assembly reference. Remove and discard piston seals if worn or cut.

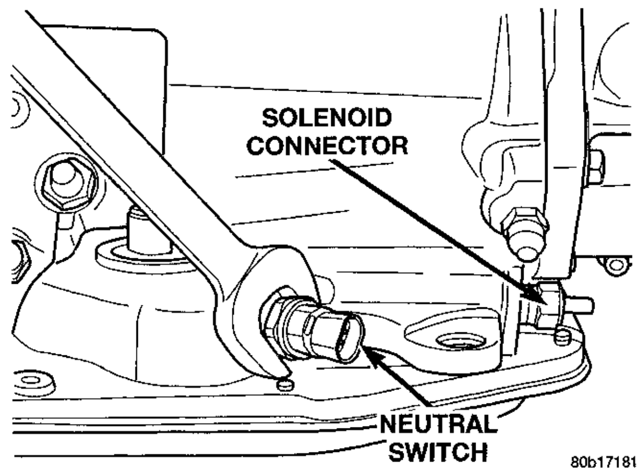

Fig. 99 Park/Neutral Position Switch

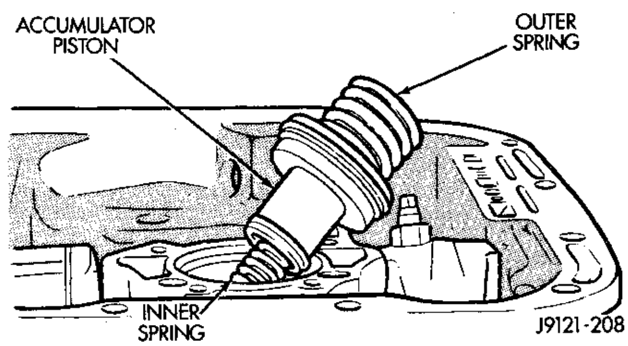

Fig. 100 Accumulator Component Removal

(12) Remove pump oil seal with suitable pry tool or slide-hammer mounted screw.

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DISASSEMBLY AND ASSEMBLY (Continued)

(13) Remove front band lever pin access plug (Fig. 101). Use square end of 1/4 in. drive extension to remove plug as shown.

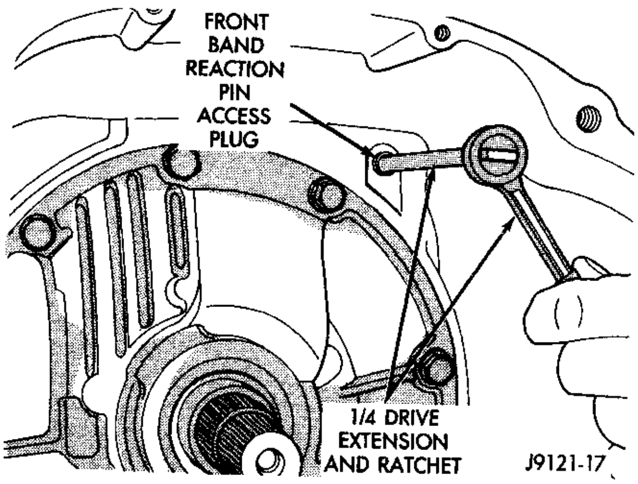

Fig. 101 Front Band Lever Pin Access Plug

(14) Remove oil pump and reaction shaft support assembly as follows:

(a) Tighten front band adjusting screw until band is tight around front clutch retainer (Fig. 102). This will prevent retainer from coming out with pump and possibly damaging clutch or pump components.

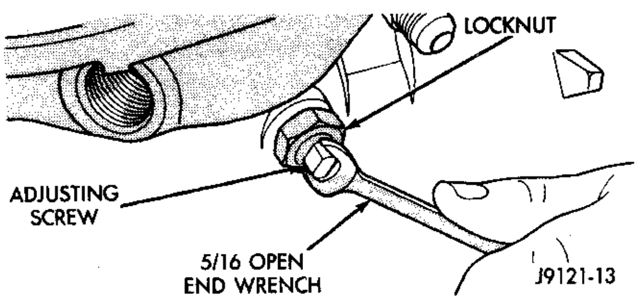

Fig. 102 Tightening Front Band To Hold Front Clutch In Place

(b) Remove oil pump bolts.

(c) Thread Slide Hammer Tools C-3752 into threaded holes in flange of oil pump housing (Fig. 103).

(d) Remove oil pump and reaction shaft support by bumping slide hammers outward alternately to pull pump from case (Fig. 104).

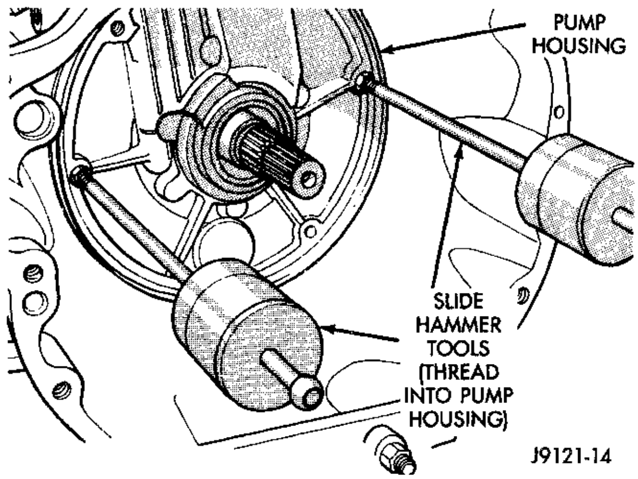

Fig. 103 Oil Pump Removal Tools

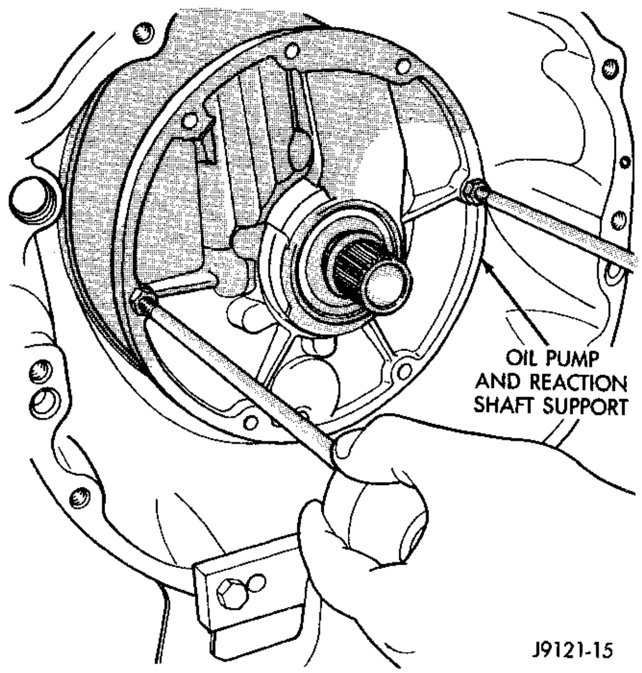

Fig. 104 Oil Pump Removal

DISASSEMBLY AND ASSEMBLY (Continued)

(15) Remove oil pump gasket (Fig. 105). Note gasket position in case for assembly reference.

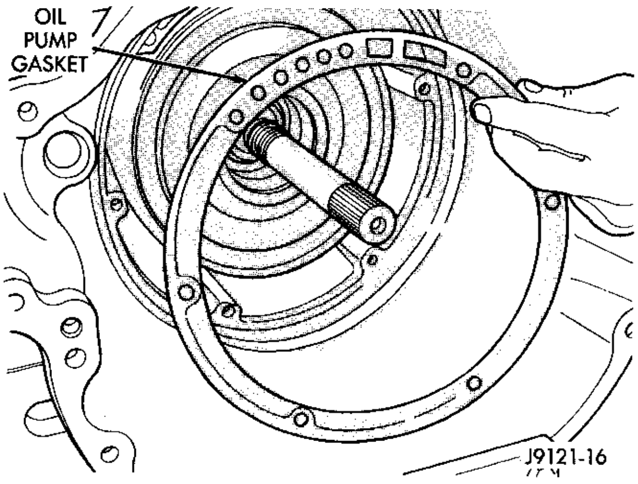

Fig. 105 Oil Pump Gasket

(16) Loosen front band adjusting screw until band is completely loose.

(17) Remove front band strut and anchor (Fig. 106).

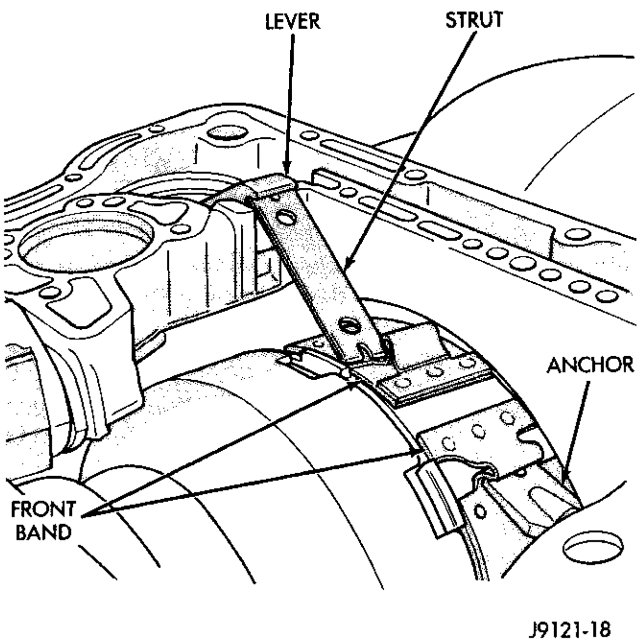

Fig. 106 Front Band Linkage

(18) Squeeze front band together slightly and slide band over front clutch retainer and out of case (Fig. 107).

(19) Remove front and rear clutch assemblies as a unit (Fig. 108).

(20) Remove front band reaction pin and lever. Start pin through lever and out of case bore with drift or punch. Then use pencil magnet to withdraw pin completely (Fig. 109).

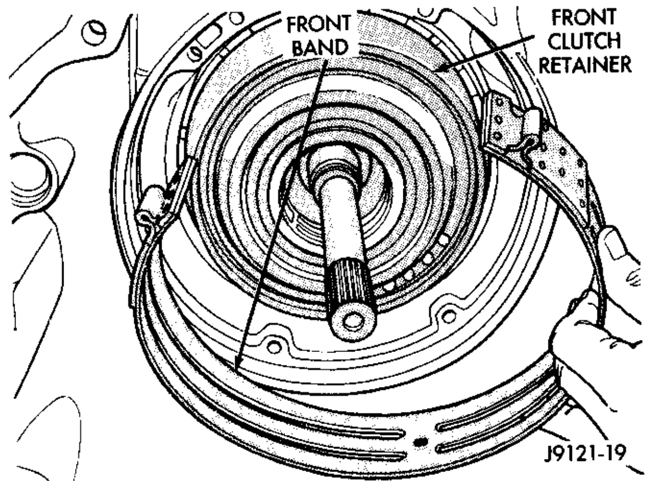

Fig. 107 Front Band

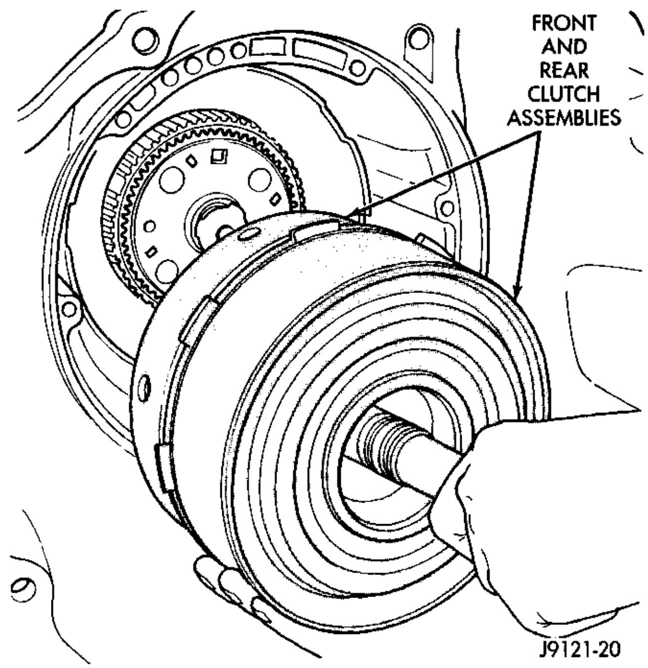

Fig. 108 Removing Front/Rear Clutch Assemblies

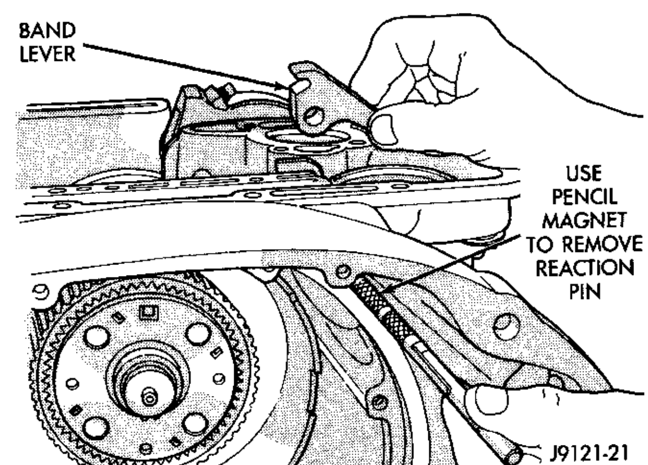

Fig. 109 Front Band Lever And Pin

DISASSEMBLY AND ASSEMBLY (Continued)

(21) Remove intermediate shaft thrust washer. Triangular shaped washer will either be on shaft pilot hub or in rear clutch retainer (Fig. 110).

(22) Remove thrust plate from intermediate shaft hub (Fig. 111).

(23) Remove intermediate shaft-planetary geartrain assembly (Fig. 112).

(24) If overdrive unit is not to be serviced, install Alignment Shaft 6227-2 into the overdrive unit to prevent misalignment of the overdrive clutches during service of main transmission components.

(25) Loosen rear band locknut and loosen adjusting screw 3-4 turns.

(26) Remove snap ring that retains low-reverse drum on overdrive piston retainer hub (Fig. 113).

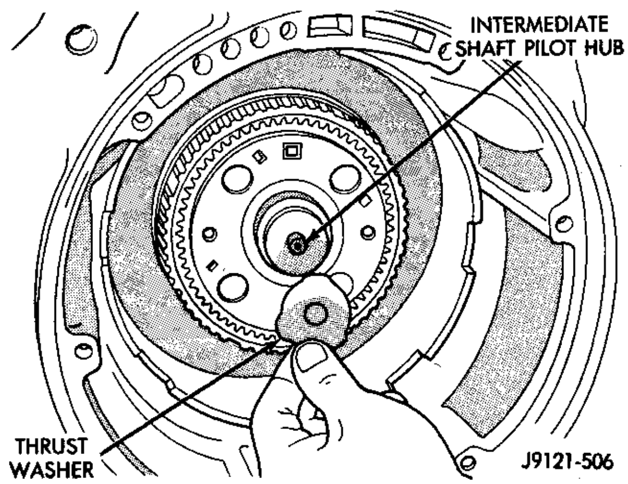

Fig. 110 Intermediate Shaft Thrust Washer

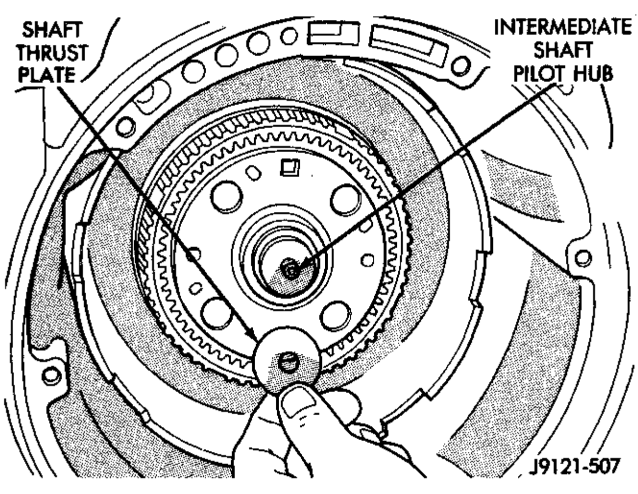

Fig. 111 Intermediate Shaft Thrust Plate

(27) Slide low-reverse drum and thrust washer off piston retainer hub and out of rear band (Fig. 114).

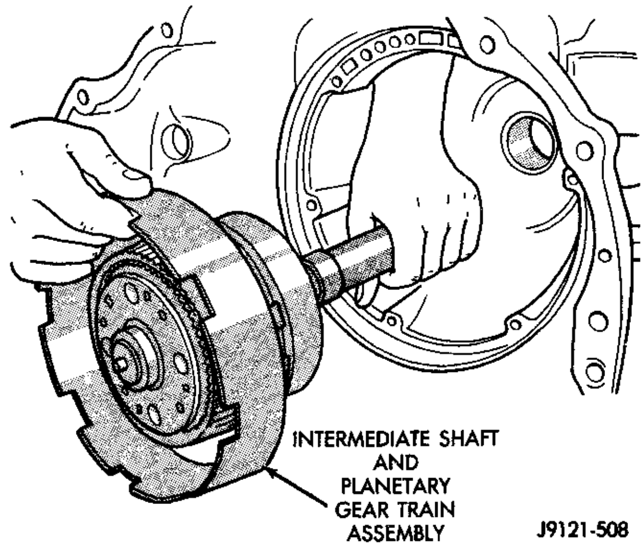

Fig. 112 Intermediate Shaft And Planetary Geartrain

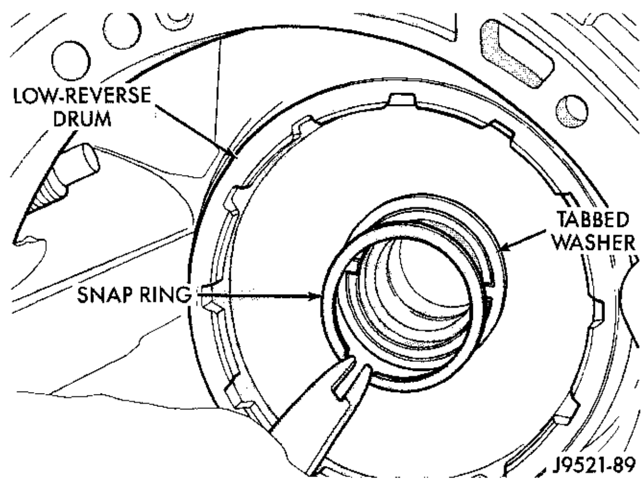

Fig. 113 Low-Reverse Drum Snap Ring

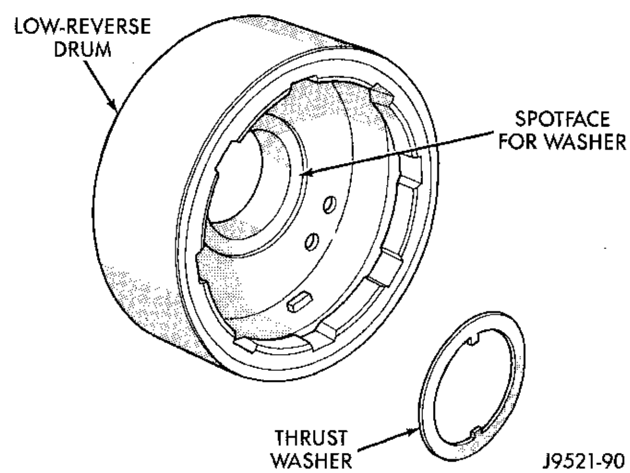

Fig. 114 Low-Reverse Drum And Thrust Washer

DISASSEMBLY AND ASSEMBLY (Continued)

(28) Note that overrunning clutch race will remain on splines of low-reverse drum after removal (Fig. 115). **The race is a permanent press fit on the hub splines. Do not attempt to remove the race.**

(29) Remove overrunning clutch assembly (Fig. 116). Assembly can be removed without displacing rollers and springs if care is exercised. Note position of rollers and springs for assembly reference.

(30) Remove rear band adjusting lever, reaction lever and pin (Fig. 117).

(31) Remove strut from rear band. Keep strut with levers and pin for cleaning, inspection and assembly reference.

(32) Remove rear band and link (Fig. 118).

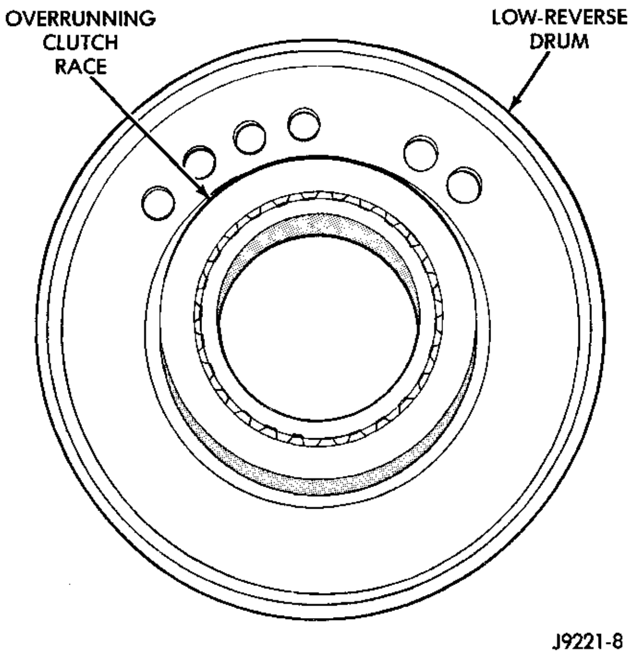

Fig. 115 Overrunning Clutch Race Position On Low-Reverse Drum

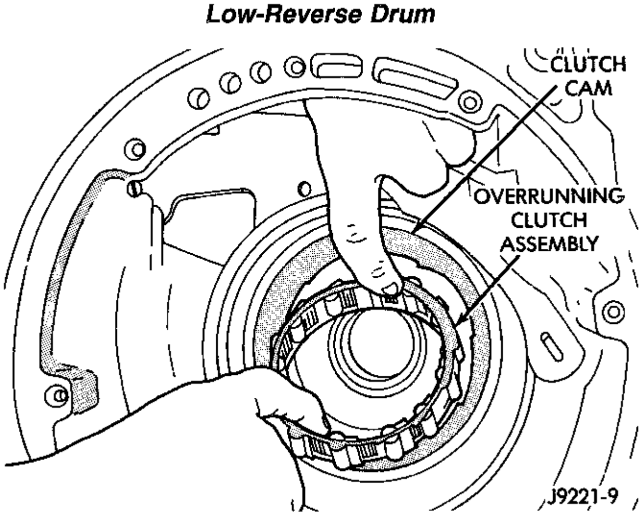

Fig. 116 Overrunning Clutch

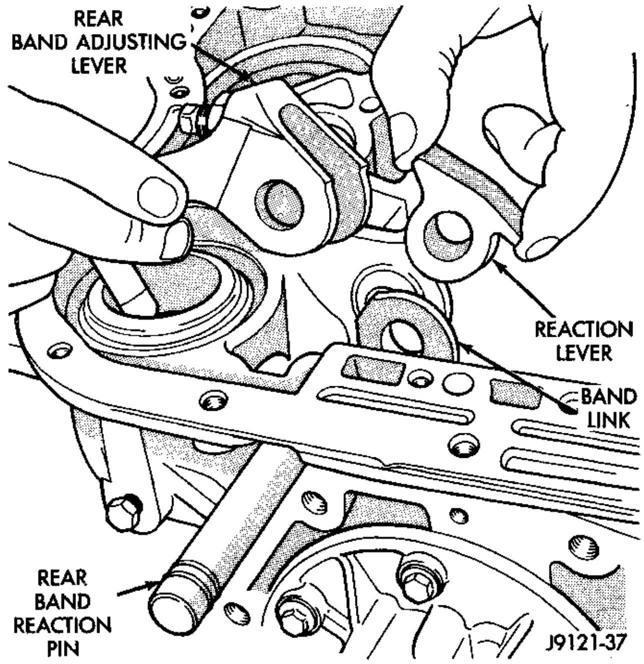

Fig. 117 Rear Band Levers And Pins

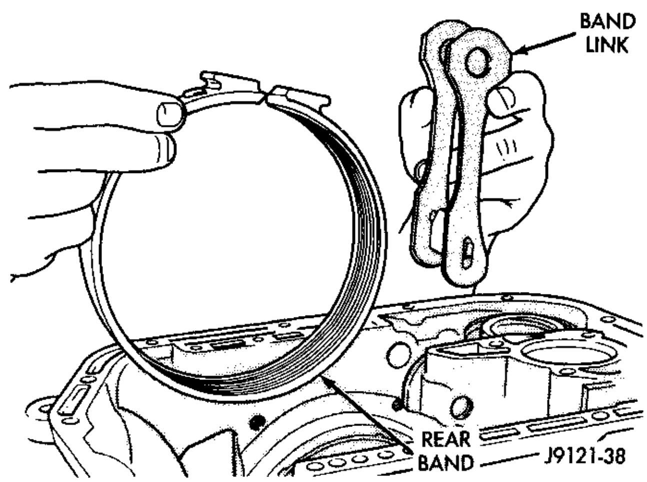

Fig. 118 Rear Band And Link

DISASSEMBLY AND ASSEMBLY (Continued)

(33) Compress front servo rod guide with large C-clamp and Tool C-4470, or Compressor Tool C-3422-B (Fig. 119). Compress guide only enough to permit snap ring removal (about 1/8 in.).

(34) Remove servo piston snap ring (Fig. 119). Unseat one end of ring. Then carefully work removal tool around back of ring until free of ring groove. **Exercise caution when removing snap ring. Servo bore can be scratched or nicked if care is not exercised.**

(35) Remove tools and remove servo piston and spring.

(36) Compress rear servo piston with C-clamp and Tool C-4470, or Valve Spring Compressor C-3422-B (Fig. 120). Compress servo spring retainer only enough to permit snap ring removal.

(37) Remove servo piston snap ring (Fig. 120). Start one end of ring out of bore. Then carefully work removal tool around back of snap ring until free of ring groove. **Exercise caution when removing snap ring. Servo bore can be scratched or nicked if care is not exercised.**

(38) Remove tools and remove rear servo retainer, spring and piston assembly.

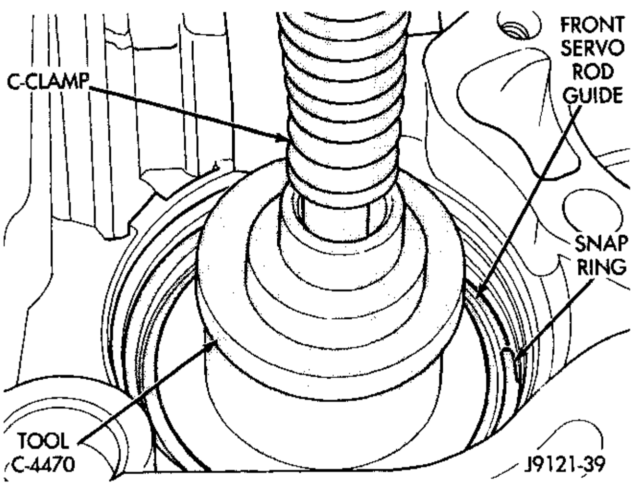

Fig. 119 Front Servo Retaining Snap Ring

ASSEMBLY

Do not allow dirt, grease, or foreign material to enter the case or transmission components during assembly. Keep the transmission case and components clean. Also make sure the tools and workbench area used for reassembly operations are equally clean.

Shop towels used for wiping off tools and your hands must be made from **lint free** materials. Lint will stick to transmission parts and could interfere with valve operation or even restrict fluid passages.

Lubricate transmission clutch and gear components with Mopar® ATF Plus 3, type 7176, during

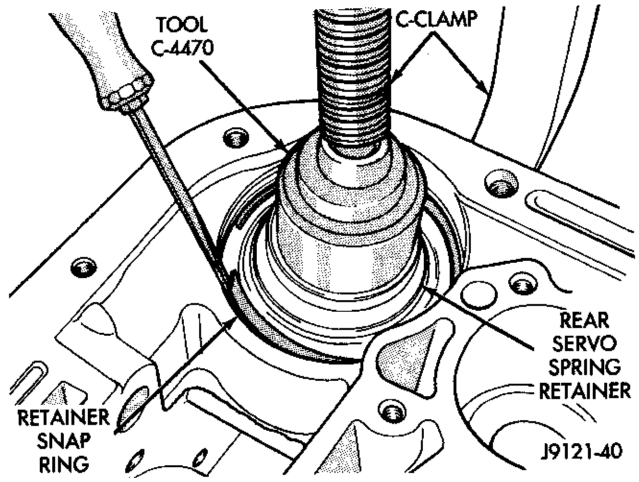

Fig. 120 Rear Servo Retaining Snap Ring

reassembly. Soak clutch discs in transmission fluid before installation.

Use Mopar® Door Ease, or Ru-Glyde on piston seals and O-rings to ease installation. Petroleum jelly can also be used to lubricate and hold thrust washers and plates in position during assembly.

Do not use chassis grease, bearing grease, white grease, or similar lubricants on any part. These types of lubricants can eventually block or restrict fluid passages and valve operation. Use petroleum jelly only.

Do not force parts into place. The transmission components and sub-assemblies are easily installed by hand when properly aligned. If a part seems difficult to install, it is either misaligned or incorrectly assembled. Verify that thrust washers, thrust plates and seal rings are correctly positioned.

The planetary geartrain, front/rear clutch assemblies and oil pump are all much easier to install when the transmission case is upright. Either tilt the case upward with wood blocks, or cut a hole in the bench large enough for the intermediate shaft and rear support. Then lower the shaft and support into the hole and support the rear of the case directly on the bench.

FRONT/REAR SERVO

(1) Lubricate rear servo piston seal with Mopar® Door Ease or ATF Plus 3. Lubricate servo bore in case with ATF Plus 3.

(2) Install rear servo piston in case. Position piston at slight angle to bore and insert piston with twisting motion (Fig. 121).

(3) Install rear servo spring and retainer in case bore (Fig. 122). Be sure spring is seated on piston.

(4) Compress rear servo piston with C-clamp or Valve Spring Compressor C-3422-B and install servo piston snap ring (Fig. 123).

DISASSEMBLY AND ASSEMBLY (Continued)

(5) Lubricate front servo piston components and servo bore in case with transmission fluid.

(6) Install front servo piston in bore. Carefully "run" small, suitable tool around piston ring to press it back into groove and ease installation (Fig. 124). Rotate piston into bore at same time. Rock piston slightly to ease piston ring past snap ring groove and into bore.

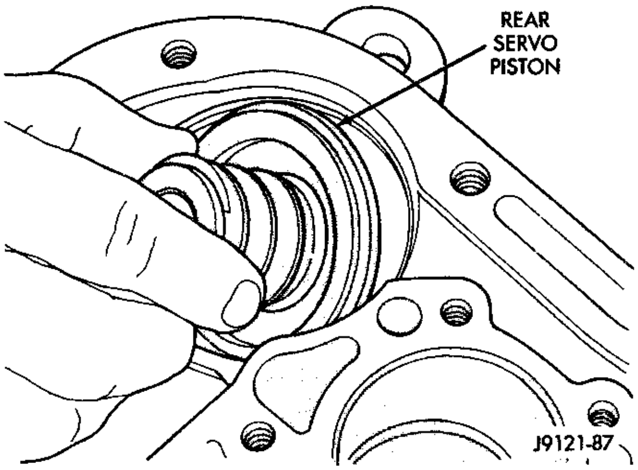

Fig. 121 Rear Servo Piston

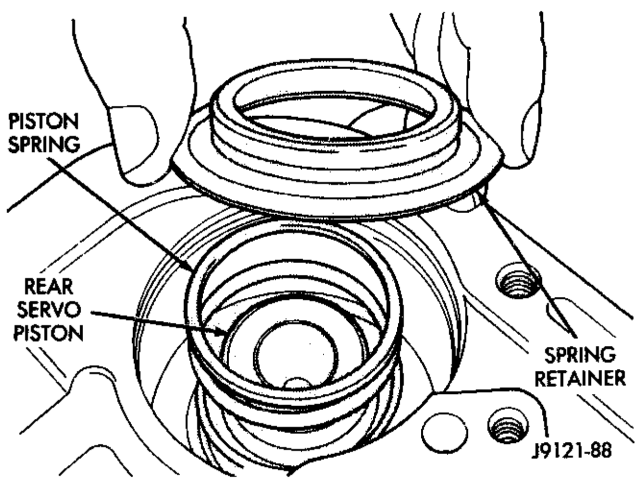

Fig. 122 Rear Servo Piston Spring And Retainer

(7) Bottom front servo piston in bore and install servo spring.

(8) Install front servo piston rod guide as follows:

(a) Place Tool SP-5560 (or similar size tool) on guide and position C-clamp on tool and case (Fig. 125).

(b) Slowly compress rod guide while simultaneously easing seal ring into bore with suitable tool.

(9) Install rod guide snap ring (Fig. 125).

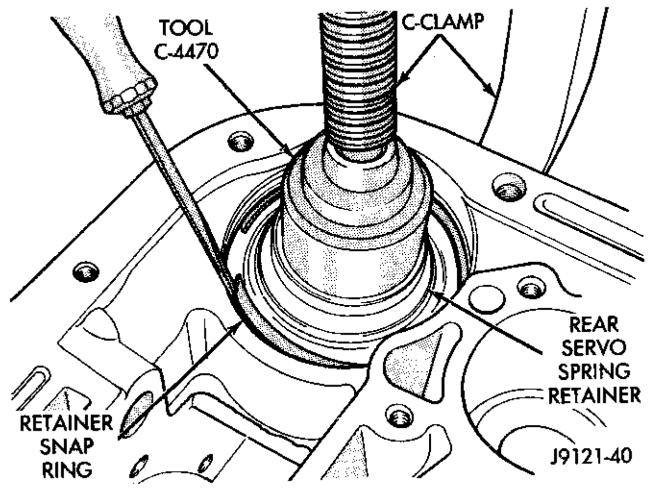

Fig. 123 Rear Servo Snap Ring

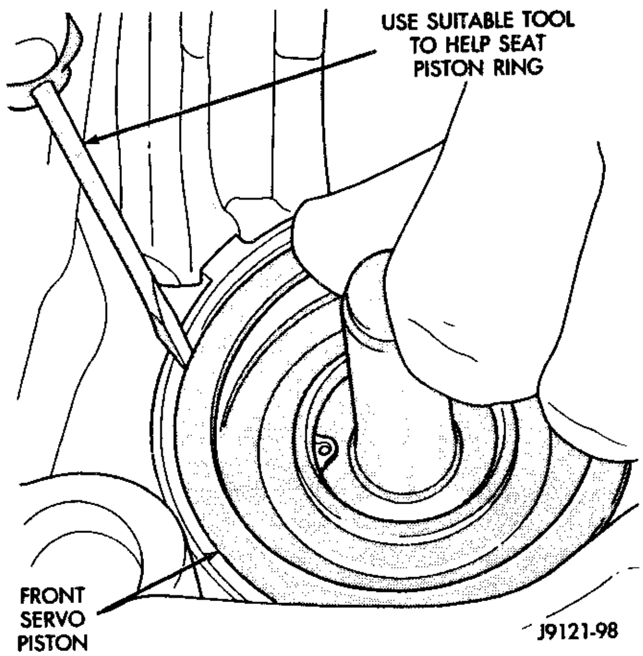

Fig. 124 Front Servo Piston

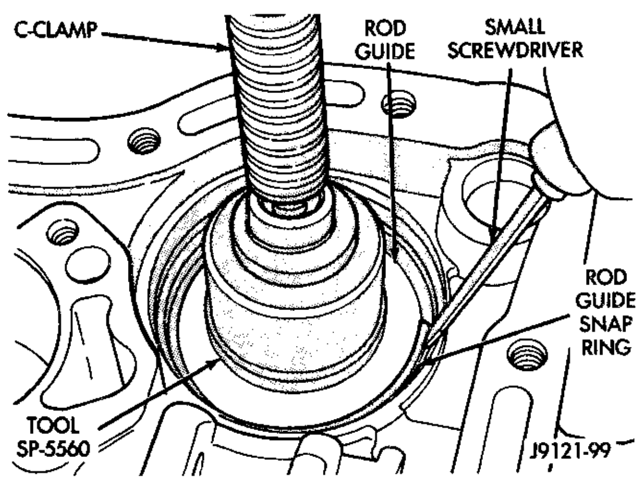

Fig. 125 Front Servo Rod Guide And Snap Ring

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DISASSEMBLY AND ASSEMBLY (Continued)

OVERRUNNING CLUTCH, REAR BAND, AND LOW-REVERSE DRUM

(1) Install overrunning clutch components if not yet installed.

(2) Position rear band and link in case (Fig. 126).

(3) Install low-reverse drum (Fig. 127). Slide drum through rear band, onto piston retainer hub and into engagement with overrunning clutch and race.

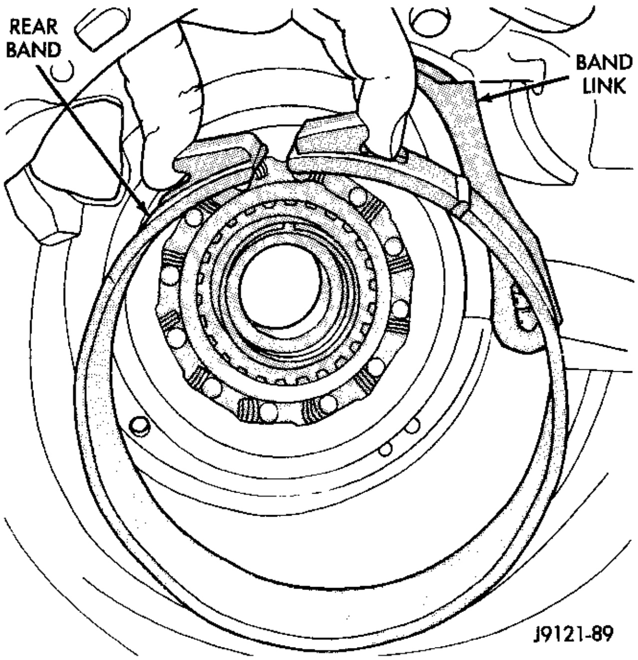

Fig. 126 Rear Band And Link

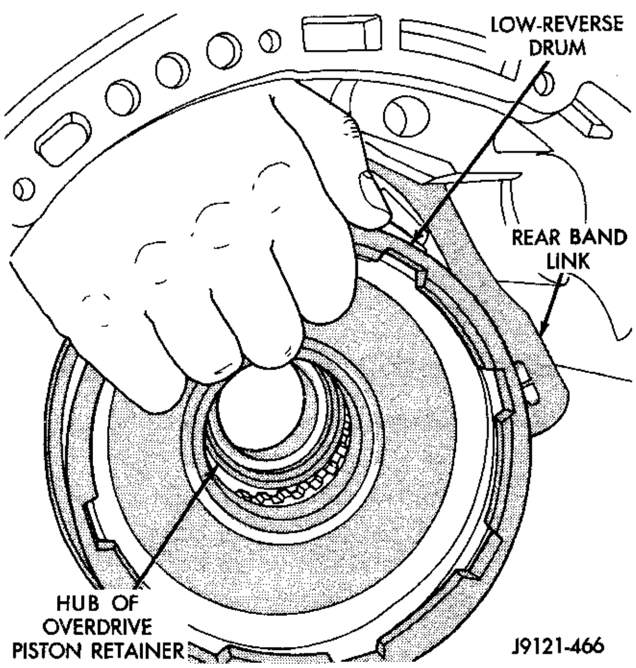

Fig. 127 Low-Reverse Drum

(4) Install thrust washer in low-reverse drum spot-face (Fig. 128). Use petroleum jelly to hold washer in place.

(5) Install snap ring that secures low-reverse drum to piston retainer hub (Fig. 128).

(6) Insert band reaction pin part way into case and band link (Fig. 129).

(7) Install rear band adjusting lever, reaction lever, and strut (Fig. 130). Be sure levers and strut are aligned and engaged before seating band reaction pin in case.

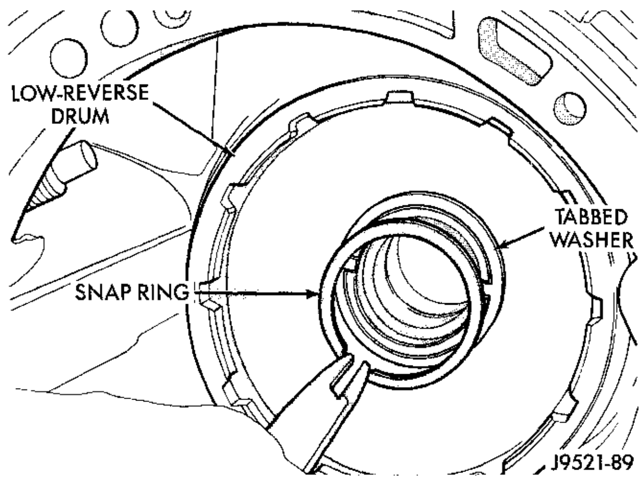

Fig. 128 Low-Reverse Drum Snap Ring

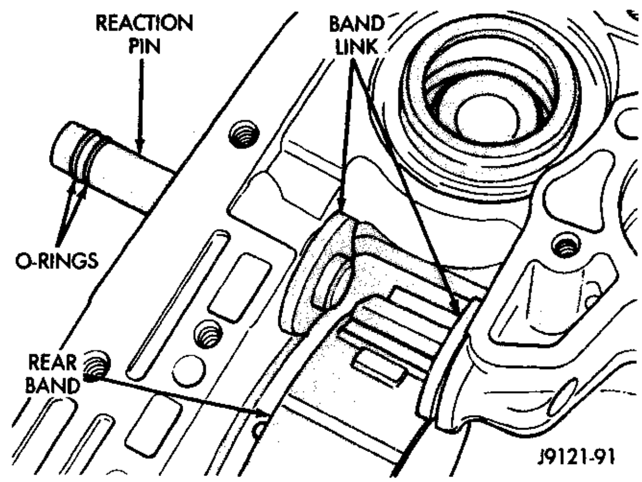

Fig. 129 Rear Band Reaction Pin

DISASSEMBLY AND ASSEMBLY (Continued)

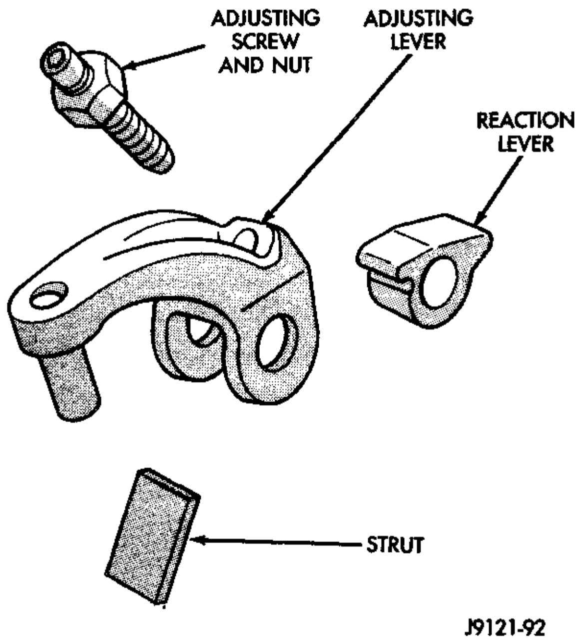

Fig. 130 Rear Band Levers And Strut

PLANETARY GEARTRAIN, FRONT/REAR CLUTCH, AND FRONT BAND

(1) Remove Alignment Shaft 6227-2, if installed previously.

(2) Install assembled intermediate shaft and planetary geartrain (Fig. 131). **Support shaft carefully during installation. Do not allow shaft bearing/bushing surfaces to become nicked or scratched.**

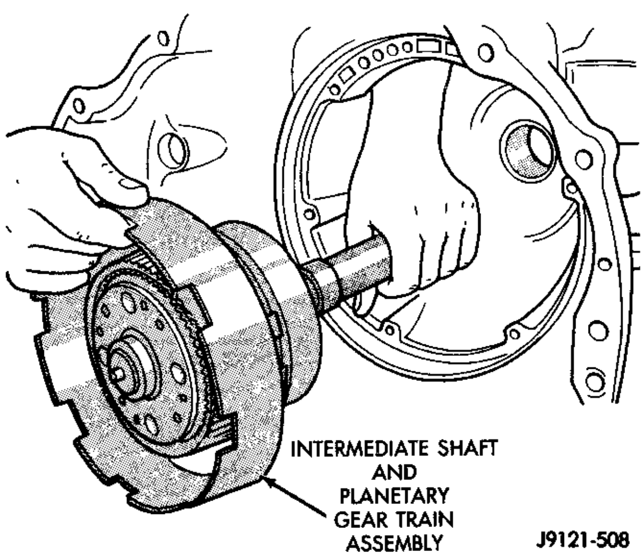

Fig. 131 Intermediate Shaft And Planetary Geartrain

(3) Lubricate intermediate shaft thrust plate with petroleum jelly and install plate on shaft pilot hub (Fig. 132).

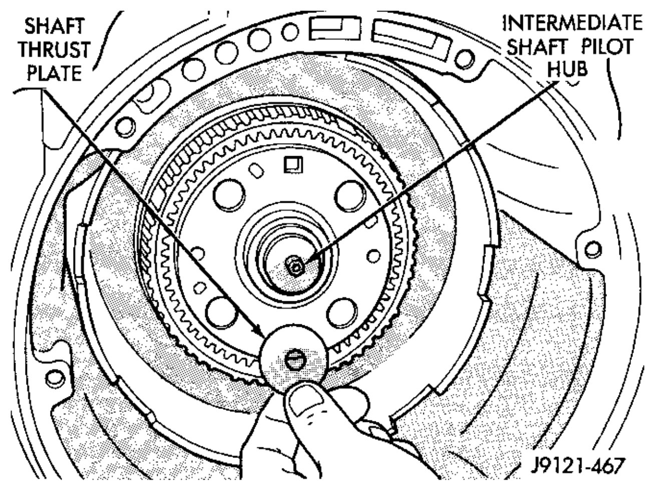

Fig. 132 Intermediate Shaft Thrust Plate

(4) Check input shaft front seal rings, fiber thrust washer and rear seal ring (Fig. 133). Be ends of rear seal ring are hooked together and diagonal cut ends of front seal rings are firmly seated against each other as shown. Lubricate seal rings with petroleum jelly after checking them.

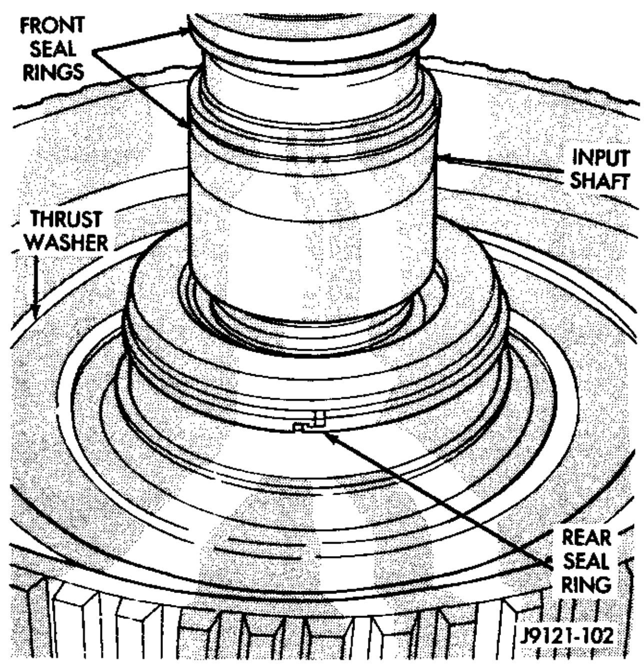

Fig. 133 Input Shaft Seal Ring And Thrust Washer

DISASSEMBLY AND ASSEMBLY (Continued)

(5) Assemble front and rear clutches (Fig. 134). Align lugs on front clutch discs. Mount front clutch on rear clutch. Turn front clutch retainer back and forth until front clutch discs are fully seated on rear clutch splined hub.

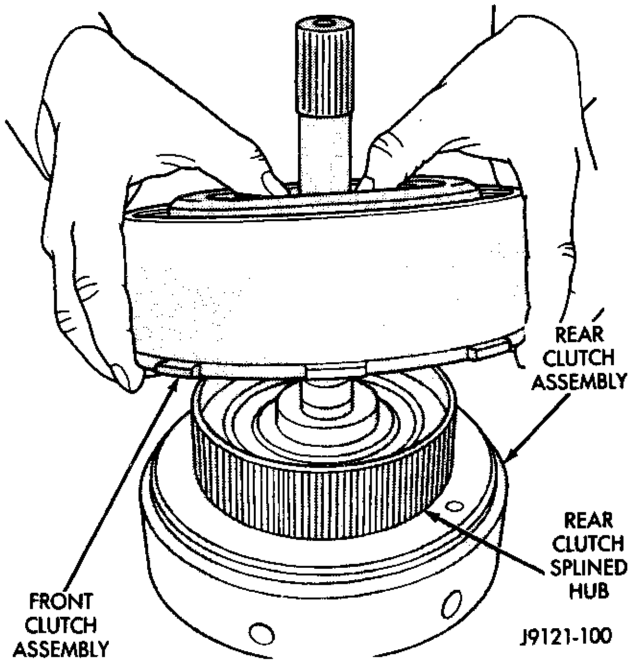

Fig. 134 Assembling Front And Rear Clutches

(6) Install intermediate shaft thrust washer in hub of rear clutch retainer (Fig. 135). Use petroleum jelly to hold washer in place. Position washer so grooves are facing outward. **Washer only fits one way in clutch retainer hub.**

(7) Place transmission case in upright position, or place blocks under front end of transmission repair stand to tilt case rearward. This makes it easier to install front/rear clutch assembly.

(8) Align discs in rear clutch. Then install and engage assembly in front planetary and driving shell (Fig. 136). Turn clutch retainers back and forth until both clutches are seated.

(9) Position front band lever in case and over servo rod guide. Then install front band lever pin in case and slide it through lever.

(10) Coat threads of front band pin access plug with sealer and install it in case. Tighten plug to 17 N·m (13 ft. lbs.) torque.

(11) Slide front band over front clutch retainer and install front band strut and anchor (Fig. 137).

(12) Tighten front band adjusting screw until band is tight on clutch retainer. This will hold clutches in place while oil pump is being installed. **Verify that front/rear clutch assembly is still properly seated before tightening band.**

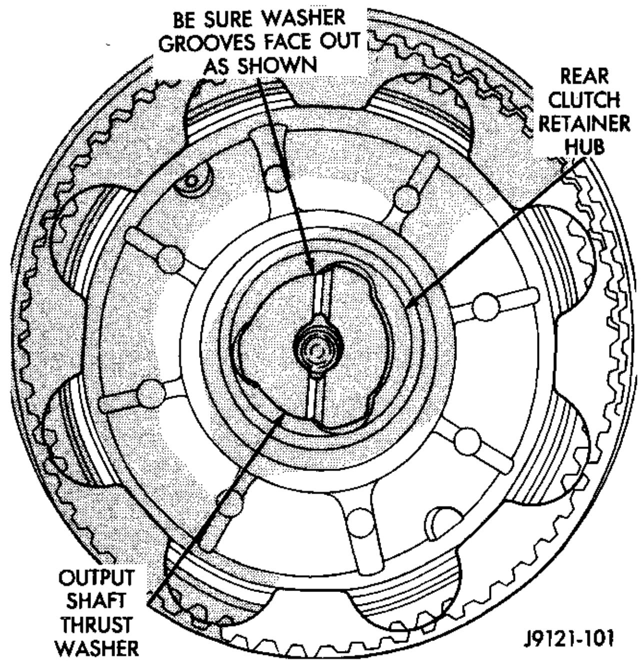

Fig. 135 Intermediate Shaft Thrust Washer

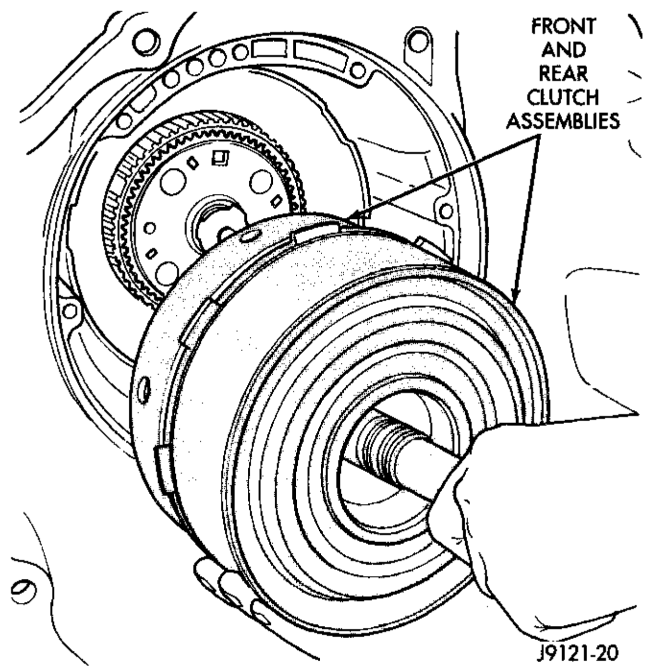

Fig. 136 Front/Rear Clutch Assemblies

DISASSEMBLY AND ASSEMBLY (Continued)

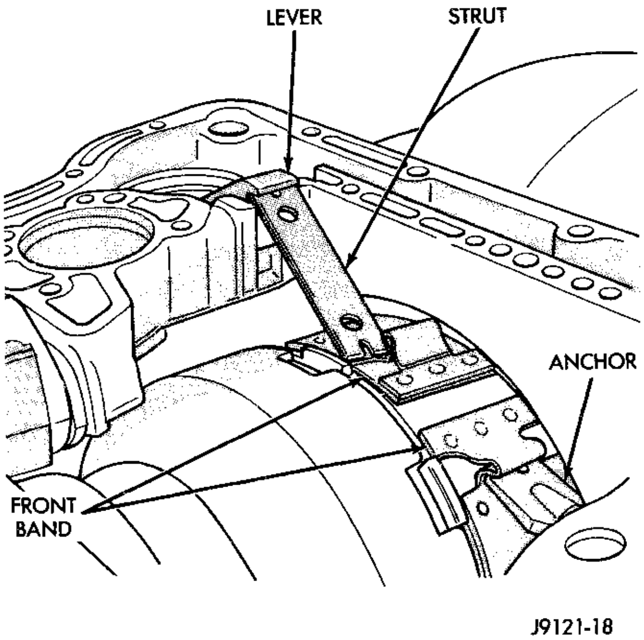

Fig. 137 Front Band And Linkage

OIL PUMP

(1) Install oil pump Pilot Studs C-3288-B in case (Fig. 138).

(2) Install new oil pump gasket on pilot studs and seat it in case. Be sure gasket is properly aligned with fluid passages in case (Fig. 138).

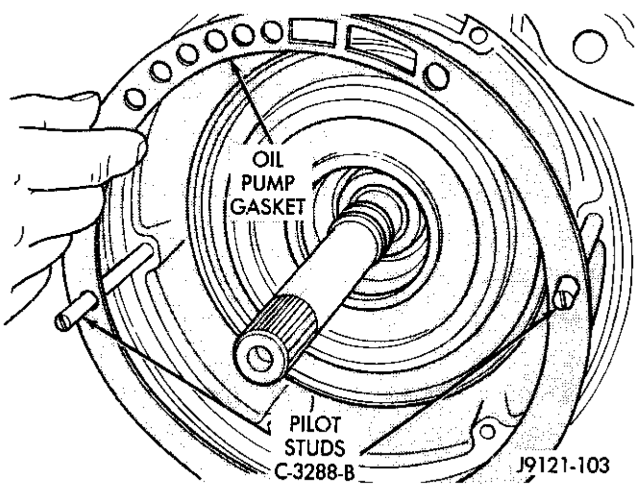

Fig. 138 Oil Pump Gasket And Pilot Studs

(3) Coat front clutch thrust washer with petroleum jelly to hold it in place. Then install washer over reaction shaft hub and seat it on pump (Fig. 139).

CAUTION: The thrust washer bore (I.D.), is chamfered on one side. Make sure the chamfered side is installed so it faces the pump.

(4) Check seal rings on reaction shaft support. Be sure rings are hooked together correctly. Also be sure

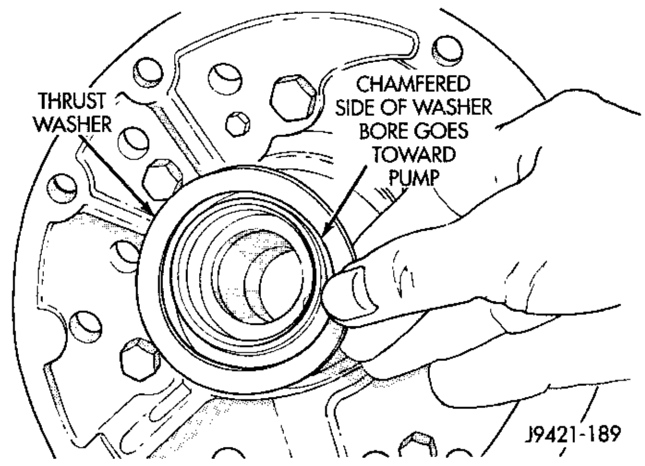

Fig. 139 Front Clutch Thrust Washer

fiber thrust washer is in position (Fig. 140). Use extra petroleum jelly to hold washer in place if necessary.

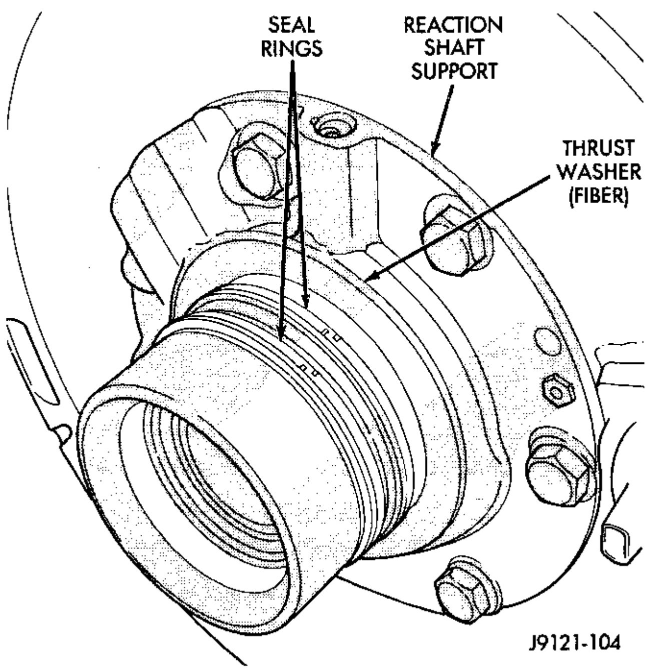

Fig. 140 Reaction Shaft Seal Ring And Thrust Washer

(5) Lubricate oil pump seals with petroleum Mopar® ATF Plus 3, type 7176.

(6) Mount oil pump on pilot studs and slide pump into case opening (Fig. 141). **Work pump into case by hand. Do not use a mallet or similar tools to seat pump.**

(7) Remove pilot studs and install oil pump bolts. Tighten pump bolts alternately and evenly to fully seat pump in case. Then final-tighten pump bolts to 20 N·m (15 ft. lbs.) torque.

DISASSEMBLY AND ASSEMBLY (Continued)

(8) Verify correct installation. Rotate input and intermediate shafts and check for bind. If bind exists, components are either mis-assembled, or not seated. Disassemble and correct as necessary before proceeding.

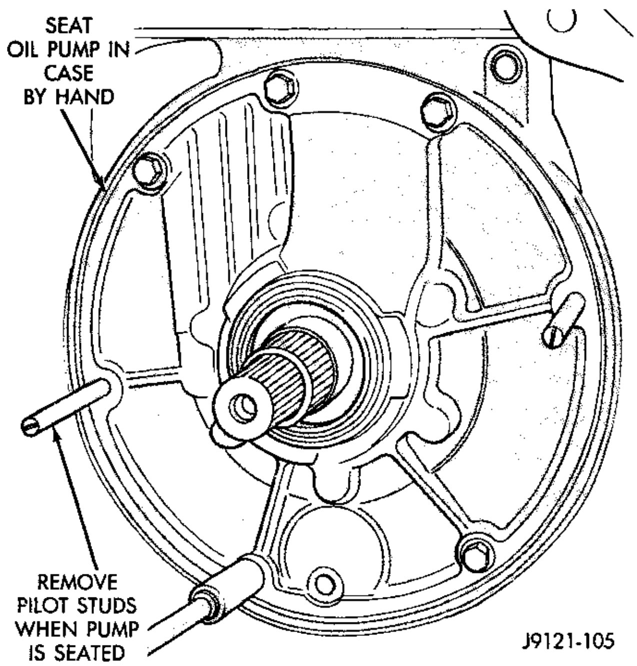

Fig. 141 Oil Pump

INPUT SHAFT END PLAY CHECK

NOTE: Overdrive unit must be installed in order to correctly measure the input shaft end-play.

(1) Check input shaft end play as follows.
(2) Attach dial indicator to converter housing (Fig. 142). Position indicator plunger against input shaft and zero indicator.
(3) Move input shaft in and out and record reading.
(4) End play should be 0.86 - 2.13 mm (0.034 - 0.084 in.).
(5) If end play is incorrect, change intermediate shaft thrust washer. The thrust washer controls end play and is available in three thicknesses for adjustment purposes.

ACCUMULATOR, VALVE BODY, OIL PAN, AND TORQUE CONVERTER

(1) Install accumulator inner spring, piston and outer spring (Fig. 143).
(2) Verify that park/neutral position switch has **not** been installed in case. Valve body can not be installed if switch is in position.
(3) Install new valve body manual shaft seal in case (Fig. 144). Lubricate seal lip and manual shaft

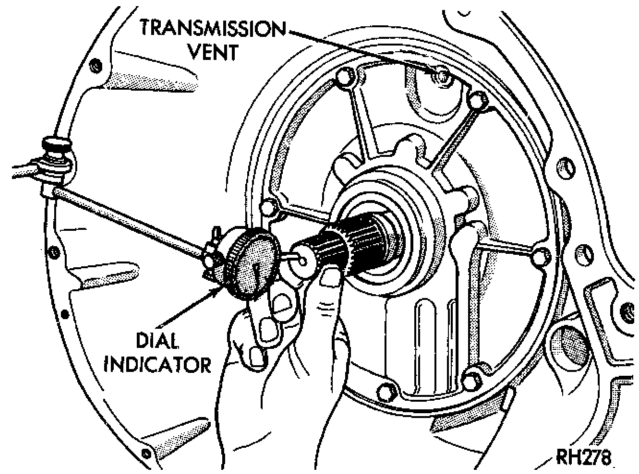

Fig. 142 Checking Input Shaft End Play

with petroleum jelly. Start seal over shaft and into case. Seat seal with 15/16 inch, deep well socket.
(4) Install valve body as follows:
(a) Start park rod into park pawl. If rod will not slide past park pawl, pawl is engaged in park gear. Rotate overdrive output shaft with suitable size 12 point socket; this will free pawl and allow rod to engage.
(b) Align and seat valve body on case. Be sure manual lever shaft and overdrive connector are fully seated in case.
(c) Install and start all valve body attaching bolts by hand. Then tighten bolts evenly, in a diagonal pattern to 12 N·m (105 in. lbs.) torque. **Do not overtighten valve body bolts. This could result in distortion and cross leakage after installation..**
(5) Install new filter on valve body. Tighten filter screws to 4 N·m (35 in. lbs.).
(6) Install seal on park/neutral position switch. Then install and tighten switch to 34 N·m (25 ft. lbs.).

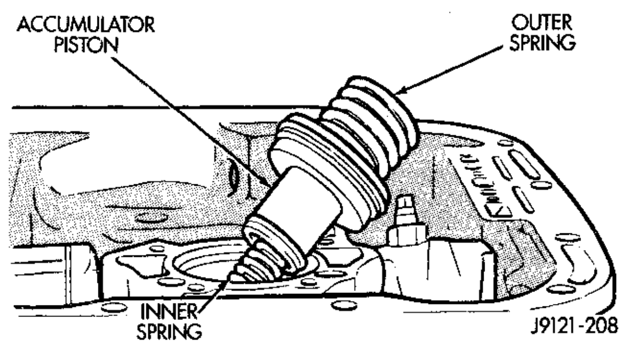

Fig. 143 Accumulator Piston And Springs

DISASSEMBLY AND ASSEMBLY (Continued)

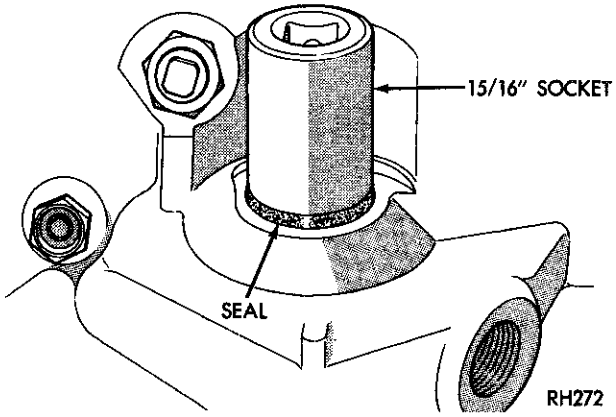

Fig. 144 Manual Lever Shaft Seal

CAUTION: If the condition of the transmission before the overhaul procedure caused excessive metallic or fiber contamination in the fluid, replace the torque converter and reverse flush the cooler(s) and cooler lines. Fluid contamination and transmission failure can result if not done.

(7) Install torque converter. Use C-clamp or metal strap to hold converter in place for installation.

BAND ADJUSTMENT AND FINAL

(1) Adjust front and rear bands as follows:
(a) Loosen locknut on each band adjusting screw 4-5 turns.
(b) Tighten both adjusting screws to 8 N·m (72 in. lbs.).
(c) Back off front band adjusting screw 2-7/8 turns.
(d) Back off rear band adjusting screw 2 turns.
(e) Hold each adjusting screw in position and tighten locknut to 34 N·m (25 ft. lbs.) torque.
(2) Install magnet in oil pan. Magnet seats on small protrusion at corner of pan.
(3) Position new oil pan gasket on case and install oil pan. Tighten pan bolts to 17 N·m (13 ft. lbs.).
(4) Install throttle valve and shift selector levers on valve body manual lever shaft.
(5) Apply small quantity of dielectric grease to terminal pins of solenoid case connector and neutral switch.
(6) Fill transmission with recommended fluid. Refer to Service Procedures section of this group.
(7) Road test vehicle to verify repair.

OVERRUNNING CLUTCH CAM/OVERDRIVE PISTON RETAINER

NOTE: TO SERVICE THE OVERRUNNING CLUTCH CAM AND THE OVERDRIVE PISTON RETAINER, THE TRANSMISSION GEARTRAIN AND OVERDRIVE UNIT MUST BE REMOVED FROM THE TRANSMISSION.

DISASSEMBLY

(1) Remove the overdrive piston (Fig. 145).
(2) Remove the overdrive piston retainer bolts.
(3) Remove overdrive piston retainer.
(4) Remove case gasket.
(5) Tap old cam out of case with pin punch. Insert punch through bolt holes at rear of case (Fig. 146). Alternate position of punch to avoid cocking cam during removal.
(6) Clean clutch cam bore and case. Be sure to remove all chips/shavings generated during cam removal.

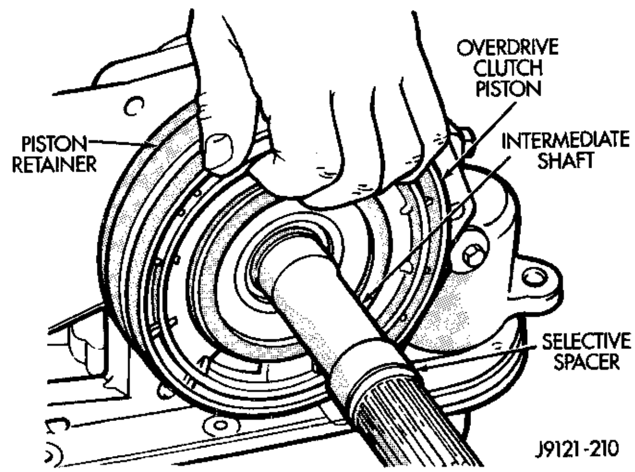

Fig. 145 Overdrive Piston Removal

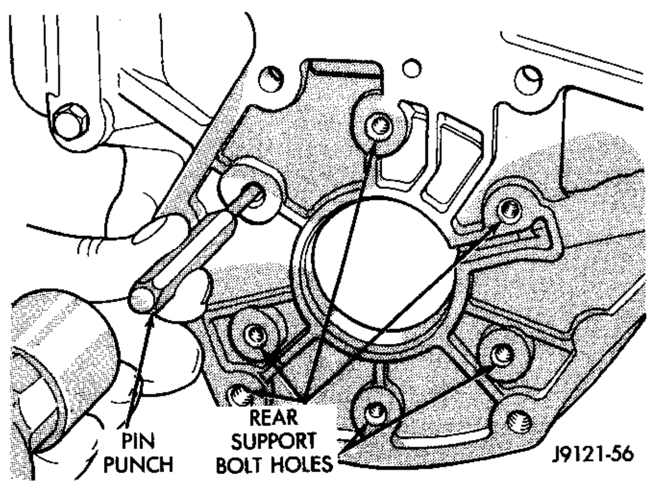

Fig. 146 Overrunning Clutch Cam

ASSEMBLY

(1) Temporarily install overdrive piston retainer in case. Use 3-4 bolts to secure retainer.
(2) Align and start new clutch cam and spring retainer in case. Be sure serrations on cam and in

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DISASSEMBLY AND ASSEMBLY (Continued)

case are aligned (Fig. 147). Then tap cam into case just enough to hold it in place.

(3) **Verify that cam is correctly positioned before proceeding any further. Narrow ends of cam ramps should be to left when cam is viewed from front end of case** (Fig. 147).

(4) Insert Adapter Tool SP-5124 into piston retainer (Fig. 148).

(5) Assemble Puller Bolt SP-3701 and Press Plate SP-3583-A (Fig. 149).

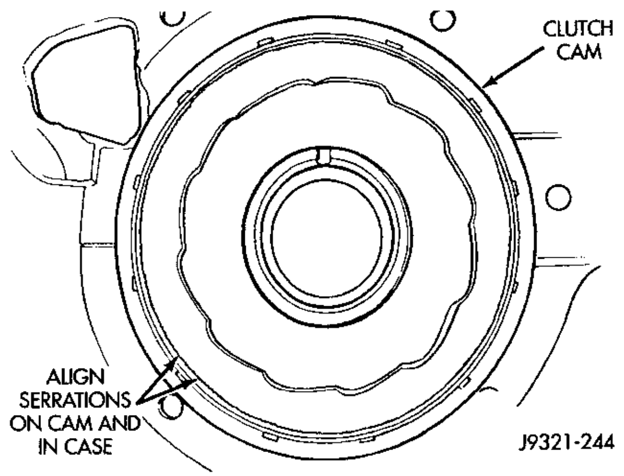

Fig. 147 Positioning Replacement Clutch Cam In Case

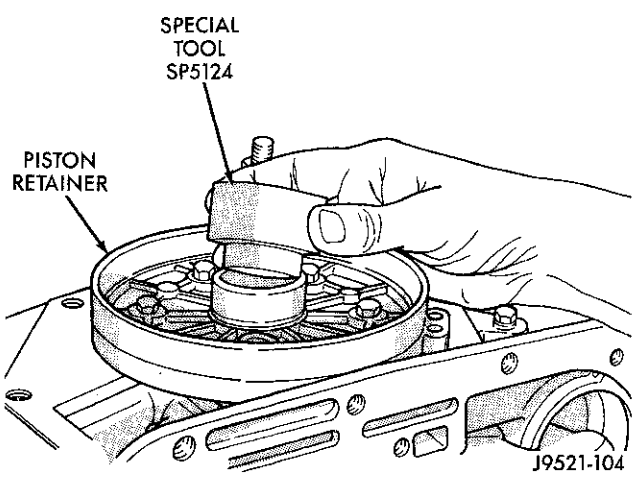

Fig. 148 Positioning Adapter Tool In Overdrive Piston Retainer

(6) Install assembled puller plate and bolt (Fig. 150). Insert bolt through cam, case and adapter tool. Be sure plate is seated squarely on cam.

(7) Hold puller plate and bolt in place and install puller nut SP-3701 on puller bolt (Fig. 151).

(8) Tighten puller nut to press clutch cam into case (Fig. 151). **Be sure cam is pressed into case evenly and does not become cocked.**

(9) Remove clutch cam installer tools.

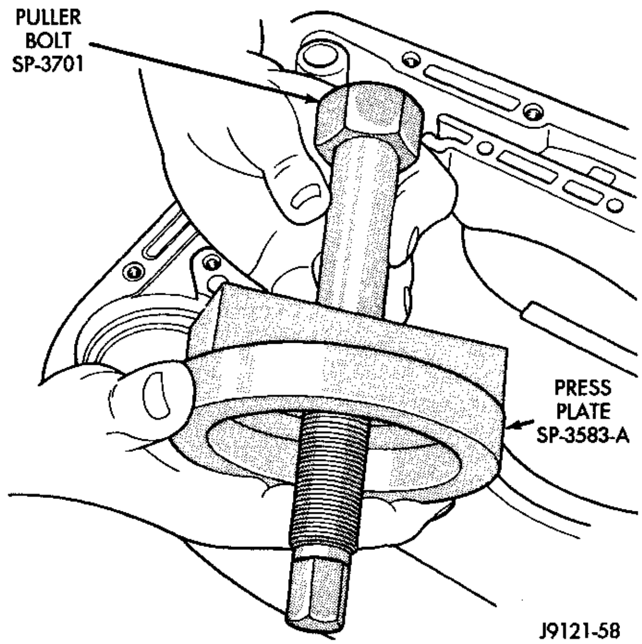

Fig. 149 Assembling Clutch Cam Puller Bolt And Press Plate

(10) **Stake case in 12 places around clutch cam to help secure cam in case. Use blunt punch or chisel to stake case.**

(11) Remove piston retainer from case. Cover retainer with plastic sheeting, or paper to keep it dust free.

(12) Clean case and cam thoroughly. Be sure any chips/shavings generated during cam installation are removed from case.

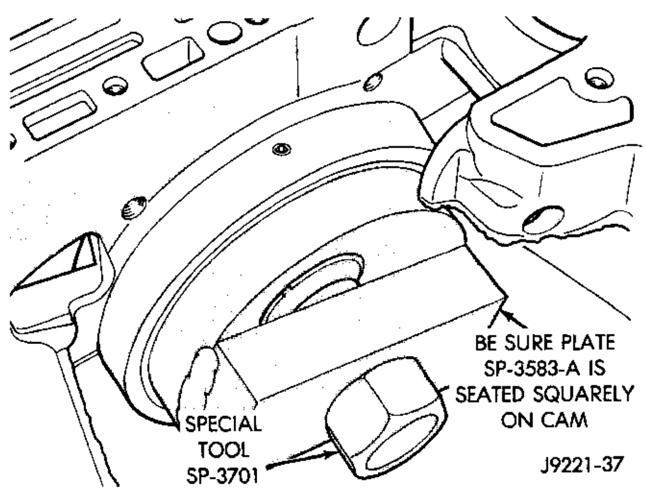

Fig. 150 Positioning Puller Plate On Clutch Cam

(13) Install new gasket at rear of transmission case. Use petroleum jelly to hold gasket in place. Be sure to align governor feed holes in gasket with feed passages in case (Fig. 152). Also install gasket before overdrive piston retainer. Center hole in gasket is

DISASSEMBLY AND ASSEMBLY (Continued)

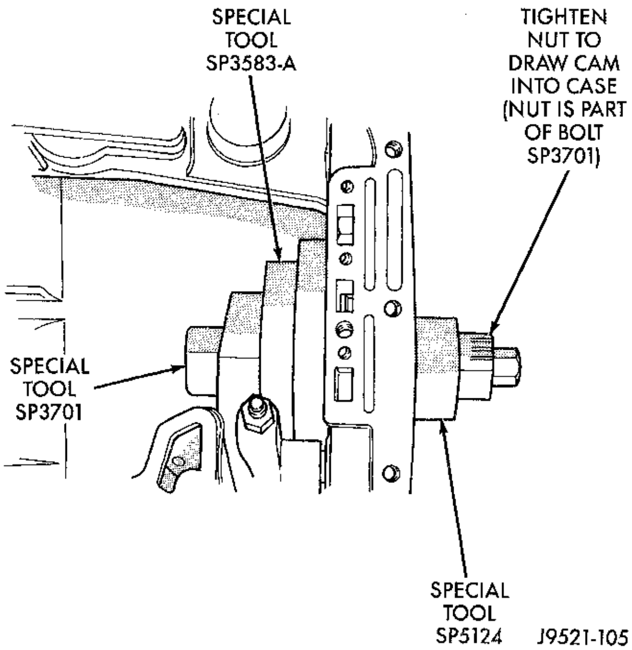

Fig. 151 Pressing Overrunning Clutch Cam Into Case

smaller than retainer and cannot be installed over retainer.

(14) Position overdrive piston retainer on transmission case and align bolt holes in retainer, gasket and case (Fig. 153). Then install and tighten retainer bolts to 17 N·m (13 ft. lbs.) torque.

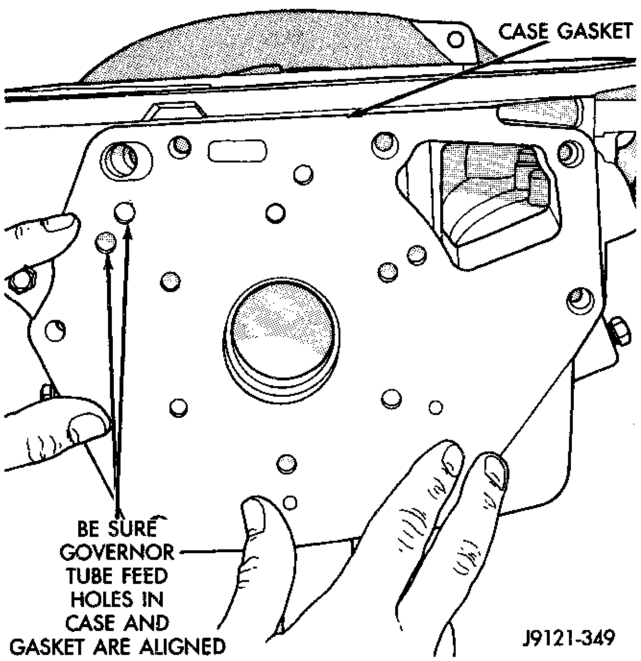

Fig. 152 Installing/Aligning Case Gasket

(15) Install new seals on overdrive piston.

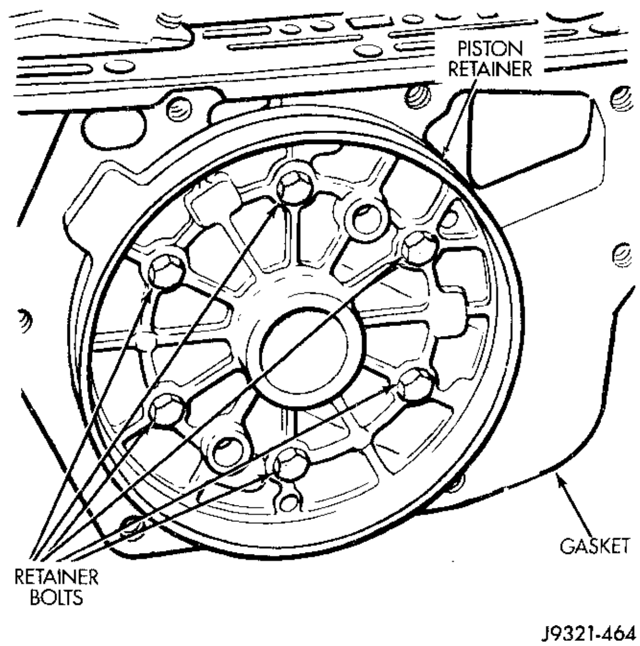

Fig. 153 Aligning Overdrive Piston Retainer

(16) Stand transmission case upright on bellhousing.

(17) Position Guide Ring 8114-1 on outer edge of overdrive piston retainer.

(18) Position Seal Guide 8114-3 on inner edge of overdrive piston retainer.

(19) Install overdrive piston in overdrive piston retainer by: aligning locating lugs on overdrive piston to the two mating holes in retainer.

(a) Aligning locating lugs on overdrive piston to the two mating holes in retainer.

(b) Lubricate overdrive piston seals with Mopar® Door Ease, or equivalent.

(c) Install piston over Seal Guide 8114–3 and inside Guide Ring 8114–1.

(d) Push overdrive piston into position in retainer.

(e) Verify that the locating lugs entered the lug bores in the retainer.

NOTE: INSTALL THE REMAINING TRANSMISSION COMPONENTS AND OVERDRIVE UNIT.

FRONT SERVO PISTON

DISASSEMBLY

(1) Remove seal ring from rod guide (Fig. 154).

(2) Remove small snap ring from servo piston rod. Then remove piston rod, spring and washer from piston.

(3) Remove and discard servo component O-ring and seal rings.

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DISASSEMBLY AND ASSEMBLY (Continued)

ASSEMBLY

Clean and inspect front servo components.

(1) Lubricate new O-ring and seal rings with petroleum jelly and install them on piston, guide and rod.

(2) Install rod in piston. Install spring and washer on rod. Compress spring and install snap ring (Fig. 154).

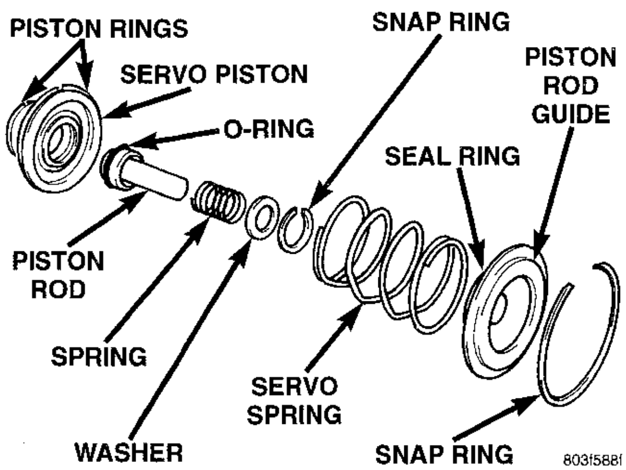

Fig. 154 Front Servo

REAR SERVO PISTON

DISASSEMBLY

(1) Remove small snap ring and remove plug and spring from servo piston (Fig. 155).

(2) Remove and discard servo piston seal ring.

ASSEMBLY

(1) Lubricate piston and guide seals with petroleum jelly. Lubricate other servo parts with Mopar® ATF Plus 3, Type 7176, transmission fluid.

(2) Install new seal ring on servo piston.

(3) Assemble piston, plug, spring and new snap ring.

(4) Lubricate piston seal lip with petroleum jelly.

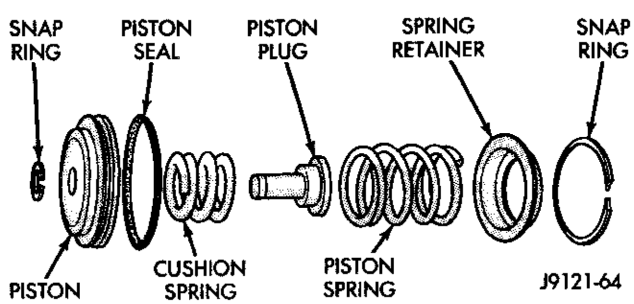

Fig. 155 Rear Servo Components

OIL PUMP AND REACTION SHAFT SUPPORT

DISASSEMBLY

(1) Mark position of support in oil pump body for assembly alignment reference. Use scriber or paint to make alignment marks.

(2) Place pump body on two wood blocks.

(3) Remove reaction shaft support bolts and separate support from pump body (Fig. 156).

(4) Remove pump inner and outer gears (Fig. 157).

(5) Remove O-ring seal from pump body (Fig. 158). Discard seal after removal.

(6) Remove oil pump seal with Remover Tool C-3981. Discard seal after removal.

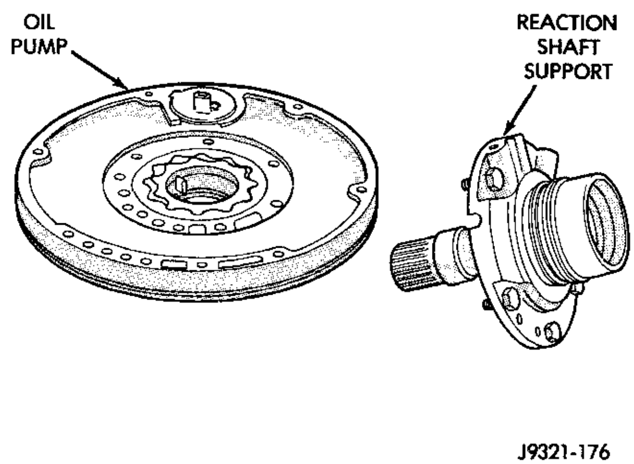

Fig. 156 Reaction Shaft Support

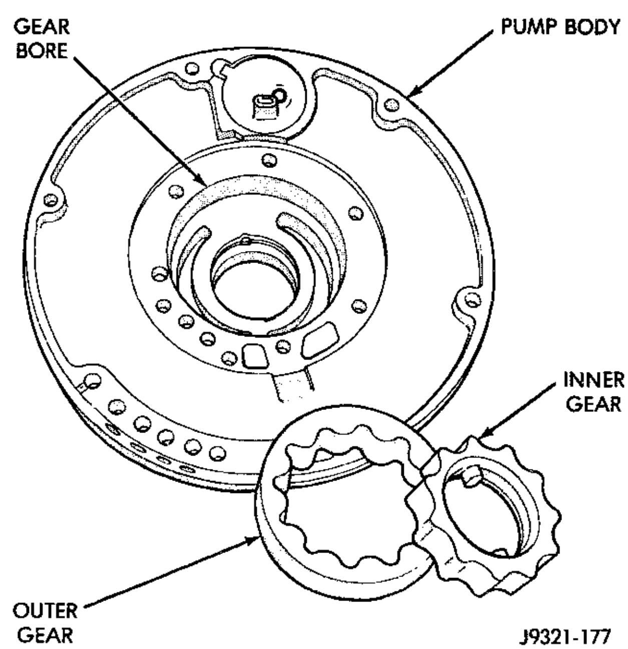

Fig. 157 Pump Gear

DISASSEMBLY AND ASSEMBLY (Continued)

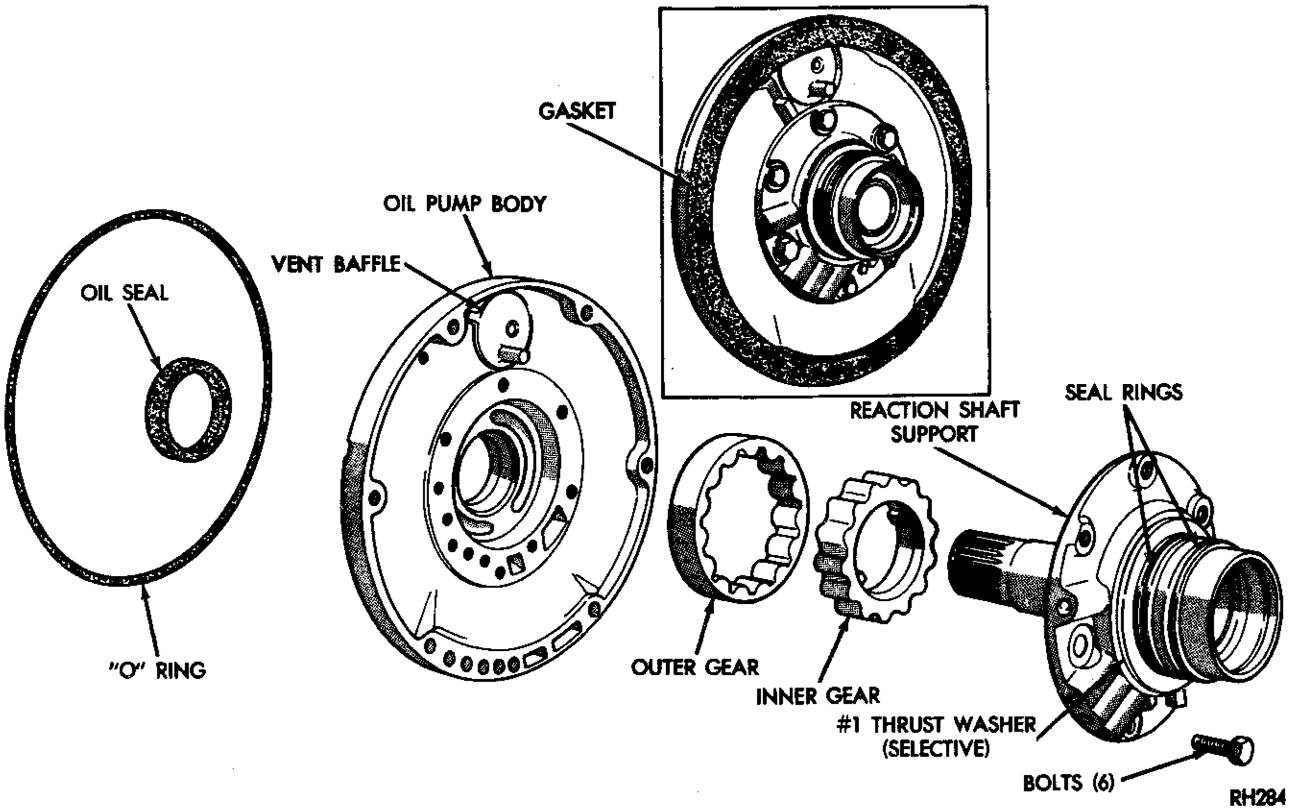

Fig. 158 Oil Pump And Reaction Shaft Components

OIL PUMP BUSHING REMOVAL

(1) Position pump housing on clean, smooth surface with gear cavity facing down.

(2) Remove bushing with Tool Handle C-4171 and Bushing Remover SP-3550 (Fig. 159).

REACTION SHAFT SUPPORT BUSHING REMOVAL

(1) Assemble Cup Tool SP-3633, Nut SP-1191 and Bushing Remover SP-5301 (Fig. 161).

(2) Hold cup tool firmly against reaction shaft. Thread remover tool into bushing as far as possible by hand.

(3) Using wrench, thread remover tool an additional 3-4 turns into bushing to firmly engage tool.

(4) Tighten tool hex nut against cup tool to pull bushing from shaft. Clean all chips from shaft and support after bushing removal.

ASSEMBLY

OIL PUMP BUSHING INSTALLATION

(1) Assemble Tool Handle C-4171 and Bushing Installer SP-5118.

(2) Place bushing on installer tool and start bushing into shaft.

(3) Tap bushing into place until Installer Tool SP-5118 bottoms in pump cavity. Keep tool and bushing square with bore. Do not allow bushing to become cocked during installation.

(4) Stake pump bushing in two places with blunt punch. Remove burrs from stake points with knife blade (Fig. 160).

REACTION SHAFT SUPPORT BUSHING INSTALLATION

(1) Place reaction shaft support upright on a clean, smooth surface.

(2) Assemble Bushing Installer Tools C-4171 and SP-5302. Then slide new bushing onto installer tool (Fig. 161).

(3) Start bushing in shaft. Tap bushing into shaft until installer tool bottoms against support flange.

(4) Clean reaction shaft support thoroughly after bushing replacement (to remove any chips).

(1) Lubricate pump gears with transmission fluid and install them in pump body.

(2) Install thrust washer on reaction shaft support hub. Lubricate washer with petroleum jelly or transmission fluid before installation.

(3) If reaction shaft seal rings are being replaced, install new seal rings on support hub. Lubricate seal rings with transmission fluid or petroleum jelly after installation. Squeeze each ring until ring ends are securely hooked together.

DISASSEMBLY AND ASSEMBLY (Continued)

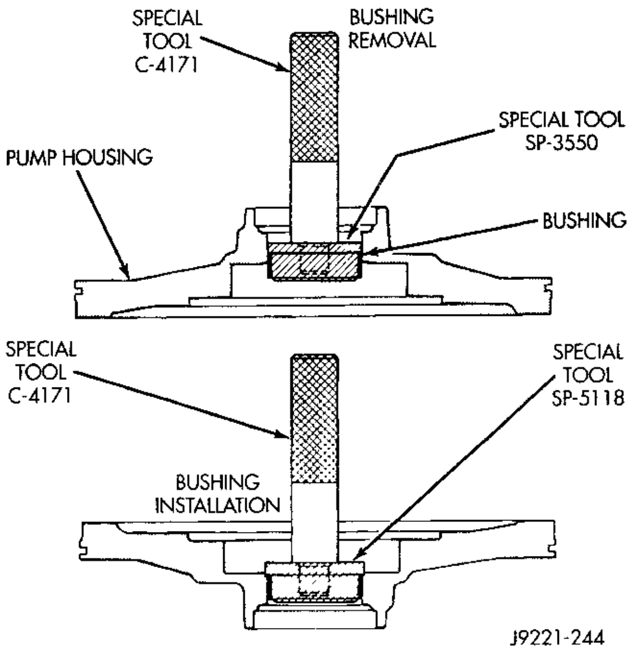

Fig. 159 Oil Pump Bushing

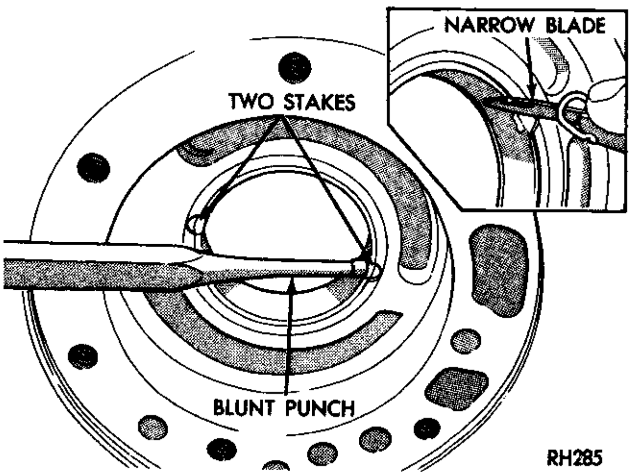

Fig. 160 Staking-Deburring Oil Pump Bushing

CAUTION: The reaction shaft support seal rings will break if overspread, or twisted. If new rings are being installed, spread them only enough for installation. Also be very sure the ring ends are securely hooked together after installation. Otherwise, the rings will either prevent pump installation, or break during installation.

(4) Align and install reaction shaft support on pump body.

(5) Install bolts attaching reaction shaft support to pump. Tighten bolts to 20 N·m (175 in. lbs.) torque.

(6) Install new pump seal with Installer Tool C-3860-A (Fig. 162). Use hammer or mallet to tap seal into place.

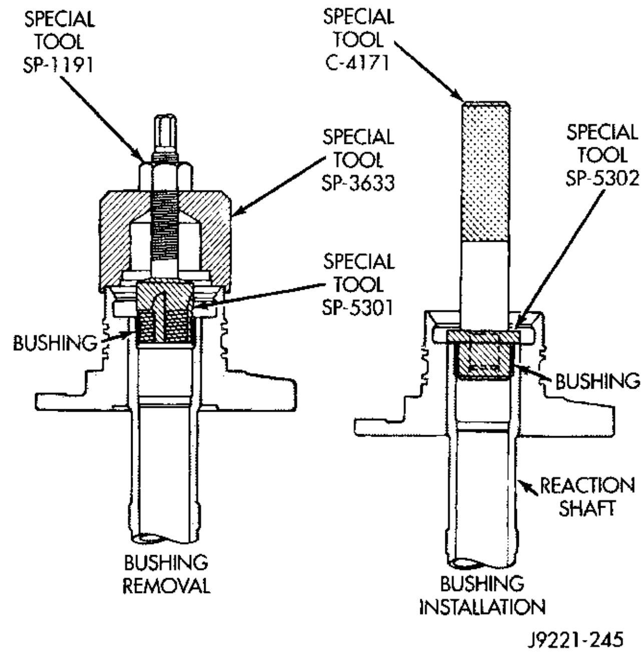

Fig. 161 Reaction Shaft Bushing

(7) Install new O-ring on pump body. Lubricate oil seal and O-ring with petroleum jelly.

(8) Cover pump assembly to prevent dust entry and set aside for assembly installation.

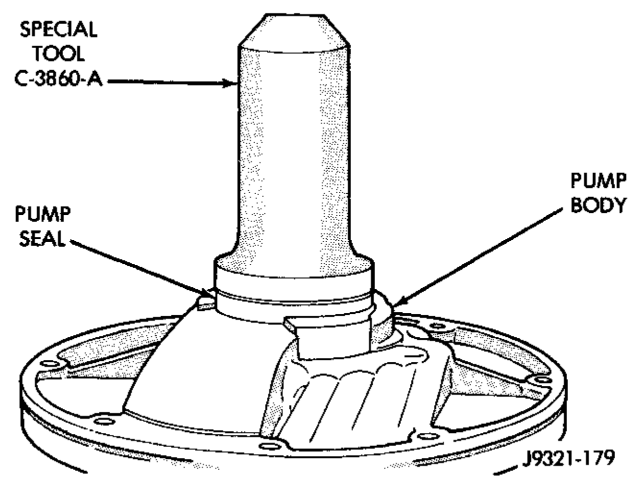

Fig. 162 Oil Pump Seal

FRONT CLUTCH

DISASSEMBLY

(1) Remove waved snap ring and remove reaction plate, clutch plates and clutch discs.

(2) Compress clutch piston retainer and piston springs with Compressor Tool C-3863-A (Fig. 163).

(3) Remove retainer snap ring and remove compressor tool.

DISASSEMBLY AND ASSEMBLY (Continued)

(4) Remove clutch piston springs (Fig. 164). **Note position of piston springs for assembly reference.**

(5) Remove clutch piston from retainer with a twisting motion.

(6) Remove and discard clutch piston inner and outer seals.

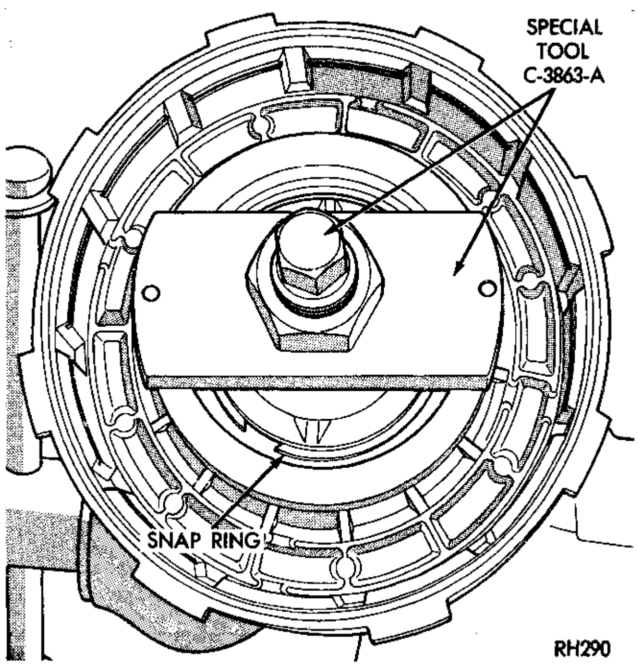

Fig. 163 Removing Front Clutch Spring Retainer Snap Ring

(7) Assemble Tool Handle C-4171 and Bushing Remover SP-3629 (Fig. 165).

(8) Insert remover tool in bushing and drive bushing straight out of clutch retainer.

ASSEMBLY

NOTE: The 46RE transmission uses 3 discs in the front clutch. The 47RE transmission uses 4 discs.

(1) Mount Bushing Installer SP-5511 on tool handle (Fig. 165).

(2) Slide new bushing onto installer tool and start bushing into retainer.

(3) Tap new bushing into place until installer tool bottoms against clutch retainer.

(4) Remove installer tools and clean retainer thoroughly.

(5) Soak clutch discs in transmission fluid.

(6) Install new inner and outer seals on clutch piston. Be sure seal lips face interior of retainer.

(7) Lubricate new inner and outer piston seals with Ru-Glyde, or Mopar® Door Ease.

(8) Install clutch piston in retainer. Use twisting motion to seat piston in bottom of retainer. A thin strip of plastic (about 0.015 - 0.020 in. thick), can be used to guide seals into place if necessary.

CAUTION: Never push the clutch piston straight in. This will fold the seals over causing leakage and clutch slip. In addition, never use any type of metal tool to help ease the piston seals into place. Metal tools will cut, shave, or score the seals.

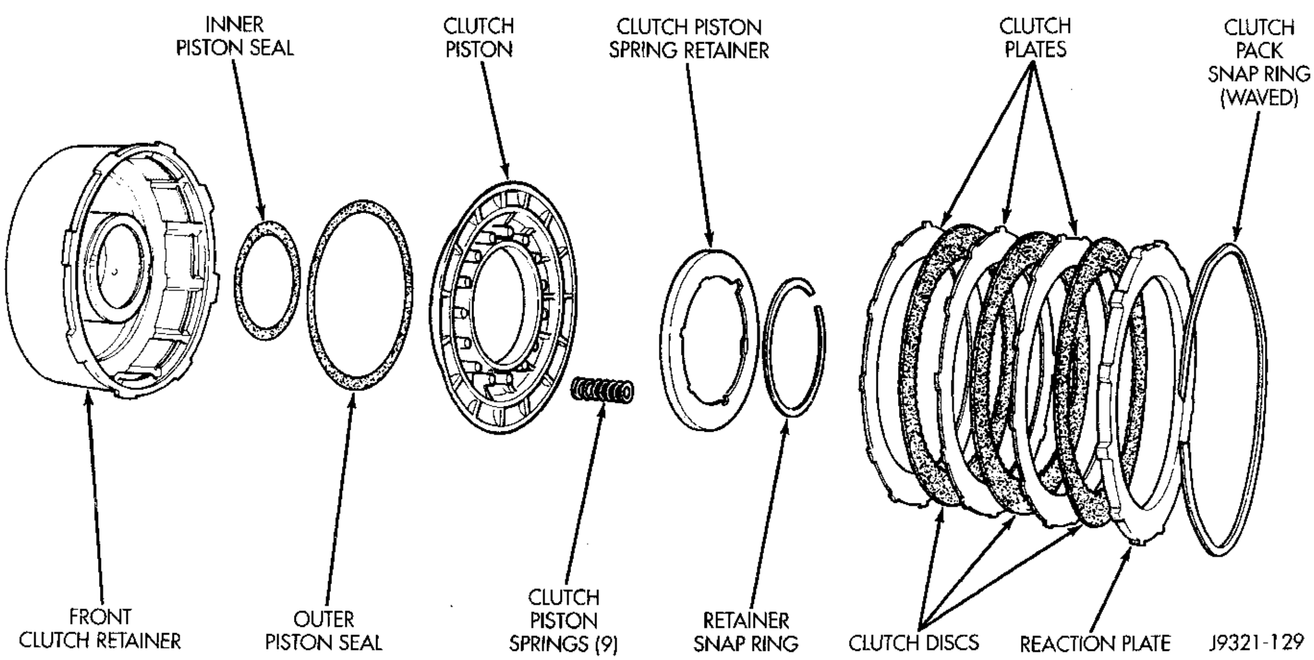

Fig. 164 46RE Front Clutch Components

DISASSEMBLY AND ASSEMBLY (Continued)

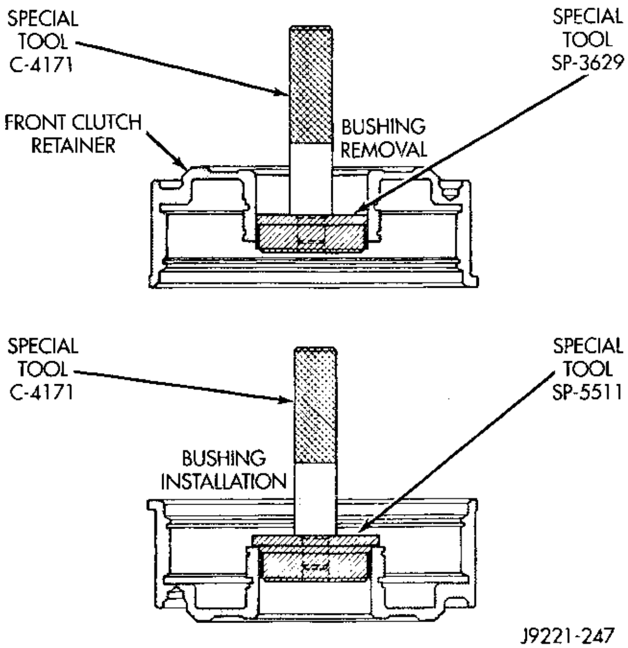

Fig. 165 Front Clutch Retainer Bushing Replacement Tools

(9) Install and position nine clutch piston springs (Fig. 166).

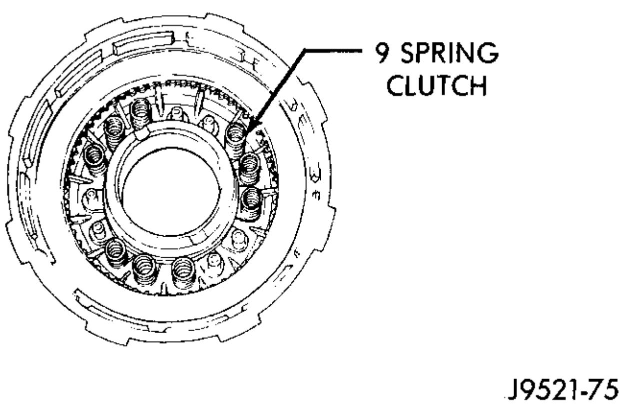

Fig. 166 Front Clutch Spring Position

(10) Install spring retainer on top of piston springs.

(11) Compress spring retainer and piston springs with Tool C-3863-A.

(12) Install spring retainer snap ring and remove compressor tool.

(13) Install clutch plates and discs (Fig. 164). Three clutch discs, three steel plates and one reaction plate are required.

(14) Install reaction plate followed by waved snap ring.

(15) Check clutch pack clearance with feeler gauge (Fig. 167). Clearance between waved spring and pressure plate should 1.78 - 3.28 mm (0.070 - 0.129 in.).

If clearance is incorrect, clutch plates, clutch discs, snap ring, or pressure plate may have to be changed.

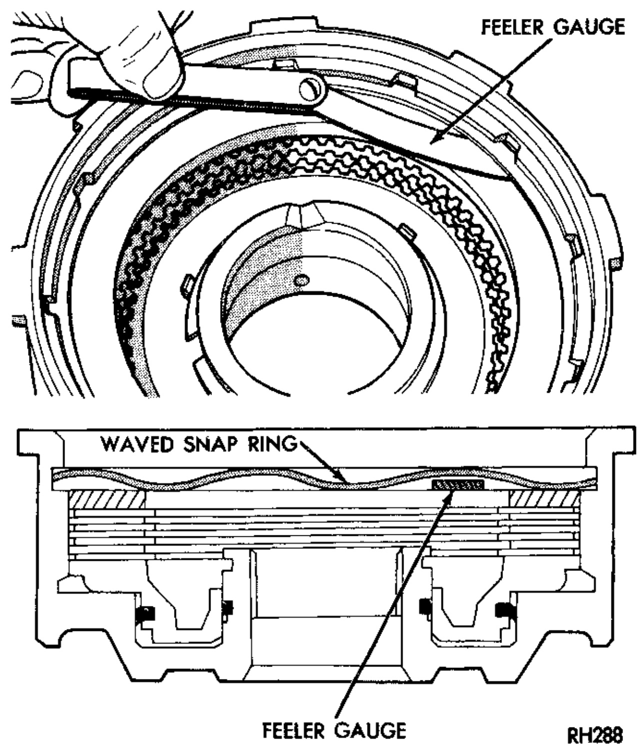

Fig. 167 Typical Method Of Measuring Front Clutch Pack Clearance

REAR CLUTCH

DISASSEMBLY

(1) Remove clutch pack select fit snap ring.

(2) Remove reaction plate and remove clutch plates and discs (Fig. 168).

(3) Remove pressure plate, wave spring, spacer ring and piston spring from clutch retainer.

(4) Remove clutch piston from piston retainer with a twisting motion.

(5) Remove input shaft thrust washer, if washer remained in piston retainer hub during removal.

(6) Remove seals from clutch piston. Discard seals after removal.

If the input shaft must be replaced, first remove the retaining ring that secures the shaft in the piston retainer hub. Then press the old shaft out of the retainer with a shop press using suitable press tools to press on the shaft and to support the retainer hub as close to the shaft as possible.

ASSEMBLY

(1) Lubricate the splines of the new shaft with petroleum jelly or Mopar® ATF Plus 3, type 7176. Then align the shaft in the piston retainer and carefully press it into place using suitable press tools to press the shaft and to support the retainer hub as

DISASSEMBLY AND ASSEMBLY (Continued)

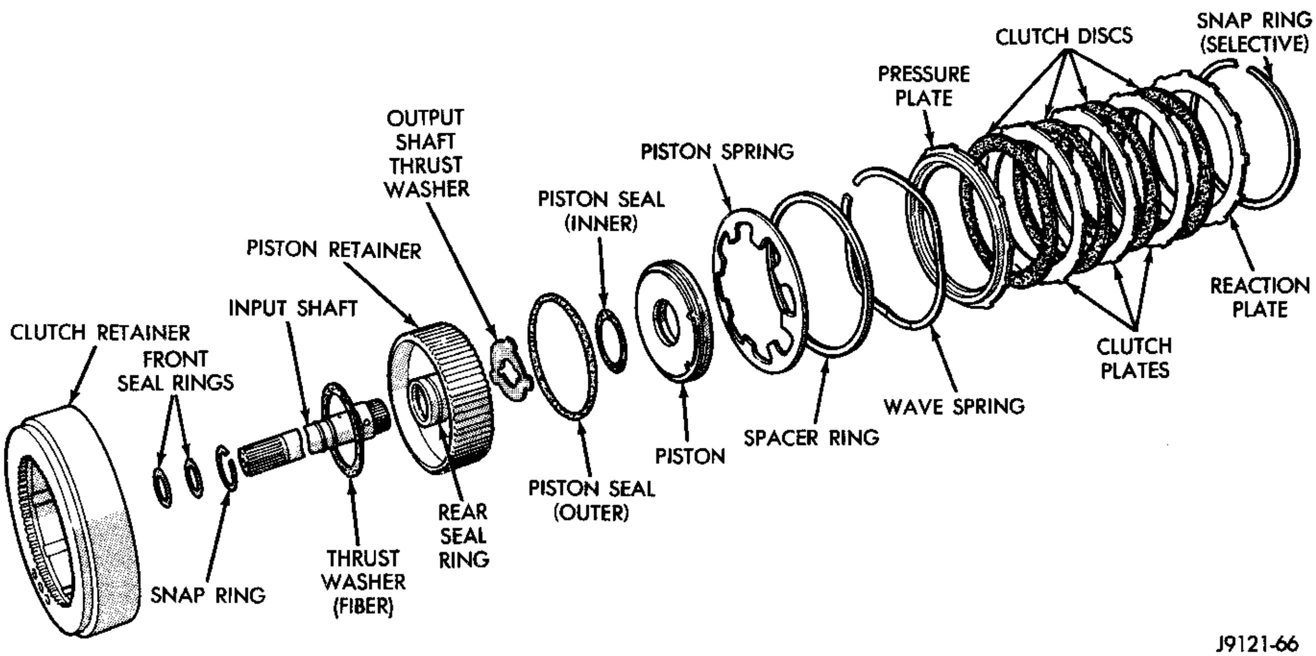

Fig. 168 Rear Clutch Components

close to the shaft as possible. Do not allow the shaft to become cocked during installation. The retainer can be cracked if misalignment occurs.

(2) Install the shaft retaining ring after pressing the shaft into place. Be sure the ring is fully seated before proceeding with clutch assembly.

(3) Invert the input shaft in the press and using the same tools as in removal, press on shaft enough to seat the snap-ring into the retainer.

(4) Soak clutch discs in transmission fluid before assembly.

(5) Install new seals on clutch piston. Lubricate piston seals with Mopar® Door Ease, or Ru-Glyde to ease installation. **Be sure seal lips face input shaft.**

(6) Install clutch piston in retainer. Use twisting motion to seat piston in bottom of retainer. A thin strip of plastic (about 0.020″ thick), can be used to guide seals into place if necessary.

CAUTION: Never push the clutch piston straight in. This will fold the seals over causing leakage and clutch slip. In addition, never use any type of metal tool to help ease the piston seals into place. Metal tools will cut, shave, or score the seals.

(7) Assemble piston retainer and clutch retainer.

(8) Support clutch retainer with wood blocks, or insert input shaft through pre-drilled hole in work-bench. Clutch pack components are easier to install if retainers are properly supported.

(9) Install piston spring in clutch retainer. Concave side of spring faces upward and away from clutch piston.

(10) Install spacer ring on top of piston spring.

(11) Install wave spring on top of spacer ring. Then seat wave spring in retainer groove. **If wave spring will not seat properly, spacer ring has probably shifted over and into wave spring groove in retainer. Use small screwdriver to realign spacer ring if necessary.**

(12) Install inner pressure plate in clutch retainer.

(13) Install first clutch disc followed by steel plate until all discs and plates are installed. 4 clutch discs and steel plates are required (Fig. 168).

(14) Install reaction plate on top of last clutch disc.

(15) Install selective snap ring to secure clutch pack in retainer.

(16) Install new seal rings on input shaft if necessary (Fig. 169). Be very sure ring ends are all securely hooked together before proceeding.

(17) Check clutch pack clearance with feeler gauge (Fig. 170). Clearance should be 0.63 to 1.14 mm (0.025 to 0.045 in.).

(18) If clutch pack clearance is incorrect, clutch pack snap ring, may have to be replaced.

(19) Install thrust washer on piston retainer hub. Use petroleum jelly to hold thrust washer in place.

DISASSEMBLY AND ASSEMBLY (Continued)

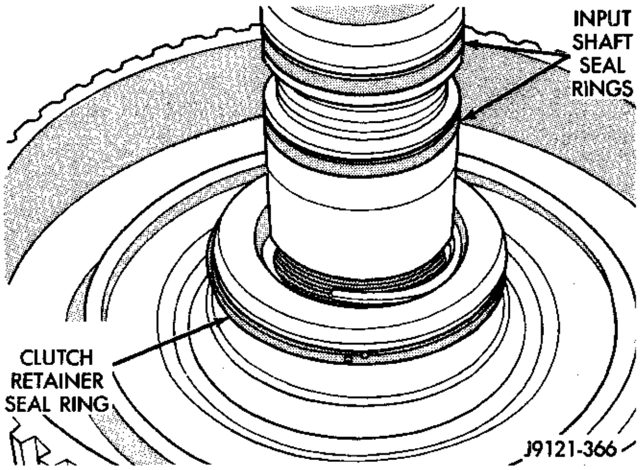

Fig. 169 Input Shaft Seal Ring Locations

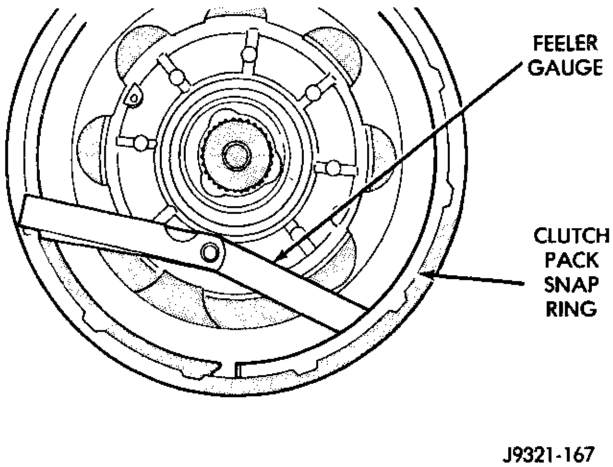

Fig. 170 Measuring Rear Clutch Pack Clearance

PLANETARY GEARTRAIN/OUTPUT SHAFT

DISASSEMBLY

(1) Remove planetary snap ring from intermediate shaft (Fig. 171). Discard snap ring as it is not reusable.

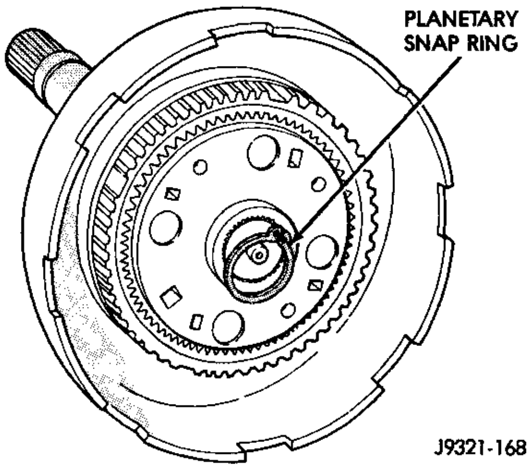

Fig. 171 Removing Planetary Snap Ring

(2) Remove front planetary gear and front annulus gear as assembly (Fig. 172).

(3) Remove front planetary gear and thrust washer from front annulus gear (Fig. 173). Note thrust washer position for assembly reference.

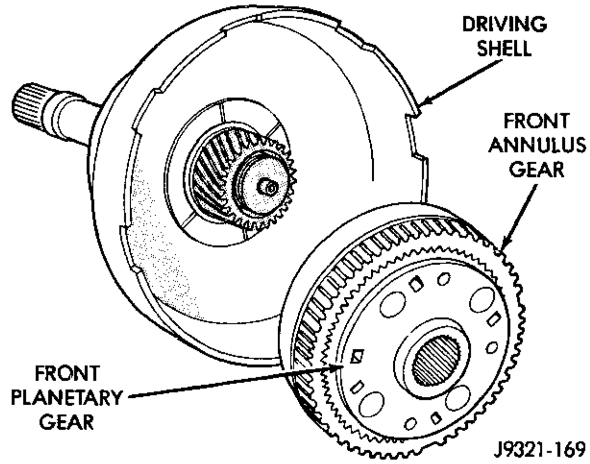

Fig. 172 Removing Front Planetary And Annulus Gears

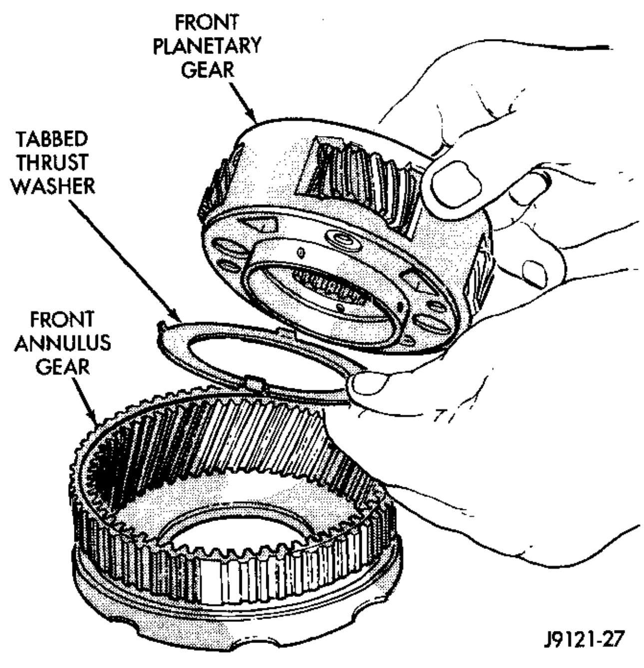

Fig. 173 Disassembling Front Planetary And Annulus Gears

DISASSEMBLY AND ASSEMBLY (Continued)

(4) Remove tabbed thrust washer from driving shell (Fig. 174). Note washer position for assembly reference.

(5) Remove sun gear and driving shell as assembly (Fig. 175).

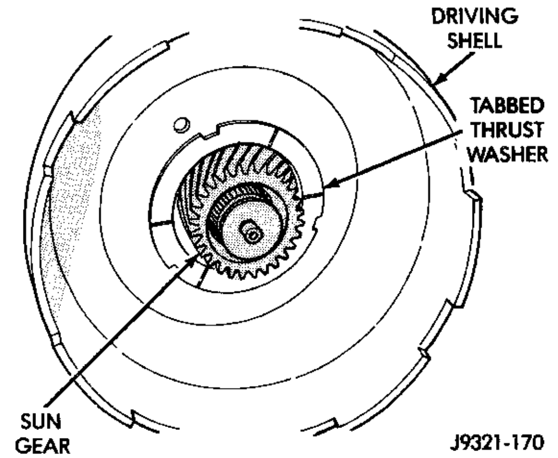

Fig. 174 Driving Shell Thrust Washer Removal

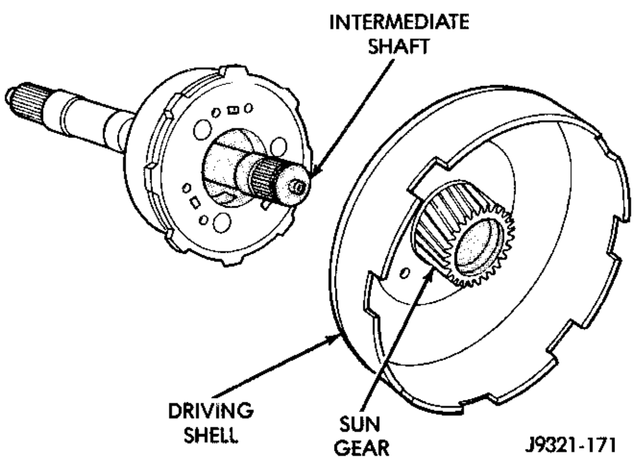

Fig. 175 Sun Gear And Driving Shell Removal

(6) Remove tabbed thrust washer from rear planetary gear (Fig. 176). Note washer position on gear for assembly reference.

(7) Remove rear planetary gear and rear annulus gear from intermediate shaft (Fig. 177).

(8) Remove thrust plate from rear annulus gear (Fig. 178).

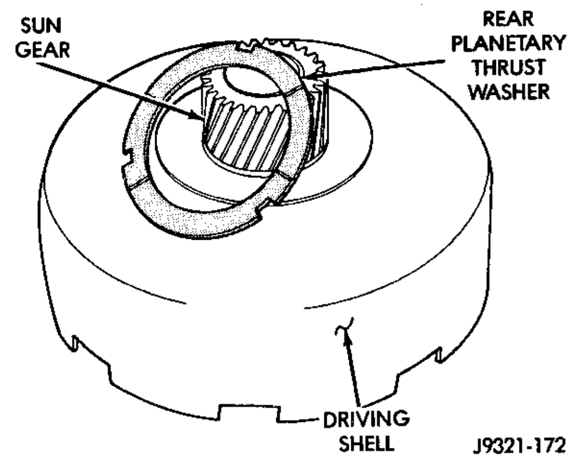

Fig. 176 Rear Planetary Thrust Washer Removal

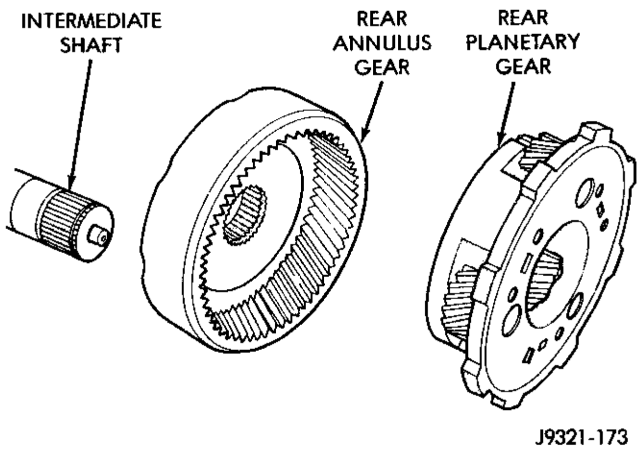

Fig. 177 Rear Planetary And Annulus Gear Removal

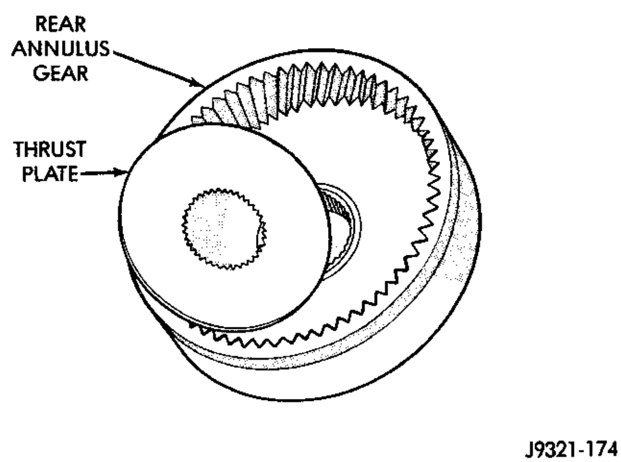

Fig. 178 Rear Annulus Thrust Plate Removal

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DISASSEMBLY AND ASSEMBLY (Continued)

ASSEMBLY

(1) Lubricate sun gear and planetary gears with transmission fluid during assembly. Use petroleum jelly to lubricate intermediate shaft bushing surfaces, thrust washers and thrust plates and to hold these parts in place during assembly.

(2) Install front snap ring on sun gear and install gear in driving shell. Then install thrust plate over sun gear and against rear side of driving shell (Fig. 179). Install rear snap ring to secure sun gear and thrust plate in driving shell.

(3) Install rear annulus gear on intermediate shaft (Fig. 180).

(4) Install thrust plate in annulus gear (Fig. 181). Be sure plate is seated on shaft splines and against gear.

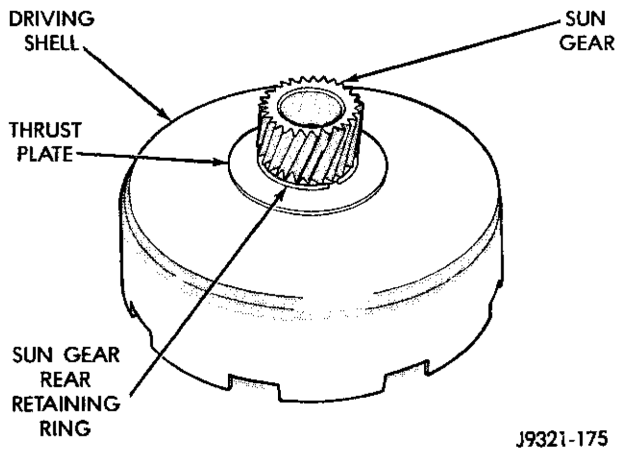

Fig. 179 Sun Gear Installation

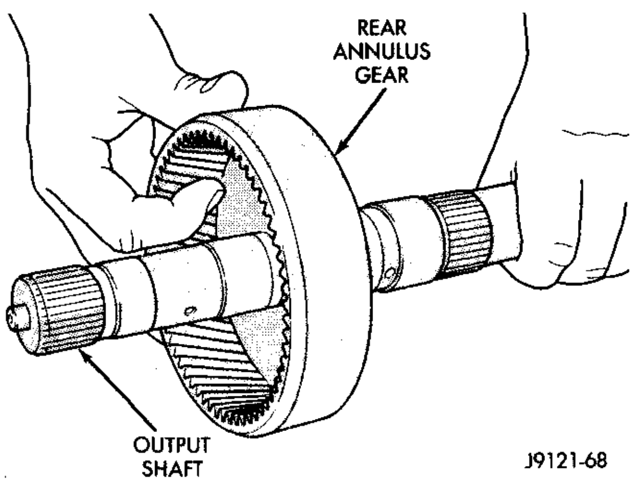

Fig. 180 Installing Rear Annulus Gear On Intermediate Shaft

(5) Install rear planetary gear in rear annulus gear (Fig. 182). Be sure planetary carrier is seated against annulus gear.

(6) Install tabbed thrust washer on front face of rear planetary gear (Fig. 183). Seat washer tabs in

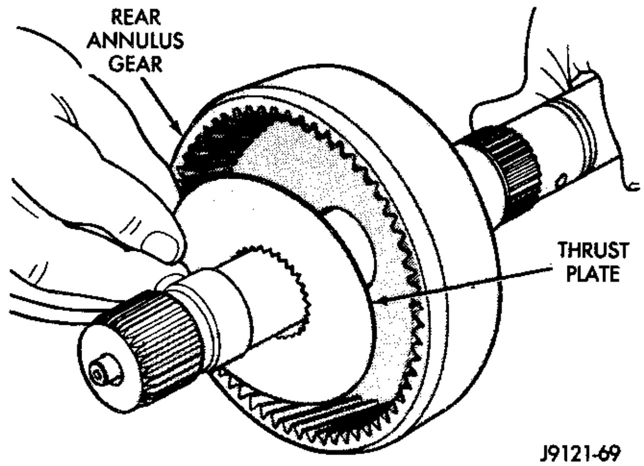

Fig. 181 Installing Rear Annulus Thrust Plate

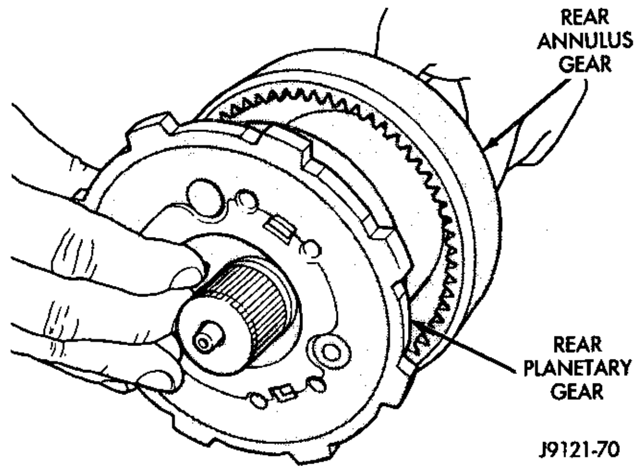

Fig. 182 Installing Rear Planetary Gear

matching slots in face of gear carrier. Use extra petroleum jelly to hold washer in place if desired.

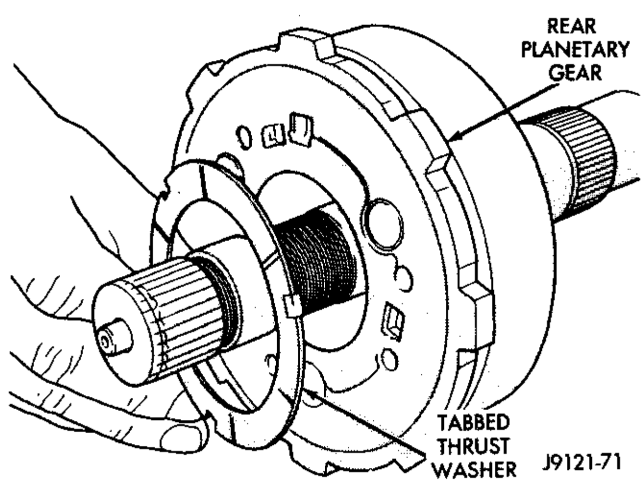

Fig. 183 Installing Rear Planetary Thrust Washer

DISASSEMBLY AND ASSEMBLY (Continued)

(7) Lubricate sun gear bushings with petroleum jelly or transmission fluid.

(8) Install sun gear and driving shell on intermediate shaft (Fig. 184). Seat shell against rear planetary gear. Verify that thrust washer on planetary gear was not displaced during installation.

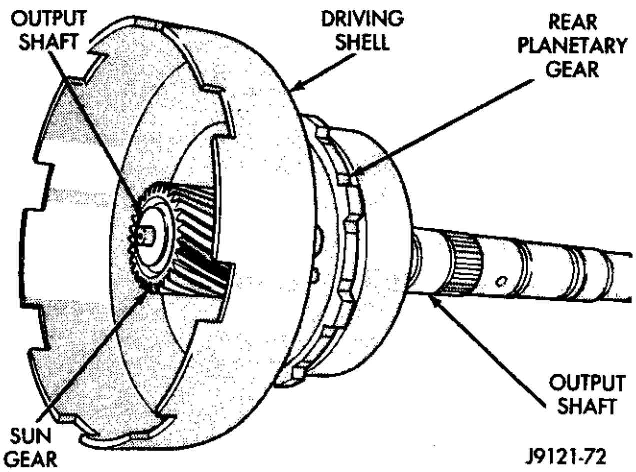

Fig. 184 Installing Sun Gear And Driving Shell

(9) Install tabbed thrust washer in driving shell (Fig. 185), be sure washer tabs are seated in tab slots of driving shell. Use extra petroleum jelly to hold washer in place if desired.

(10) Install tabbed thrust washer on front planetary gear (Fig. 186). Seat washer tabs in matching slots in face of gear carrier. Use extra petroleum jelly to hold washer in place if desired.

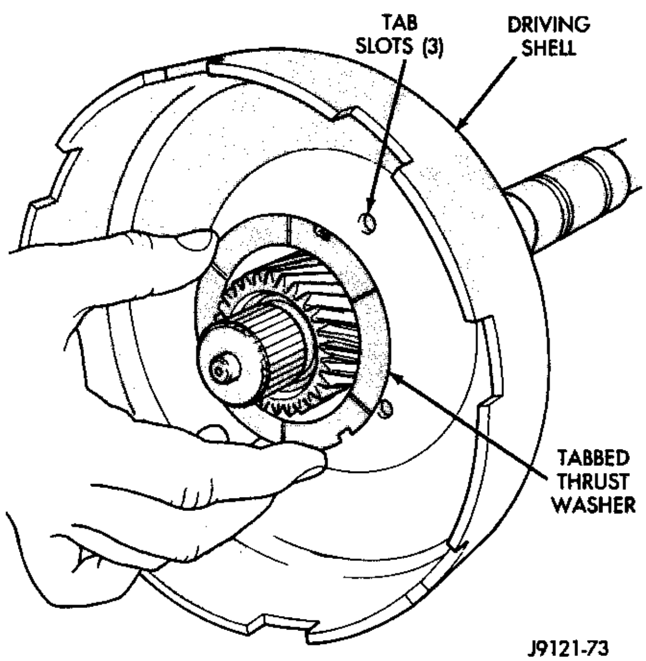

Fig. 185 Installing Driving Shell Thrust Washer

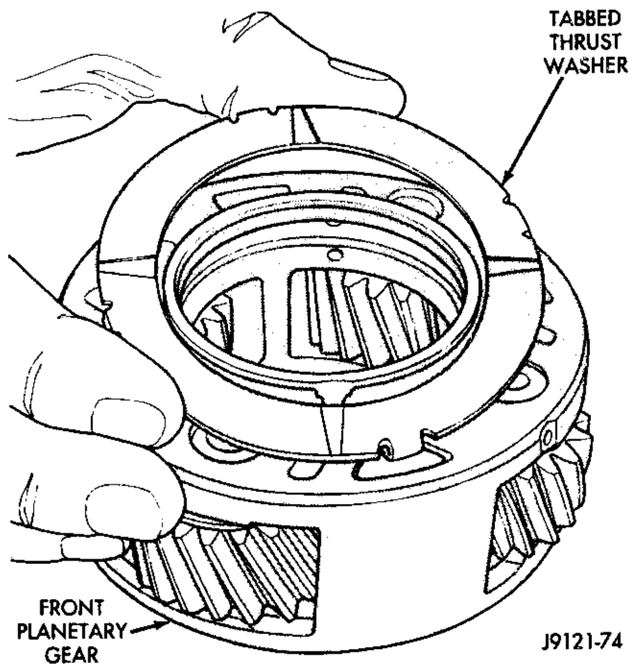

Fig. 186 Installing Thrust Washer On Front Planetary Gear

(11) Install front annulus gear over and onto front planetary gear (Fig. 187). Be sure gears are fully meshed and seated.

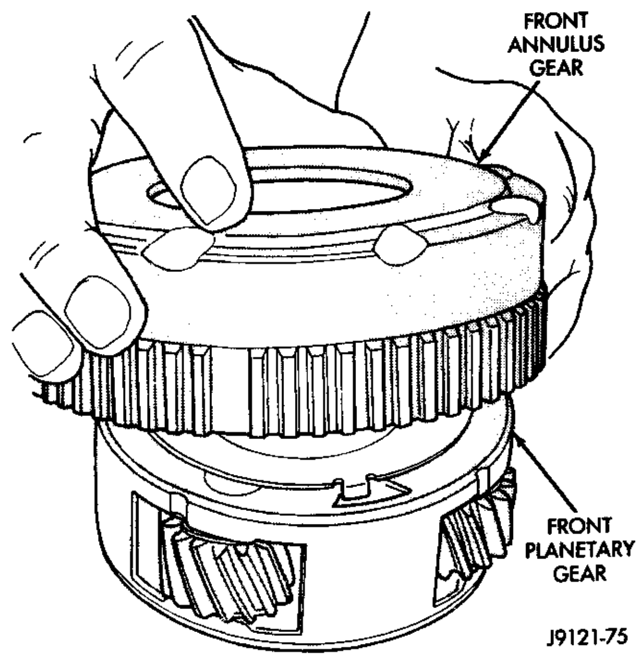

Fig. 187 Assembling Front Planetary And Annulus Gears

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DISASSEMBLY AND ASSEMBLY (Continued)

(12) Install front planetary and annulus gear assembly (Fig. 188). Hold gears together and slide them onto shaft. Be sure planetary pinions are seated on sun gear and that planetary carrier is seated on intermediate shaft.

(13) Place geartrain in upright position. Rotate gears to be sure all components are seated and properly assembled. Snap ring groove at forward end of intermediate shaft will be completely exposed when components are assembled correctly.

(14) Install new planetary snap ring in groove at end of intermediate shaft (Fig. 189).

(15) Turn planetary geartrain over. Position wood block under front end of intermediate shaft and support geartrain on shaft. Be sure all geartrain parts have moved forward against planetary snap ring. This is important for accurate end play check.

(16) Check planetary geartrain end play with feeler gauge (Fig. 190). Insert gauge between rear annulus gear and shoulder on intermediate shaft as shown. End play should be 0.15 to 1.22 mm (0.006 to 0.048 in.).

(17) If end play is incorrect, install thinner/thicker planetary snap ring as needed.

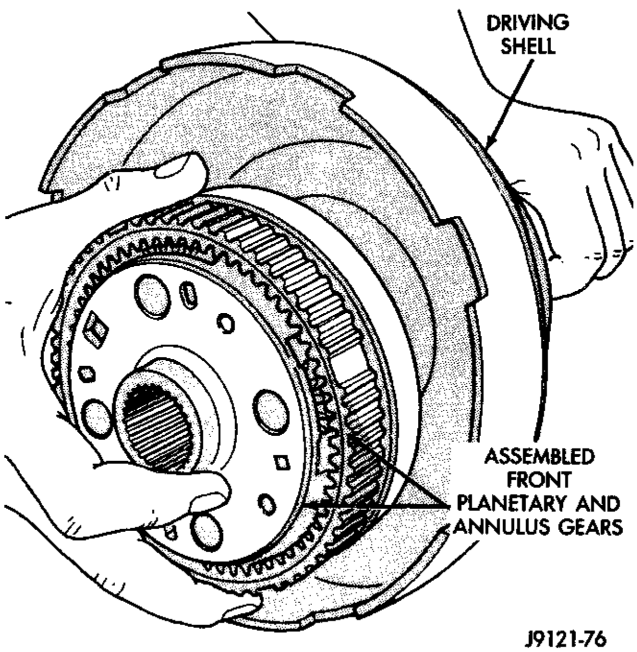

Fig. 188 Installing Front Planetary And Annulus Gear Assembly

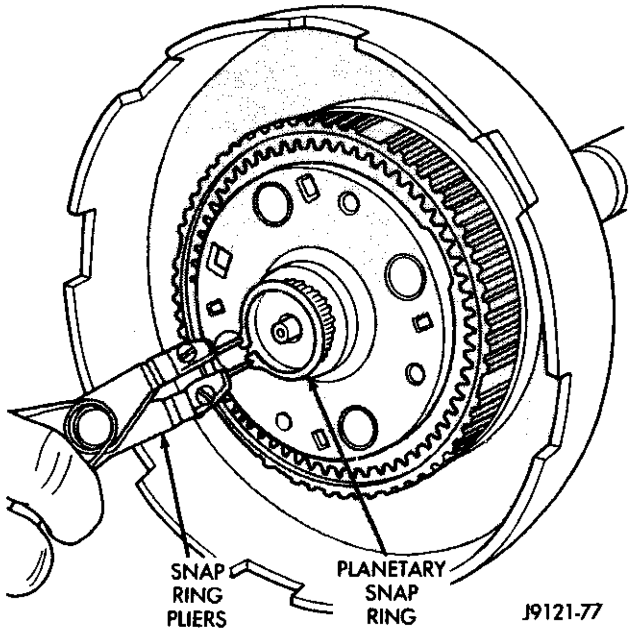

Fig. 189 Installing Planetary Snap Ring

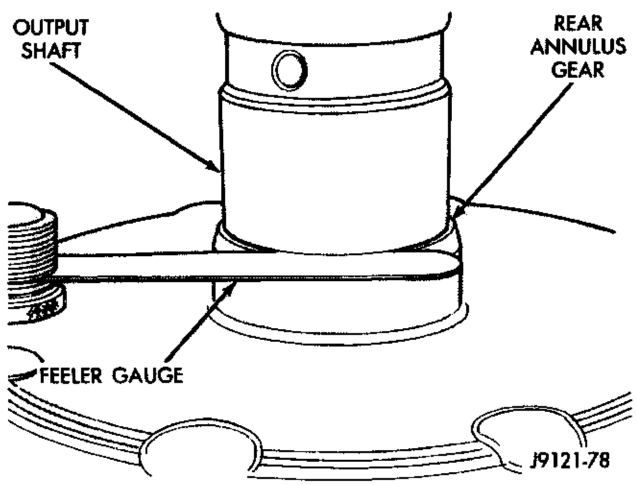

Fig. 190 Checking Planetary Geartrain End Play

DISASSEMBLY AND ASSEMBLY (Continued)

OVERDRIVE UNIT

DISASSEMBLY

(1) Remove transmission speed sensor and O-ring seal from overdrive case (Fig. 191).

(2) Remove overdrive piston thrust bearing (Fig. 192).

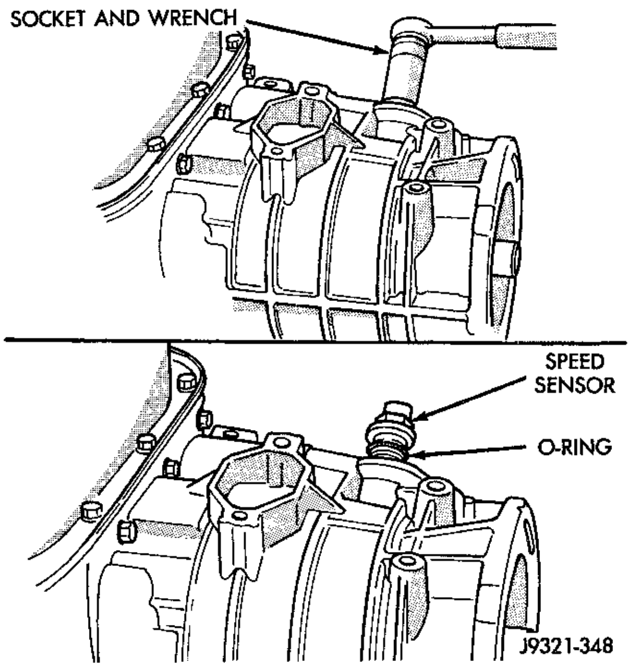

Fig. 191 Transmission Speed Sensor Removal/ Installation

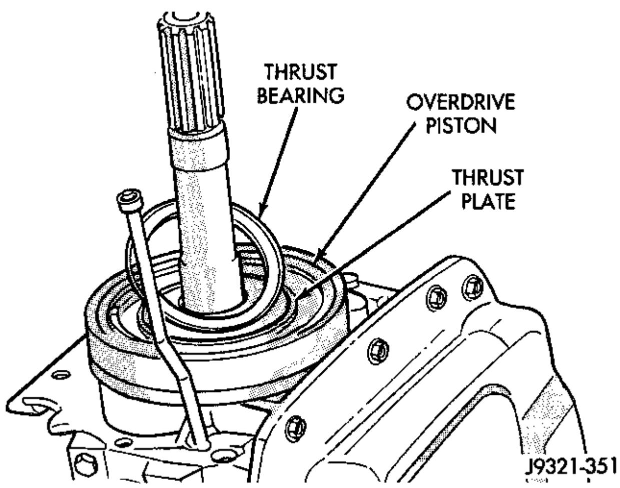

Fig. 192 Overdrive Piston Thrust Bearing Removal/ Installation

OVERDRIVE PISTON

(1) Remove overdrive piston thrust plate (Fig. 193). Retain thrust plate. It is a select fit part and may possibly be reused.

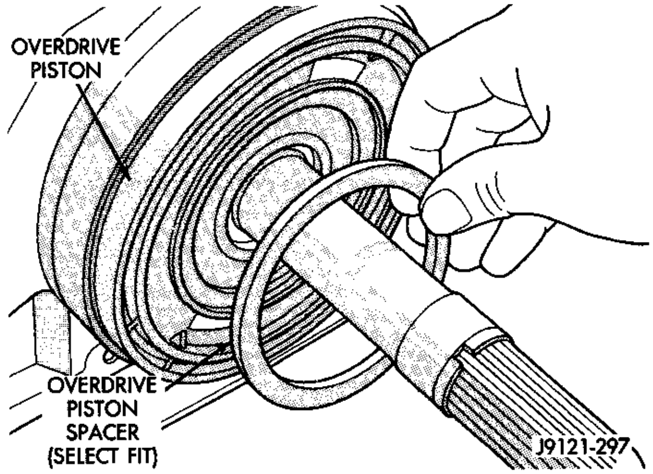

Fig. 193 Overdrive Piston Thrust Plate Removal/ Installation

(2) Remove intermediate shaft spacer (Fig. 194). Retain spacer. It is a select fit part and may possibly be reused.

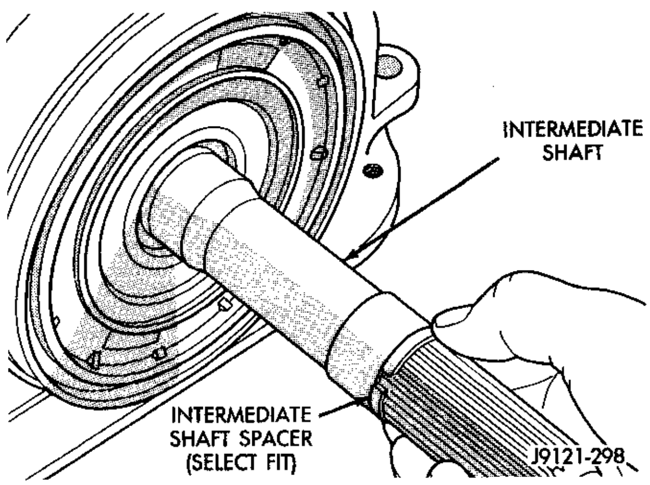

Fig. 194 Intermediate Shaft Spacer Location

(3) Remove overdrive piston from retainer (Fig. 195).

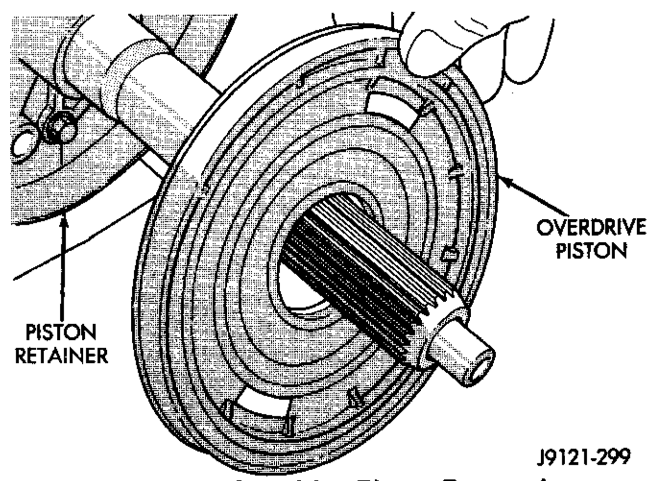

Fig. 195 Overdrive Piston Removal

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DISASSEMBLY AND ASSEMBLY (Continued)

OVERDRIVE CLUTCH PACK

NOTE: The overdrive clutch pack in the 46RE transmission uses 4 clutch discs. The overdrive clutch pack in the 47RE uses 5 discs.

(1) Remove overdrive clutch pack wire retaining ring (Fig. 196).

(2) Remove overdrive clutch pack (Fig. 197).

(3) Note position of clutch pack components for assembly reference (Fig. 198).

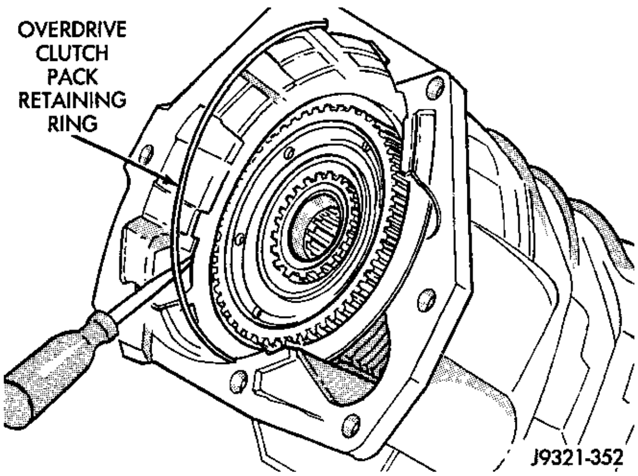

Fig. 196 Removing Overdrive Clutch Pack Retaining Ring

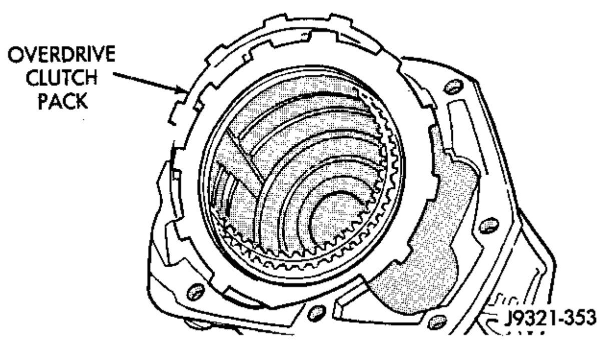

Fig. 197 Overdrive Clutch Pack Removal

OVERDRIVE GEARTRAIN

(1) Remove overdrive clutch wave spring (Fig. 199).

(2) Remove overdrive clutch reaction snap ring (Fig. 200). Note that snap ring is located in same groove as wave spring.

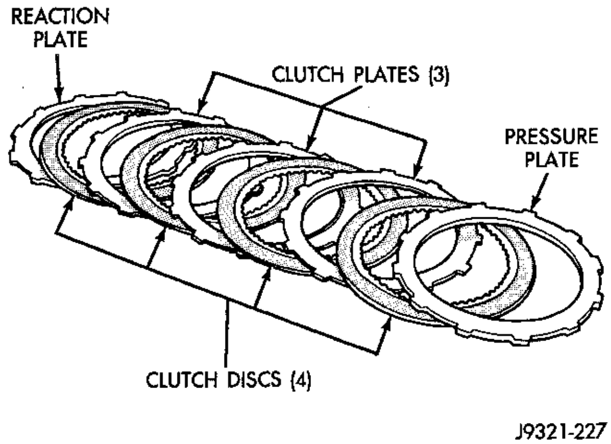

Fig. 198 46RE Overdrive Clutch Component Position

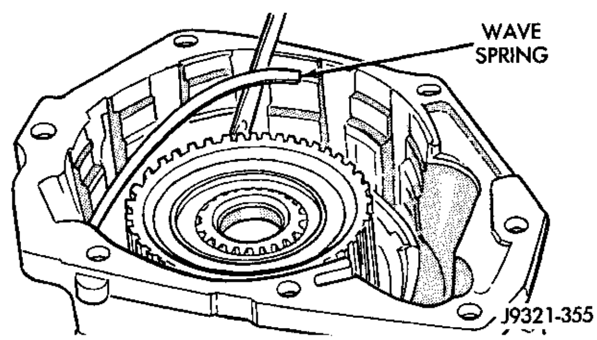

Fig. 199 Overdrive Clutch Wave Spring Removal/ Installation

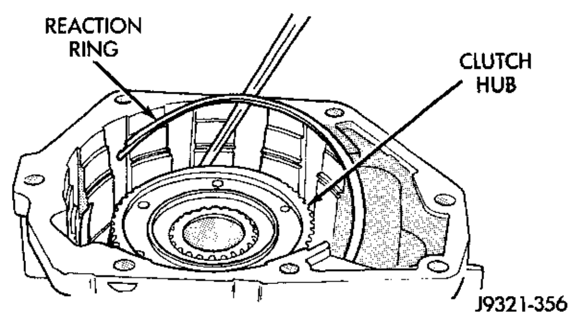

Fig. 200 Overdrive Clutch Reaction Snap Ring Removal/Installation

DISASSEMBLY AND ASSEMBLY (Continued)

(3) Remove Torx head screws that attach access cover and gasket to overdrive case (Fig. 201).

(4) Remove access cover and gasket (Fig. 202).

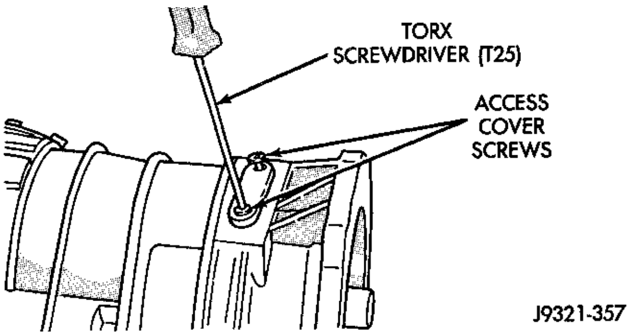

Fig. 201 Access Cover Screw Removal/Installation

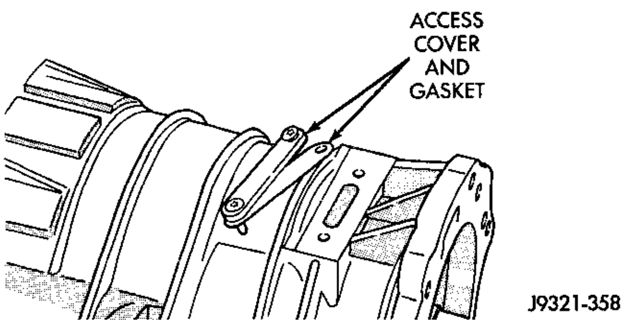

Fig. 202 Access Cover And Gasket Removal/ Installation

(5) Expand output shaft bearing snap ring with expanding-type snap ring pliers. Then push output shaft forward to release shaft bearing from locating ring (Fig. 203).

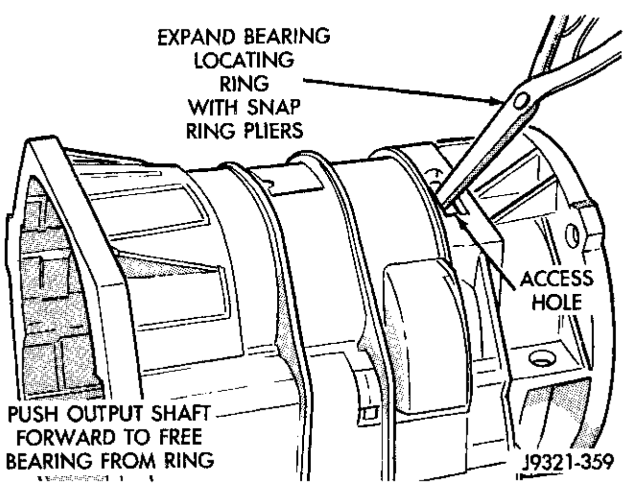

Fig. 203 Releasing Bearing From Locating Ring

(6) Lift gear case up and off geartrain assembly (Fig. 204).

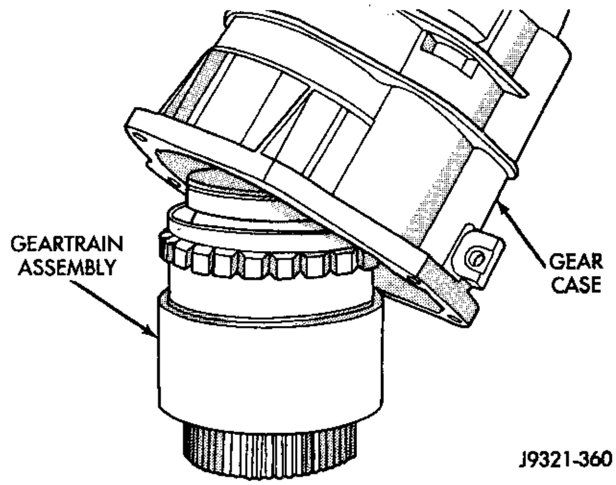

Fig. 204 Removing Gear Case From Geartrain Assembly

(7) Remove snap ring that retains rear bearing on output shaft.

(8) Remove rear bearing from output shaft (Fig. 205).

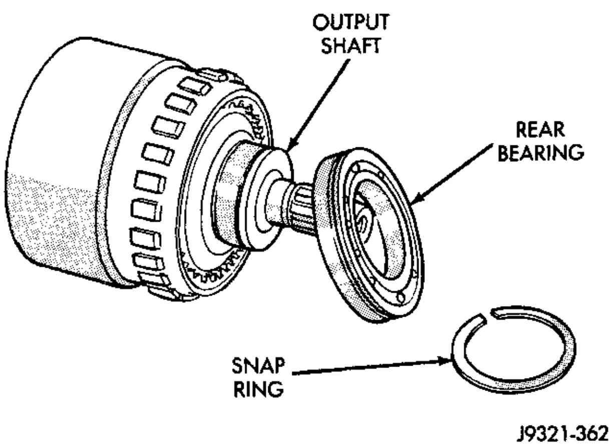

Fig. 205 Rear Bearing Removal

DISASSEMBLY AND ASSEMBLY (Continued)

DIRECT CLUTCH, HUB AND SPRING

NOTE: The direct clutch in the 46RE uses 8 clutch discs. The direct clutch in the 47RE uses 10 clutch discs.

WARNING: THE NEXT STEP IN DISASSEMBLY INVOLVES COMPRESSING THE DIRECT CLUTCH SPRING. IT IS EXTREMELY IMPORTANT THAT PROPER EQUIPMENT BE USED TO COMPRESS THE SPRING AS SPRING FORCE IS APPROXIMATELY 830 POUNDS. USE SPRING COMPRESSOR TOOL 6227-1 AND A HYDRAULIC SHOP PRESS WITH A MINIMUM RAM TRAVEL OF 5-6 INCHES. THE PRESS MUST ALSO HAVE A BED THAT CAN BE ADJUSTED UP OR DOWN AS REQUIRED. RELEASE CLUTCH SPRING TENSION SLOWLY AND COMPLETELY TO AVOID PERSONAL INJURY.

(1) Mount geartrain assembly in shop press (Fig. 206).

(2) Position Compressor Tool 6227-1 on clutch hub (Fig. 206). Support output shaft flange with steel press plates as shown and center assembly under press ram.

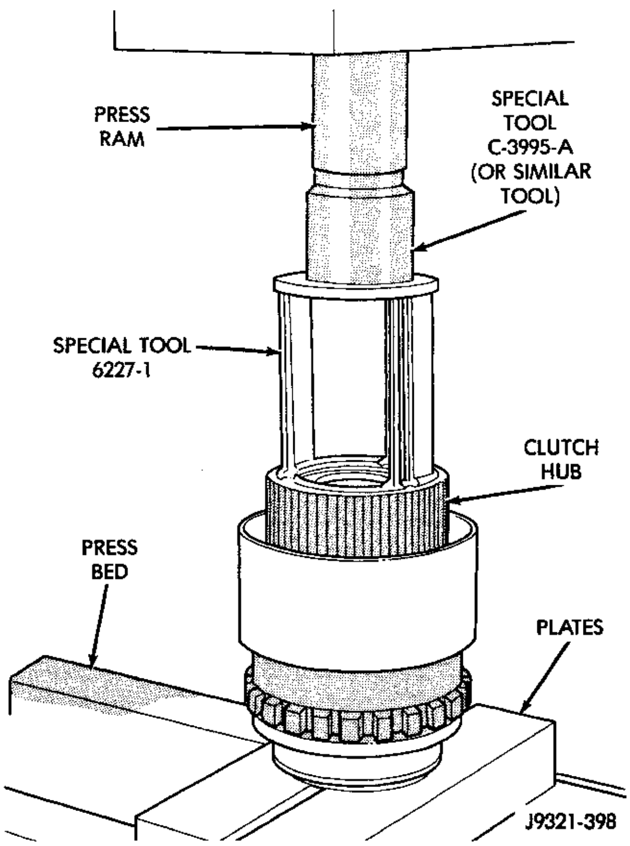

Fig. 206 Geartrain Mounted In Shop Press

(3) Apply press pressure slowly. Compress hub and spring far enough to expose clutch hub retaining ring and relieve spring pressure on clutch pack snap ring (Fig. 206).

(4) Remove direct clutch pack snap ring (Fig. 207).

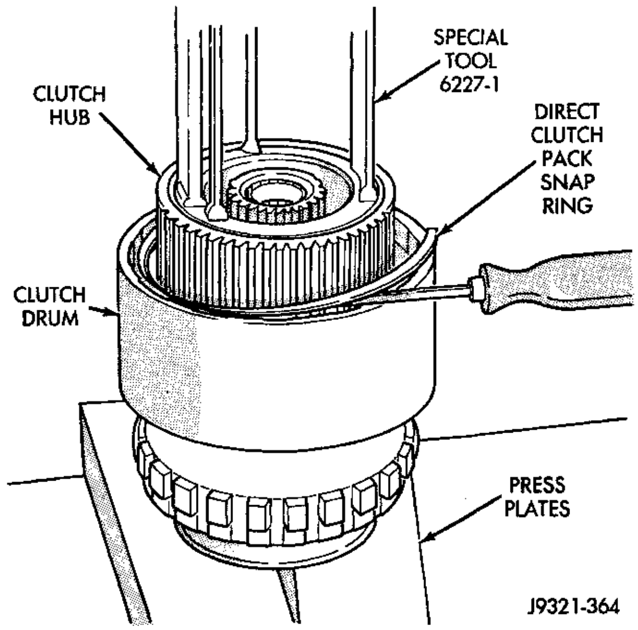

Fig. 207 Direct Clutch Pack Snap Ring Removal

(5) Remove direct clutch hub retaining ring (Fig. 208).

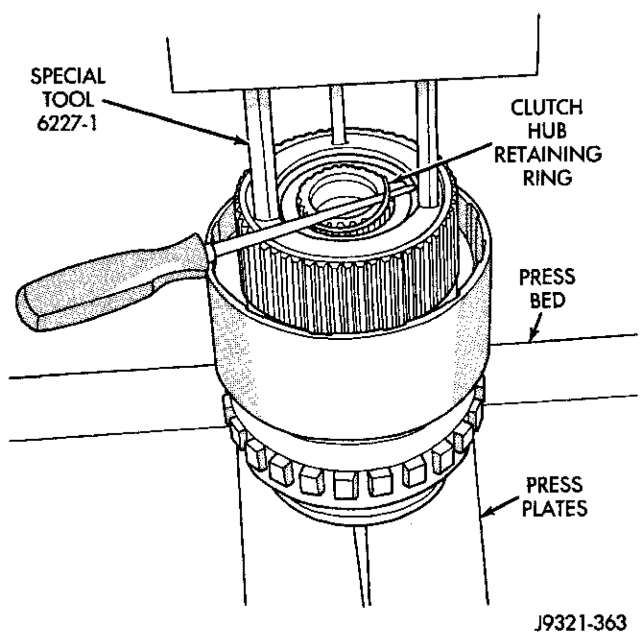

Fig. 208 Direct Clutch Hub Retaining Ring Removal

DISASSEMBLY AND ASSEMBLY (Continued)

(6) Release press load slowly and completely (Fig. 209).

(7) Remove Special Tool 6227-1. Then remove clutch pack from hub (Fig. 209).

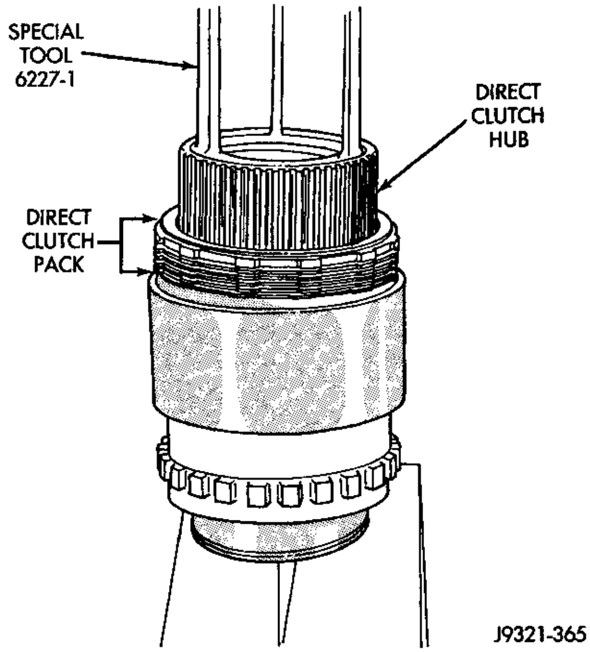

Fig. 209 Direct Clutch Pack Removal

Geartrain

(1) Remove direct clutch hub and spring (Fig. 210).

(2) Remove sun gear and spring plate. Then remove planetary thrust bearing and planetary gear (Fig. 211).

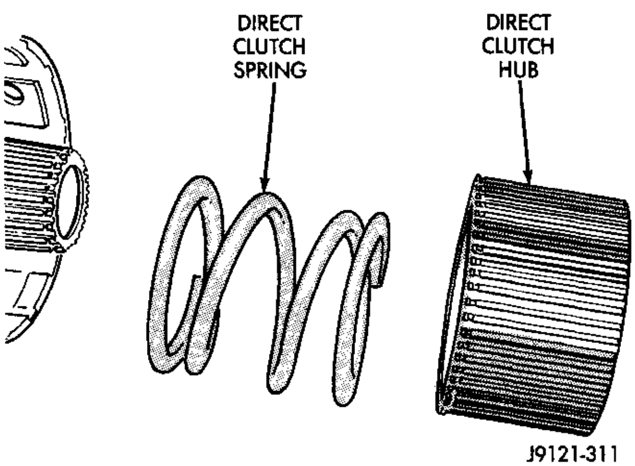

Fig. 210 Direct Clutch Hub And Spring Removal

(3) Remove overrunning clutch assembly with expanding type snap ring pliers (Fig. 212). Insert pliers into clutch hub. Expand pliers to grip hub splines and remove clutch with counterclockwise, twisting motion.

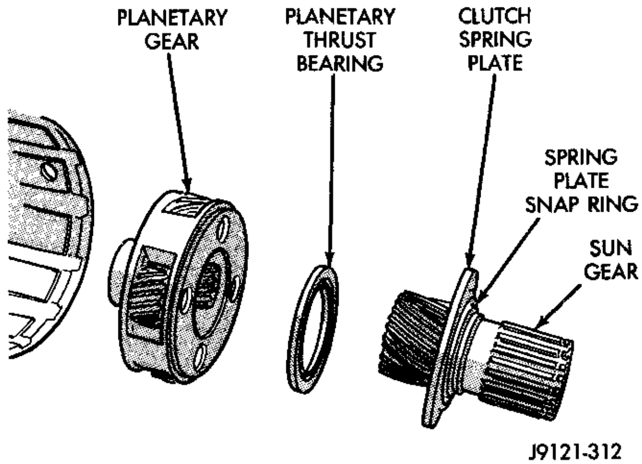

Fig. 211 Removing Sun Gear, Thrust Bearing And Planetary Gear

(4) Remove thrust bearing from overrunning clutch hub.

(5) Remove overrunning clutch from hub.

(6) Mark position of annulus gear and direct clutch drum for assembly alignment reference (Fig. 213). Use small center punch or scriber to make alignment marks.

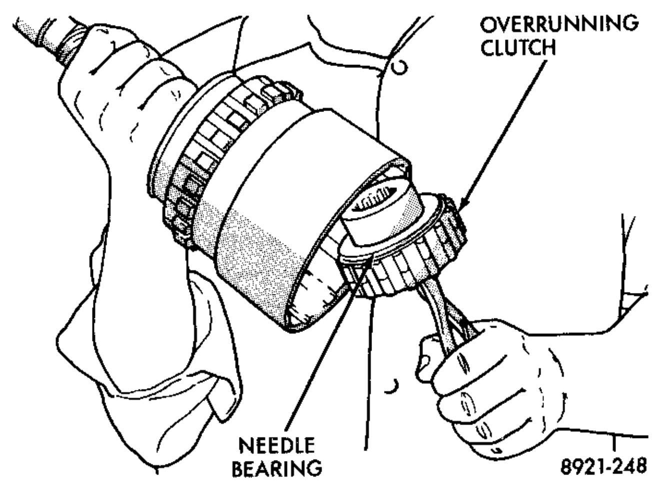

Fig. 212 Overrunning Clutch Assembly Removal/ Installation

(7) Remove direct clutch drum rear retaining ring (Fig. 214).

(8) Remove direct clutch drum outer retaining ring (Fig. 215).

(9) Mark annulus gear and output shaft for assembly alignment reference (Fig. 216). Use punch or scriber to mark gear and shaft.

(10) Remove snap ring that secures annulus gear on output shaft (Fig. 217). Use two screwdrivers to unseat and work snap ring out of groove as shown.

DISASSEMBLY AND ASSEMBLY (Continued)

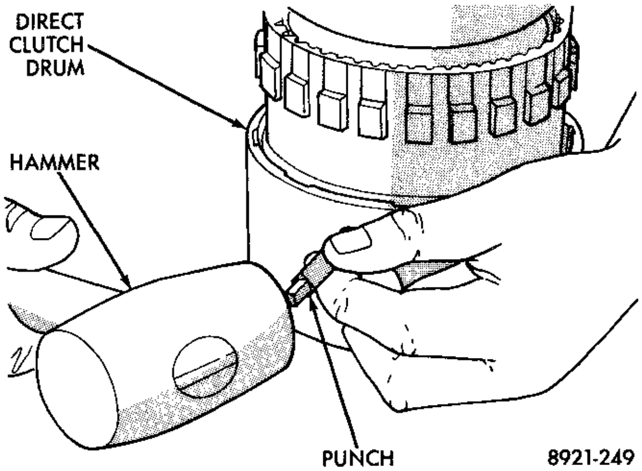

Fig. 213 Marking Direct Clutch Drum And Annulus Gear For Assembly Alignment

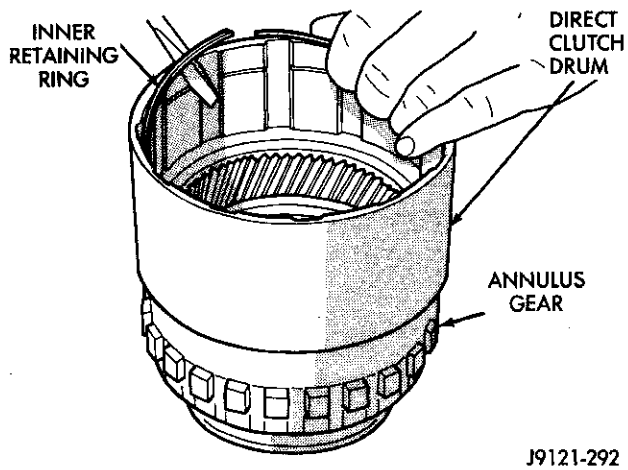

Fig. 214 Clutch Drum Inner Retaining Ring Removal

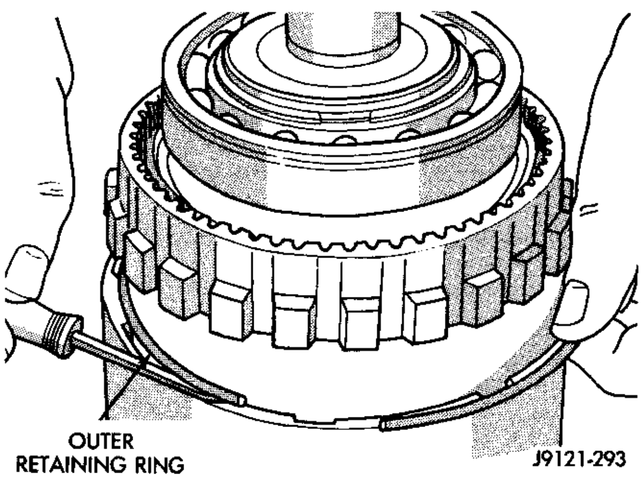

Fig. 215 Clutch Drum Outer Retaining Ring Removal

(11) Remove annulus gear from output shaft (Fig. 218). Use rawhide or plastic mallet to tap gear off shaft.

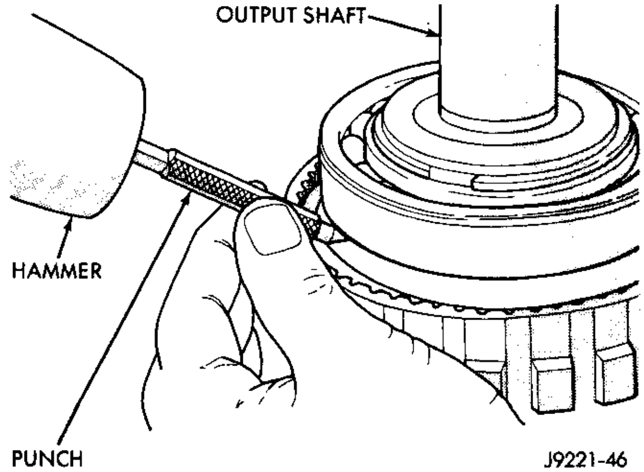

Fig. 216 Marking Annulus Gear And Output Shaft For Assembly Alignment

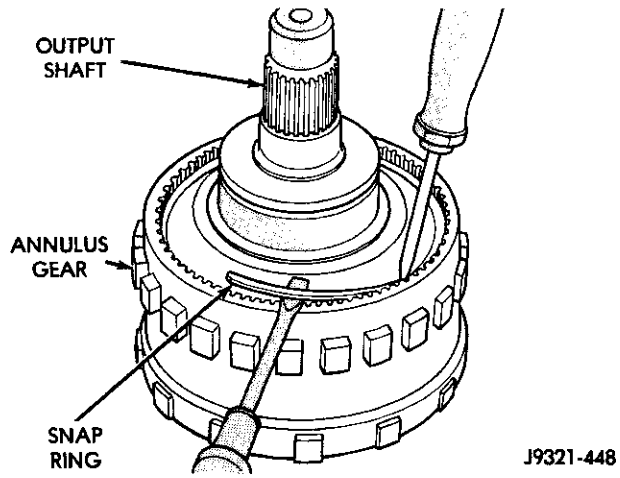

Fig. 217 Annulus Gear Snap Ring Removal

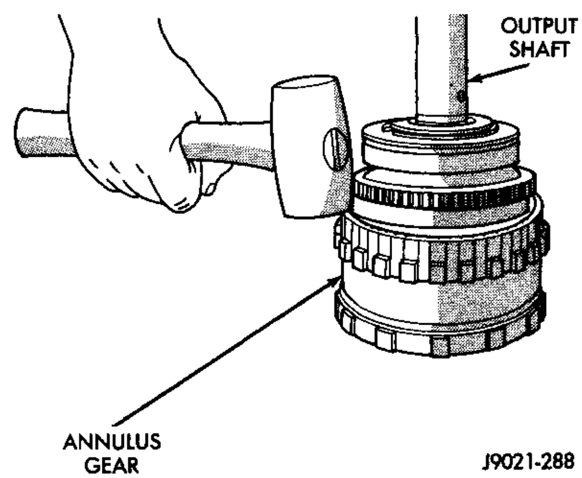

Fig. 218 Annulus Gear Removal

DISASSEMBLY AND ASSEMBLY (Continued)

GEAR CASE AND PARK LOCK

(1) Remove locating ring from gear case.
(2) Remove park pawl shaft retaining bolt and remove shaft, pawl and spring.
(3) Remove reaction plug snap ring and remove reaction plug.
(4) Remove output shaft seal.

ASSEMBLY

GEARTRAIN AND DIRECT CLUTCH

(1) Soak direct clutch and overdrive clutch discs in Mopar® ATF Plus transmission fluid. Allow discs to soak for 10-20 minutes.
(2) Install new pilot bushing and clutch hub bushing in output shaft if necessary (Fig. 219). Lubricate bushings with petroleum jelly, or transmission fluid.

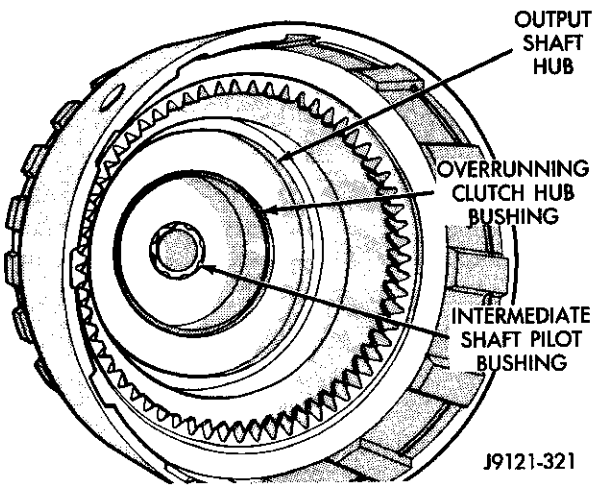

Fig. 219 Output Shaft Pilot Bushing

(3) Install annulus gear on output shaft, if removed. Then install annulus gear retaining snap ring (Fig. 220).
(4) Align and install clutch drum on annulus gear (Fig. 221). Be sure drum is engaged in annulus gear lugs.
(5) Install clutch drum outer retaining ring (Fig. 221).
(6) Slide clutch drum forward and install inner retaining ring (Fig. 222).

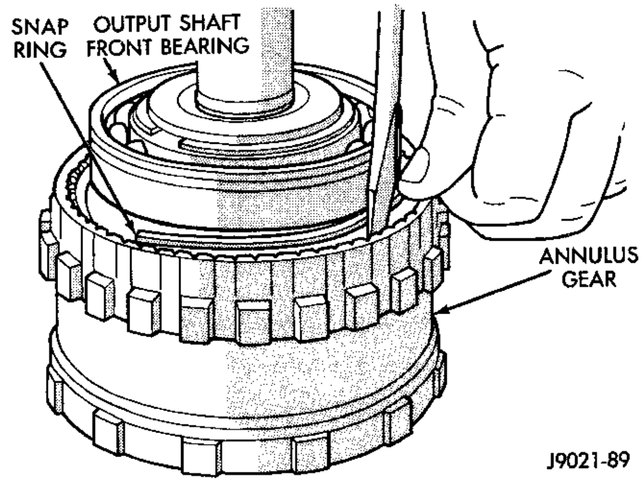

Fig. 220 Annulus Gear Installation

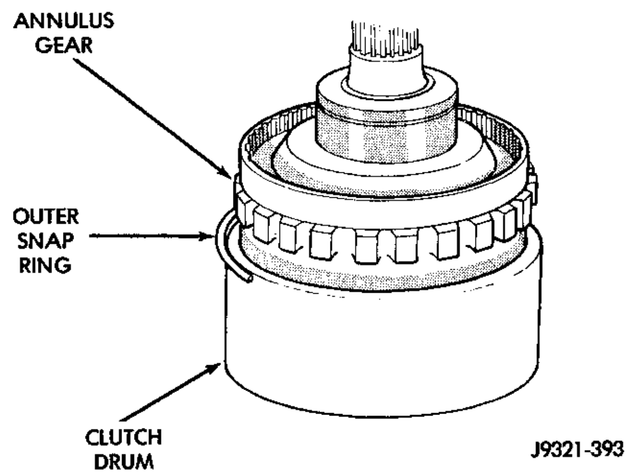

Fig. 221 Clutch Drum And Outer Retaining Ring Installation

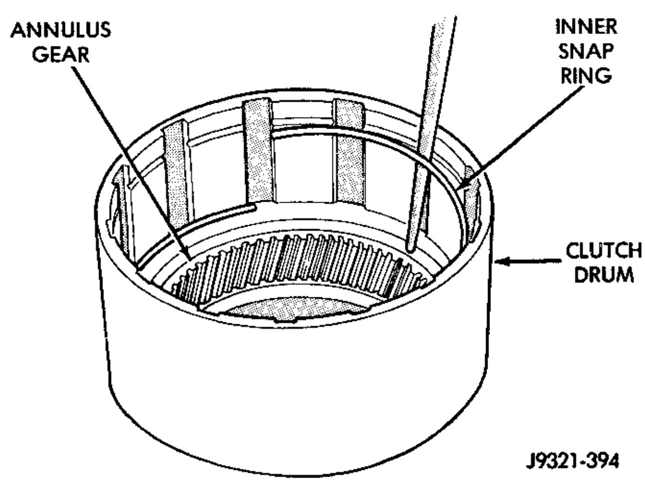

Fig. 222 Clutch Drum Inner Retaining Ring Installation

DISASSEMBLY AND ASSEMBLY (Continued)

(7) Install rear bearing and snap ring on output shaft (Fig. 223). Be sure locating ring groove in bearing is toward rear.

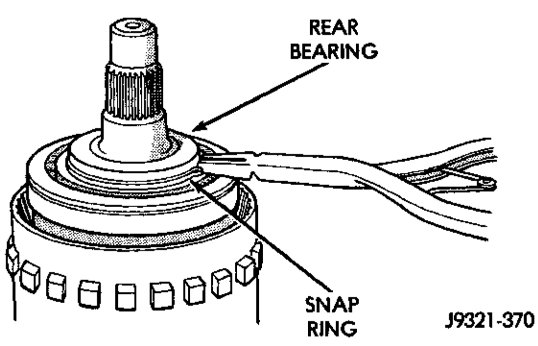

Fig. 223 Rear Bearing And Snap Ring Installation

(8) Install overrunning clutch on hub (Fig. 224). **Note that clutch only fits one way. Shoulder on clutch should seat in small recess at edge of hub.**

(9) Install thrust bearing on overrunning clutch hub. Use generous amount of petroleum jelly to hold bearing in place for installation. **Bearing fits one way only. Be sure bearing is seated squarely against hub. Reinstall bearing if it does not seat squarely.**

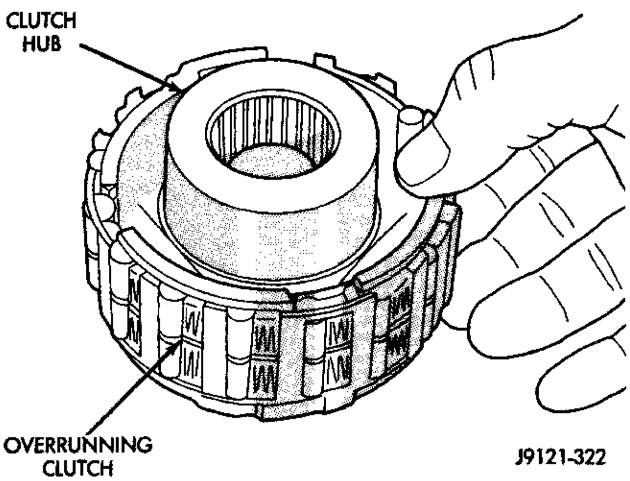

Fig. 224 Assembling Overrunning Clutch And Hub

(10) Install overrunning clutch in output shaft (Fig. 225). Insert snap ring pliers in hub splines. Expand pliers to grip hub. Then install assembly with counterclockwise, twisting motion.

(11) Install planetary gear in annulus gear (Fig. 226). **Be sure planetary pinions are fully seated in annulus gear before proceeding.**

(12) Coat planetary thrust bearing and bearing contact surface of spring plate with generous amount of petroleum jelly. This will help hold bearing in place during installation.

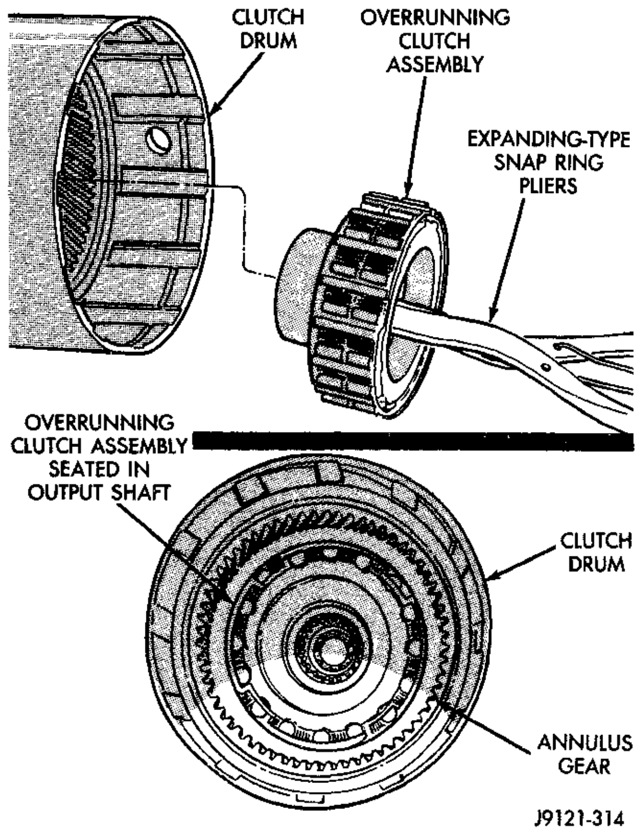

Fig. 225 Overrunning Clutch Installation

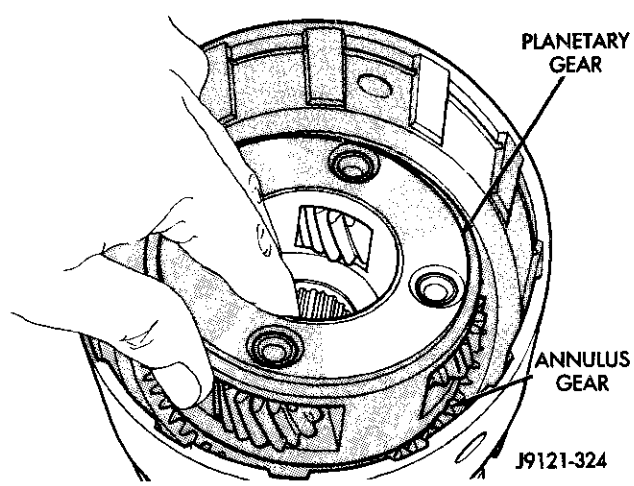

Fig. 226 Planetary Gear Installation

DISASSEMBLY AND ASSEMBLY (Continued)

(13) Install planetary thrust bearing on sun gear (Fig. 227). Slide bearing onto gear and seat it against spring plate as shown. **Bearing fits one way only. If it does not seat squarely against spring plate, remove and reposition bearing.**

(14) Install assembled sun gear, spring plate and thrust bearing (Fig. 228). Be sure sun gear and thrust bearing are fully seated before proceeding.

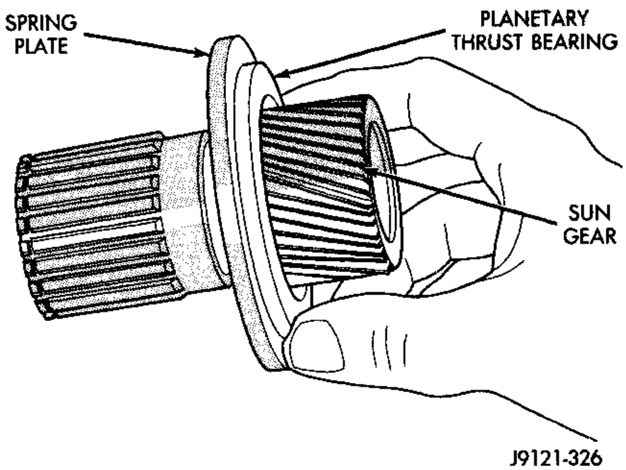

Fig. 227 Planetary Thrust Bearing Installation

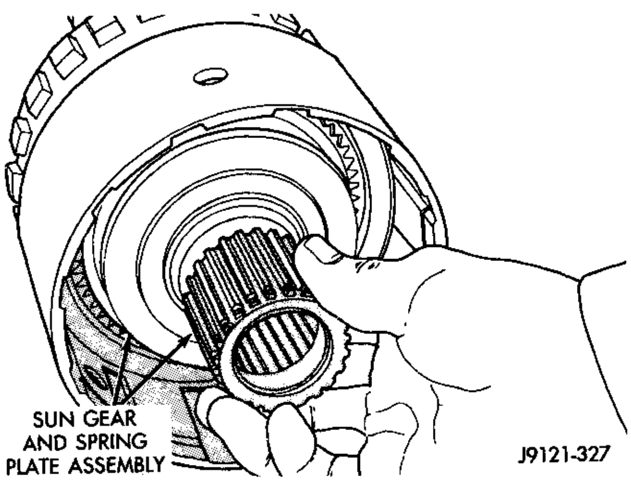

Fig. 228 Sun Gear Installation

(15) Mount assembled output shaft, annulus gear, and clutch drum in shop press. Direct clutch spring, hub and clutch pack are easier to install with assembly mounted in press.

(16) Align splines in hubs of planetary gear and overrunning clutch with Alignment tool 6227-2 (Fig. 229). Insert tool through sun gear and into splines of both hubs. Be sure alignment tool is fully seated before proceeding.

(17) Install direct clutch spring (Fig. 230). Be sure spring is properly seated on spring plate.

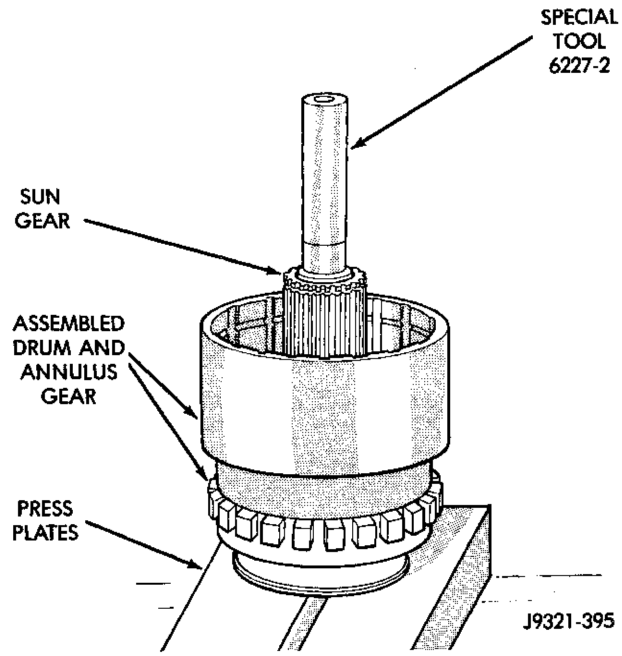

Fig. 229 Alignment Tool Installation

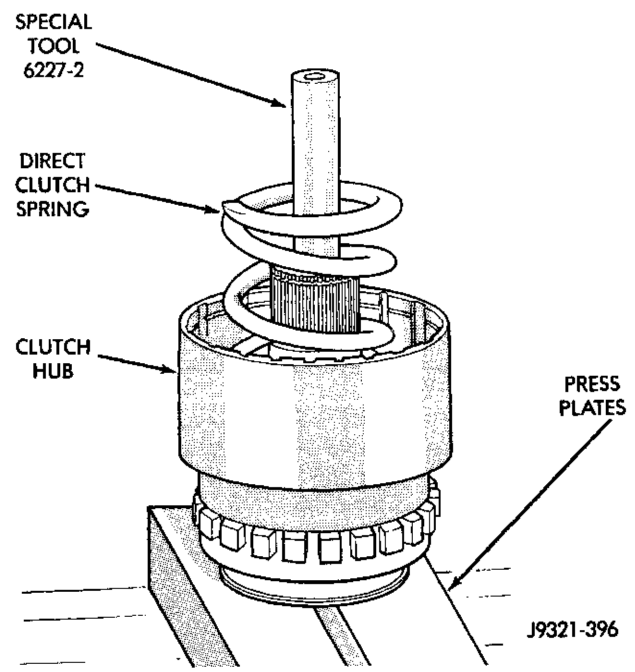

Fig. 230 Direct Clutch Spring Installation

NOTE: The direct clutch in the 46RE uses 8 clutch discs. The direct clutch in the 47RE uses 10 clutch discs.

(18) Assemble and install direct clutch pack on hub as follows:

(a) Assemble clutch pack components (Fig. 231).

(b) Install direct clutch reaction plate on clutch hub first. **Note that one side of reaction plate**

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DISASSEMBLY AND ASSEMBLY (Continued)

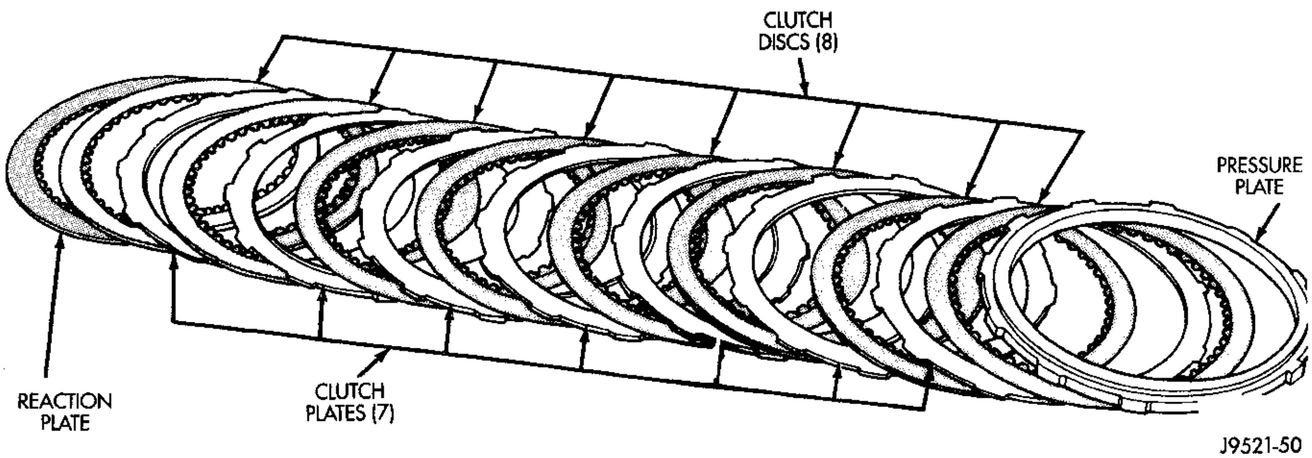

Fig. 231 46RE Direct Clutch Pack Components

is counterbored. Be sure this side faces rearward. Splines at rear of hub are raised slightly. Counterbore in plate fits over raised splines. Plate should be flush with this end of hub (Fig. 232).

(c) Install first clutch disc followed by a steel plate until all discs and plates have been installed.

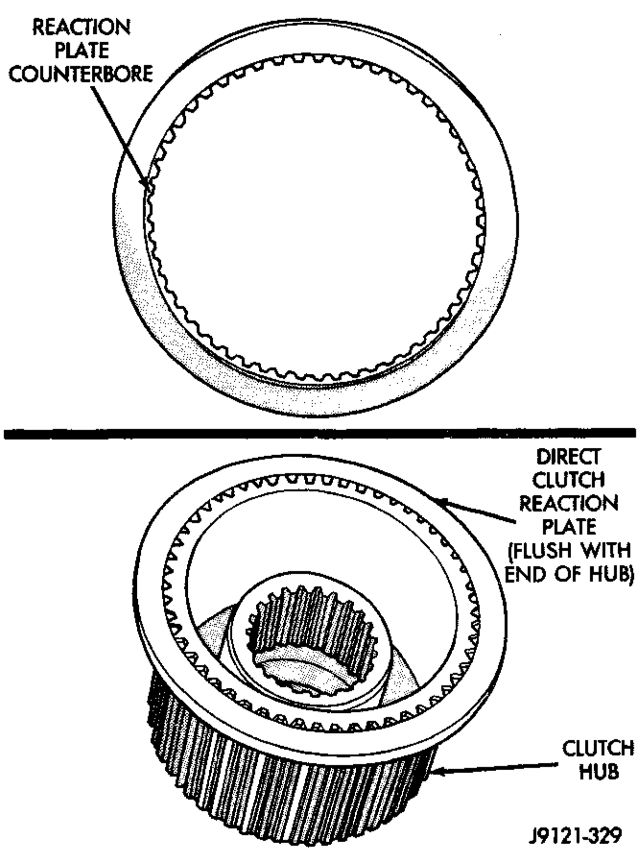

Fig. 232 Correct Position Of Direct Clutch Reaction Plate

(d) Install pressure plate. This is last clutch pack item to be installed. **Be sure plate is installed with shoulder side facing upward (Fig. 233).**

(19) Install clutch hub and clutch pack on direct clutch spring (Fig. 234). **Be sure hub is started on sun gear splines before proceeding.**

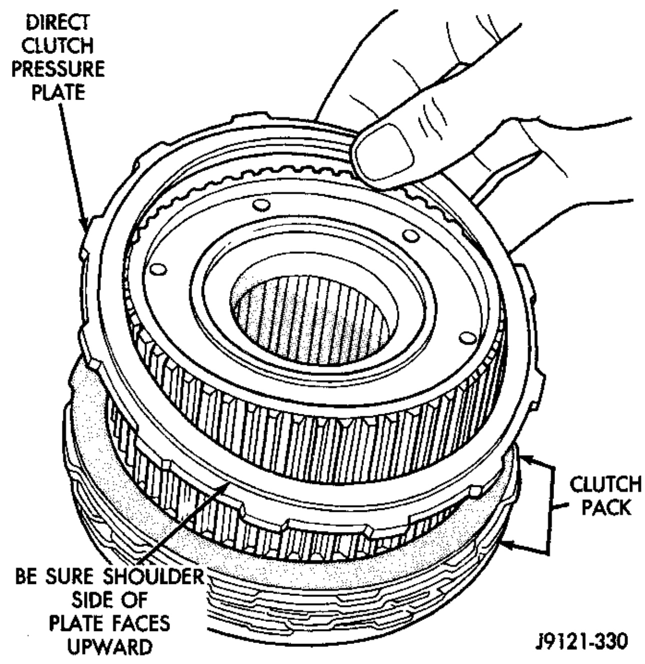

Fig. 233 Correct Position Of Direct Clutch Pressure Plate

DISASSEMBLY AND ASSEMBLY (Continued)

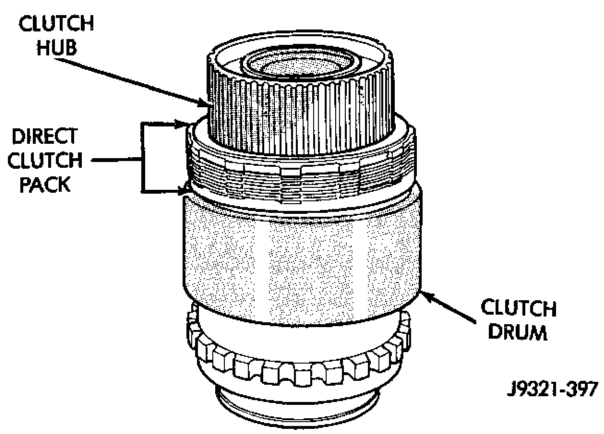

Fig. 234 Direct Clutch Pack And Clutch Hub Installation

WARNING: THE NEXT STEP IN GEARTRAIN ASSEMBLY INVOLVES COMPRESSING THE DIRECT CLUTCH HUB AND SPRING. IT IS EXTREMELY IMPORTANT THAT PROPER EQUIPMENT BE USED TO COMPRESS THE SPRING AS SPRING FORCE IS APPROXIMATELY 830 POUNDS. USE COMPRESSOR TOOL C-6227-1 AND A HYDRAULIC-TYPE SHOP PRESS WITH A MINIMUM RAM TRAVEL OF 6 INCHES. THE PRESS MUST ALSO HAVE A BED THAT CAN BE ADJUSTED UP OR DOWN AS REQUIRED. RELEASE CLUTCH SPRING TENSION SLOWLY AND COMPLETELY TO AVOID PERSONAL INJURY.

(20) Position Compressor Tool 6227-1 on clutch hub.

(21) Compress clutch hub and spring just enough to place tension on hub and hold it in place.

(22) Slowly compress clutch hub and spring. Compress spring and hub only enough to expose ring grooves for clutch pack snap ring and clutch hub retaining ring.

(23) Realign clutch pack on hub and seat clutch discs and plates in clutch drum.

(24) Install direct clutch pack snap ring (Fig. 235). **Be very sure snap ring is fully seated in clutch drum ring groove.**

(25) Install clutch hub retaining ring (Fig. 236). **Be very sure retaining ring is fully seated in sun gear ring groove.**

(26) Slowly release press ram, remove compressor tools and remove geartrain assembly.

GEAR CASE

(1) Position park pawl and spring in case and install park pawl shaft. Verify that end of spring with 90° bend is hooked to pawl and straight end of spring is seated against case.

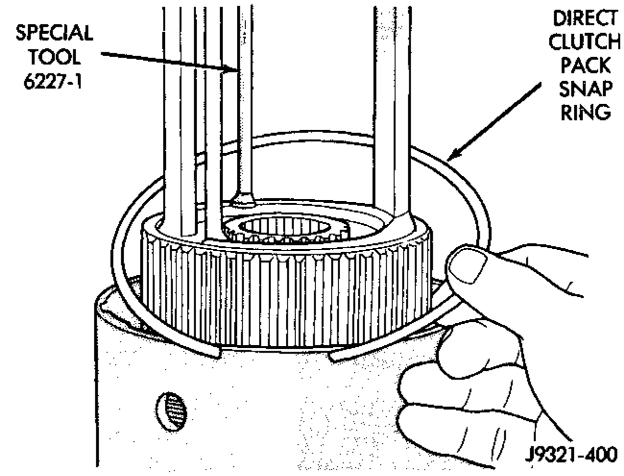

Fig. 235 Direct Clutch Pack Snap Ring Installation

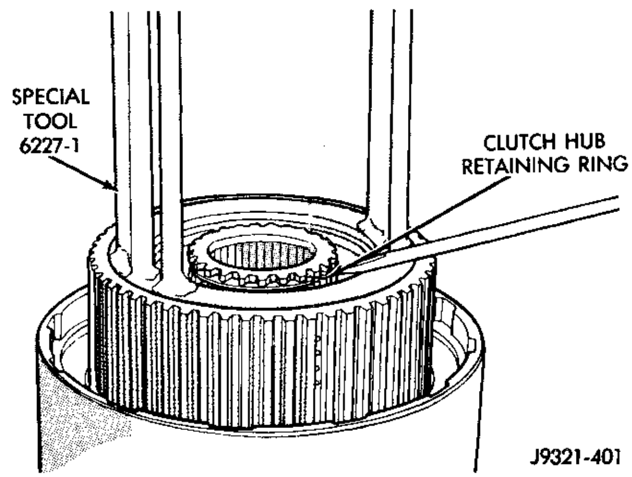

Fig. 236 Clutch Hub Retaining Ring Installation

(2) Install pawl shaft retaining bolt. Tighten bolt to 27 N·m (20 ft. lbs.) torque.

(3) Install park lock reaction plug. **Note that plug has locating pin at rear (Fig. 237). Be sure pin is seated in hole in case before installing snap ring.**

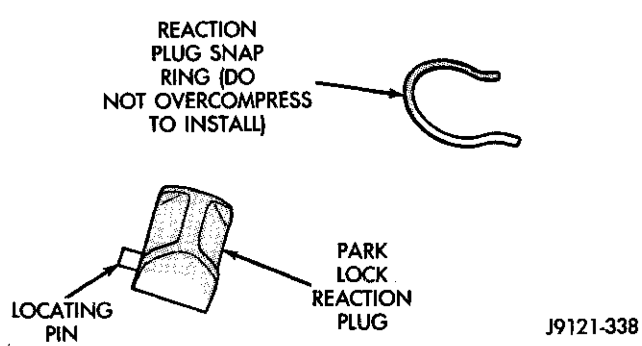

Fig. 237 Reaction Plug Locating Pin And Snap-Ring

DISASSEMBLY AND ASSEMBLY (Continued)

(4) Install reaction plug snap-ring (Fig. 238). **Compress snap ring only enough for installation; do not distort it.**

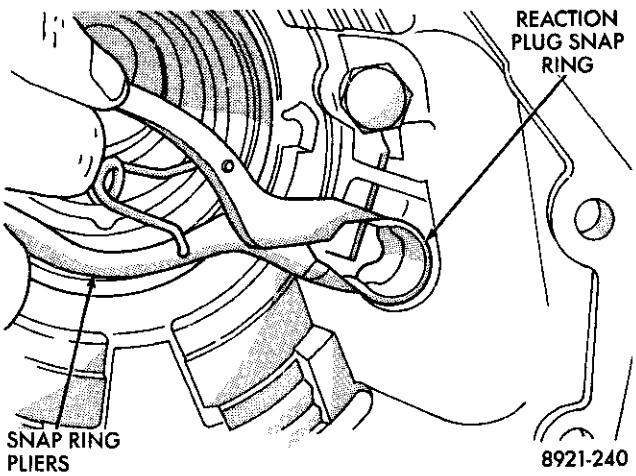

Fig. 238 Reaction Plug And Snap-Ring Installation

(5) Install new seal in gear case. Use Handle C-4171 and Installer C-3995-A to seat seal in case.

(6) Verify that tab ends of rear bearing locating ring extend into access hole in gear case (Fig. 239).

(7) Support geartrain on Tool 6227-1 (Fig. 240). Be sure tool is securely seated in clutch hub.

(8) Install overdrive gear case on geartrain (Fig. 240).

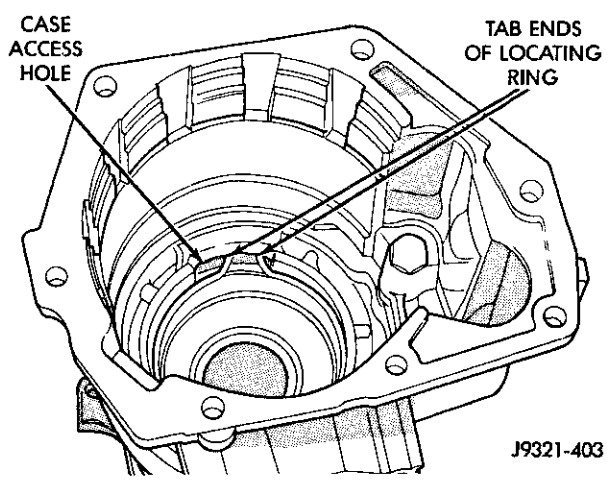

Fig. 239 Correct Rear Bearing Locating Ring Position

(9) Expand front bearing locating ring with snap ring pliers (Fig. 241). Then slide case downward until locating ring locks in bearing groove and release snap ring.

(10) Install locating ring access cover and gasket in overdrive unit case (Fig. 242).

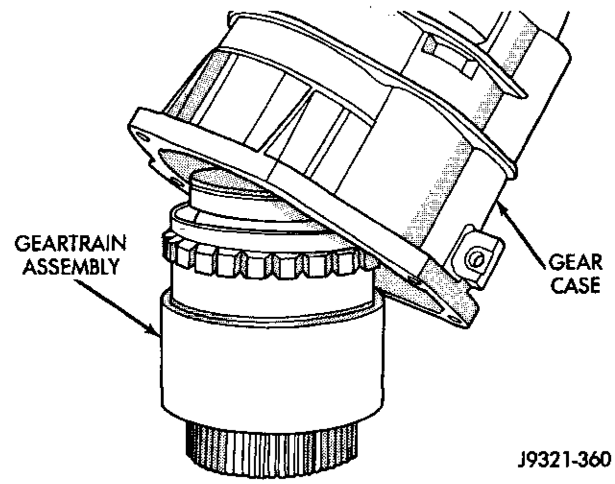

Fig. 240 Overdrive Gear Case Installation

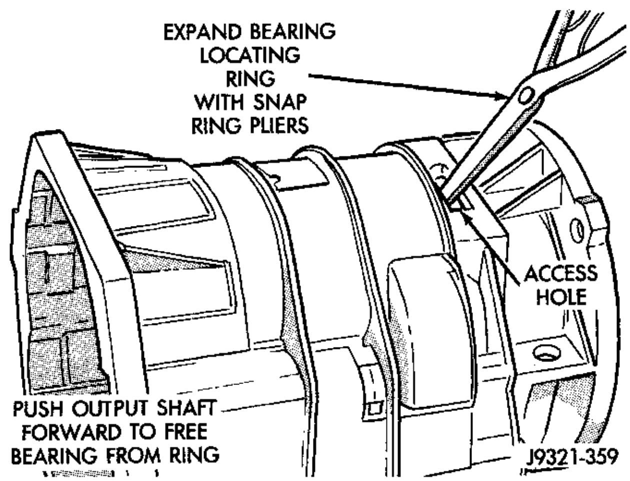

Fig. 241 Seating Locating Ring In Rear Bearing

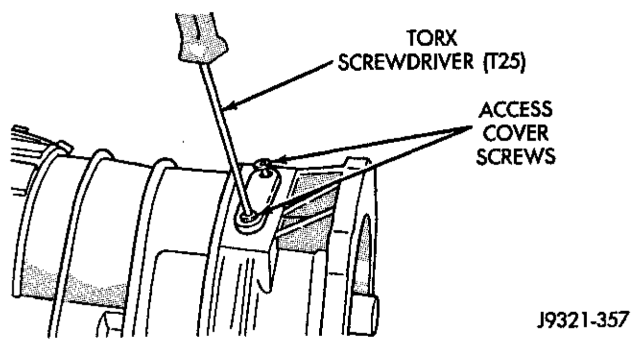

Fig. 242 Locating Ring Access Cover And Gasket Installation

OVERDRIVE CLUTCH

NOTE: The overdrive clutch pack in the 46RE transmission uses 4 clutch discs. The overdrive clutch pack in the 47RE uses 5 discs.

DISASSEMBLY AND ASSEMBLY (Continued)

(1) Install overdrive clutch reaction ring first. Reaction ring is flat with notched ends (Fig. 243).

(2) Install wave spring on top of reaction ring (Fig. 244). **Reaction ring and wave ring both fit in same ring groove.** Use screwdriver to seat each ring securely in groove. Also ensure that the ends of the two rings are offset from each other.

(3) Assemble overdrive clutch pack (Fig. 245).

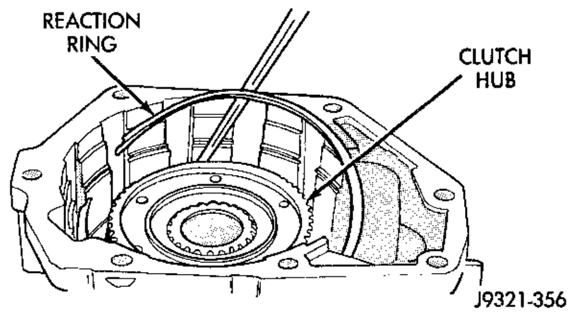

Fig. 243 Overdrive Clutch Reaction Ring Installation

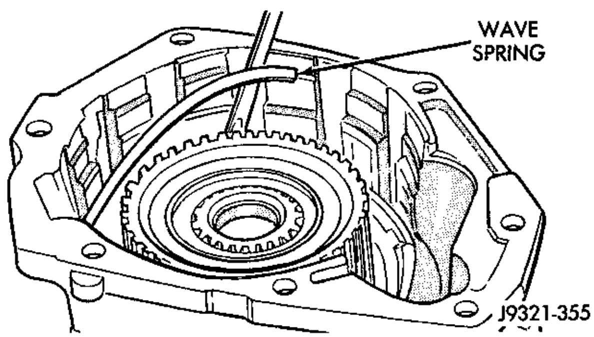

Fig. 244 Overdrive Clutch Wave Spring Installation

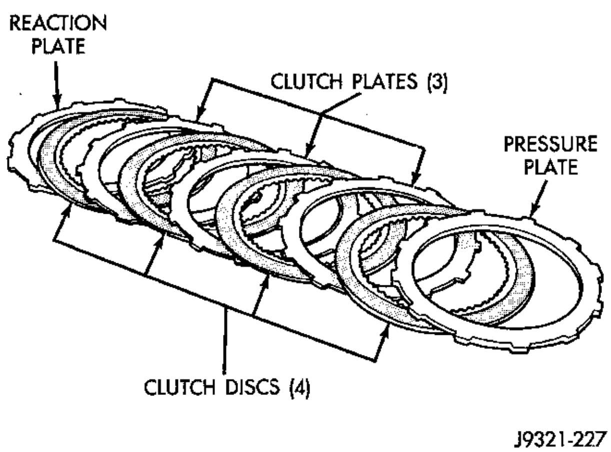

Fig. 245 46RE Overdrive Clutch Components

(4) Install overdrive clutch reaction plate first.

(5) Install first clutch disc followed by first clutch plate. Then install remaining clutch discs and plates in same order.

(6) Install clutch pack pressure plate.

(7) Install clutch pack wire-type retaining ring (Fig. 246).

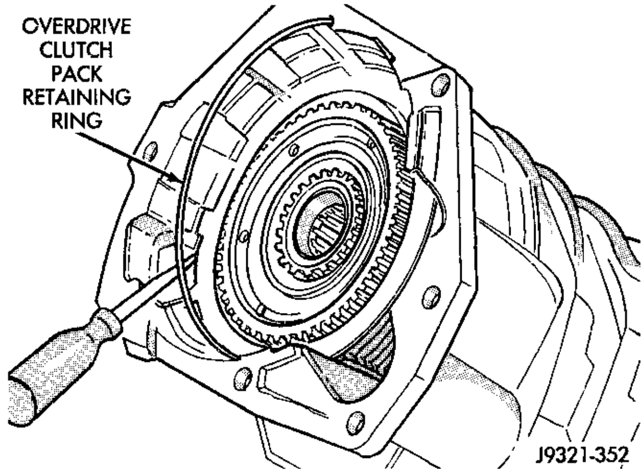

Fig. 246 Overdrive Clutch Pack Retaining Ring Installation

INTERMEDIATE SHAFT SPACER SELECTION

(1) Place overdrive unit in vertical position. Mount it on blocks, or in workbench with appropriate size mounting hole cut into it. Be sure unit is facing upward for access to direct clutch hub. Also be sure output shaft is not loaded and internal components are moved rearward for accurate measurement.

(2) Determine correct thickness intermediate shaft spacer as follows:

(a) Insert Special Tool 6312 through sun gear, planetary gear and into pilot bushing in output shaft. Be sure tool bottoms against planetary shoulder.

(b) Position Gauge Tool 6311 across face of overdrive case (Fig. 247). Then position Dial Caliper C-4962 over gauge tool.

(c) Extend sliding scale of dial caliper downward through gauge tool slot until scale contacts end of Gauge Alignment Tool 6312. Lock scale in place. Remove dial caliper tool and note distance measured (Fig. 247).

(d) Select proper thickness end play spacer from spacer chart based on distance measured (Fig. 248).

(e) Remove Gauge Alignment Tool 6312.

OD THRUST PLATE SELECTION

(1) Place overdrive unit in vertical position. Mount it on blocks, or in workbench with appropriate size mounting hole cut into it. Be sure unit is facing upward for access to direct clutch hub. Also be sure output shaft is not loaded and internal components are moved rearward for accurate measurement.

(2) Determine correct thickness overdrive piston thrust plate as follows:

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DISASSEMBLY AND ASSEMBLY (Continued)

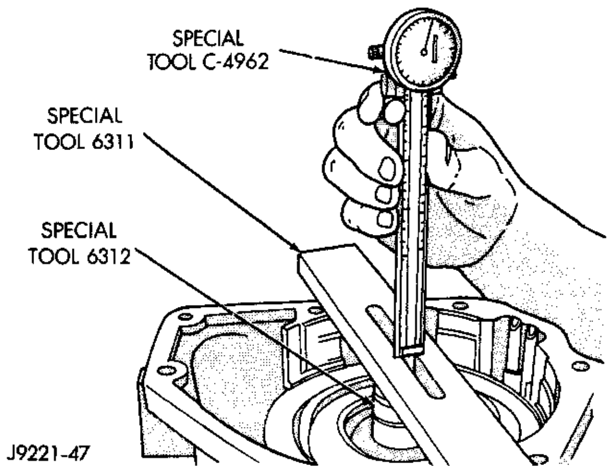

Fig. 247 Shaft End Play Measurement

End Play Measurement (Inches)	Spacer Thickness (Inches)
.7336 - .7505	.158 - .159
.7506 - .7675	.175 - .176
.7676 - .7855	.193 - .194
.7856 - .8011	.211 - .212

J9121-341

Fig. 248 Intermediate Shaft End Play Spacer Selection

(a) Position Gauge Tool 6311 across face of overdrive case. Then position Dial Caliper C-4962 over gauge tool (Fig. 249).

(b) Measure distance to clutch hub thrust bearing seat at four points 90° apart. Then average measurements by adding them and dividing by 4.

(c) Select and install required thrust plate from information in thrust plate chart (Fig. 250).

(3) Leave Alignment Tool 6227-2 in place. Tool will keep planetary and clutch hub splines in alignment until overdrive unit is ready for installation on transmission.

(4) Transmission speed sensor can be installed at this time if desired. However, it is recommended that sensor not be installed until after overdrive unit is secured to transmission.

OVERDRIVE PISTON

(1) Install new seals on overdrive piston.

(2) Stand transmission case upright on bellhousing.

(3) Position Guide Ring 8114-1 on outer edge of overdrive piston retainer.

(4) Position Seal Guide 8114-3 on inner edge of overdrive piston retainer.

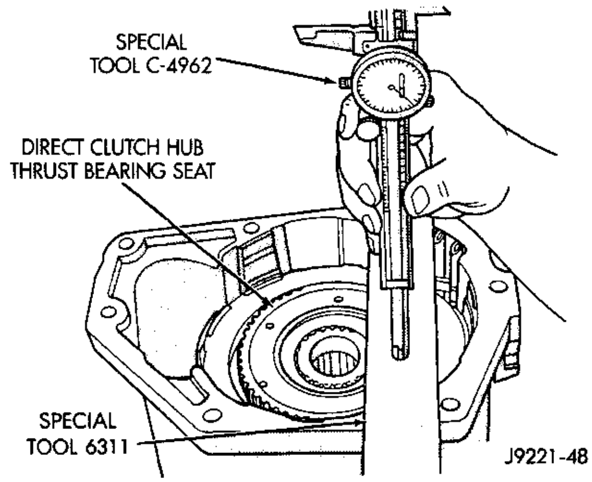

Fig. 249 Overdrive Piston Thrust Plate Measurement

End Play Measurement (Inches)	Spacer Thickness (Inches)
1.7500 - 1.7649	.108 - .110
1.7650 - 1.7799	.123 - .125
1.7800 - 1.7949	.138 - .140
1.7950 - 1.8099	.153 - .155
1.8100 - 1.8249	.168 - .170
1.8250 - 1.8399	.183 - .185
1.8400 - 1.8549	.198 - .200
1.8550 - 1.8699	.213 - .215
1.8700 - 1.8849	.228 - .230
1.8850 - 1.8999	.243 - .245

J9121-342

Fig. 250 Overdrive Piston Thrust Plate Selection

(5) Install overdrive piston in overdrive piston retainer by:

(a) Aligning locating lugs on overdrive piston to the two mating holes in retainer.

(b) Lubricate overdrive piston seals with Mopar® Door Ease, or equivalent.

(c) Install piston over Seal Guide 8114–3 and inside Guide Ring 8114–1.

(d) Push overdrive piston into position in retainer.

(e) Verify that the locating lugs entered the lug bores in the retainer.

(6) Install intermediate shaft spacer on intermediate shaft.

(7) Install overdrive piston thrust plate on overdrive piston.

(8) Install overdrive piston thrust bearing on overdrive piston.

(9) Install transmission speed sensor and O-ring seal in overdrive case.

CLEANING AND INSPECTION

VALVE BODY

Clean the valve housings, valves, plugs, springs, and separator plates with a standard parts cleaning solution only. Do not use gasoline, kerosene, or any type of caustic solution.

Do not immerse any of the electrical components in cleaning solution. Clean the governor solenoid and sensor and the dual solenoid and harness assembly by wiping them off with dry shop towels only.

Dry all except the electrical parts with compressed air. Make sure all passages are clean and free from obstructions. **Do not use rags or shop towels to dry or wipe off valve body components. Lint from these materials can stick to valve body parts, interfere with valve operation, and clog filters and fluid passages.**

Wipe the governor pressure sensor and solenoid valve with dry, lint free shop towels only. The O-rings on the sensor and solenoid valve are the only serviceable components. Be sure the vent ports in the solenoid valve are open and not blocked by dirt or debris. Replace the valve and/or sensor only when DRB scan tool diagnosis indicates this is necessary. Or, if either part has sustained physical damage (dented, deformed, broken, etc.).

CAUTION: Do not turn the small screw at the end of the solenoid valve for any reason. Turning the screw in either direction will ruin solenoid calibration and result in solenoid failure. In addition, the filter on the solenoid valve is NOT serviceable. Do not try to remove the filter as this will damage the valve housing.

Inspect the throttle and manual valve levers and shafts (Fig. 251). Do not attempt to straighten a bent shaft or correct a loose lever. Replace these components if worn, bent, loose or damaged in any way.

Inspect all of the valve body mating surfaces for scratches, nicks, burrs, or distortion. Use a straightedge to check surface flatness. Minor scratches may be removed with crocus cloth using only very light pressure.

Minor distortion of a valve body mating surface may be corrected by smoothing the surface with a sheet of crocus cloth. Position the crocus cloth on a surface plate, sheet of plate glass or equally flat surface. If distortion is severe or any surfaces are heavily scored, the valve body will have to be replaced.

CAUTION: Many of the valves and plugs, such as the throttle valve, shuttle valve plug, 1-2 shift valve and 1-2 governor plug, are made of coated aluminum. Aluminum components are identified by the dark color of the special coating applied to the surface (or by testing with a magnet). Do not sand aluminum valves or plugs under any circumstances. This practice could damage the special coating causing the valves/plugs to stick and bind.

Inspect the valves and plugs for scratches, burrs, nicks, or scores. Minor surface scratches on steel valves and plugs can be removed with crocus cloth but **do not round off the edges of the valve or plug lands.** Maintaining sharpness of these edges is vitally important. The edges prevent foreign matter from lodging between the valves and plugs and the bore.

Inspect all the valve and plug bores in the valve body. Use a penlight to view the bore interiors. Replace the valve body if any bores are distorted or scored. Inspect all of the valve body springs. The springs must be free of distortion, warpage or broken coils.

Check the two separator plates for distortion or damage of any kind. Inspect the upper housing, lower housing, 3-4 accumulator housing, and transfer plate carefully. Be sure all fluid passages are clean and clear. Check condition of the upper housing and transfer plate check balls as well. The check balls and ball seats must not be worn or damaged.

Trial fit each valve and plug in its bore to check freedom of operation. When clean and dry, the valves and plugs should drop freely into the bores.

Valve body bores do not change dimensionally with use. If the valve body functioned correctly when new, it will continue to operate properly after cleaning and inspection. It should not be necessary to replace a valve body assembly unless it is damaged in handling.

The only serviceable valve body components are listed below. The remaining valve body components are serviced only as part of a complete valve body assembly. Serviceable parts are:

- dual solenoid and harness assembly
- solenoid gasket
- solenoid case connector O-rings and shoulder bolt
- switch valve and spring
- pressure adjusting screw and bracket assembly
- throttle lever
- manual lever and shaft seal
- throttle lever shaft seal, washer, and E-clip
- fluid filter and screws
- detent ball and spring
- valve body screws
- governor pressure solenoid
- governor pressure sensor and retaining clip
- park lock rod and E-clip

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CLEANING AND INSPECTION (Continued)

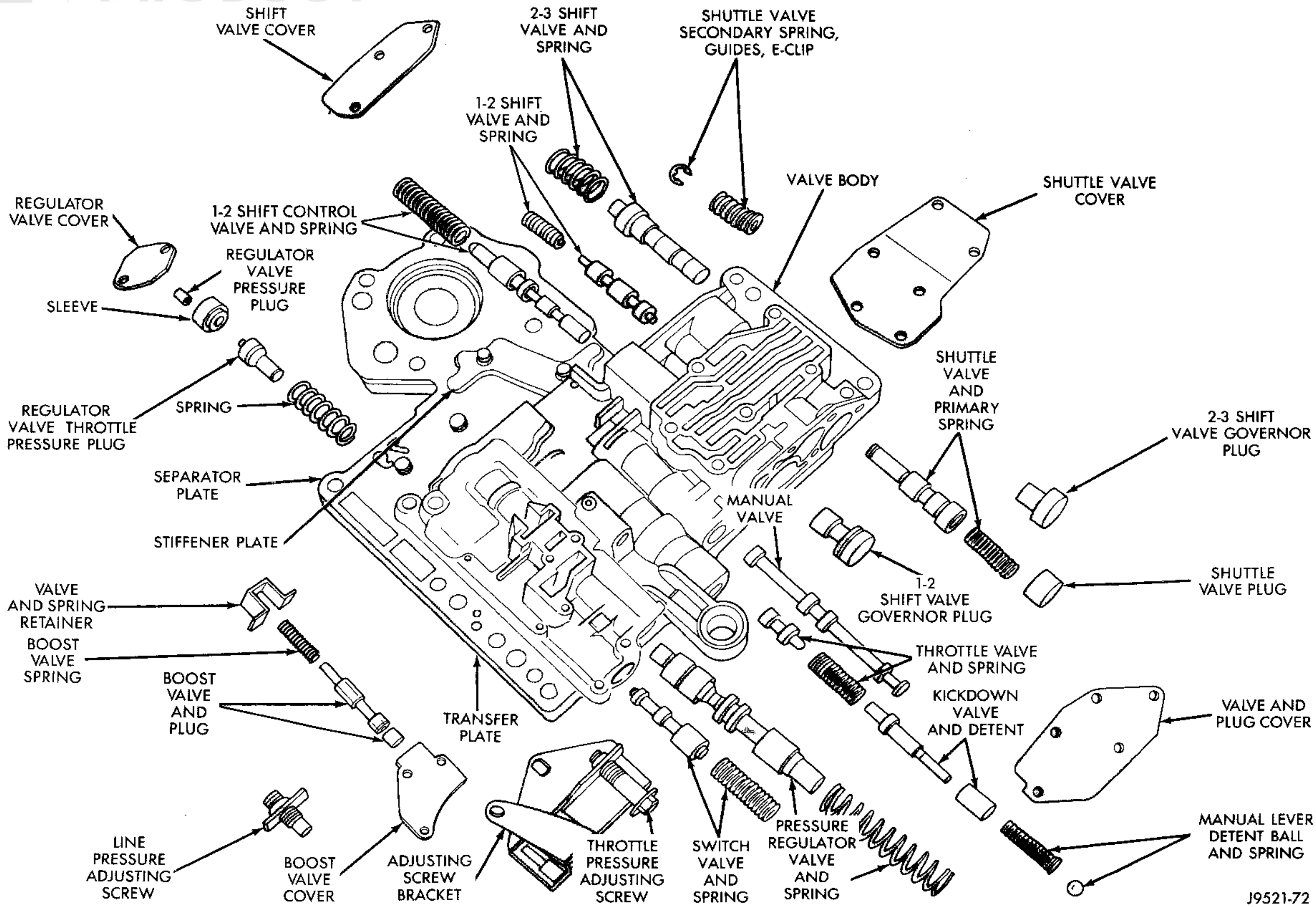

Fig. 251 Upper Housing Valves, Plug, Springs And Brackets

CLEANING AND INSPECTION (Continued)

TRANSMISSION

GENERAL INFORMATION

Inspect the transmission bushings during overhaul. Bushing condition is important as worn, scored bushings contribute to low pressures, clutch slip and accelerated wear of other components. However, do not replace bushings as a matter of course. Replace bushings only when they are actually worn, or scored.

Use recommended tools to replace bushings. The tools are sized and designed to remove, install, and seat bushings correctly. The bushing replacement tools are included in Bushing Tool Set C-3887-B.

Pre-sized service bushings are available for replacement purposes. Only the sun gear bushings are not serviced. Low cost of the sun gear assembly makes it easier to simply replace the gear and bushings as an assembly.

Heli-Coil inserts can be used to repair damaged, stripped or worn threads in aluminum parts. These inserts are available from most automotive parts suppliers. Stainless steel inserts are recommended.

The use of crocus cloth is permissible where necessary, providing it is used carefully. When used on shafts, or valves, use extreme care to avoid rounding off sharp edges. Sharp edges are vital as they prevent foreign matter from getting between the valve and valve bore.

Do not reuse oil seals, gaskets, seal rings, or O-rings during overhaul. Replace these parts as a matter of course. Also do not reuse snap rings or E-clips that are bent or distorted. Replace these parts as well.

Lubricate transmission parts with Mopar® ATF Plus, Type 7176, transmission fluid during overhaul and assembly. Use petroleum jelly, Mopar® Door Ease, or Ru-Glyde to prelubricate seals, O-rings, and thrust washers. Petroleum jelly can also be used to hold parts in place during reassembly.

TRANSMISSION CASE CLEANING AND INSPECTION

Clean the case in a solvent tank. Flush the case bores and fluid passages thoroughly with solvent. Dry the case and all fluid passages with compressed air. Be sure all solvent is removed from the case and that all fluid passages are clear.

NOTE: Do not use shop towels or rags to dry the case (or any other transmission component) unless they are made from lint-free materials. Lint will stick to case surfaces and transmission components and circulate throughout the transmission after assembly. A sufficient quantity of lint can block fluid passages and interfere with valve body operation.

Inspect the case for cracks, porous spots, worn bores, or damaged threads. Damaged threads can be repaired with Helicoil thread inserts. However, the case will have to be replaced if it exhibits any type of damage or wear.

Lubricate the front band adjusting screw threads with petroleum jelly and thread the screw part-way into the case. Be sure the screw turns freely.

OVERRUNNING CLUTCH/LOW-REVERSE DRUM/OVERDRIVE PISTON RETAINER

Clean the overrunning clutch assembly, clutch cam, low-reverse drum, and overdrive piston retainer in solvent. Dry them with compressed air after cleaning.

Inspect condition of each clutch part after cleaning. Replace the overrunning clutch roller and spring assembly if any rollers or springs are worn or damaged, or if the roller cage is distorted, or damaged. Replace the cam if worn, cracked or damaged.

Replace the low-reverse drum if the clutch race, roller surface or inside diameter is scored, worn or damaged. **Do not remove the clutch race from the low-reverse drum under any circumstances. Replace the drum and race as an assembly if either component is damaged.**

Examine the overdrive piston retainer carefully for wear, cracks, scoring or other damage. Be sure the retainer hub is a snug fit in the case and drum. Replace the retainer if worn or damaged.

ACCUMULATOR

Inspect the accumulator piston and seal rings (Fig. 252). Replace the seal rings if worn or cut. Replace the piston if chipped or cracked.

Check condition of the accumulator inner and outer springs (Fig. 252). Replace the springs if the coils are cracked, distorted or collapsed.

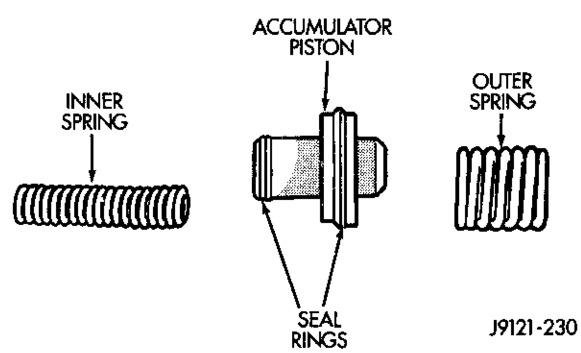

Fig. 252 Accumulator Components

FRONT SERVO

Clean the servo piston components with solvent and dry them with compressed air. Wipe the band clean with lint free shop towels.

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CLEANING AND INSPECTION (Continued)

Replace the front band if distorted, lining is burned, flaking off, or worn to the point where the grooves in the lining material are no longer visible.

Inspect the servo components. Replace the springs if collapsed, distorted or broken. Replace the guide, rod and piston if cracked, bent, or worn. Discard the servo snap ring if distorted or warped.

Check the servo piston bore for wear. If the bore is severely scored, or damaged, it will be necessary to replace the case.

Replace any servo component if doubt exists about condition. Do not reuse suspect parts.

REAR SERVO

Remove and discard the servo piston seal ring (Fig. 253). Then clean the servo components with solvent and dry with compressed air. Replace either spring if collapsed, distorted or broken. Replace the plug and piston if cracked, bent, or worn. Discard the servo snap rings and use a new ones at assembly.

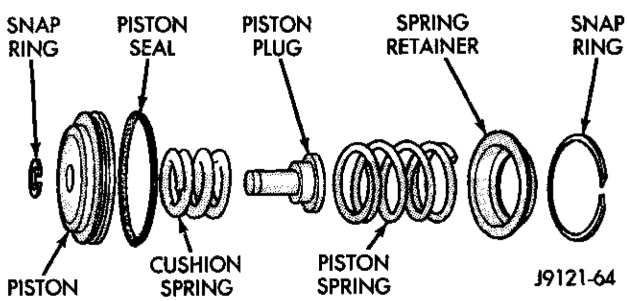

Fig. 253 Rear Servo Components

OIL PUMP AND REACTION SHAFT SUPPORT

Clean pump and support components with solvent and dry them with compressed air.

Check condition of the seal rings and thrust washer on the reaction shaft support. The seal rings do not need to be replaced unless cracked, broken, or severely worn.

Inspect the pump and support components. Replace the pump or support if the seal ring grooves or machined surfaces are worn, scored, pitted, or damaged. Replace the pump gears if pitted, worn chipped, or damaged.

Check the pump vent. The vent must be secure. Replace the pump body if the vent is cracked, broken, or loose.

Inspect the pump bushing. Then check the reaction shaft support bushing. Replace either bushing only if heavily worn, scored or damaged. It is not necessary to replace the bushings unless they are actually damaged.

(1) Install the gears in the pump body and measure pump component clearances as follows:

(a) Clearance between outer gear and reaction shaft housing should be 0.010 to 0.063 mm (0.0004 to 0.0025 in.). Clearance between inner gear and reaction shaft housing should be 0.010 to 0.063 mm (0.0004 to 0.0025 in.). Both clearances can be measured at the same time by:

(I) Installing the pump gears in the pump housing.

(II) Position an appropriate piece of Plastigage™ across both gears.

(III) Align the plastigage to a flat area on the reaction shaft housing.

(IV) Install the reaction shaft to the pump housing.

(V) Separate the reaction shaft housing from the pump housing and measure the Plastigage™ following the instructions supplied with it.

(b) Clearance between inner gear tooth and outer gear should be 0.08 to 0.19 mm (0.0035 to 0.0075 in.). Measure clearance with an appropriate feeler gauge (Fig. 254).

(c) Clearance between outer gear and pump housing should also be 0.010 to 0.19 mm (0.0035 to 0.0075 in.). Measure clearance with an appropriate feeler gauge.

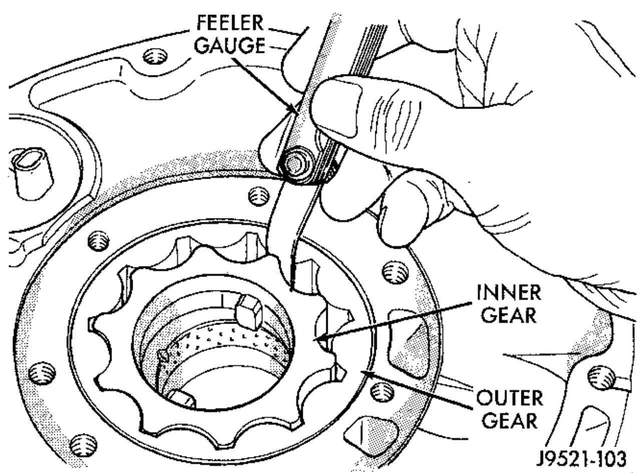

Fig. 254 Checking Pump Gear Tip Clearance

FRONT CLUTCH

Clean and inspect the front clutch components. Replace the clutch discs if warped, worn, scored, burned or charred, the lugs are damaged, or if the facing is flaking off. Replace the steel plates and reaction plate if heavily scored, warped, or broken. Be sure the driving lugs on the discs and plate are also in good condition. The lugs must not be bent, cracked or damaged in any way.

Replace the piston springs and spring retainer if either are distorted, warped or broken.

Check the lug grooves in the clutch piston retainer. The steel plates should slide freely in the slots. Replace the piston retainer if the grooves are worn or damaged. Also check action of the check ball in the

CLEANING AND INSPECTION (Continued)

piston retainer. The ball must move freely and not stick.

Replace the retainer bushing if worn, scored, or there is any doubt about bushing condition.

Inspect the piston and retainer seal surfaces for nicks or scratches. Minor scratches can be removed with crocus cloth. However, replace the piston and/or retainer if the seal surfaces are seriously scored.

Check the clutch piston check ball. The ball should be securely in place. Replace the piston if the ball is missing, or seized in place.

REAR CLUTCH

Clean the clutch components with solvent and dry them with compressed air.

Check condition of the input shaft seal rings. It is not necessary to remove or replace rings unless they are broken, cracked, or no longer securely hooked together.

Inspect the input shaft splines and machined surfaces. Very minor nicks or scratches can be smoothed off with crocus cloth. replace the shaft if the splines are damaged, or any of the machined surfaces are severely scored.

Replace the clutch discs if warped, worn, scored, burned/charred, the lugs are damaged, or if the facing is flaking off.

Replace the steel plates and the pressure plate if heavily scored, warped, or broken. Be sure the driving lugs on the discs and plates are also in good condition. The lugs must not be bent, cracked or damaged in any way.

Replace the piston spring and wave spring if either part is distorted, warped or broken.

Check the lug grooves in the clutch retainer. The steel plates should slide freely in the slots. Replace the retainer if the grooves are worn or damaged. Also check action of the retainer check ball. The ball must move freely and not stick.

Inspect the piston and retainer seal surfaces for nicks or scratches. Minor scratches can be removed with crocus cloth. However, replace the piston and/or retainer if the seal surfaces are seriously damaged.

Check thrust washer condition. Washer thickness should be 1.55 to 1.60 mm (0.061 to 0.063 in.). Replace the washer if worn or damaged.

Check condition of the two seal rings on the input shaft and the single seal ring on the piston retainer hub. Replace the seal rings only if severely worn, cracked, or cannot be hooked together.

PLANETARY GEARTRAIN/OUTPUT SHAFT

Clean the intermediate shaft and planetary components in solvent and dry them with compressed air.

Inspect the planetary gear sets and annulus gears. The planetary pinions, shafts, washers, and retaining pins are serviceable. However, if a pinion carrier is damaged, the entire planetary gear set must be replaced as an assembly.

Replace the annulus gears if the teeth are chipped, broken, or worn, or the gear is cracked. Replace the planetary thrust plates and the tabbed thrust washers if cracked, scored or worn.

Inspect the machined surfaces of the intermediate shaft. Be sure the oil passages are open and clear. Replace the shaft if scored, pitted, or damaged.

Inspect the sun gear and driving shell. If either component is worn or damaged, remove the sun gear rear retaining ring and separate the sun gear and thrust plate from the driving shell. Then replace the necessary component.

Replace the sun gear as an assembly if the gear teeth are chipped or worn. Also replace the gear as an assembly if the bushings are scored or worn. The sun gear bushings are not serviceable. Replace the thrust plate if worn, or severely scored. Replace the driving shell if distorted, cracked, or damaged in any way.

Replace all snap rings during geartrain assembly. Reusing snap rings is not recommended.

OVERDRIVE UNIT

Clean the geartrain and case components with solvent. Dry all parts except the bearings with compressed air. Allow bearings to air dry.

Do not use shop towels for wiping parts dry unless the towels are made from a lint-free material. A sufficient quantity of lint (from shop towels, cloths, rags, etc.) could plug the transmission filter and fluid passages.

Discard the old case gasket and seals. Do not attempt to salvage these parts. They are not reusable. Replace any of the overdrive unit snap rings if distorted or damaged.

Minor nicks or scratches on components can be smoothed with crocus cloth. However, do not attempt to reduce severe scoring on any components with abrasive materials. Replace severely scored components; do not try to salvage them.

Check condition of the park lock components and the overdrive case.

Replace the case if cracked, scored, or damaged. Replace the park lock pawl, plug, or spring if worn or damaged. Be sure the bullet at the end of the park lock rod is in good condition. Replace the rod if the bullet is worn or the rod itself is bent or distorted. Do not attempt to straighten the rod.

Check the bushings in the overdrive case. Replace the bushings if severely scored or worn. Also replace the case seal if loose, distorted, or damaged.

Examine the overdrive and direct clutch discs and plates. Replace the discs if the facing is worn,

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CLEANING AND INSPECTION (Continued)

severely scored, or burned and flaking off. Replace the clutch plates if worn, heavily scored, or cracked. Check the lugs on the clutch plates for wear. The plates should slide freely in the drum. Replace the plates or drum if binding occurs.

Check condition of the annulus gear, direct clutch hub, clutch drum and clutch spring. Replace the gear, hub and drum if worn or damaged. Replace the spring if collapsed, distorted, or cracked.

Be sure the splines and lugs on the gear, drum and hub are in good condition. The clutch plates and discs should slide freely in these components.

Inspect the thrust bearings and spring plate. Replace the plate if worn or scored. Replace the bearings if rough, noisy, brinnelled, or worn.

Inspect the planetary gear assembly and the sun gear and bushings. If either the sun gear or the bushings are damaged, replace the gear and bushings as an assembly. The gear and bushings are not serviced separately.

The planetary carrier and pinions must be in good condition. Also be sure the pinion pins are secure and in good condition. Replace the carrier if worn or damaged.

Inspect the overrunning clutch and race. The race surface should be smooth and free of scores. Replace the overrunning clutch assembly or the race if either assembly is worn or damaged in any way.

Inspect the output shaft and governor components. Replace the shaft pilot bushing and inner bushing if damaged. Replace either shaft bearing if rough or noisy. Replace the bearing snap rings if distorted or cracked.

Check the machined surfaces on the output shaft. These surfaces should clean and smooth. Very minor nicks or scratches can be smoothed with crocus cloth. Replace the shaft if worn, scored or damaged in any way.

Inspect the output shaft bushings. The small bushing is the intermediate shaft pilot bushing. The large bushing is the overrunning clutch hub bushing. Replace either bushing if scored, pitted, cracked, or worn.

ADJUSTMENTS

TRANSMISSION THROTTLE VALVE CABLE ADJUSTMENT

The transmission throttle valve is operated by a cam on the valve body throttle lever. The throttle lever is actuated by a cable connected to the engine throttle body lever (Fig. 255). A retaining clip at the engine-end of the cable is removed to provide for cable adjustment. The retaining clip is then installed back onto the throttle valve cable to lock in the adjustment.

A correctly adjusted throttle valve cable, will cause the throttle lever on the transmission to move simultaneously with the throttle body lever from the idle position. Proper adjustment allows simultaneous movement without causing the transmission throttle lever to move ahead of, or lag behind the throttle body lever.

THROTTLE VALVE CABLE ADJUSTMENT CHECK

(1) Turn ignition key to OFF position.

(2) Remove air cleaner.

(3) Verify that throttle body lever is at curb idle position. Then verify that transmission throttle lever (Fig. 255) is also at idle (full forward) position.

(4) Slide cable off attachment stud on throttle body lever (Fig. 255).

(5) Compare position of cable end to attachment stud on throttle body lever:

(a) Cable end and attachment stud should be aligned (or centered on one another) to within 1 mm (0.039 in.) in either direction.

(b) If cable end and attachment stud are misaligned (off center), cable will have to be adjusted as described in following procedure.

(6) Reconnect cable end to attachment stud. Then with aid of a helper, observe movement of transmission throttle lever and lever on throttle body.

(a) If both levers move simultaneously from idle to half-throttle and back to idle position, adjustment is correct.

(b) If transmission throttle lever moves ahead of, or lags behind throttle body lever, cable adjustment will be necessary. Or, if throttle body lever prevents transmission lever from returning to closed position, cable adjustment will be necessary.

THROTTLE VALVE CABLE ADJUSTMENT PROCEDURE

(1) Turn ignition switch to OFF position and shift into Park.

(2) Remove air cleaner.

(3) Disconnect cable end from attachment stud on throttle body. **Carefully slide cable off stud. Do not pull or pry cable off.**

(4) Verify that transmission throttle lever is in idle (full forward) position. Then be sure lever on throttle body is at curb idle position.

(5) Insert a small screwdriver under edge of retaining clip and remove retaining clip.

(6) Center cable end on attachment stud to within 1 mm (0.039 in.).

(7) Install retaining clip onto cable housing.

(8) Check cable adjustment. Be sure transmission throttle lever and lever on throttle body move simultaneously and as described in cable adjustment checking procedure.

ADJUSTMENTS (Continued)

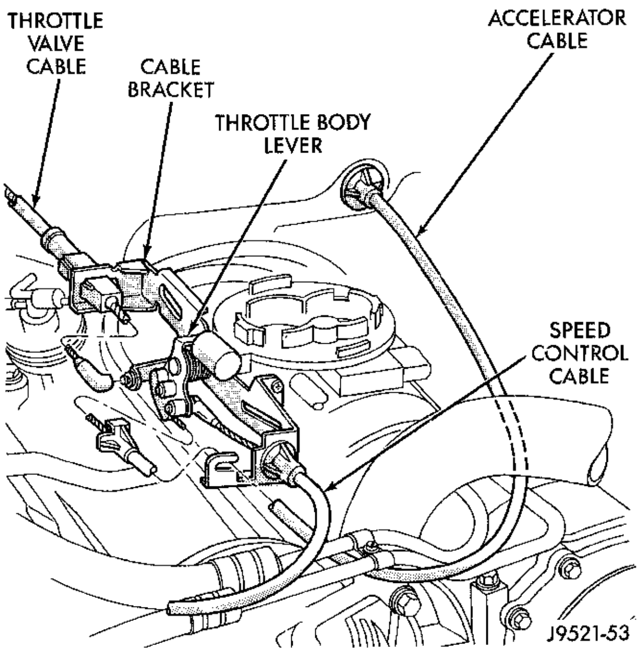

Fig. 255 Throttle Valve Cable Attachment —At Engine

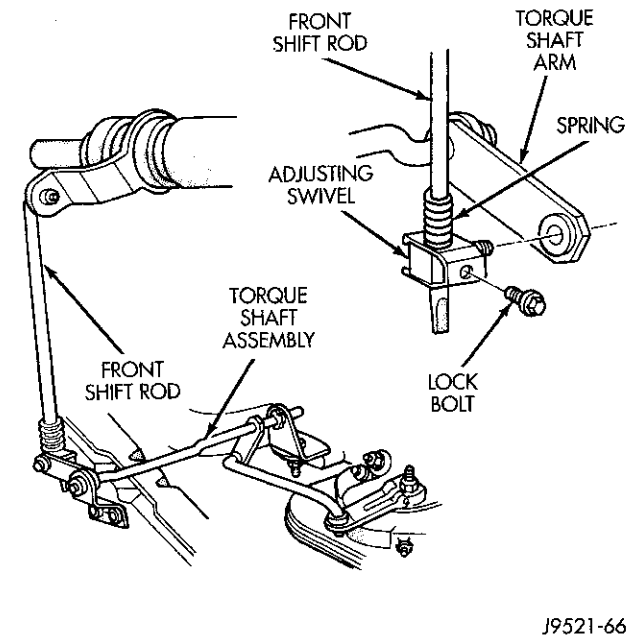

Fig. 256 Linkage Adjustment Components

GEARSHIFT LINKAGE ADJUSTMENT

Check linkage adjustment by starting engine in Park and Neutral. Adjustment is acceptable if the engine starts in only these two positions. Adjustment is incorrect if the engine starts in one position but not both positions

If the engine starts in any other position, or if the engine will not start in any position, the park/neutral switch is probably faulty.

LINKAGE ADJUSTMENT

Check condition of the shift linkage (Fig. 256). Do not attempt adjustment if any component is loose, worn, or bent. Replace any suspect components.

Replace the grommet securing the shift rod or torque rod in place if either rod was removed from the grommet. Remove the old grommet as necessary and use suitable pliers to install the new grommet.

(1) Shift transmission into Park.

(2) Raise and support vehicle.

(3) Loosen lock bolt in front shift rod adjusting swivel (Fig. 256).

(4) Ensure that the shift rod slides freely in the swivel. Lube rod and swivel as necessary.

(5) Move transmission shift lever fully rearward to the Park detent.

(6) Center adjusting swivel on shift rod.

(7) Tighten swivel lock bolt to 10 N·m (90 in. lbs.).

(8) Lower vehicle and verify proper adjustment.

FRONT BAND ADJUSTMENT

The front (kickdown) band adjusting screw is located on the left side of the transmission case above the manual valve and throttle valve levers.

(1) Raise vehicle.

(2) Loosen band adjusting screw locknut (Fig. 257). Then back locknut off 3-5 turns. Be sure adjusting screw turns freely in case. Apply lubricant to screw threads if necessary.

(3) Tighten band adjusting screw to 8 N·m (72 in. lbs.) torque with Inch Pound Torque Wrench C-3380-A, a 3-in. extension and 5/16 socket.

CAUTION: If Adapter C-3705 is needed to reach the adjusting screw (Fig. 258), tighten the screw to only 5 N·m (47-50 in. lbs.) torque.

46RE TRANSMISSION

- Back off front band adjusting screw 2-7/8 turns.
- Hold adjuster screw in position and tighten locknut to 41 N·m (30 ft. lbs.) torque.

47RE TRANSMISSION

- Back off front band adjusting screw 1-7/8 turns.
- Hold adjuster screw in position and tighten locknut to 41 N·m (30 ft. lbs.) torque.

(4) Lower vehicle.

ADJUSTMENTS (Continued)

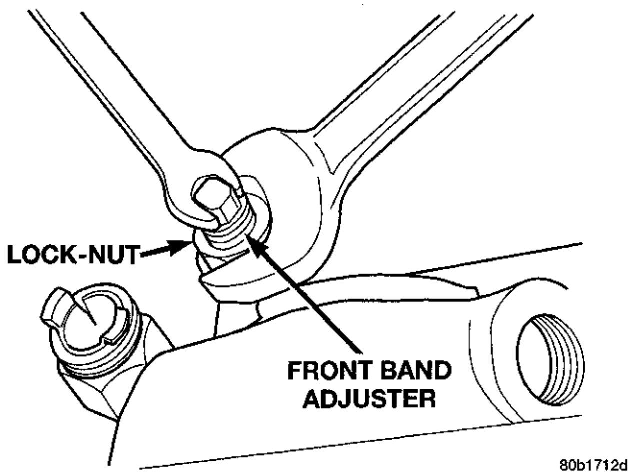

Fig. 257 Front Band Adjustment Screw Location

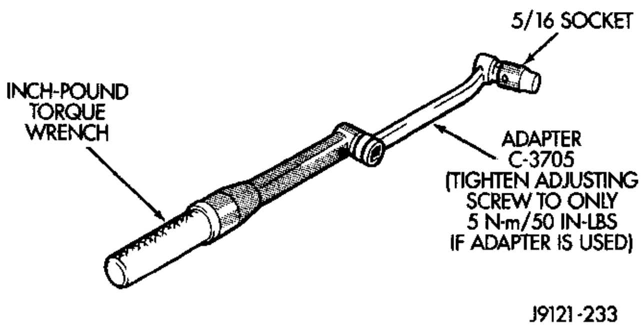

Fig. 258 Band Adjustment Adapter Tool

REAR BAND ADJUSTMENT

The transmission oil pan must be removed for access to the rear band adjusting screw.

(1) Raise vehicle.

(2) Remove transmission oil pan and drain fluid.

(3) Loosen band adjusting screw locknut 5-6 turns. Be sure adjusting screw turns freely in lever.

(4) Tighten adjusting screw to 8 N·m (72 in. lbs.) torque (Fig. 259).

46RE TRANSMISSION

- Back off adjusting screw 2 turns.
- Hold adjusting screw in place and tighten locknut to 34 N·m (25 ft. lbs.) torque.

47RE TRANSMISSION

- Back off adjusting screw 3 turns.
- Hold adjusting screw in place and tighten locknut to 34 N·m (25 ft. lbs.) torque.

(5) Position new gasket on oil pan and install pan on transmission. Tighten pan bolts to 17 N·m (13 ft. lbs.) torque.

(6) Lower vehicle and refill transmission with Mopar® ATF Plus 3, Type 7176 fluid.

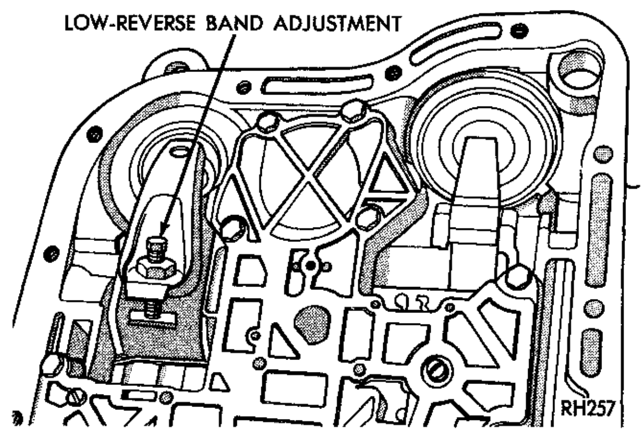

Fig. 259 Rear Band Adjustment Screw Location

VALVE BODY

CONTROL PRESSURE ADJUSTMENTS

There are two control pressure adjustments on the valve body;

- Line Pressure
- Throttle Pressure

Line and throttle pressures are interdependent because each affects shift quality and timing. As a result, both adjustments must be performed properly and in the correct sequence. Adjust line pressure first and throttle pressure last.

ADJUSTMENTS (Continued)

LINE PRESSURE ADJUSTMENT

Measure distance from the valve body to the inner edge of the adjusting screw with an accurate steel scale (Fig. 260).

Distance should be 33.4 mm (1-5/16 in.).

If adjustment is required, turn the adjusting screw in, or out, to obtain required distance setting.

NOTE: The 33.4 mm (1-5/16 in.) setting is an approximate setting. Manufacturing tolerances may make it necessary to vary from this dimension to obtain desired pressure.

One complete turn of the adjusting screw changes line pressure approximately 1-2/3 psi (9 kPa).

Turning the adjusting screw counterclockwise increases pressure while turning the screw clockwise decreases pressure.

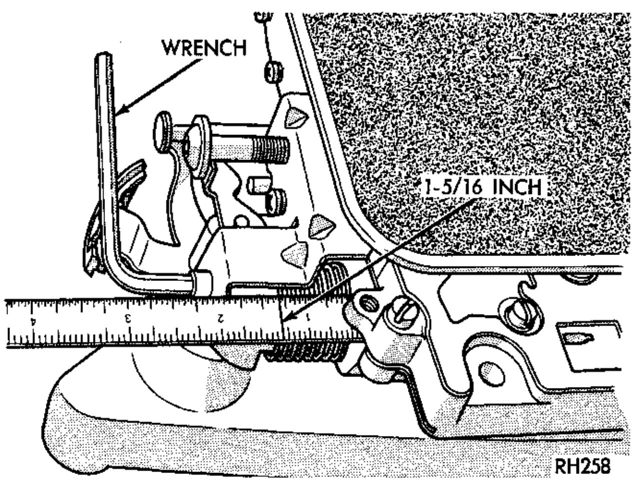

Fig. 260 Line Pressure Adjustment

THROTTLE PRESSURE ADJUSTMENT

Insert Gauge Tool C-3763 between the throttle lever cam and the kickdown valve stem (Fig. 261).

Push the gauge tool inward to compress the kickdown valve against the spring and bottom the throttle valve.

Maintain pressure against kickdown valve spring. Turn throttle lever stop screw until the screw head touches throttle lever tang and the throttle lever cam touches gauge tool.

NOTE: The kickdown valve spring must be fully compressed and the kickdown valve completely bottomed to obtain correct adjustment.

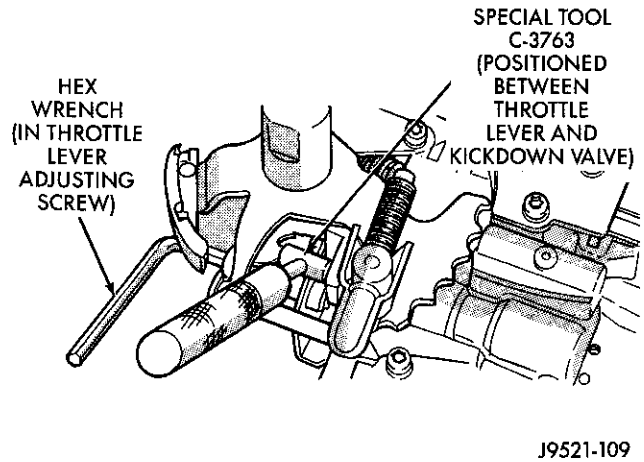

Fig. 261 Throttle Pressure Adjustment

SCHEMATICS AND DIAGRAMS

HYDRAULIC SCHEMATICS

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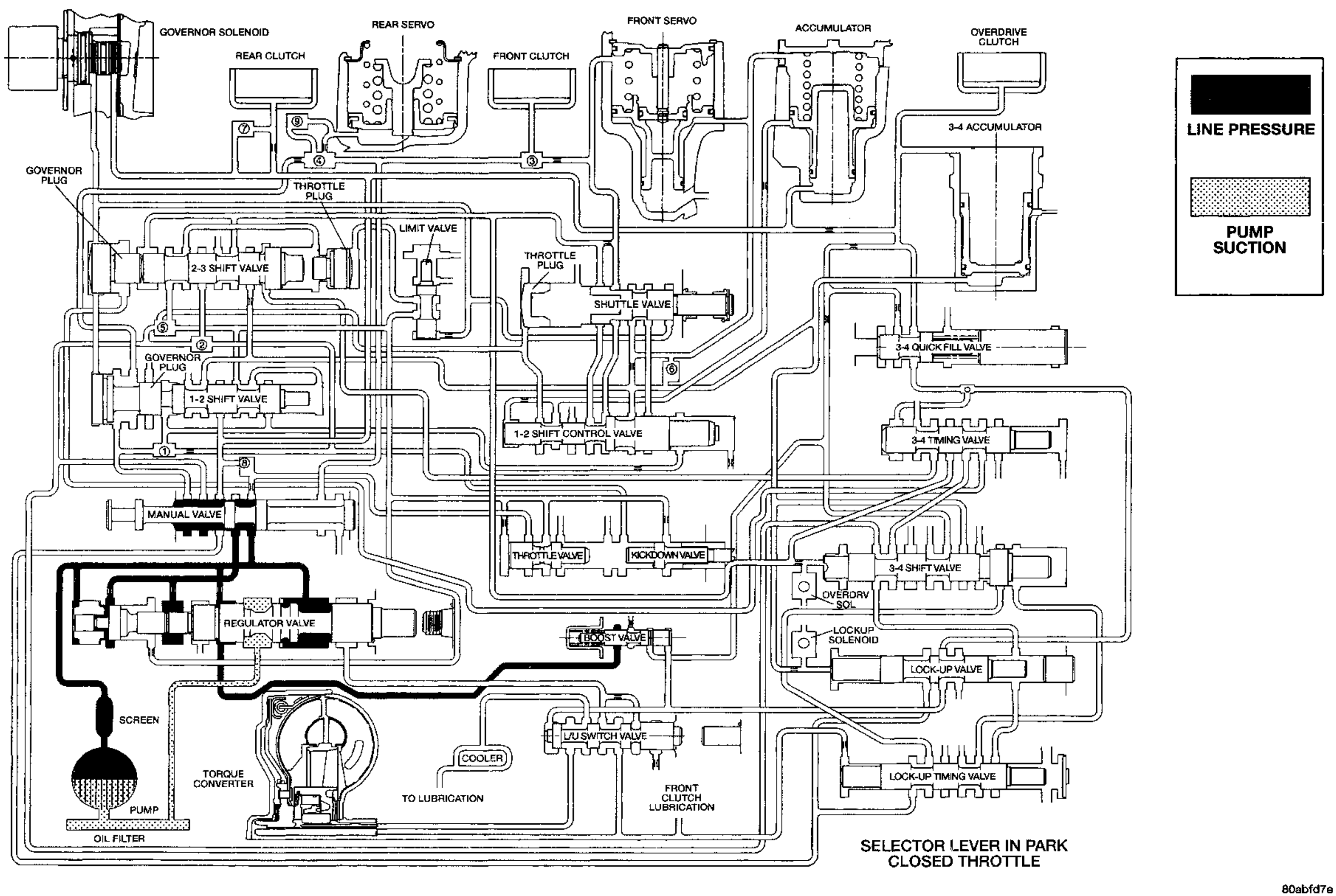

HYDRAULIC FLOW IN PARK

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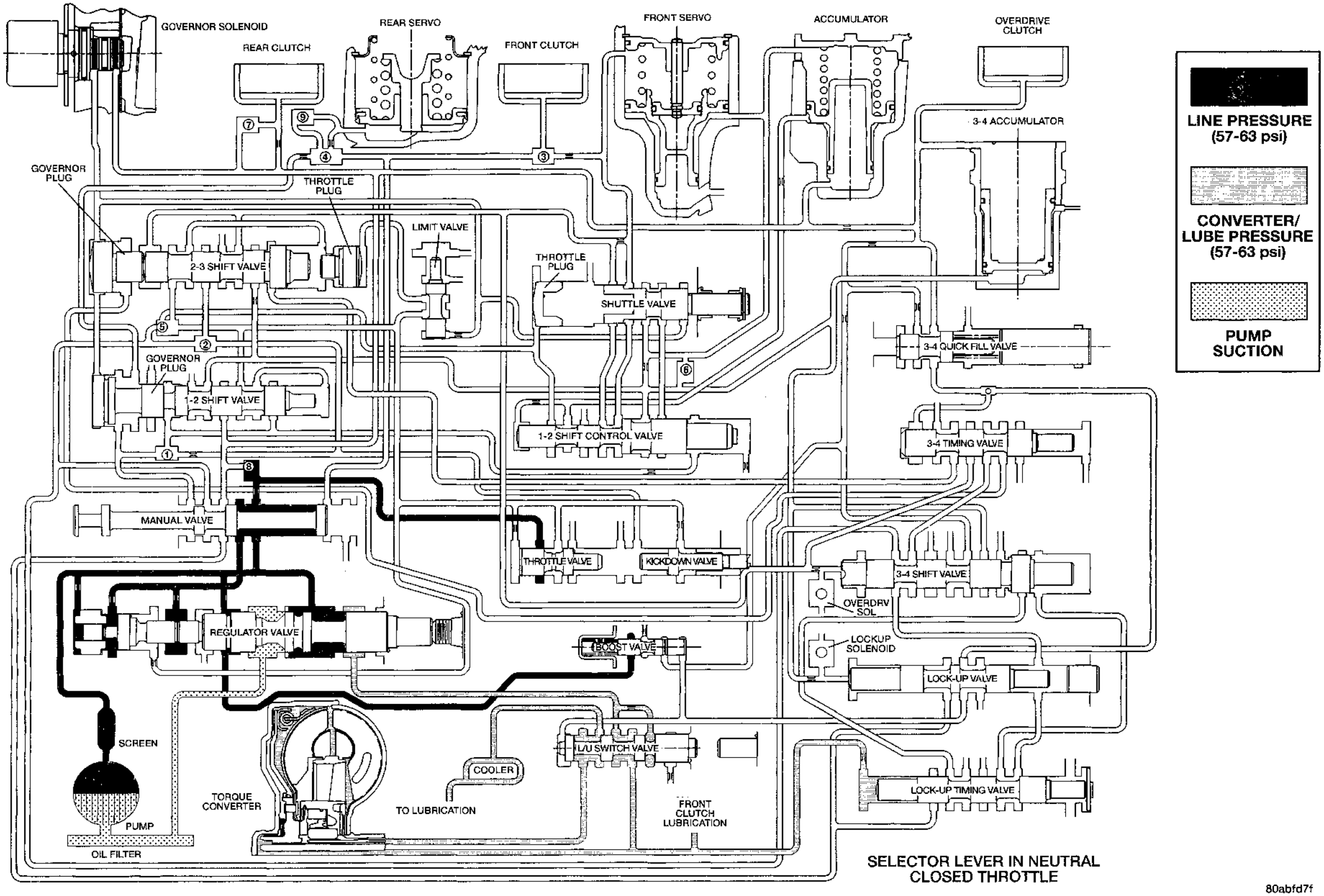
SCHEMATICS AND DIAGRAMS (Continued)



HYDRAULIC FLOW IN NEUTRAL

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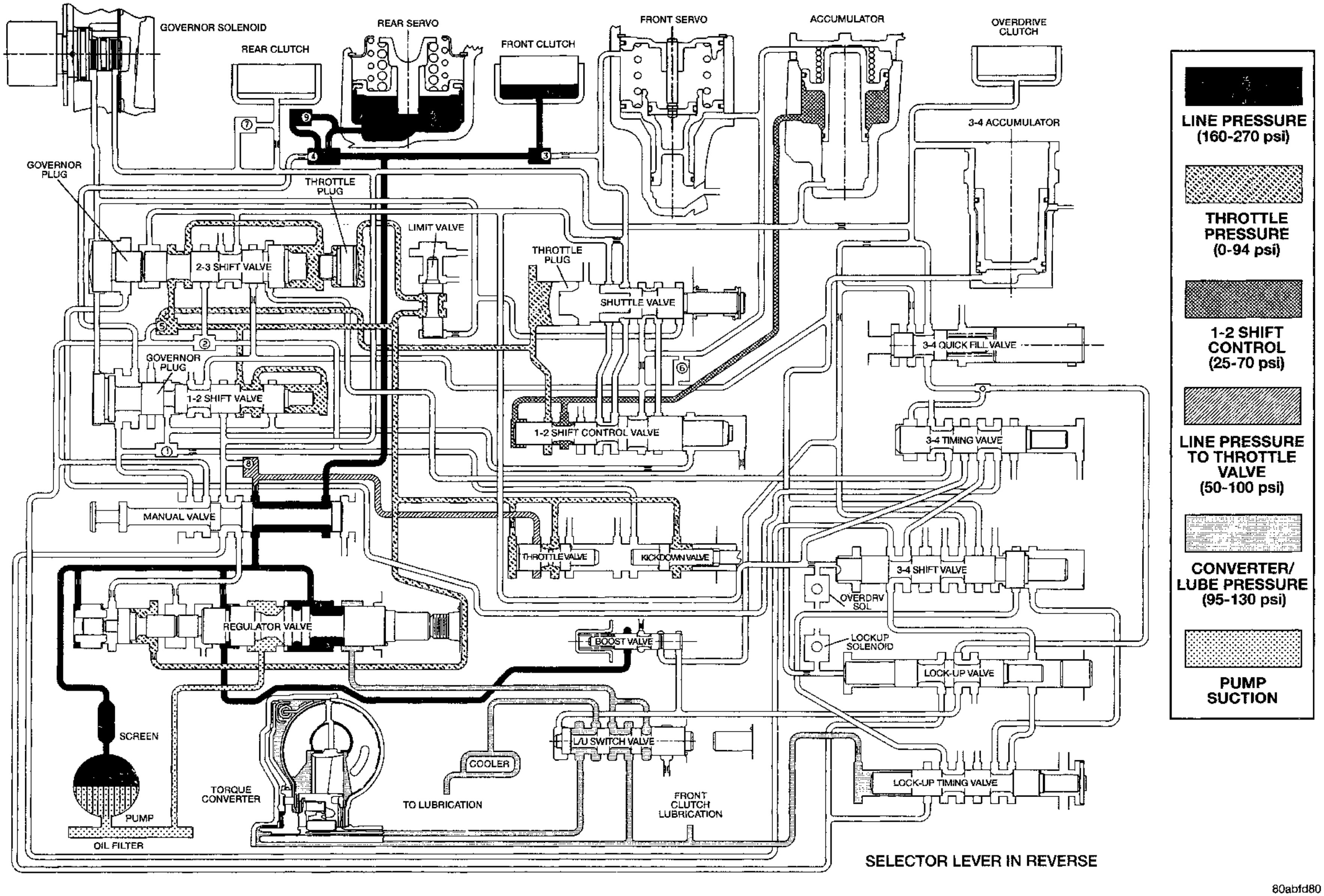

HYDRAULIC FLOW IN REVERSE

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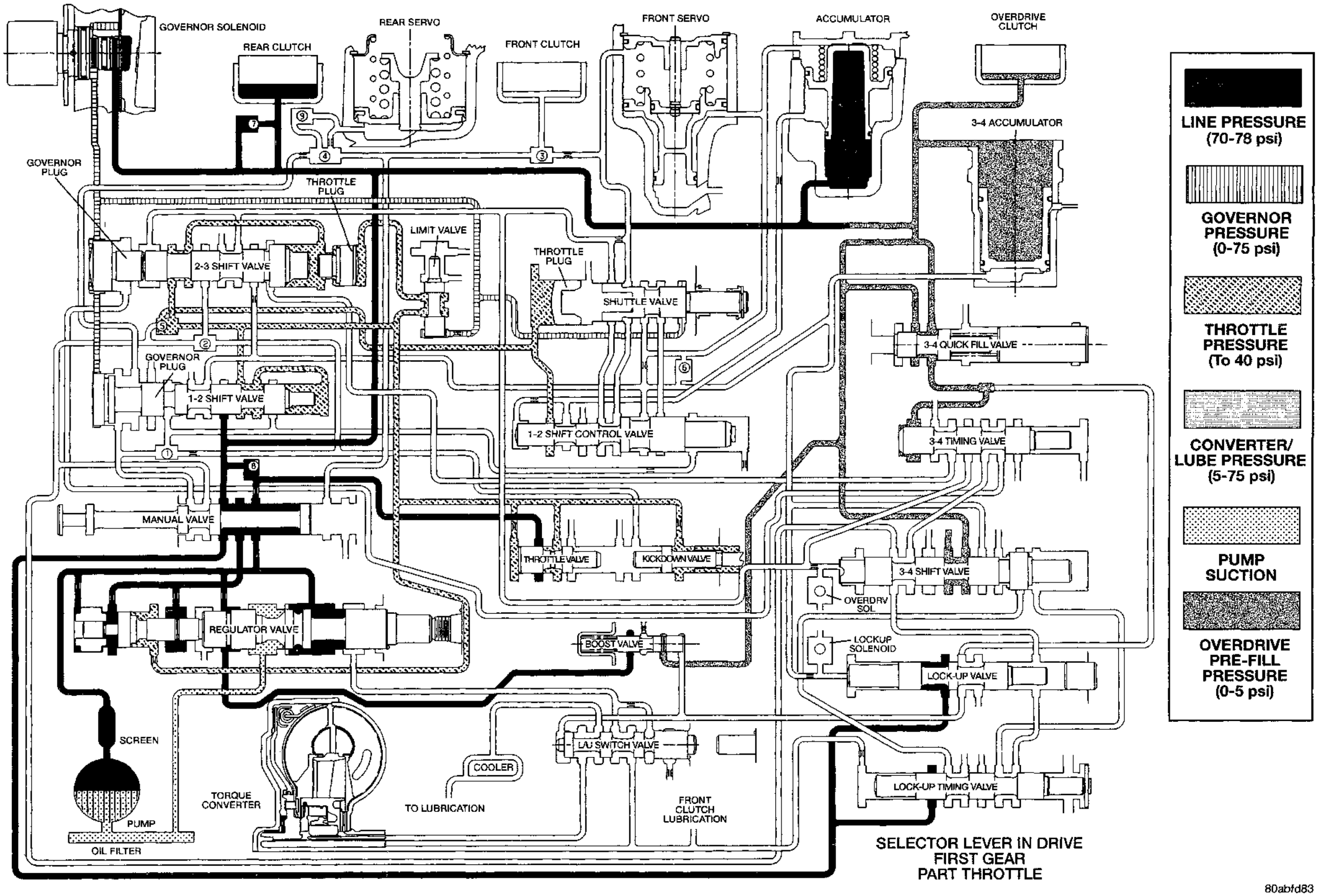

HYDRAULIC FLOW IN DRIVE FIRST GEAR

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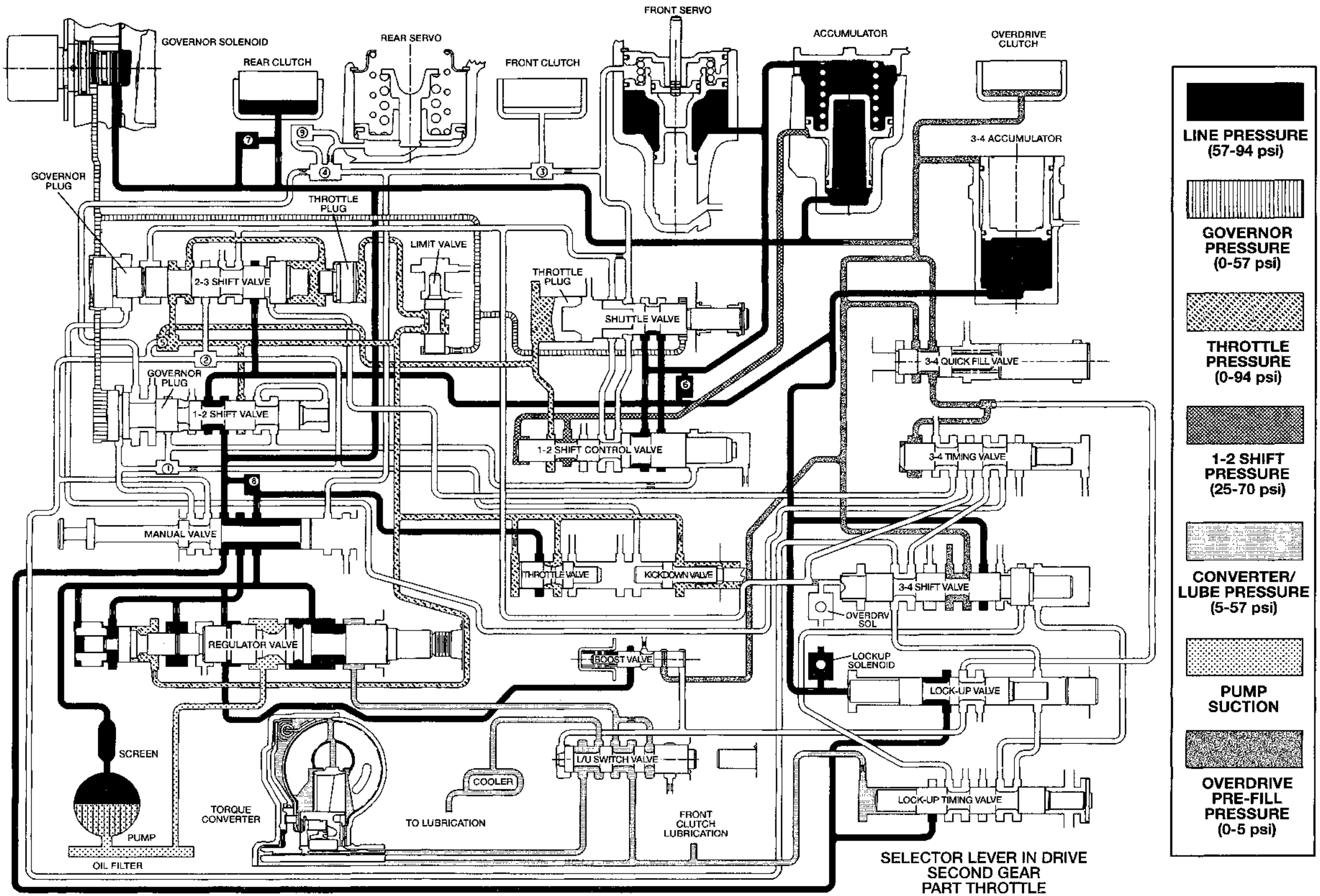

HYDRAULIC FLOW IN DRIVE SECOND GEAR

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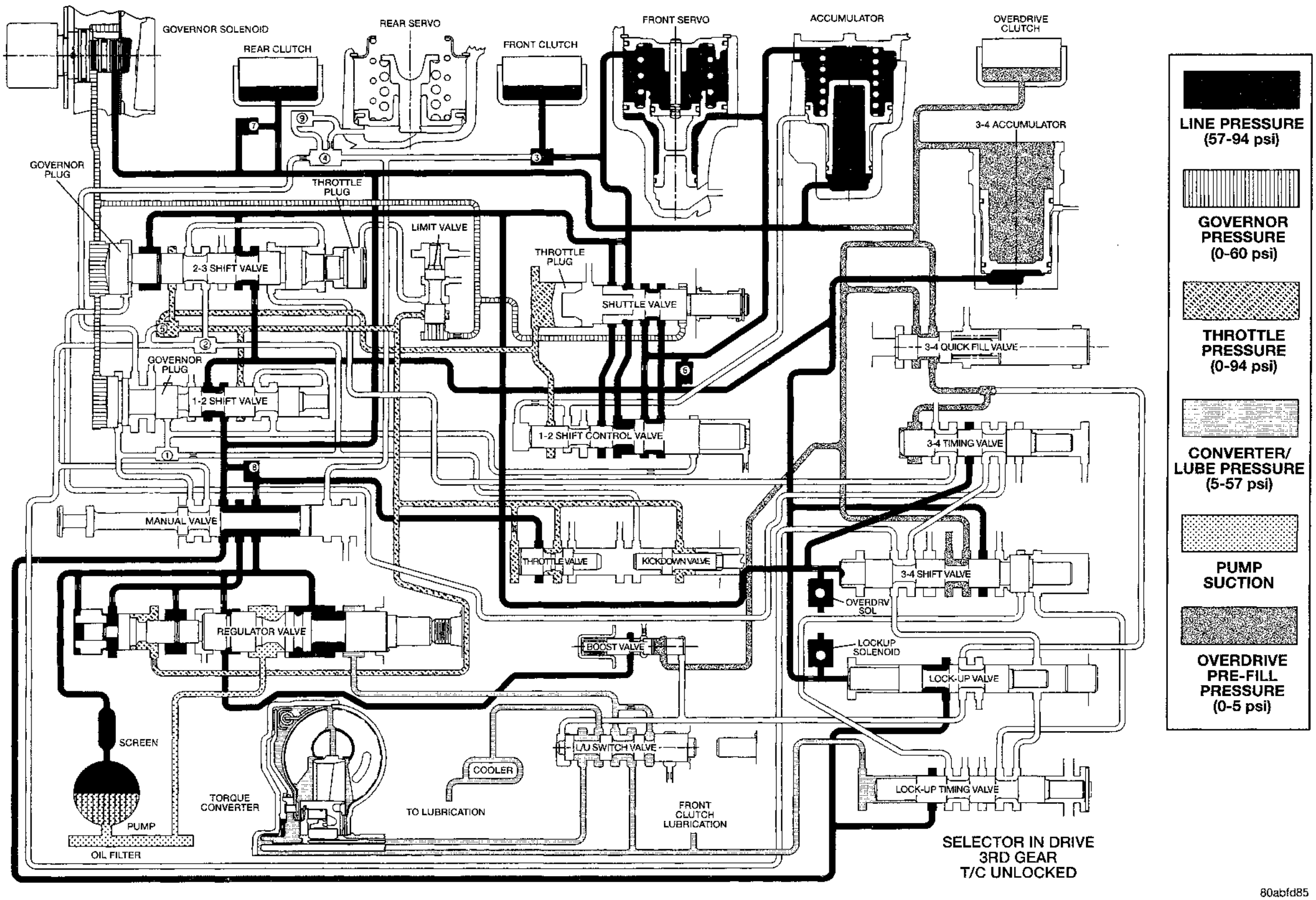

HYDRAULIC FLOW IN DRIVE THIRD GEAR (CONVERTER CLUTCH NOT APPLIED)

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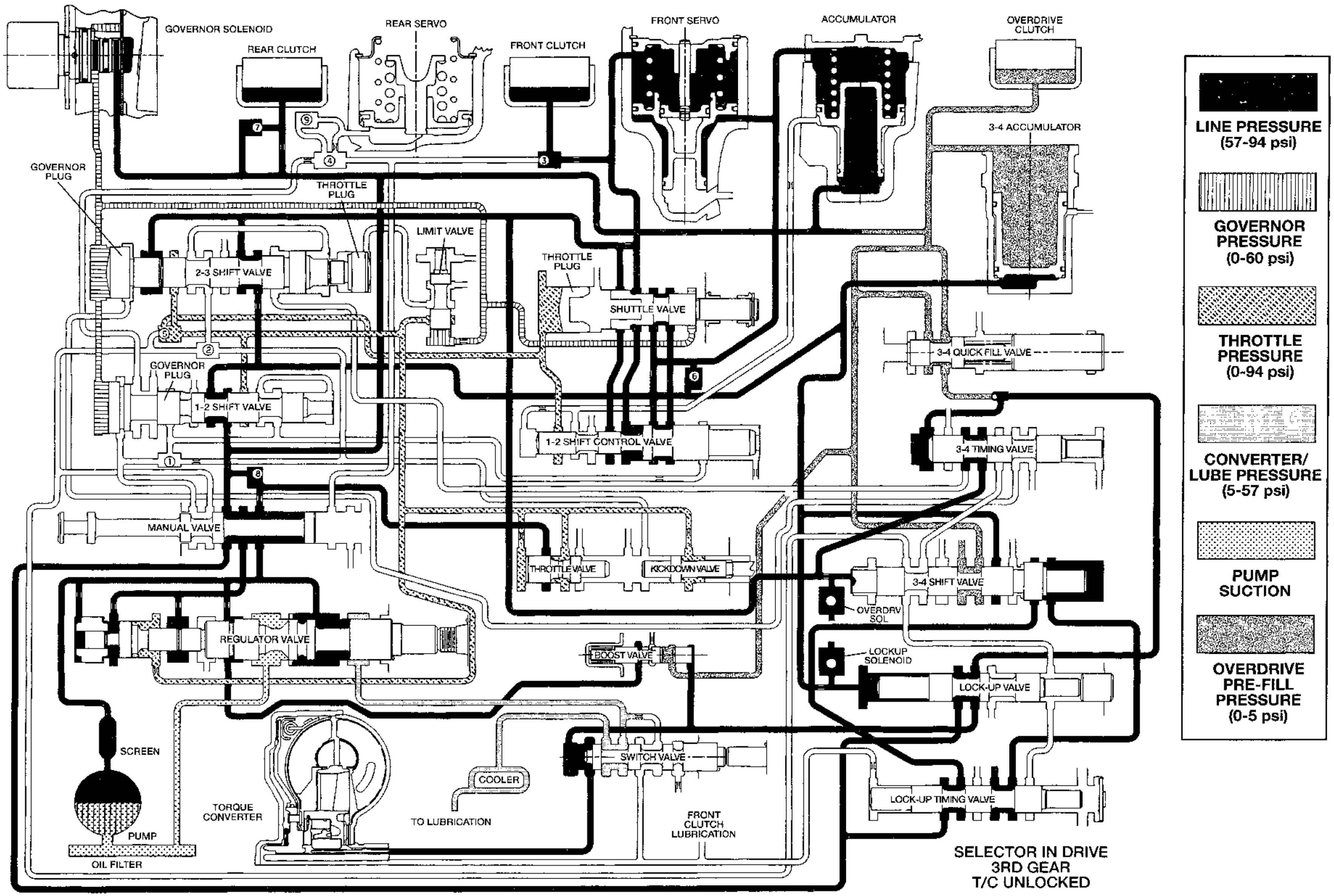

HYDRAULIC FLOW IN DRIVE THIRD GEAR (CONVERTER CLUTCH APPLIED)

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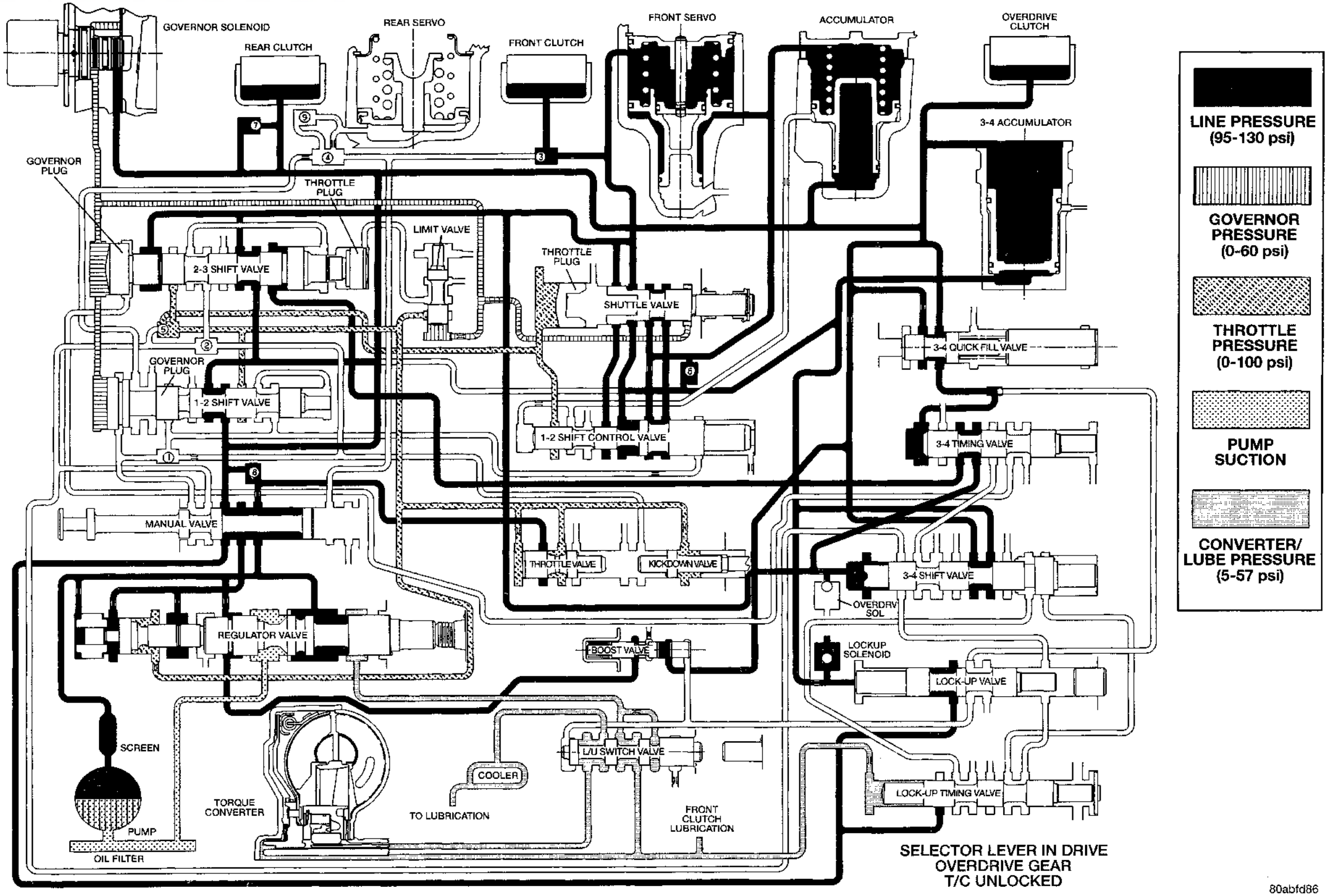

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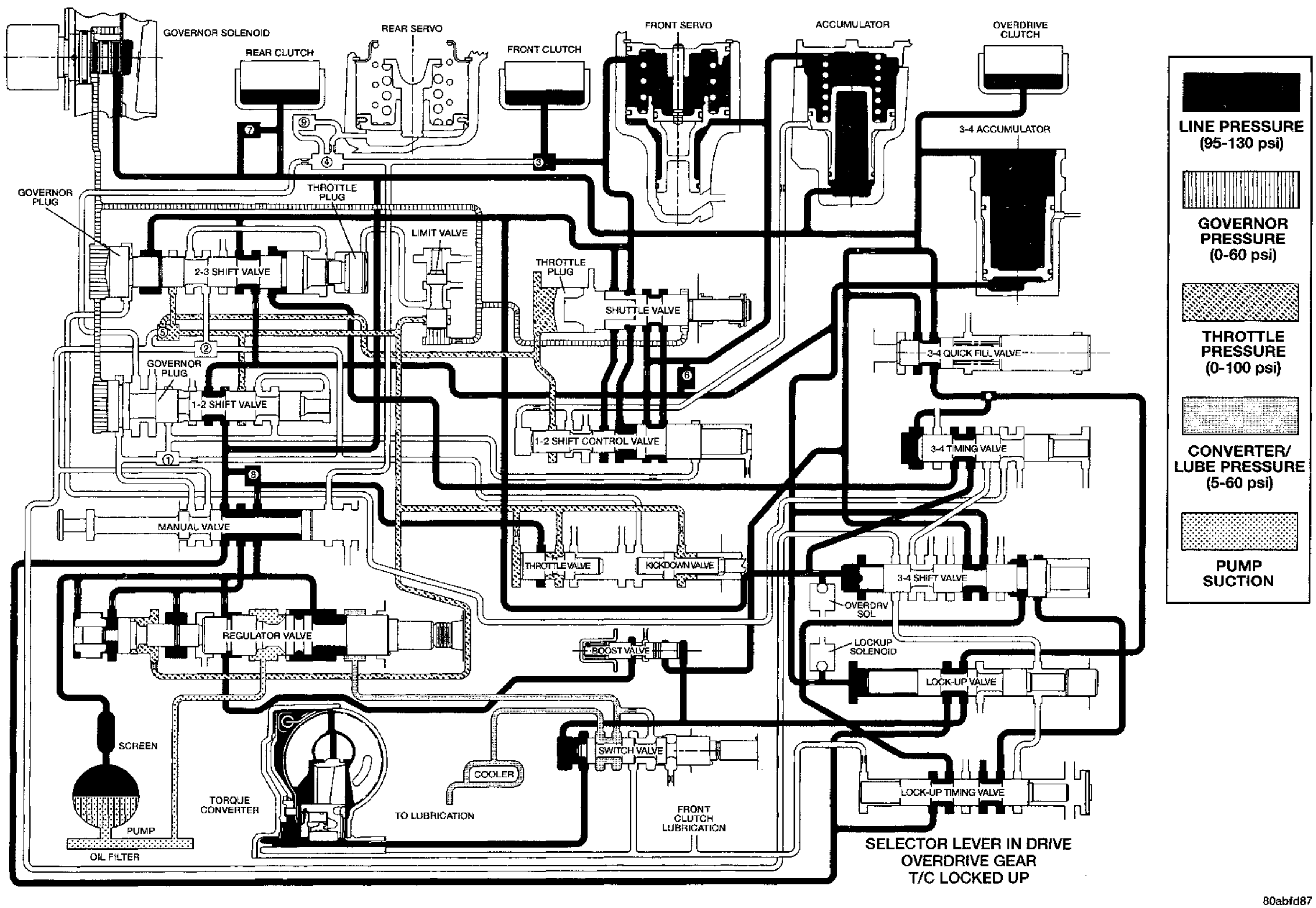

HYDRAULIC FLOW IN DRIVE FOURTH GEAR (CONVERTER CLUTCH APPLIED)

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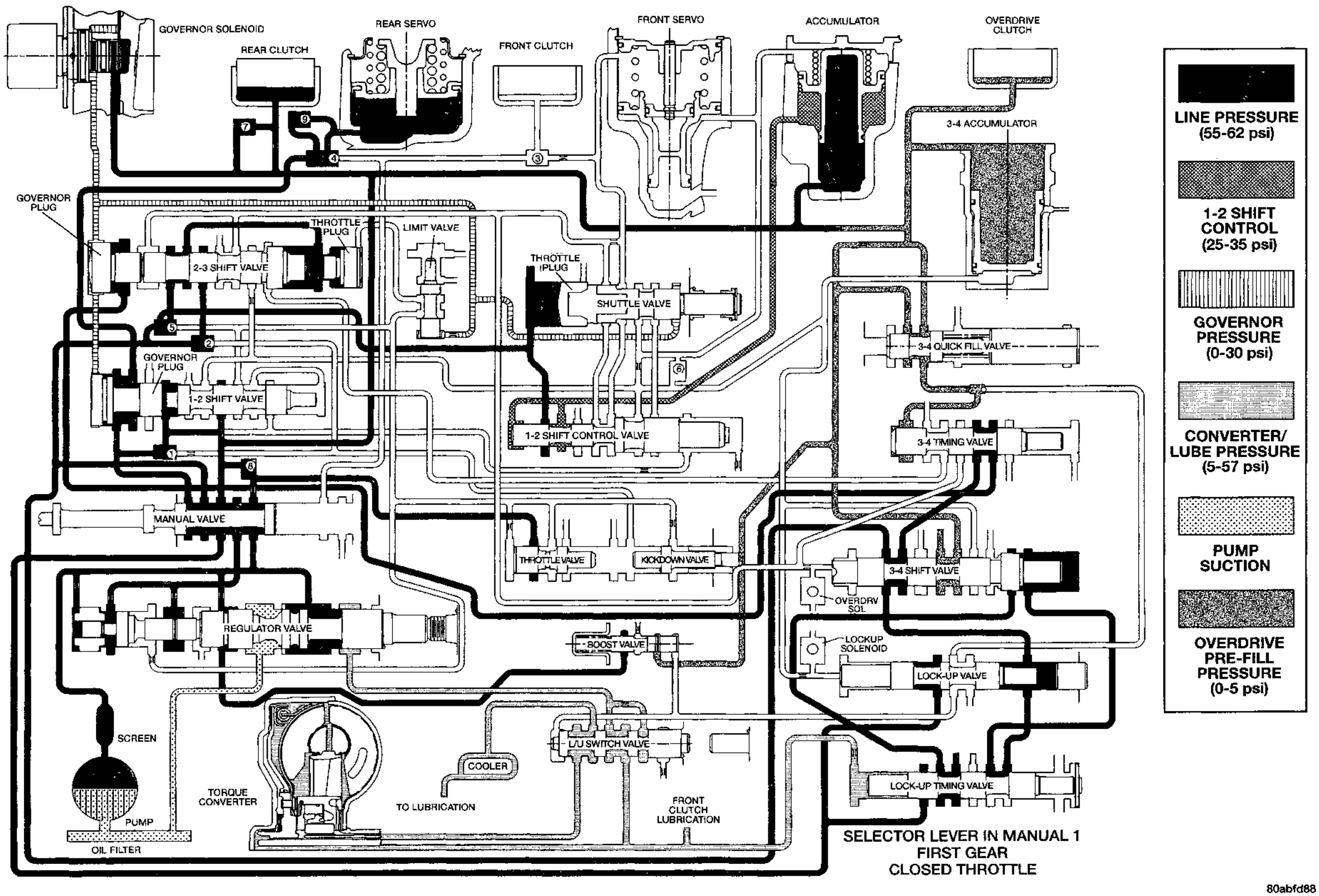
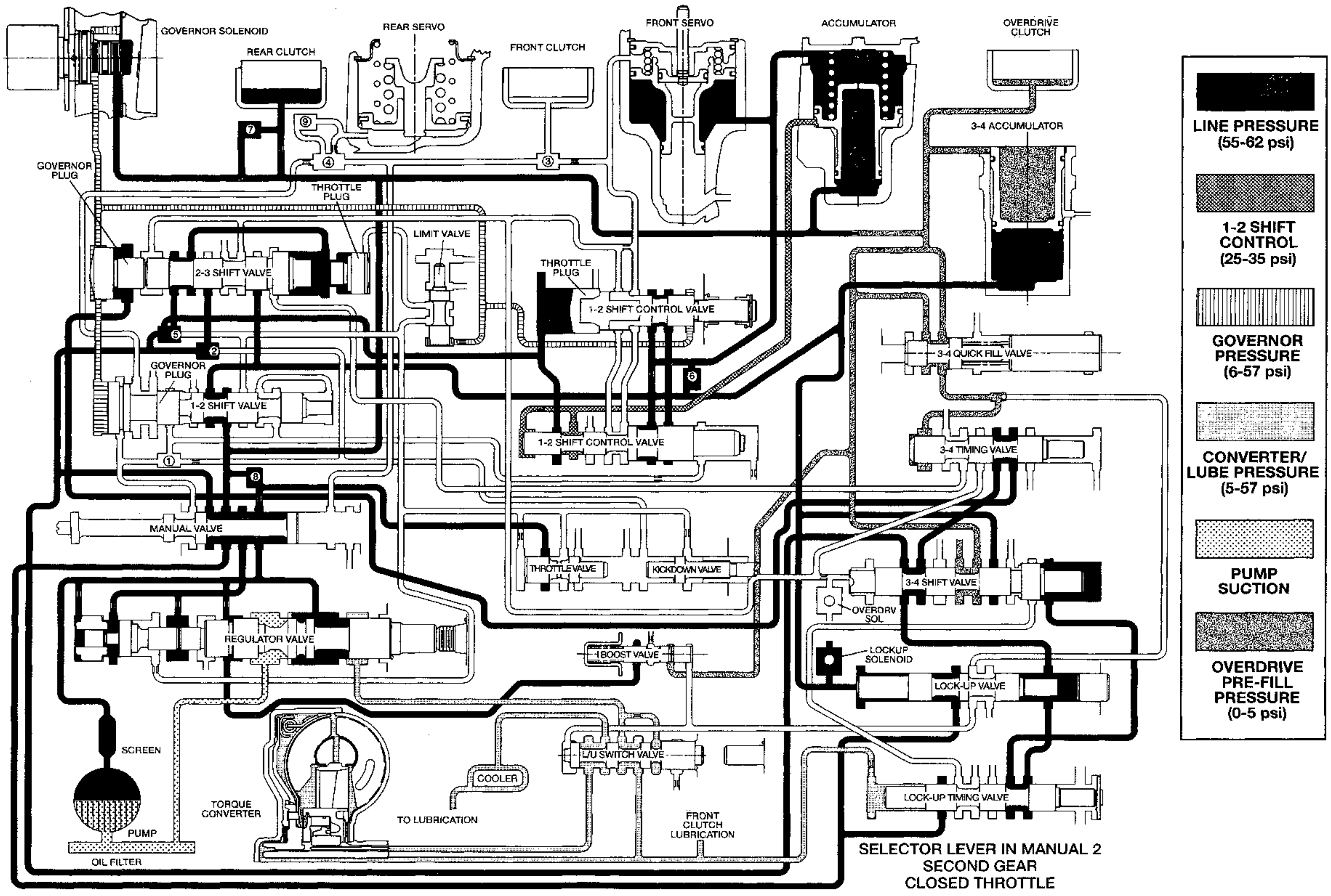


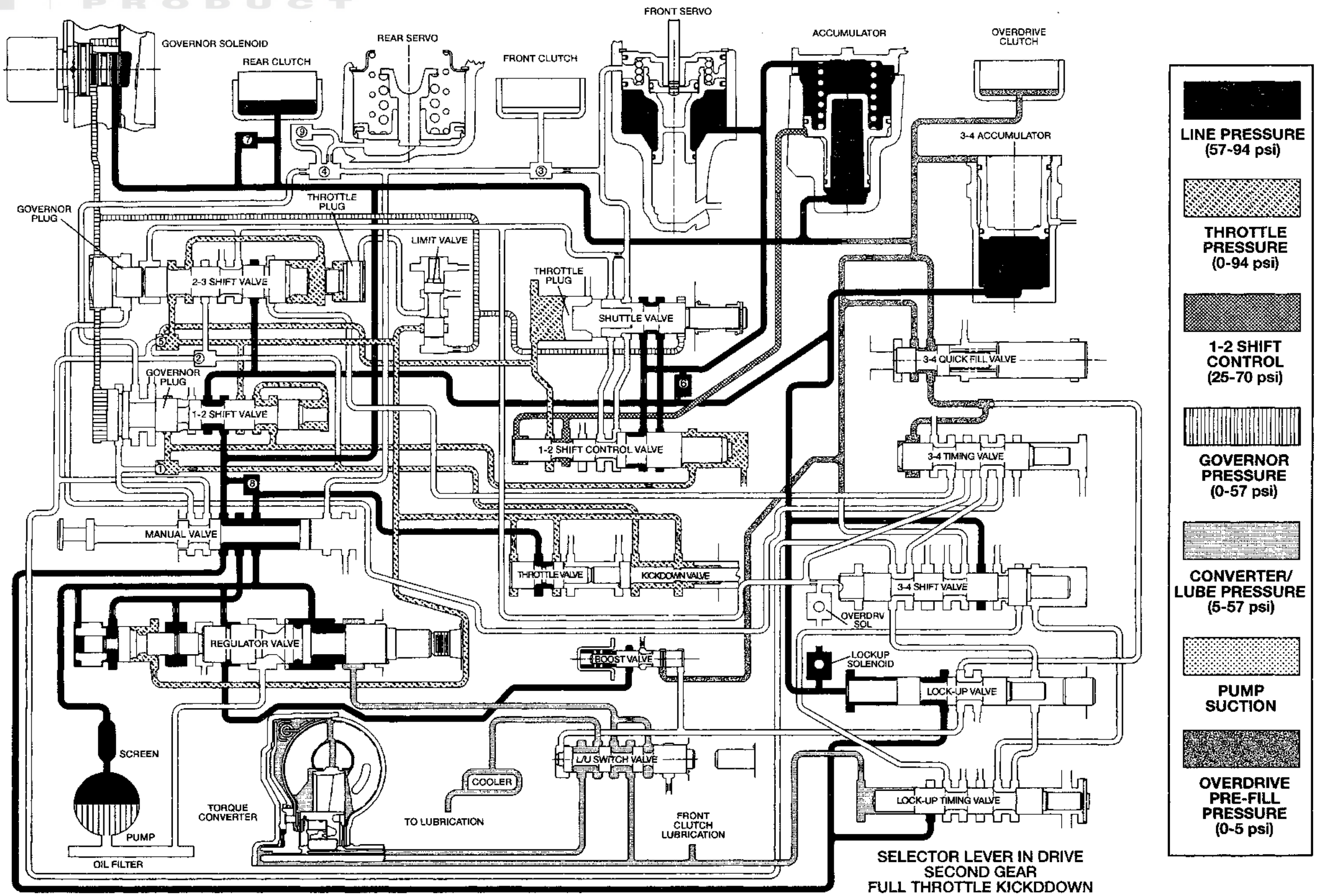
HYDRAULIC FLOW IN MANUAL LOW (1)

Mopar AUTHENTIC RESTORATION PRODUCT



HYDRAULIC FLOW IN MANUAL SECOND (2)

Mopar AUTHENTIC RESTORATION™ PRODUCT



HYDRAULIC FLOW DURING FULL THROTTLE 3–2 DOWNSHIFT (PASSING GEAR)

AUTHENTIC RESTORATION PRODUCT

SPECIFICATIONS

46/47RE TRANSMISSION

GENERAL

Oil pump gear tip clearance	0.089-0.190 mm	0.004-0.008 in.
Planetary end play	0.150-1.22 mm	0.006-0.048 in.
Input shaft end play	0.86-2.13 mm	0.034-0.084 in.
Clutch pack clearance/ Front 3-disc.	1.78-3.28mm	0.070-0.129 in.
Clutch pack clearance/ Rear 4-disc.	0.64-1.14 mm	0.025-0.045 in.
46RE Overdrive clutch disc usage	4 discs	
47RE Overdrive clutch disc usage	5 discs	
46RE Direct clutch disc usage	8 discs	
47RE Direct clutch disc usage	10 discs	
46RE Front clutch disc usage	3 discs	
47RE Front clutch disc usage	4 discs	
Band adjustment from 72 in. lbs. 46RE Front band 46RE Rear band	 Back off 2-7/8 turns Back off 2 turns	
Band adjustment from 72 in. lbs. 47RE Front band 47RE Rear band	 Back off 1-7/8 turns Back off 3 turns	
Recommended fluid	Mopar® ATF Plus 3, type 7176	

TORQUE

DESCRIPTION	TORQUE
Bolt, torque convertor 46RE	31 N·m (23 ft. lbs.)
Bolt, torque convertor 47RE	47 N·m (35 ft. lbs.)
Bolt/nut, crossmember	68 N·m (50 ft. lbs.)
Bolt, driveplate to crankshaft	75 N·m (55 ft. lbs.)
Plug, front band reaction	17 N·m (13 ft. lbs.)
Locknut, front band adj.	34 N·m (25 ft. lbs.)
Switch, park/neutral	34 N·m (25 ft. lbs.)
Bolt, fluid pan	17 N·m (13 ft. lbs.)
Bolt, oil pump	20 N·m (15 ft. lbs.)
Bolt, overrunning clutch cam	17 N·m (13 ft. lbs.)
Bolt, O/D to trans.	34 N·m (25 ft. lbs.)
Bolt, O/D piston retainer	17 N·m (13 ft. lbs.)
Plug, pressure test port	14 N·m (10 ft. lbs.)
Bolt, reaction shaft support	20 N·m (15 ft. lbs.)
Locknut, rear band	41 N·m (30 ft. lbs.)
Bolt. speedometer adapter	11 N·m (8 ft. lbs.)
Screw, fluid filter	4 N·m (35 in. lbs.)
Bolt, valve body to case	12 N·m (100 in. lbs.)

AUTHENTIC RESTORATION PRODUCT

SPECIFICATIONS (Continued)

THRUST WASHER/SPACER/SNAP RING DIMENSIONS

Front clutch thrust washer (reaction shaft support hub)	1.55 mm 2.15 mm	0.061 in. 0.084 in. 0.102 in.
Rear clutch thrust washer (clutch retainer)	1.55 mm	0.061 in.
Output shaft thrust plate (output shaft pilot hub)	1.5-1.6 mm	0.060-0.063 in.
Output shaft thrust washer (rear clutch hub)	1.3-1.4 mm 1.75-1.8 mm 2.1-2.2 mm	0.052-0.054 in. 0.068-0.070 in. 0.083-0.085 in.
Rear clutch pack snap ring	1.5-1.6 mm 1.9-1.95 mm	0.060-0.062 in. 0.074-0.076 in.
Planetary geartrain snap ring (at front of output shaft)	1.4-1.5 mm 1.6-1.7 mm	0.055-0.059 in. 0.062-0.066 in.

Overdrive piston thrust plate	Thrust plate and spacer are select fit components. Refer to size charts and
Intermediate shaft spacer	selection procedures in Overdrive Unit disassembly and assembly section.

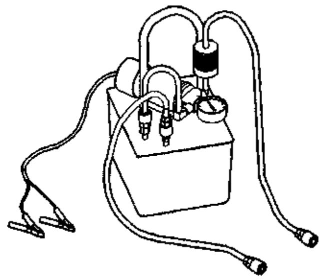
PRESSURE TEST

Overdrive clutch	Fourth gear only	Pressure should be 469-496 kPa (68-72 psi) with closed throttle and increase to 620-896 kPa (90-130 psi) at 1/2 to 3/4 throttle.
Line pressure (at accumulator)	Closed throttle	372-414 kPa (54-60 psi).
Front servo	Third gear only	No more than 21 kPa (3 psi) lower than line pressure.
Rear servo	1 range R range	No more than 21 kPa (3 psi) lower than line pressure. 1103 kPa (160 psi) at idle, builds to 1862 kPa (270 psi) at 1600 rpm.
Governor	D range closed throttle	Pressure should respond smoothly to changes in mph and return to 0-7 kPa (0-1.5 psi) when stopped with transmission in D, 1, 2. Pressure above 7 kPa (1.5 psi) at stand still will prevent transmission from downshifting.

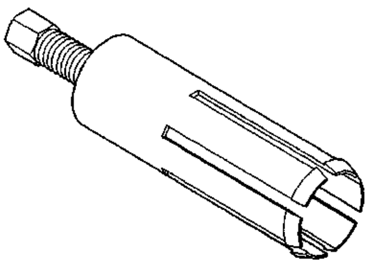
AUTHENTIC RESTORATION PRODUCT

SPECIAL TOOLS

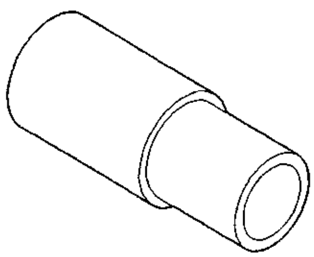
RE TRANSMISSION



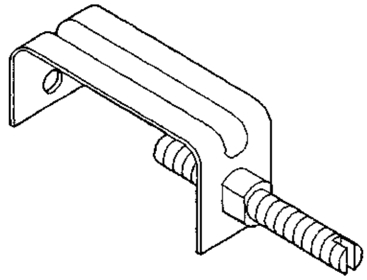
Oil Cooler Flusher—6906



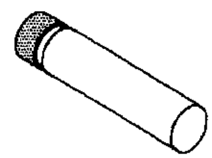
Remover—6957



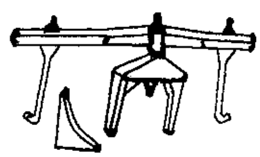
Installer—6951



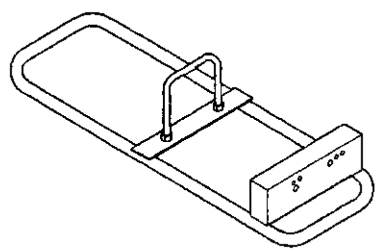
Retainer, Detent Ball and Spring—6583



Gauge Block—6312

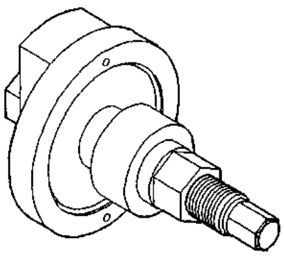


Fixture, Engine Support—C-3487-A

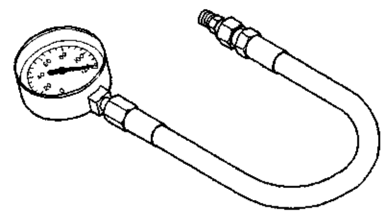


Transmission Repair Stand—C-3750-B

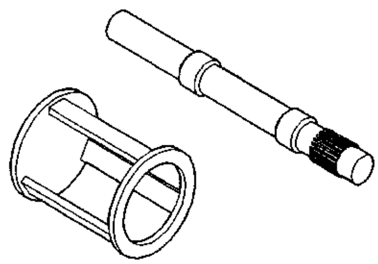
SPECIAL TOOLS (Continued)



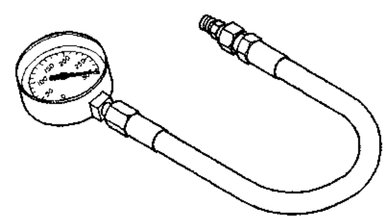
Spring Compressor—C-3863-A



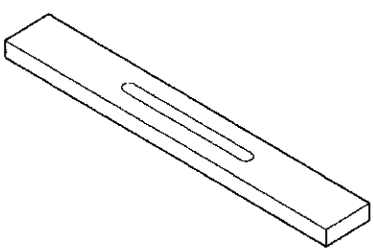
Pressure Gauge—C-3292



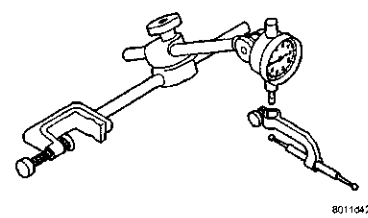
Spring Compressor and Alignment Shaft—6227



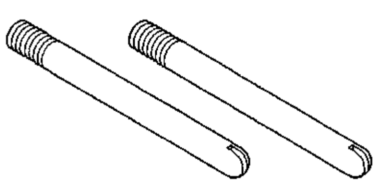
Pressure Gauge—C-3293SP



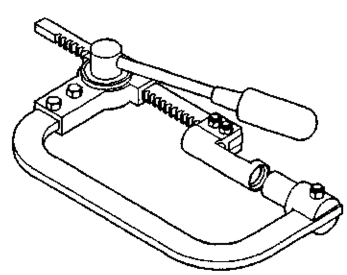
Gauge Bar—6311



Dial Indicator—C-3339



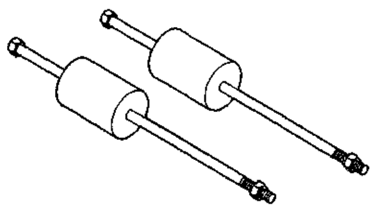
Extension Housing Pilot—C-3288-B



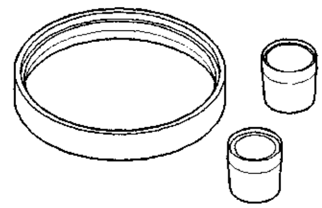
Spring Compressor—C-3422-B

AUTHENTIC RESTORATION PRODUCT

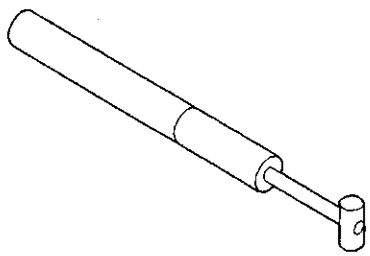
SPECIAL TOOLS (Continued)



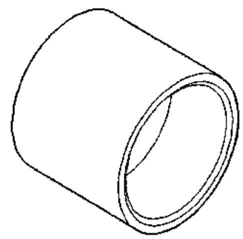
Puller, Slide Hammer—C-3752



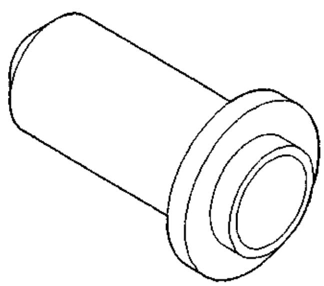
Overdrive Piston Seal Installer—8114



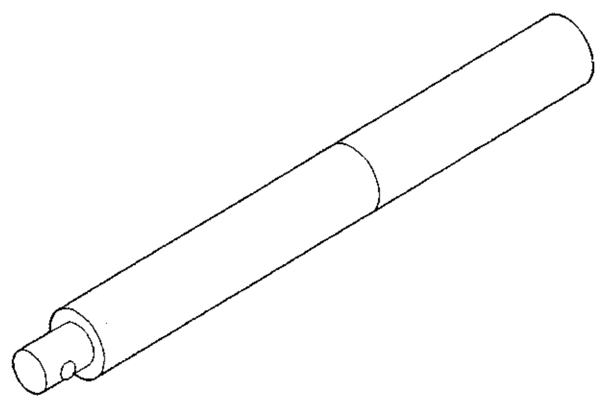
Gauge, Throttle Setting—C-3763



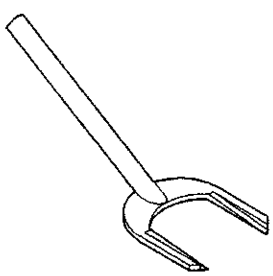
Installer—C-3995-A



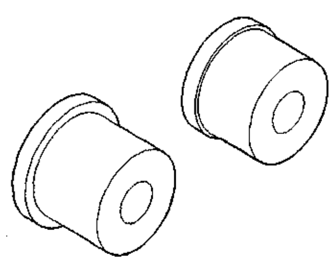
Seal Installer—C-3860–A



Universal Handle—C-4171

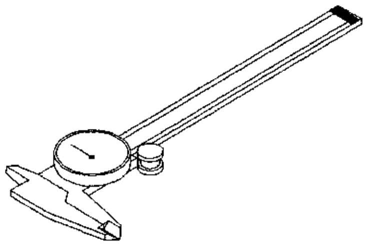


Seal Remover—C-3985-B

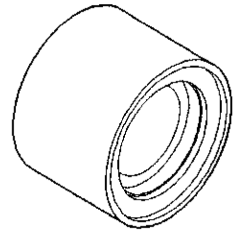


Remover/Installer—C-4470

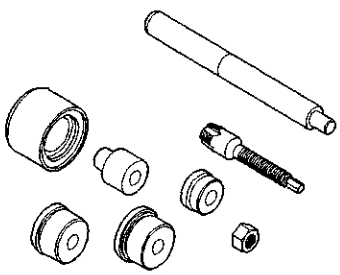
SPECIAL TOOLS (Continued)



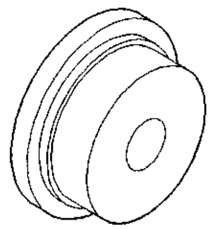
Dial Caliper—C-4962



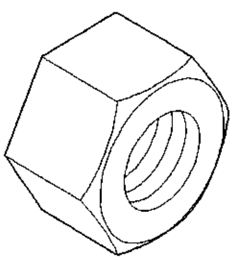
Cup, Bushing Remover—SP-3633, From kit C-3887-J



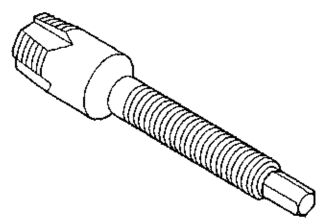
Bushing Remover/Intsaller Set—C-3887-J



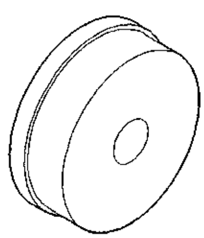
Installer, Oil Pump Bushing—SP-5118, From kit C-3887-J



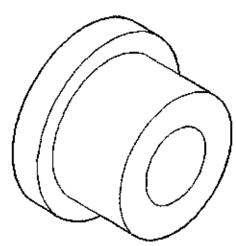
Nut, Bushing Remover—SP-1191, From kit C-3887-J



Remover, Reaction Shaft Bushing—SP-5301, From kit C-3887-J



Remover, Front Clutch Bushing—SP-3629, From kit C-3887-J



Installer, Reaction Shaft Bushing—SP-5302, From kit C-3887-J

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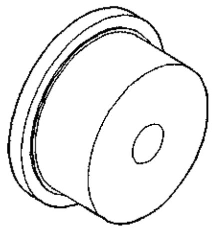
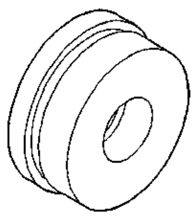
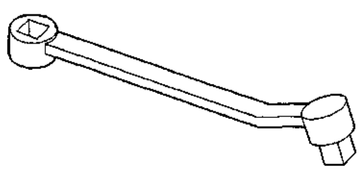
SPECIAL TOOLS (Continued)



Installer, Front Clutch Bushing—SP-5511, From kit C-3887-J



Remover, Bushing—SP-3550, From kit C-3887-J



Adapter, Band Adjuster—C-3705

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NV231HD AND NV241LD TRANSFER CASE

INDEX

GENERAL INFORMATION

NV231HD AND NV241LD INTRODUCTION

The NV231HD and NV241LD are part-time transfer cases with a low-range gear system. They provide three operating ranges plus a Neutral position. The low range position provides a gear reduction ratio of 2.72:1 for increased low speed torque capability. Operating ranges are: 2-high, 4-high and 4-low.

The gear cases, retainer and extension are all of aluminum. Drive sprockets and an interconnecting drive chain are used to transmit engine torque to the front/rear propeller shafts. The mainshaft, input gear and front output shaft are supported by ball and needle bearings.

OPERATING RANGES

Transfer case operating ranges are:

- 4x2 (2-wheel drive)
- 4x4 (4-wheel drive)
- 4 Lo (4-wheel drive low range

The 4x2 range is for use on any road surface at any time.

The 4x4 and 4 Lo ranges are for off road use only. They are not for use on hard surface roads. The only exception being when the road surface is covered by ice and snow.

The low range reduction gear system is operative in 4 Lo range only. This range is for extra pulling power in off road situations. Low range reduction ratio is 2.72:1.

A front axle disconnect system is used to achieve two-wheel drive mode. The axle disconnect vacuum motor is actuated by a vacuum switch on the transfer case. The switch is operated by the transfer case range rod.

SHIFT MECHANISM

The transfer case is operated by an adjustable floor mounted shift linkage. The transfer case shift lever is directly attached to the shift sector. The sector operates the range and mode forks within the transfer case.

A straight line shift pattern is used with a neutral detent. Lever range positions are imprinted in the shift knob.

TRANSFER CASE IDENTIFICATION

An identification tag (Fig. 1) is attached to the rear case of every transfer case. The tag provides the transfer case model number, assembly number, serial number, and low range ratio.

The transfer case serial number also represents the date of buil.

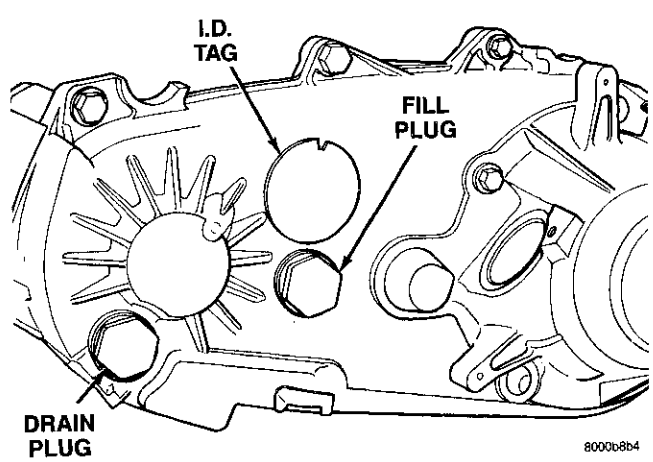

Fig. 1 Transfer Case Identification Tag—Typical

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GENERAL INFORMATION (Continued)

RECOMMENDED LUBRICANT AND FILL LEVEL

Recommended lubricant for the NV231HD and NV241LD transfer case models is Mopar® Dexron II, or ATF Plus. Use this fluid for topping off the level, refilling after service, or normal fluid changes.

Do not use anti-friction additives or similar products in the NV231HD or NV241LD transfer cases. Use recommended lubricant only.

Approximate lubricant refill capacities are 1.5 to 2 liters (3 to 3.6 pints) for the NV231HD and 2.7 L (5.0 pts.) for the NV241LD.

Correct fluid level for the transfer cases is to the bottom edge of the fill plug hole. Be sure that the vehicle is level when checking the fill level.

DIAGNOSIS AND TESTING

SERVICE DIAGNOSIS

Before beginning repair on a suspected transfer case malfunction, check all other driveline components beforehand.

The actual cause of a problem may be related to such items as: front hubs, axles, propeller shafts, wheels and tires, transmission, or clutch instead. If all other driveline components are in good condition and operating properly, refer to the Service Diagnosis chart for further information.

DIAGNOSIS AND TESTING (Continued)

SERVICE DIAGNOSIS

Condition	Possible Cause	Correction
TRANSFER CASE DIFFICULT TO SHIFT OR WILL NOT SHIFT INTO DESIRED RANGE	(1) Vehicle speed too great to permit shifting. (2) If vehicle was operated for extended period in 4H mode on dry paved surface, driveline torque load may cause difficulty. (3) Transfer case external shift linkage binding. (4) Insufficient or incorrect lubricant. (5) Internal components binding, worn or damaged.	(1) Stop vehicle and shift into desired range. Or reduce speed to 3-4 km/h (2-3 mph) before attempting to shift. (2) Stop vehicle, shift transmission to Neutral, shift transfer case to 2H mode and operate vehicle in 2H on dry paved surfaces. (3) Lubricate, repair or replace linkage bushings or tighten loose components as necessary. (4) Drain and refill to edge of fill hole with DEXRON II® or MOPAR-MERCON® Automatic Transmission Fluid. (5) Disassemble unit and replace worn or damaged components as necessary.
TRANSFER CASE NOISY IN ALL DRIVE MODES	(1) Insufficient or incorrect lubricant.	(1) Drain and refill to edge of fill hole with DEXRON II® or MOPAR-MERCON® Automatic Transmission Fluid. Check for leaks and repair if necessary. **Note: If unit is still noisy after drain and refill, disassembly and inspection may be required to locate source of noise.**
NOISY IN – OR JUMPS OUT OF – FOUR WHEEL DRIVE LOW RANGE	(1) Transfer case not completely engaged in 4L position. (2) Shift linkage out of adjustment. (3) Shift linkage loose or binding. (4) Range fork damaged, inserts worn, or fork is binding on shift rail. (5) Low range gear worn or damaged.	(1) Stop vehicle, shift transfer case to Neutral, then shift back into 4L position. (2) Adjust linkage. (3) Tighten, lubricate or repair linkage as necessary. (4) Disassemble unit and repair as necessary. (5) Disassemble and repair as necessary.
LUBRICANT LEAKING FROM OUTPUT SHAFT SEALS OR FROM VENT	(1) Transfer case overfilled. (2) Vent closed or restricted. (3) Output shaft seals damaged or installed incorrectly.	(1) Drain to correct level. (2) Clear or replace vent if necessary. (3) Replace seals. Be sure seal lip faces interior of case when installed. Also be sure yoke seal surfaces are not scored or nicked. Remove scores and nicks with fine sandpaper or replace yoke(s) if necessary.
ABNORMAL TIRE WEAR	(1) Extended operation on dry hard surface (paved) roads in 4H range.	(1) Operate in 2H on hard surface (paved) roads.

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SERVICE PROCEDURES

FLUID DRAIN/REFILL

(1) Raise vehicle.
(2) Position drain pan under transfer case.
(3) Remove drain and fill plugs and drain lubricant completely.
(4) Install drain plug. Tighten plug to 41-54 N·m (30-40 ft. lbs.).
(5) Remove drain pan.
(6) Fill transfer case to bottom edge of fill plug opening with Mopar® Dexron II.
(7) Install and tighten fill plug to 41-54 N·m (30-40 ft. lbs.).
(8) Lower vehicle.

REMOVAL AND INSTALLATION

TRANSFER CASE

REMOVAL

(1) Raise and support vehicle.
(2) Remove skid plate, if equipped.
(3) Position drain oil container under transfer case.
(4) Remove transfer case drain plug and drain lubricant into container.
(5) Disconnect vent hose and vacuum harness at transfer case switch.
(6) Disconnect shift rod from grommet in transfer case shift lever, or from floor shift arm whichever provides easy access. Use channel lock style pliers to press rod out of lever grommet.
(7) Support transmission with jack stand.
(8) Remove rear crossmember.
(9) Mark front and rear propeller shafts for assembly reference.
(10) Remove front and rear propeller shafts.
(11) Support transfer case with suitable jack. Secure transfer case to jack with safety chains.
(12) Remove nuts attaching transfer case to transmission.
(13) Move transfer case assembly rearward until free of transmission output shaft.
(14) Lower jack and move transfer case from under vehicle.

INSTALLATION

(1) Align and seat transfer case on transmission. Be sure transfer case input gear splines are aligned with transmission output shaft. Align splines by rotating transfer case rear output shaft yoke if necessary. Do not install any transfer case attaching nuts until the transfer case is completely seated against the transmission.
(2) Install and tighten transfer case attaching nuts. If case has 5/16 in. studs, tighten nuts to 30-41 N·m (22-30 ft.lbs.). If case has 3/8 studs, tighten nuts to 41-47 N·m (30-35 ft. lbs.).
(3) Install rear crossmember.
(4) Remove jack stand from under transmission.
(5) Align and connect propeller shafts.
(6) Connect vacuum harness and vent hose.
(7) Connect shift rod to transfer case lever or floor shift arm. Use channel lock style pliers to press rod back into lever grommet.
(8) Adjust shift linkage, if necessary.
(9) Fill transfer case with recommended transmission fluid and install fill plug.
(10) Install skid plate, if equipped.
(11) Lower vehicle

SHIFT LEVER

REMOVAL

(1) Shift transfer case into 4L.
(2) Remove transfer case shifter knob cap.
(3) Remove nut holding shifter knob to shift lever.
(4) Remove shifter knob.
(5) Raise and support vehicle.
(6) Loosen adjusting trunnion lock bolt and slide shift rod out of trunnion. If rod lacks enough travel to come out of trunnion, push trunnion out of shift lever.
(7) Remove bolts holding shift lever to the underside of the body.
(8) Separate shift lever from vehicle.

INSTALLATION

(1) Position shift lever on vehicle. Use care when passing the shift lever through the shifter boot to prevent damage to the shifter boot.
(2) Install bolts to hold shift lever to the underside of the body.
(3) Install trunnion to shift lever, if necessary.
(4) Install shift rod to trunnion, if necessary.
(5) Lower vehicle.
(6) Install shift knob on shift lever.
(7) Install nut to hold shifter knob to shift lever.
(8) Install shifter knob cap.
(9) Adjust the transfer case shift linkage.
(10) Verify transfer case operation.

FRONT OUTPUT SHAFT SEAL—NV231HD

REMOVAL

(1) Raise vehicle.
(2) Remove front propeller shaft. Refer to Group 3, Differential and Driveline, for proper procedure.
(3) Remove companion flange (Fig. 2).

REMOVAL AND INSTALLATION (Continued)

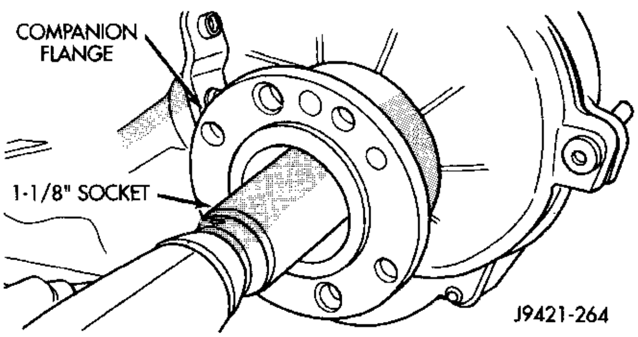

Fig. 2 Removing Companion Flange Nut

(4) Remove companion flange from output shaft. Use a suitable puller if flange can not be removed by hand.

(5) Remove companion flange rubber seal from front output shaft (Fig. 3).

(6) Remove seal from front case with pry tool (Fig. 4).

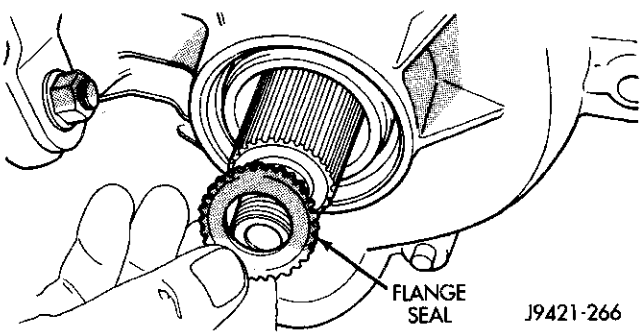

Fig. 3 Companion Flange Seal Removal

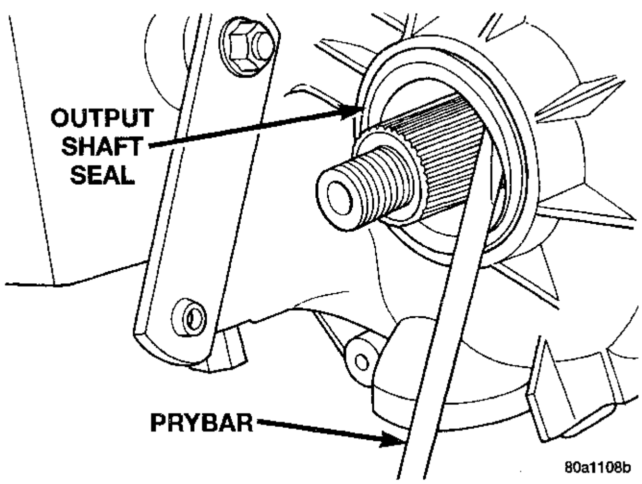

Fig. 4 Remove Front Output Shaft Seal

INSTALLATION

(1) Install new front output seal in front case with Installer Tool 8143 as follows:

(a) Place new seal on tool. Garter spring on seal goes toward interior of case.

(b) Start seal in bore with light taps from hammer (Fig. 5). Once seal is started, continue tapping seal into bore until installer tool seats against case.

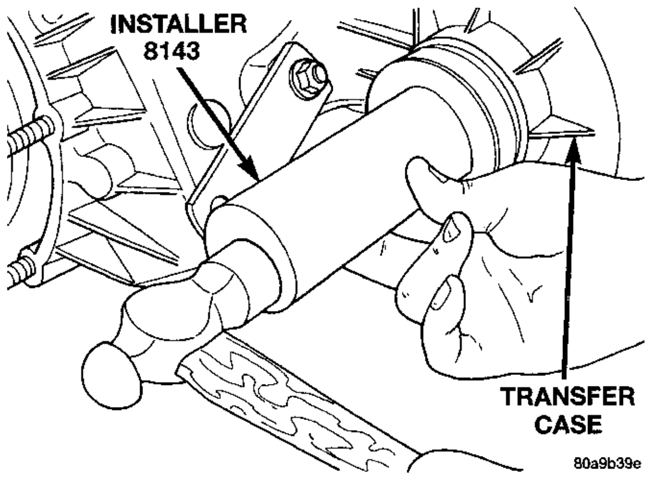

Fig. 5 Front Output Seal Installation

(2) Install companion flange seal on front shaft (Fig. 6).

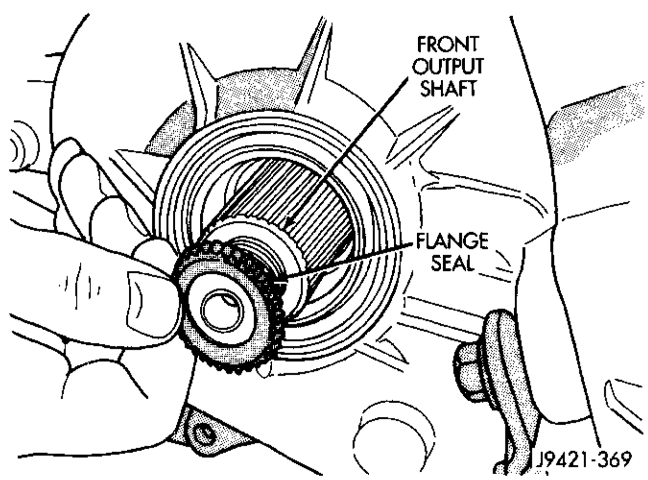

Fig. 6 Installing Flange Seal On Front Shaft

(3) Install companion flange on front shaft (Fig. 7). Then install and tighten flange nut to 176-271 N·m (130-200 ft. lbs.) torque.

(4) Install propeller shaft. Refer to Group 3, Differential and Driveline, for proper procedures.

FRONT OUTPUT SHAFT SEAL—NV241LD

REMOVAL

(1) Shift transfer case into neutral.

(2) Remove companion flange nut (Fig. 8). Discard nut after removal. It is not reusable.

(3) Remove companion flange from output shaft. Use a suitable puller if flange can not be removed by hand.

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REMOVAL AND INSTALLATION (Continued)

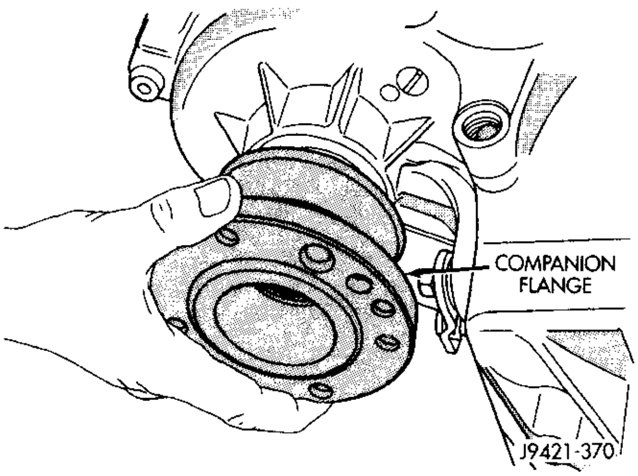

Fig. 7 Installing Companion Flange On Front Shaft

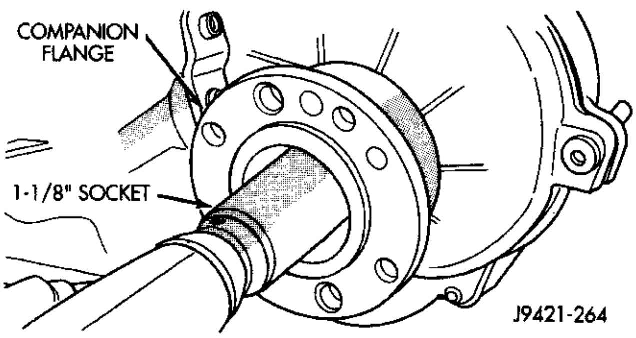

Fig. 8 Removing Companion Flange Nut

(4) Remove companion flange rubber seal from front output shaft (Fig. 9).

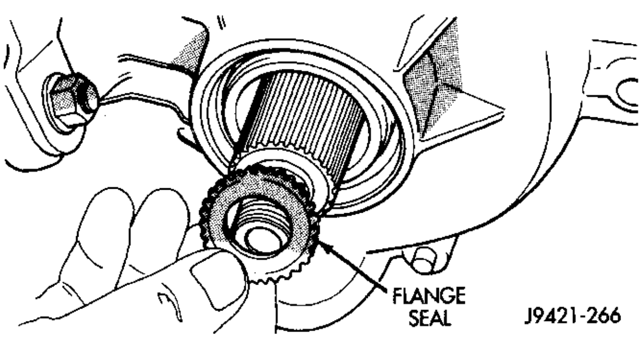

Fig. 9 Companion Flange Seal Removal

(5) Remove front output shaft seal with suitable pry tool, or a slide hammer mounted screw.

INSTALLATION

(1) Install new front output seal in front case with Installer Tool 6888 and Tool Handle C-4171 (Fig. 10) as follows:

(a) Place new seal on tool. Garter spring on seal goes toward interior of case.

(b) Start seal in bore. Once seal is started, continue tapping seal into bore until installer tool bottoms against case.

(c) Remove installer and verify that seal is recessed the proper amount. Seal should be 2.03 to 2.5 mm (0.080 to 0.100 in.) below top edge of seal bore in front case (Fig. 11). This is correct final seal position.

CAUTION: Be sure the front output seal is seated below the top edge of the case bore as shown. The seal could loosen, or become cocked if not seated to recommended depth.

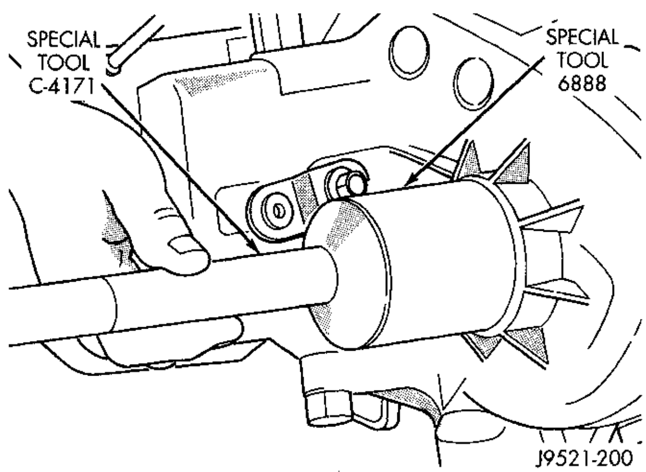

Fig. 10 Front Output Seal Installation

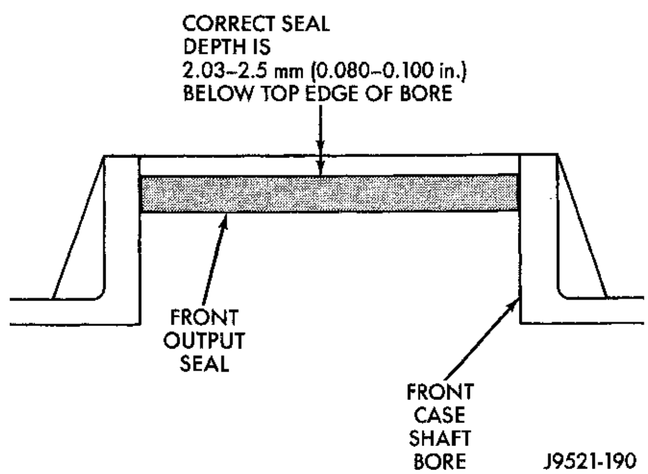

Fig. 11 Checking Front Output Seal Installation Depth

REMOVAL AND INSTALLATION (Continued)

(2) Install companion flange seal on front shaft (Fig. 12).

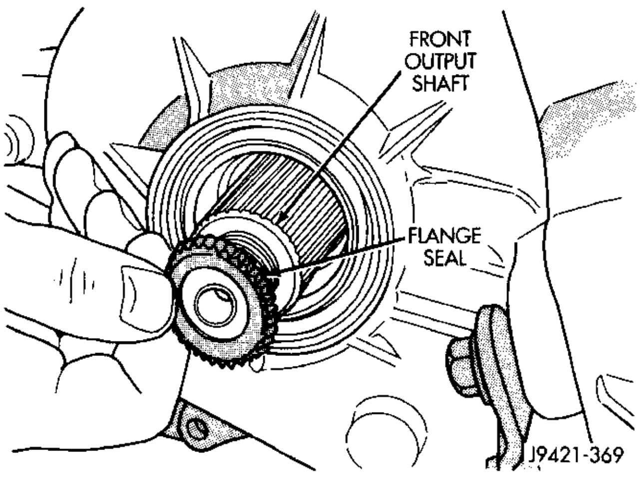

Fig. 12 Installing Flange Seal On Front Shaft

(3) Install companion flange on front shaft (Fig. 13). Then install and tighten flange nut to 176-271 N·m (130-200 ft. lbs.) torque.

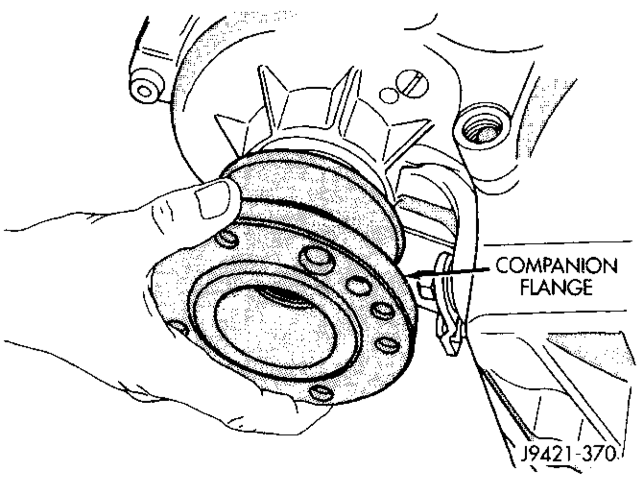

Fig. 13 Installing Companion Flange On Front Shaft

REAR RETAINER BUSHING AND SEAL

REMOVAL

(1) Raise and support vehicle.

(2) Remove rear propeller shaft. Refer to Group 3, Differential and Driveline, for proper procedure.

(3) Using a suitable pry tool or slide-hammer mounted screw, remove the rear retainer seal.

(4) Using Remover 8158, remove bushing from rear retainer.

INSTALLATION

(1) Clean fluid residue from sealing surface and inspect for defects.

(2) Position replacement bushing in rear retainer with fluid port in bushing aligned with slot in housing.

(3) Using Installer 8157, drive bushing into housing until installer seats against case.

(4) Using Installer D-163, install seal in rear retainer (Fig. 14).

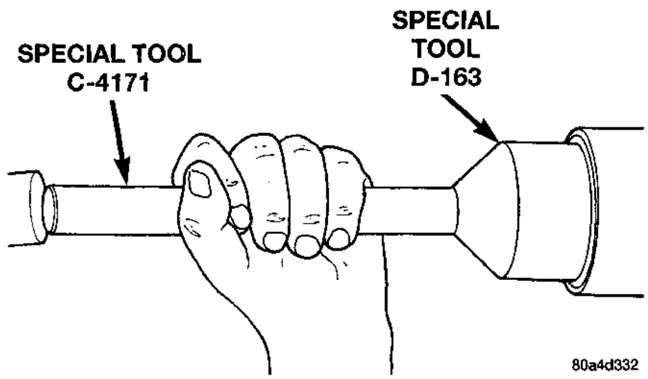

Fig. 14 Install Rear Retainer Seal

(5) Install propeller shaft.

(6) Verify proper fluid level.

(7) Lower vehicle.

DISASSEMBLY AND ASSEMBLY

TRANSFER CASE

DISASSEMBLY

Position transfer case in a shallow drain pan. Remove drain plug and drain any remaining lubricant remaining in case.

REAR EXTENSION, RETAINER AND REAR CASE

(1) Remove rear extension bolts (Fig. 15).

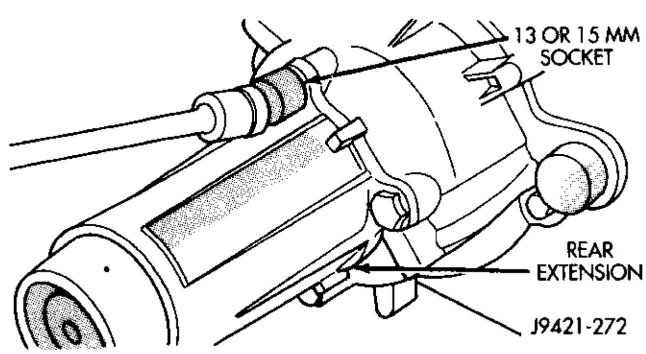

Fig. 15 Rear Extension Bolt Removal

(2) Remove rear extension (Fig. 16). Tap extension once or twice with a plastic mallet to break sealer bead and loosen it. Seal at rear of extension is serviceable. If seal is damaged, it can be removed with small chisel and punch.

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DISASSEMBLY AND ASSEMBLY (Continued)

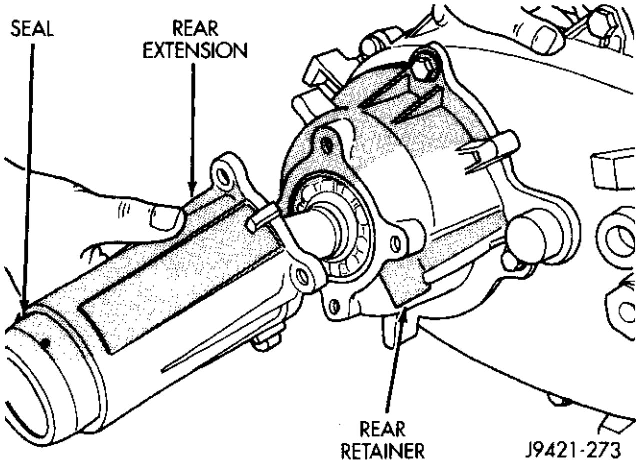

Fig. 16 Rear Extension Removal

(3) Remove output bearing retaining ring with heavy duty snap ring pliers (Fig. 17).

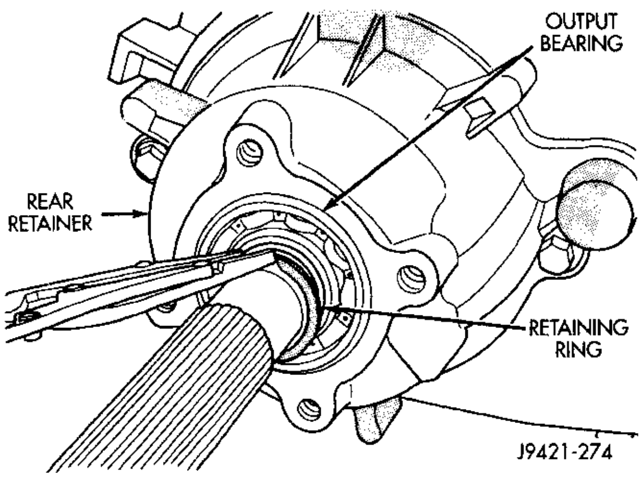

Fig. 17 Removing Output Bearing Retaining Ring

(4) Remove rear retainer bolts (Fig. 18).

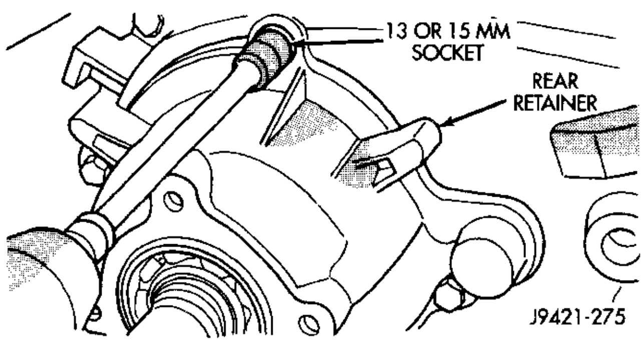

Fig. 18 Removing Rear Extension Bolts

(5) Loosen rear retainer with pry bar placed under flange (Fig. 19).

(6) Remove rear retainer and output bearing as assembly (Fig. 20).

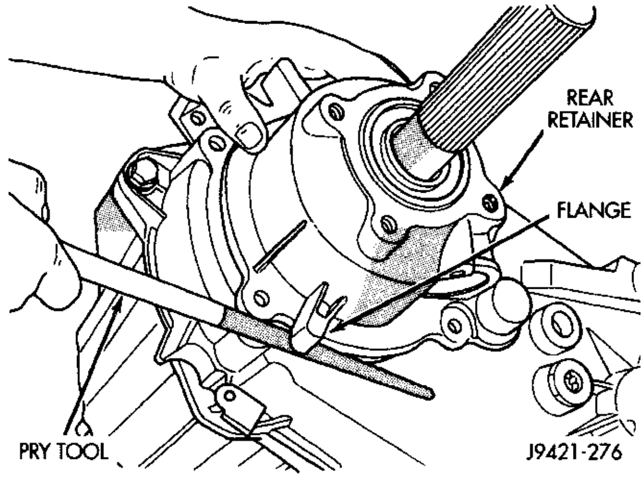

Fig. 19 Loosening Rear Retainer

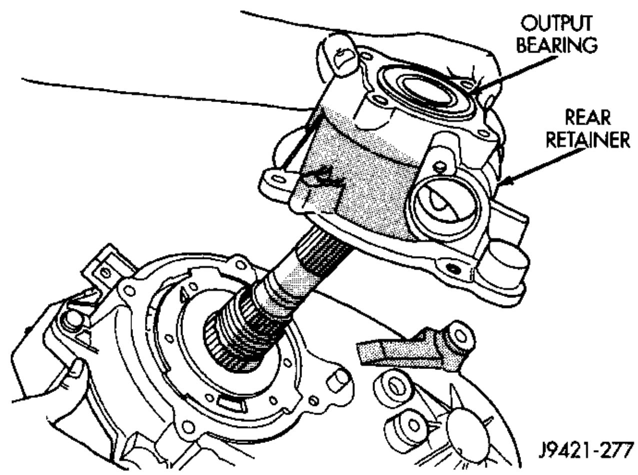

Fig. 20 Rear Retainer Removal

COMPANION FLANGE AND SHIFT LEVER REMOVAL

(1) Shift transfer case into neutral.

(2) Remove companion flange nut (Fig. 21). Discard nut after removal. It is not reusable.

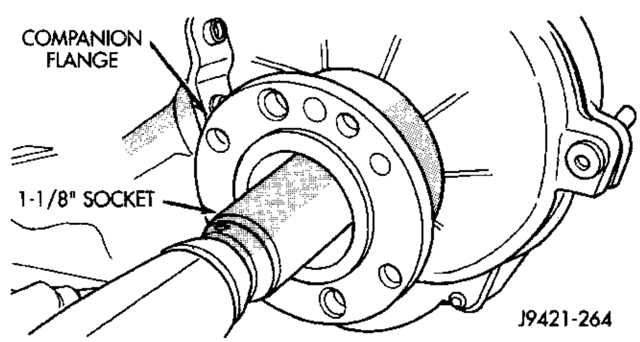

Fig. 21 Removing Companion Flange Nut

(3) Remove companion flange from front output shaft. Use a suitable puller if flange can not be removed by hand.

DISASSEMBLY AND ASSEMBLY (Continued)

(4) Remove companion flange rubber seal from front output shaft (Fig. 22).

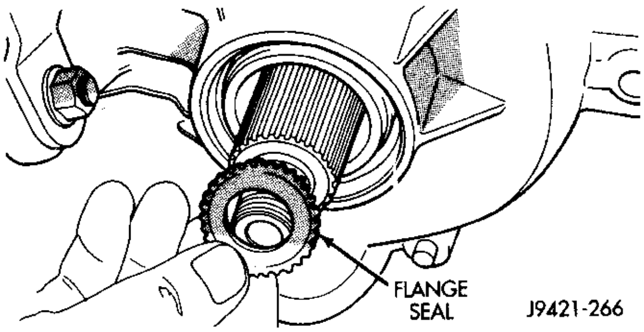

Fig. 22 Companion Flange Seal Removal

(5) Remove nut and washer that retain shift lever to sector shaft. Then remove shift lever from shaft (Fig. 23).

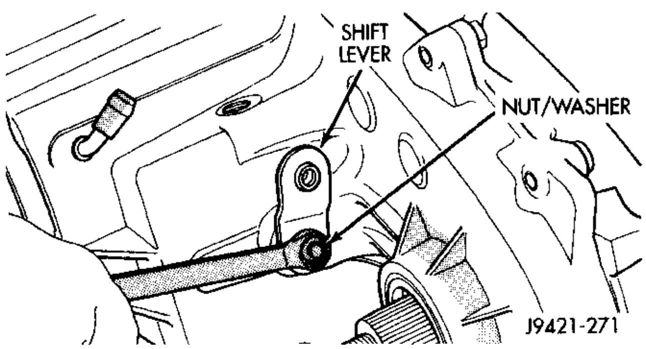

Fig. 23 Shift Lever Removal

FRONT OUTPUT SHAFT AND DRIVE CHAIN REMOVAL

(1) Remove output bearing retaining ring with heavy duty snap ring pliers.
(2) Remove output shaft bearing.
(3) Note position of bolts that attach rear case to front case (Fig. 24). Some bolts/studs at ends of case require flat washers. Mark position of these bolts with paint or scriber.
(4) Remove rear case-to-front case bolts.
(5) Loosen rear case with pry tool to break sealer bead. Insert tool in slot at each end of case (Fig. 25).
(6) Unseat rear case from alignment dowels (Fig. 26).
(7) Remove rear case and oil pump assembly from front case.

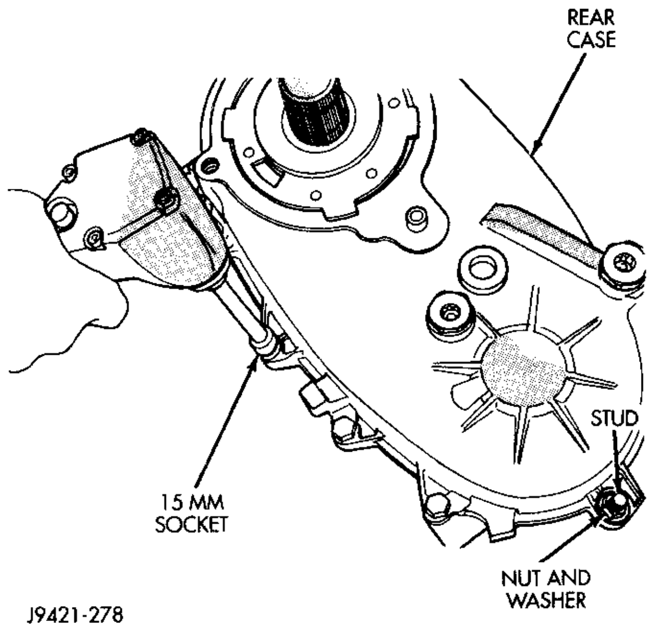

Fig. 24 Removing Case Attaching Bolts

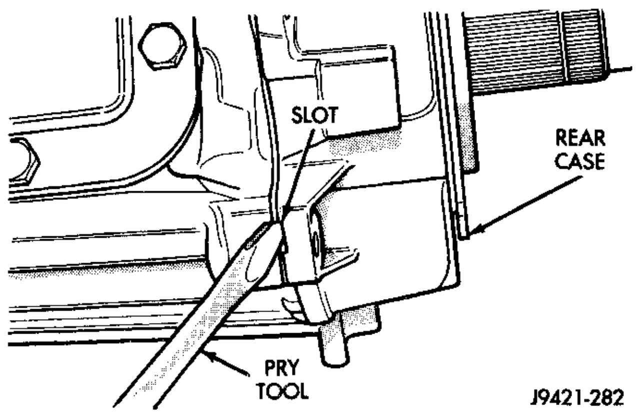

Fig. 25 Loosening Rear Case (Breaking Sealer Bead)

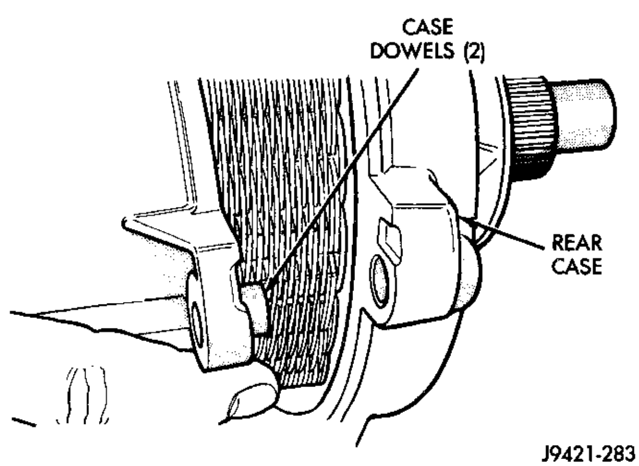

Fig. 26 Removing Rear Case From Alignment Dowels

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DISASSEMBLY AND ASSEMBLY (Continued)

(8) Remove shift rail cup and spring (Fig. 27).

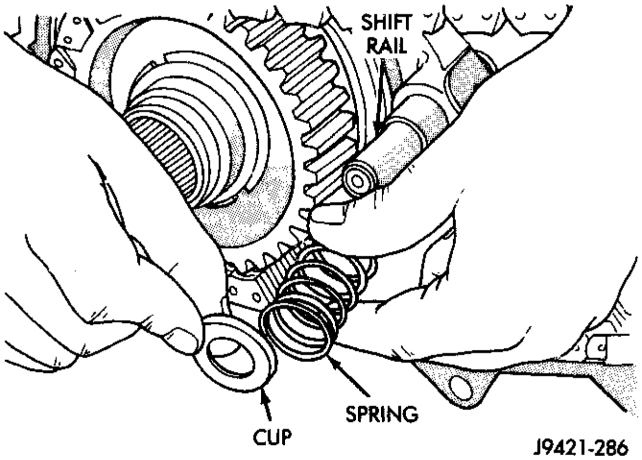

Fig. 27 Shift Rail Cup And Spring Removal

(9) Remove front sprocket retaining ring (Fig. 28).

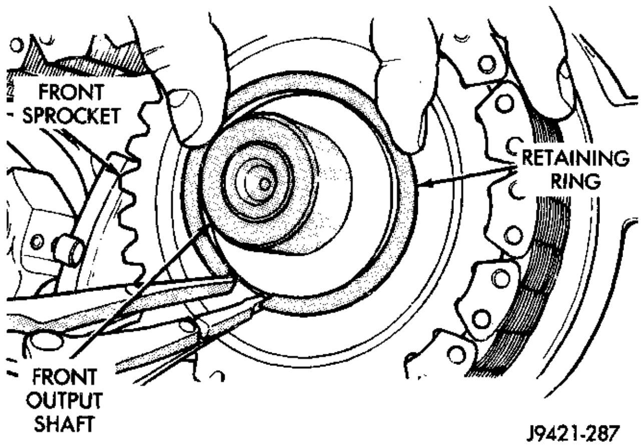

Fig. 28 Removing Front Sprocket Retaining Ring

(10) Pull mainshaft, front sprocket and chain outward about 25.4 mm (1–inch) simultaneously (Fig. 29).

(11) Remove chain from mainshaft drive sprocket and remove front sprocket and chain as assembly.

SHIFT FORK AND MAINSHAFT REMOVAL

(1) Remove vacuum/indicator switch (Fig. 30).

(2) Loosen poppet plunger screw (Fig. 31).

(3) Remove poppet plunger screw and spring (Fig. 32). Note that screw has O-ring seal. Remove and discard seal this seal.

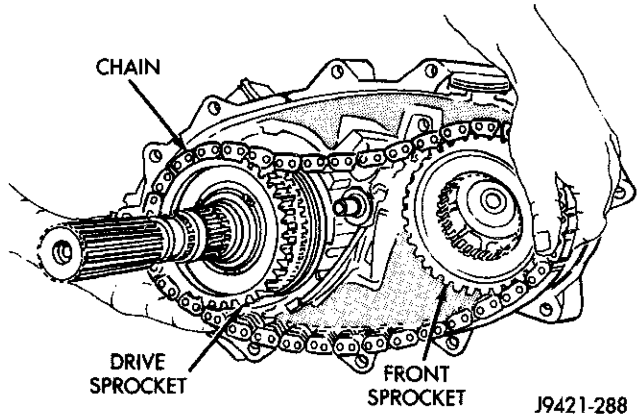

Fig. 29 Removing Drive Chain And Front Sprocket

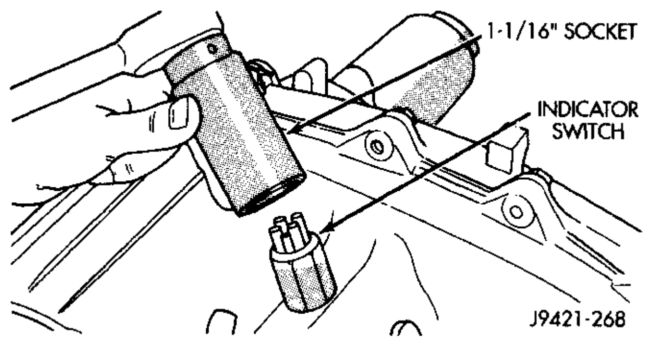

Fig. 30 Vacuum/Indicator Switch Removal

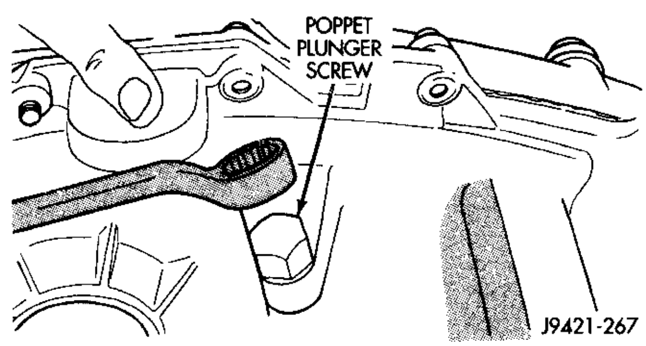

Fig. 31 Loosening Poppet Plunger Screw

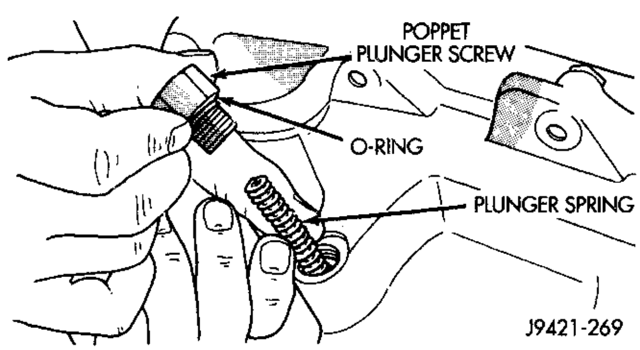

Fig. 32 Poppet Plunger Screw And Spring Removal

DISASSEMBLY AND ASSEMBLY (Continued)

(4) Remove poppet plunger with magnet (Fig. 33).

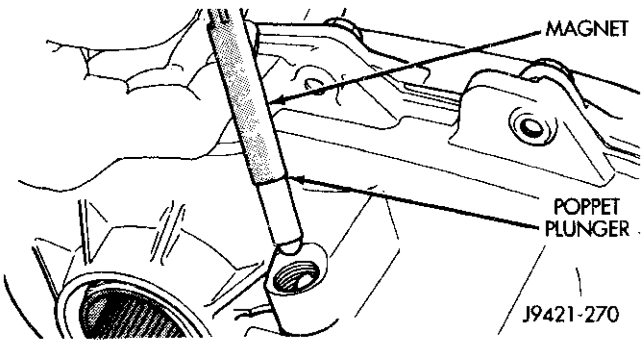

Fig. 33 Poppet Plunger Removal

(5) Remove front output shaft from bearing in case (Fig. 34).

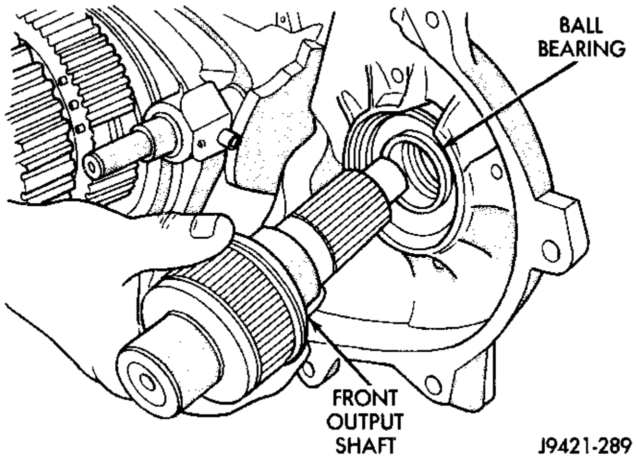

Fig. 34 Front Output Shaft Removal

(6) Pull mainshaft assembly out of input gear, mode sleeve and case.

(7) Remove mode fork, mode sleeve, and shift rail as assembly (Fig. 35). Note which way sleeve fits in fork (short side of sleeve goes to front).

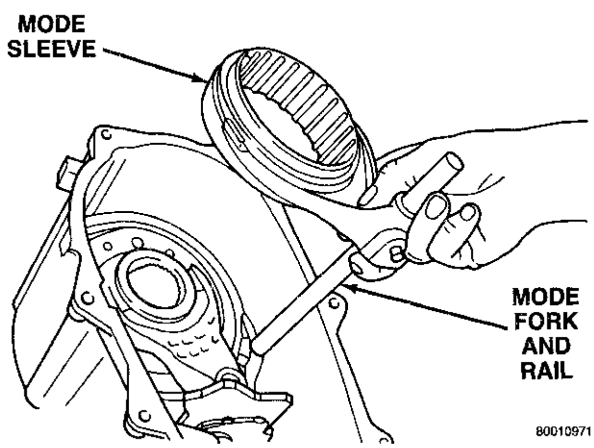

Fig. 35 Mode Fork And Sleeve Removal

(8) Remove range fork retaining ring.

Remove range fork and hub as an assembly (Fig. 36). Note fork position for installation reference.

(9) Remove shift sector (Fig. 37).

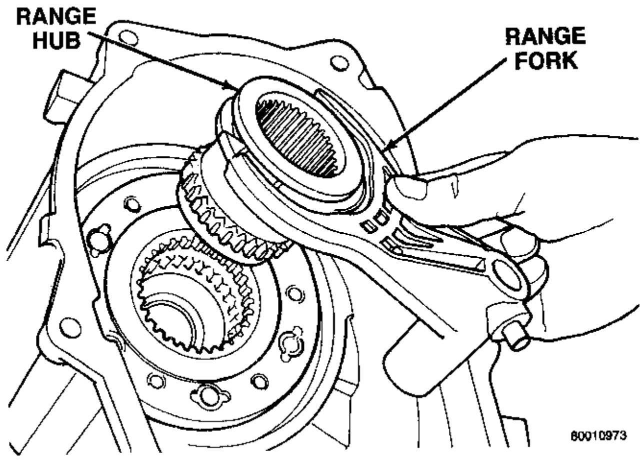

Fig. 36 Range Fork And Hub Removal

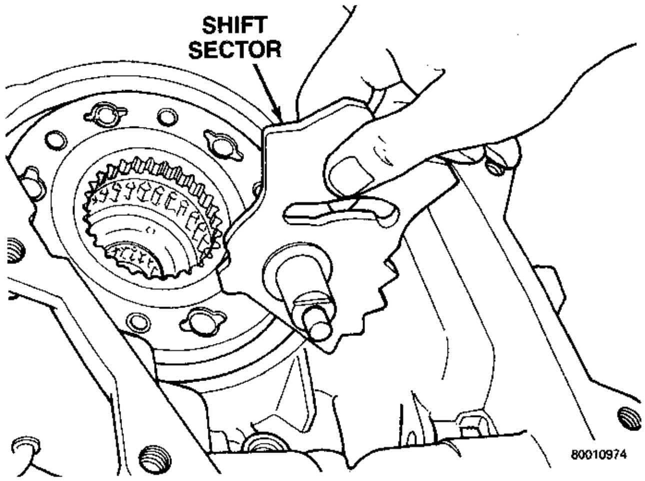

Fig. 37 Shift Sector Removal

DISASSEMBLY AND ASSEMBLY (Continued)

(10) Remove shift sector shaft nylon retainer and O–ring from shaft bore in front case (Fig. 38).

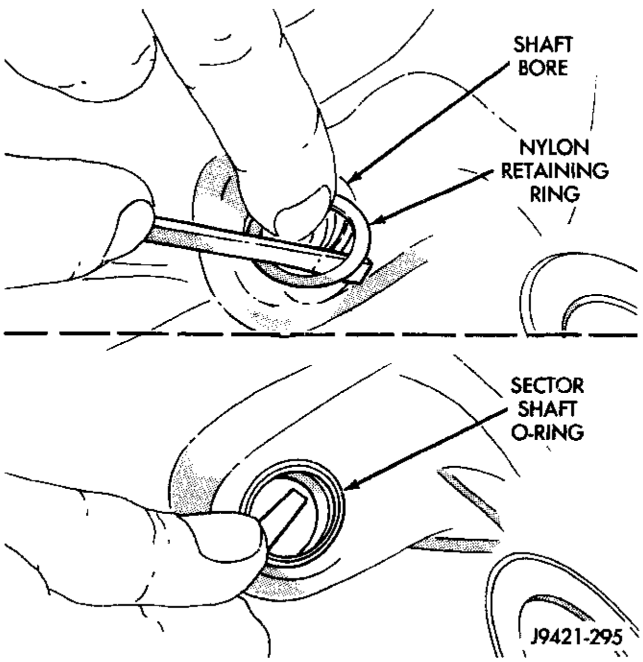

Fig. 38 Removing Sector Shaft O–Ring And Retainer

MAINSHAFT DISASSEMBLY

(1) Remove mode hub retaining ring with heavy duty snap-ring pliers (Fig. 39).

(2) Slide mode hub off mainshaft (Fig. 40).

(3) Slide drive sprocket off mainshaft (Fig. 41).

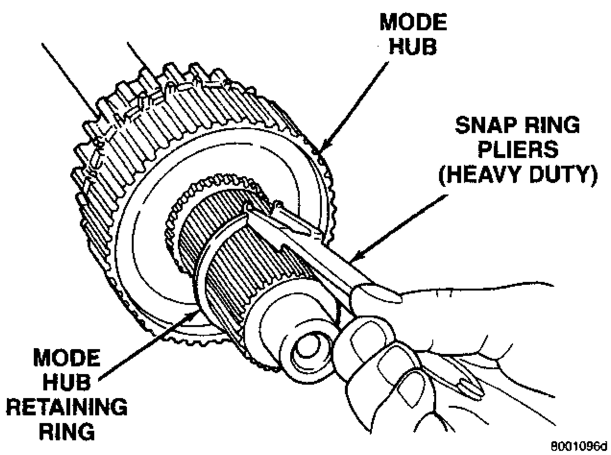

Fig. 39 Mode Hub Retaining Ring Removal

INPUT AND PLANETARY GEAR REMOVAL

(1) Remove front bearing retainer attaching bolts (Fig. 42).

(2) Remove front bearing retainer. Pry retainer loose with pry tool positioned in slots at each end of retainer (Fig. 43).

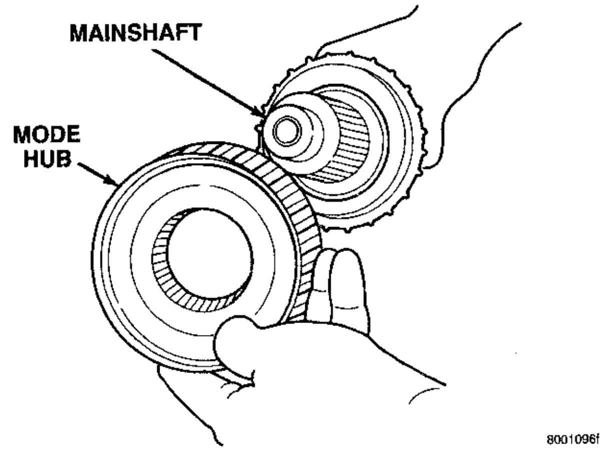

Fig. 40 Mode Hub Removal

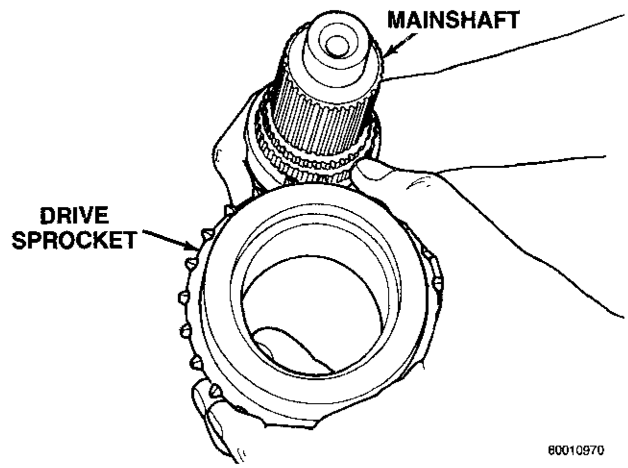

Fig. 41 Drive Sprocket Removal

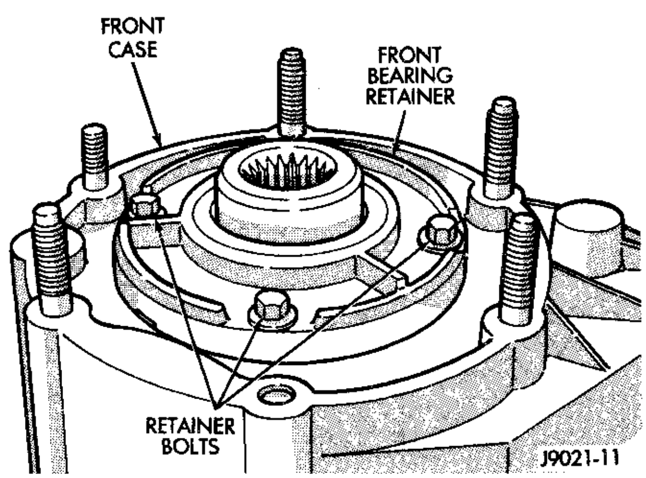

Fig. 42 Front Bearing Retainer Bolts

(3) Remove front bearing retainer seal. Tap seal out with drift and hammer.

(4) Remove input gear retaining ring with heavy duty snap ring pliers (Fig. 44).

DISASSEMBLY AND ASSEMBLY (Continued)

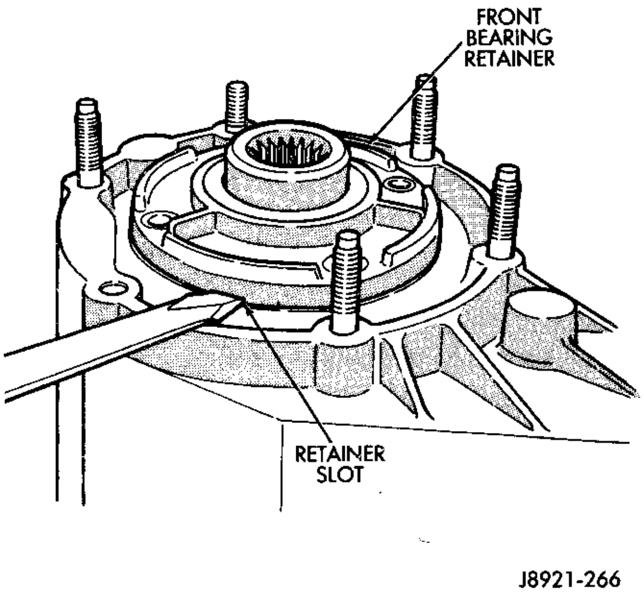

Fig. 43 Front Bearing Retainer Removal

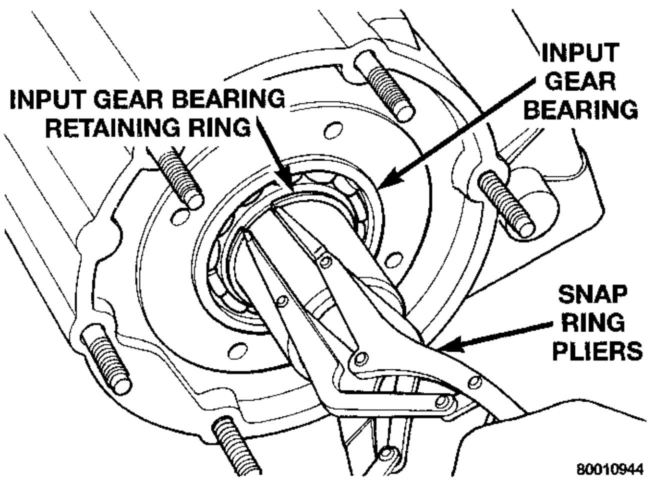

Fig. 44 Removing Input Gear Retaining ring

(5) Place front case in horizontal position. Then remove input gear and low range gear as an assembly (Fig. 45). Tap gear out of bearing with plastic mallet, if necessary.

INPUT AND PLANETARY GEAR DISASSEMBLY

(1) Remove snap-ring that retains input gear in low range gear (Fig. 46).

(2) Remove retainer (Fig. 47).

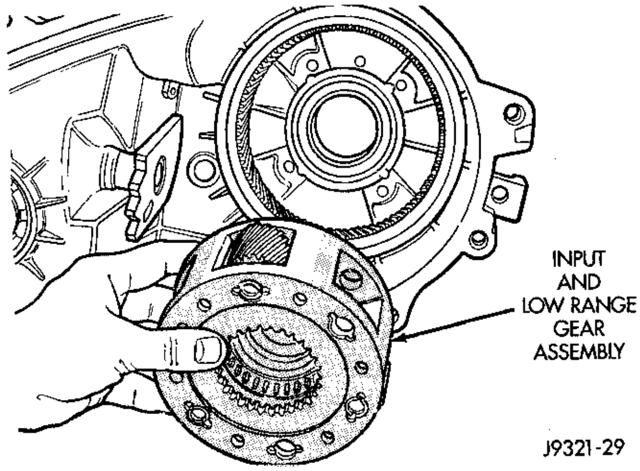

Fig. 45 Input Gear And Planetary Carrier Removal

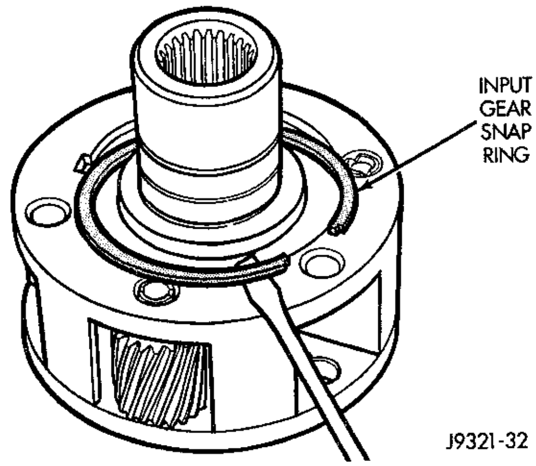

Fig. 46 Input Gear Snap-Ring Removal

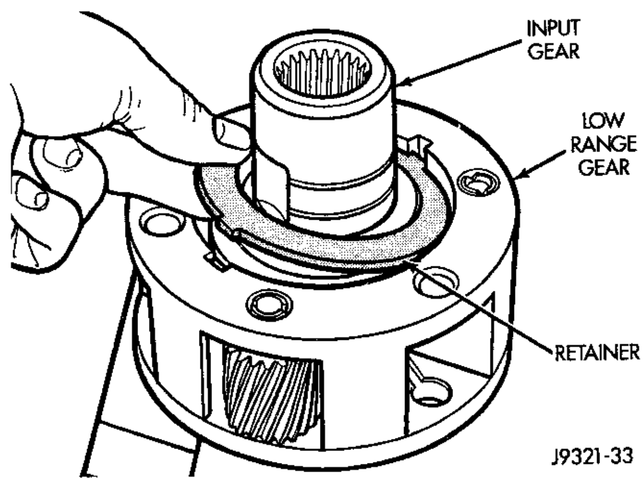

Fig. 47 Input Gear Retainer Removal

DISASSEMBLY AND ASSEMBLY (Continued)

(3) Remove front tabbed thrust washer (Fig. 48).

(4) Remove input gear (Fig. 49).

(5) Remove rear tabbed thrust washer from low range gear (Fig. 50).

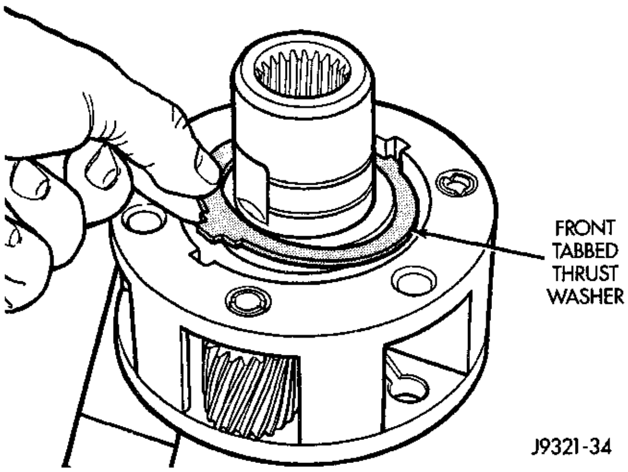

Fig. 48 Front Tabbed Thrust Washer Removal

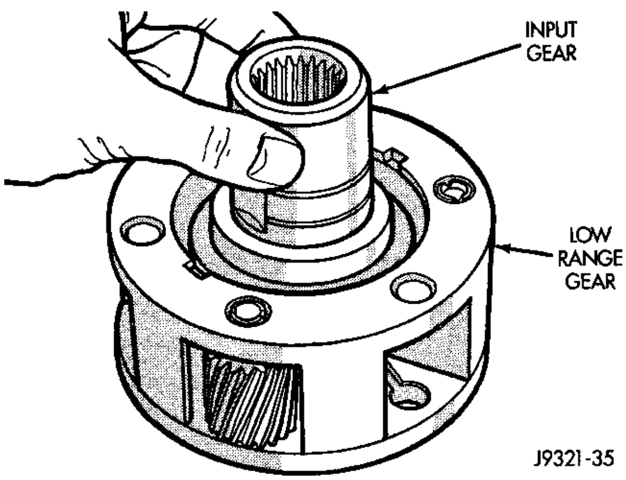

Fig. 49 Input Gear Removal

ASSEMBLY

BEARING AND SEAL REPLACEMENT

(1) Using Remover C-4210 and Handle C-4171, drive input shaft bearing from case from inside annulus gear opening (Fig. 51).

(2) Install locating ring on new bearing.

(3) Position case so that the forward end is facing upward.

(4) Using Remover C-4210 and Handle C-4171, drive input shaft bearing into case. The bearing locating ring must be fully seated on case (Fig. 52).

(5) Using Installer 6953, remove front output shaft bearing.

(6) Start front shaft output bearing in case (Fig. 53). Then seat bearing with Handle C-4171 and Installer 6953.

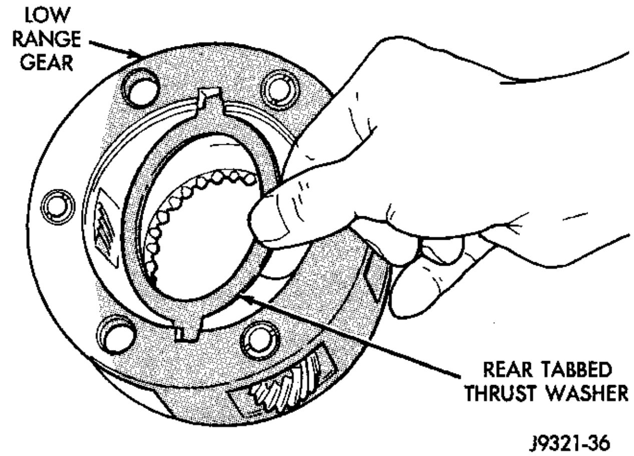

Fig. 50 Rear Tabbed Thrust Washer Removal

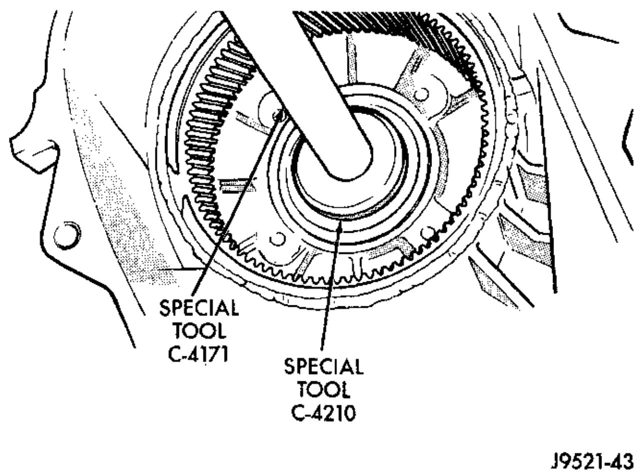

Fig. 51 Input Shaft Bearing Removal

(7) Install front output bearing retaining ring.

(8) Install new front output seal in NV241LD front case with Installer Tool 6888 and Tool Handle C-4171 as follows:

(a) Place new seal on tool. **Garter spring on seal goes toward interior of case.**

(b) Start seal in bore with light taps from hammer (Fig. 54). Once seal is started, continue tapping seal into bore until installer tool bottoms against case.

(c) Remove installer and verify that seal is recessed the proper amount (Fig. 55). Seal should be 2.03 to 2.5 mm (0.080 to 0.100 in.) below top edge of seal bore in front case. This is correct final seal position.

CAUTION: Be sure the front output seal is seated below the top edge of the case bore as shown. The seal could loosen, or become cocked if not seated to recommended depth.

DISASSEMBLY AND ASSEMBLY (Continued)

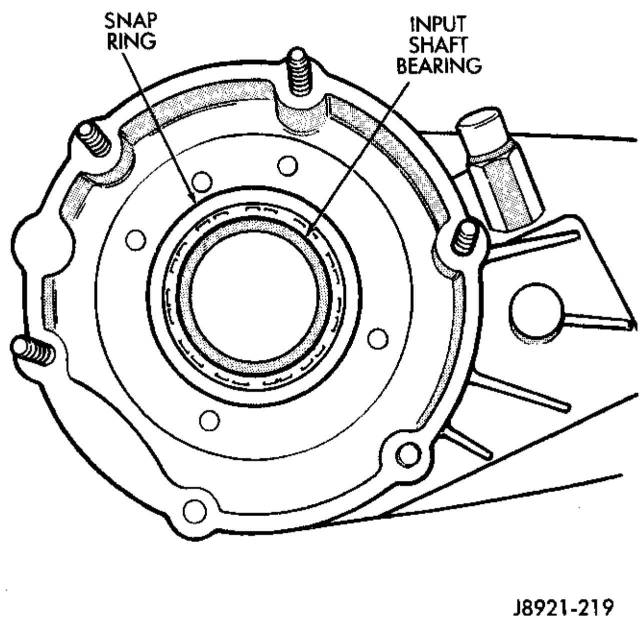

Fig. 52 Seating Input Shaft Bearing

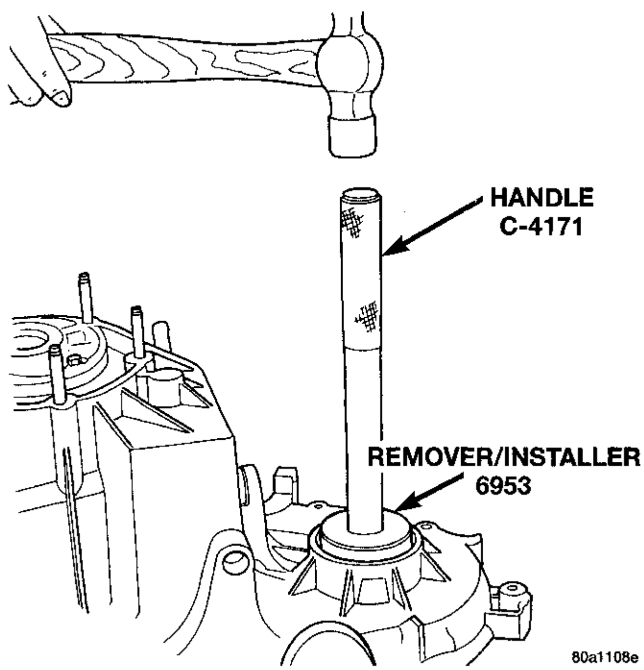

Fig. 53 Front Output Bearing Installation

(9) Install new front output seal in NV231HD front case with Installer Tool 8143 as follows:

(a) Place new seal on tool. Garter spring on seal goes toward interior of case.

(b) Start seal in bore with light taps from hammer (Fig. 56). Once seal is started, continue tapping seal into bore until installer tool seats against case.

(10) Remove seal from front bearing retainer with suitable pry tool.

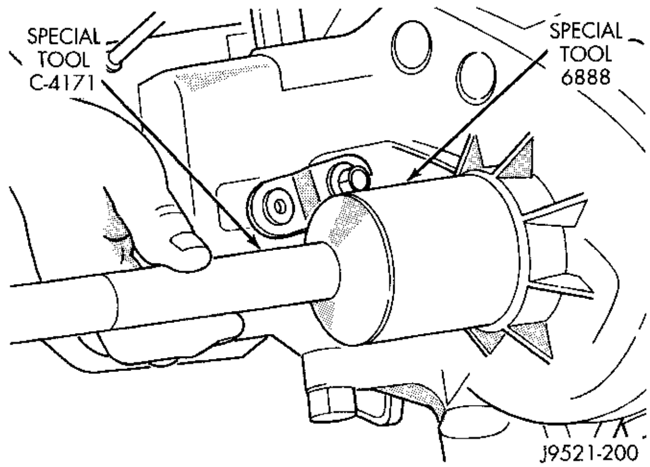

Fig. 54 Front Output Seal Installation

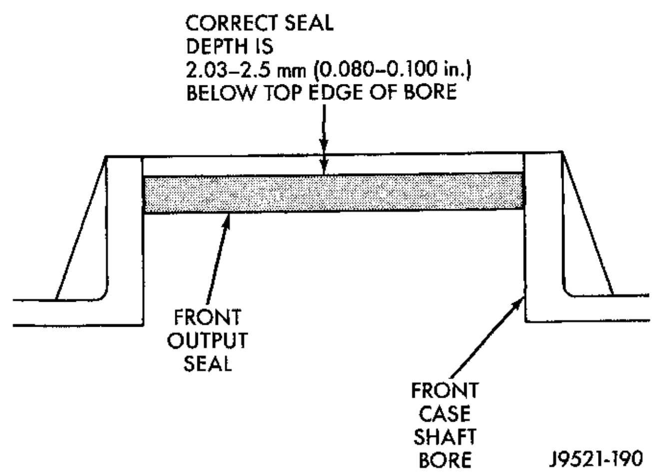

Fig. 55 Checking Front Output Seal Installation Depth

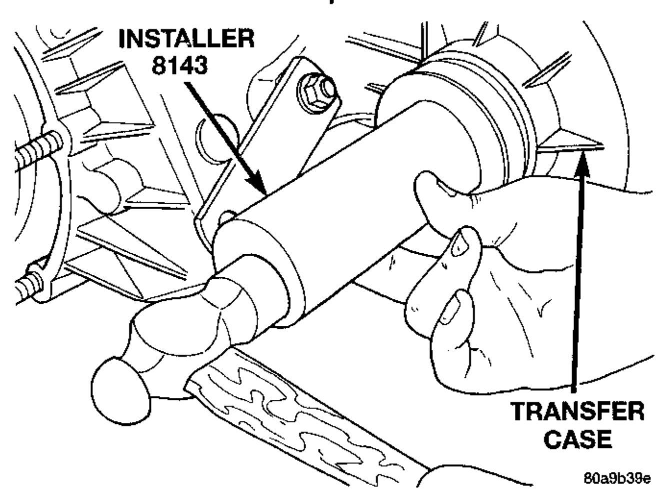

Fig. 56 Front Output Seal Installation

(11) Install new oil seal in front bearing retainer with Installer 7884 (Fig. 57).

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DISASSEMBLY AND ASSEMBLY (Continued)

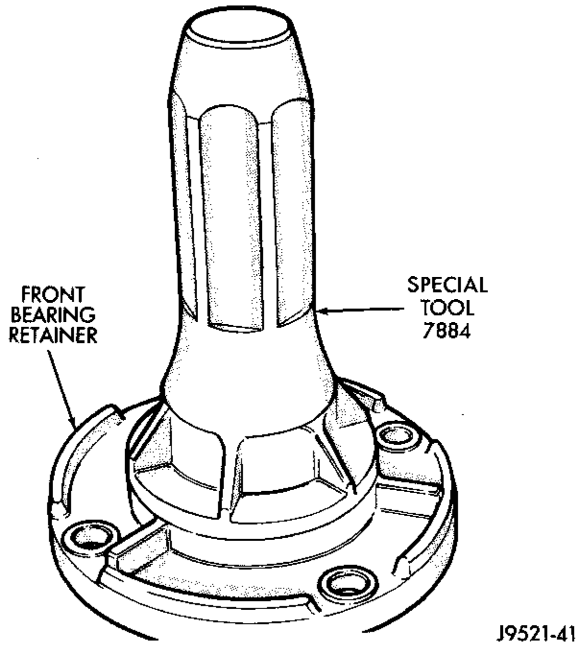

Fig. 57 Install Front Bearing Retainer Seal

(12) Remove seal from oil pump with suitable pry tool.

(13) Install new seal in oil pump with Installer 7888 (Fig. 58).

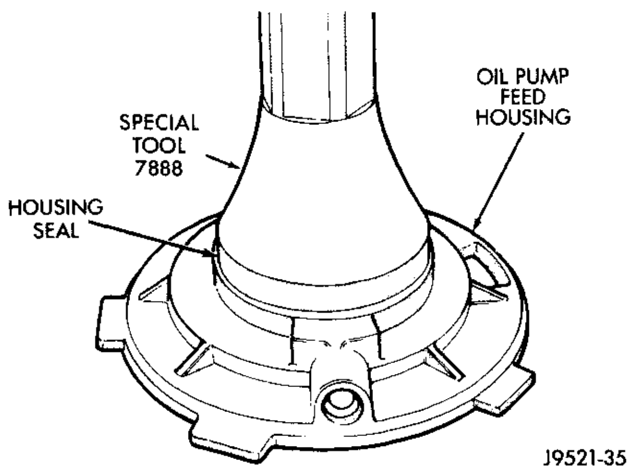

Fig. 58 Install Oil Pump Seal

(14) Remove input gear pilot bearing by inserting a suitably sized drift into the splined end of the input gear and driving the bearing out with the drift and a hammer (Fig. 59).

(15) Install new pilot bearing with Plug C-293-3.

(16) Remove the output shaft rear bearing with the screw and jaws from Remover L-4454 and Cup 8148 (Fig. 60).

(17) Install new bearing with Tool Handle C-4171 and Installer 5066 (Fig. 61). The bearing bore is

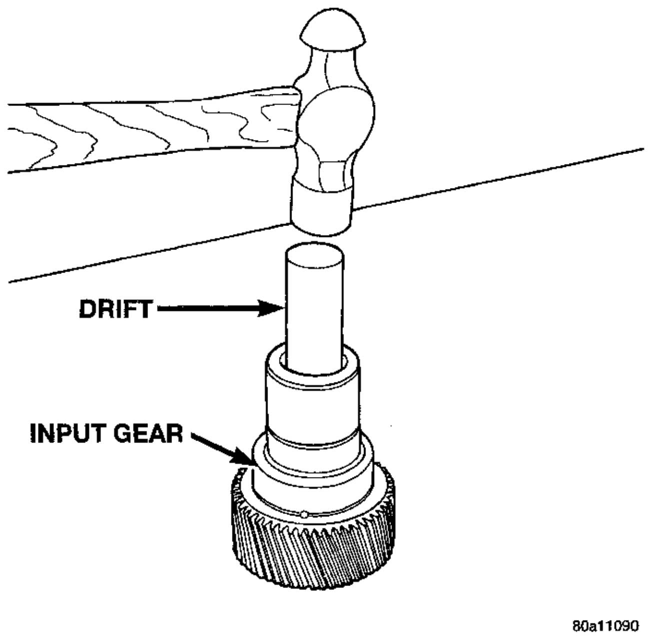

Fig. 59 Remove Input Gear Pilot Bearing

chamfered at the top. Install the bearing so it is flush with the lower edge of this chamfer (Fig. 62).

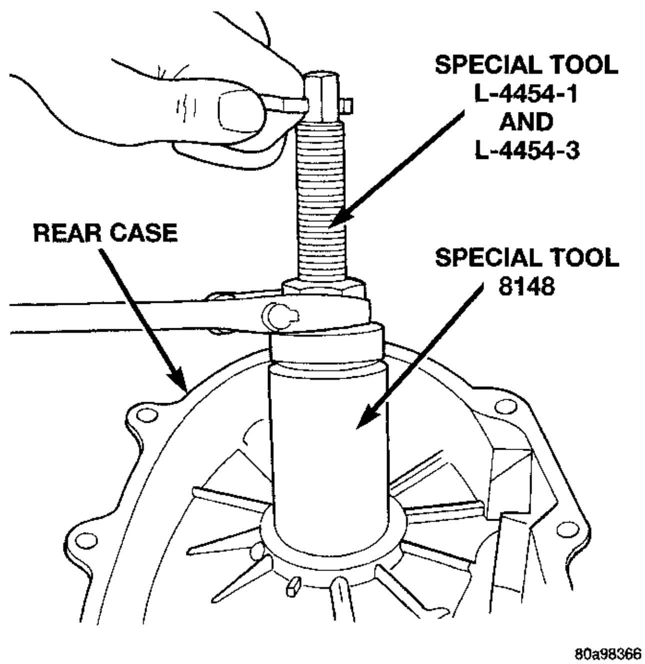

Fig. 60 Output Shaft Rear Bearing Removal

INPUT AND PLANETARY GEAR ASSEMBLY

(1) Lubricate gears and thrust washers (Fig. 63) with recommended transmission fluid.

(2) Install first thrust washer in low range gear (Fig. 63). Be sure washer tabs are properly aligned in gear notches.

DISASSEMBLY AND ASSEMBLY (Continued)

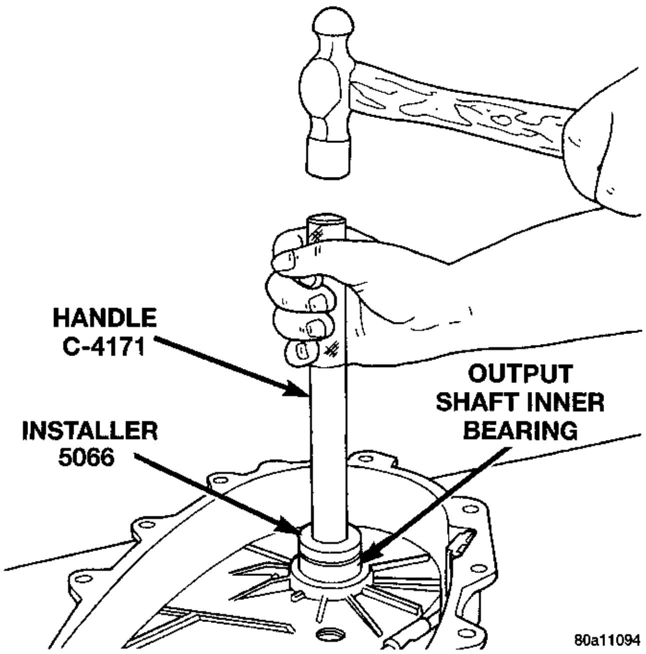

Fig. 61 Output Shaft Rear Bearing Installation

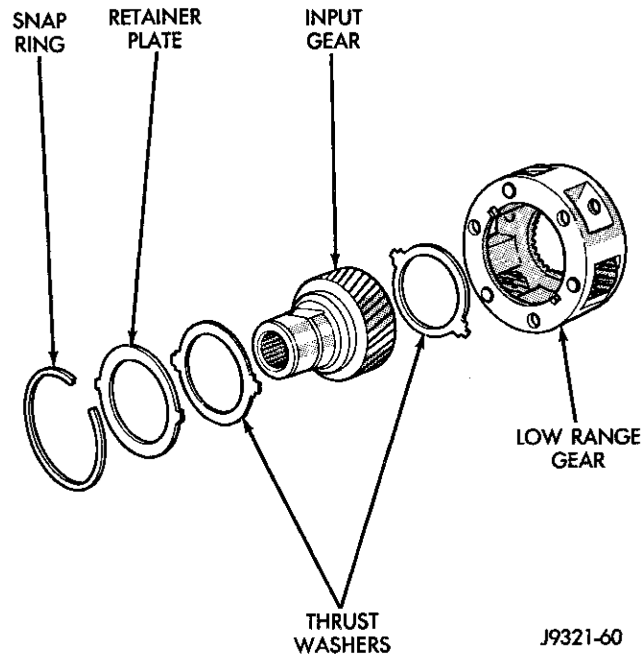

Fig. 63 Input/Low Range Gear Components

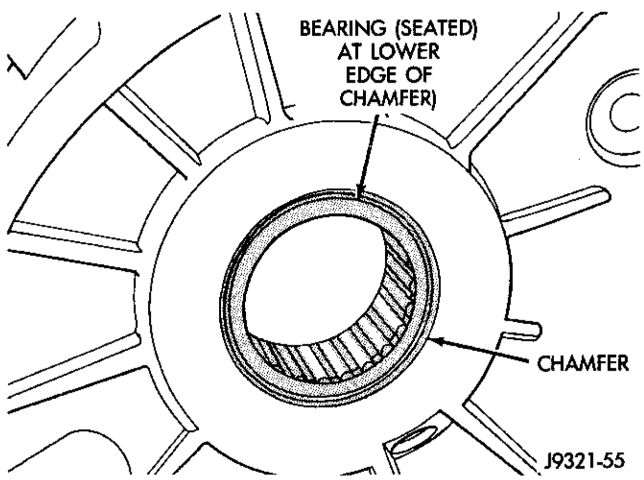

Fig. 62 Output Shaft Rear Bearing Installation Depth

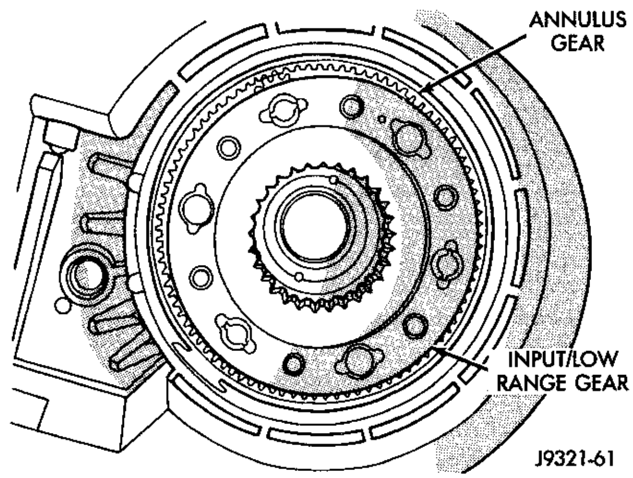

Fig. 64 Input/Low Range Gear Installation

(3) Install input gear in low range gear. Be sure input gear is fully seated.

(4) Install remaining thrust washer in low range gear and on top of input gear. Be sure washer tabs are properly aligned in gear notches.

(5) Install retainer on input gear and install snap-ring.

INPUT AND PLANETARY GEAR INSTALLATION

(1) Align and install low range/input gear assembly in front case (Fig. 64). Be sure low range gear pinions are engaged in annulus gear and that input gear shaft is fully seated in front bearing.

(2) Install snap-ring to hold input/low range gear into front bearing (Fig. 65).

(3) Clean gasket sealer residue from retainer and inspect retainer for cracks or other damage.

(4) Apply a 3 mm (1/8 in.) bead of Mopar® gasket maker or silicone adhesive to sealing surface of retainer.

(5) Align cavity in seal retainer with fluid return hole in front of case.

CAUTION: Do not block fluid return cavity on sealing surface of retainer when applying Mopar® gasket maker or silicone adhesive sealer. Seal failure and fluid leak can result.

(6) Install bolts to hold retainer to transfer case (Fig. 66). Tighten to 21 N·m (16 ft. lbs.) of torque.

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DISASSEMBLY AND ASSEMBLY (Continued)

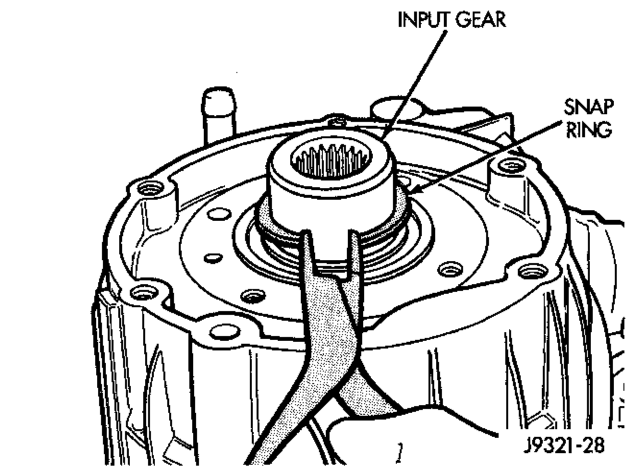

Fig. 65 Install Snap-Ring

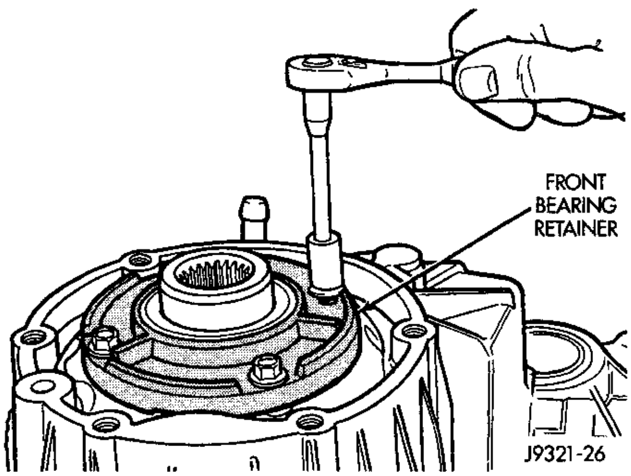

Fig. 66 Install Front Bearing Retainer

MAINSHAFT ASSEMBLY

(1) Lubricate mainshaft splines with recommended transmission fluid.

(2) Slide drive sprocket onto mainshaft.

(3) Slide mode hub onto mainshaft.

(4) Install mode hub retaining ring. Verify that the retaining ring is fully seated in mainshaft groove.

SHIFT FORKS AND MAINSHAFT INSTALLATION

(1) Support front case on wood blocks so case interior is facing up. Place blocks between mounting studs on forward surface of case. Be sure blocks will not interfere with input gear installation.

(2) Lubricate mainshaft components with Dexron II transmission fluid.

(3) Lubricate sector shaft with transmission fluid and install shift sector in case (Fig. 67). Position slot in sector so it will be aligned with shift fork pin when shift forks are installed.

(4) Assemble and install range fork and hub (Fig. 68). Be sure hub is properly seated in low range gear and engaged to the input gear.

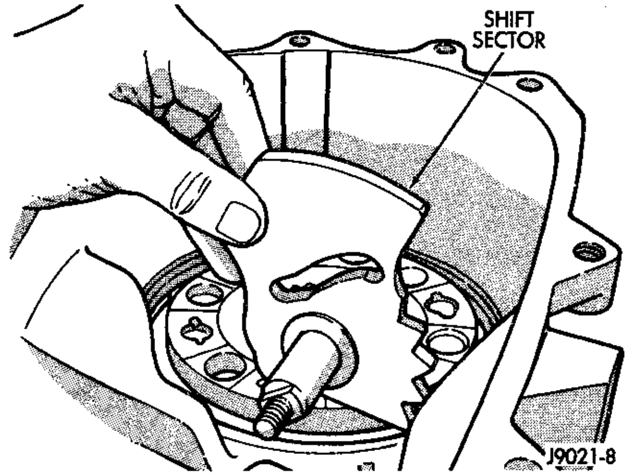

Fig. 67 Shift Sector Installation

(5) Align and insert range fork pin in shift sector slot.

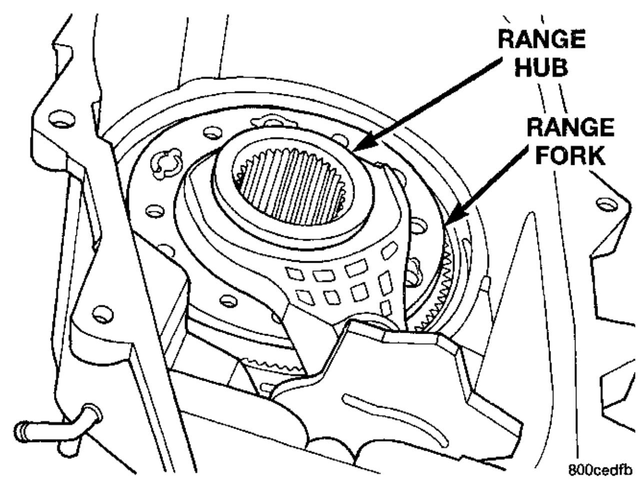

Fig. 68 Install Range Fork And Hub Assembly

(6) Install assembled mainshaft (Fig. 69). Be sure shaft is seated in pilot bearing and input gear.

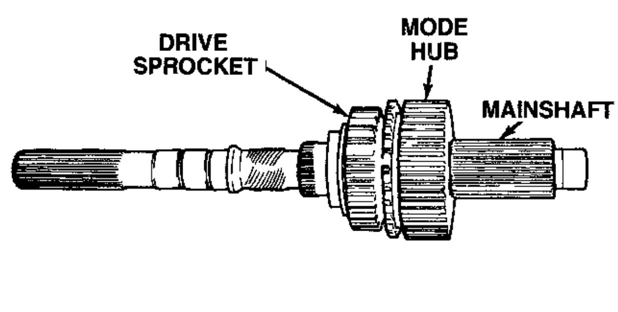

Fig. 69 Mainshaft Assembly Installation

(7) Install new pads on mode fork if necessary.

(8) Insert mode sleeve in mode fork mode fork. Be sure long side of sleeve is toward long end of shift rail (Fig. 70).

DISASSEMBLY AND ASSEMBLY (Continued)

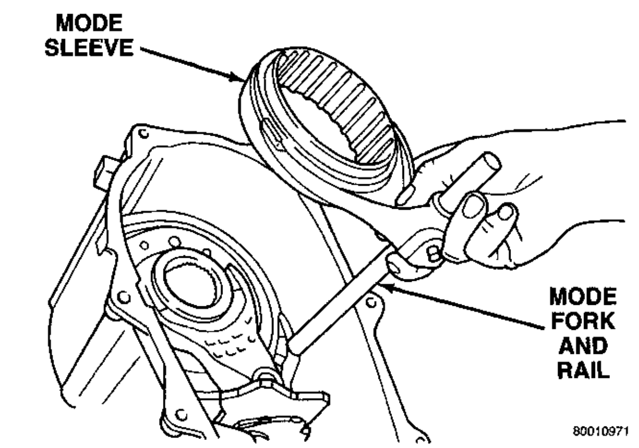

Fig. 70 Assembling Mode Fork And Sleeve

(9) Install assembled mode fork and sleeve (Fig. 71). Be sure fork rail goes through range fork and into case bore. Also be sure sleeve is aligned and seated on mainshaft hub.

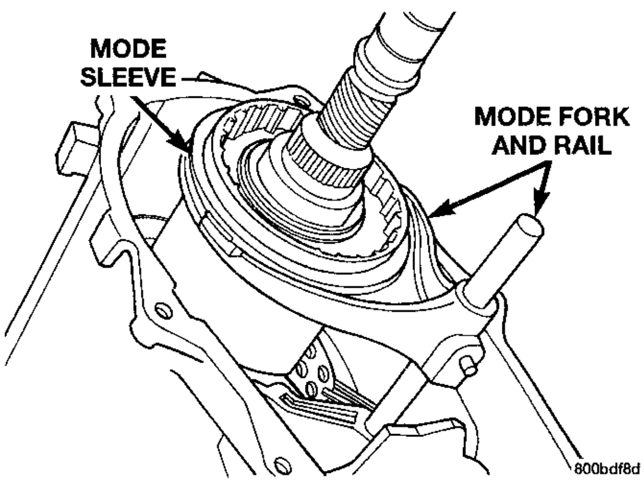

Fig. 71 Mode Fork And Sleeve Installation

(10) Install vacuum/indicator switch (Fig. 72). Tighten switch to 20-34 N·m (15-25 ft. lbs.) torque. Install new O-ring on switch beforehand, if necessary.

(11) Install new sector shaft O-ring and O-ring

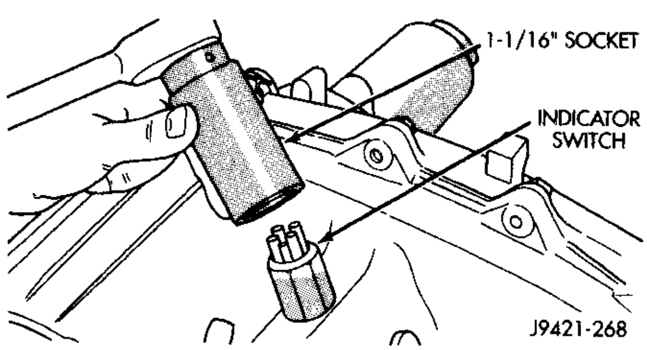

Fig. 72 Vacuum/Indicator Switch Installation

retainer in sector shaft bore (Fig. 73). Lubricate O-ring with transmission fluid or petroleum jelly after installation.

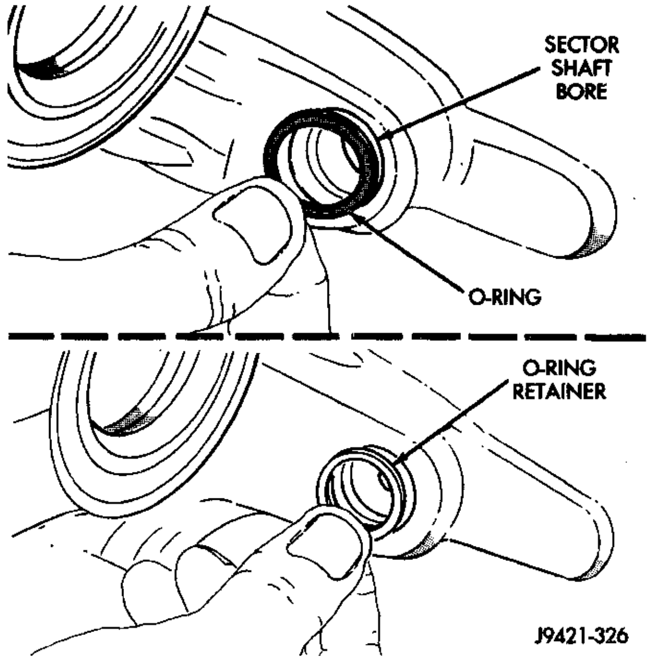

Fig. 73 Sector Shaft O-Ring And Retainer Installation

(12) Install shift lever on sector shaft (Fig. 74).

(13) Install washer and nut on sector shaft to secure shift lever. Apply 1-2 drops Mopar® Lock N' Seal, or equivalent, to nut threads before installation. Then tighten nut to 27-34 N·m (20-25 ft. lbs.) torque.

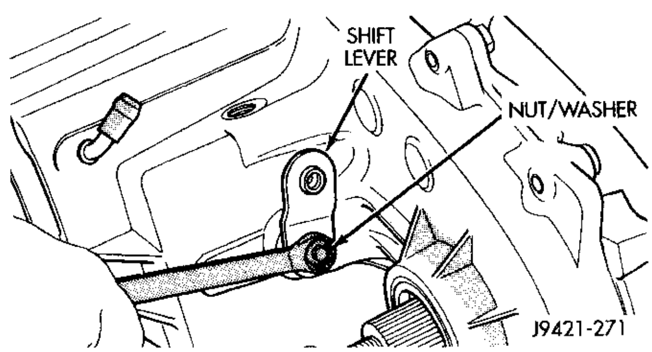

Fig. 74 Shift Lever Installation

(14) Install poppet plunger and spring (Fig. 75).

(15) Install new O-ring on poppet screw and install screw in front case (Fig. 76). Tighten screw to 16-24 N·m (12-18 ft. lbs.).

FRONT OUTPUT SHAFT AND DRIVE CHAIN INSTALLATION

(1) Install front output shaft in bearing (Fig. 77).

(2) Insert front sprocket in drive chain (Fig. 78).

(3) Install drive chain around mainshaft sprocket (Fig. 78). Then position front sprocket over front shaft.

DISASSEMBLY AND ASSEMBLY (Continued)

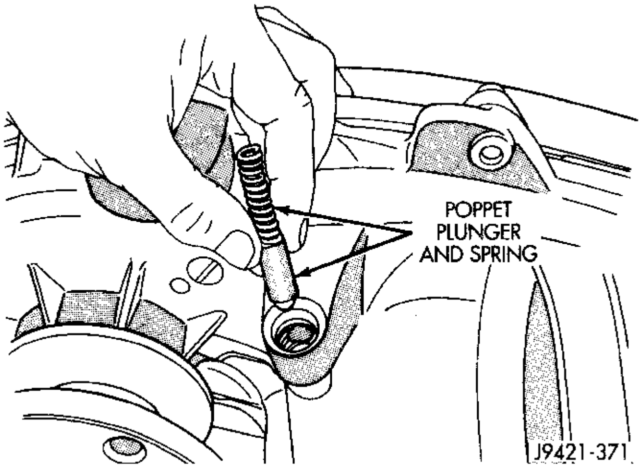

Fig. 75 Poppet Plunger And Spring Installation

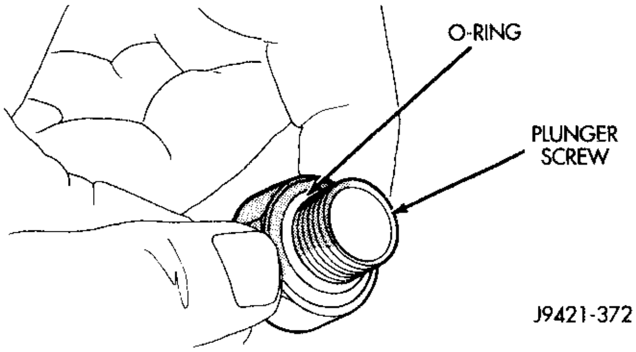

Fig. 76 O-Ring Installation On Poppet Plunger Screw

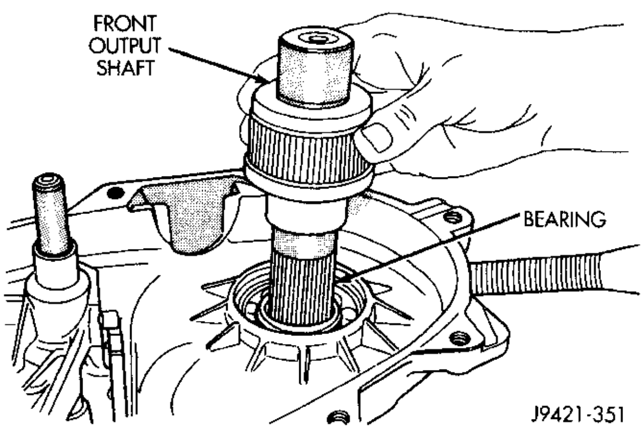

Fig. 77 Front Output Shaft Installation

(4) Raise mainshaft about 2.54 cm (one inch) and seat front sprocket on front output shaft.

(5) If mainshaft and mode sleeve were unseated during chain installation, align and reseat mainshaft in input gear and hub.

(6) Install front sprocket retaining ring (Fig. 79).

(7) Install spring and cup on shift rail (Fig. 80).

(8) Insert magnet in front case pocket (Fig. 81).

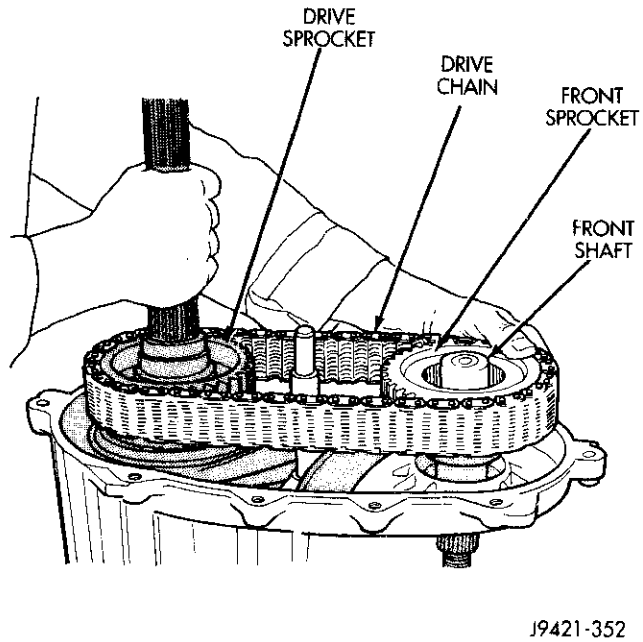

Fig. 78 Drive Chain And Front Sprocket Installation

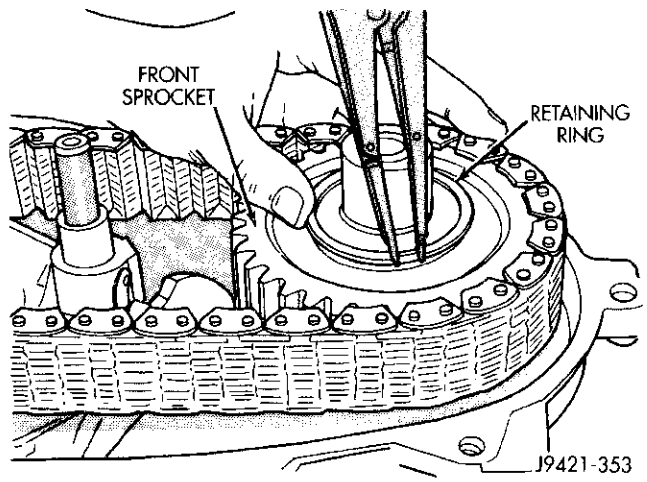

Fig. 79 Front Sprocket Retaining Ring Installation

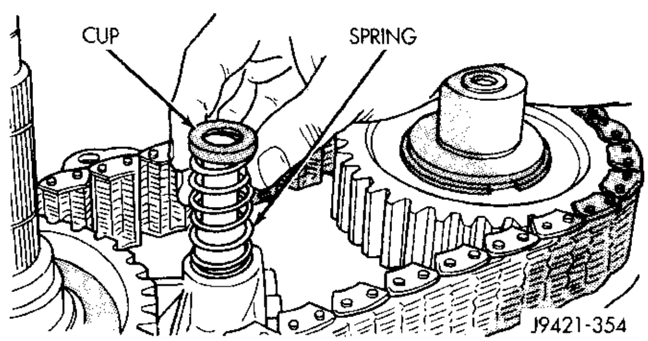

Fig. 80 Shift Rail Spring And Cup Installation

DISASSEMBLY AND ASSEMBLY (Continued)

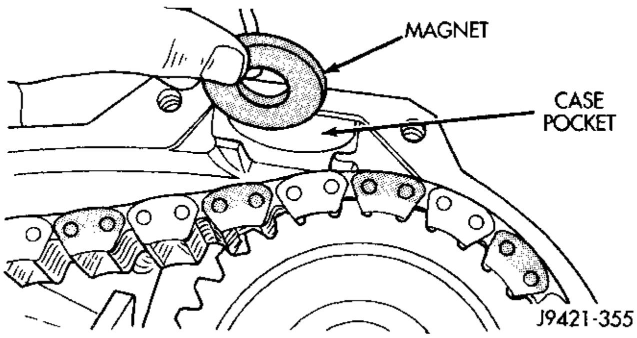

Fig. 81 Case Magnet Installation

OIL PUMP AND REAR CASE ASSEMBLY/INSTALLATION

Lubricate the oil pump components with Dexron II before installation. Prime the oil pickup tube by pouring a little oil into the tube before installation.

(1) Install new O-ring in pickup tube inlet of oil pump (Fig. 82).

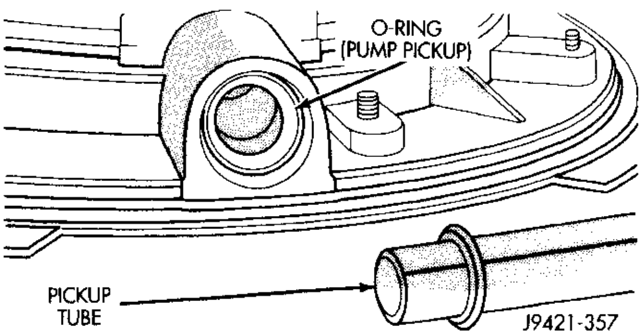

Fig. 82 Pickup Tube O-Ring Installation

(2) Position oil pickup tube and filter in rear case. Be sure pickup filter is seated in case pocket and that pickup tube is aligned in case notches (Fig. 83). Be sure hose that connects tube to filter is securely positioned.

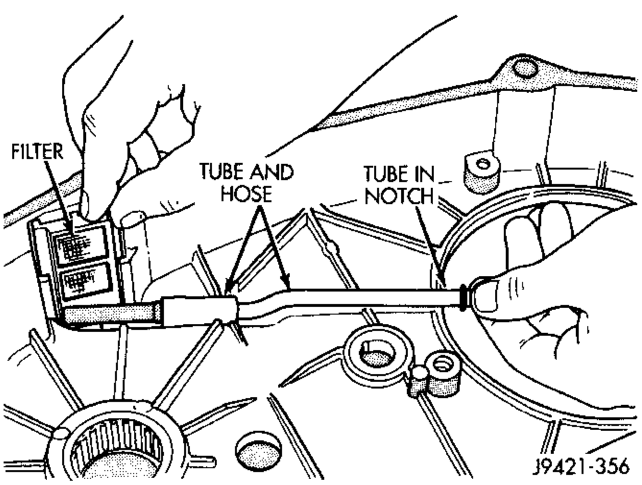

Fig. 83 Oil Pickup Tube And Filter Position In Rear Case

(3) Insert oil pickup tube in oil pump and position pump in rear case (Fig. 84).

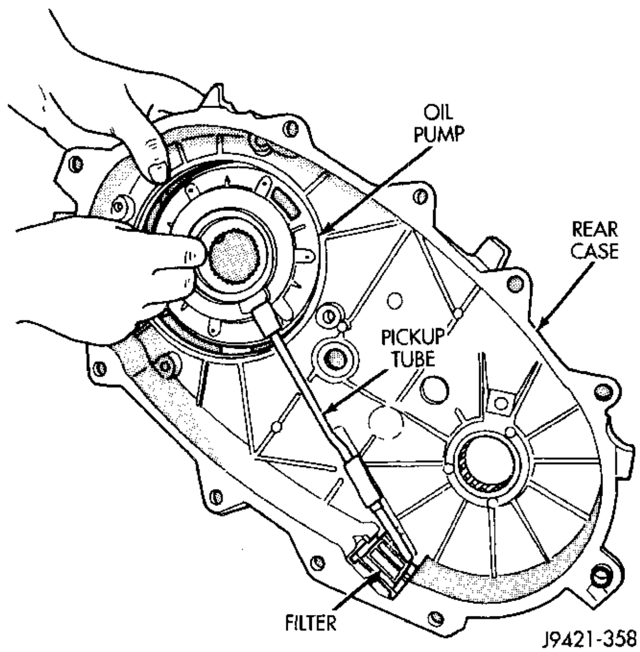

Fig. 84 Positioning Oil Pump In Rear Case

(4) Apply bead of Mopar® Gasket Maker, or equivalent, to mating surface of front case. Keep sealer bead width to maximum of 3/16 inch. Do not use excessive amount of sealer as excess will be displaced into case interior.

(5) Align oil pump with mainshaft and align shift rail with bore in rear case. Then install rear case and oil pump assembly (Fig. 85). Be sure oil pump and pickup tube remain in position during case installation.

(6) Install 4-5 rear case-to front case bolts to hold rear case in position. Tighten bolts snug but not to specified torque at this time.

CAUTION: Verify that shift rail (Fig. 86), and case alignment dowels are seated before installing any bolts. Case could be cracked if shaft rail or dowels are misaligned.

(7) Verify that oil pump is aligned and seated on rear case. Reposition pump if necessary.

(8) Check stud at end of case halves (Fig. 87). If stud was loosened or came out during disassembly, apply Loctite 242 to stud threads and reseat stud in case.

(9) Apply Loctite 242 to remainder of rear case-to-front case bolt threads and install bolts. Be sure lock washers are used on studs/bolts at case ends. Tighten bolts, or stud nuts as follows:

- flange head bolts to 47-61 N·m (35-45 ft. lbs.)
- all other bolts/nuts to 27-34 N·m (20-25 ft. lbs.)

DISASSEMBLY AND ASSEMBLY (Continued)

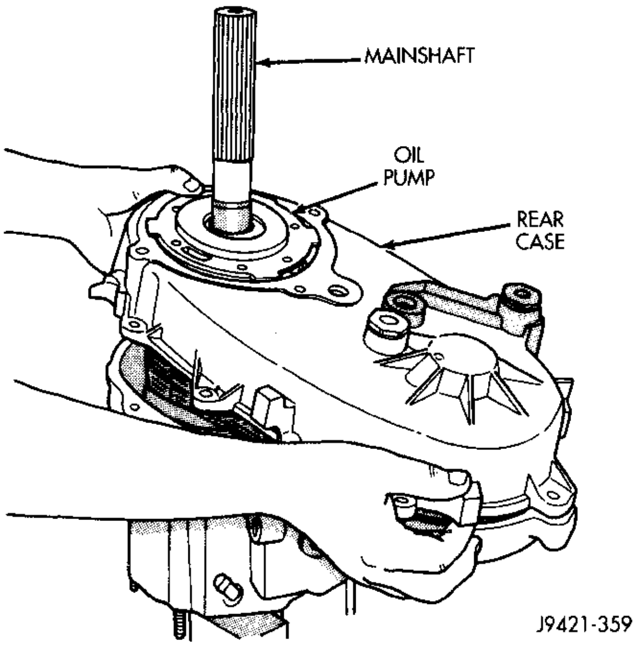

Fig. 85 Rear Case And Oil Pump Installation

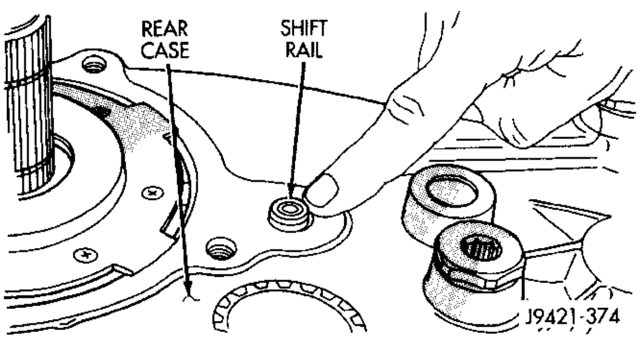

Fig. 86 Shift Rail Seated In Rear Case Bore

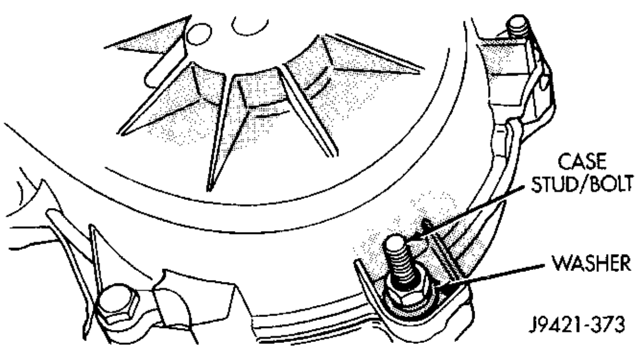

Fig. 87 Washer Installation On Case Stud And Dowel Bolts

(10) Install oil pump retaining ring on mainshaft (Fig. 88).

(11) Install rear output bearing and snap ring to output shaft.

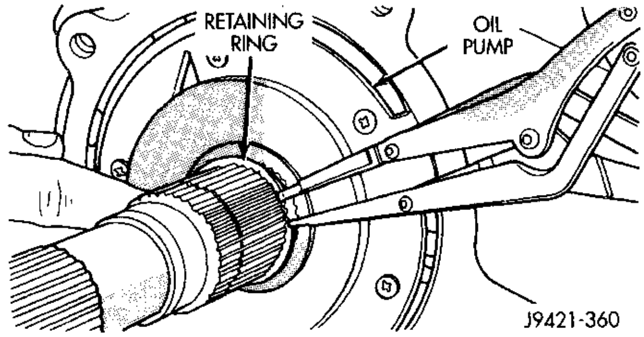

Fig. 88 Oil Pump Retaining Ring Installation

COMPANION FLANGE INSTALLATION

(1) Install companion flange seal on front shaft (Fig. 89).

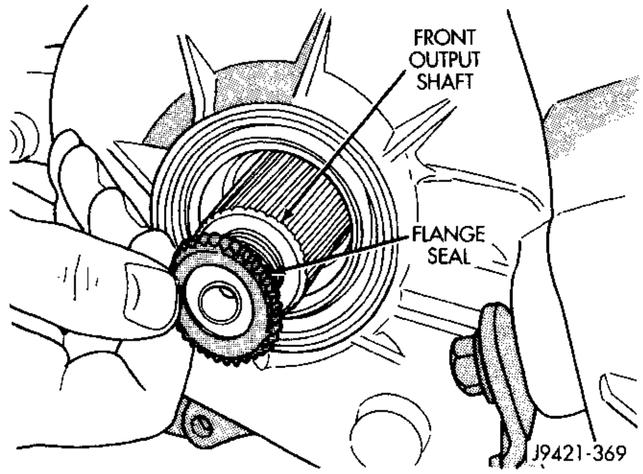

Fig. 89 Installing Flange Seal On Front Shaft

(2) Install companion flange on front shaft (Fig. 90). Then install and tighten flange nut to 176-271 N·m (130-200 ft. lbs.) torque.

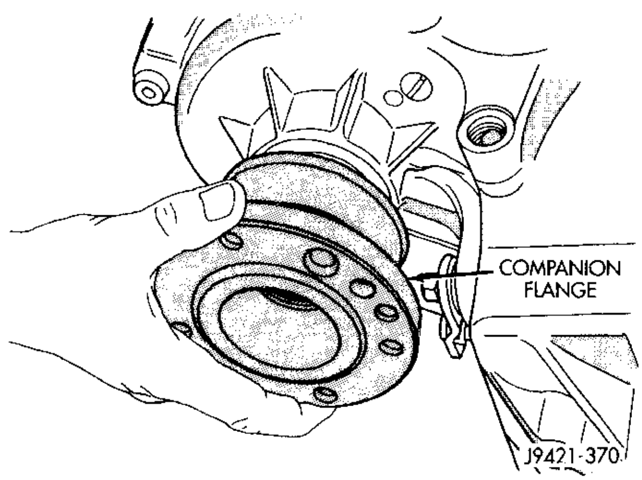

Fig. 90 Installing Companion Flange On Front Shaft

DISASSEMBLY AND ASSEMBLY (Continued)

REAR RETAINER AND EXTENSION INSTALLATION

(1) Clean mating surfaces of transfer case housing and the rear retainer of any original gasket material.

(2) Install new rear retainer gasket onto the transfer case housing or rear retainer.

(3) Align and install rear retainer on rear case (Fig. 91).

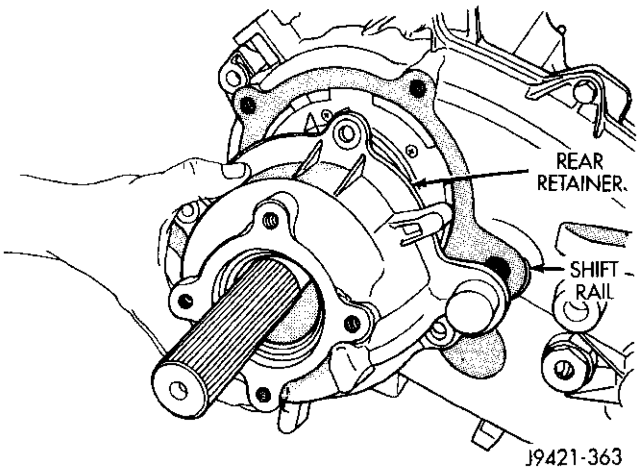

Fig. 91 Rear Retainer Installation

(4) Apply Mopar® silicone sealer to threads of rear retainer bolts. Then install retainer bolts finger tight.

(5) Install output bearing on mainshaft and seat it in rear retainer with suitable size pipe tool (Fig. 92).

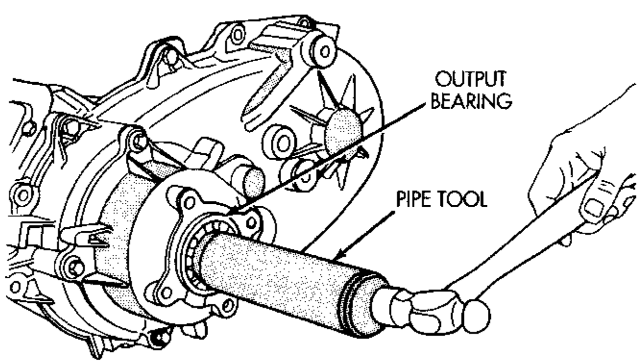

Fig. 92 Output Bearing Installation

(6) Install output bearing retaining ring (Fig. 93).

(7) Tighten rear retainer bolts to 27-34 N·m (20-25 ft. lbs.) torque.

(8) Install new seal in rear extension with suitable size installer tool.

(9) Apply bead of Mopar® Gasket Maker, or equivalent, to mating surface of rear extension. Keep sealer bead width to maximum of 3/16 inch. Do not use excessive amount of sealer as excess could be displaced into output bearing.

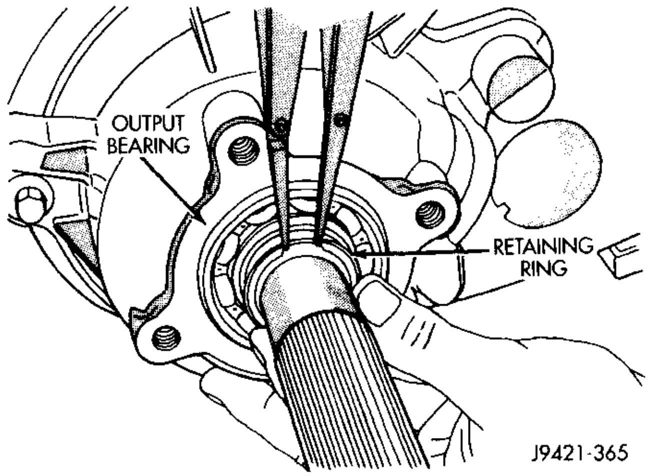

Fig. 93 Output Bearing Retaining Ring Installation

(10) Align and install rear extension on retainer (Fig. 94).

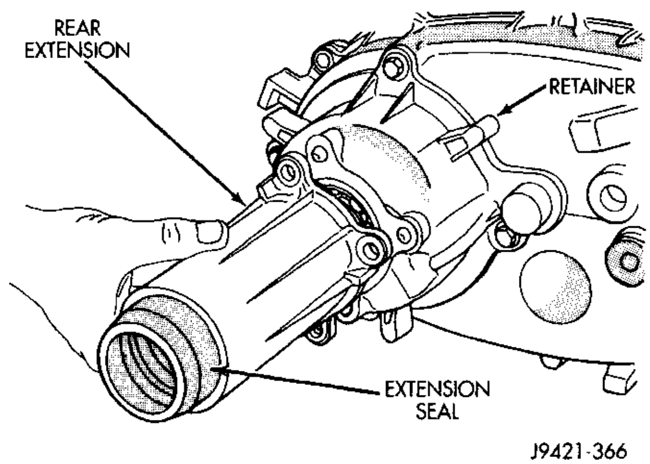

Fig. 94 Rear Extension Installation

(11) Apply Mopar® silicone sealer to threads of rear extension bolts. Then install and tighten bolts to 27-34 N·m (20-25 ft. lbs.) torque.

CLEANING AND INSPECTION

TRANSFER CASE CLEANING AND INSPECTION

Clean the transfer case parts with a standard parts cleaning solvent. Remove all traces of sealer from the cases and retainers with a scraper and 3M all purpose cleaner. Use compressed air to remove solvent residue from oil feed passages in the case halves, retainers, gears, and shafts.

The oil pickup screen can be cleaned with solvent. Shake excess solvent from the screen after cleaning and allow it to air dry. Do not use compressed air.

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CLEANING AND INSPECTION (Continued)

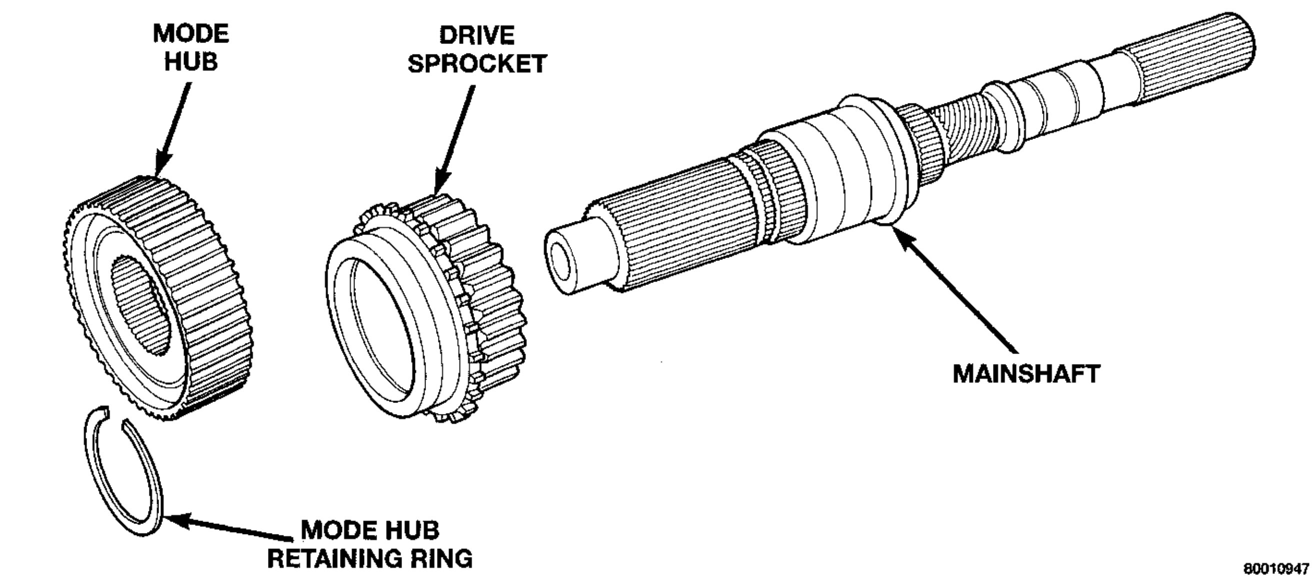

Fig. 95 Mainshaft, Mode Hub, And Drive Sprocket

MAINSHAFT/SPROCKET/HUB INSPECTION

Inspect the splines on the hub and shaft and the teeth on the sprocket (Fig. 95). Minor nicks and scratches can be smoothed with an oilstone, however, replace any part is damaged.

Check the contact surfaces in the sprocket bore and on the mainshaft. Minor nicks and scratches can be smoothed with 320–400 grit emery cloth but do not try to salvage the shaft if nicks or wear is severe.

INPUT GEAR AND PLANETARY CARRIER

Check the teeth on the gear (Fig. 96). Minor nicks can be dressed off with an oilstone but replace the gear if any teeth are broken, cracked, or chipped. The bearing surface on the gear can be smoothed with 300–400 grit emery cloth if necessary.

Examine the carrier body and pinion gears for wear or damage. The carrier will have to be replaced as an assembly if the body, pinion pins, or pinion gears are damaged.

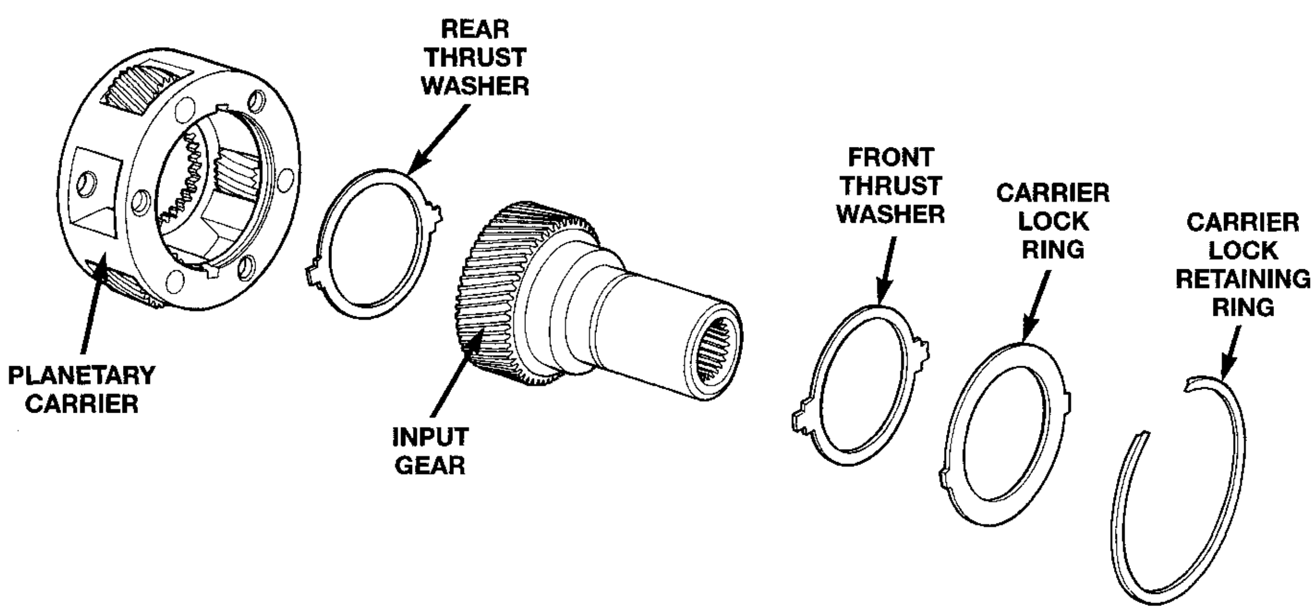

Fig. 96 Input Gear And Carrier Components

CLEANING AND INSPECTION (Continued)

Check the lock ring and both thrust washers for wear or cracks. Replace them if necessary. Also replace the lock retaining ring if bent, distorted, or broken.

SHIFT FORKS/HUBS/SLEEVES

Check condition of the shift forks and mode fork shift rail (Fig. 97). Minor nicks on the shift rail can be smoothed with 320–400 grit emery cloth.

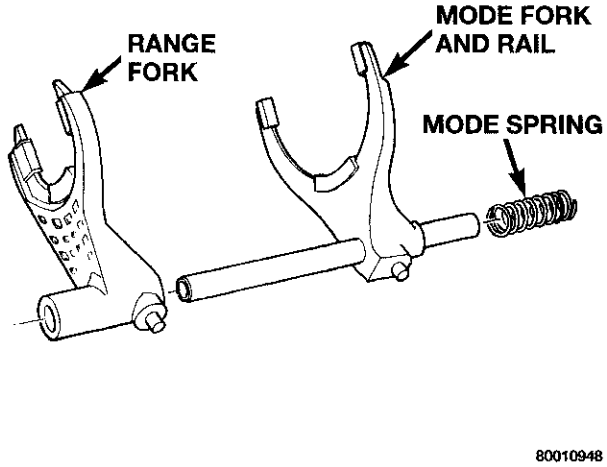

Fig. 97 Shift forks

Inspect the shift fork wear pads (Fig. 98). The mode fork pads are serviceable and can be replaced if necessary. The range fork pads are not serviceable. The fork must be replaced as an assembly if the pads are worn or damaged.

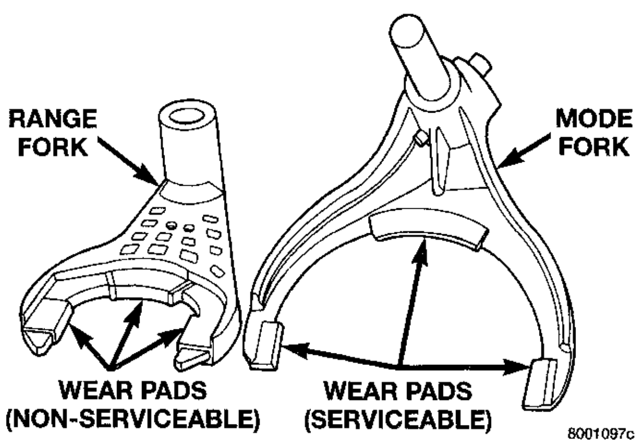

Fig. 98 Shift Fork And Wear Pad Locations

Check both of the sleeves for wear or damage, especially on the interior teeth. Replace the sleeves if wear or damage is evident.

REAR RETAINER COMPONENTS

Inspect the retainer components. Replace the bearing if rough or noisy. Check the retainer for cracks or wear in the bearing bore. Clean the retainer sealing surfaces with a scraper and 3M all purpose cleaner. This will ensure proper adhesion of the sealer during reassembly.

Inspect the retaining rings and washers. Replace any part if distorted, bent, or broken. Reuse is not recommended.

Inspect rear extension bushing. Replace if worn or scored.

DRIVE CHAIN

Examine the drive chain and shaft bearings. replace the chain if stretched, distorted, or if any of the links bind. Replace the bearings if rough, or noisy.

LOW RANGE ANNULUS GEAR

Inspect annulus gear condition carefully. The gear is only serviced as part of the front case. If the gear is damaged, it will be necessary to replace the gear and front case as an assembly. Do not attempt to remove the gear (Fig. 99)

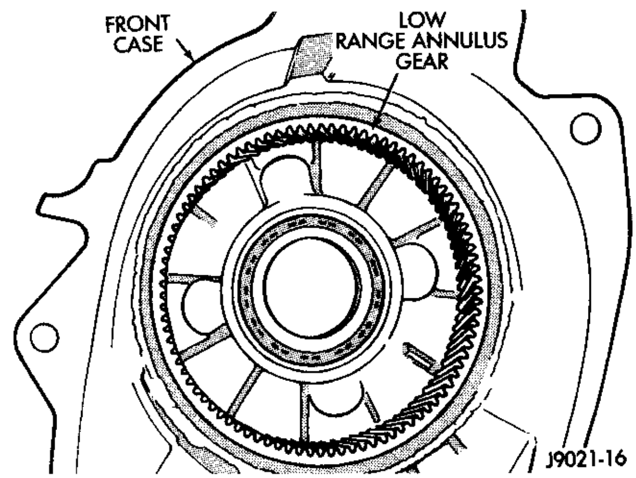

Fig. 99 Low Range Annulus Gear

FRONT-REAR CASES AND FRONT RETAINER

Inspect the cases and retainer for wear and damage. Clean the sealing surfaces with a scraper and 3M all purpose cleaner. This will ensure proper sealer adhesion at assembly. Replace the input retainer seal; do not reuse it.

Check case condition. If leaks were a problem, look for gouges and severe scoring of case sealing surfaces. Also make sure the front case mounting studs are in good condition.

Check the front case mounting studs and vent tube. The tube can be secured with Loctite 271 or 680 if loose. The stud threads can be cleaned up with a die if necessary. Also check condition of the fill/ drain plug threads in the rear case. The threads can be repaired with a thread chaser or tap if necessary.

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CLEANING AND INSPECTION (Continued)

Or the threads can be repaired with Helicoil stainless steel inserts if required.

OIL PUMP/OIL PICKUP

Examine the oil pump pickup parts. Replace the pump if any part appears to be worn or damaged. Do not disassemble the pump as individual parts are not available. The pump is only available as a complete assembly. The pickup screen, hose, and tube are the only serviceable parts and are available separately.

ADJUSTMENTS

SHIFT LINKAGE ADJUSTMENT

(1) Move shift lever into 2H position.
(2) Raise vehicle.
(3) Loosen shift rod lock bolt at trunnion (Fig. 100).

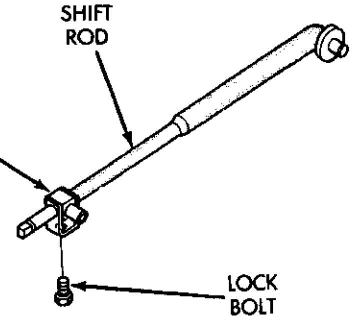


Fig. 100 Shift Rod Lock Bolt Location

(4) Check shift rod fit in trunnion. Be sure rod does not bind in trunnion.
(5) Verify that transfer case shift lever is in 2H position. The 2H position on the transfer case shift arm is the second position from full forward.
(6) Lower vehicle.
(7) Position the shift lever on the cab such that the distance from the instrument panel to the 2H position dot in the shift lever insert is 14.6 cm (5.75 in.). Ensure that the measurement is made parallel to the floor of the vehicle.
(8) Tighten shift rod lock bolt to 10 N·m (90 in. lbs.) torque.
(9) Check shift linkage operation. Be sure transfer case shifts into and operates properly in all ranges.

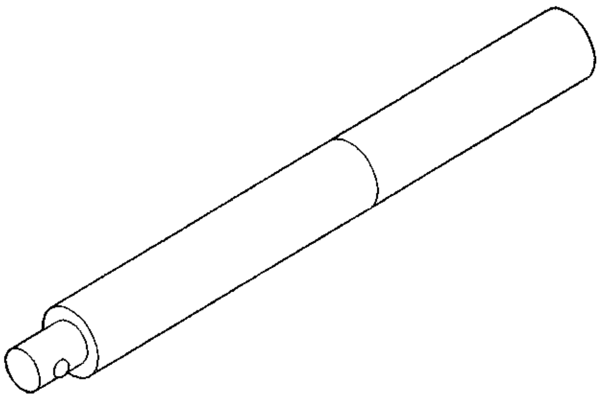
SPECIFICATIONS

TORQUE

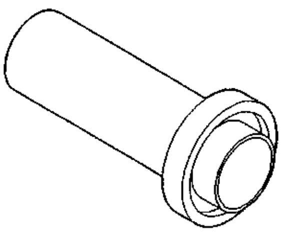
DESCRIPTION	TORQUE
Plug, Detent	16–24 N·m (12–18 ft. lbs.)
Bolt, Diff. Case	17–27 N·m (15–24 ft. lbs.)
Plug, Drain/Fill	40–45 N·m (30–40 ft. lbs.)
Bolt, Extension Housing	35–46 N·m (26–34 ft. lbs.)
Bolt, Front Brg. Retainer	16–27 N·m (12–20 ft. lbs.)
Bolt, Case Half	35–46 N·m (26–34 ft. lbs.)
Nut, Front Yoke	122–176 N·m (90–130 ft. lbs.)
Screw, Oil Pump	1.2–1.8 N·m (12–15 in. lbs.)
Nut, Range Lever	27–34 N·m (20–25 ft. lbs.)
Bolt, Rear Retainer	35–46 N·m (26–34 ft. lbs.)
Nuts, Mounting	35–47 N·m (26–35 ft. lbs.)
Bolts, U-Joint	19 N·m (17 ft. lbs.)
Vacuum Switch	20–34 N·m (15–25 ft. lbs.)

SPECIAL TOOLS

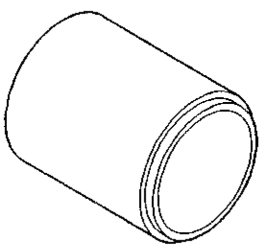
NV231HD AND NV241LD



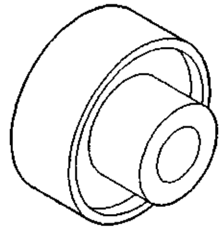
C-4171 Handle



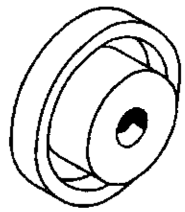
8143 Installer, Seal



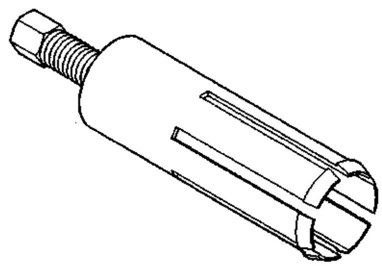
6888 Installer, Seal



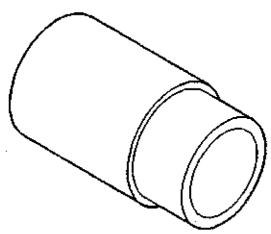
6953 Installer, Bearing



C-4210 Installer, Seal



8158 Remover, Bushing



8157 Installer, Bushing

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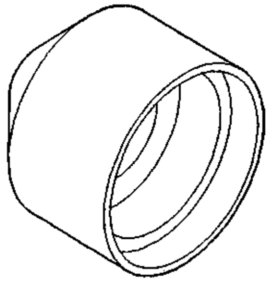
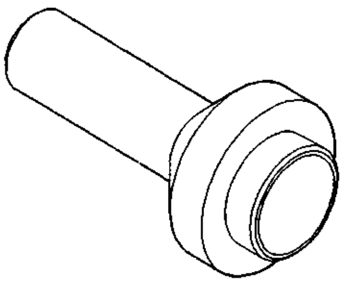
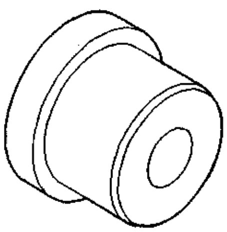
SPECIAL TOOLS (Continued)



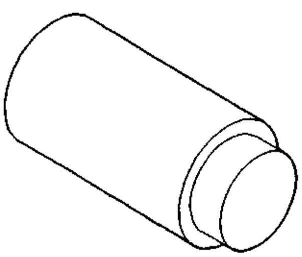
D-163 Installer, Seal



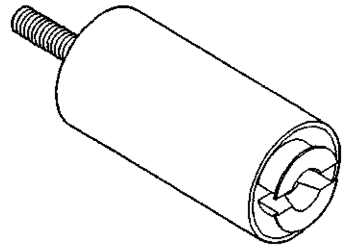
7884 Installer, Seal



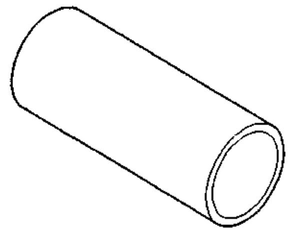
5066 Installer, Bushing



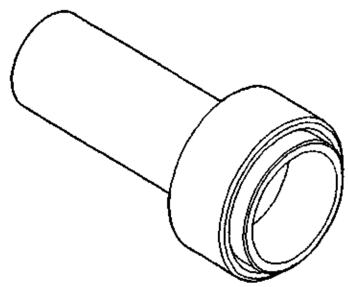
C-293-3 Plug, Extension



L-4454 Remover, Bearing



8148 Cup



7888 Installer, Pump Housing Seal

NV241HD TRANSFER CASE

INDEX

GENERAL INFORMATION

NV241HD INTRODUCTION

The NV241HD is a part-time transfer case with a low-range gear system. The transfer case provides three operating ranges plus a Neutral position. The low range position provides a gear reduction ratio of 2.72:1 for increased low speed torque capability. Operating ranges are: 2-high, 4-high and 4-low.

The gear cases, retainer and extension are all of aluminum. Drive sprockets and an interconnecting drive chain are used to transmit engine torque to the front/rear propeller shafts. The mainshaft, input gear and front output shaft are supported by ball and needle bearings.

The synchro mechanism consists of a brass stop ring, synchro hub with 3 struts and 2 retaining springs and the sliding clutch (Fig. 1). The synchro components allow the transfer case to be shifted between 2H and 4H ranges while the vehicle is in motion. However, the vehicle must be stopped in order to shift into 4L range.

OPERATING RANGES

Transfer case operating ranges are:

- 4x2 (2-wheel drive)
- 4x4 (4-wheel drive)
- 4 Lo (4-wheel drive low range

The 4x2 range is for use on any road surface at any time.

The 4x4 and 4 Lo ranges are for off road use only. They are not for use on hard surface roads. The only exception being when the road surface is covered by ice and snow.

The low range reduction gear system is operative in 4 Lo range only. This range is for extra pulling power in off road situations. Low range reduction ratio is 2.72:1.

A front axle disconnect system is used to achieve two-wheel drive mode. The axle disconnect vacuum motor is actuated by a vacuum switch on the transfer case. The switch is operated by the transfer case range rod.

SHIFT MECHANISM

The transfer case is operated by an adjustable floor mounted shift linkage. The transfer case shift lever is directly attached to the shift sector. The sector operates the range and mode forks within the transfer case.

A straight line shift pattern is used with a neutral detent. Lever range positions are imprinted in the shift knob.

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GENERAL INFORMATION (Continued)

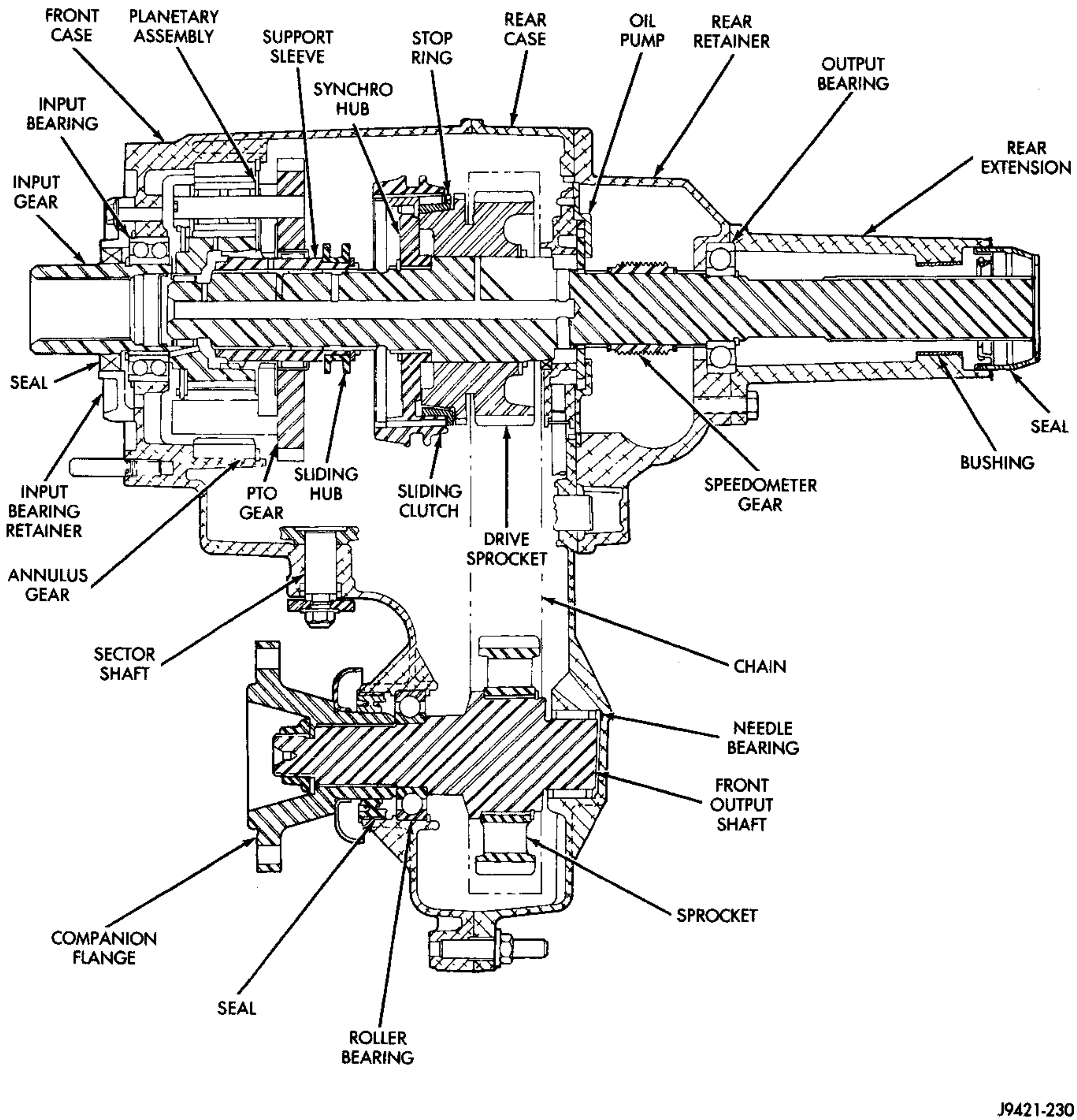

Fig. 1 NV241HD Transfer Case

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GENERAL INFORMATION (Continued)

PTO CAPABILITY

The NV241HD transfer case has power take-off capability. A PTO gear permanently attached to the planetary carrier, and a removable PTO cover are provided for this purpose.

TRANSFER CASE IDENTIFICATION

An identification tag (Fig. 2) is attached to the rear case of every transfer case. The tag provides the transfer case model number, assembly number, serial number, and low range ratio.

The transfer case serial number also represents the date of build.

RECOMMENDED LUBRICANT AND FILL LEVEL

Recommended lubricant for the NV241HD transfer case is Mopar® Dexron II, or ATF Plus. Use this fluid for topping off the level, refilling after service, or normal fluid changes.

Do not use anti-friction additives or similar products in the NV241HD transfer case. Use recommended lubricant only.

Approximate lubricant refill capacity is 3.1 liters (6.5 pints) for the NV241HD.

Correct fluid level for the transfer case is to the bottom edge of the fill plug hole. Be sure that the vehicle is level when checking the fill level.

DIAGNOSIS AND TESTING

SERVICE DIAGNOSIS

Before beginning repair on a suspected transfer case malfunction, check all other driveline components beforehand.

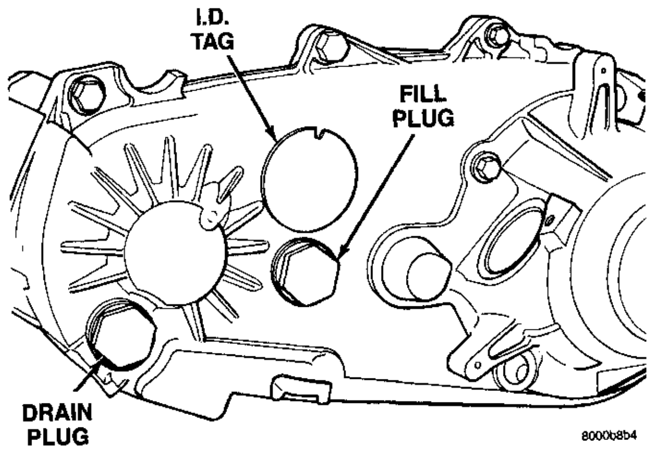

Fig. 2 Transfer Case Identification Tag—Typical

The actual cause of a problem may be related to such items as: front hubs, axles, propeller shafts, wheels and tires, transmission, or clutch instead. If all other driveline components are in good condition and operating properly, refer to the Service Diagnosis chart for further information.

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DIAGNOSIS AND TESTING (Continued)

SERVICE DIAGNOSIS

Condition	Possible Cause	Correction
TRANSFER CASE DIFFICULT TO SHIFT OR WILL NOT SHIFT INTO DESIRED RANGE	(1) Vehicle speed too great to permit shifting.	(1) Stop vehicle and shift into desired range. Or reduce speed to 3-4 km/h (2-3 mph) before attempting to shift.
	(2) If vehicle was operated for extended period in 4H mode on dry paved surface, driveline torque load may cause difficulty.	(2) Stop vehicle, shift transmission to Neutral, shift transfer case to 2H mode and operate vehicle in 2H on dry paved surfaces.
	(3) Transfer case external shift linkage binding.	(3) Lubricate, repair or replace linkage bushings or tighten loose components as necessary.
	(4) Insufficient or incorrect lubricant.	(4) Drain and refill to edge of fill hole with DEXRON II® or MOPAR-MERCON® Automatic Transmission Fluid.
	(5) Internal components binding, worn or damaged.	(5) Disassemble unit and replace worn or damaged components as necessary.
TRANSFER CASE NOISY IN ALL DRIVE MODES	(1) Insufficient or incorrect lubricant.	(1) Drain and refill to edge of fill hole with DEXRON II® or MOPAR-MERCON® Automatic Transmission Fluid. Check for leaks and repair if necessary. **Note: If unit is still noisy after drain and refill, disassembly and inspection may be required to locate source of noise.**
NOISY IN – OR JUMPS OUT OF – FOUR WHEEL DRIVE LOW RANGE	(1) Transfer case not completely engaged in 4L position.	(1) Stop vehicle, shift transfer case to Neutral, then shift back into 4L position.
	(2) Shift linkage out of adjustment.	(2) Adjust linkage.
	(3) Shift linkage loose or binding.	(3) Tighten, lubricate or repair linkage as necessary.
	(4) Range fork damaged, inserts worn, or fork is binding on shift rail.	(4) Disassemble unit and repair as necessary.
	(5) Low range gear worn or damaged.	(5) Disassemble and repair as necessary.
LUBRICANT LEAKING FROM OUTPUT SHAFT SEALS OR FROM VENT	(1) Transfer case overfilled.	(1) Drain to correct level.
	(2) Vent closed or restricted.	(2) Clear or replace vent if necessary.
	(3) Output shaft seals damaged or installed incorrectly.	(3) Replace seals. Be sure seal lip faces interior of case when installed. Also be sure yoke seal surfaces are not scored or nicked. Remove scores and nicks with fine sandpaper or replace yoke(s) if necessary.
ABNORMAL TIRE WEAR	(1) Extended operation on dry hard surface (paved) roads in 4H range.	(1) Operate in 2H on hard surface (paved) roads.

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SERVICE PROCEDURES

FLUID DRAIN/REFILL

(1) Raise vehicle.
(2) Position drain pan under transfer case.
(3) Remove drain and fill plugs and drain lubricant completely.
(4) Install drain plug. Tighten plug to 41-54 N·m (30-40 ft. lbs.).
(5) Remove drain pan.
(6) Fill transfer case to bottom edge of fill plug opening with Mopar® Dexron II.
(7) Install and tighten fill plug to 41-54 N·m (30-40 ft. lbs.).
(8) Lower vehicle.

REMOVAL AND INSTALLATION

TRANSFER CASE

REMOVAL

(1) Raise and support vehicle.
(2) Remove skid plate, if equipped.
(3) Position drain oil container under transfer case.
(4) Remove transfer case drain plug and drain lubricant into container.
(5) Disconnect vent hose and vacuum harness at transfer case switch.
(6) Disconnect shift rod from grommet in transfer case shift lever, or from floor shift arm whichever provides easy access. Use channel lock style pliers to press rod out of lever grommet.
(7) Support transmission with jack stand.
(8) Remove rear crossmember.
(9) Mark front and rear propeller shafts for assembly reference.
(10) Remove front and rear propeller shafts.
(11) Support transfer case with suitable jack. Secure transfer case to jack with safety chains.
(12) Remove nuts attaching transfer case to transmission.
(13) Move transfer case assembly rearward until free of transmission output shaft.
(14) Lower jack and move transfer case from under vehicle.

INSTALLATION

(1) Align and seat transfer case on transmission. Be sure transfer case input gear splines are aligned with transmission output shaft. Align splines by rotating transfer case rear output shaft yoke if necessary. Do not install any transfer case attaching nuts until the transfer case is completely seated against the transmission.
(2) Install and tighten transfer case attaching nuts. If case has 5/16 in. studs, tighten nuts to 30-41 N·m (22-30 ft.lbs.). If case has 3/8 studs, tighten nuts to 41-47 N·m (30-35 ft. lbs.).
(3) Install rear crossmember.
(4) Remove jack stand from under transmission.
(5) Align and connect propeller shafts.
(6) Connect vacuum harness and vent hose.
(7) Connect shift rod to transfer case lever or floor shift arm. Use channel lock style pliers to press rod back into lever grommet.
(8) Adjust shift linkage, if necessary.
(9) Fill transfer case with recommended transmission fluid and install fill plug.
(10) Install skid plate, if equipped.
(11) Lower vehicle

SHIFT LEVER

REMOVAL

(1) Shift transfer case into 4L.
(2) Remove transfer case shifter knob cap.
(3) Remove nut holding shifter knob to shift lever.
(4) Remove shifter knob.
(5) Raise and support vehicle.
(6) Loosen adjusting trunnion lock bolt and slide shift rod out of trunnion. If rod lacks enough travel to come out of trunnion, push trunnion out of shift lever.
(7) Remove bolts holding shift lever to the underside of the body.
(8) Separate shift lever from vehicle.

INSTALLATION

(1) Position shift lever on vehicle. Use care when passing the shift lever through the shifter boot to prevent damage to the shifter boot.
(2) Install bolts to hold shift lever to the underside of the body.
(3) Install trunnion to shift lever, if necessary.
(4) Install shift rod to trunnion, if necessary.
(5) Lower vehicle.
(6) Install shift knob on shift lever.
(7) Install nut to hold shifter knob to shift lever.
(8) Install shifter knob cap.
(9) Adjust the transfer case shift linkage.
(10) Verify transfer case operation.

FRONT OUTPUT SHAFT SEAL

REMOVAL

(1) Shift transfer case into neutral.
(2) Remove companion flange nut (Fig. 3). Discard nut after removal. It is not reusable.
(3) Remove companion flange from output shaft. Use a suitable puller if flange can not be removed by hand.

REMOVAL AND INSTALLATION (Continued)

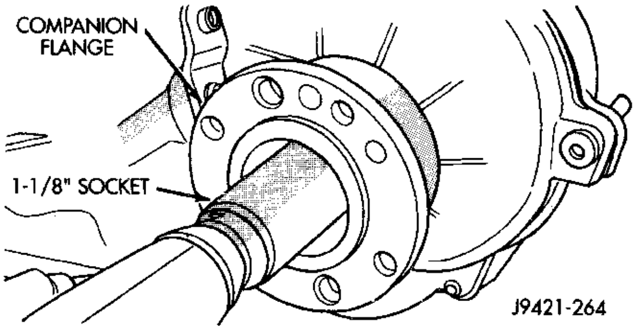

Fig. 3 Removing Companion Flange Nut

(4) Remove companion flange rubber seal from front output shaft (Fig. 4).

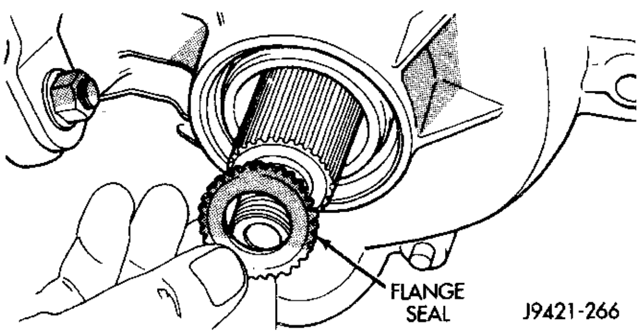

Fig. 4 Companion Flange Seal Removal

(5) Remove front output shaft seal with suitable pry tool, or a slide hammer mounted screw.

INSTALLATION

(1) Install new front output seal in front case with Installer Tool 6888 and Tool Handle C-4171 (Fig. 5) as follows:

(a) Place new seal on tool. Garter spring on seal goes toward interior of case.

(b) Start seal in bore. Once seal is started, continue tapping seal into bore until installer tool bottoms against case.

(c) Remove installer and verify that seal is recessed the proper amount. Seal should be 2.03 to 2.5 mm (0.080 to 0.100 in.) below top edge of seal bore in front case (Fig. 6). This is correct final seal position.

CAUTION: Be sure the front output seal is seated below the top edge of the case bore as shown. The seal could loosen, or become cocked if not seated to recommended depth.

(2) Install companion flange seal on front shaft (Fig. 7).

(3) Install companion flange on front shaft (Fig. 8). Then install and tighten flange nut to 176-271 N·m (130-200 ft. lbs.) torque.

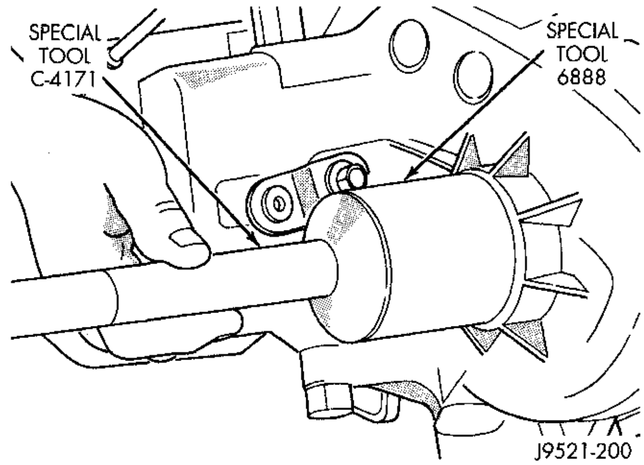

Fig. 5 Front Output Seal Installation

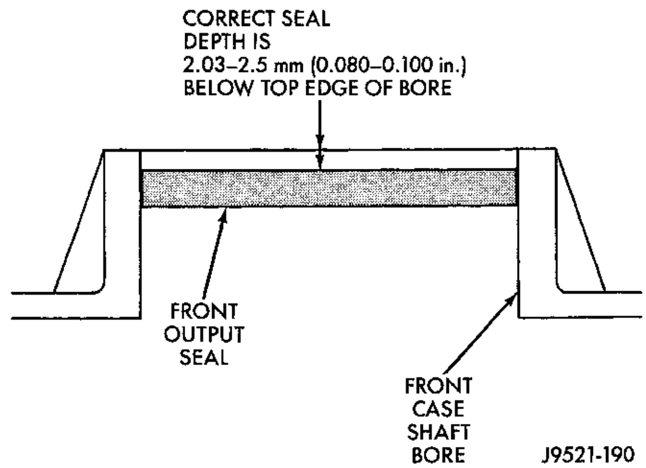

Fig. 6 Checking Front Output Seal Installation Depth

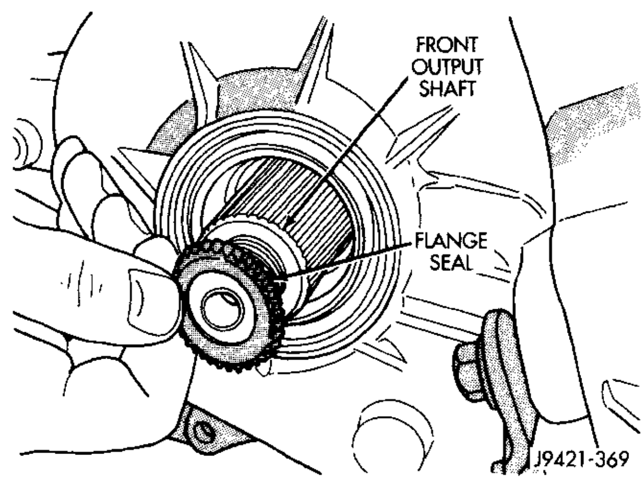

Fig. 7 Installing Flange Seal On Front Shaft

REMOVAL AND INSTALLATION (Continued)

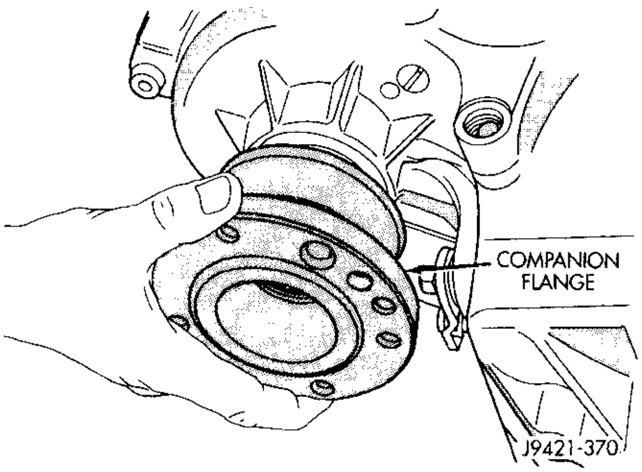

Fig. 8 Installing Companion Flange On Front Shaft

EXTENSION HOUSING BUSHING AND SEAL

REMOVAL

(1) Raise and support vehicle.

(2) Remove rear propeller shaft. Refer to Group 3, Differential and Driveline, for proper procedure.

(3) Using a suitable pry tool or slide-hammer mounted screw, remove the extension housing seal.

(4) Using Remover 8155, remove bushing from extension housing (Fig. 9).

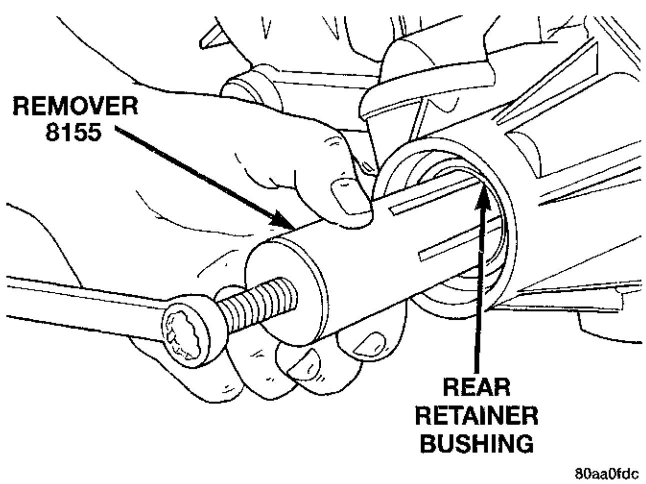

Fig. 9 Rear Retainer Bushing Removal

INSTALLATION

(1) Clean fluid residue from sealing surface and inspect for defects.

(2) Position replacement bushing in extension housing with fluid port in bushing aligned with slot in housing.

(3) Using Installer 8156, drive bushing into housing until installer seats against case (Fig. 10).

(4) Using Installer 8154, install seal in extension housing (Fig. 11).

(5) Install propeller shaft.

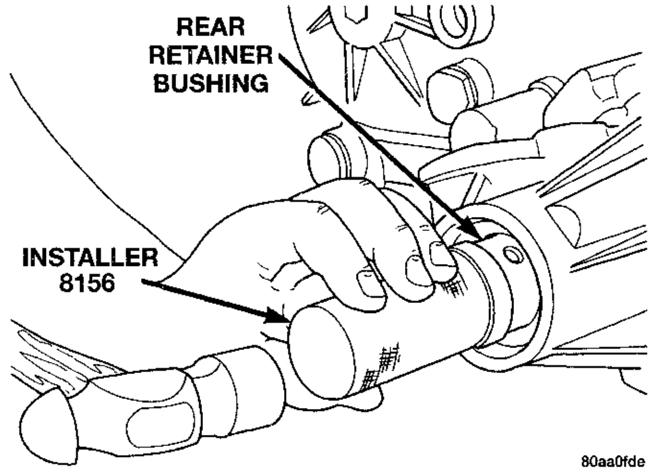

Fig. 10 Extension Housing Bushing Install

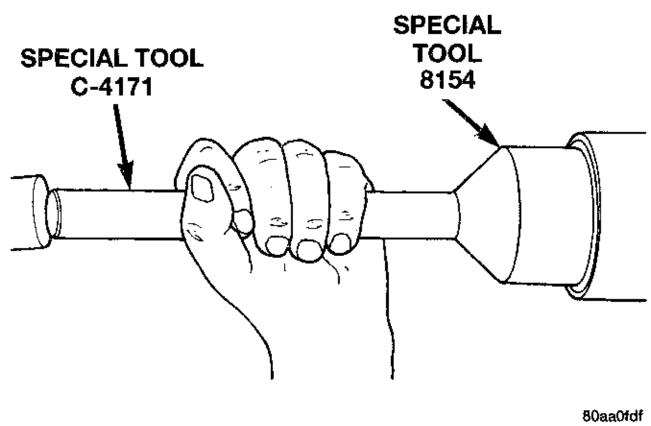

Fig. 11 Install Extension Housing Seal

(6) Verify proper fluid level.

(7) Lower vehicle.

DISASSEMBLY AND ASSEMBLY

TRANSFER CASE

DISASSEMBLY

Position transfer case in a shallow drain pan. Remove drain plug and drain any remaining lubricant remaining in case.

EXTENSION HOUSING REMOVAL

(1) Remove extension housing snap ring access cover.

(2) Remove bolts holding extension housing to rear case half.

(3) Tap extension housing with plastic or rawhide hammer to loosen sealant.

(4) Disengage extension housing snap ring from rear output shaft bearing.

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DISASSEMBLY AND ASSEMBLY (Continued)

(5) Separate extension housing from transfer case.

COMPANION FLANGE AND SHIFT LEVER REMOVAL

(1) Shift transfer case into neutral.

(2) Remove companion flange nut (Fig. 12). Discard nut after removal. It is not reusable.

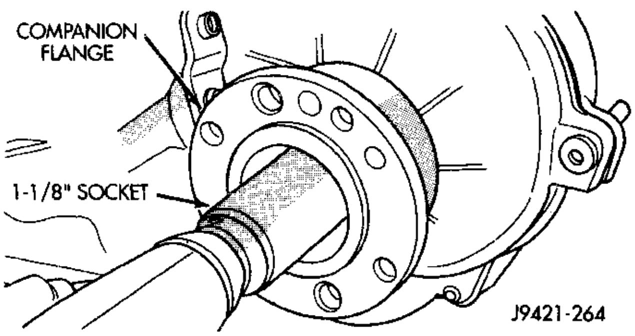

Fig. 12 Removing Companion Flange Nut

(3) Remove companion flange from front output shaft. Use a suitable puller if flange can not be removed by hand.

(4) Remove companion flange rubber seal from front output shaft (Fig. 13).

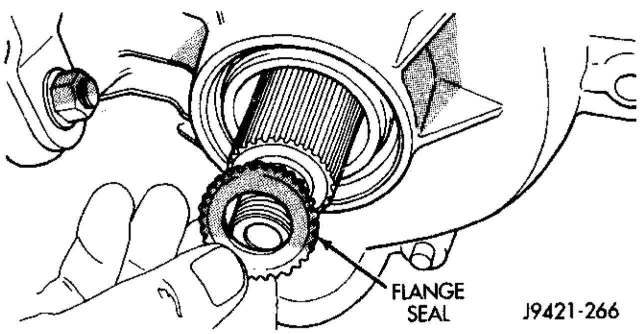

Fig. 13 Companion Flange Seal Removal

(5) Remove nut and washer that retain shift lever to sector shaft. Then remove shift lever from shaft (Fig. 14).

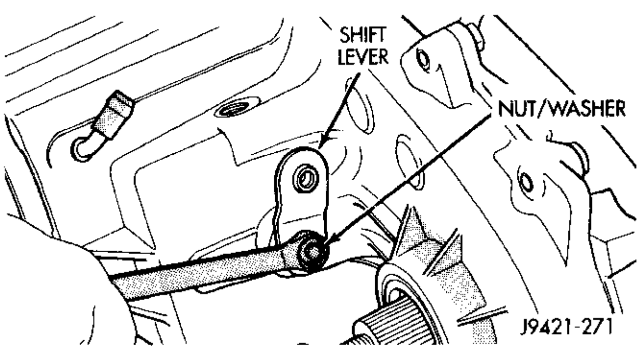

Fig. 14 Shift Lever Removal

FRONT OUTPUT SHAFT AND DRIVE CHAIN REMOVAL

(1) Remove output bearing retaining ring with heavy duty snap ring pliers.

(2) Remove output shaft bearing.

(3) Note position of bolts that attach rear case to front case (Fig. 15). Some bolts/studs at ends of case require flat washers. Mark position of these bolts with paint or scriber.

(4) Remove rear case-to-front case bolts.

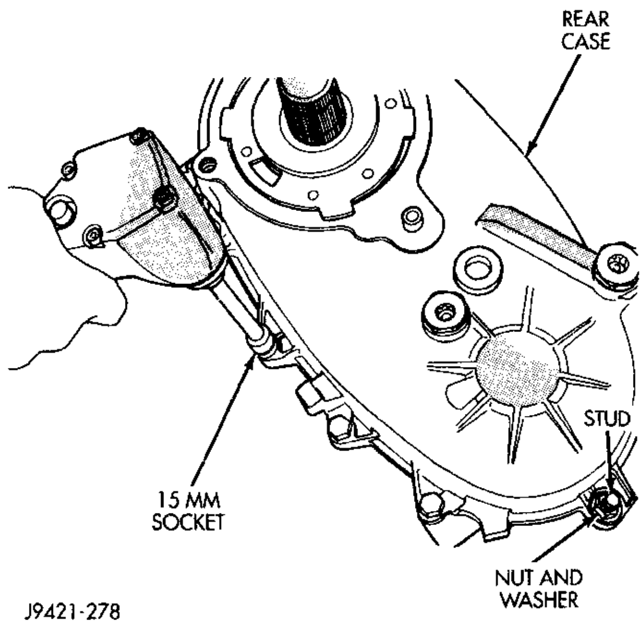

Fig. 15 Removing Case Attaching Bolts

(5) Loosen rear case with pry tool to break sealer bead. Insert tool in slot at each end of case (Fig. 16).

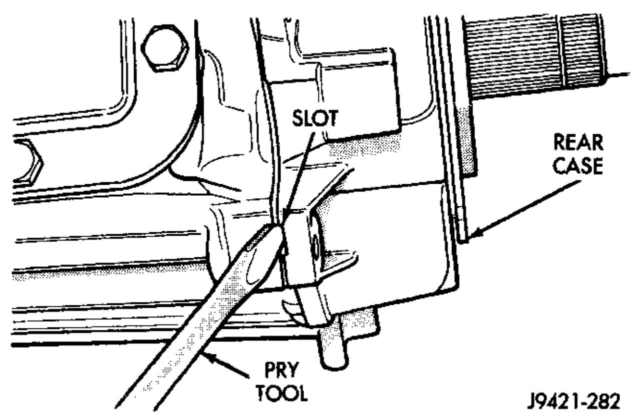

Fig. 16 Loosening Rear Case (Breaking Sealer Bead)

DISASSEMBLY AND ASSEMBLY (Continued)

(6) Unseat rear case from alignment dowels (Fig. 17).

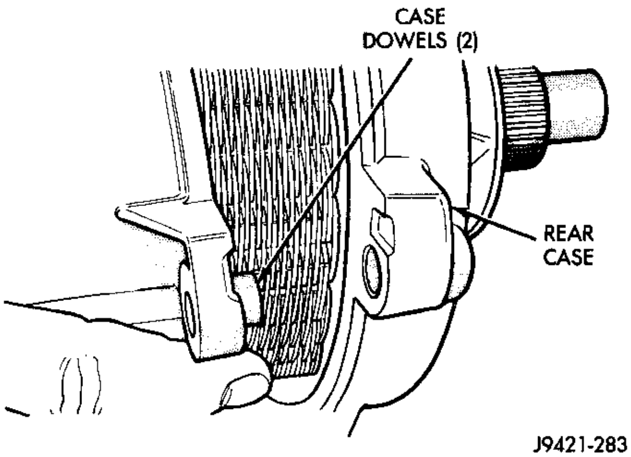

Fig. 17 Removing Rear Case From Alignment Dowels

(7) Remove rear case and oil pump assembly from front case.

(8) Remove shift rail cup and spring (Fig. 18).

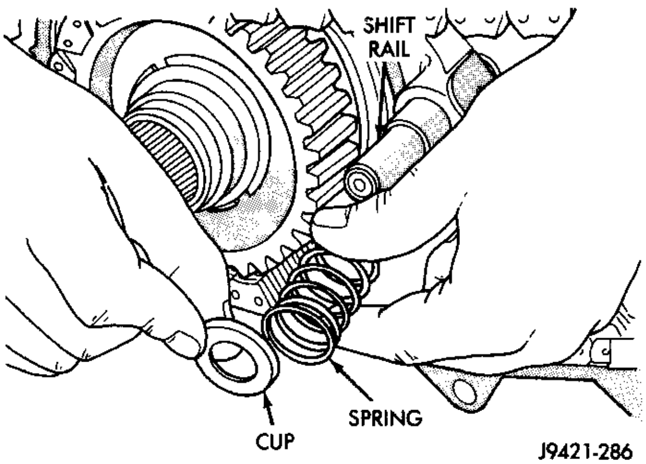

Fig. 18 Shift Rail Cup And Spring Removal

(9) Remove front sprocket retaining ring (Fig. 19).

(10) Pull mainshaft, front sprocket and chain outward about 25.4 mm (1–inch) simultaneously (Fig. 20).

(11) Remove chain from mainshaft drive sprocket and remove front sprocket and chain as assembly.

SHIFT FORK AND MAINSHAFT REMOVAL

(1) Remove vacuum/indicator switch (Fig. 21).

(2) Loosen poppet plunger screw (Fig. 22).

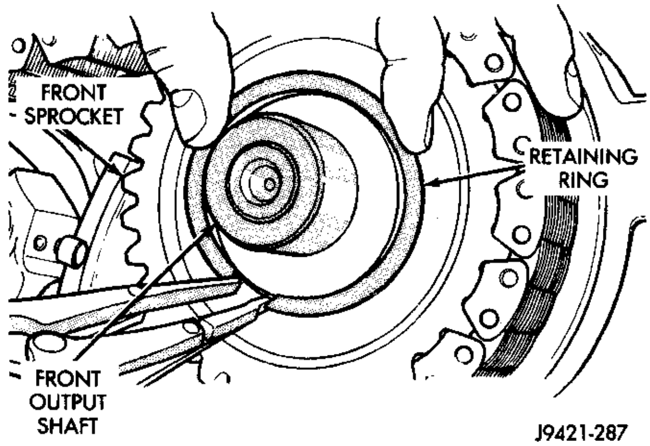

Fig. 19 Removing Front Sprocket Retaining Ring

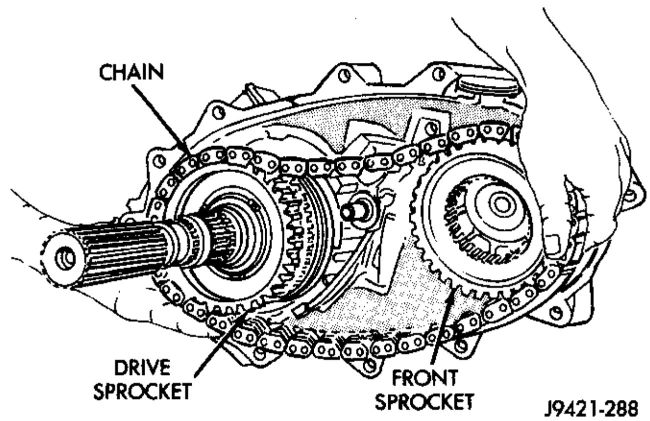

Fig. 20 Removing Drive Chain And Front Sprocket

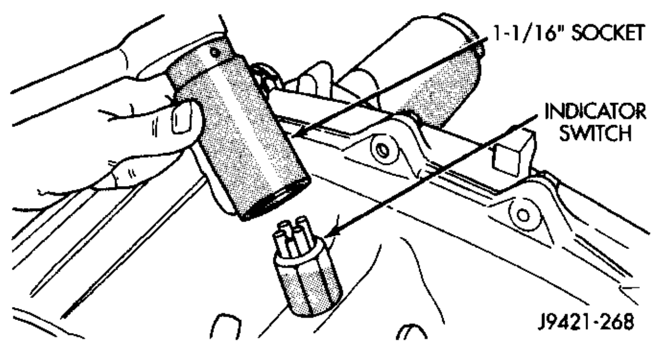

Fig. 21 Vacuum/Indicator Switch Removal

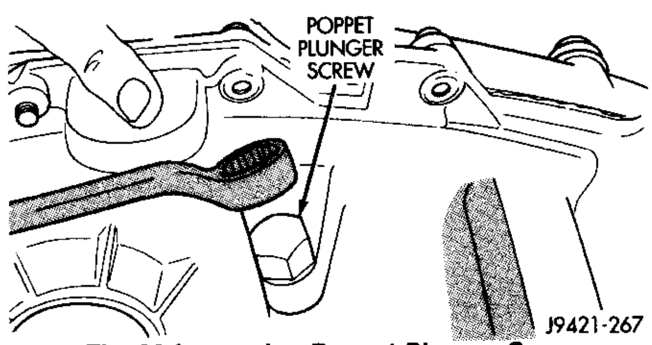

Fig. 22 Loosening Poppet Plunger Screw

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DISASSEMBLY AND ASSEMBLY (Continued)

(3) Remove poppet plunger screw and spring (Fig. 23). Note that screw has O-ring seal. Remove and discard seal this seal.

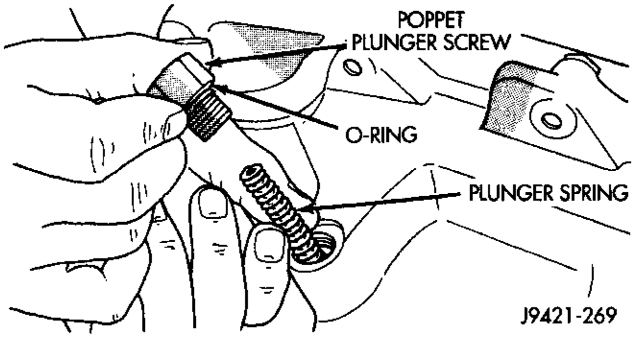

Fig. 23 Poppet Plunger Screw And Spring Removal

(4) Remove poppet plunger with magnet (Fig. 24).

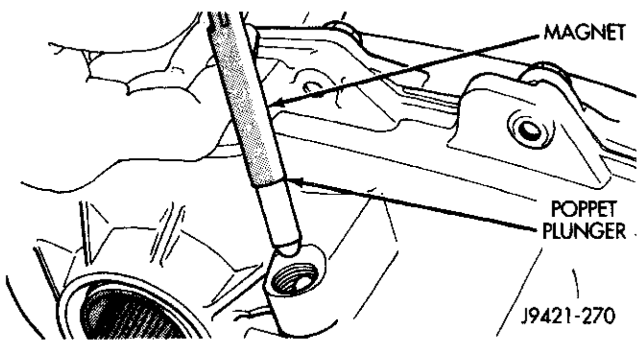

Fig. 24 Poppet Plunger Removal

(5) Remove front output shaft from bearing in case (Fig. 25).

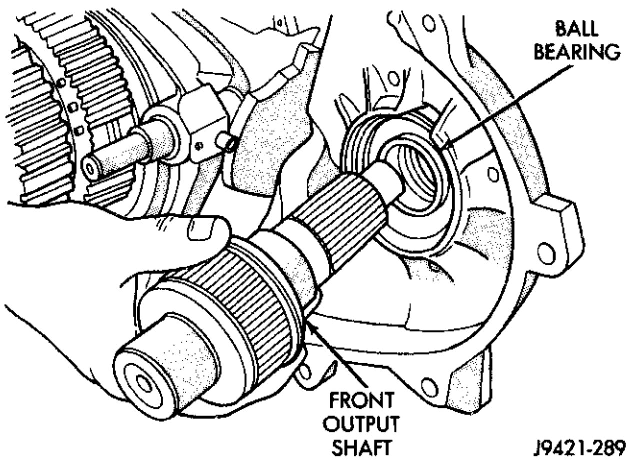

Fig. 25 Front Output Shaft Removal

(6) Pull mainshaft assembly out of input gear, sliding clutch and case (Fig. 26).

(7) Remove mode fork, sliding clutch and shift rail as assembly (Fig. 27). Note which way clutch fits in fork (long side of clutch goes to front).

(8) Remove range fork retaining ring (Fig. 28).

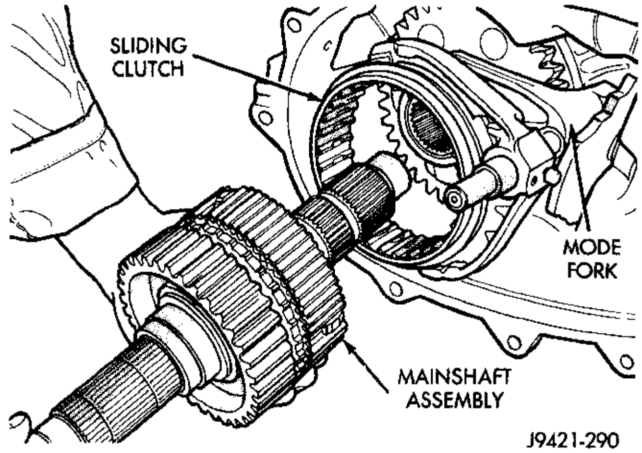

Fig. 26 Mainshaft Assembly Removal

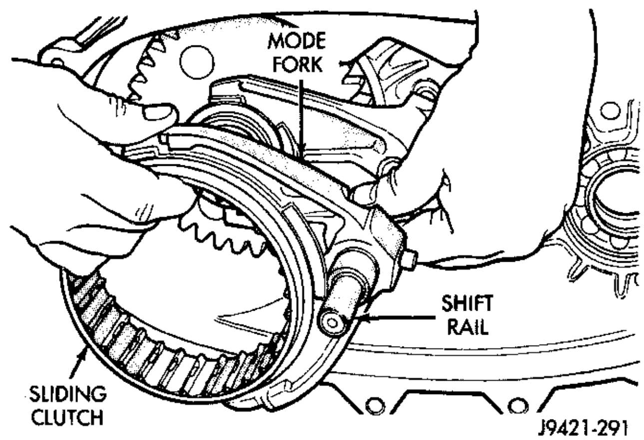

Fig. 27 Mode Fork, Shift Rail And Sliding Clutch Removal

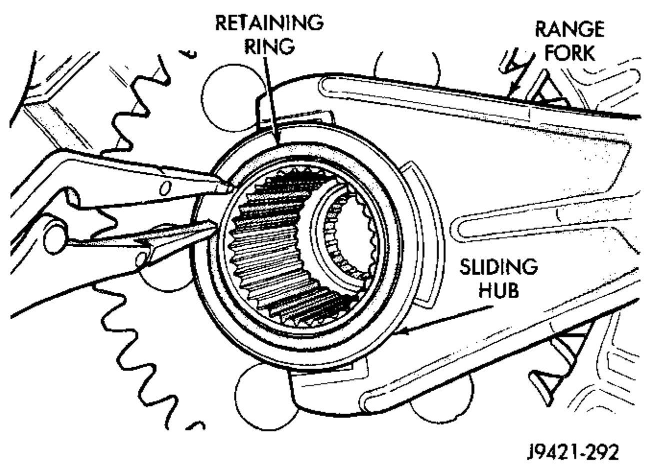

Fig. 28 Range Fork Retaining Ring Removal

DISASSEMBLY AND ASSEMBLY (Continued)

(9) Remove range fork and support sleeve as assembly (Fig. 29).

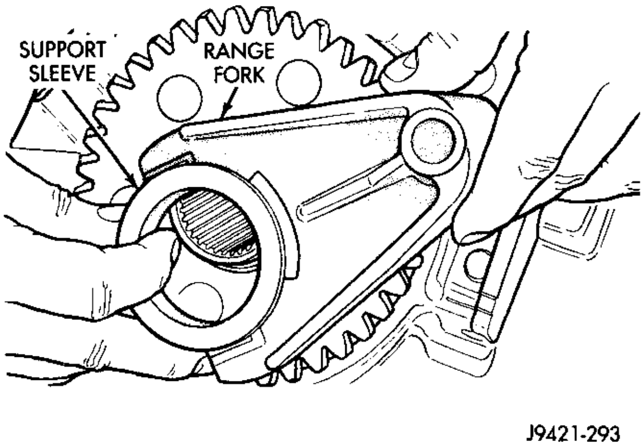

Fig. 29 Range Fork And Support Sleeve Removal

(10) Remove shift sector (Fig. 30).

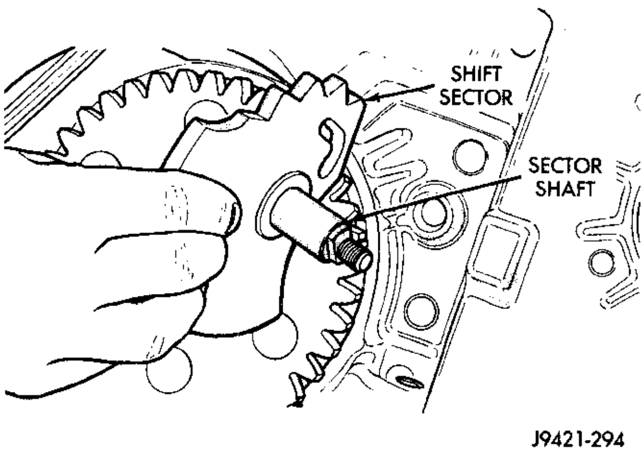

Fig. 30 Shift Sector Removal

(11) Remove shift sector shaft nylon retainer and O–ring from shaft bore in front case (Fig. 31).

MAINSHAFT DISASSEMBLY

(1) Remove retaining ring that secures synchro hub on mainshaft (Fig. 32). Use standard (instead of parallel jaw) snap ring pliers to remove this retaining ring.

(2) Remove synchro hub (Fig. 33).

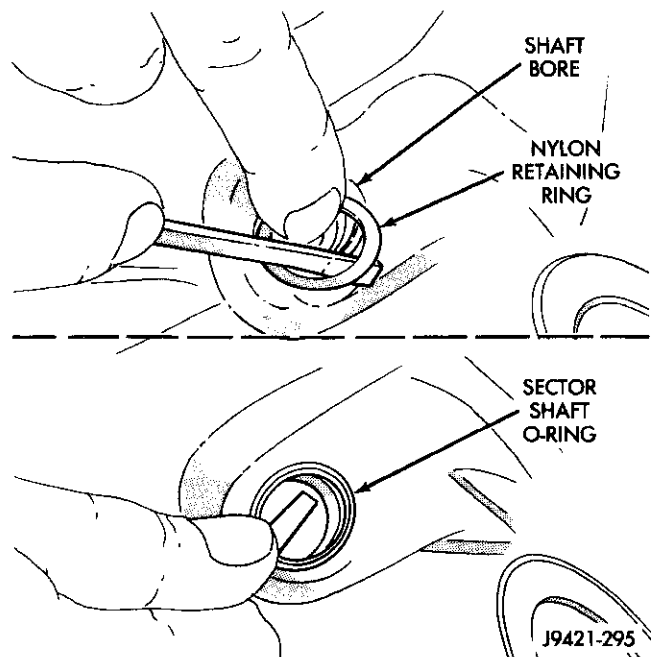

Fig. 31 Removing Sector Shaft O–Ring And Retainer

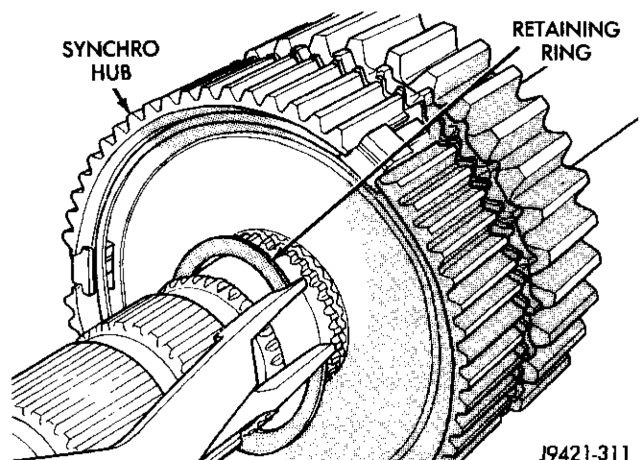

Fig. 32 Synchro Hub Retaining Ring Removal

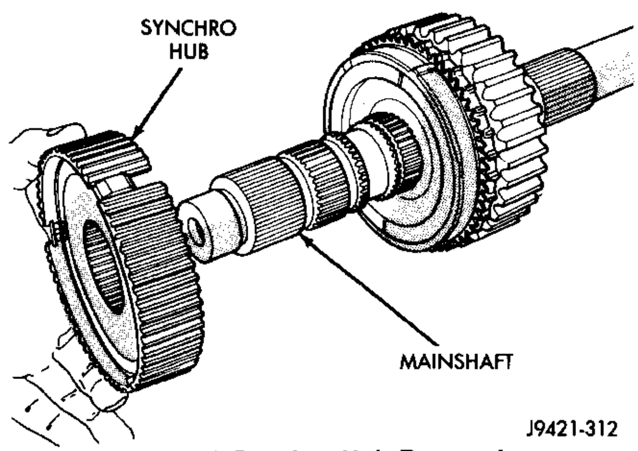

Fig. 33 Synchro Hub Removal

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DISASSEMBLY AND ASSEMBLY (Continued)

(3) Inspect synchro hub struts and springs. If struts appear worn, remove struts and springs from hub. Note position of springs for installation reference (Fig. 34).

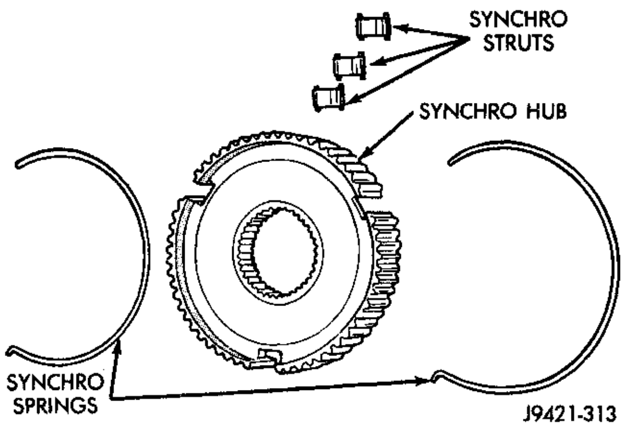

Fig. 34 Synchro Strut And Spring Removal

(4) Remove brass stop ring (Fig. 35). Discard stop ring if worn, cracked, or any teeth are missing.

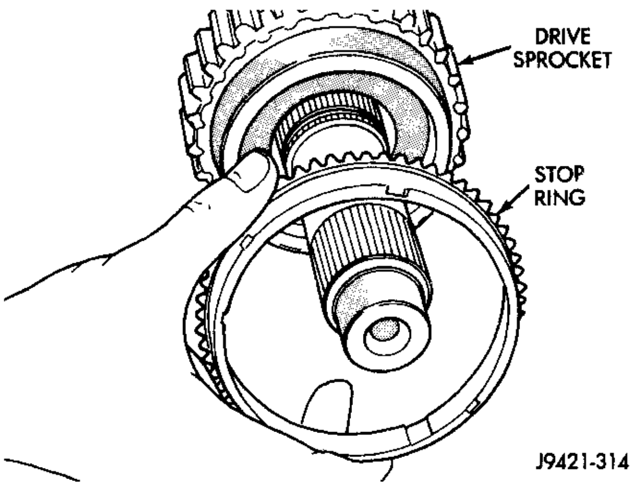

Fig. 35 Synchro Stop Ring Removal

(5) Remove drive sprocket (Fig. 36).

INPUT AND PLANETARY GEAR REMOVAL

(1) Remove input bearing retainer bolts (Fig. 37). A 10 mm socket is required.

(2) Loosen bearing retainer with pry tool. Insert tool in retainer slot as shown (Fig. 38). Then remove retainer.

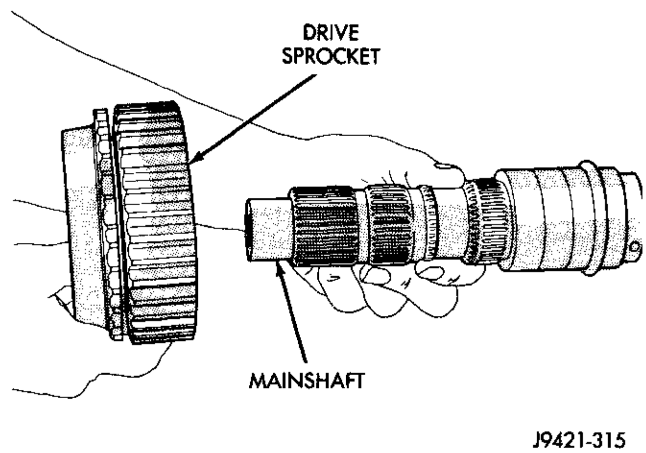

Fig. 36 Drive Sprocket Removal

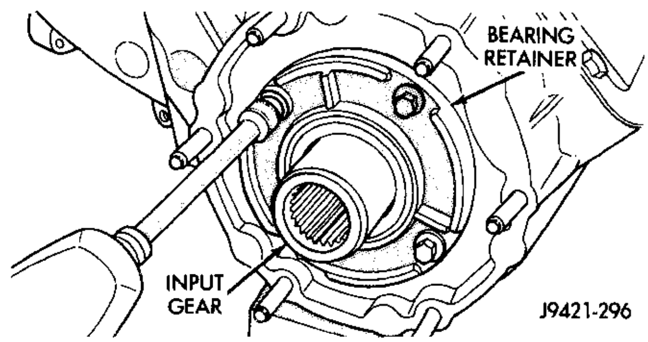

Fig. 37 Removing Input Bearing Retainer Bolts

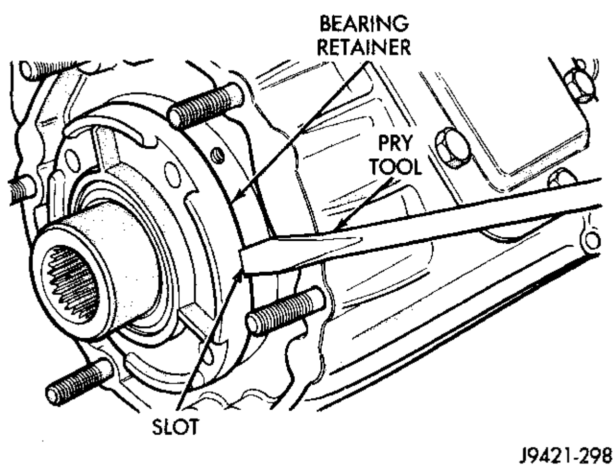

Fig. 38 Loosening/Removing Input Bearing Retainer

DISASSEMBLY AND ASSEMBLY (Continued)

(3) Remove input gear retaining ring with heavy duty parallel jaw snap ring pliers (Fig. 39).

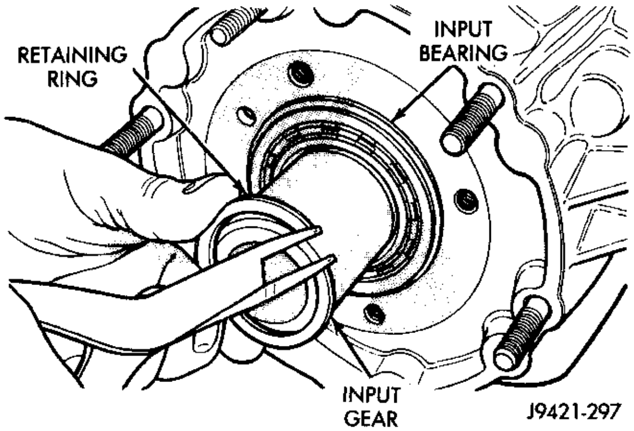

Fig. 39 Removing Input Gear Retaining Ring

(4) Tap input gear out of bearing with plastic mallet (Fig. 40).

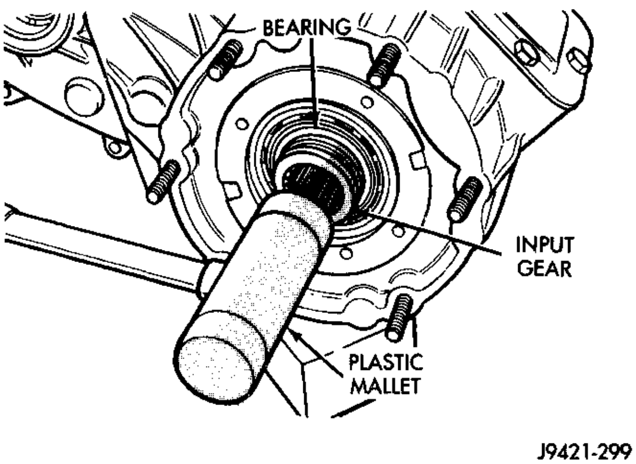

Fig. 40 Removing Input Gear Retaining Ring

(5) Remove input gear and planetary/PTO gear as assembly (Fig. 41).

INPUT AND PLANETARY GEAR DISASSEMBLY

The only removable parts in the planetary assembly are the snap rings, needle bearing, thrust washers, lock ring, input gear, and support sleeve. **The planetary carrier, PTO gear, planetary pinions, and remaining planetary components are fixed parts and are serviced as an assembly.**

(1) Position planetary assembly so PTO gear is on bench (Fig. 42).

(2) Remove retaining ring that secures input gear and lock ring in planetary assembly.

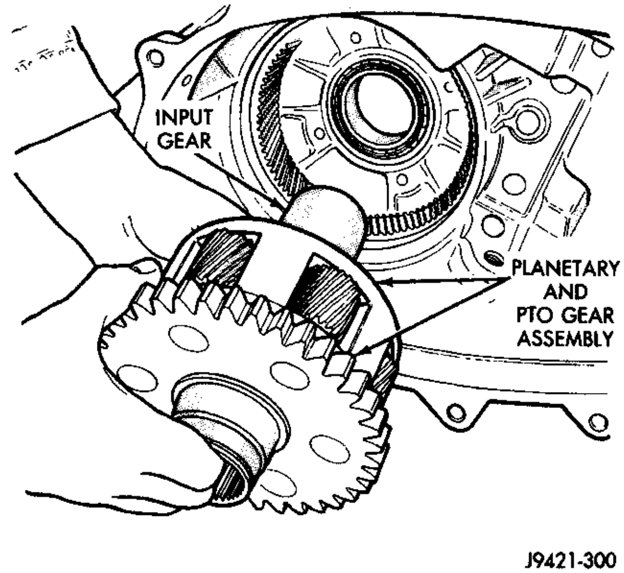

Fig. 41 Input Gear And Planetary Assembly Removal

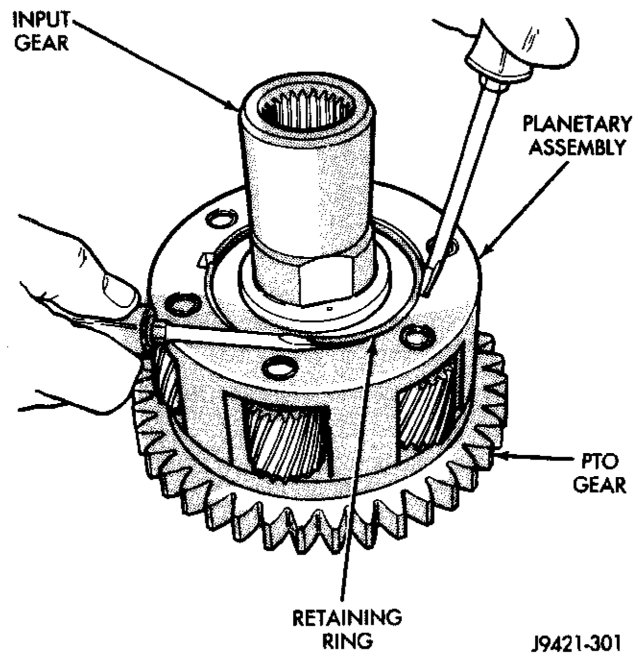

Fig. 42 Removing Lock Ring/Input Gear Retaining Ring

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DISASSEMBLY AND ASSEMBLY (Continued)

(3) Remove lock ring and front thrust washer from carrier (Fig. 43). Note that lock ring and thrust washer are both tabbed.

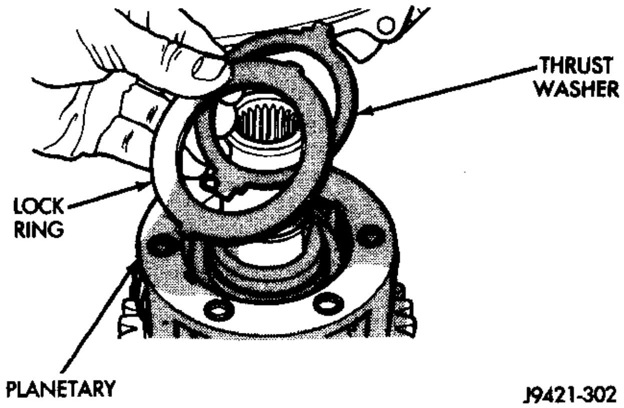

Fig. 43 Planetary Lock Ring And Front Thrust Washer Removal

(4) Remove input gear from planetary carrier (Fig. 44). Lift gear straight up and out of carrier.

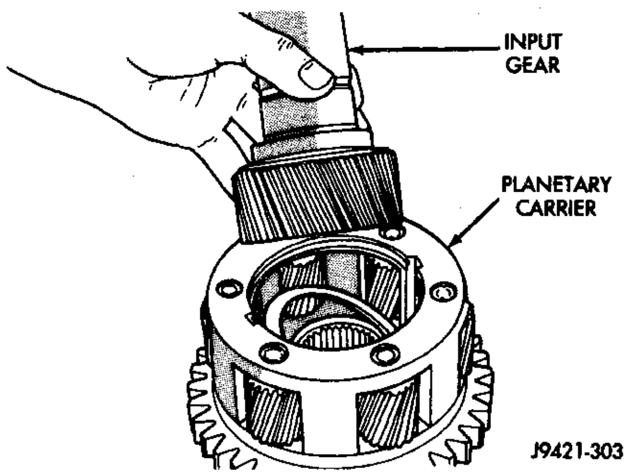

Fig. 44 Removing Input Gear From Planetary Carrier

(5) Remove support sleeve from carrier (Fig. 45).
(6) Remove rear thrust washer (Fig. 46).

ASSEMBLY

BEARING AND SEAL REPLACEMENT

(1) Using Remover C-4210 and Handle C-4171, drive input shaft bearing from case from inside annulus gear opening (Fig. 47).
(2) Install locating ring on new bearing.
(3) Position case so that the forward end is facing upward.
(4) Using Remover C-4210 and Handle C-4171, drive input shaft bearing into case. The bearing locating ring must be fully seated on case (Fig. 48).

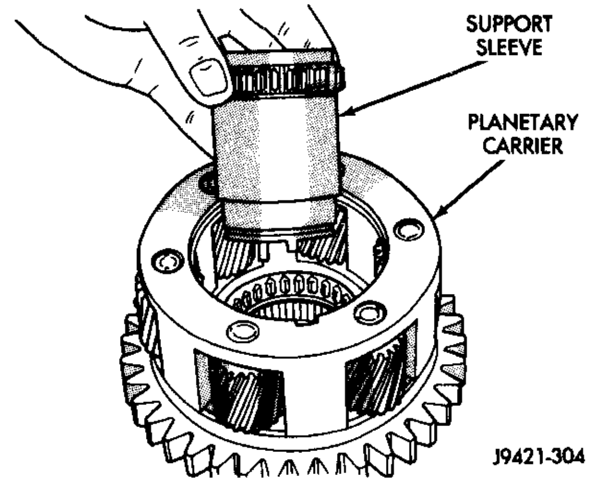

Fig. 45 Support Sleeve Removal

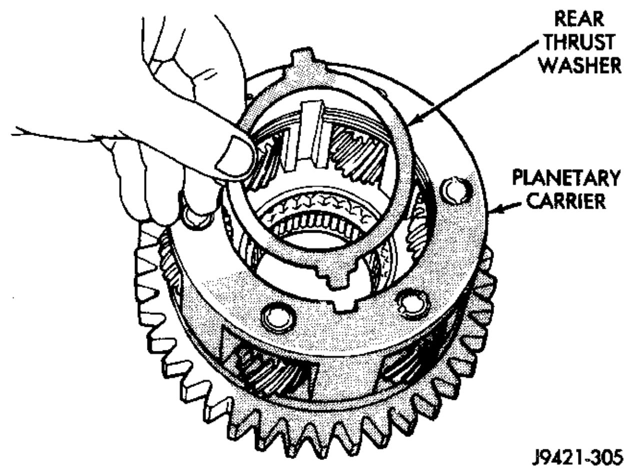

Fig. 46 Rear Thrust Washer Removal

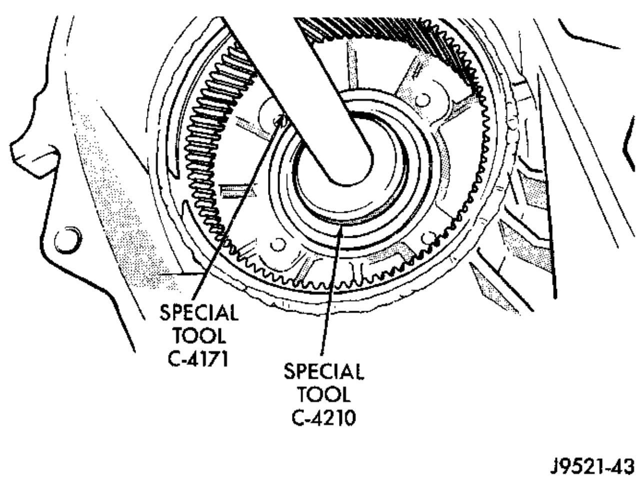

Fig. 47 Input Shaft Bearing Removal

(5) Using Installer 6953, remove front output shaft bearing.

DISASSEMBLY AND ASSEMBLY (Continued)

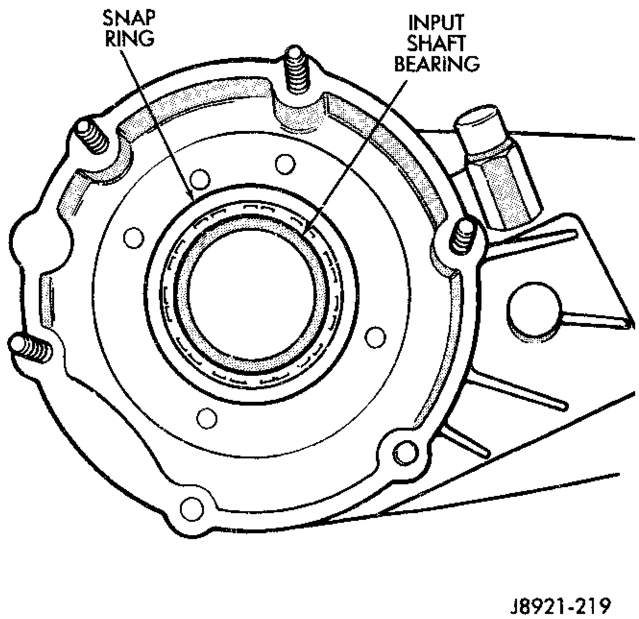

Fig. 48 Seating Input Shaft Bearing

5(6) Start front shaft output bearing in case (Fig. 49). Then seat bearing with Handle C-4171 and Installer 6953.

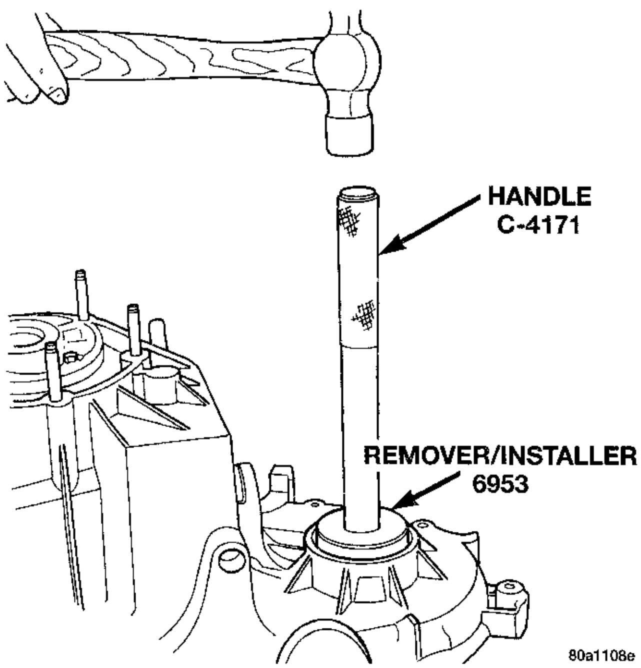

Fig. 49 Front Output Bearing Installation

(7) Install front output bearing retaining ring.

(8) Install new front output seal in front case with Installer Tool 6888 and Tool Handle C-4171 as follows:

(a) Place new seal on tool. **Garter spring on seal goes toward interior of case.**

(b) Start seal in bore with light taps from hammer (Fig. 51). Once seal is started, continue tapping seal into bore until installer tool bottoms against case.

(c) Remove installer and verify that seal is recessed the proper amount. Seal should be 2.03 to 2.5 mm (0.080 to 0.100 in.) below top edge of seal bore in front case (Fig. 64). This is correct final seal position.

CAUTION: Be sure the front output seal is seated below the top edge of the case bore as shown. The seal could loosen, or become cocked if not seated to recommended depth.

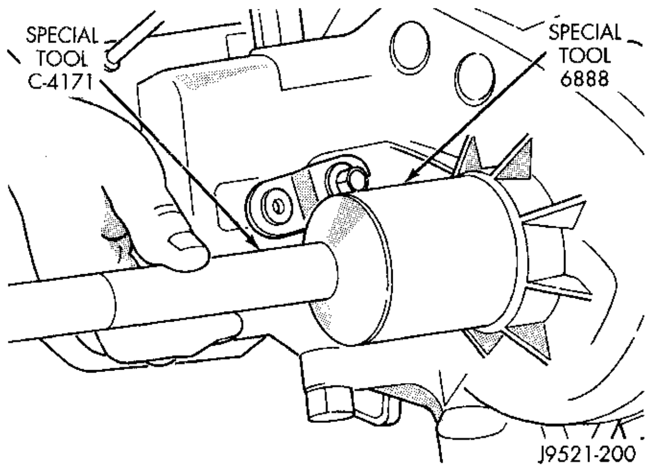

Fig. 50 Front Output Seal Installation

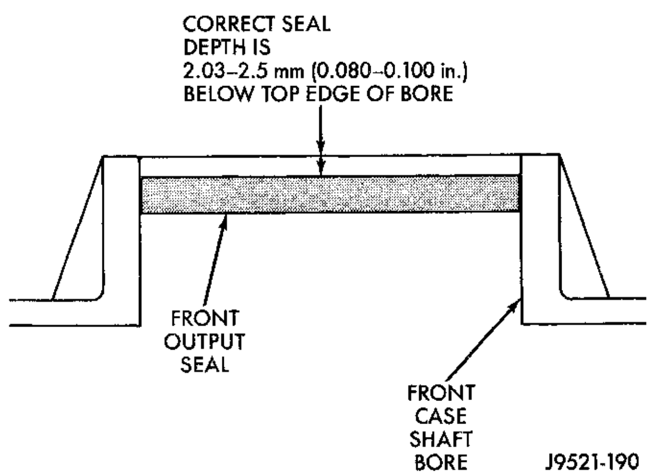

Fig. 51 Checking Front Output Seal Installation Depth

DISASSEMBLY AND ASSEMBLY (Continued)

(9) Remove seal from front bearing retainer with suitable pry tool.

(10) Install new oil seal in front bearing retainer with Installer 7884 (Fig. 52).

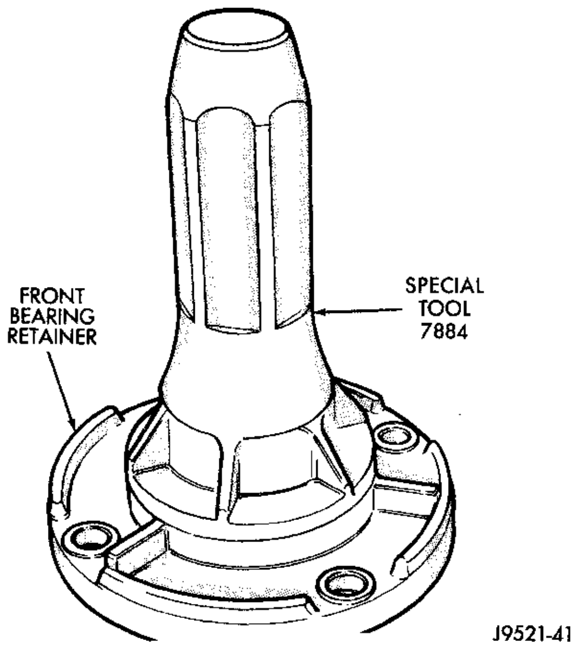

Fig. 52 Install Front Bearing Retainer Seal

(11) Remove seal from oil pump with suitable pry tool.

(12) Install new seal in oil pump with Installer 7888 (Fig. 53).

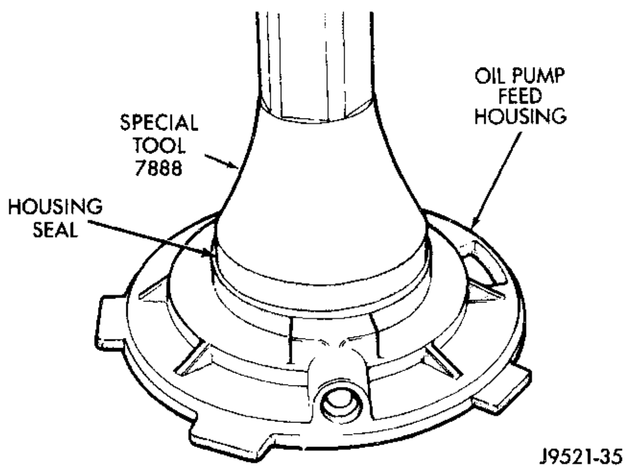

Fig. 53 Install Oil Pump Seal

(13) Inspect carrier needle bearing. If bearing is worn, rough, or damaged in any way, remove it with a brass punch and hammer (Fig. 54).

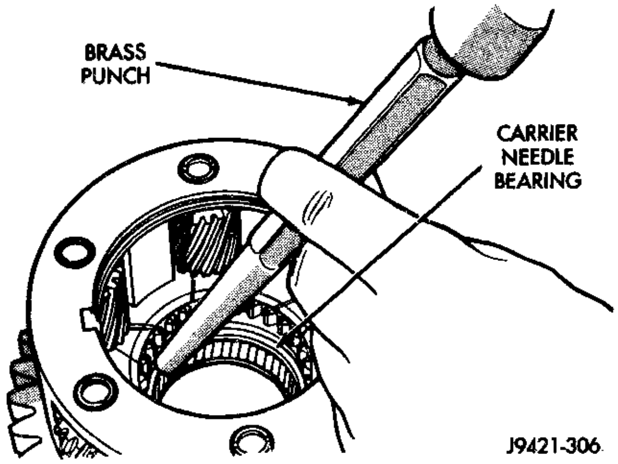

Fig. 54 Carrier Needle Bearing Removal

(14) Install new needle bearing in planetary carrier (Fig. 55). Use Handle C–4171 and Installer 5062 to install bearing.

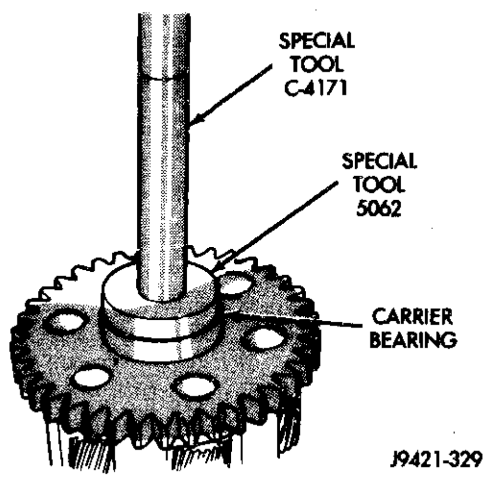

Fig. 55 Planetary Carrier Needle Bearing Installation

DISASSEMBLY AND ASSEMBLY (Continued)

(15) Remove input gear pilot bearing by inserting a suitably sized drift into the splined end of the input gear and driving the bearing out with the drift and a hammer (Fig. 56).

(16) Install new pilot bearing with Plug C-293-3.

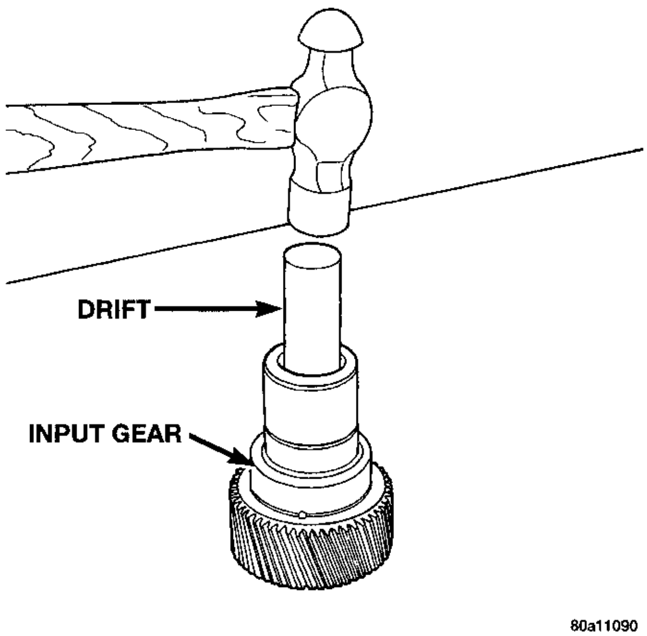

Fig. 56 Remove Input Gear Pilot Bearing

(17) Remove the output shaft rear bearing with the screw and jaws from Remover L-4454 and Cup 8148 (Fig. 57).

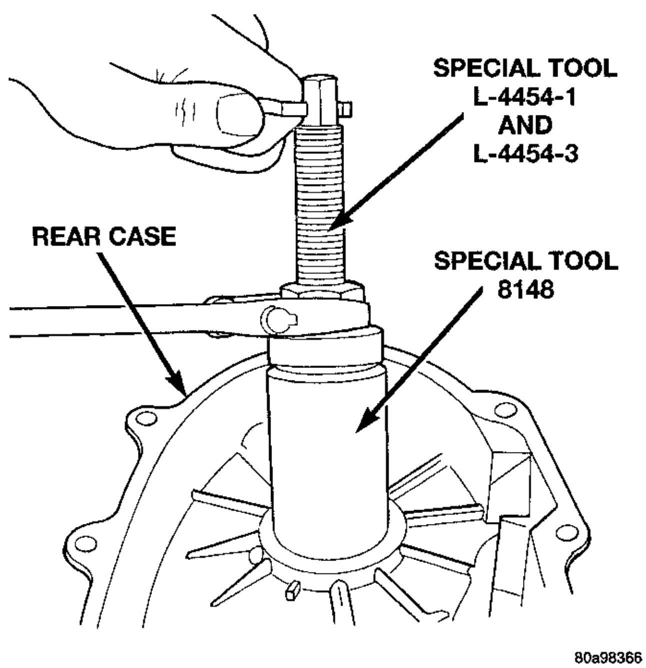

Fig. 57 Output Shaft Rear Bearing Removal

(18) Install new bearing with Tool Handle C-4171 and Installer 5066 (Fig. 58). The bearing bore is chamfered at the top. Install the bearing so it is flush with the lower edge of this chamfer (Fig. 59).

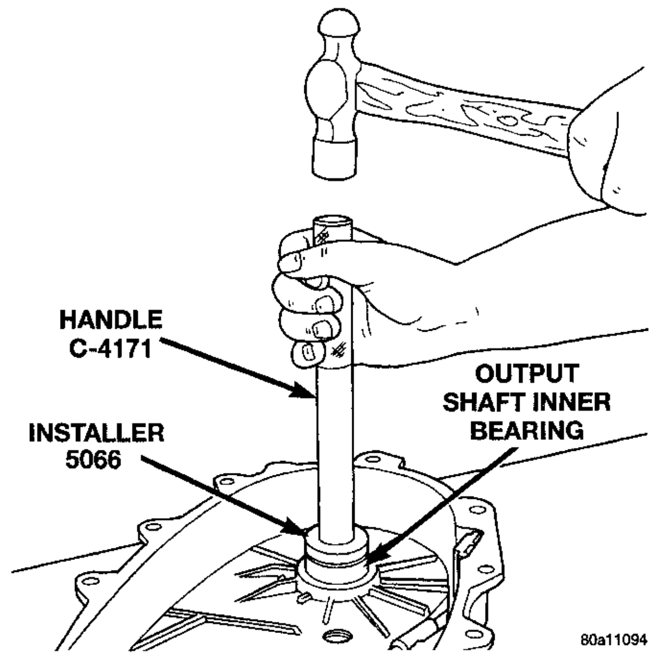

Fig. 58 Output Shaft Rear Bearing Installation

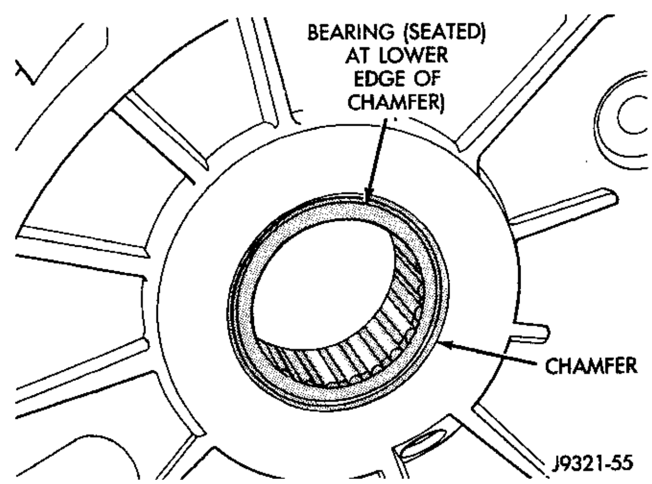

Fig. 59 Output Shaft Rear Bearing Installation Depth

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DISASSEMBLY AND ASSEMBLY (Continued)

INPUT AND PLANETARY GEAR ASSEMBLY

(1) Lubricate planetary components with transmission fluid.

(2) Install first thrust washer in carrier (Fig. 60). Lube washer with petroleum jelly before installation.

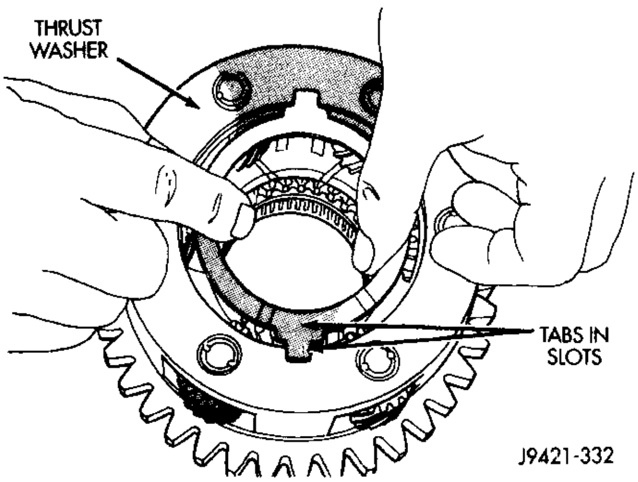

Fig. 60 Thrust Washer Installation

(3) Support carrier with wood blocks under PTO gear (Fig. 61).

(4) Install support sleeve in planetary carrier. Be sure sleeve is seated.

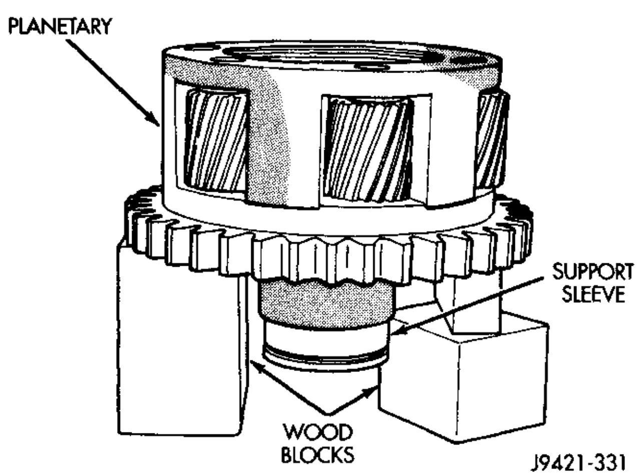

Fig. 61 Support Sleeve Installation

(5) Install input gear in planetary carrier (Fig. 62).

(6) Install second thrust washer in planetary carrier. Be sure washer tabs are seated in carrier slots.

(7) Install lock ring (Fig. 63).

(8) Install retaining ring (Fig. 64).

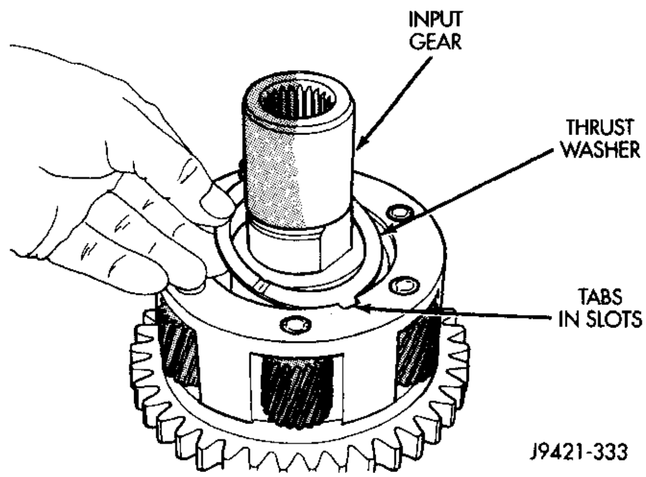

Fig. 62 Input Gear And Thrust Washer Installation

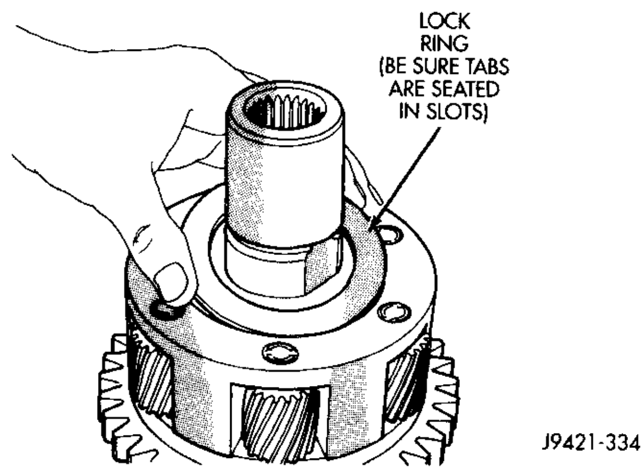

Fig. 63 Lock Ring Installation

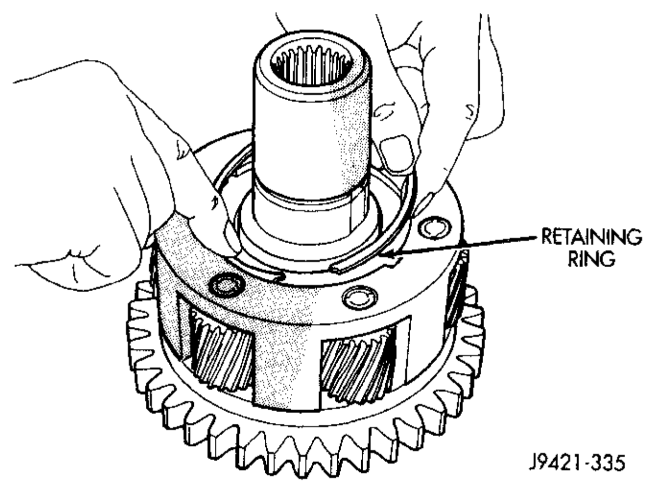

Fig. 64 Retaining Ring Installation

DISASSEMBLY AND ASSEMBLY (Continued)

INPUT AND PLANETARY GEAR INSTALLATION

(1) Lubricate planetary pinions and annulus gear with transmission fluid.

(2) Install planetary/input gear assembly in case (Fig. 65).

(3) Start planetary pinions in low range annulus gear. Then tap PTO gear, with hammer handle to seat planetary pinions in annulus gear.

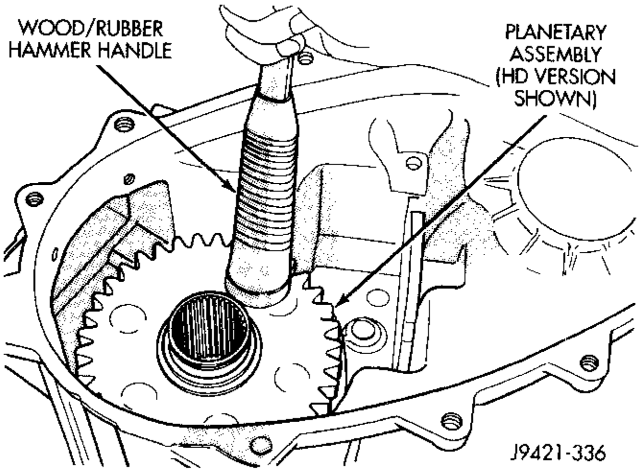

Fig. 65 Planetary/Input Gear Assembly Installation

(4) Install retaining ring on input gear (Fig. 66).

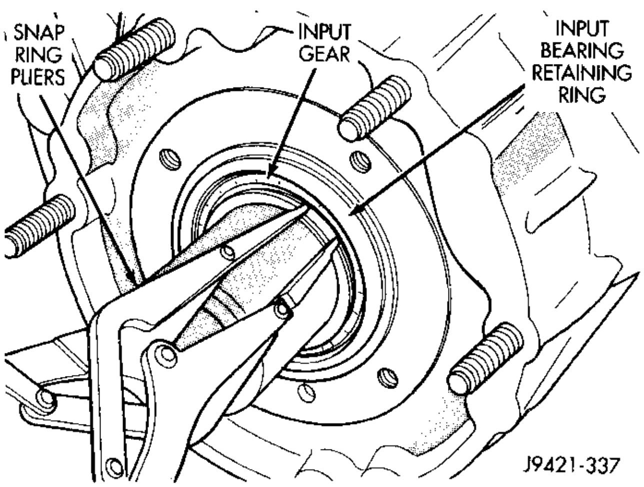

Fig. 66 Installing Input Gear Retaining Ring

(5) Apply bead of Mopar® Gasket Maker, or equivalent, to mating surface of input retainer. Keep sealer bead width to maximum of 3/16 inch. Do not use excessive amount of sealer as excess could be displaced into oil channel and feed hole in case.

(6) Align oil channel in retainer with oil feed hole in front case (Fig. 67).

(7) Install retainer on input gear shaft and front case (Fig. 68).

(8) Apply Mopar® silicone sealer to threads of input retainer bolts. Then install and tighten bolts to 27-34 N·m (20-25 ft. lbs.) torque.

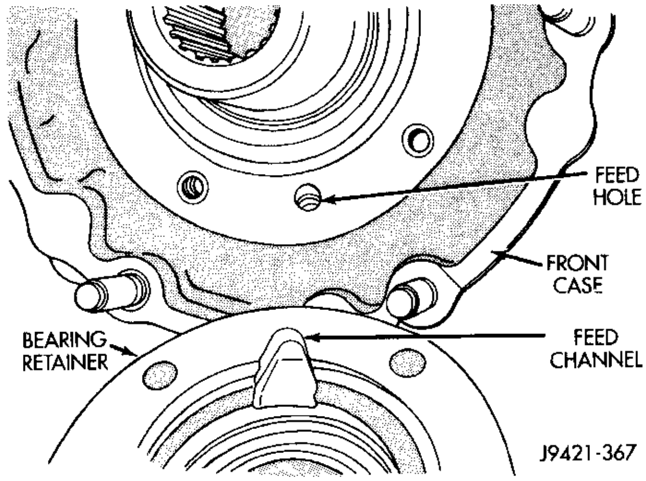

Fig. 67 Aligning Retainer Oil Channel and Case Feed Holes

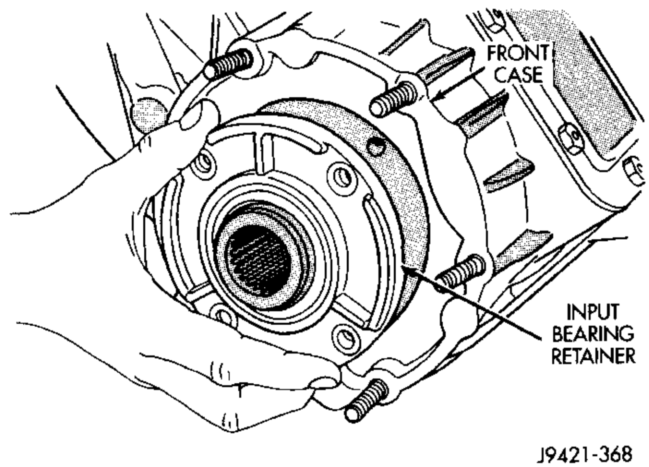

Fig. 68 Input Bearing Retainer Installation

MAINSHAFT ASSEMBLY

(1) Install drive sprocket on mainshaft (Fig. 69).

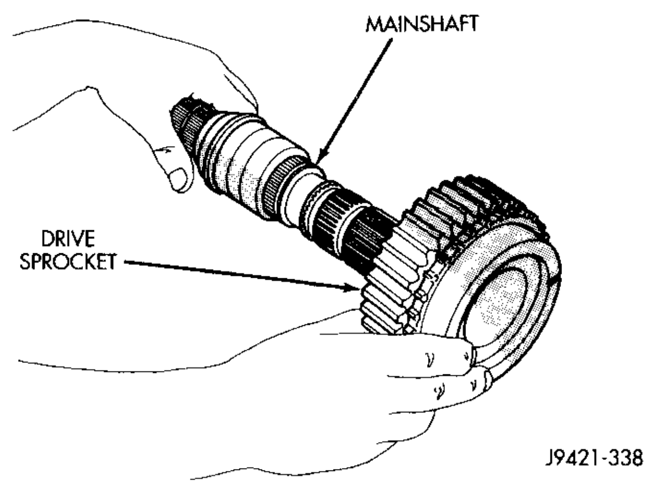

Fig. 69 Drive Sprocket Installation

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DISASSEMBLY AND ASSEMBLY (Continued)

(2) Install brass stop ring on drive sprocket (Fig. 70).

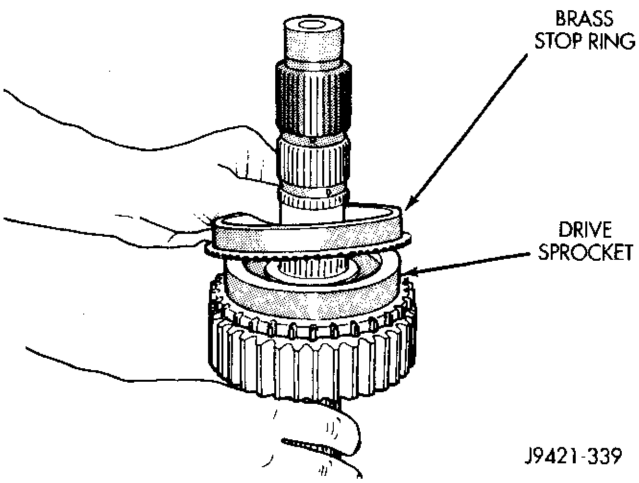

Fig. 70 Synchro Stop Ring Installation

(3) Install 3 synchro struts and 2 springs in hub as follows:

(a) Insert first strut in hub (Fig. 71). Strut shoulders rest (and slide) on sides hub slot as shown.

(b) Insert hooked end of first spring in center of strut to secure it. Then work spring into hub (Fig. 72).

(c) Press spring inward and insert last two struts in hub slots. Be sure spring is positioned under struts to properly secure them (Fig. 73).

(d) Turn hub over and install remaining spring in hub. Position hooked end of second spring 180° away from first spring end.

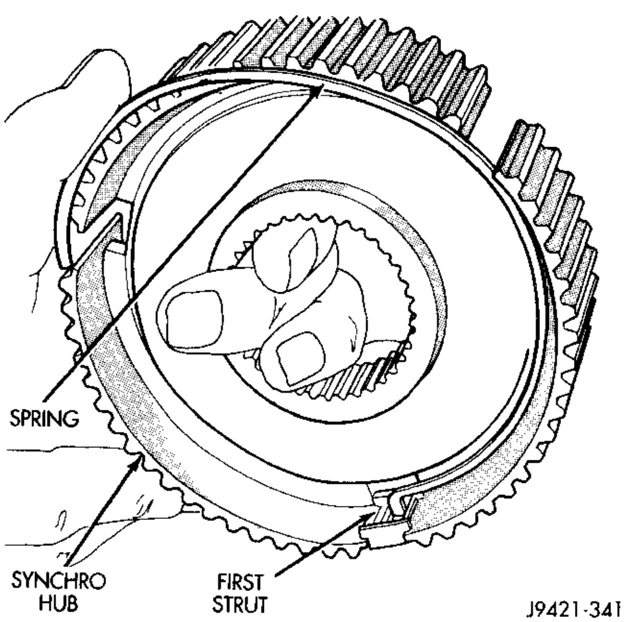

Fig. 71 Installing First Synchro Strut And Spring

(4) Install assembled synchro hub on mainshaft (Fig. 74). Hub has shoulder on one side which goes toward sprocket (rear of shaft). Flat side of hub faces front of shaft.

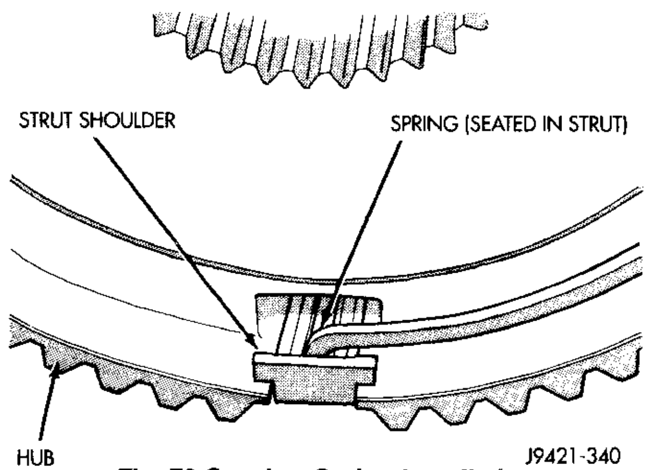

Fig. 72 Synchro Spring Installation

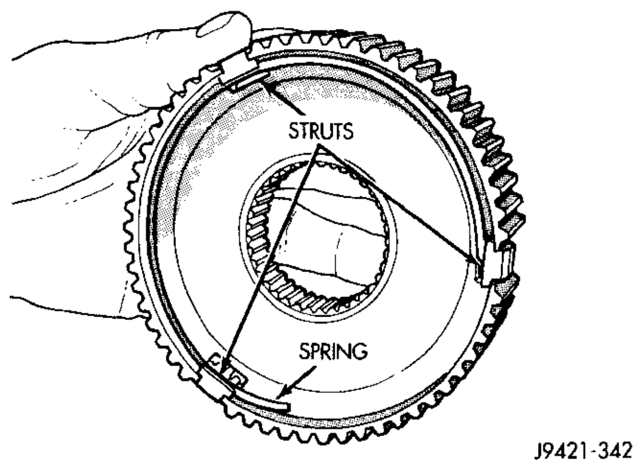

Fig. 73 Correct Position Of Struts And Springs

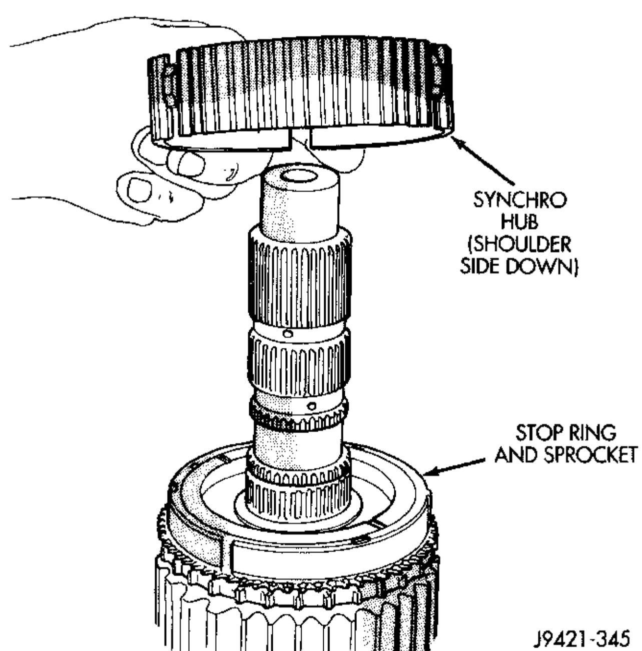

Fig. 74 Synchro Hub Installation

DISASSEMBLY AND ASSEMBLY (Continued)

(5) Install synchro hub retaining ring (Fig. 75). Be sure ring is fully seated before proceeding.

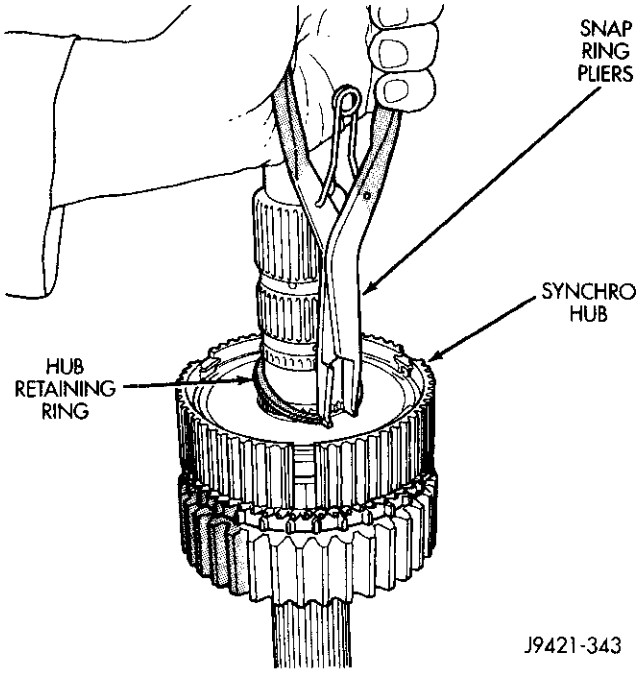

Fig. 75 Synchro Hub Retaining Ring Installation

(6) Install sliding clutch (sleeve) on synchro hub (Fig. 76).

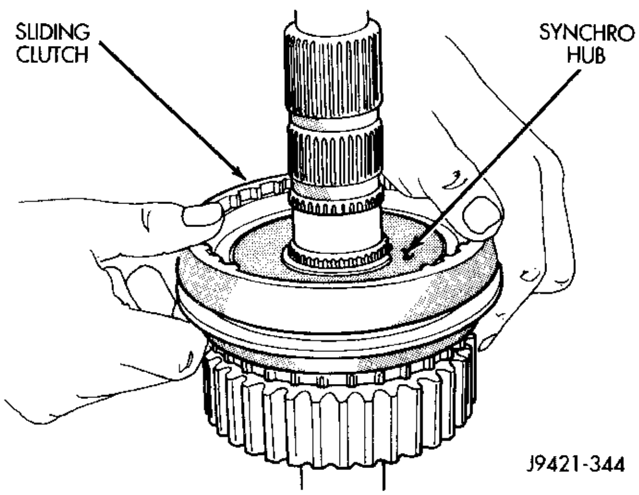

Fig. 76 Sliding Clutch Installation

CAUTION: The sliding clutch must be correctly positioned to ensure proper shifting. Position the clutch on the hub so a clutch spline is centered over each strut as shown (Fig. 77). If the clutch is installed so a gap between splines is aligned with one or more struts, gear clash will result.

SHIFT FORKS AND MAINSHAFT INSTALLATION

(1) Support front case on wood blocks so case interior is facing up. Place blocks between mounting studs on forward surface of case. Be sure blocks will not interfere with input gear installation.

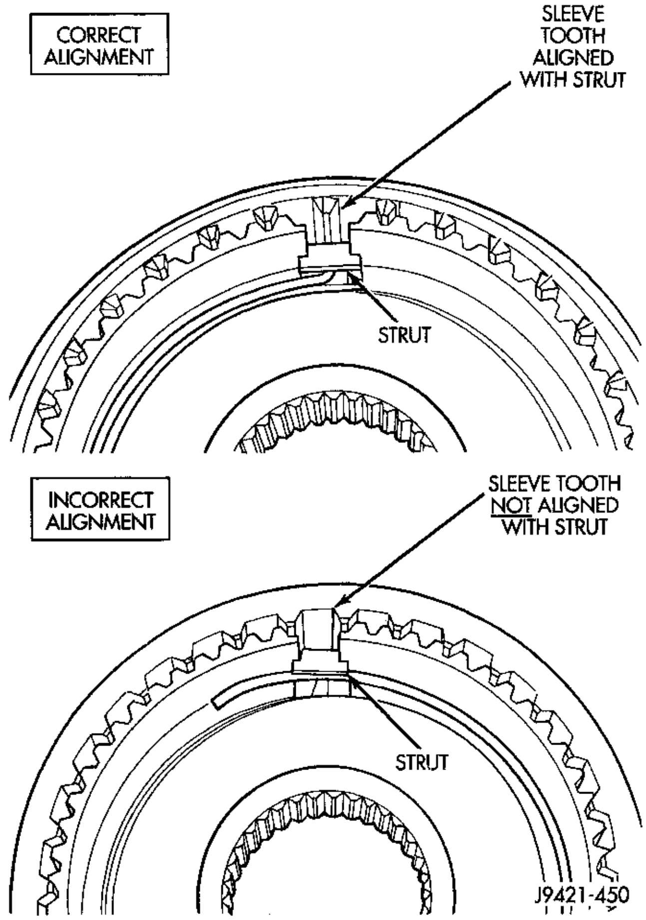

Fig. 77 Correct Alignment Of Struts And Sliding Clutch

(2) Lubricate mainshaft components with Dexron II transmission fluid.

(3) Lubricate sector shaft with transmission fluid and install shift sector in case (Fig. 78). Position slot in sector so it will be aligned with shift fork pin when shift forks are installed.

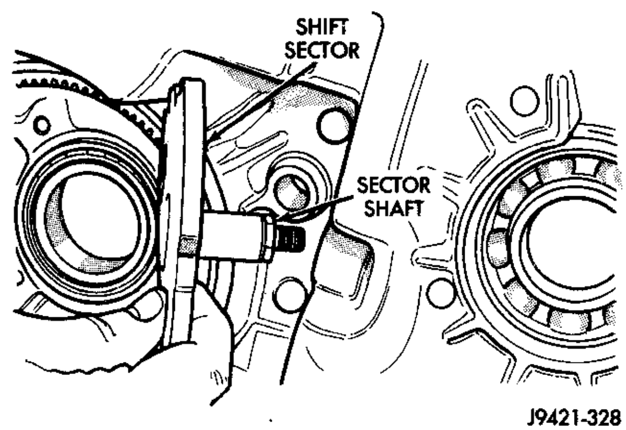

Fig. 78 Shift Sector Installation

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DISASSEMBLY AND ASSEMBLY (Continued)

(4) Assemble range fork and synchro clutch and hub (Fig. 79). Then install fork and hub in case. Seat hub on support sleeve and seat range fork pin in shift sector slot (Fig. 80).

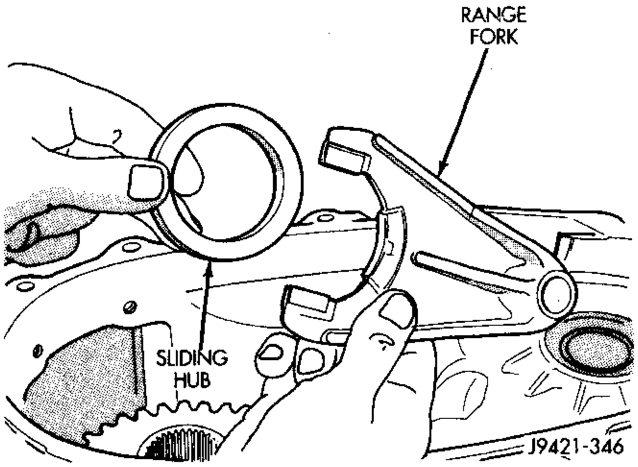

Fig. 79 Assembling Range Fork And Sliding Hub

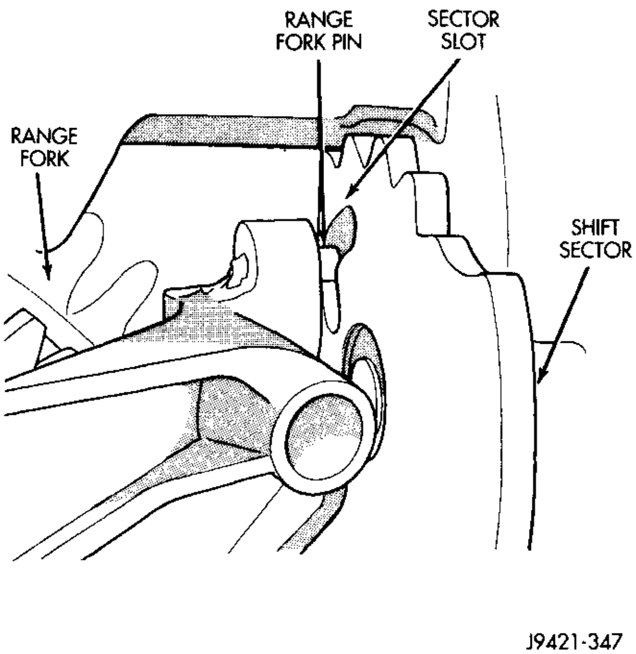

Fig. 80 Seating Range Fork And Hub

(5) Install sliding hub and retaining ring (Fig. 81). Be sure ring is fully seated before proceeding.

(6) Install mode fork and shift rail in sliding clutch (Fig. 82).

(7) Install mainshaft/mode fork assembly (Fig. 83). Guide mainshaft through hub and into input gear and shift rail through range fork and into case bore.

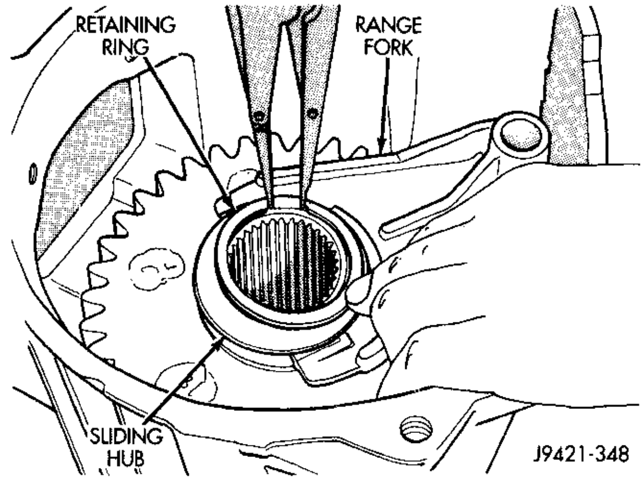

Fig. 81 Sliding Hub Retaining Ring Installation

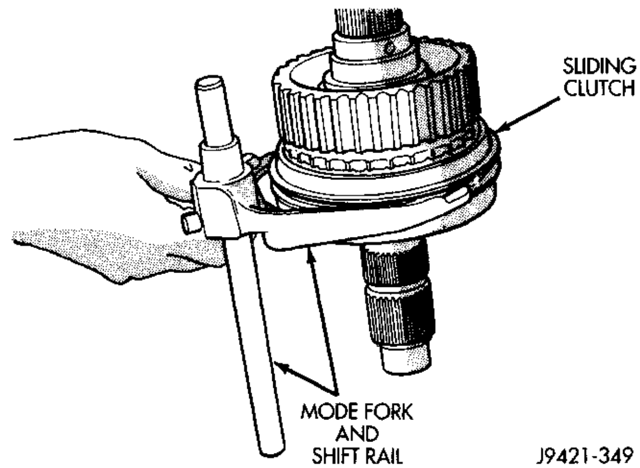

Fig. 82 Assembling Mode Fork And Mainshaft

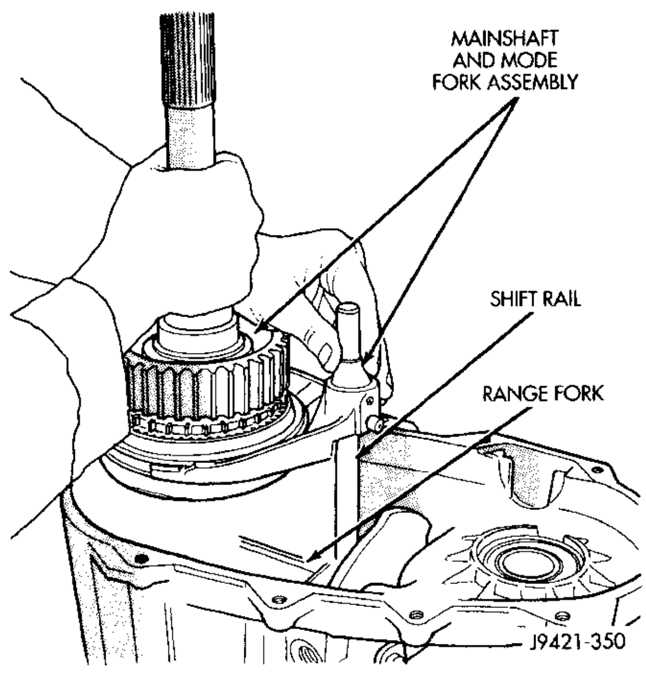

Fig. 83 Installing Mainshaft And Mode Fork Assembly

DISASSEMBLY AND ASSEMBLY (Continued)

(8) Install vacuum/indicator switch (Fig. 84). Tighten switch to 20-34 N·m (15-25 ft. lbs.) torque. Install new O-ring on switch beforehand, if necessary.

(9) Install new sector shaft O-ring and O-ring retainer in sector shaft bore (Fig. 85). Lubricate O-ring with transmission fluid or petroleum jelly after installation.

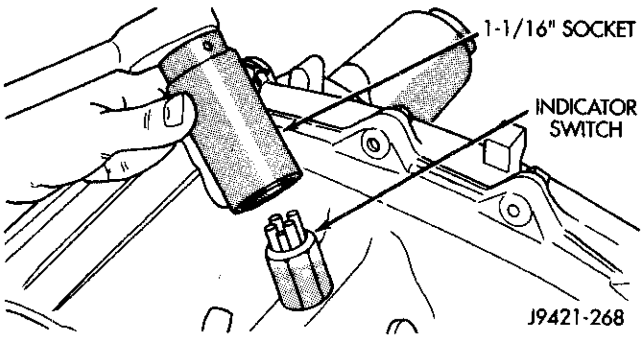

Fig. 84 Vacuum/Indicator Switch Installation

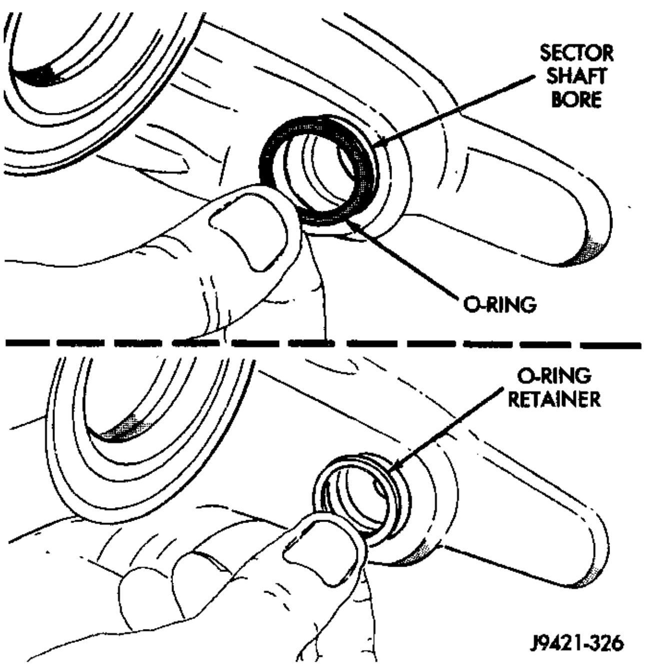

Fig. 85 Sector Shaft O-Ring And Retainer Installation

(10) Install shift lever on sector shaft (Fig. 86).

(11) Install washer and nut on sector shaft to secure shift lever. Apply 1-2 drops Mopar® Lock N' Seal, or equivalent, to nut threads before installation. Then tighten nut to 27-34 N·m (20-25 ft. lbs.) torque.

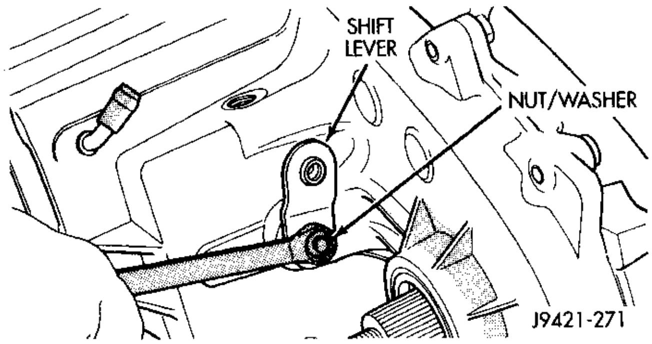

Fig. 86 Shift Lever Installation

(12) Install poppet plunger and spring (Fig. 87).

(13) Install new O-ring on poppet screw and install screw in front case (Fig. 88). Tighten screw to 16-24 N·m (12-18 ft. lbs.).

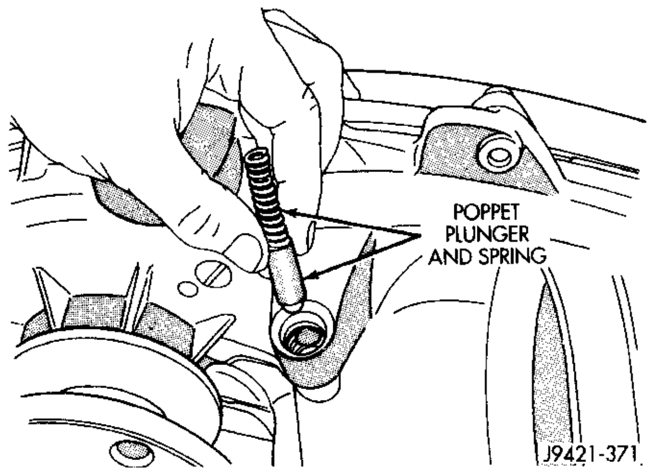

Fig. 87 Poppet Plunger And Spring Installation

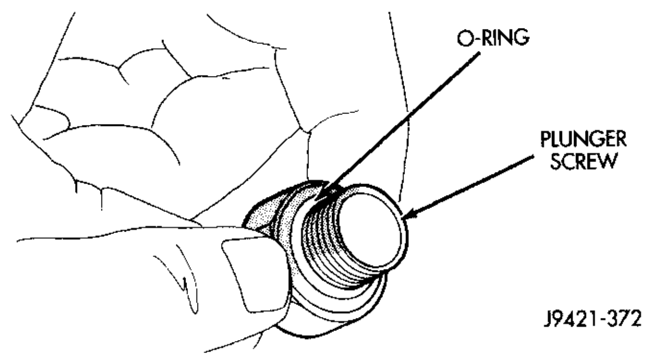

Fig. 88 O-Ring Installation On Poppet Plunger Screw

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DISASSEMBLY AND ASSEMBLY (Continued)

FRONT OUTPUT SHAFT AND DRIVE CHAIN INSTALLATION

(1) Install front output shaft in bearing (Fig. 89).

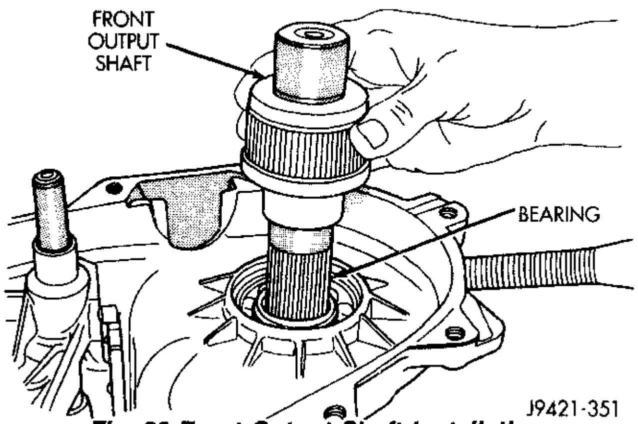

Fig. 89 Front Output Shaft Installation

(2) Insert front sprocket in drive chain (Fig. 90).

(3) Install drive chain around mainshaft sprocket (Fig. 90). Then position front sprocket over front shaft.

(4) Raise mainshaft about 2.54 cm (one inch) and seat front sprocket on front output shaft.

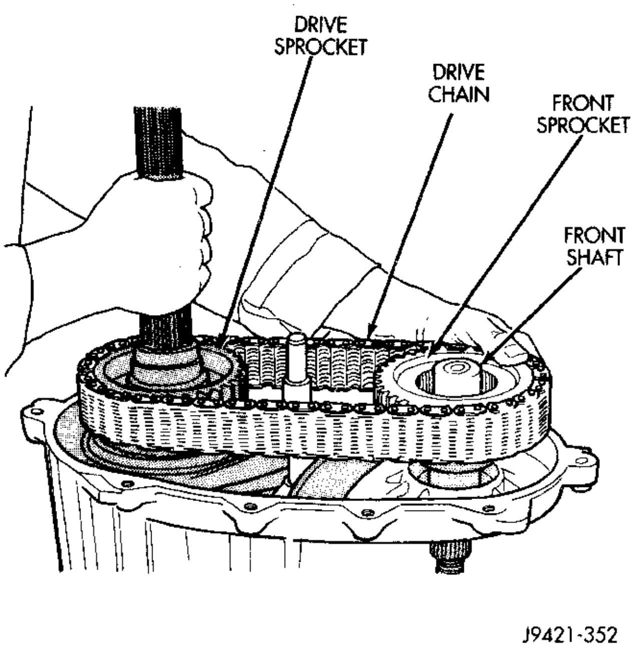

Fig. 90 Drive Chain And Front Sprocket Installation

(5) If mainshaft and sliding clutch were unseated during chain installation, align and reseat mainshaft in input gear and hub. Then reseat synchro hub in sliding clutch. Press synchro struts inward to ease clutch back onto hub.

(6) Install front sprocket retaining ring (Fig. 91).

(7) Realign sliding clutch on synchro hub if necessary. Press synchro struts inward to ease realignment. Be sure mainshaft is fully seated before proceeding.

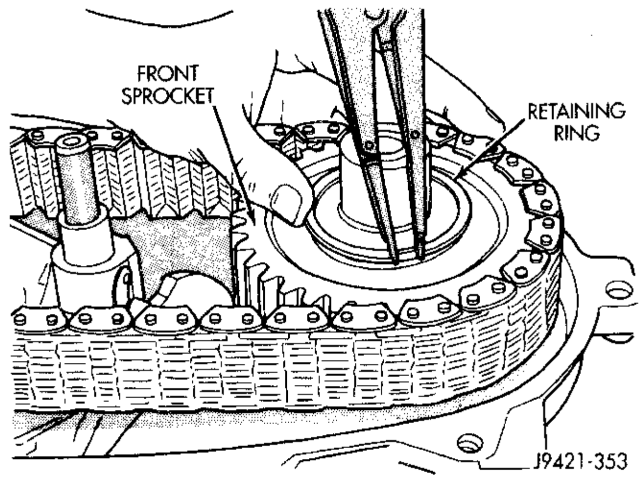

Fig. 91 Front Sprocket Retaining Ring Installation

(8) Install spring and cup on shift rail (Fig. 92).

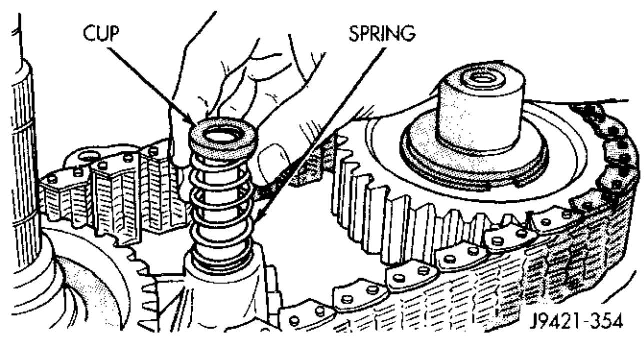

Fig. 92 Shift Rail Spring And Cup Installation

(9) Insert magnet in front case pocket (Fig. 93).

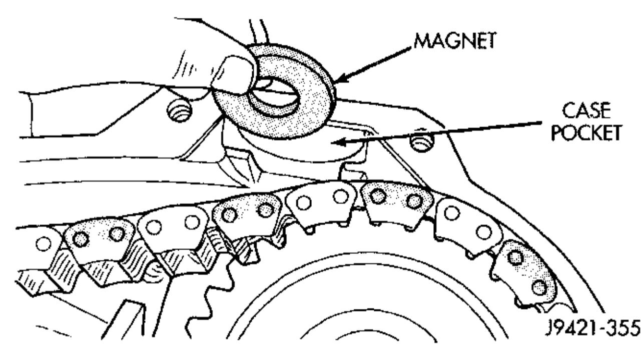

Fig. 93 Case Magnet Installation

OIL PUMP AND REAR CASE ASSEMBLY/INSTALLATION

Lubricate the oil pump components with Dexron II before installation. Prime the oil pickup tube by pouring a little oil into the tube before installation.

(1) Install new O-ring in pickup tube inlet of oil pump (Fig. 94).

(2) Position oil pickup tube and filter in rear case. Be sure pickup filter is seated in case pocket and

DISASSEMBLY AND ASSEMBLY (Continued)

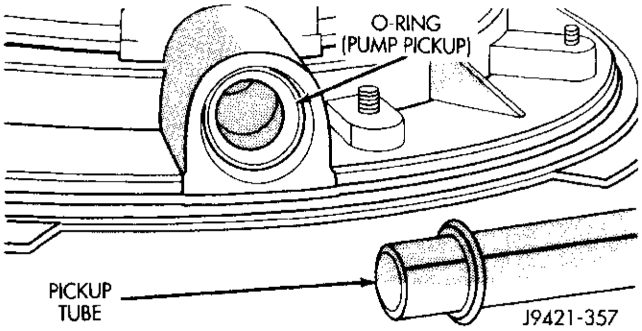

Fig. 94 Pickup Tube O-Ring Installation

that pickup tube is aligned in case notches (Fig. 95). Be sure hose that connects tube to filter is securely positioned.

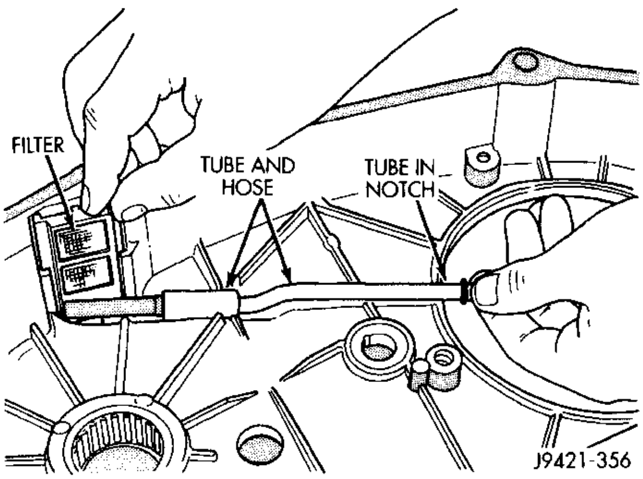

Fig. 95 Oil Pickup Tube And Filter Position In Rear Case

(3) Insert oil pickup tube in oil pump and position pump in rear case (Fig. 96).

(4) Apply bead of Mopar® Gasket Maker, or equivalent, to mating surface of front case. Keep sealer bead width to maximum of 3/16 inch. Do not use excessive amount of sealer as excess will be displaced into case interior.

(5) Align oil pump with mainshaft and align shift rail with bore in rear case. Then install rear case and oil pump assembly (Fig. 97). Be sure oil pump and pickup tube remain in position during case installation.

(6) Install 4-5 rear case-to front case bolts to hold rear case in position. Tighten bolts snug but not to specified torque at this time.

CAUTION: Verify that shift rail (Fig. 98), and case alignment dowels are seated before installing any bolts. Case could be cracked if shaft rail or dowels are misaligned.

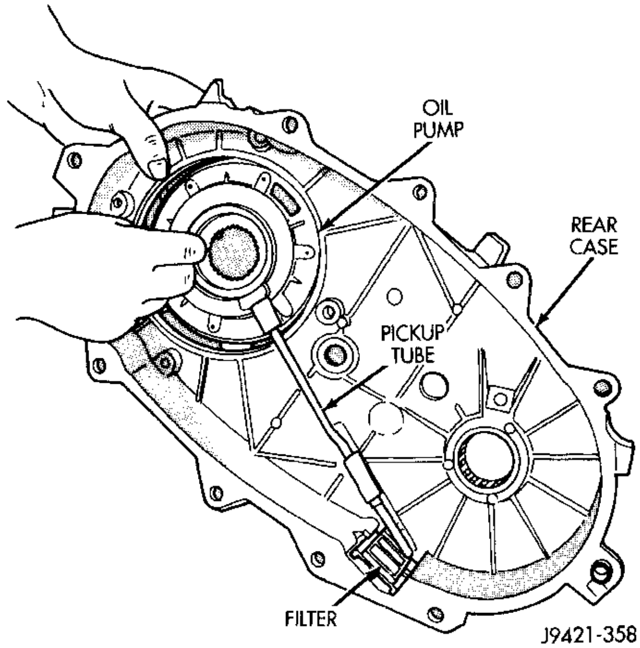

Fig. 96 Positioning Oil Pump In Rear Case

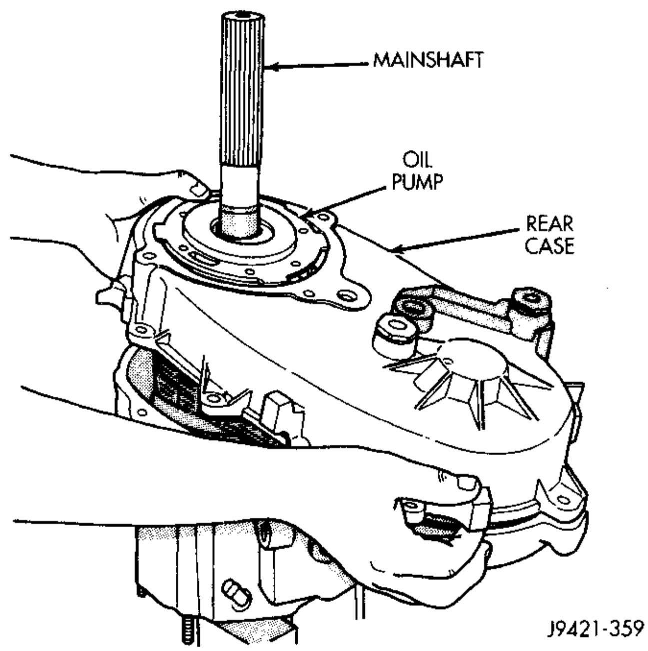

Fig. 97 Rear Case And Oil Pump Installation

(7) Verify that oil pump is aligned and seated on rear case. Reposition pump if necessary.

(8) Check stud at end of case halves (Fig. 99). If stud was loosened or came out during disassembly, apply Loctite 242 to stud threads and reseat stud in case.

(9) Apply Loctite 242 to remainder of rear case-to-front case bolt threads and install bolts. Be sure lock washers are used on studs/bolts at case ends. Tighten bolts, or stud nuts as follows:

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DISASSEMBLY AND ASSEMBLY (Continued)

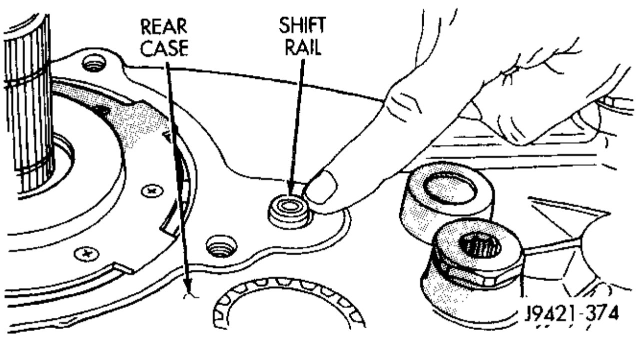

Fig. 98 Shift Rail Seated In Rear Case Bore

- flange head bolts to 47-61 N·m (35-45 ft. lbs.)
- all other bolts/nuts to 27-34 N·m (20-25 ft. lbs.)

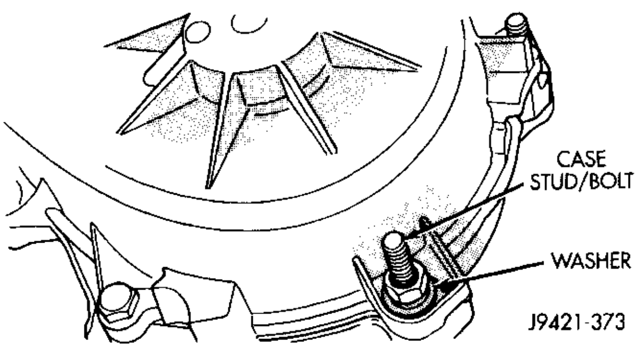

Fig. 99 Washer Installation On Case Stud And Dowel Bolts

(10) Install oil pump retaining ring on mainshaft (Fig. 100).

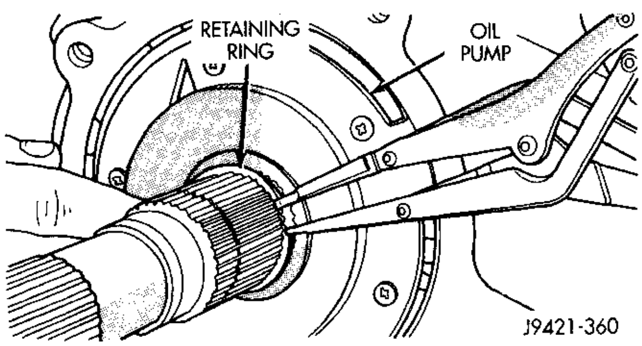

Fig. 100 Oil Pump Retaining Ring Installation

(11) Install rear output bearing and snap ring to output shaft.

COMPANION FLANGE INSTALLATION

(1) Install companion flange seal on front shaft (Fig. 101).

(2) Install companion flange on front shaft (Fig. 102). Then install and tighten flange nut to 176-271 N·m (130-200 ft. lbs.) torque.

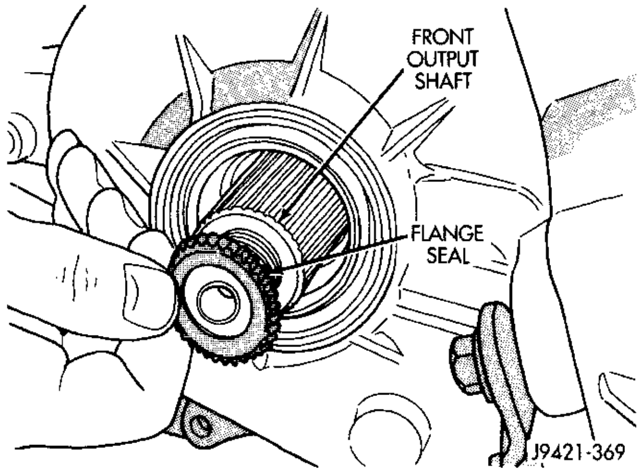

Fig. 101 Installing Flange Seal On Front Shaft

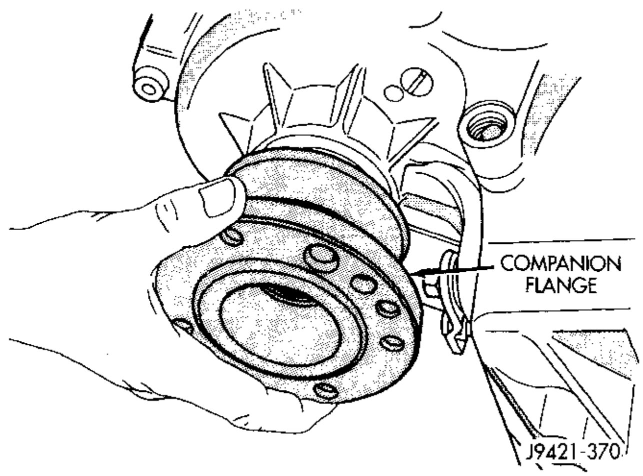

Fig. 102 Installing Companion Flange On Front Shaft

EXTENSION HOUSING AND PTO COVER

(1) Apply bead of Mopar® Gasket Maker, or equivalent, to mating surface of extension housing. Keep sealer bead width to maximum of 3/16 inch. Do not use excessive amount of sealer as excess could be displaced into oil pump.

(2) Position extension housing over output shaft.

(3) Spread extension housing retaining ring and seat extension housing on rear case. Verify that the retaining ring is seated in output shaft rear bearing.

(4) Install retaining ring access cover.

(5) Apply Mopar® silicone sealer, or equivalent, to threads of extension housing bolts. Then install bolts finger tight.

(6) Tighten extension housing bolts to 27-34 N·m (20-25 ft. lbs.) torque.

(7) Apply Mopar silicone adhesive/sealer to mating surface of PTO cover and to cover bolt shanks and underside of bolt heads. Then install and tighten bolts to 27-34 N·m (20-25 ft. lbs.) torque.

CLEANING AND INSPECTION

TRANSFER CASE CLEANING AND INSPECTION

Wash all parts thoroughly in clean solvent. Be sure all old lubricant, sealant, metal particles, dirt and foreign material are removed from the surfaces of every part.

Apply compressed air to each oil feed port and channel in both case halves to remove any foreign material or cleaning solvent residue.

If any pump component is worn, or damaged, the pump must be replaced as an assembly.

Inspect the spline teeth on the synchro hub (Fig. 103). If evidence of chipping or excessive wear is apparent, replace the hub. The hooked end of each synchro spring should be inserted in one of the struts. In addition, the springs should not interfere with the polished gear cone or inside diameters of the hub.

Inspect the stop ring for cracks and wear. Replace the ring if necessary or if doubt exists over condition. Check a replacement synchro ring for proper fit on the cone with a minimum of wobble. Also check the synchronizer struts for wear or damage.

Inspect all gear teeth and splines for wear or damage. Also check splines for burrs, or nicks. Remove minor nicks and scratches with an oil stone. Replace any part with damaged splines.

It is recommended that all retaining (snap) rings be replaced during overhaul. Most of the retaining rings can be distorted during removal and should not be reused.

Inspect the two case halves, for cracks, porosity, damaged mating surfaces, stripped bolt threads, or distortion. Replace either case half if necessary. However, stripped threads can be repaired with Heli–Coil stainless steel thread inserts. The case vent tube can be resecured with Loctite 680 if necessary.

Inspect the annulus gear. Be sure the gear teeth are in good condition. Replace the front case and annulus as an assembly if the gear is damaged.

Check condition of the shift fork pads (Fig. 104). The pads should be replaced if cracked, worn, or loose (won't stay on fork).

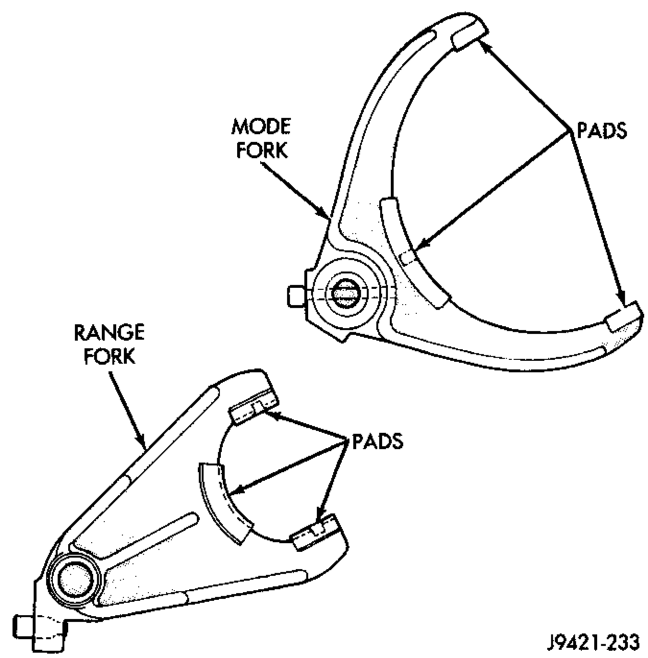

Fig. 104 Shift Fork Pads

The shift forks, clutch and sleeve should all be checked for wear, cracks, or any type of damage

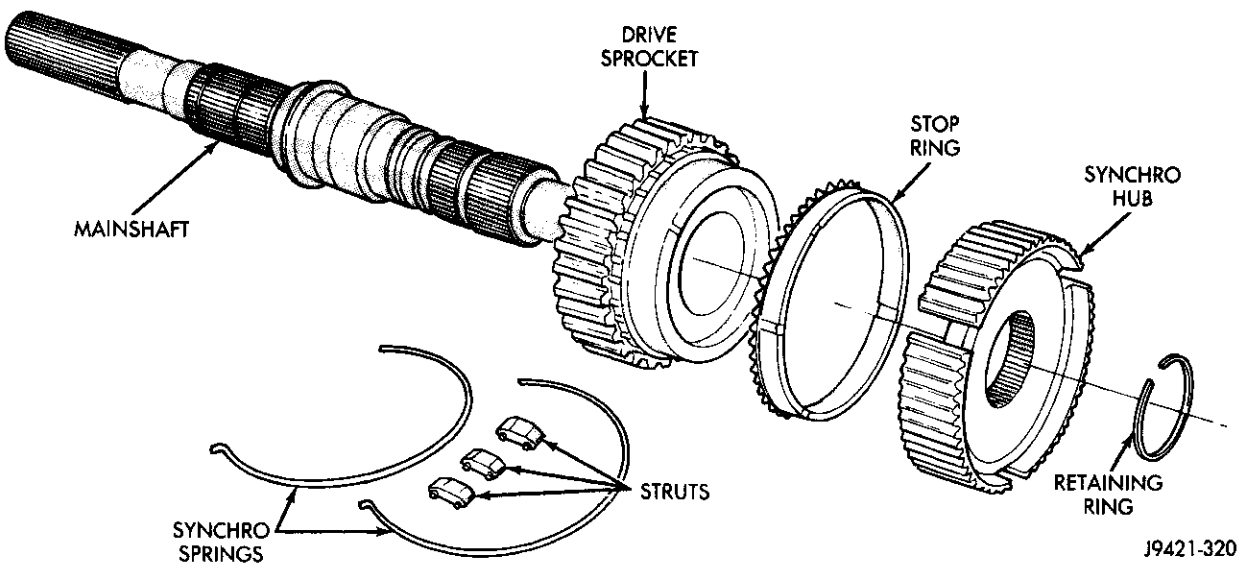

Fig. 103 Mainshaft Components

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CLEANING AND INSPECTION (Continued)

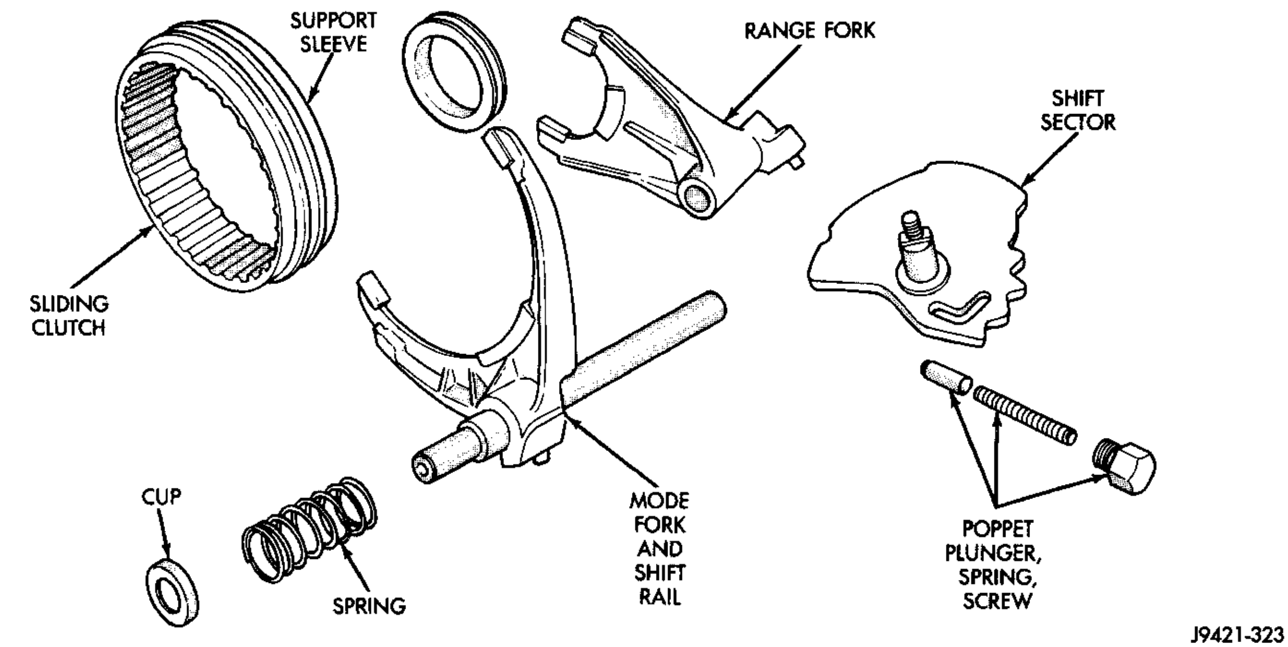

Fig. 105 Shift Fork Components

(Fig. 105). The shift sector shaft and detents should be inspected for wear. The mode fork and shift rail are a one–piece unit. If either part is damaged, replace the fork and rail as an assembly. Replace the shift rail cup and spring if they exhibit wear.

Inspect the planetary thrust washers (Fig. 106) carefully for wear or damage. Replace both washers if necessary.

The planetary carrier cannot be disassembled. It must be serviced as an assembly if damaged. Check condition of the pinion teeth and PTO gear teeth. If pinion tooth wear is evident, it will also be necessary to check condition of the annulus gear teeth.

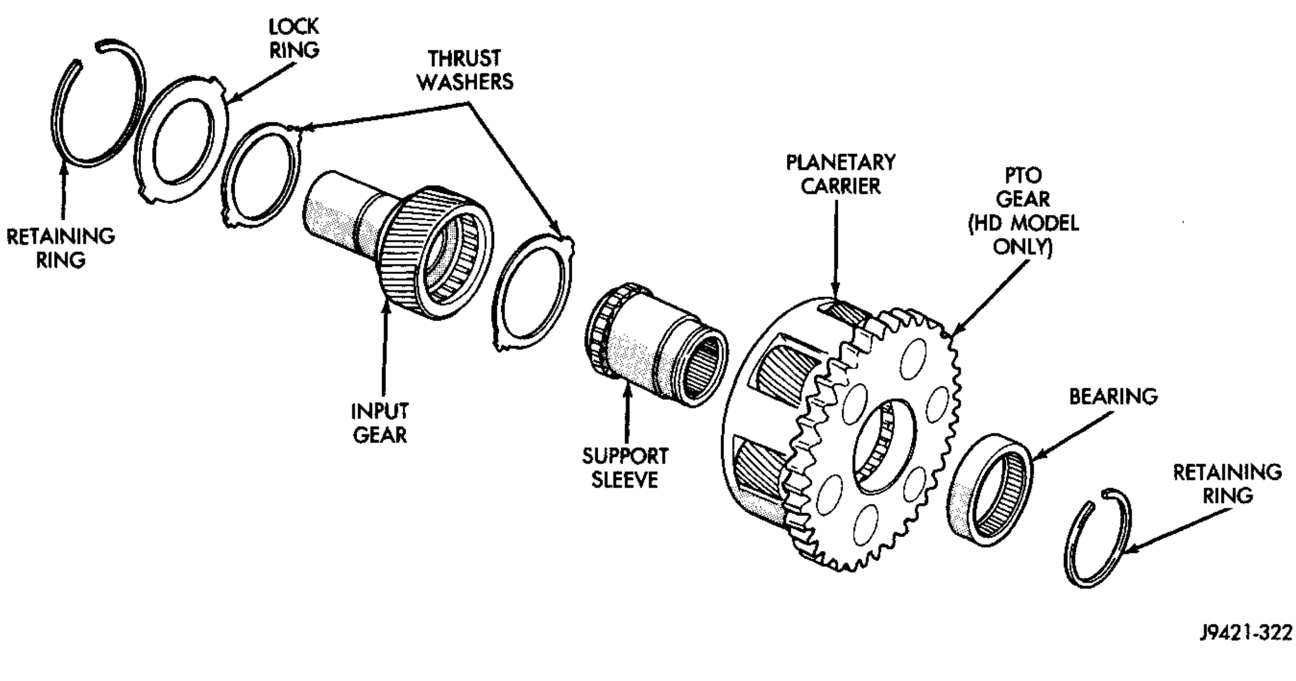

Fig. 106 Planetary And Input Gear Components

ADJUSTMENTS

SHIFT LINKAGE ADJUSTMENT

(1) Move shift lever into 2H position.
(2) Raise vehicle.
(3) Loosen shift rod lock bolt at trunnion (Fig. 107).

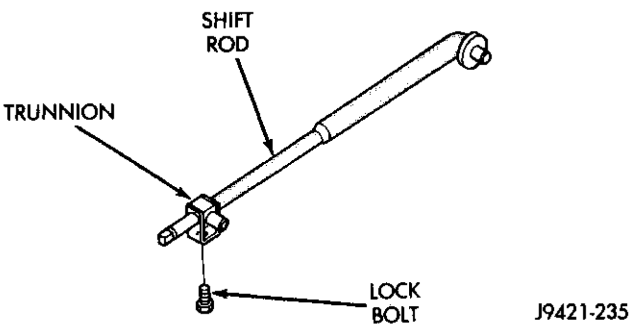

Fig. 107 Shift Rod Lock Bolt Location

(4) Check shift rod fit in trunnion. Be sure rod does not bind in trunnion.
(5) Verify that transfer case shift lever is in 2H position. The 2H position on the transfer case shift arm is the second position from full forward.
(6) Lower vehicle.
(7) Position the shift lever on the cab such that the distance from the instrument panel to the 2H position dot in the shift lever insert is 14.6 cm (5.75 in.). Ensure that the measurement is made parallel to the floor of the vehicle.
(8) Tighten shift rod lock bolt to 10 N·m (90 in. lbs.) torque.
(9) Check shift linkage operation. Be sure transfer case shifts into and operates properly in all ranges.

SPECIFICATIONS

TORQUE

DESCRIPTION	TORQUE
Plug, Detent	16–24 N·m (12–18 ft. lbs.)
Bolt, Diff. Case	17–27 N·m (15–24 ft. lbs.)
Plug, Drain/Fill	40–45 N·m (30–40 ft. lbs.)
Bolt, Extension Housing	35–46 N·m (26–34 ft. lbs.)
Bolt, Front Brg. Retainer	16–27 N·m (12–20 ft. lbs.)
Bolt, Case Half	35–46 N·m (26–34 ft. lbs.)
Nut, Front Yoke	122–176 N·m (90–130 ft. lbs.)
Screw, Oil Pump	1.2–1.8 N·m (12–15 in. lbs.)
Nut, Range Lever	27–34 N·m (20–25 ft. lbs.)
Nuts, Mounting	35–47 N·m (26–35 ft. lbs.)
Bolts, U-Joint	19 N·m (17 ft. lbs.)
Vacuum Switch	20–34 N·m (15–25 ft. lbs.)

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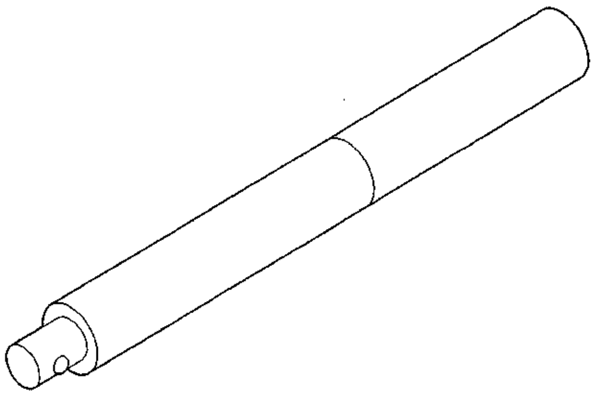
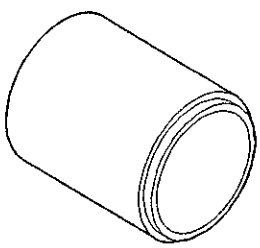
SPECIAL TOOLS

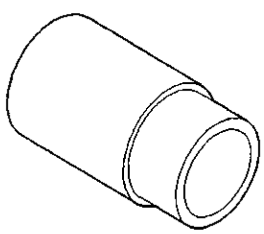
NV241HD



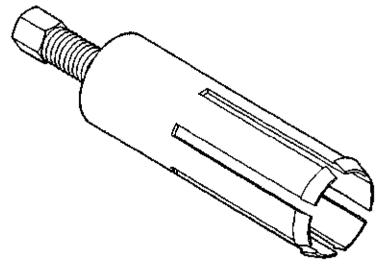
C-4171 Handle



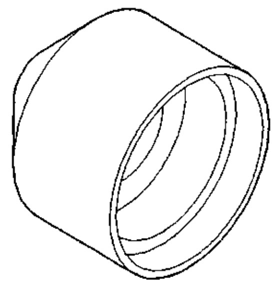
6888 Installer, Seal



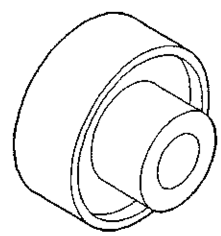
8157 Installer, Bushing



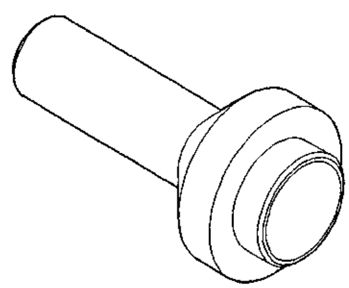
8158 Remover, Bushing



D-163 Installer, Seal

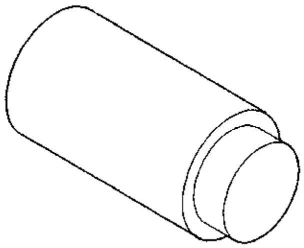


6953 Installer, Bearing

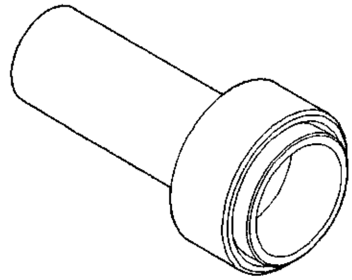


7884 Installer, Seal

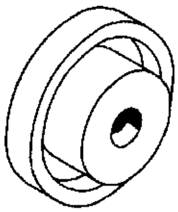
SPECIAL TOOLS (Continued)



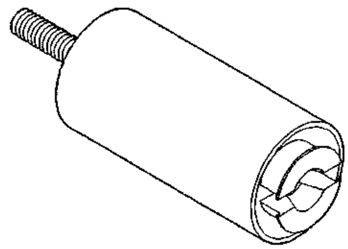
C-293-3 Plug, Extension



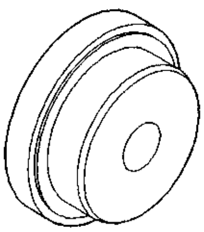
7888 Installer, Pump Housing Seal



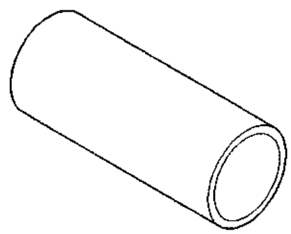
C-4210 Installer, Seal



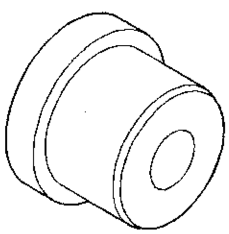
L-4454 Remover, Bearing



5062 Installer, Bearing



8148 Cup



5066 Installer, Bushing

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NV021 PTO ADAPTER

INDEX

GENERAL INFORMATION

GENERAL INFORMATION

The NV 021 PTO adapter provides power take–off capability for BR models with an automatic transmission. The adapter is available as an option on 2–wheel drive 2500 and 3500 models.

The NV 021 adapter is similar in appearance and mounting to a small transfer case (Fig. 1). A 4–wheel drive automatic transmission is used to simplify adapter mounting. The adapter has mounting studs in the front case for attachment to the overdrive unit gear case.

Basic components consist of the front case and rear extension, mainshaft, input gear, PTO gear, shift sector, and shift fork, shift rail and sleeve.

The mainshaft is supported in by a needle bearing in the input gear hub and by a ball bearing in the rear extension. The input gear is supported by a roller bearing in the front case. The PTO gear is splined to the input gear and is retained by a snap ring.

The input bearing is secured in the front case by a retainer. The output bearing is secured by a retaining ring on the mainshaft and by a second retaining ring in the rear extension.

The speedometer drive gear is located at the rear of the mainshaft. The gear is secured on the shaft with two snap rings.

SHIFT LEVER AND LINKAGE

A floor mounted shift lever assembly (Fig. 2), is used for selecting desired operating range. The lever is attached to the adapter shift lever by a single shift rod (Fig. 3). The floor linkage assembly is the same as used on 4–wheel drive models with a transfer case.

GENERAL INFORMATION (Continued)

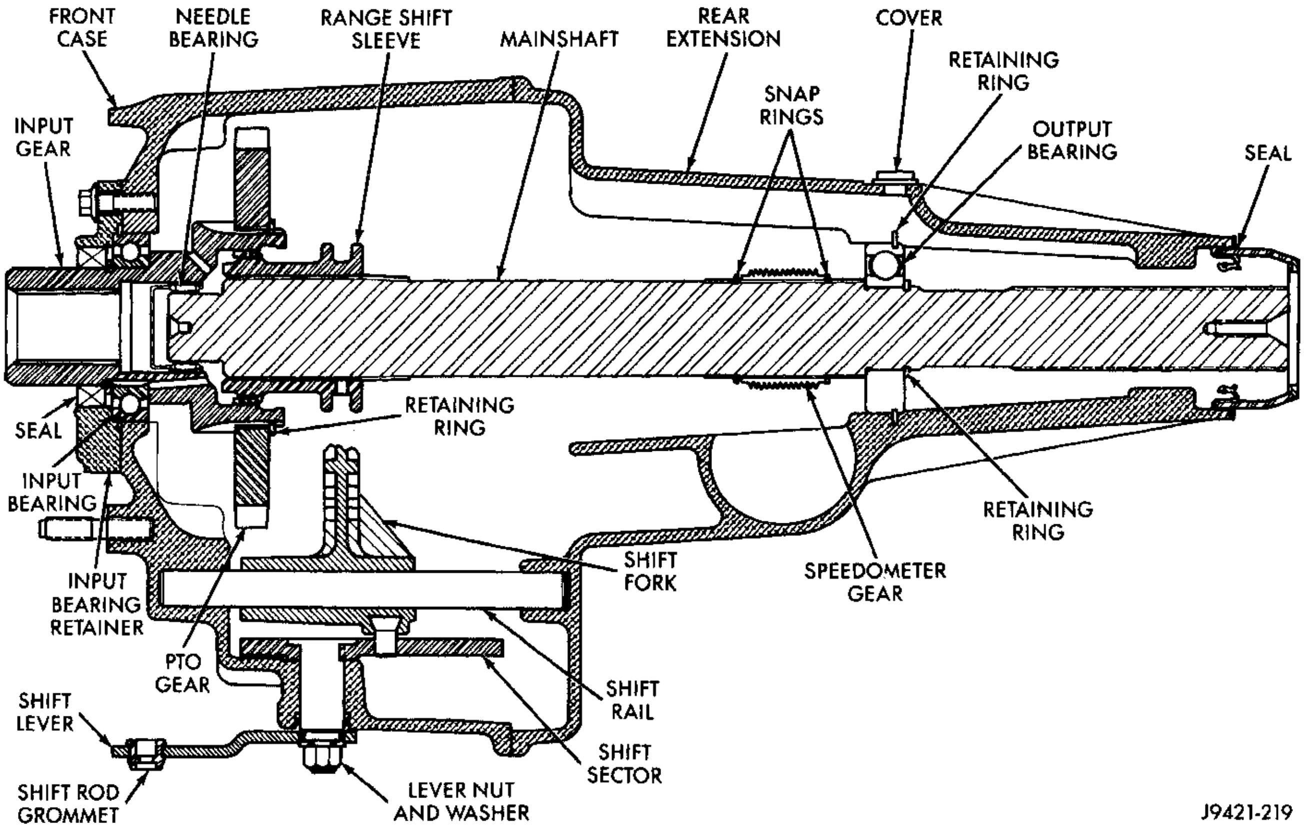

Fig. 1 NV 021 PTO Adapter

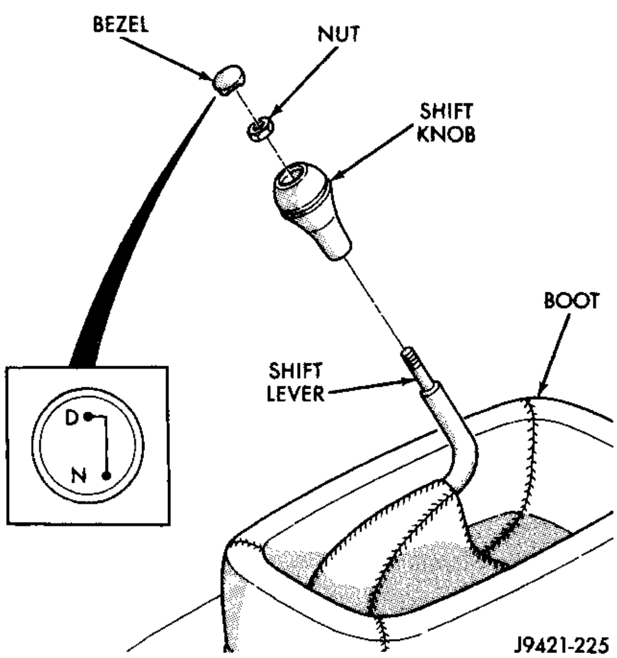

Fig. 2 Adapter Shift Lever And Shift Pattern

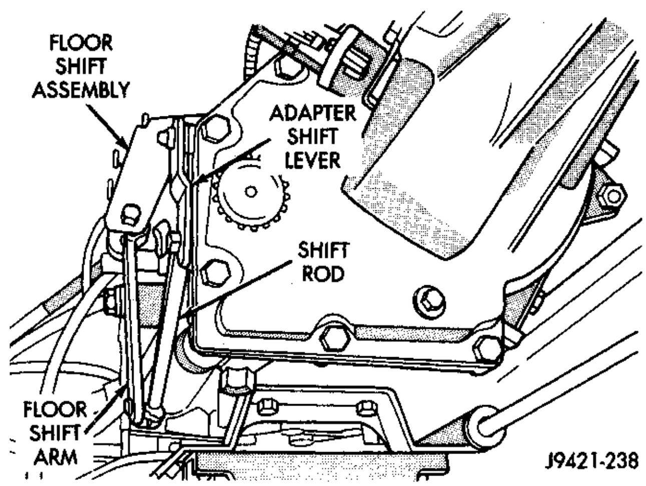

Fig. 3 Floor Shift Linkage

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GENERAL INFORMATION (Continued)

The adapter shift lever is attached directly to the shift sector shaft. Sector position is controlled by a detent poppet, spring and screw (Fig. 4). The poppet, under pressure from the spring, maintains sector detent position.

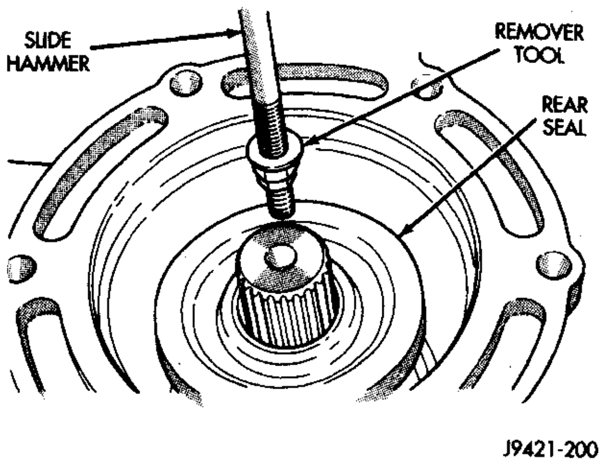

Fig. 4 Shift Sector Detent Controls

PTO ACCESSORY EQUIPMENT

Power take–off accessories such as pumps, gear drives, and towing equipment, are operated by a drive gear on the PTO adapter mainshaft.

The drive gear is accessible by removing the PTO access cover on the front case (Fig. 5). The auxiliary equipment to be operated is bolted directly to the adapter once the cover has been removed.

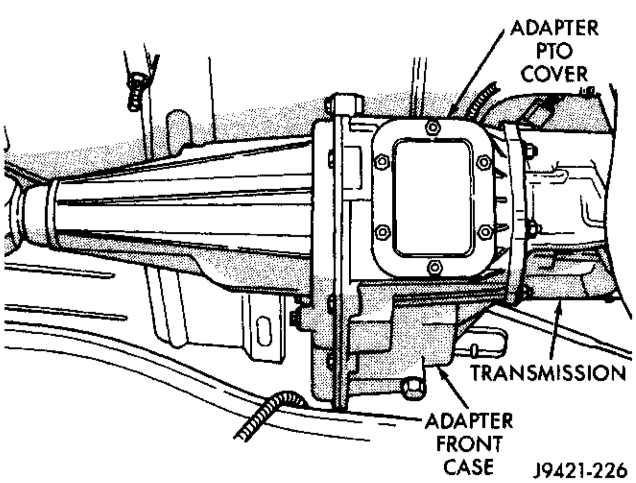

Fig. 5 PTO Access Cover Location

RECOMMENDED LUBRICANT AND FILL LEVEL

Recommended lubricant for the NV 021 is Mopar Dexron II, or ATF Plus transmission fluid.

Approximate fluid capacity is 2.17 liters (4.6 pints). The adapter fill and drain plugs are located in the rear extension (Fig. 6).

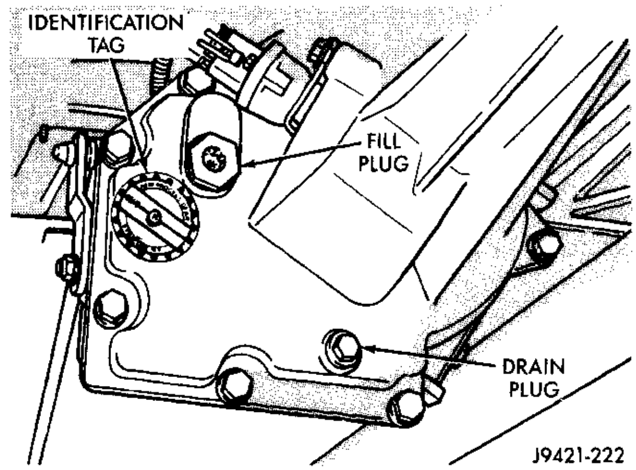

Fig. 6 Drain And Fill Plug Locations

The correct fill level is to the **bottom edge** of the fill plug hole.

ADAPTER IDENTIFICATION

A round, identification tag (Fig. 7) is attached to the rear extension. The tag provides the adapter model number, assembly number, serial number, and ratio.

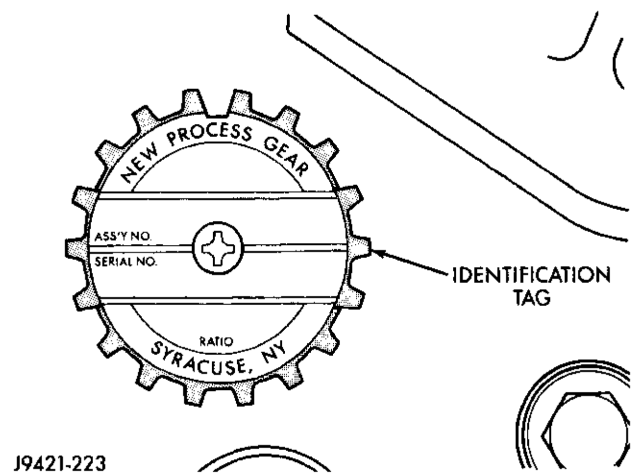

Fig. 7 Adapter I.D. Tag

The adapter serial number also represents the date of build. For example, a serial number of 9–10–93 would represent September 10, 1996.

DESCRIPTION AND OPERATION

PTO ADAPTER OPERATING RANGES AND SHIFTING

The NV 021 is a dual range unit. Operating ranges consist of drive (D) and neutral (N).

D range is used for normal driving and for PTO accessory operation while the vehicle is in motion.

DESCRIPTION AND OPERATION (Continued)

N range is used for PTO accessory operation when the vehicle is stopped.

N range is also used for breakdown towing with the front end raised. In this situation, the transmission must be shifted into Park and the PTO adapter into N range.

Operating/Shifting The PTO Adapter

To operate a PTO accessory while the vehicle is in motion:

- shift adapter into D range before engine start
- start engine
- shift transmission into D range and drive vehicle
- operate PTO accessory

To operate a PTO accessory while the vehicle is stopped:

- leave engine running
- shift transmission and adapter both into Neutral
- shift transmission back to Drive
- operate PTO accessory

To shift the adapter out of N and back to D range:

- leave engine running
- apply service brakes
- shift transmission into Reverse
- shift transmission back to Neutral and immediately shift adapter into D

To shift the adapter from D range into N:

- stop vehicle
- leave engine running
- shift transmission to Neutral
- shift adapter to N
- shift transmission back to D range
- operate accessory

DIAGNOSIS AND TESTING

ADAPTER SERVICE DIAGNOSIS

The PTO adapter should not be removed until diagnosis indicates a fault has actually occurred. Verify that the other driveline components (transmission, axle), are operating correctly before removing the adapter.

Begin diagnosis by checking fluid level and shift linkage adjustment. Have a helper observe linkage operation if necessary.

If auxiliary power take–off equipment is attached to the adapter, be sure the device is properly attached and in mesh with the PTO gear. Loose, misaligned, or incompatible auxiliary equipment will result in noise and unsatisfactory operation.

The following diagnosis information provides a listing of probable causes of an adapter malfunction. Use the lists as a guideline during diagnosis.

Inoperative

If the adapter will not drive a PTO accessory, the most probable causes are:

- PTO accessory not compatible with adapter (no gear mesh)
- PTO accessory loose, or misaligned
- PTO accessory damaged/inoperative
- adapter shift lever or shift rod disconnected
- transmission not in drive range

Noisy Operation

The most probable causes of noise are:

- low lubricant level
- PTO accessory loose, misaligned, or not compatible
- misadjusted shift rod
- engine/transmission mounts loose/damaged
- loose linkage or adapter assembly bolts
- output bearing snap ring not seated in bearing groove
- damaged input/output bearing
- worn/damaged shift fork, sleeve, or input gear
- loose/missing poppet, spring, or screw
- PTO gear teeth damaged

Hard Shifting

The most probable causes of a hard shift condition are:

- incorrect shift technique
- transmission and adapter shaft speeds not matched
- PTO accessory misaligned, or loose
- low lubricant level (leak or underfilled)
- shift rod loose or misadjusted
- shift lever nut loose or missing
- engine/transmission mounts loose/damaged
- adapter shift fork or sleeve damaged

Fluid Leaks

Fluid leaks from the adapter will generally be from the vent, front/rear seal, front case–to–rear case joint, poppet plunger screw, or adapter–to–transmission joint.

A leak at the front end of the adapter may not always be from the input bearing retainer seal. Check front leaks carefully as the actual leak source may be the transmission.

SERVICE PROCEDURES

PTO ADAPTER SERVICE

The adapter can be removed and disassembled for service when necessary. Removal/installation and overhaul procedures are provided in this section.

Gaskets are not used in the PTO adapter. All mating surfaces are to be coated with Mopar Gasket Maker, Mopar Silicone Adhesive Sealer, or Loctite 518.

SERVICE PROCEDURES (Continued)

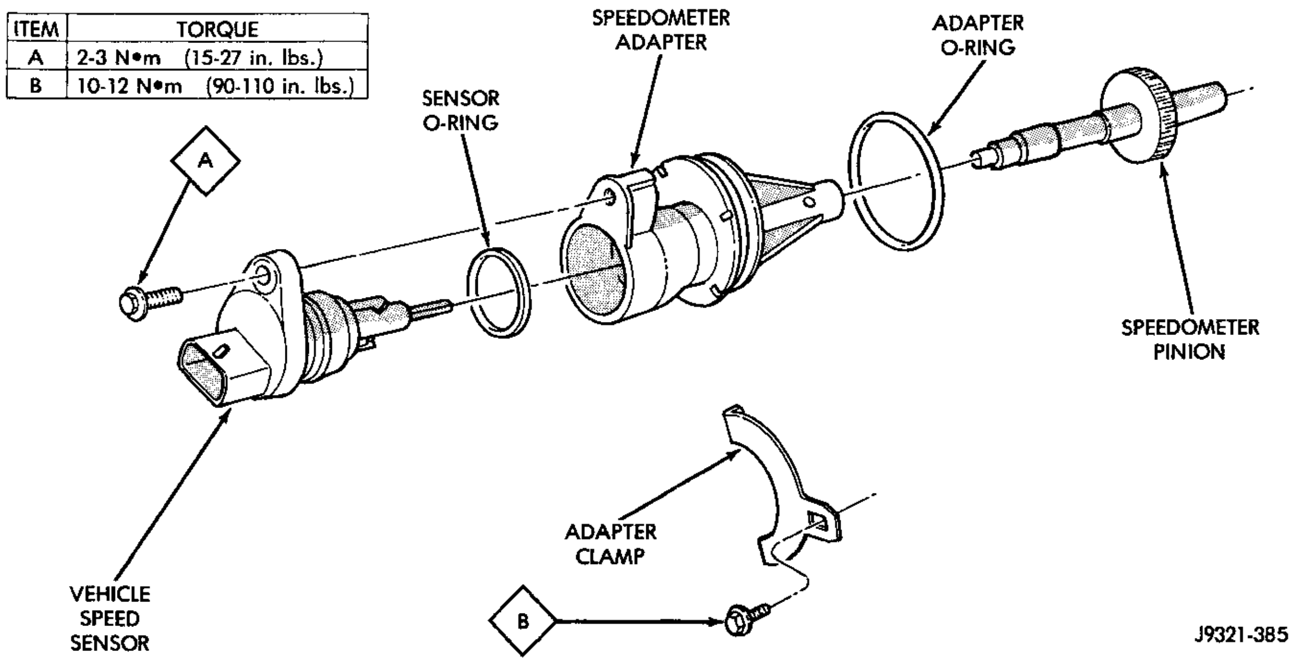

Fig. 8 Speedometer Components

SPEEDOMETER SERVICE

(1) Raise vehicle.
(2) Disconnect wires from vehicle speed sensor.
(3) Remove adapter clamp and screw (Fig. 8).
(4) Remove speed sensor and speedometer adapter as assembly.
(5) Remove speed sensor retaining screw and remove sensor from adapter.
(6) Remove speedometer pinion from adapter.
(7) Inspect sensor and adapter O–rings. Remove and discard O–rings if worn or damaged.
(8) Inspect terminal pins in speed sensor. Clean pins with Mopar electrical spray cleaner if dirty or oxidized. Replace sensor if faulty, or pins are loose, severely corroded, or damaged.

Speedometer Installation And Indexing

(1) Thoroughly clean adapter flange and adapter mounting surface in housing. Surfaces must be clean for proper adapter alignment and speedometer operation.
(2) Install new O–rings on speed sensor and speedometer adapter if necessary.
(3) Lubricate sensor and adapter O–rings with transmission fluid.
(4) Install vehicle speed sensor in speedometer adapter. Tighten sensor attaching screw to 2–3 N·m (15–27 in. lbs.) torque.
(5) Install speedometer pinion in adapter.
(6) Count number of teeth on speedometer pinion. Do this before installing assembly in housing. Then lubricate pinion teeth with transmission fluid.
(7) Note index numbers on adapter body (Fig. 9). These numbers will correspond to number of teeth on pinion.

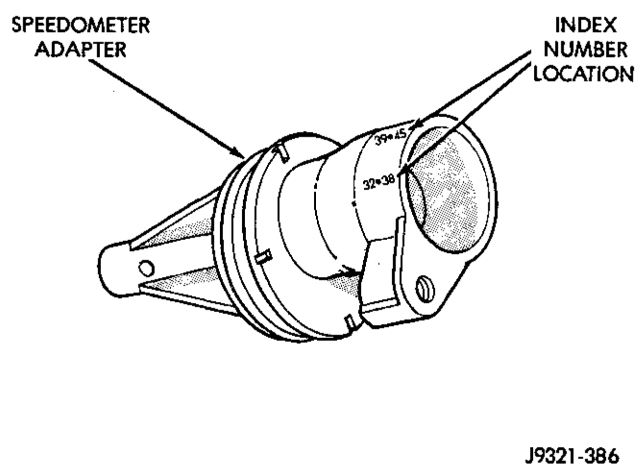

Fig. 9 Location Of Index Numbers On Speedometer Adapter

(8) Install speedometer assembly in housing.
(9) Rotate adapter until required range numbers are at 6 O'clock position. Be sure range index numbers correspond to number of teeth on pinion gear.
(10) Install speedometer adapter clamp and retaining screw. Tighten clamp screw to 10–12 N·m (90–110 in. lbs.) torque.
(11) Connect wires to vehicle speed sensor.
(12) Lower vehicle.

REMOVAL AND INSTALLATION

ADAPTER

REMOVAL

(1) Raise vehicle.

(2) If adapter is to be removed for disassembly and overhaul, remove drain plug and drain lubricant from adapter.

(3) Disconnect vehicle speed sensor wires at sensor (Fig. 10).

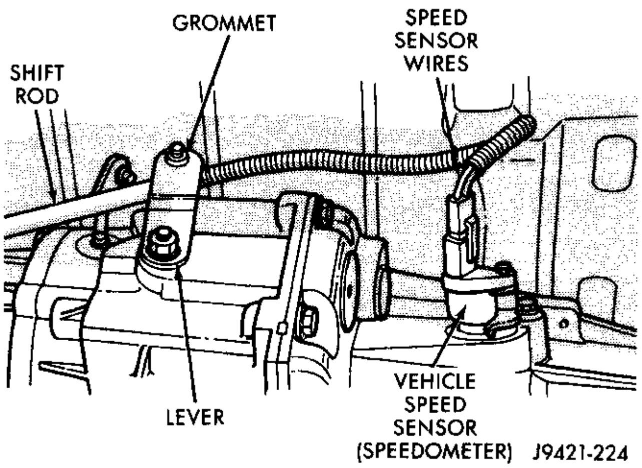

Fig. 10 Shift Rod And Speed Sensor Wire Attachment

(4) Disconnect shift rod from grommet in adapter shift lever. Use channel lock–style pliers to press rod out of grommet.

(5) Mark propeller shaft yoke for alignment reference. Then disconnect and remove propeller shaft.

(6) Remove nuts securing adapter mounting studs to transmission extension (Fig. 11).

(7) Slide adapter studs out of transmission extension and remove adapter from vehicle.

(8) If a gasket is used between adapter and transmission, retain gasket if in good condition.

INSTALLATION

(1) If adapter was overhauled, fill adapter to bottom edge of fill plug hole with Mopar Dexron II, or ATF Plus transmission fluid. Tighten fill plug to 41–54 N·m (30–40 ft. lbs.) torque.

(2) Clean mounting surfaces of adapter and transmission extension with solvent.

(3) Apply 2–3 drops of Mopar Lock N' Seal, or Loctite 242 to adapter mounting nuts.

(4) Install gasket on adapter (if equipped). Apply thin bead of sealer to transmission extension and to gasket, if used.

(5) Install adapter on transmission and install adapter mounting nuts. If adapter has 5/16 studs, tighten nuts to 30–41 N·m (22–30 ft. lbs.). If adapter has 3/8 studs, tighten nuts to 41–47 N·m (30–35 ft. lbs.).

(6) Lubricate propeller shaft slip yoke with transmission fluid or petroleum jelly.

(7) Align and install propeller shaft. Tighten shaft clamp bolts to 19 N·m (170 in. lbs.) torque.

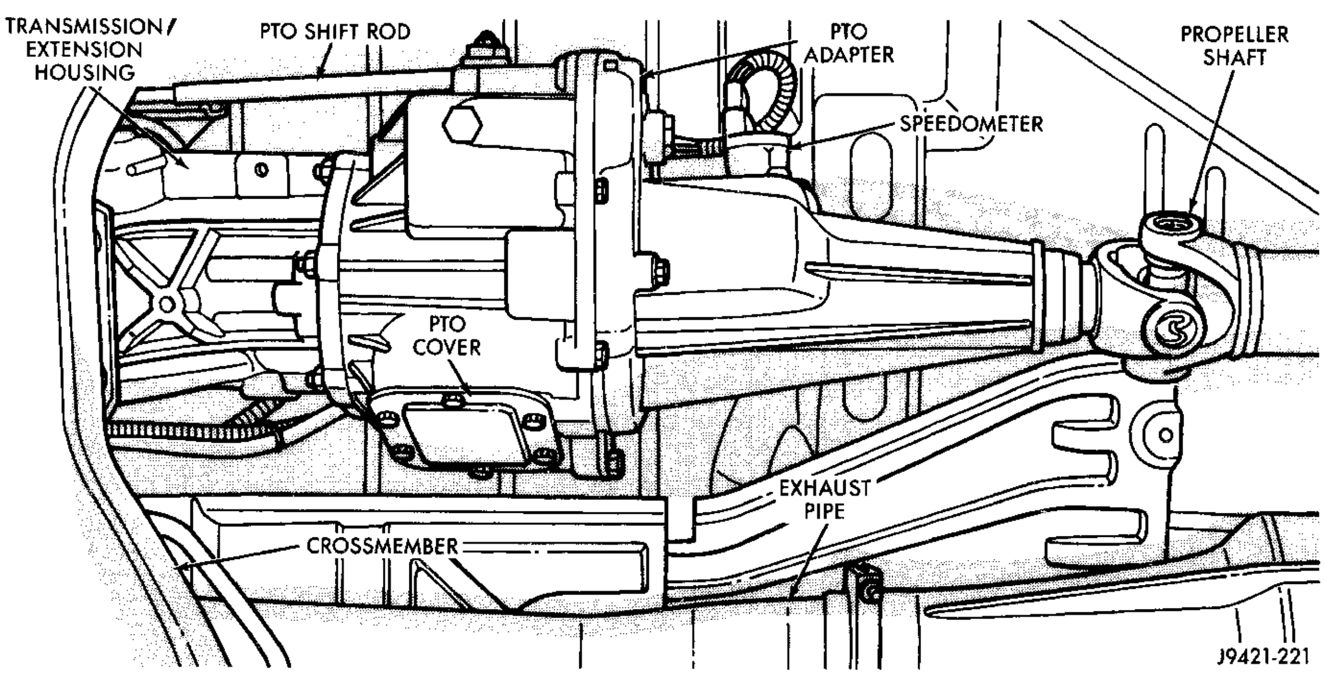

Fig. 11 PTO Adapter Mounting

REMOVAL AND INSTALLATION (Continued)

(8) Connect shift rod to adapter shift lever. Be sure rod is fully seated in plastic grommet.

(9) Adjust shift rod if necessary.

(10) Lower vehicle.

DISASSEMBLY AND ASSEMBLY

ADAPTER OVERHAUL

DISASSEMBLY

(1) If adapter was not drained during removal, remove drain bolt at bottom of front housing and drain lubricant into drain pan (Fig. 12).

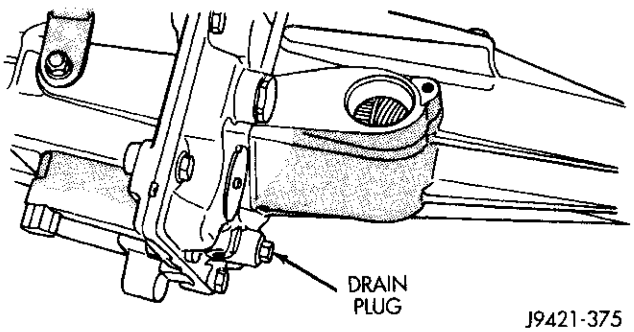

Fig. 12 Drain Bolt Location

(2) Remove mainshaft bearing retaining ring access cover and gasket (Fig. 13). Cover must be removed from extension for access to retaining ring. A torx head bit is required to remove cover screws.

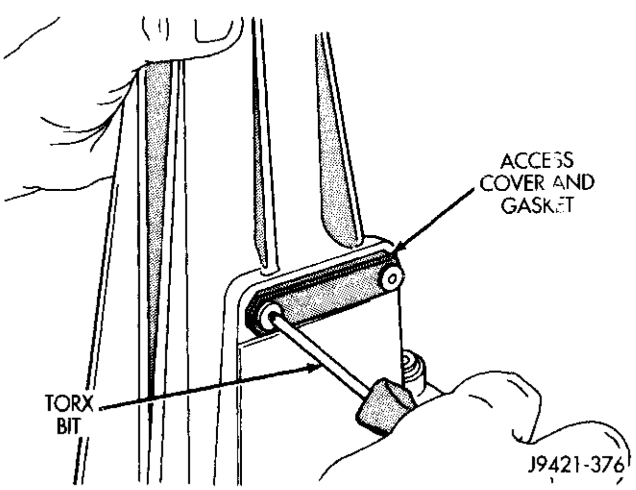

Fig. 13 Retaining Ring Access Cover Removal

(3) Remove input bearing retainer bolts (Fig. 14).

(4) Remove input bearing retainer as follows: Insert pry tool in retainer slot (Fig. 15). Then pry retainer outward to break sealer bead and remove retainer (Fig. 16).

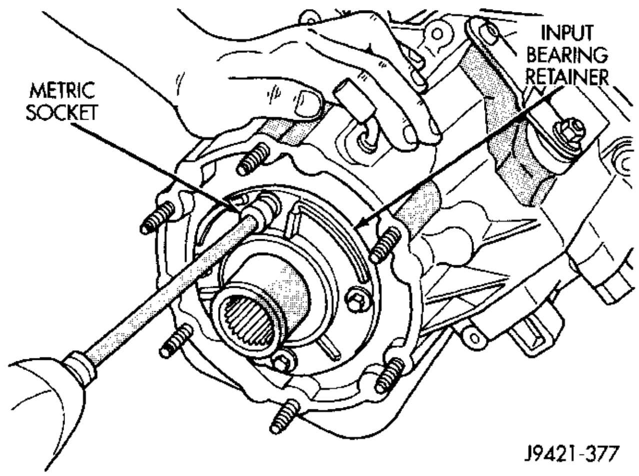

Fig. 14 Removing Input Bearing Retainer Bolts

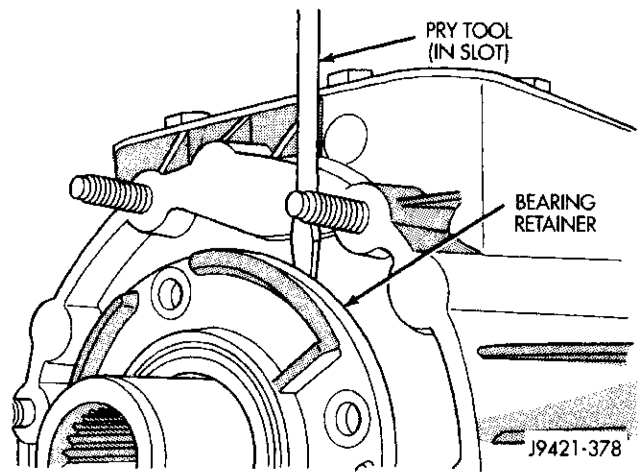

Fig. 15 Loosening Bearing Retainer (Breaking Sealer Bead)

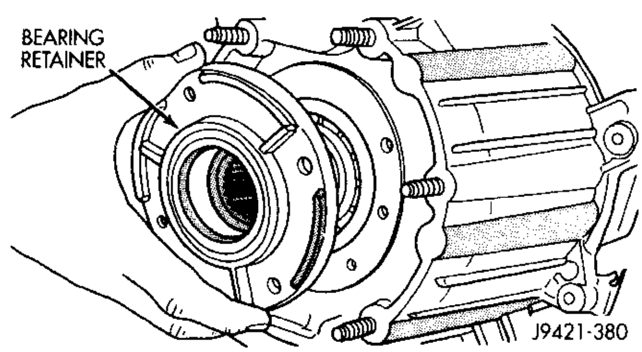

Fig. 16 Input Bearing Retainer Removal

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DISASSEMBLY AND ASSEMBLY (Continued)

(5) Remove input gear retaining ring (Fig. 17).

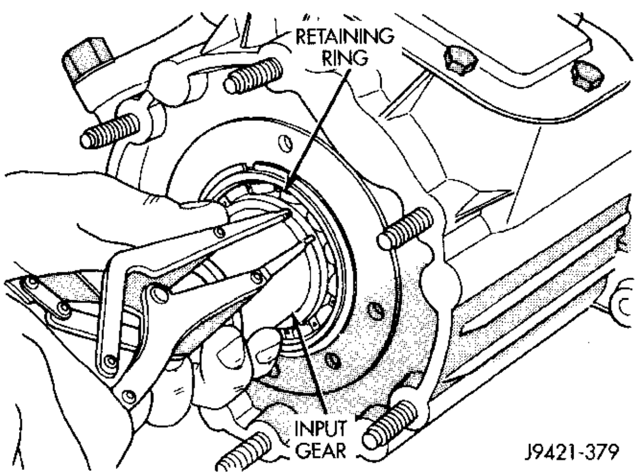

Fig. 17 Input Gear Retaining Ring Removal

(6) Support adapter on 3–4 small wood blocks (Fig. 18). Position blocks under transmission mounting surface of front case and between studs.

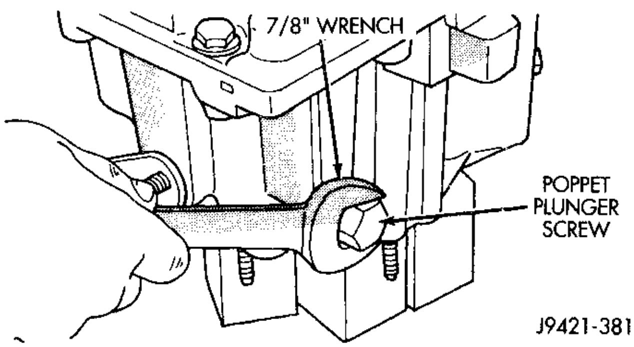

Fig. 18 Poppet Screw Removal

(7) Remove poppet plunger screw.
(8) Remove spring and poppet plunger (Fig. 19).

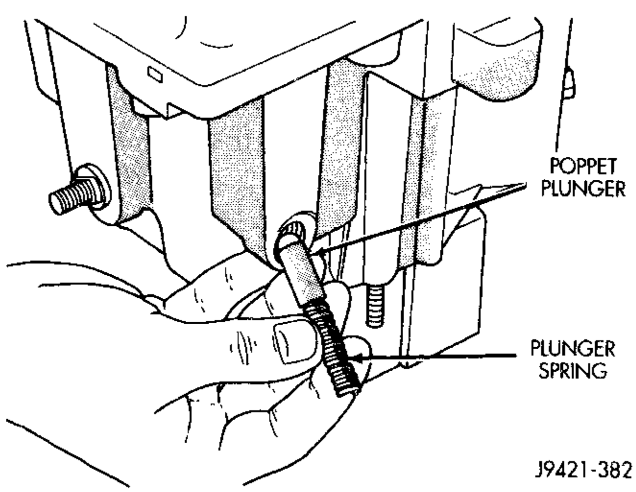

Fig. 19 Poppet And Spring Removal

(9) Loosen nut and washer that attach shift lever to sector shaft (Fig. 20). Then remove, nut, washer and lever from sector shaft (Fig. 21).

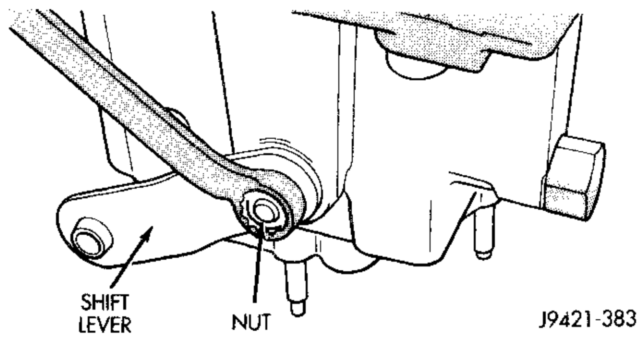

Fig. 20 Loosening Shift Lever Nut

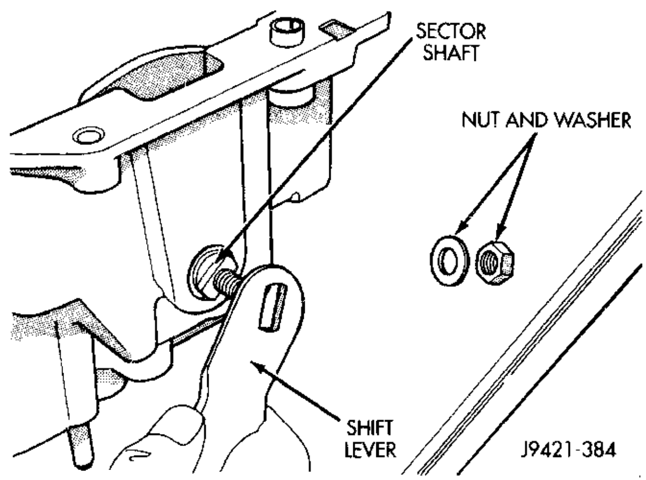

Fig. 21 Shift Lever, Nut And Washer Removal

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DISASSEMBLY AND ASSEMBLY (Continued)

(10) Remove bolts attaching front case to rear extension (Fig. 22). **Two attaching bolts require a flat washer (Fig. 23). Note position of these bolts for assembly reference. Mark bolt position with scriber or with paint stripe.**

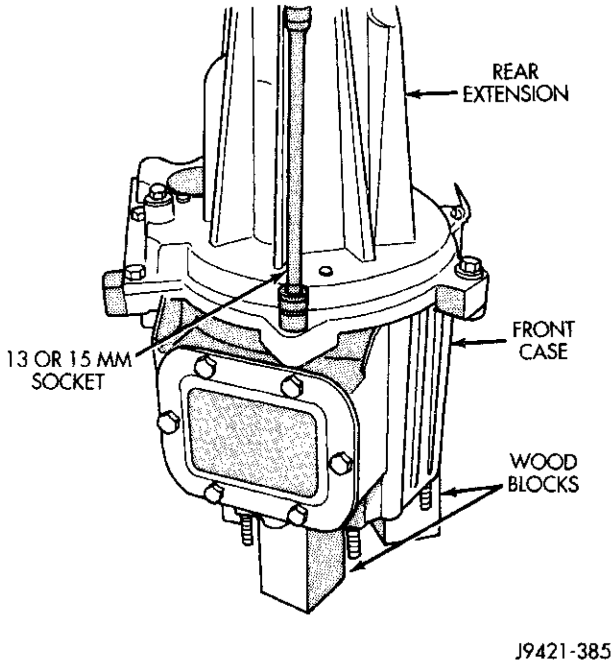

Fig. 22 Removing Rear Extension Attaching Bolts

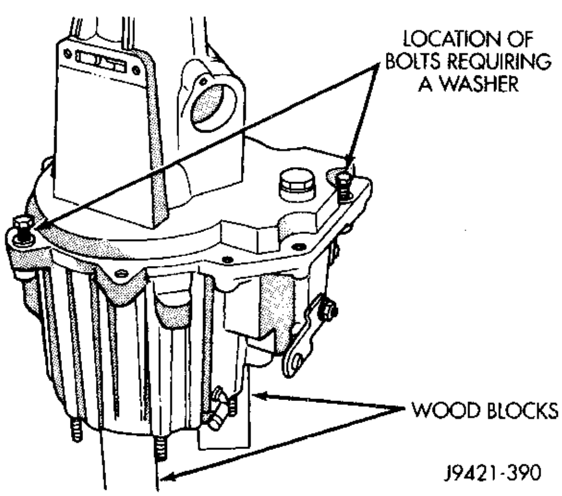

Fig. 23 Location Of Rear Extension Bolts Requiring Washers

(11) Pry extension away from front case with flat blade screwdriver. Position screwdriver in slots provided at each end of case and extension (Fig. 24).

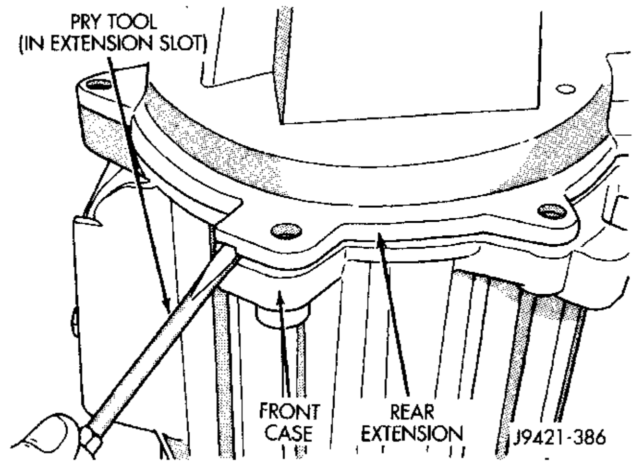

Fig. 24 Loosening Rear Extension (Breaking Sealer Bead)

(12) Remove rear extension as follows:

(a) Spread mainshaft bearing retaining ring with snap ring pliers (Fig. 25).

(b) Lift extension up and off mainshaft and front case (Fig. 26).

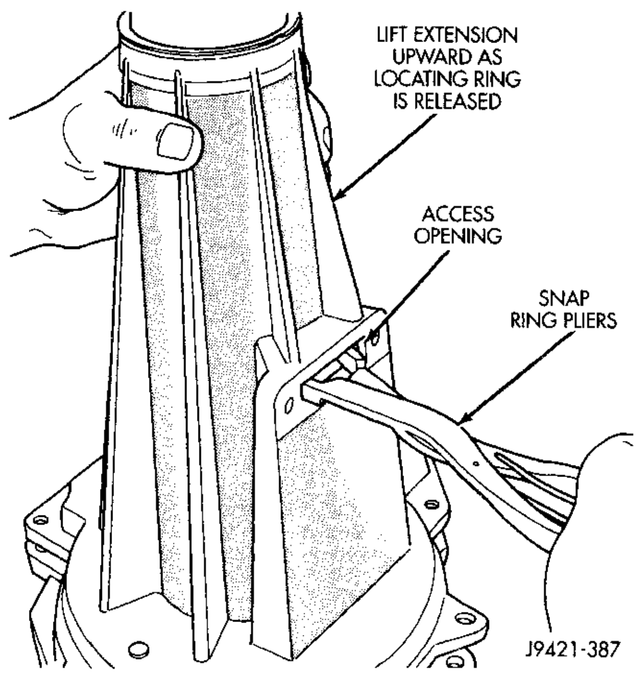

Fig. 25 Releasing Mainshaft Bearing Retaining Ring

DISASSEMBLY AND ASSEMBLY (Continued)

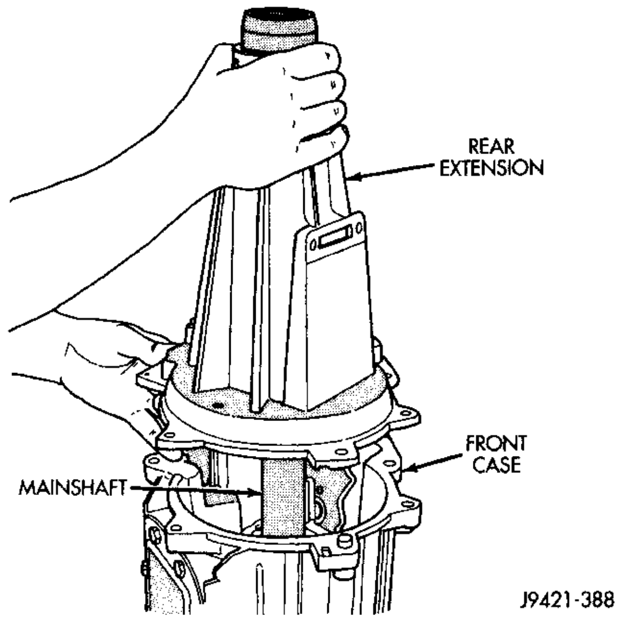

Fig. 26 Removing Rear Extension

(13) Remove mainshaft by lifting it straight up and out of input gear and shift sleeve (Fig. 27).

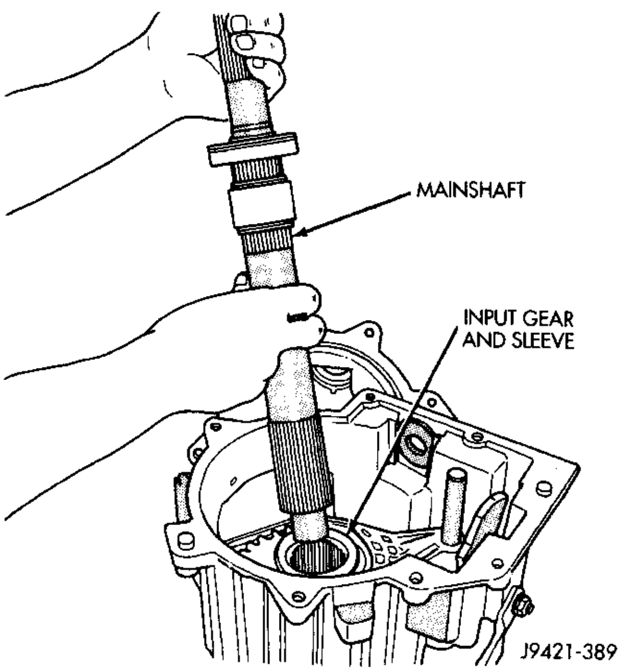

Fig. 27 Mainshaft Removal

(14) Remove rear output bearing retaining ring from mainshaft (Fig. 28).

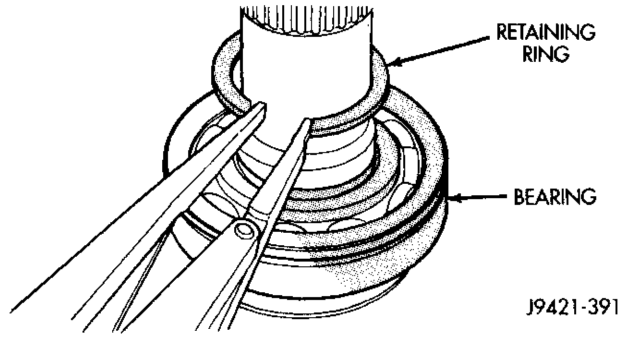

Fig. 28 Output Bearing Snap Ring Removal

(15) Remove output bearing from mainshaft. **Note position of snap ring groove in bearing for installation reference (Fig. 29).**

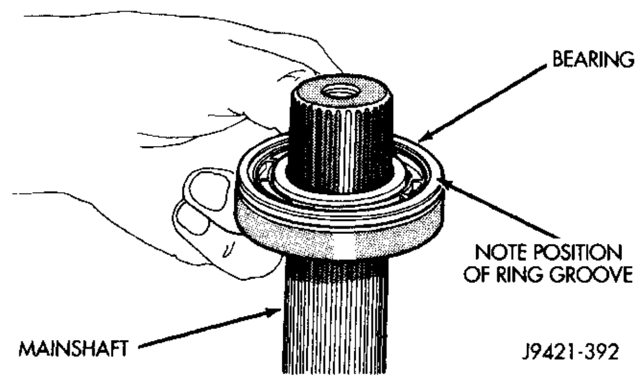

Fig. 29 Mainshaft Output Bearing Removal

(16) Remove speedometer gear rear retaining ring (Fig. 30).

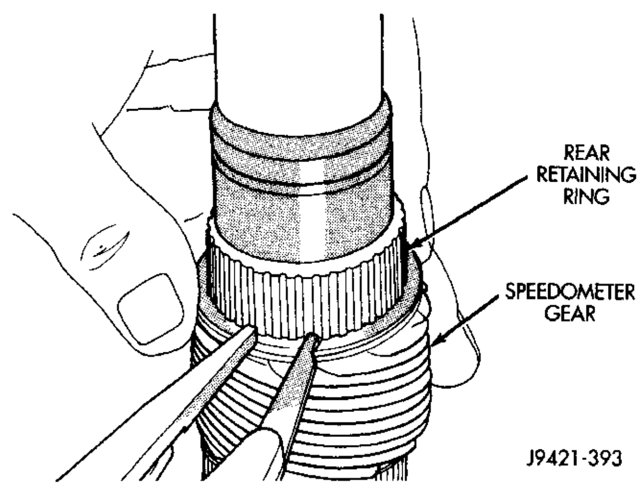

Fig. 30 Speedometer Gear Rear Snap Ring Removal

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DISASSEMBLY AND ASSEMBLY (Continued)

(17) Remove speedometer gear from mainshaft (Fig. 31).

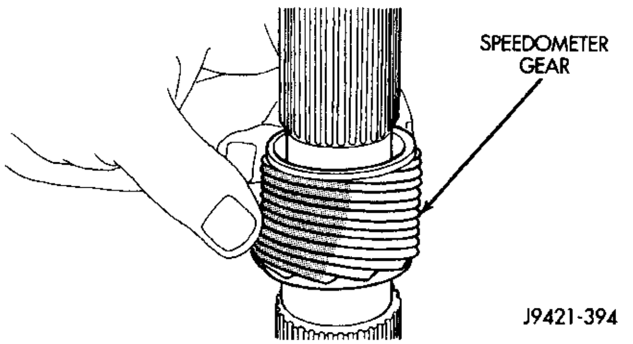

Fig. 31 Speedometer Gear Removal

(18) Remove speedometer gear front snap ring from mainshaft (Fig. 32).

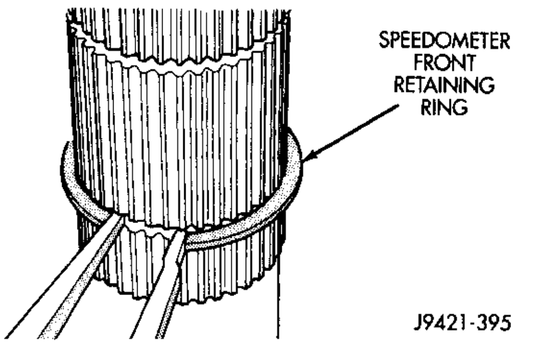

Fig. 32 Speedometer Gear Front Snap Ring Removal

(19) Remove shift rail by pulling it up and out of fork and case (Fig. 33).

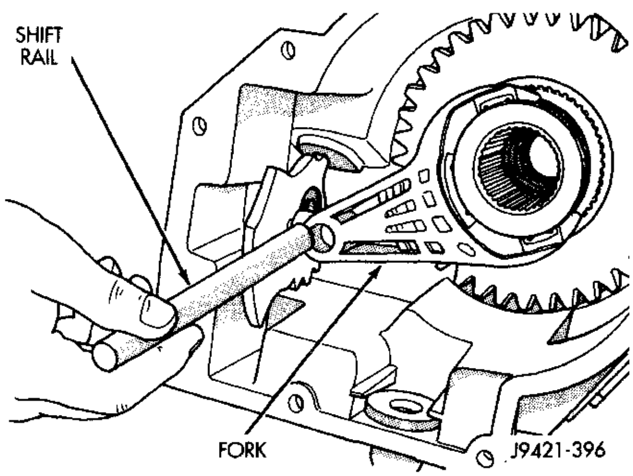

Fig. 33 Shift Rail Removal

(20) Remove shift fork and shift sleeve as assembly (Fig. 34).

(21) Separate shift fork and sleeve (Fig. 35). Note position of sleeve for installation reference.

(22) Roll case on side and off wood blocks.

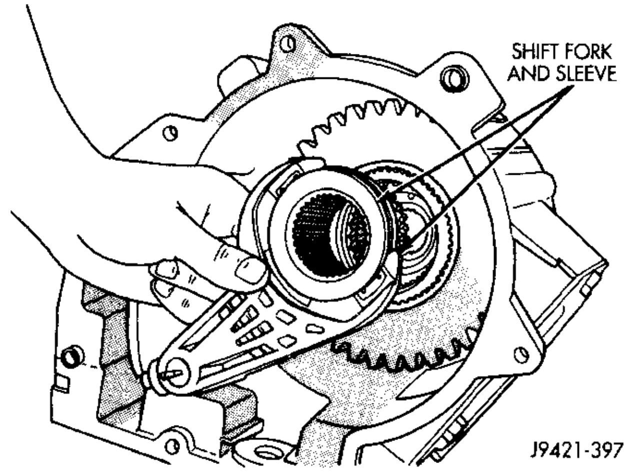

Fig. 34 Shift Fork And Sleeve Removal

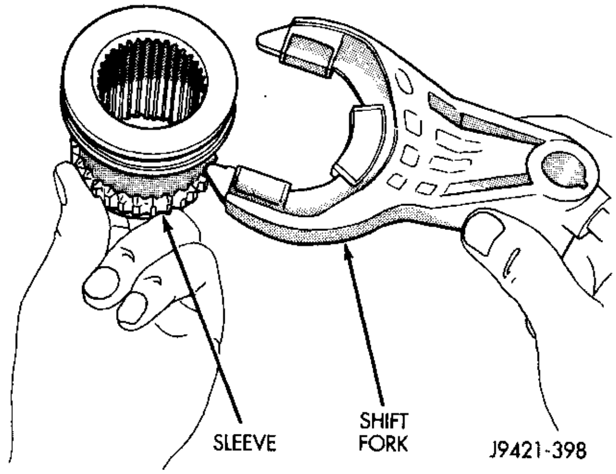

Fig. 35 Separating Shift Fork And Sleeve

(23) Tap input gear out of bearing with plastic mallet (Fig. 36).

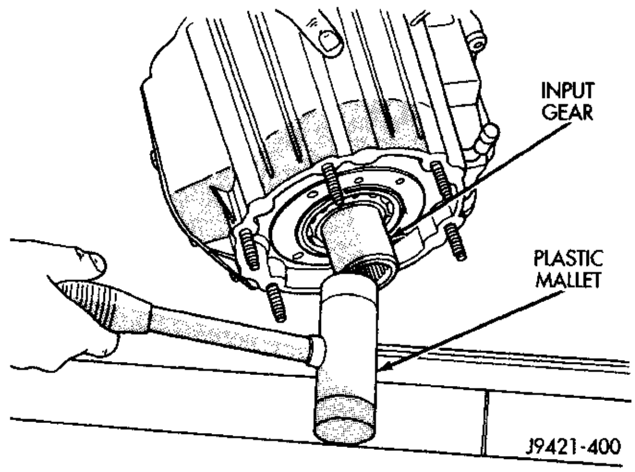

Fig. 36 Starting Input Gear Out of Bearing

DISASSEMBLY AND ASSEMBLY (Continued)

(24) Remove PTO and input gear assembly (Fig. 37). Lift assembly up and out of input bearing and case.

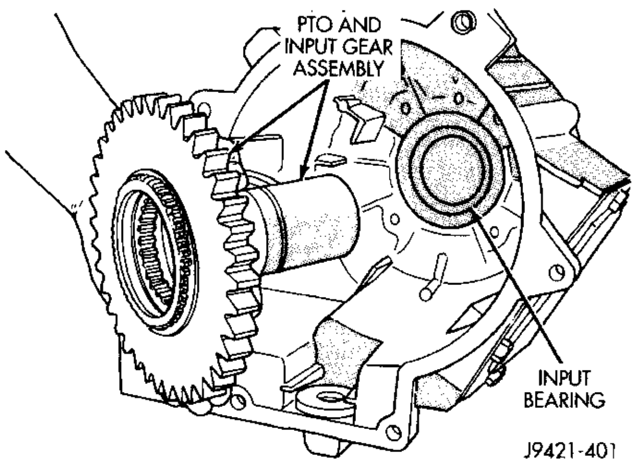

Fig. 37 Removing PTO/Input Gear Assembly

(25) Remove retaining ring that secures PTO gear on input gear (Fig. 38). Then slide PTO gear off input gear (Fig. 39).

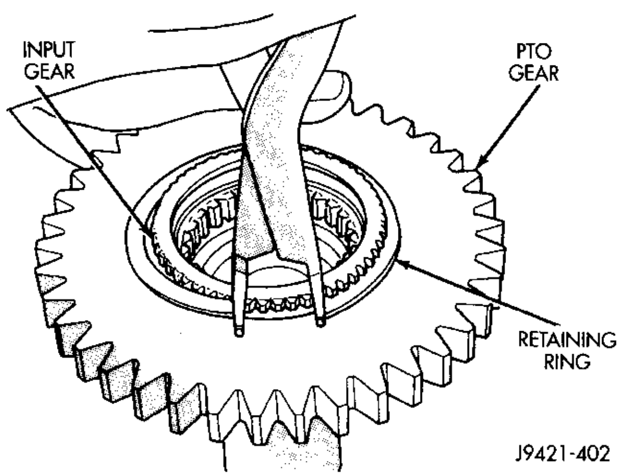

Fig. 38 Removing PTO Gear Retaining Ring

(26) Remove sector shaft O–ring retainer (Fig. 40), and O–ring (Fig. 41).

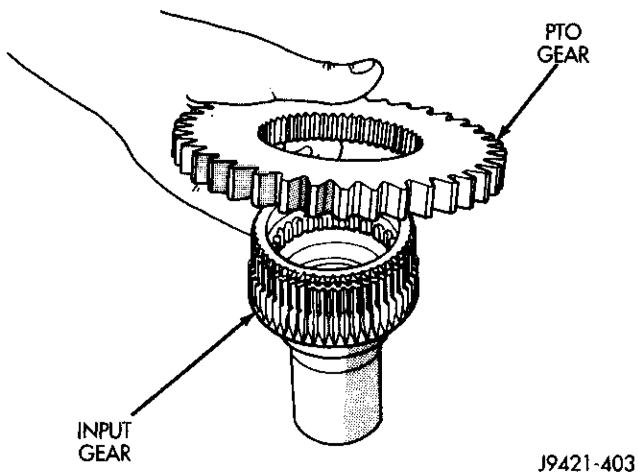

Fig. 39 Removing PTO Gear From Input Gear

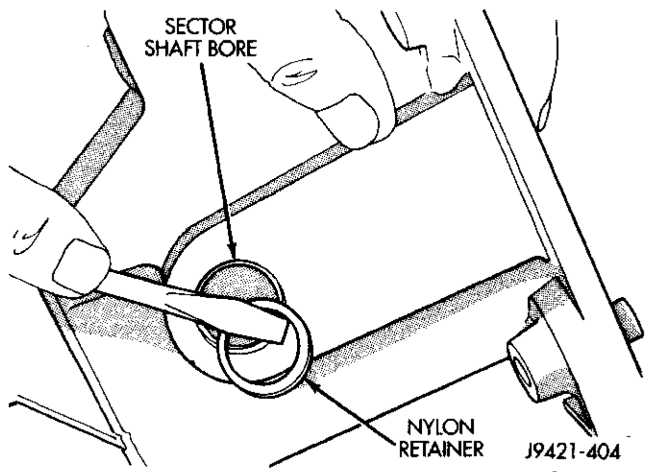

Fig. 40 Removing Shift Sector O–Ring Retainer

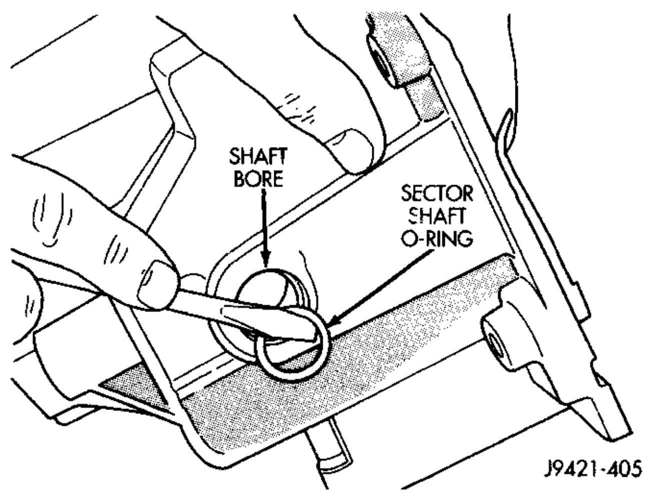

Fig. 41 Removing Shift Sector O–Ring

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DISASSEMBLY AND ASSEMBLY (Continued)

(27) Remove input bearing from front case with Driver Handle C–4171 and Tool C–4210 or 7828, whichever fits best (Fig. 42). **Bearing can only be removed from case interior because of bearing locating ring.**

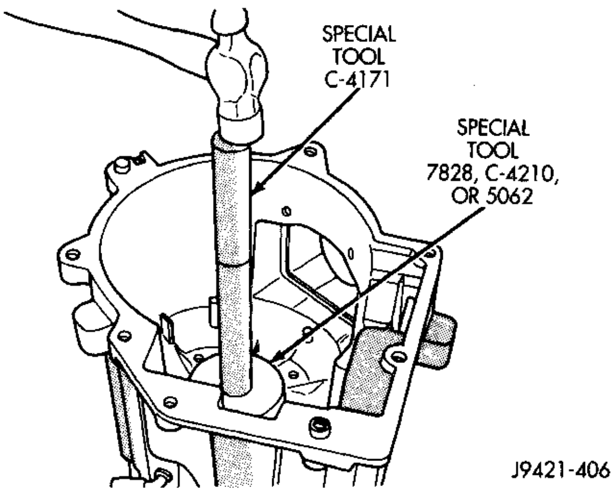

Fig. 42 Input Bearing Removal

(28) Inspect condition of needle bearing in input gear. If bearing is rough/noisy, worn, or brinnelled, remove bearing as follows:

(a) Turn bolt of Puller MD998346 to retract puller jaws. Then position puller jaws under bearing (Fig. 43).

(b) Tighten puller bolt to expand puller jaws and secure them under bearing.

(c) Grip puller bridge and turn puller nut clockwise to draw bearing out of gear (Fig. 44). **Note that bearing has built in cup plug (Fig. 45).**

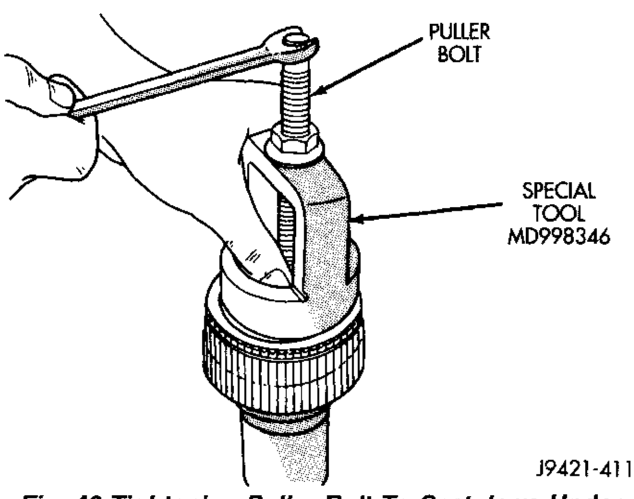

Fig. 43 Tightening Puller Bolt To Seat Jaws Under Bearing

ASSEMBLY

Lubricate the adapter components with Mopar Dexron II, or ATF Plus during assembly operations. In addition, since gaskets are not used in the adapter, sealing surfaces are to be coated with Mopar Gasket Maker, Loctite 518, or Mopar silicone adhesive/sealer. Therefore, it is important that all sealing surfaces be clean and free of grease and oil before applying sealers.

(1) Start input bearing in front case bore. Verify that locating ring is installed on bearing (Fig. 46). Note that bearing can only be installed from case exterior because of the ring which controls depth of installation.

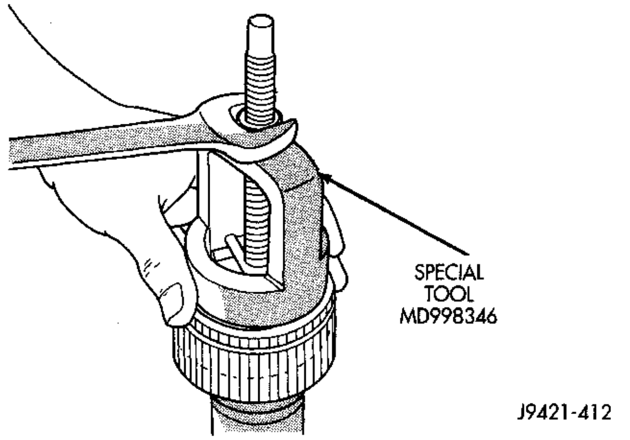

Fig. 44 Tightening Puller Nut To Pull Bearing From Gear

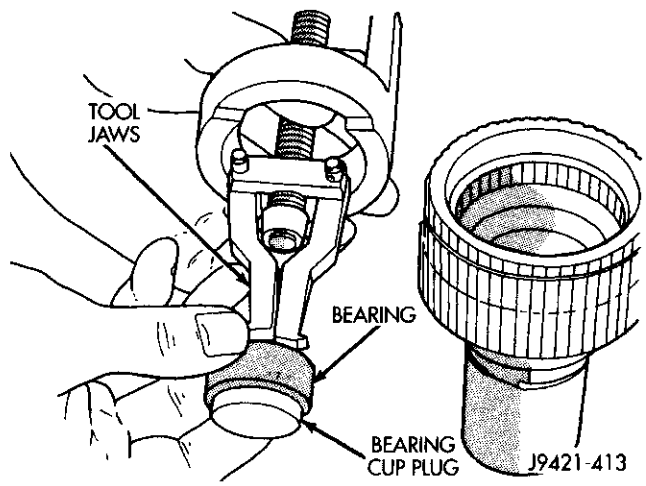

Fig. 45 Bearing Removed From Gear

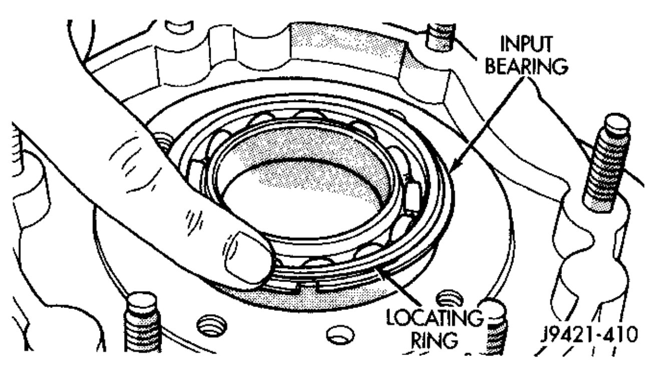

Fig. 46 Input Bearing Locating Ring Position

DISASSEMBLY AND ASSEMBLY (Continued)

(2) Seat input bearing in case (Fig. 47). Use driver Handle C– 4171 and Installer C–4210, 5062, or 7828 to install bearing. Seat bearing until locating ring is flush against case.

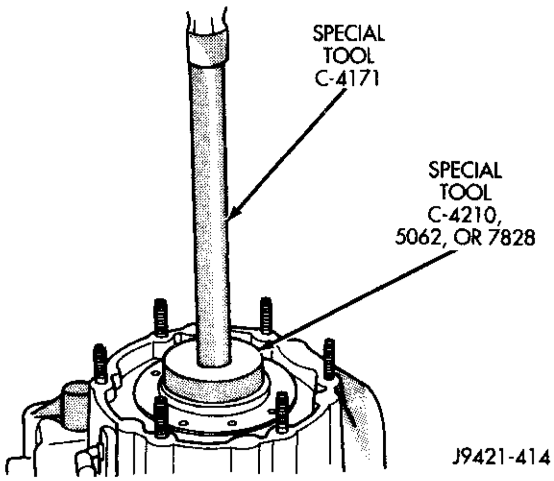

Fig. 47 Input Bearing Installation

(3) Install new needle bearing in input gear with Driver Handle C–4171 and Installer 5065 (Fig. 48).

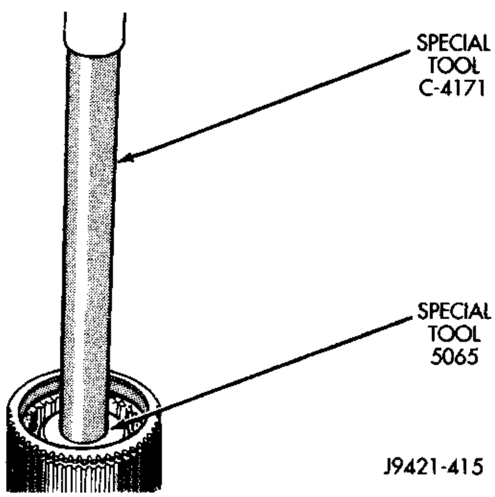

Fig. 48 Installing Needle Bearing In Input Gear

(4) Install new sector shaft O–ring (Fig. 49), and O–ring retainer (Fig. 50) in sector shaft bore.

(5) Install shift sector in front case (Fig. 51).

(6) Support front case on 3–4 small wood blocks so interior of case is facing up. Position blocks between studs on front case.

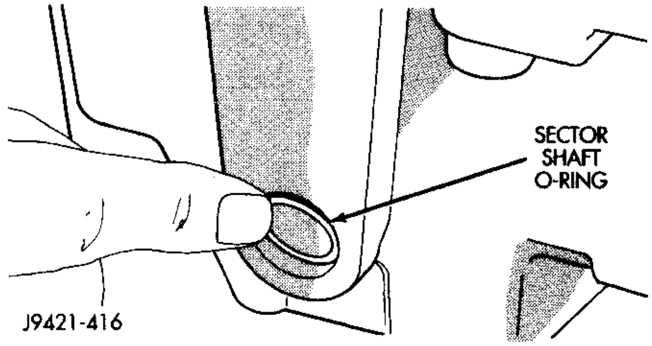

Fig. 49 Sector Shaft O–Ring Installation

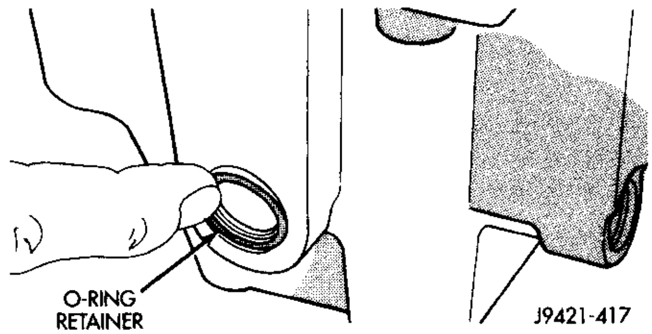

Fig. 50 Sector Shaft O–Ring Retainer Installation

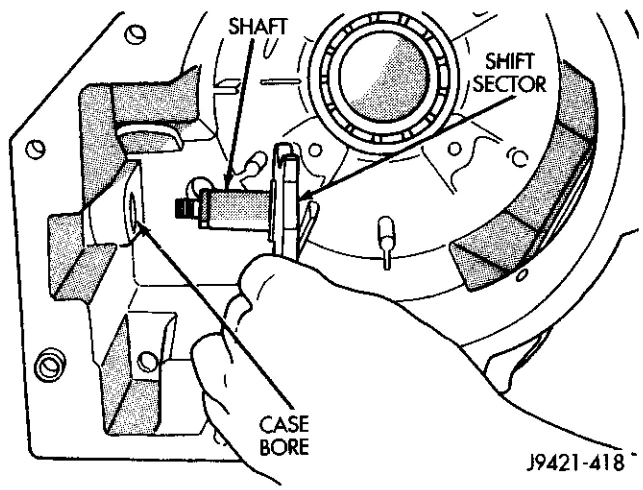

Fig. 51 Shift Sector Installation

AUTHENTIC RESTORATION PRODUCT

DISASSEMBLY AND ASSEMBLY (Continued)

(7) Install PTO gear on input gear (Fig. 52).
(8) Install PTO gear retaining ring (Fig. 53).

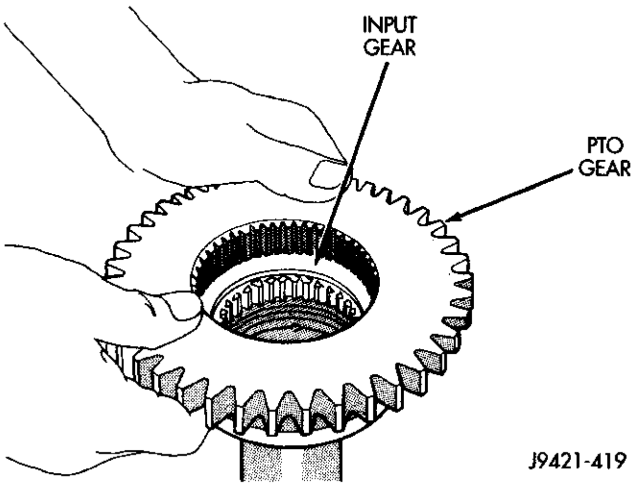

Fig. 52 Assembling Input And PTO Gears

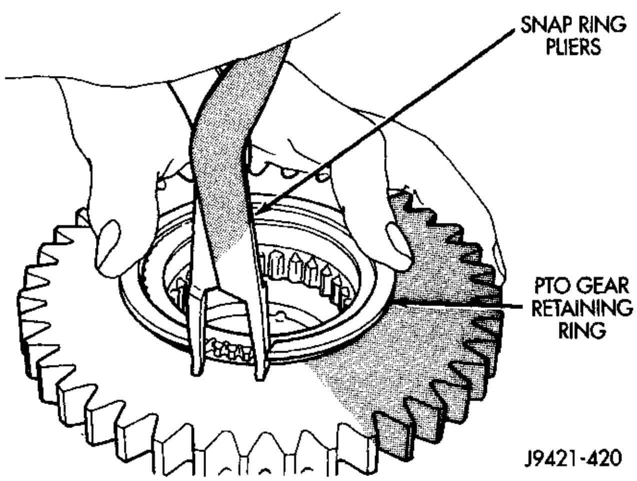

Fig. 53 Installing PTO Gear Retaining Ring

(9) Install input/PTO gear assembly in case (Fig. 54).

(10) **Tap PTO gear with wood hammer handle until snap ring groove in input gear is accessible.**

(11) Remove front case from wood blocks and position case so input gear is accessible.

(12) Install retaining ring on input gear (Fig. 55). **Be sure ring is fully seated in gear groove.**

(13) Remount front case on wood blocks.

(14) Assemble shift fork and sleeve (Fig. 56). Then install fork and sleeve (Fig. 57). Be sure sleeve is seated in input gear.

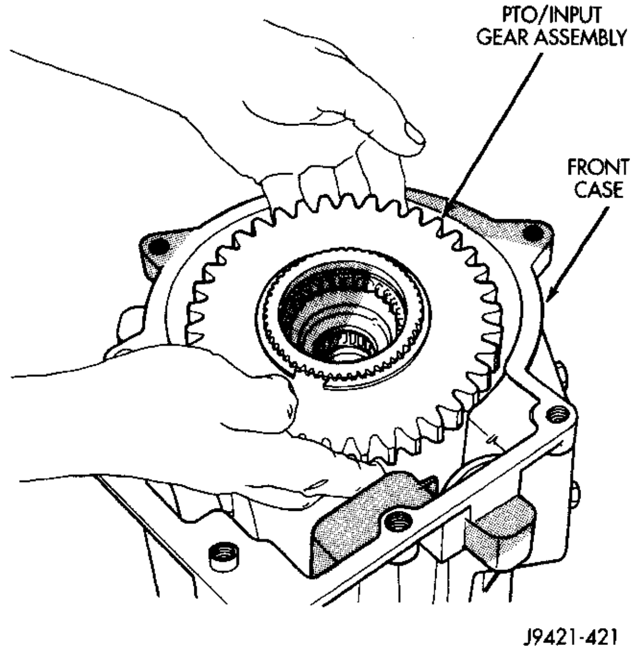

Fig. 54 Installing Input/PTO Gear Assembly In Case

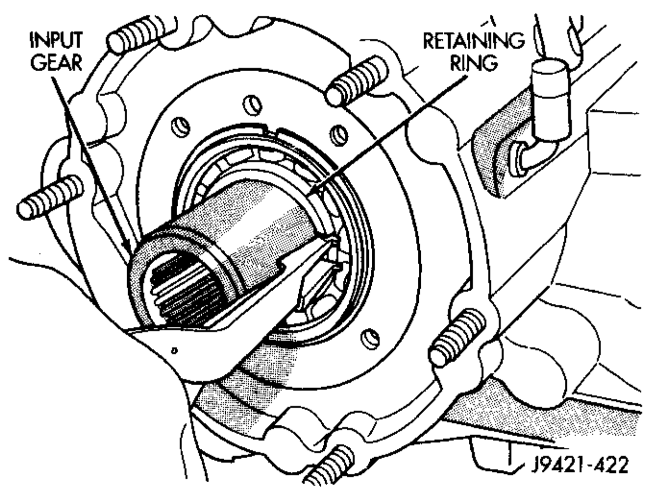

Fig. 55 Installing Input Gear Retaining Snap Ring

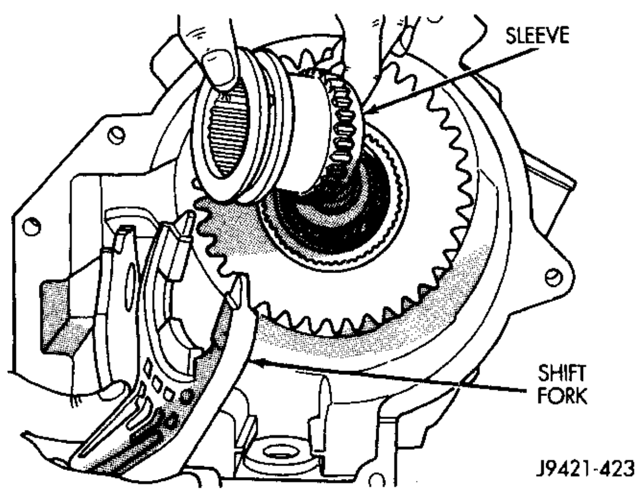

Fig. 56 Assembling Shift Fork And Sleeve

DISASSEMBLY AND ASSEMBLY (Continued)

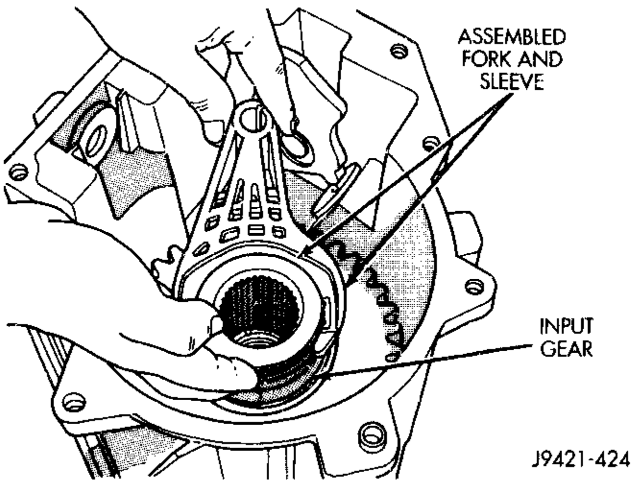

Fig. 57 Shift Fork And Sleeve Installation

(15) Align and install shift fork pin in sector slot (Fig. 58).

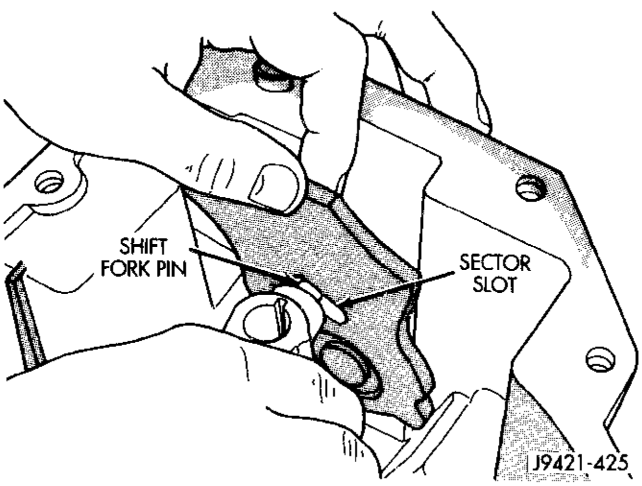

Fig. 58 Inserting Shift Fork Pin In Sector Slot

(16) Align shift sleeve in input gear and align shift fork with shift rail bore in case.

(17) Install shift rail through fork and into case bore (Fig. 59).

(18) Install shift lever on sector shaft (Fig. 60). Then install lever washer and nut on sector shaft (Fig. 61). Apply Loctite 242 to nut before installation and tighten nut to 27–34 N·m (20–25 ft. lbs.) torque.

(19) Install magnet in case pocket.

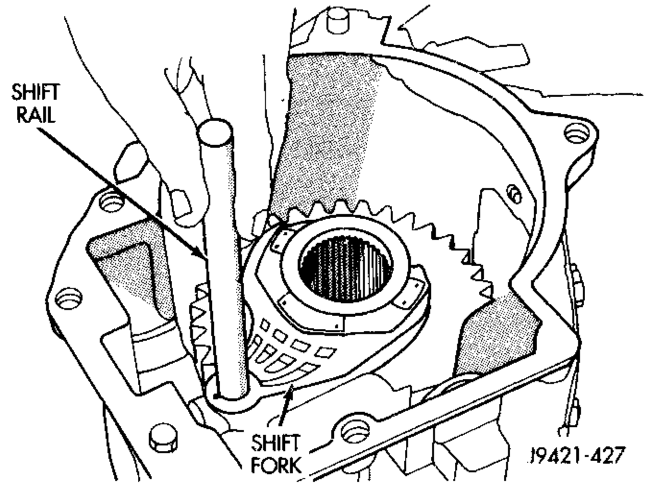

Fig. 59 Shift Rail Installation

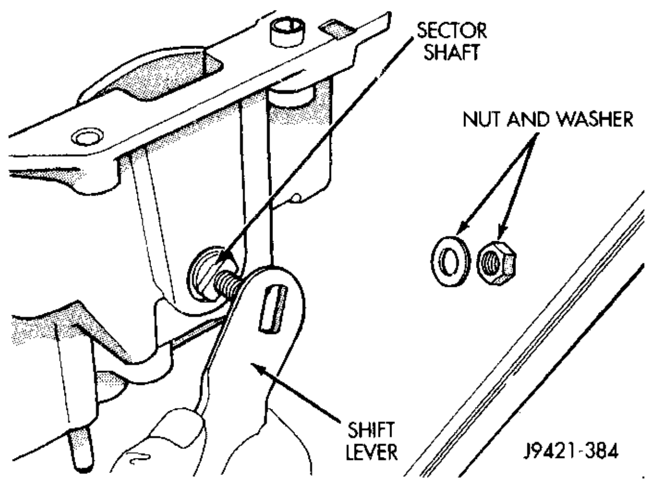

Fig. 60 Shift Lever Installation

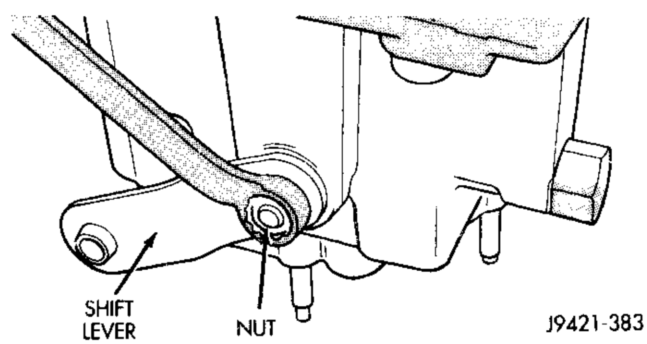

Fig. 61 Installing/Tightening Shift Lever Nut And Washer

AUTHENTIC RESTORATION PRODUCT

DISASSEMBLY AND ASSEMBLY (Continued)

(20) Install mainshaft (Fig. 62). Guide shaft through sleeve and into input gear bearing.

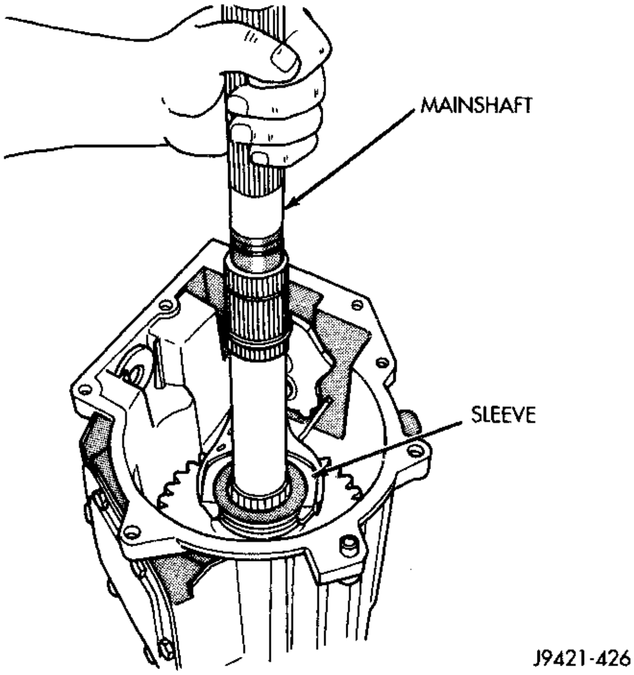

Fig. 62 Mainshaft Installation

(21) Install first speedometer snap ring on shaft (Fig. 63), followed by speedometer gear (Fig. 64). Then install second snap ring to secure gear on shaft (Fig. 65).

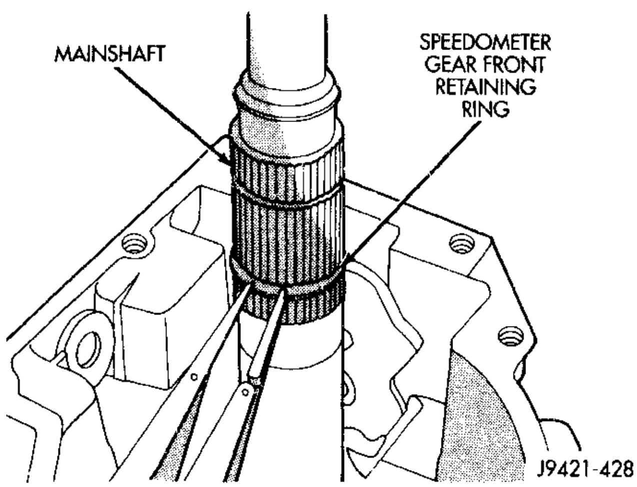

Fig. 63 Speedometer Front Ring installation

(22) Install output bearing on mainshaft (Fig. 66). **Be sure groove in outer race of bearing is toward rear of shaft. If bearing is reversed, retaining ring (in extension) will not align bearing.**

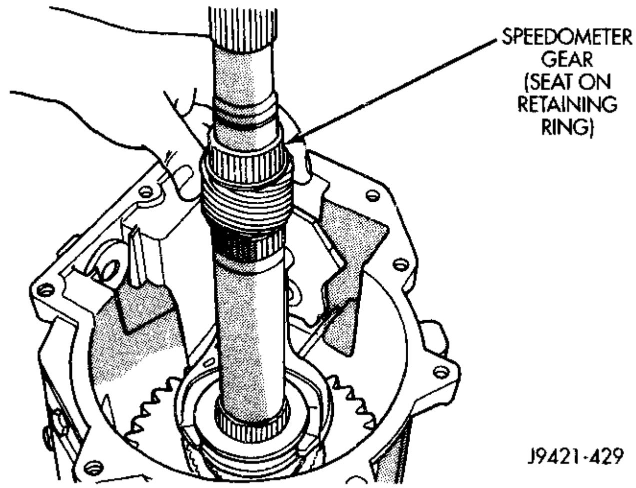

Fig. 64 Speedometer Gear installation

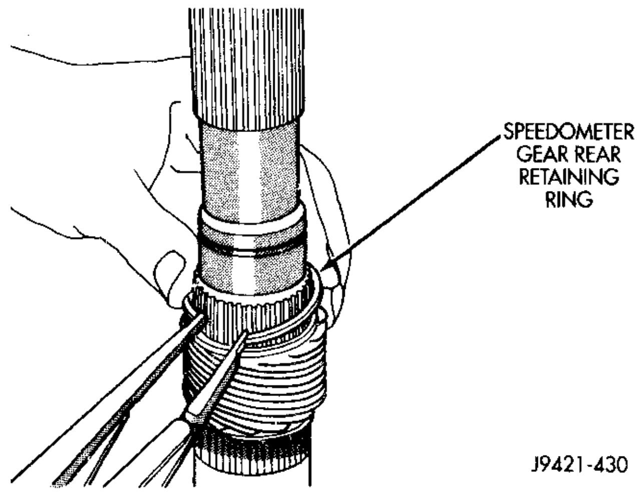

Fig. 65 Speedometer Front Ring installation

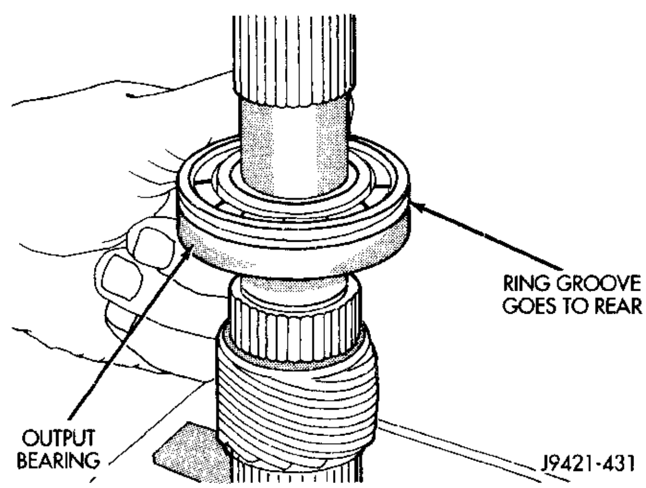

Fig. 66 Output Bearing Installation

DISASSEMBLY AND ASSEMBLY (Continued)

(23) Install output bearing retaining ring (Fig. 67). Use parallel jaw pliers to install ring.

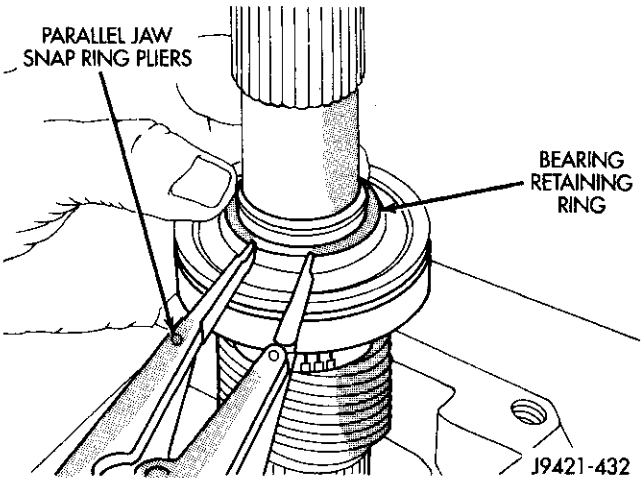

Fig. 67 Output Bearing Retaining Ring Installation

(24) Install new seal in rear extension if necessary. Use suitable size installer tool and be sure seal is fully seated.

(25) Apply bead of Mopar Gasket Maker, Loctite 518, or Mopar silicone adhesive sealer to mating surface of front case and rear extension. Sealer beads should be no more than 1/8 to 3/16 in. wide.

(26) Align and install rear extension on front case (Fig. 68).

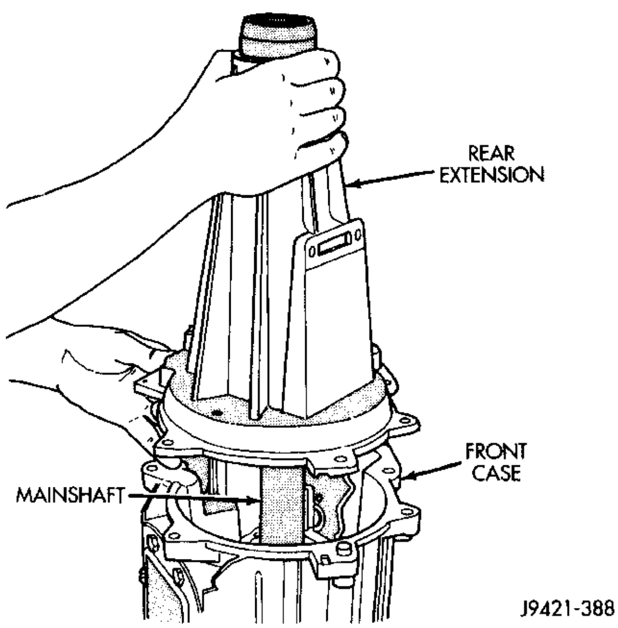

Fig. 68 Installing Rear Extension On Front Case

(27) Install one or two extension–to–front case bolts to hold assembly together. Be sure dowels are aligned in extension before hand tightening bolts.

(28) Remove adapter assembly from wood blocks and place assembly in horizontal position on workbench.

(29) Seat output bearing retaining ring as follows:

(a) Reach in access cover opening in rear extension with snap ring pliers (Fig. 69).

(b) Spread retaining ring with snap ring pliers and seat it in groove of output bearing. **If retaining ring is not aligned with bearing groove, tilt front case upward so mainshaft will move rearward for alignment.**

(c) Verify that retaining ring is fully seated in ring groove before proceeding (Fig. 70).

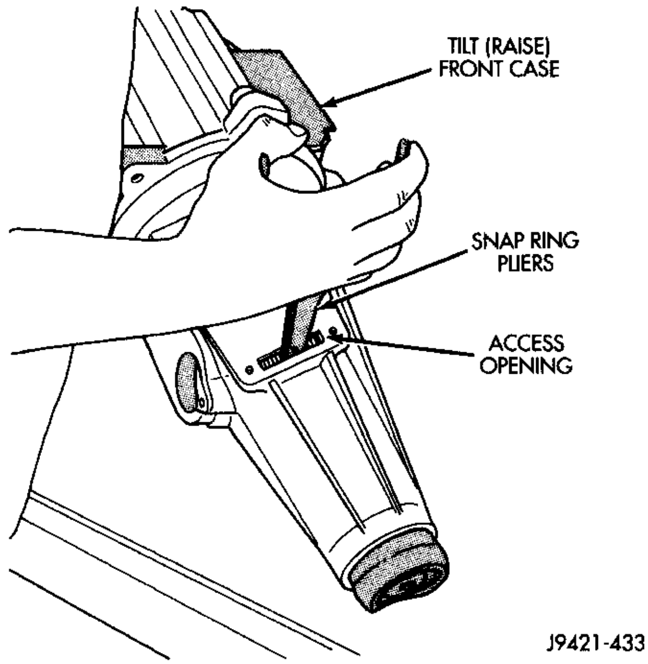

Fig. 69 Seating Output Bearing Retaining Ring

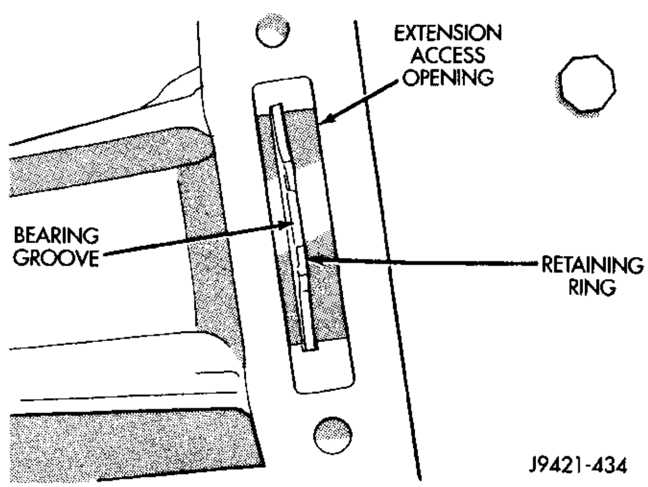

Fig. 70 Correct Seating Of Retaining Ring

AUTHENTIC RESTORATION PRODUCT

DISASSEMBLY AND ASSEMBLY (Continued)

(30) Install access cover and gasket in rear extension (Fig. 71). Then install and tighten torx screws to 8–11 N·m (75–95 in. lbs.) (Fig. 72).

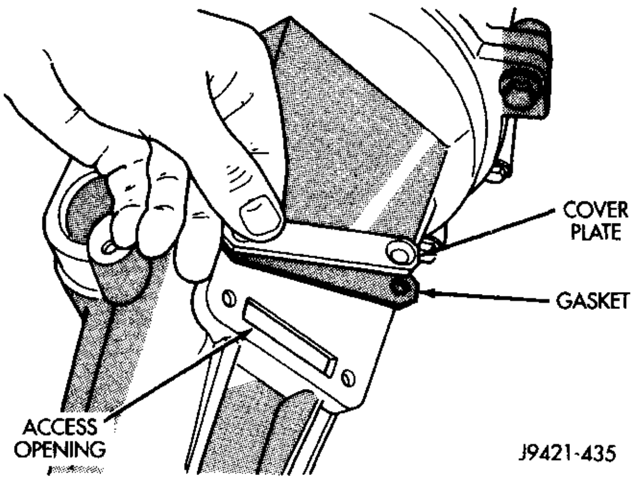

Fig. 71 Access Cover And Gasket Installation

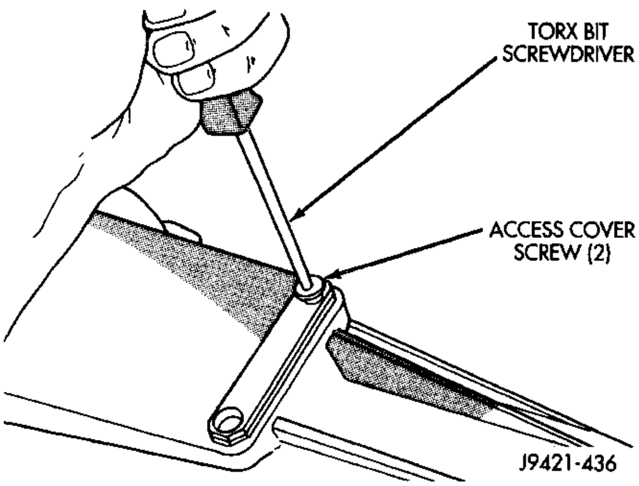

Fig. 72 Installing Access Cover Screws

(31) Install new seal in input bearing retainer with Handle C- 4171 and Installer 7828, C–4974, or similar size installer tool (Fig. 73).

(32) Install input bearing retainer as follows:

(a) Note position of oil channel in retainer and oil feed hole in front case (Fig. 74). Be sure retainer is installed so channel is aligned with feed hole.

(b) Apply bead of Mopar Gasket Maker, Loctite 518, or Mopar silicone adhesive sealer to seal surface of retainer. Sealer bead should be no more than 1/8 to 3/16 in. wide.

(c) Apply transmission fluid to input gear hub.

(d) Align retainer channel with feed hole in case and install retainer (Fig. 75).

(e) Apply sealer to retainer bolts. Then install and tighten bolts to 16–24 N·m (12–18 ft. lbs.) torque.

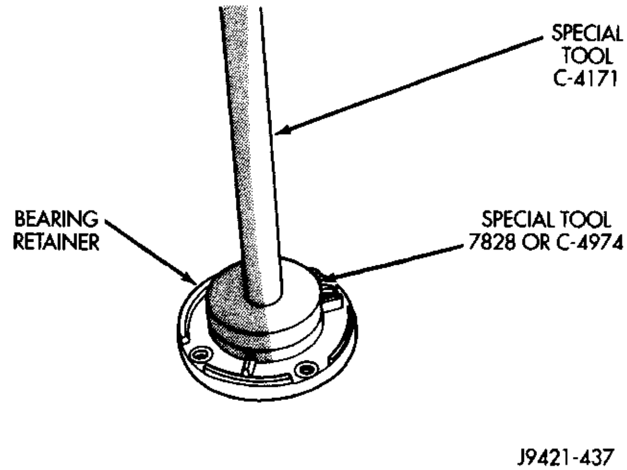

Fig. 73 Installing Input Bearing Retainer Seal

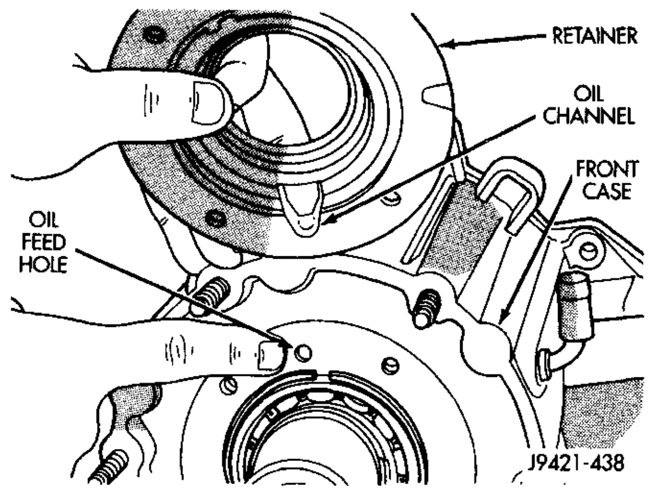

Fig. 74 Retainer Oil Channel And Case Oil Feed Hole Locations

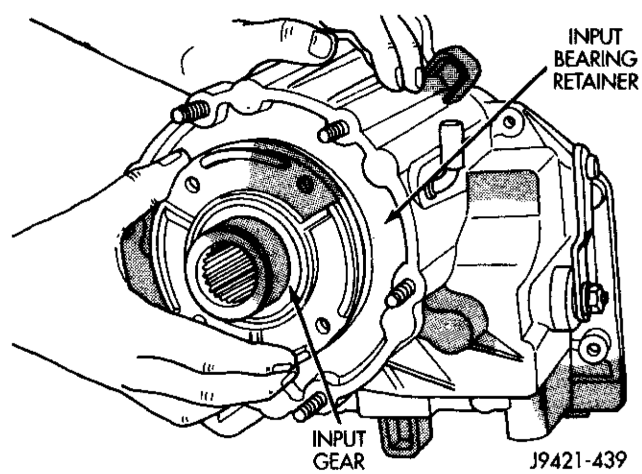

Fig. 75 Input Bearing Retainer Installation

DISASSEMBLY AND ASSEMBLY (Continued)

CAUTION: If a silicone sealer is used, do not use any more sealer than recommended. Excessive amounts of sealer will be displaced into the area between the retainer and case. This could result in partial or full blockage of the bearing oil feed hole in the front case.

(33) Install poppet plunger and spring in front case detent bore (Fig. 76).

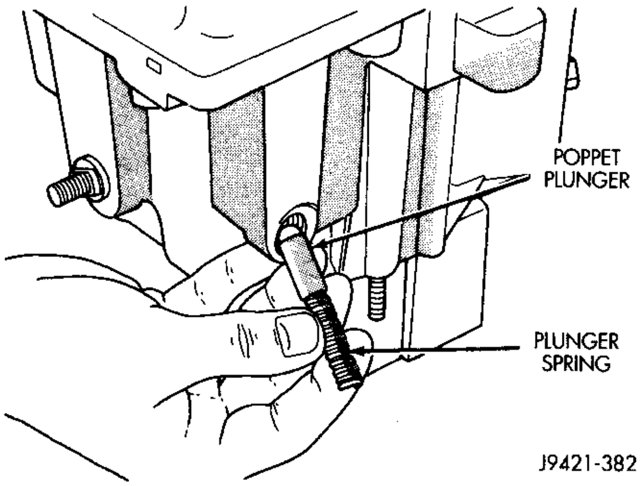

Fig. 76 Poppet Plunger And Spring Installation

(34) Install new O–ring on poppet plunger screw. Then install screw in front case (Fig. 77). Tighten screw to 16–24 N·m (12– 18 ft. lbs.) torque.

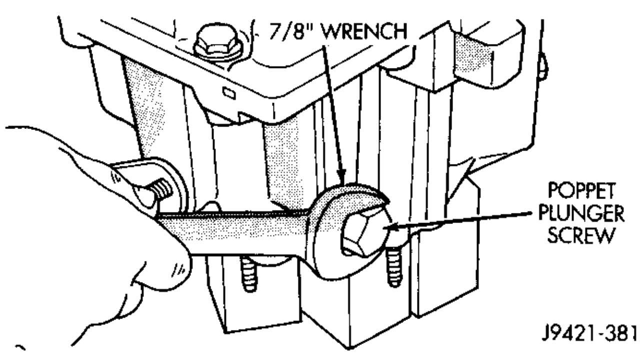

Fig. 77 Poppet Plunger Screw Installation

(35) Install indicator switch in front case. Tighten switch to 20–34 N·m (15–25 ft. lbs.) torque.

(36) Install and tighten drain plug to 41–54 N·m (30–40 ft. lbs.) torque.

(37) Fill adapter with 2.1 liters (4.6 pints) liters of Mopar Dexron II, or ATF Plus transmission fluid and install fill plug. Tighten fill plug to 41–54 N·m (30–40 ft. lbs.) torque.

(38) Apply Mopar silicone adhesive/sealer to PTO cover mating surface and to threads of cover bolts. Then install cover and tighten bolts to 27–34 N·m (20–25 ft. lbs.) torque.

CLEANING AND INSPECTION

ADAPTER

Clean the adapter components with solvent. Dry all the parts (except bearings) with compressed air. Allow bearings to air dry, or wipe them dry with clean shop towels.

Inspect the front case and rear extension (Fig. 78), for cracks, damaged threads, or scored mating surfaces. Minor scratches and nicks can be smoothed off with emery cloth. Damaged threads can be repaired with Heli–Coil, stainless steel thread inserts.

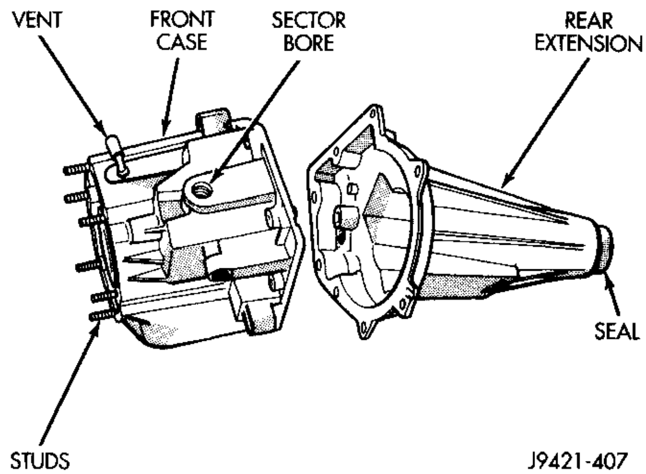

Fig. 78 Front Case And Extension

Be sure the front case sector bore, vent tube, and mounting studs are in good condition. Replace the extension oil seal if it is cut, or torn. Also check the retaining ring in the extension interior (Fig. 79). This ring secures the mainshaft output bearing to the extension.

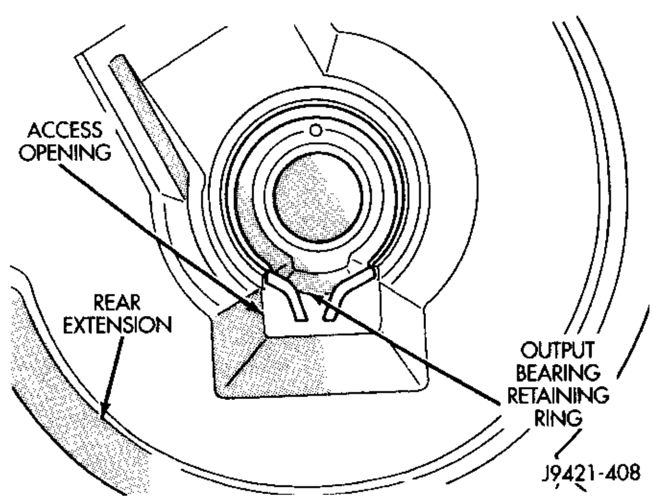

Fig. 79 Bearing Retaining Ring Location In Extension

AUTHENTIC RESTORATION PRODUCT

CLEANING AND INSPECTION (Continued)

The extension has a bushing at the rear. If the bushing is worn, remove the seal. Then remove the bushing by cutting and collapsing it with a cape chisel. A new bushing can be installed with any suitable size installer tool similar to 5065 or 5062.

Slide the PTO gear onto the input gear and check fit (Fig. 80). Replace either gear if any gear teeth, or splines are damaged. Also check the bearing/seal surface of the input gear. Small scratches on this surface can be smoothed with 320/400 grit emery cloth if necessary.

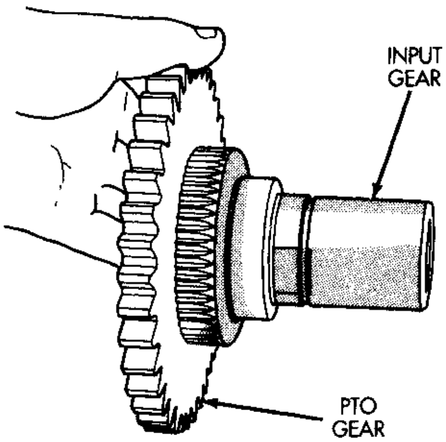

Fig. 80 Input And PTO Gears

The various snap rings used in the adapter should be replaced during overhaul. This is recommended as some of the snap rings can be distorted during removal. A distorted snap ring will not seat properly.

Inspect the bearings carefully. Rotate them by hand and check for noise or roughness. Replace any bearing exhibiting roughness, noise, or visible surface damage of the rollers or bearing balls.

Check the splines and gear teeth on the PTO gear, mainshaft, and shift sleeve. Replace any component exhibiting damage.

Install new O–rings on the poppet screw and in the sector shaft bore. Do not reuse the original O–rings.

Check condition of the plastic inserts on the shift fork. Be sure the inserts are not worn through, or otherwise damaged. Replace the fork if worn, or damaged in any way.

ADJUSTMENTS

SHIFT LINKAGE

(1) Place adapter floor shift lever in D position.
(2) Raise vehicle.
(3) Loosen locknut on shift rod.
(4) Verify that adapter shift lever is in D position.
(5) Tighten shift rod locknut and lower vehicle.

SPECIFICATIONS

NV 021 ADAPTER

TORQUE

Description	Torque
Access Cover Screws	8–11 N•m (75–95 in. lbs.)
Adapter Mounting Nuts:	
With 5/16 stud	30–41 N•m (22–30 ft. lbs.)
With 3/8 stud	41–47 N•m (30–35 ft. lbs.)
Adapter Shift Lever Nut	27–34 N•m (20–25 ft. lbs.)
Fill/Drain Plugs	41–54 N•m (30–40 ft. lbs.)
Front Case-To-Rear Extension Bolts	27–34 N•m (20–25 ft. lbs.)
Indicator Switch	20–34 N•m (15–25 ft. lbs.)
Input Bearing Retainer Bolts	16–24 N•m (12–18 ft. lbs.)
Poppet Plunger Screw	16–24 N•m (12–18 ft. lbs.)
Propeller Shaft Clamp Bolts	19 N•m (170 in. lbs.)

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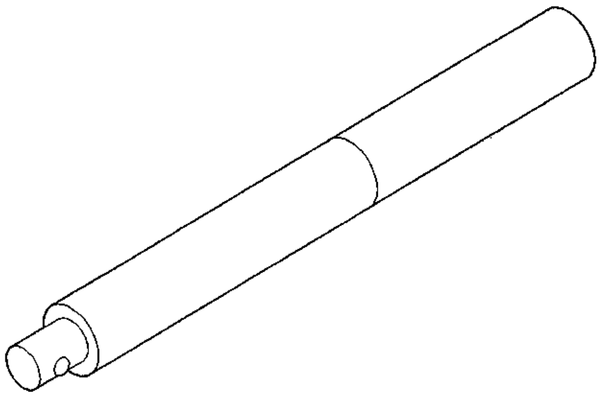
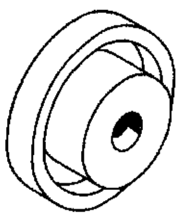
SPECIAL TOOLS

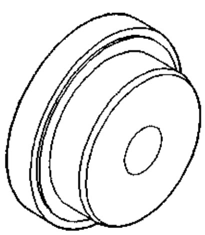
NV 021 ADAPTER



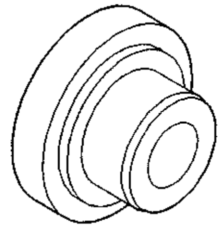
Handle C-4171



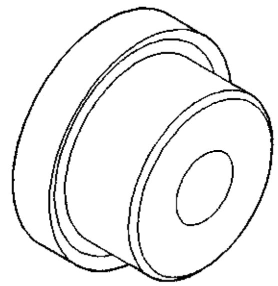
Driver C-4210



Driver 5062



Driver 5065



Driver 7828

Mopar AUTHENTIC RESTORATION PRODUCT

TIRES AND WHEELS

CONTENTS

TIRES

INDEX

DESCRIPTION AND OPERATION

TIRES

Tires are designed and engineered for each specific vehicle. They provide the best overall performance for normal operation. The ride and handling characteristics match the vehicle's requirements. With proper care they will give excellent reliability, traction, skid resistance, and tread life.

Driving habits have more effect on tire life than any other factor. Careful drivers will obtain in most cases, much greater mileage than severe use or careless drivers. A few of the driving habits which will shorten the life of any tire are:

- Rapid acceleration
- Severe brake applications
- High speed driving
- Excessive speeds on turns
- Striking curbs and other obstacles

Radial-ply tires are more prone to irregular tread wear. It is important to follow the tire rotation interval shown in the section on Tire Rotation. This will help to achieve a greater tread life.

TIRE IDENTIFICATION

Tire type, size, aspect ratio and speed rating are encoded in the letters and numbers imprinted on the side wall of the tire. Refer to the chart to decipher the tire identification code (Fig. 1).

Performance tires have a speed rating letter after the aspect ratio number. The speed rating is not always printed on the tire sidewall. These ratings are:

- **Q** up to 100 mph
- **S** up to 112 mph
- **T** up to 118 mph
- **U** up to 124 mph
- **H** up to 130 mph
- **V** up to 149 mph
- **Z** more than 149 mph (consult the tire manufacturer for the specific speed rating)

An All Season type tire will have either **M + S, M & S or M–S** (indicating mud and snow traction) imprinted on the side wall.

TIRE CHAINS

Tire snow chains may be used on **certain** models. Refer to the Owner's Manual for more information.

DESCRIPTION AND OPERATION (Continued)

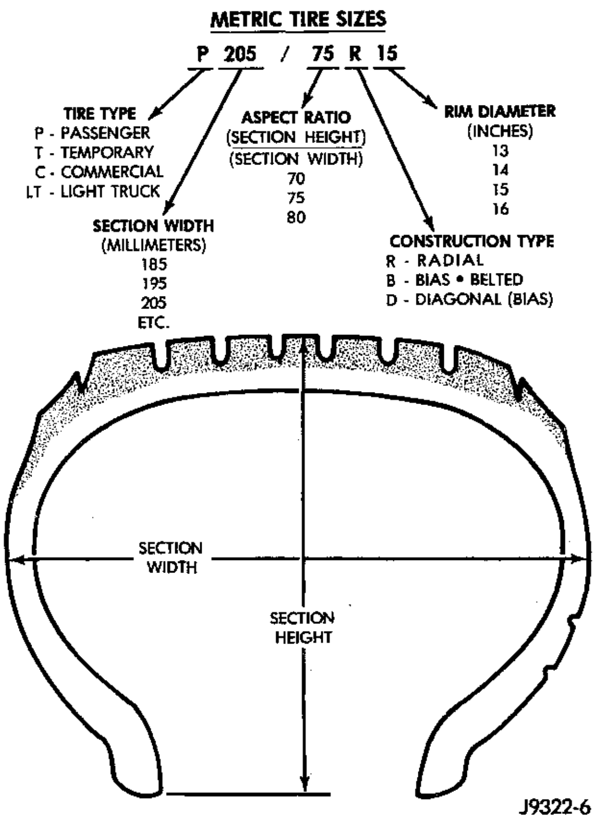


Fig. 1 Tire Identification

RADIAL-PLY TIRES

Radial-ply tires improve handling, tread life and ride quality, and decrease rolling resistance.

Radial-ply tires must always be used in sets of four. Under no circumstances should they be used on the front only. They may be mixed with temporary spare tires when necessary. A maximum speed of 50 MPH is recommended while a temporary spare is in use.

Radial-ply tires have the same load-carrying capacity as other types of tires of the same size. They also use the same recommended inflation pressures.

The use of oversized tires, either in the front or rear of the vehicle, can cause vehicle drive train failure. This could also cause inaccurate wheel speed signals when the vehicle is equipped with Anti-Lock Brakes.

The use of tires from different manufactures on the same vehicle is NOT recommended. The proper tire pressure should be maintained on all four tires. For proper tire pressure refer to the Tire Inflation Pressure Chart provided with the vehicle.

SPARE TIRE–TEMPORARY

The temporary spare tire is designed for emergency use only. The original tire should be repaired or replaced at the first opportunity and reinstall. Do not exceed speeds of 50 MPH. Refer to Owner's Manual for complete details.

TIRE INFLATION PRESSURES

CAUTION: Models 2500 and 3500 now use a high pressure snap-in tire valve. Do not substitute with other tire valves. The Tire and Rim industry designations are TR413 for low pressure and 600HP for high pressure.

Under inflation (Fig. 2) causes rapid shoulder wear and tire flexing.

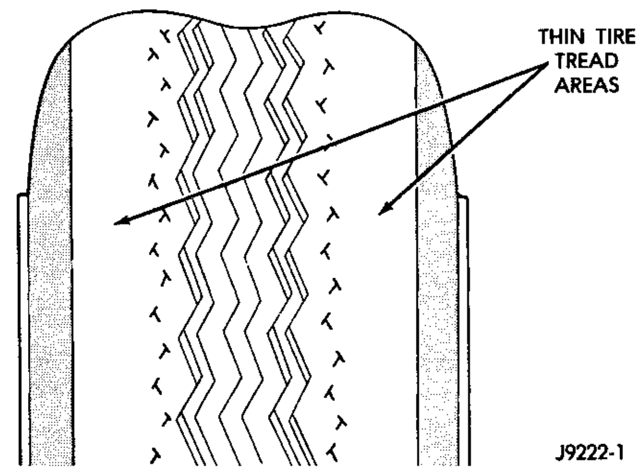


Fig. 2 Under Inflation Wear

Over inflation (Fig. 3) causes rapid center wear and loss of the tire's ability to cushion shocks.

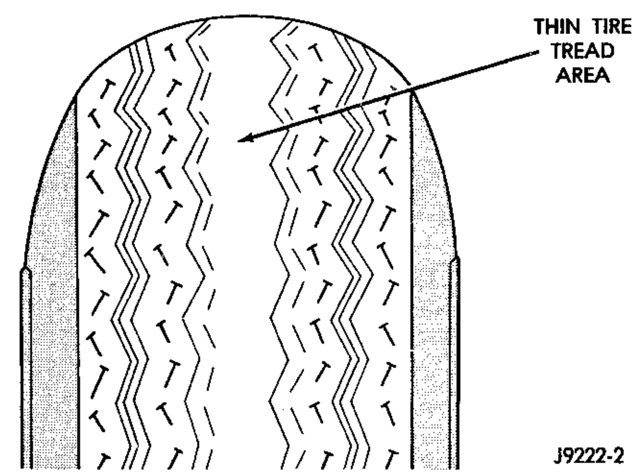


Fig. 3 Over Inflation Wear

Improper inflation can cause;

- Uneven wear patterns
- Reduced tread life
- Reduced fuel economy
- Unsatisfactory ride
- Cause the vehicle to drift

AUTHENTIC RESTORATION PRODUCT

DESCRIPTION AND OPERATION (Continued)

Refer to the Tire Inflation Pressure brochure for information regarding proper tire inflation. This information is provided with the Owner's Manual.

This pressure has been carefully selected to provide for safe vehicle operation. Tire pressure should be checked **cold** once a month. Tire pressure decreases when the outside temperature drops.

Inflation pressures specified on the placards are always **cold inflation pressure**. Cold inflation pressure is obtained after the vehicle has not been operated for at least 3 hours. Tire inflation pressures may increase from 2 to 6 pounds per square inch (psi) during operation. **Do not** reduce this normal pressure build-up.

Vehicles loaded to the maximum capacity should not be driven at continuous speeds above 75 mph (120 km/h).

WARNING: OVER OR UNDER INFLATED TIRES CAN AFFECT VEHICLE HANDLING AND MAY RESULT IN LOSS OF VEHICLE CONTROL.

TIRE PRESSURE FOR HIGH SPEED OPERATION

Chrysler Corporation advocates driving at safe speeds within posted speed limits. Where speed limits allow the vehicle to be driven at high speeds, correct tire inflation pressure is very important. For speeds up to and including 120 km/h (75 mph), tires must be inflated to the pressures shown on the tire placard. For continuous speeds in excess of 120 km/h (75 mph), tires must be inflated to the maximum pressure specified on the tire sidewall.

Vehicles loaded to the maximum capacity should not be driven at continuous speeds above 75 mph (120 km/h).

For emergency vehicles that are driven at speeds over 90 mph (144 km/h), special high speed tires must be used. Consult tire manufacturer for correct inflation pressure recommendations.

REPLACEMENT TIRES

The original equipment tires provide a proper balance of many characteristics such as:

- Ride
- Noise
- Handling
- Durability
- Tread life
- Traction
- Rolling resistance
- Speed capability

It is recommend that tires equivalent to the original equipment tires be used when replacement is needed.

Failure to use equivalent replacement tires may adversely affect the safety and handling of the vehicle.

The use of oversize tires not listed in the specification charts may cause interference with vehicle components. Under extremes of suspension and steering travel, interference with vehicle components may cause tire damage.

WARNING: FAILURE TO EQUIP THE VEHICLE WITH TIRES HAVING ADEQUATE SPEED CAPABILITY CAN RESULT IN SUDDEN TIRE FAILURE.

DIAGNOSIS AND TESTING

PRESSURE GAUGES

A quality air pressure gauge is recommended to check tire pressure. After checking the air pressure, replace valve cap finger tight.

TREAD WEAR INDICATORS

Tread wear indicators are molded into the bottom of the tread grooves. When tread depth is 1.6 mm (1/16 in.), the tread wear indicators will appear as a 13 mm (1/2 in.) band (Fig. 4).

Tire replacement is necessary when indicators appear in two or more grooves or if localized balding occurs.

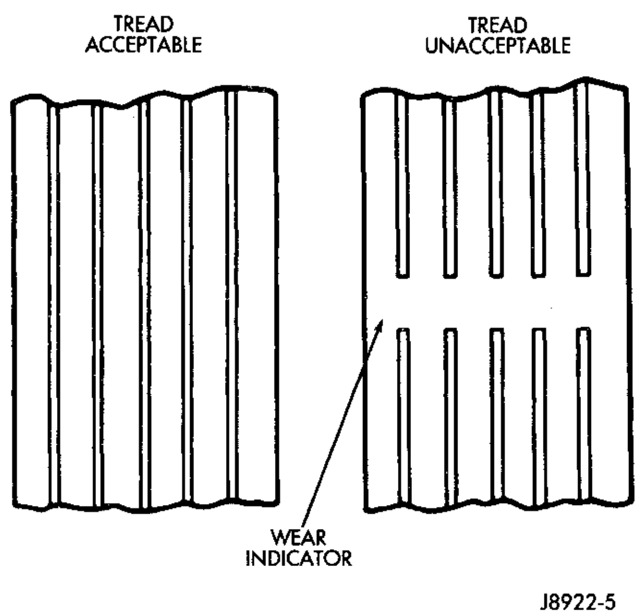
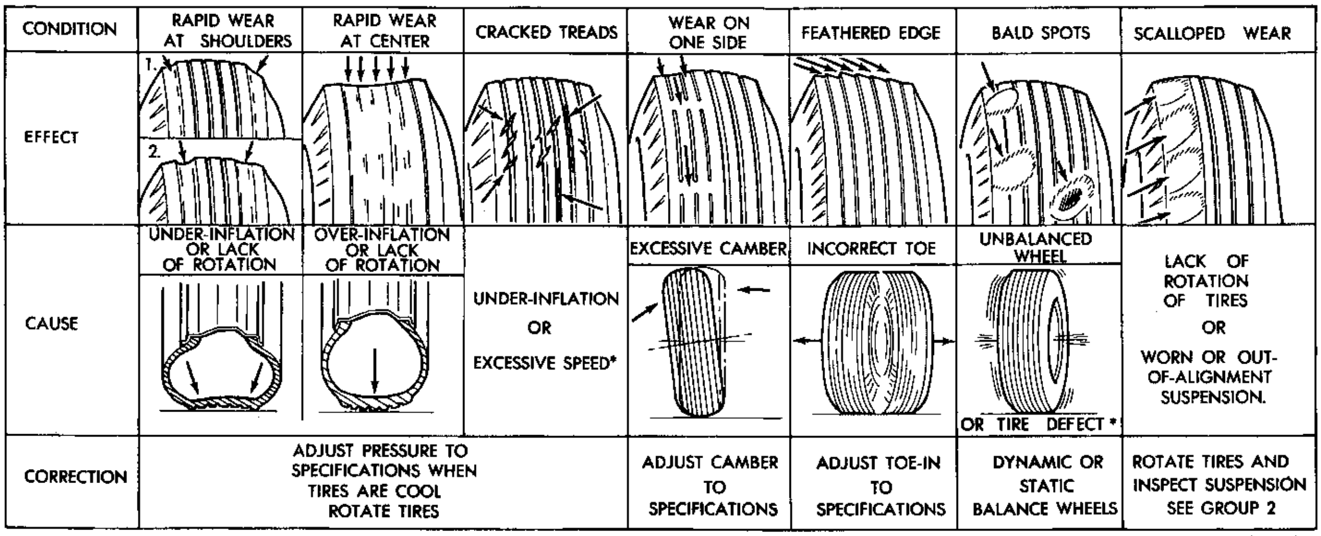


Fig. 4 Tread Wear Indicators

TIRE WEAR PATTERNS

Under inflation will cause wear on the shoulders of tire. Over inflation will cause wear at the center of tire.

DIAGNOSIS AND TESTING (Continued)



CONDITION	RAPID WEAR AT SHOULDERS	RAPID WEAR AT CENTER	CRACKED TREADS	WEAR ON ONE SIDE	FEATHERED EDGE	BALD SPOTS	SCALLOPED WEAR
EFFECT	1. 2.						
CAUSE	UNDER-INFLATION OR LACK OF ROTATION	OVER-INFLATION OR LACK OF ROTATION	UNDER-INFLATION OR EXCESSIVE SPEED*	EXCESSIVE CAMBER	INCORRECT TOE	UNBALANCED WHEEL OR TIRE DEFECT*	LACK OF ROTATION OF TIRES OR WORN OR OUT-OF-ALIGNMENT SUSPENSION.
CORRECTION	ADJUST PRESSURE TO SPECIFICATIONS WHEN TIRES ARE COOL ROTATE TIRES			ADJUST CAMBER TO SPECIFICATIONS	ADJUST TOE-IN TO SPECIFICATIONS	DYNAMIC OR STATIC BALANCE WHEELS	ROTATE TIRES AND INSPECT SUSPENSION SEE GROUP 2

*HAVE TIRE INSPECTED FOR FURTHER USE.

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Fig. 5 Tire Wear Patterns

Excessive camber causes the tire to run at an angle to the road. One side of tread is then worn more than the other (Fig. 5).

Excessive toe-in or toe-out causes wear on the tread edges and a feathered effect across the tread (Fig. 5).

TIRE NOISE OR VIBRATION

Radial-ply tires are sensitive to force impulses caused by improper mounting, vibration, wheel defects, or possibly tire imbalance.

To find out if tires are causing the noise or vibration, drive the vehicle over a smooth road at varying speeds. Note the noise level during acceleration and deceleration. The engine, differential and exhaust noises will change as speed varies, while the tire noise will usually remain constant.

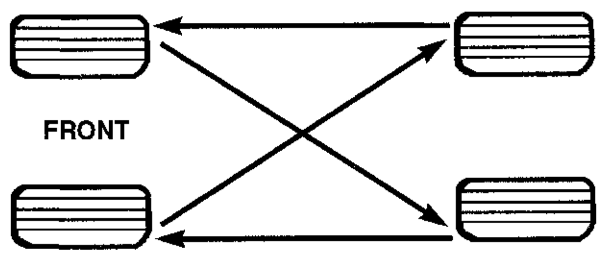

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Fig. 6 Tire Rotation Pattern

SERVICE PROCEDURES

ROTATION

Tires on the front and rear axles operate at different loads and perform different steering, driving, and braking functions. For these reasons, the tires wear at unequal rates. They may also develop irregular wear patterns. These effects can be reduced by rotating the tires according to the maintenance schedule in the Owners Manual. This will improve tread life, traction and maintain a smooth quiet ride.

The recommended method of tire rotation is (Fig. 6). Other methods can be used, but may not provide the same tire longevity benefits.

Dual wheel vehicles require a different tire rotation pattern. Refer to (Fig. 7) for the proper tire rotation with dual wheels.

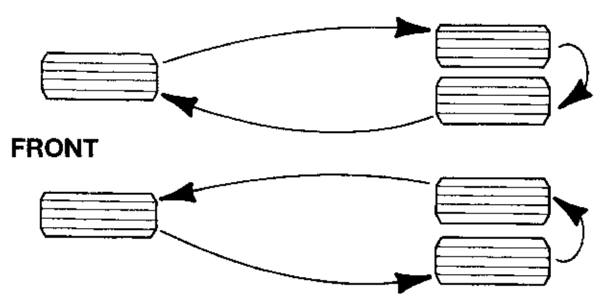

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Fig. 7 Dual Wheel Tire Rotation Pattern

SERVICE PROCEDURES (Continued)

MATCH MOUNTING

Wheels and tires are match mounted at the factory. This means that the high spot of the tire is matched to the low spot on the wheel rim. Each are marked with a bright colored temporary label on the outboard surface for alignment. The wheel is also marked permanently on the inside of the rim in the tire well. This permanent mark may be a paint dot or line, a permanent label or a stamped impression such as an X. An optional location mark is a small spherical indentation on the vertical face of the outboard flange on some non styled base steel wheels. The tire must be removed to locate the permanent mark on the inside of the wheel.

Before dismounting a tire from its wheel, a reference mark should be placed on the tire at the valve stem location. This reference will ensure that it is remounted in the original position on the wheel.

(1) Remove the tire and wheel assembly from the vehicle and mount on a service dynamic balance machine.

(2) Measure the total runout on the center of the tire tread rib with a dial indicator. Record the indicator reading. Mark the tire to indicate the high spot. Place a mark on the tire at the valve stem location (Fig. 8).

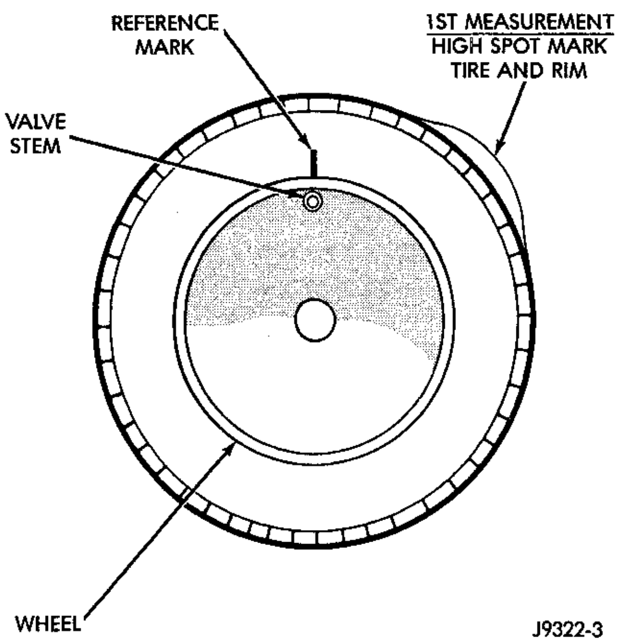

Fig. 8 First Measurement On Tire

(3) Break down the tire and remount it 180 degrees on the rim (Fig. 9).

(4) Measure the total indicator runout again. Mark the tire to indicate the high spot.

(5) If runout is still excessive, the following procedures must be done.

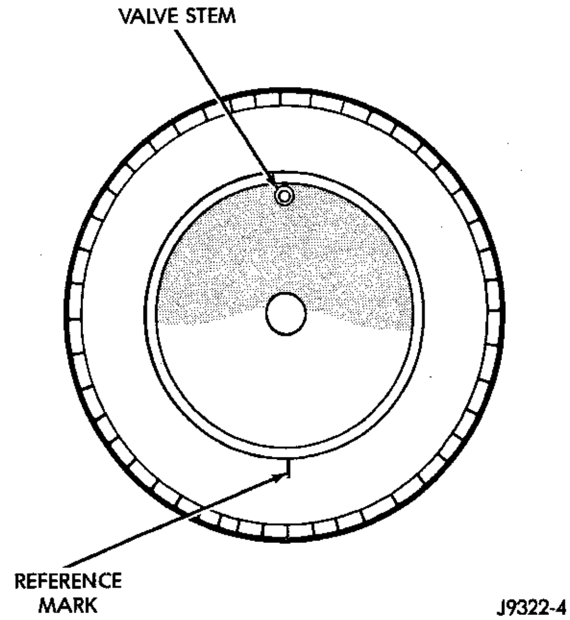

Fig. 9 Remount Tire 180 Degrees

- If the high spot is within 101.6 mm (4.0 in.) of the first spot and is still excessive, replace the tire.
- If the high spot is within 101.6 mm (4.0 in.) of the first spot on the wheel, the wheel may be out of specifications. Refer to Wheel and Tire Runout.
- If the high spot is NOT within 101.6 mm (4.0 in.) of either high spot, draw an arrow on the tread from second high spot to first. Break down the tire and remount it 90 degrees on rim in that direction (Fig. 10). This procedure will normally reduce the runout to an acceptable amount.

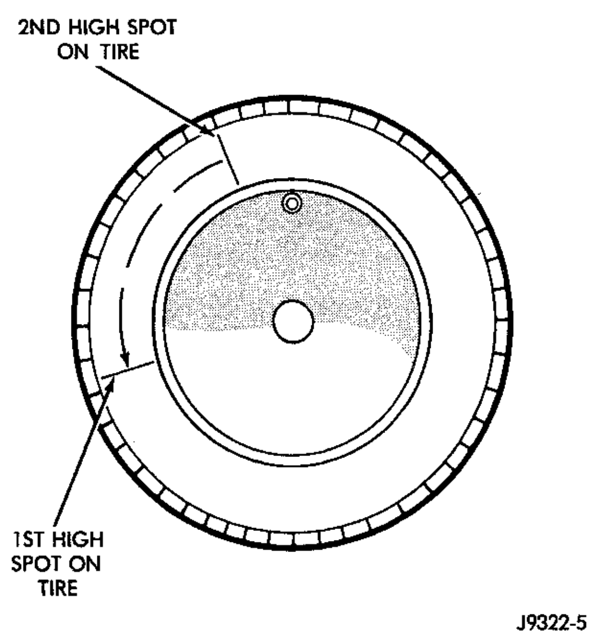

Fig. 10 Remount Tire 90 Degrees In Direction of Arrow

SERVICE PROCEDURES (Continued)

REPAIRING LEAKS

For proper repairing, a radial tire must be removed from the wheel. Repairs should only be made if the defect, or puncture, is in the tread area (Fig. 11). The tire should be replaced if the puncture is located in the sidewall.

Deflate tire completely before removing the tire from the wheel. Use lubrication such as a mild soap solution when dismounting or mounting tire. Use tools free of burrs or sharp edges which could damage the tire or wheel rim.

Before mounting tire on wheel, make sure all rust is removed from the rim bead and repaint if necessary.

Install wheel on vehicle, and tighten to proper torque specification.

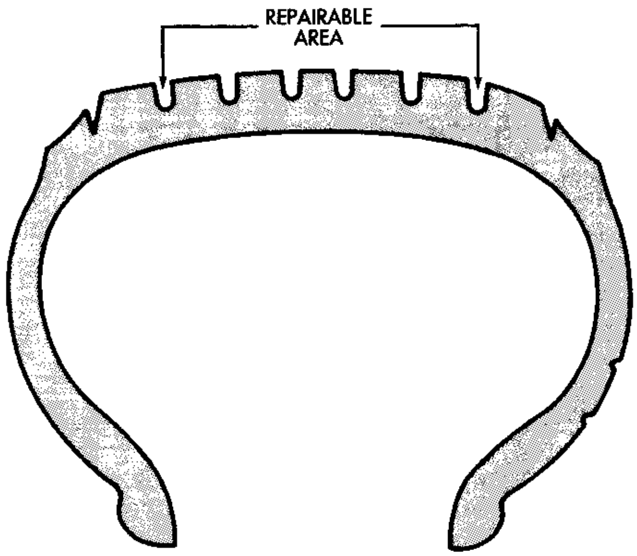

Fig. 11 Tire Repair Area

CLEANING AND INSPECTION

CLEANING TIRES

Remove protective coating on tires before delivery of vehicle. This coating may cause deterioration of tires.

To remove the protective coating applying warm water and let it soak for a few minutes. Then scrub the coating away with a soft bristle brush. Steam cleaning may also be used to remove the coating.

NOTE: DO NOT use gasoline, mineral oil, oil-based solvent or wire brush for cleaning.

SPECIFICATIONS

TIRE REVOLUTIONS PER MILE

TIRE SIZE	SUPPLIER	REVOLUTIONS PER MILE
P225/75/R16 XL	GOODYEAR	716 rpm
P245/75R16	GOODYEAR	689 rpm
P245/75R16	MICHELIN	691 rpm
P265/75R16	GOODYEAR	660 rpm
P275/60R17	GOODYEAR	693 rpm
LT245/75R16 E	GOODYEAR	683 rpm
LT245/75R16 E	MICHELIN	678 rpm
LT215/85R16 E	MICHELIN	687 rpm
LT215/85R16 E M/S	MICHELIN	683 rpm

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WHEELS

INDEX

DESCRIPTION AND OPERATION

WHEELS INFORMATION

Original equipment wheels are designed for the specified Maximum Vehicle Capacity.

All models use steel or cast aluminum drop center wheels. The safety rim wheel (Fig. 1) has raised sections between the rim flanges and the rim well.

Initial inflation of the tire forces the bead over these raised sections. In case of tire failure, the raised sections hold the tire in position on the wheel until the vehicle can be brought to a safe stop.

Cast aluminum wheels require special balance weights and alignment equipment.

Ram Truck Models equipped with dual rear wheels have eight-stud hole rear wheels. The wheels have a flat mounting surface (Fig. 2). The slots in the wheel must be aligned to provide access to the valve stem (Fig. 3).

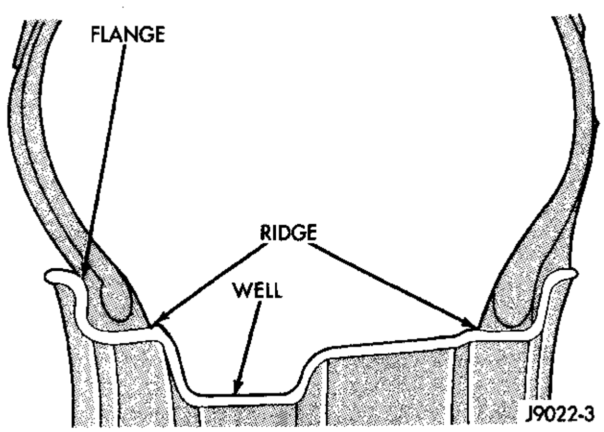

Fig. 1 Safety Rim

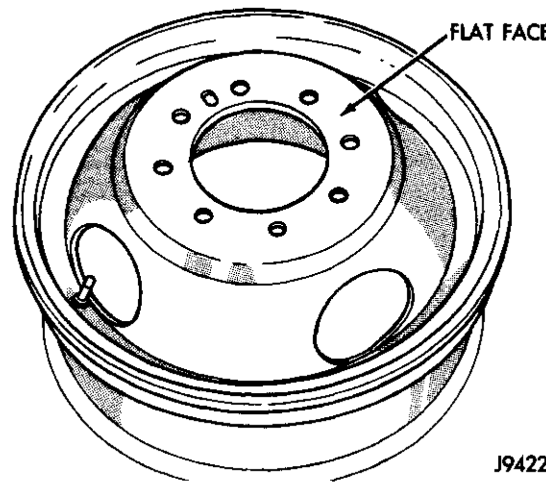

Fig. 2 Flat Face Wheel

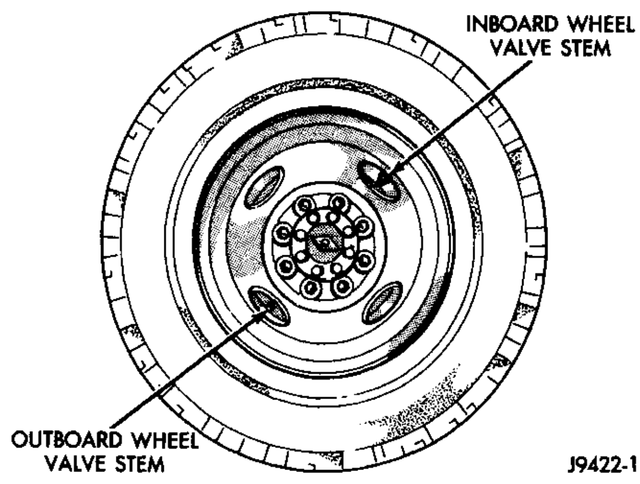

Fig. 3 Dual Rear Wheels

DIAGNOSIS AND TESTING

WHEEL INSPECTION

Inspect wheels for:

- Excessive run out
- Dents or cracks
- Damaged wheel lug nut holes
- Air Leaks from any area or surface of the rim

NOTE: Do not attempt to repair a wheel by hammering, heating or welding.

If a wheel is damaged an original equipment replacement wheel should be used. When obtaining replacement wheels, they should be equivalent in load carrying capacity. The diameter, width, offset, pilot hole and bolt circle of the wheel should be the same as the original wheel.

WARNING: FAILURE TO USE EQUIVALENT REPLACEMENT WHEELS MAY ADVERSELY AFFECT THE SAFETY AND HANDLING OF THE VEHICLE. USED WHEELS ARE NOT RECOMMENDED. THE SERVICE HISTORY OF THE WHEEL MAY HAVE INCLUDED SEVERE TREATMENT OR VERY HIGH MILEAGE. THE RIM COULD FAIL WITHOUT WARNING.

TIRE AND WHEEL RUNOUT

Radial runout is the difference between the high and low points on the tire or wheel (Fig. 4).

Lateral runout is the **wobble** of the tire or wheel.

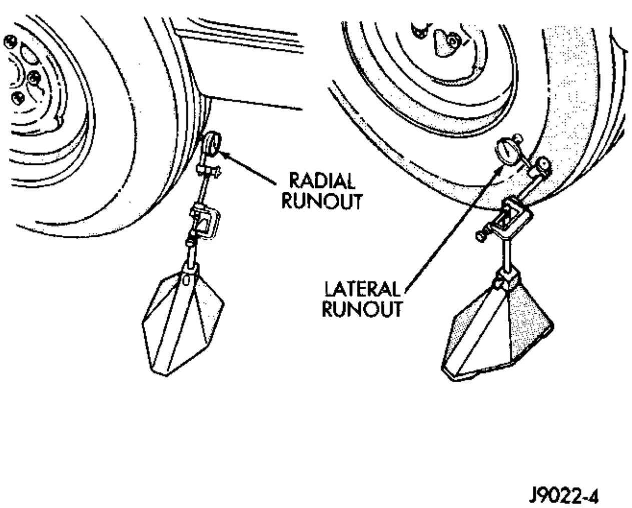

Fig. 4 Checking Tire/Wheel/Hub Runout

Radial runout of more than 1.5 mm (.060 inch) measured at the center line of the tread may cause the vehicle to shake.

Lateral runout of more than 2.0 mm (.080 inch) measured near the shoulder of the tire may cause the vehicle to shake.

Sometimes radial runout can be reduced. Relocate the wheel and tire assembly on the mounting studs (See Method 1). If this does not reduce runout to an acceptable level, the tire can be rotated on the wheel. (See Method 2).

METHOD 1 (RELOCATE WHEEL ON HUB)

(1) Drive vehicle a short distance to eliminate tire flat spotting from a parked position.

(2) Check wheel bearings and adjust if adjustable or replace if necessary.

(3) Check the wheel mounting surface.

(4) Relocate wheel on the mounting, two studs over from the original position.

(5) Tighten wheel nuts until all are properly torqued, to eliminate brake distortion.

(6) Check radial runout. If still excessive, mark tire sidewall, wheel, and stud at point of maximum runout and proceed to Method 2.

METHOD 2 (RELOCATE TIRE ON WHEEL)

NOTE: Rotating the tire on wheel is particularly effective when there is runout in both tire and wheel.

(1) Remove tire from wheel and mount wheel on service dynamic balance machine.

(2) Check wheel radial runout (Fig. 5) and lateral runout (Fig. 6).

- STEEL WHEELS: Radial runout 0.040 in., Lateral runout 0.045 in. (maximum)
- ALUMINUM WHEELS: Radial runout 0.030 in., Lateral runout 0.035 in. (maximum)

(3) If point of greatest wheel lateral runout is near original chalk mark, remount tire 180 degrees. Recheck runout, Refer to match mounting procedure.

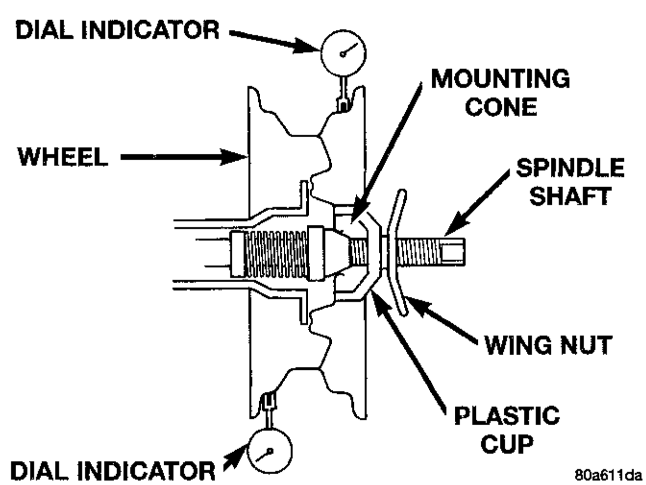

Fig. 5 Radial Runout

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DIAGNOSIS AND TESTING (Continued)

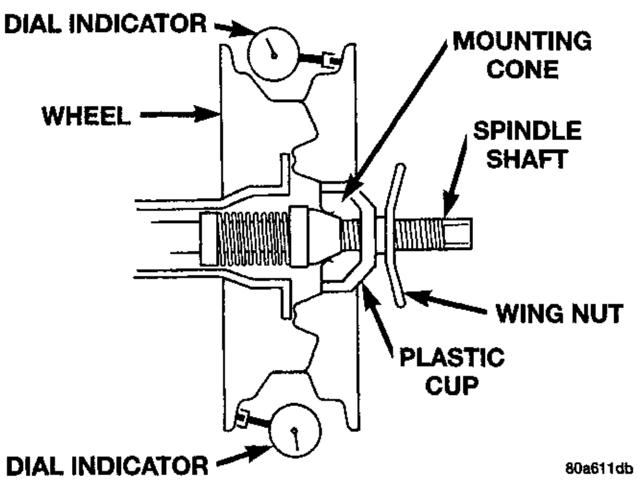

Fig. 6 Lateral Runout

SERVICE PROCEDURES

WHEEL INSTALLATION

CAUTION: Models equipped with chrome plated wheels are not supplied with chrome plated lug nuts. Under no circumstances are chrome plated lug nuts to be used, use only the factory specified lug nuts.

CAUTION: All 8800 GVW 4x4 vehicles have a factory install spacer behind the right front wheel.

The wheel studs and nuts are designed for specific applications. Do not use replacement parts of lesser quality or a substitute design.

The 3500 use a two piece flat face nut (Fig. 7).

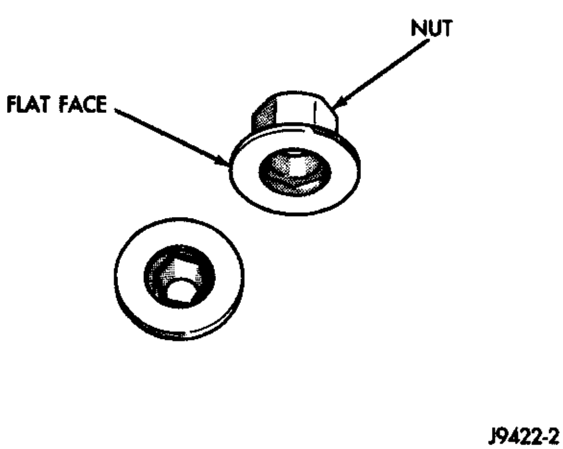

Fig. 7 Two Piece Lug Nut

All aluminum and some steel wheels have wheel stud nuts which feature an enlarged nose. This enlarged nose is necessary to ensure proper retention of the aluminum wheels.

Before installing the wheel, be sure to remove any build up of corrosion on the wheel mounting surfaces. Ensure wheels are installed with good metal-to-metal contact. Improper installation could cause loosening of wheel nuts. This could affect the safety and handling of your vehicle.

To install the 5 stud wheel, first position it properly on the mounting surface. All wheel nuts should then be tightened just snug. Gradually tighten them in sequence to specified torque (Fig. 8). **Never use oil or grease on studs.**

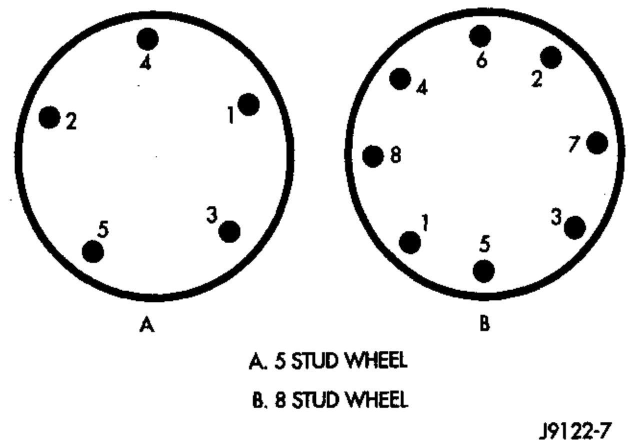

Fig. 8 Lug Nut Tightening Pattern

DUAL REAR WHEEL INSTALLATION

Dual rear wheels use a special heavy duty lug nut wrench. It is recommended to remove and install dual rear wheels only when the proper wrench is available. The wrench is also use to remove wheel center caps for more information refer to Owner's Manual.

The tires on both wheels must be completely raised off the ground when tightening the lug nuts. This will ensure correct wheel centering and maximum wheel clamping.

A two piece flat face lug nut with right-hand threads is used for retaining the wheels on the hubs (Fig. 7).

The dual rear wheel lug nuts should be tightened according to the following procedure:

- Place two drops of oil to the interface of the nut/washer (Fig. 9) before installing on the wheel stud.

NOTE: Do not use more then two drops of oil on the nut/washer, since the center caps attach in this area.

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SERVICE PROCEDURES (Continued)

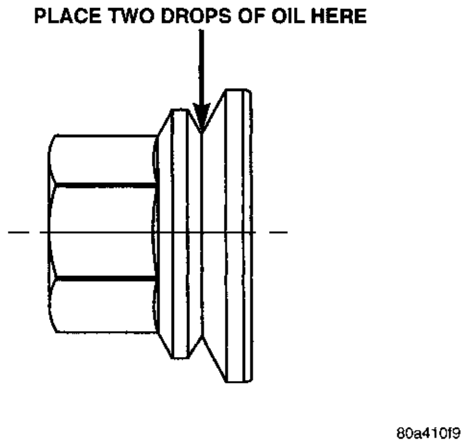

Fig. 9 Oil Location

• Tighten the wheel lug nuts in the numbered sequential pattern until they are snug tight. Then tighten lug nut to specified torque following same number sequence (Fig. 8).

• Tighten lug nuts in same numbered sequence a second time to the specified torque. This will ensure that the wheels are thoroughly mated.

• Check lug nut specified torque after 100 miles (160 kilometers). Also after 500 miles (800 kilometers) of vehicle operation.

NOTE: Wheel lug nuts should be tightened to specified torque at every maintenance interval thereafter.

TIRE AND WHEEL BALANCE

It is recommended that a two plane service dynamic balancer be used when a tire and wheel assembly require balancing. Refer to balancer operation instructions for proper cone mounting procedures. Typically use front cone mounting method for steel wheels. For aluminum wheel use back cone mounting method without cone spring.

NOTE: Static should be used only when a two plane balancer is not available.

NOTE: Cast aluminum and forged aluminum wheels require coated balance weights and special alignment equipment.

Wheel balancing can be accomplished with either on or off vehicle equipment. When using on-vehicle balancing equipment, remove the opposite wheel/tire. Off-vehicle balancing is recommended.

For static balancing, find location of heavy spot causing the imbalance. Counter balance wheel directly opposite the heavy spot. Determine weight required to counter balance the area of imbalance. Place half of this weight on the **inner** rim flange and the other half on the **outer** rim flange (Fig. 10).

For dynamic balancing, the balancing equipment is designed to locate the amount of weight to be applied to both the inner and outer rim flange (Fig. 11).

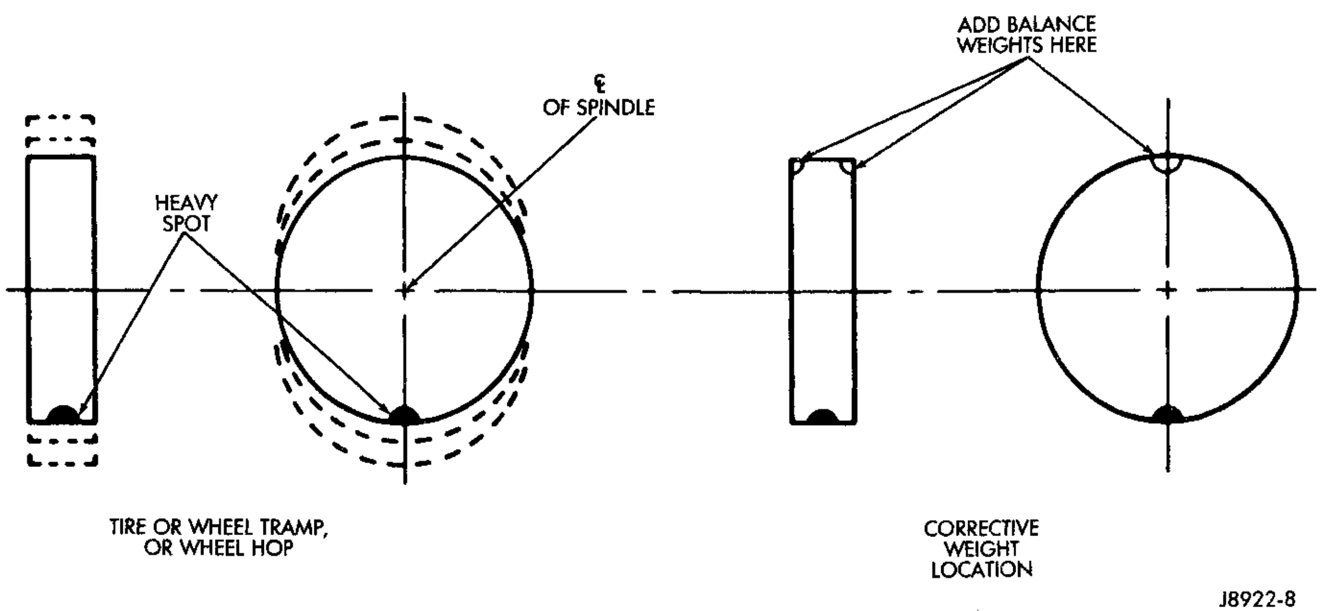

Fig. 10 Static Unbalance & Balance

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SERVICE PROCEDURES (Continued)

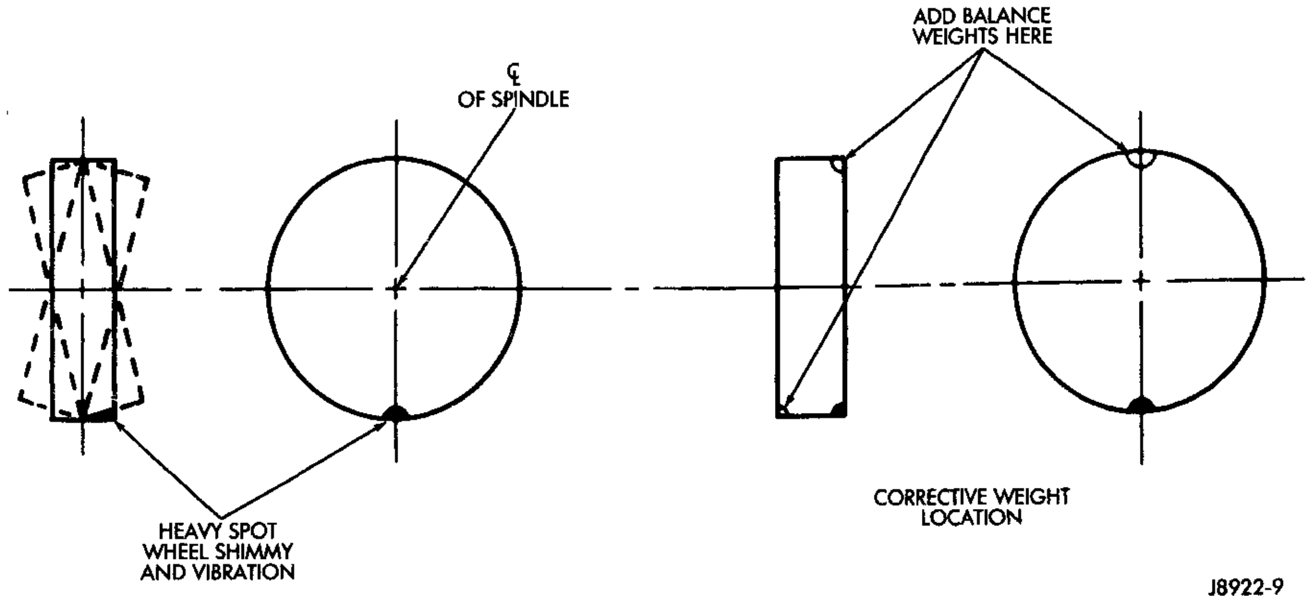

Fig. 11 Dynamic Unbalance & Balance

SPECIFICATIONS

TORQUE CHART

DESCRIPTION	TORQUE
Lug Nut	
BR1500 (5 Stud Wheel)	130 N·m (95 ft. lbs.)
BR2500 (8 Stud Wheel)	180 N·m (135 ft. lbs.)
BR3500 (8 Stud Dual Wheel)	195 N·m (145 ft. lbs.)

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BODY

CONTENTS

GENERAL SERVICE INFORMATION

GENERAL INFORMATION

SAFETY PRECAUTIONS AND WARNINGS

WARNING: EYE PROTECTION SHOULD BE USED WHEN SERVICING GLASS COMPONENTS. PERSONAL INJURY CAN RESULT.

USE A OSHA APPROVED BREATHING FILTER WHEN SPRAYING PAINT OR SOLVENTS IN A CONFINED AREA. PERSONAL INJURY CAN RESULT.

AVOID PROLONGED SKIN CONTACT WITH PETROLEUM OR ALCOHOL– BASED CLEANING SOLVENTS. PERSONAL INJURY CAN RESULT.

DO NOT STAND UNDER A HOISTED VEHICLE THAT IS NOT PROPERLY SUPPORTED ON SAFETY STANDS. PERSONAL INJURY CAN RESULT.

CAUTION: When holes must be drilled or punched in an inner body panel, verify depth of space to the outer body panel, electrical wiring, or other components. Damage to vehicle can result.

Do not weld exterior panels unless combustible material on the interior of vehicle is removed from the repair area. Fire or hazardous conditions, can result.

Always have a fire extinguisher ready for use when welding.

Disconnect the negative (-) cable clamp from the battery when servicing electrical components that are live when the ignition is OFF. Damage to electrical system can result.

Do not use abrasive chemicals or compounds on painted surfaces. Damage to finish can result.

Do not use harsh alkaline based cleaning solvents on painted or upholstered surfaces. Damage to finish or color can result.

Do not hammer or pound on plastic trim panel when servicing interior trim. Plastic panels can break.

Chrysler Corporation uses many different types of push-in fasteners to secure the interior and exterior trim to the body. Most of these fasteners can be reused to assemble the trim during various repair procedures. At times, a push-in fastener cannot be removed without damaging the fastener or the component it is holding. If it is not possible to remove a fastener without damaging a component or body, cut or break the fastener and use a new one when installing the component. Never pry or pound on a plastic or pressed-board trim component. Using a suitable fork-type prying device, pry the fastener from the retaining hole behind the component being removed. When installing, verify fastener alignment with the retaining hole by hand. Push directly on or over the fastener until it seats. Apply a low-force pull to the panel to verify that it is secure.

When it is necessary to remove components to service another, it should not be necessary to apply excessive force or bend a component to remove it. Before damaging a trim component, verify hidden fasteners or captured edges holding the component in place.

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BODY DIAGNOSTIC PROCEDURES

INDEX

DESCRIPTION AND OPERATION

WATER LEAKS

Water leaks can be caused by poor sealing, improper body component alignment, body seam porosity, missing plugs, or blocked drain holes. Centrifugal and gravitational force can cause water to drip from a location away from the actual leak point, making leak detection difficult. All body sealing points should be water tight in normal wet-driving conditions. Water flowing downward from the front of the vehicle should not enter the passenger or luggage compartment. Moving sealing surfaces will not always seal water tight under all conditions. At times, side glass or door seals will allow water to enter the passenger compartment during high pressure washing or hard driving rain (severe) conditions. Overcompensating on door or glass adjustments to stop a water leak that occurs under severe conditions can cause premature seal wear and excessive closing or latching effort. After completing a repair, water-test vehicle to verify leak has stopped before returning vehicle to use.

VISUAL INSPECTION BEFORE WATER LEAK TESTS

Verify that floor and body plugs are in place, body drains are clear, and body components are properly aligned and sealed. If component alignment or sealing is necessary, refer to the appropriate section of this group for proper procedures.

WATER LEAK TESTS

WARNING: DO NOT USE ELECTRIC SHOP LIGHTS OR TOOLS IN WATER TEST AREA. PERSONAL INJURY CAN RESULT.

When the conditions causing a water leak have been determined, simulate the conditions as closely as possible.

• If a leak occurs with the vehicle parked in a steady light rain, flood the leak area with an open-ended garden hose.

• If a leak occurs while driving at highway speeds in a steady rain, test the leak area with a reasonable velocity stream or fan spray of water. Direct the spray in a direction comparable to actual conditions.

• If a leak occurs when the vehicle is parked on an incline, hoist the end or side of the vehicle to simulate this condition. This method can be used when the leak occurs when the vehicle accelerates, stops or turns. If the leak occurs on acceleration, hoist the front of the vehicle. If the leak occurs when braking, hoist the back of the vehicle. If the leak occurs on left turns, hoist the left side of the vehicle. If the leak occurs on right turns, hoist the right side of the vehicle. For hoisting recommendations refer to Group 0, Lubrication and Maintenance, General Information section.

WATER LEAK DETECTION

To detect a water leak point-of-entry, do a water test and watch for water tracks or droplets forming on the inside of the vehicle. If necessary, remove interior trim covers or panels to gain visual access to the leak area. If the hose cannot be positioned without being held, have someone help do the water test.

Some water leaks must be tested for a considerable length of time to become apparent. When a leak appears, find the highest point of the water track or drop. The highest point usually will show the point of entry. After leak point has been found, repair the leak and water test to verify that the leak has stopped.

Locating the entry point of water that is leaking into a cavity between panels can be difficult. The trapped water may splash or run from the cavity, often at a distance from the entry point. Most water leaks of this type become apparent after accelerating, stopping, turning, or when on an incline.

MIRROR INSPECTION METHOD

When a leak point area is visually obstructed, use a suitable mirror to gain visual access. A mirror can also be used to deflect light to a limited-access area to assist in locating a leak point.

BRIGHT LIGHT LEAK TEST METHOD

Some water leaks in the luggage compartment can be detected without water testing. Position the vehicle in a brightly lit area. From inside the darkened

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DESCRIPTION AND OPERATION (Continued)

luggage compartment inspect around seals and body seams. If necessary, have a helper direct a drop light over the suspected leak areas around the luggage compartment. If light is visible through a normally sealed location, water could enter through the opening.

PRESSURIZED LEAK TEST METHOD

When a water leak into the passenger compartment cannot be detected by water testing, pressurize the passenger compartment and soap test exterior of the vehicle. To pressurize the passenger compartment, close all doors and windows, start engine, and set heater control to high blower in HEAT position. If engine can not be started, connect a charger to the battery to ensure adequate voltage to the blower. With interior pressurized, apply dish detergent solution to suspected leak area on the exterior of the vehicle. Apply detergent solution with spray device or soft bristle brush. If soap bubbles occur at a body seam, joint, seal or gasket, the leak entry point could be at that location.

WIND NOISE

Wind noise is the result of most air leaks. Air leaks can be caused by poor sealing, improper body component alignment, body seam porosity, or missing plugs in the engine compartment or door hinge pillar areas. All body sealing points should be airtight in normal driving conditions. Moving sealing surfaces will not always seal airtight under all conditions. At times, side glass or door seals will allow wind noise to be noticed in the passenger compartment during high crosswinds. Over compensating on door or glass adjustments to stop wind noise that occurs under severe conditions can cause premature seal wear and excessive closing or latching effort. After a repair procedure has been performed, test vehicle to verify noise has stopped before returning vehicle to use.

Wind noise can also be caused by improperly fitted exterior moldings or body ornamentation. Loose moldings can flutter, creating a buzzing or chattering noise. An open cavity or protruding edge can create a whistling or howling noise. Inspect the exterior of the vehicle to verify that these conditions do not exist.

VISUAL INSPECTION BEFORE TESTS

Verify that floor and body plugs are in place and body components are aligned and sealed. If component alignment or sealing is necessary, refer to the appropriate section of this group for proper procedures.

ROAD TESTING WIND NOISE

(1) Drive the vehicle to verify the general location of the wind noise.

(2) Apply 50 mm (2 in.) masking tape in 150 mm (6 in.) lengths along weatherstrips, weld seams or moldings. After each length is applied, drive the vehicle. If noise goes away after a piece of tape is applied, remove tape, locate, and repair defect.

POSSIBLE CAUSE OF WIND NOISE

- Moldings standing away from body surface can catch wind and whistle.
- Gaps in sealed areas behind overhanging body flanges can cause wind-rushing sounds.
- Misaligned movable components.
- Missing or improperly installed plugs in pillars.
- Weld burn through holes.

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PAINT

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GENERAL INFORMATION

PAINT CODE

Exterior vehicle body colors are identified on the Body Code plate. The plate is located on the floor pan under the passenger seat or attached to the front face of the radiator closure panel. Refer to the Introduction section at the front of this manual for body code plate description. The paint code is also identified on the Vehicle Safety Certification Label which is located on the drivers door shut face. The color names provided in the Paint and Trim Code Description chart are the color names used on most repair product containers.

BASE COAT/CLEAR COAT FINISH

On most vehicles a two-part paint application (base coat/clear coat) is used. Color paint that is applied to primer is called base coat. The clear coat protects the base coat from ultraviolet light and provides a durable high-gloss finish.

WET SANDING, BUFFING, AND POLISHING

Minor acid etching, orange peel, or smudging in clear coat or single-stage finishes can be reduced with light wet sanding, hand buffing, and polishing. **If the finish has been wet sanded in the past, it cannot be repeated. Wet sanding operation should be performed by a trained automotive paint technician.**

CAUTION: Do not remove clear coat finish, if equipped. Base coat paint must retain clear coat for durability.

PAINTED SURFACE TOUCH-UP

When a painted metal surface has been scratched or chipped, it should be touched-up as soon as possible to avoid corrosion. For best results, use Mopar® Scratch Filler/Primer, Touch-Up Paints and Clear Top Coat. Refer to Introduction group of this manual for Body Code Plate information.

TOUCH-UP PROCEDURE

(1) Scrape loose paint and corrosion from inside scratch or chip.

(2) Clean affected area with Mopar® Tar/Road Oil Remover, and allow to dry.

(3) Fill the inside of the scratch or chip with a coat of filler/primer. Do not overlap primer onto good surface finish. The applicator brush should be wet enough to puddle-fill the defect without running. Do not stroke brush applicator on body surface. Allow the filler/primer to dry hard.

(4) Cover the filler/primer with color touch-up paint. Do not overlap touch-up color onto the original color coat around the scratch or chip. Butt the new color to the original color, if possible. Do not stroke applicator brush on body surface. Allow touch-up paint to dry hard.

(5) On vehicles without clear coat, the touch-up color can be lightly wet sanded (1500 grit) and polished with rubbing compound.

(6) On vehicles with clear coat, apply clear top coat to touch-up paint with the same technique as described in Step 4. Allow clear top coat to dry hard. If desired, Step 5 can be performed on clear top coat.

SPECIFICATIONS

AFTERMARKET REPAIR PRODUCTS

EXTERIOR PAINT CODES AND SUPPLIER STOCK NUMBERS

COLOR NAME	CHRY CODE*	PPG	BASF	DuPONT	SHERWIN-WILLIAMS	AKZO NOBEL SIKKENS
Metallic Red Metallic Clear Coat	LRF	4447	22116	B9230	45860	CHA92:LRF
Metallic Red Metallic Clear Coat	RRC	4974/ 5025	25046	B9517	50274	CHA95:RRC
Flame Red Pearl Coat	PR4	4679	23043	B9326	46916	CHA93:PR4
Light Driftwood Satin Glow	MFA	4569	22110	B9263	46579	CHA92:MFA
Light Driftwood Satin Glow	RFK	5011	25053	B9570	50736	CHA95:RFK
Emerald Green Pearl Coat	PGS	4785	24075	B9460	48539	CHA94:PGS
Emerald Green Pearl Coat	PGF	4639	23042	B9328	46976	CHA92:PGF
Bright Jade Pearl Coat	SQM	18885	26094	B9620	51534	CHA96:SQM
Forest Green Pearl Coat	SG8	5065	166649	B9609	51062	CHA95:SG8
Dark Chestnut Pearl Coat	TU1	5243	27036	B9732	52935	CHA97:TU1
Dark Chestnut Pearl Coat	TU3	5245	27037	B9737	52934	CHA97:TU3
Intense Blue Pearl Coat	VB3	5357	28074	B9822	54468	CHA98:VB3
Black Clear Coat	DX8	9700	15214	99	34858 90-5950	CHA85:DX8
Bright White Clear Coat	GW7	4037	18238	B8833	37298	CHA88:GW7

NOTE: *Herberts Standox and Spies Hecker use the Chrysler paint code as listed on the Body Code Plate and the Vehicle Safety Certification label.

INTERIOR PAINT CODES AND SUPPLIER STOCK NUMBERS

INTERIOR COLOR	CHRY CODE	PPG	BASF	DuPONT	SHERWIN-WILLIAMS	AKZO NOBEL SIKKENS
Agate	AZ	9856 2-1461	22135	C9208	45994	CHALAZI
Mist Gray	C3	35799 2–1576	25065	C9507	50508	CHARC3I
Camel	K9	28589 2-1647	28120	N/A	55934	CHAVK9I

STATIONARY GLASS

INDEX

DESCRIPTION AND OPERATION

SAFETY PRECAUTIONS

WARNING: DO NOT OPERATE THE VEHICLE WITHIN 24 HOURS OF WINDSHIELD INSTALLATION. IT TAKES AT LEAST 24 HOURS FOR URETHANE ADHESIVE TO CURE. IF IT IS NOT CURED, THE WINDSHIELD MAY NOT PERFORM PROPERLY IN AN ACCIDENT.

URETHANE ADHESIVES ARE APPLIED AS A SYSTEM. USE GLASS CLEANER, GLASS PREP SOLVENT, GLASS PRIMER, PVC (VINYL) PRIMER AND PINCHWELD (FENCE) PRIMER PROVIDED BY THE ADHESIVE MANUFACTURER. IF NOT, STRUCTURAL INTEGRITY COULD BE COMPROMISED.

CHRYSLER DOES NOT RECOMMEND GLASS ADHESIVE BY BRAND. TECHNICIANS SHOULD REVIEW PRODUCT LABELS AND TECHNICAL DATA SHEETS, AND USE ONLY ADHESIVES THAT THEIR MANUFACTURES WARRANT WILL RESTORE A VEHICLE TO THE REQUIREMENTS OF FMVSS 212. TECHNICIANS SHOULD ALSO INSURE THAT PRIMERS AND CLEANERS ARE COMPATIBLE WITH THE PARTICULAR ADHESIVE USED.

BE SURE TO REFER TO THE URETHANE MANUFACTURER'S DIRECTIONS FOR CURING TIME SPECIFICATIONS, AND DO NOT USE ADHESIVE AFTER ITS EXPIRATION DATE.

VAPORS THAT ARE EMITTED FROM THE URETHANE ADHESIVE OR PRIMER COULD CAUSE PERSONAL INJURY. USE THEM IN A WELL-VENTILATED AREA.

SKIN CONTACT WITH URETHANE ADHESIVE SHOULD BE AVOIDED. PERSONAL INJURY MAY RESULT.

ALWAYS WEAR EYE AND HAND PROTECTION WHEN WORKING WITH GLASS.

CAUTION: Protect all painted and trimmed surfaces from coming in contact with urethane or primers.

Be careful not to damage painted surfaces when removing moldings or cutting urethane around windshield.

It is difficult to salvage a windshield during the removal operation. The windshield is part of the structural support for the roof. The urethane bonding used to secure the windshield to the fence is difficult to cut or clean from any surface. If the moldings are set in urethane, it would also be unlikely they could be salvaged. Before removing the windshield, check the availability of the windshield and moldings from the parts supplier.

REMOVAL AND INSTALLATION

WINDSHIELD

REMOVAL

(1) Remove inside rear view mirror (Fig. 1).

(2) Remove cowl cover. Refer to Cowl Cover Removal paragraph in this group.

(3) With doors open, remove windshield molding (Fig. 2). Pull outward on molding beginning at the bottom of A-pillars using pliers.

(4) Cut urethane bonding from around windshield using a suitable sharp cold knife (C-4849). A pneumatic cutting device can be used but is not recommended (Fig. 3).

(5) Separate windshield from vehicle.

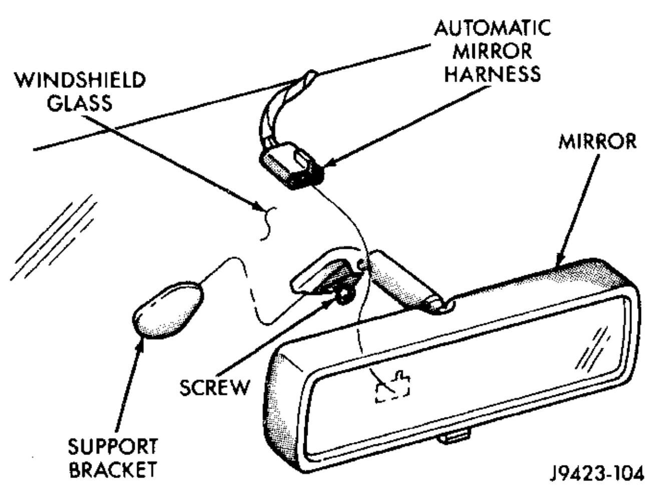

Fig. 1 Rear View Mirror

AUTHENTIC RESTORATION PRODUCT

REMOVAL AND INSTALLATION (Continued)

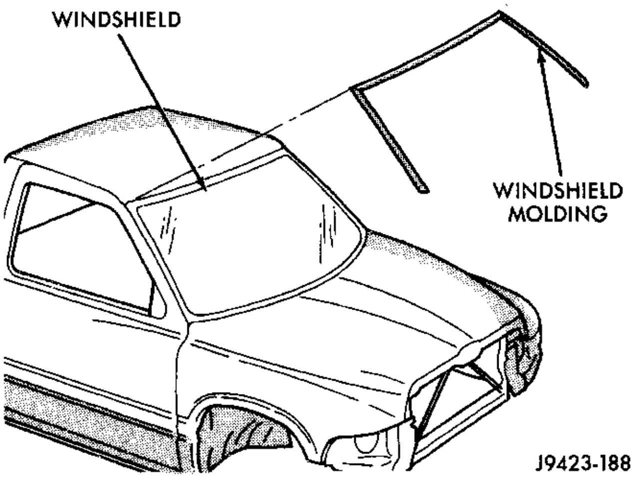

Fig. 2 Windshield Moldings

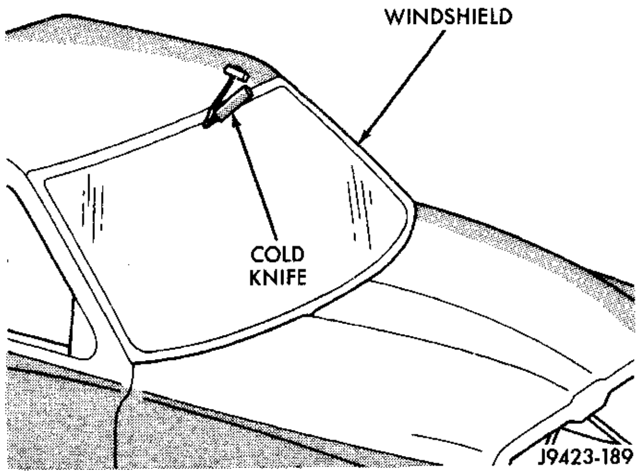

Fig. 3 Cut Urethane Around Windshield

INSTALLATION

WARNING: Allow the urethane at least 24 hours to cure before returning the vehicle to use.

CAUTION: Roll down the left and right front door glass and open the rear glass slider (if available) before installing windshield to avoid pressurizing the passenger compartment if a door is slammed before urethane is cured. Water leaks can result.

The windshield fence should be cleaned of most of its old urethane bonding material. A small amount of old urethane, approximately 1-2 mm in height, should remain on the fence. Do not grind off or completely remove all old urethane from the fence, the paint finish and bonding strength will be adversely affected. Support spacers should be cleaned and properly installed on weld studs or repair screws at bottom of windshield opening.

(1) Place replacement windshield into windshield opening and position glass in the center of the opening against the support spacers. Mark the glass at the support spacers with a grease pencil or pieces of masking tape and ink pen to use as a reference for installation. Remove replacement windshield from windshield opening (Fig. 4).

(2) Position the windshield inside up on a suitable work surface with two padded, wood 10 cm by 10 cm by 50 cm (4 in. by 4 in. by 20 in.) blocks, placed parallel 75 cm (2.5 ft.) apart (Fig. 5).

(3) Clean inside of windshield with MOPAR Glass Cleaner and lint-free cloth.

(4) Apply clear glass primer 25 mm (1 in.) wide around perimeter of windshield and wipe with a new clean and dry lint- free cloth.

(5) Apply the molding to the windshield:

- Press the upper corners of the molding onto the windshield.
- Press the header section onto the windshield.
- Press the A-Pillar sections onto the windshield.

(6) Apply black-out primer onto the glass using the windshield molding as a guide. The primer should be 15 mm (5/8 in.) wide on the top and sides of the glass and 25 mm (1 in.) on the bottom of windshield. Allow at least three minutes drying time.

(7) Position one 5 mm (3/16 in.) soft spacer (p/n 55028214) at the bottom of the windshield fence (Fig. 6).

(8) Apply a 13mm (1/2 in.) high and 10mm (3/8 in.) wide bead of urethane around the perimeter of windshield. At the bottom, apply the bead 7 mm (1/4 in.) inboard from the glass edge. On the three sides where the molding is on the glass, follow the edge of molding. The urethane bead should be shaped in a triangular cross-section, this can be achieved by notching the tip of the applicator (Fig. 7).

(9) With the aid of a helper, position the windshield over the windshield opening. Align the reference marks at the bottom of the windshield to the support spacers.

(10) Slowly lower windshield glass to the fence opening guiding the lower corners into proper position. Beginning at the bottom and continuing to the top, push glass onto fence along the A-Pillars. Push windshield inward to the fence at the bottom corners (Fig. 8).

(11) Clean excess urethane from exterior with MOPAR Super Clean or equivalent.

(12) Apply 150 mm (6 in.) lengths of 50 mm (2 in.) masking tape spaced 250 mm (10 in.) apart to hold molding in place until urethane cures.

(13) Install cowl cover and wipers.

(14) Install inside rear view mirror.

(15) After urethane has cured, remove tape strips and water test windshield to verify repair.

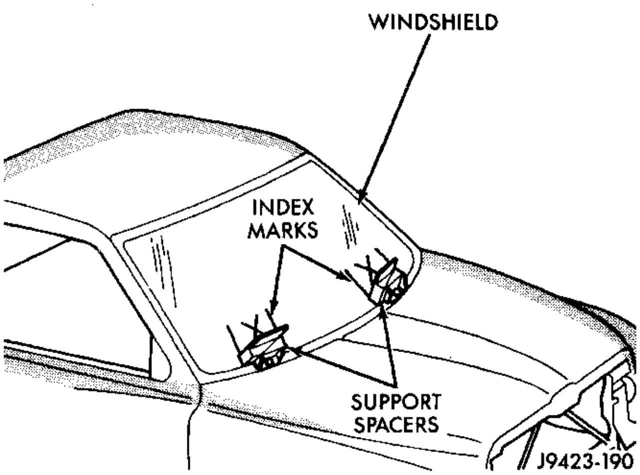

Fig. 4 Center Windshield and Mark at Support Spacers

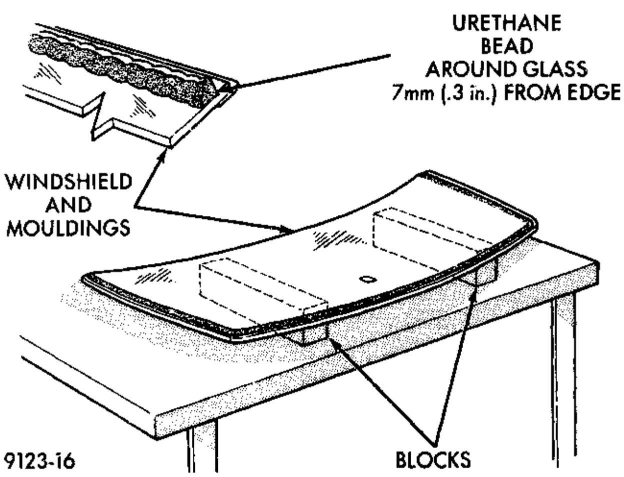

Fig. 5 Work Surface Set up and Molding Installation

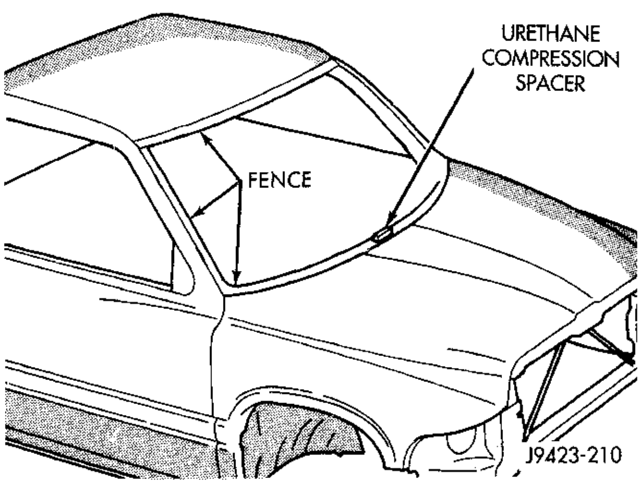

Fig. 6 Position Urethane Compression Spacer

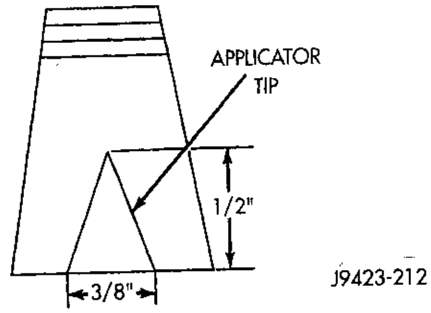

Fig. 7 Applicator Tip

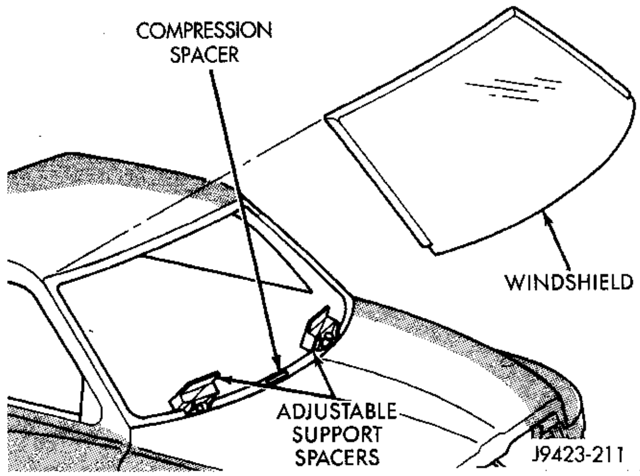

Fig. 8 Lower Windshield Into Position

BACKLITE

REMOVAL

It is difficult to salvage the backlite during the removal operation. The backlite is part of the structural support for the roof. The urethane bonding used to secure the glass to the fence is difficult to cut or clean from any surface. Since the molding is set in urethane, it is unlikely it would be salvaged. Before removing the backlite, check the availability from the parts supplier.

The backlite is attached to the window frame with urethane adhesive. The urethane adhesive is applied cold and seals the surface area between the window opening and the glass. The primer adheres the urethane adhesive to the backlite.

(1) Roll down door glass.
(2) If necessary, remove quarter trim panels.
(3) Remove headliner.
(4) Remove cab back panel trim.
(5) Bend rear window retaining tabs inward against glass.
(6) Using a suitable pneumatic knife from inside the vehicle, cut urethane holding rear glass frame to opening fence.
(7) Separate glass from vehicle.

REMOVAL AND INSTALLATION (Continued)

INSTALLATION

(1) Clean urethane adhesive from around rear glass opening fence.
(2) Apply black-out primer to outer edge of replacement rear glass frame.
(3) Apply black-out primer to rear glass opening fence.
(4) Apply a 13 mm (0.5 in.) bead of urethane around the perimeter of the window frame bonding surface (Fig. 9).
(5) Set glass on lower fence and move glass forward into opening (Fig. 10).
(6) Firmly push glass against rear window glass opening fence.
(7) Bend tabs around edges of rear window opening fence to retain glass.
(8) Clean excess urethane from exterior with MOPAR, Super Clean or equivalent.
(9) Allow urethane to cure at least 24 hours (full cure is 72 hours).
(10) Water test to verify repair before returning vehicle to service.
(11) Install interior trim.

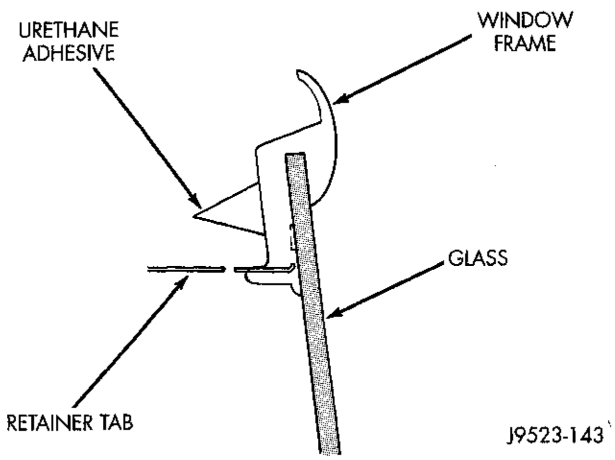

Fig. 9 Urethane Adhesive Application

SLIDING BACKLITE

If complete removal of the sliding backlite is required, refer to the backlite removal/installation procedures in this group.

SLIDING VENT GLASS

REMOVAL

(1) Slide the upper left and upper right run channels out of window frame (Fig. 11).
(2) Slide left and right glass panels upward, remove and separate latch and keeper (Fig. 12).

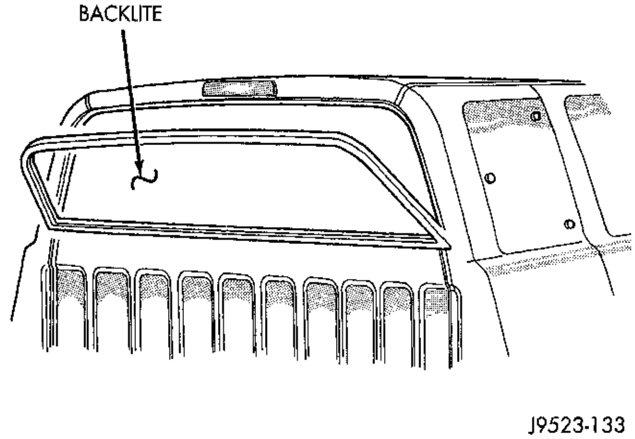

Fig. 10 Backlite Installation

(3) If necessary, remove lower glass channel and replace (Fig. 13).

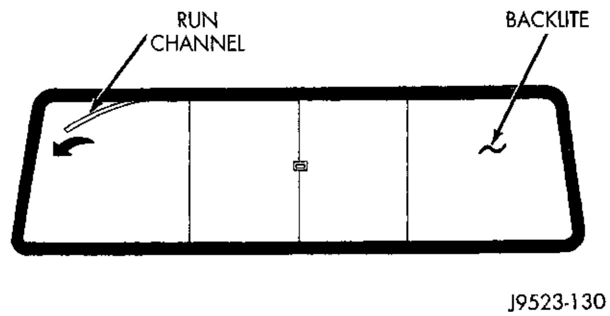

Fig. 11 Run Channel Removal

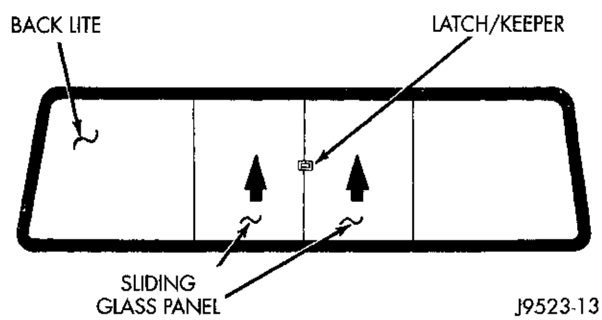

Fig. 12 Glass Panel Removal

INSTALLATION

(1) If necessary, install lower run channel.
(2) Position left and right glass panels at window opening and lower into the lower run channel. The glass panels must be in the closed position (Fig. 14).
(3) Slide the upper left and upper right run channels into the window frame.
(4) Verify window and latch/keeper operation.

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REMOVAL AND INSTALLATION (Continued)

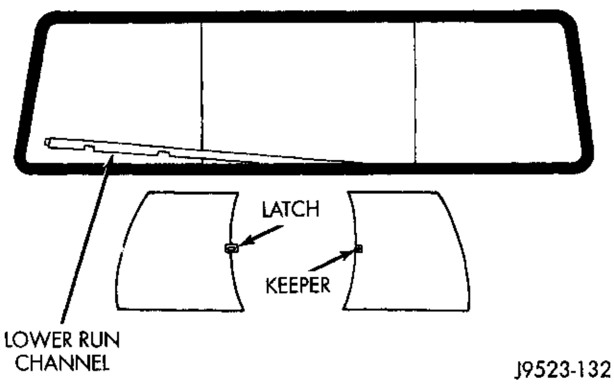

Fig. 13 Lower Run Channel Removal

SLIDING BACKLITE LATCH AND KEEPER

REMOVAL

(1) Disengage latch and keeper.
(2) Remove latch/keeper screws.
(3) Separate Latch/keeper from glass panel.

INSTALLATION

(1) Position Latch/keeper on glass panel.
(2) Install screws. Tighten the screws with 1.5 N·m (15 in. lbs.) torque.
(3) Engage latch and keeper to verify operation.

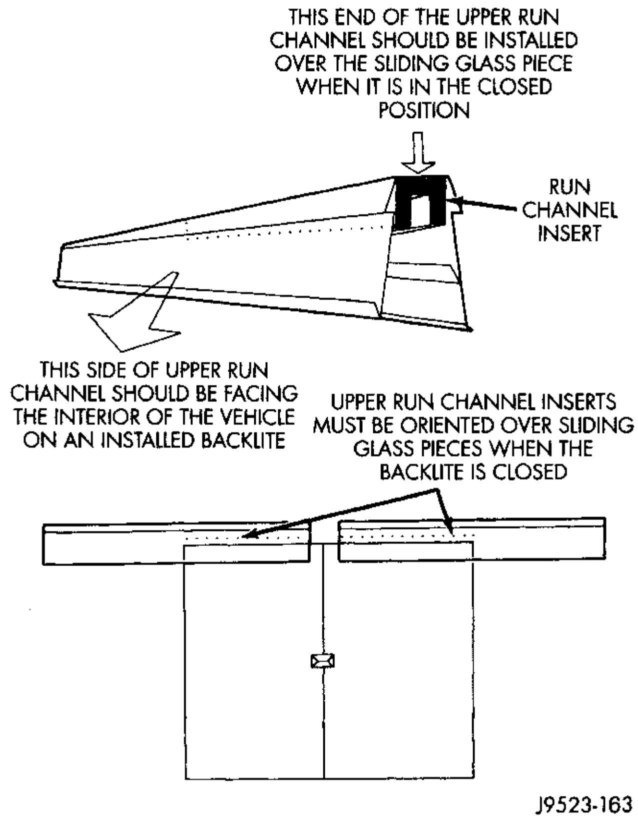

Fig. 14 Glass Panel Installation

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SEATS

INDEX

REMOVAL AND INSTALLATION

BENCH SEAT TRACK

REMOVAL

(1) Remove seat from vehicle.
(2) Remove inboard seat belt buckles.
(3) Remove bolts attaching seat track to seat cushion frame (Fig. 1).
(4) Separate seat track from seat cushion frame.

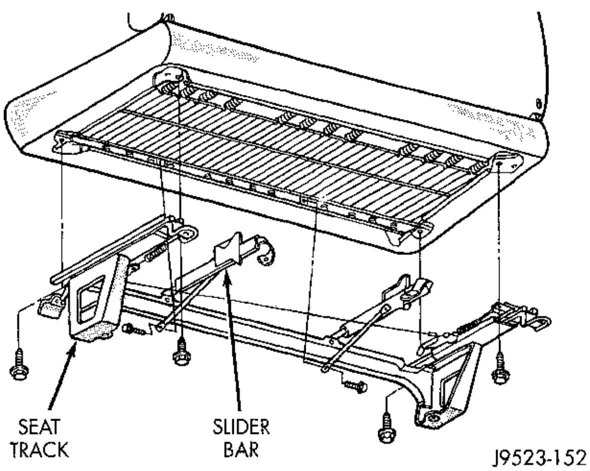

Fig. 1 Seat Track Removal

INSTALLATION

(1) Position seat track on seat cushion frame.
(2) Ensure seat track and slider bar are aligned.
(3) Install rear seat track bolts. Tighten seat track bolts to 25 N·m (18 ft.lbs.) torque.
(4) Install inboard seat belt buckles. Tighten bolts to 40 N·m (30 ft.lbs.) torque.
(5) Pull seat release and move track rearward.
(6) Install front seat track bolts. Tighten seat track bolts to 25 N·m (18 ft.lbs.) torque.
(7) Align slider bars and install bolts. Tighten slider bar bolts to 10.0 N·m (7 ft.lbs.) torque.
(8) Install seat.

BENCH SEAT BACK

REMOVAL

(1) Move seat to the full forward position.
(2) Release J-Strap and peel back side of cover (corner flap) (Fig. 3).
(3) Remove bolts attaching seat back to seat cushion and separate seat back from seat cushion (Fig. 2).

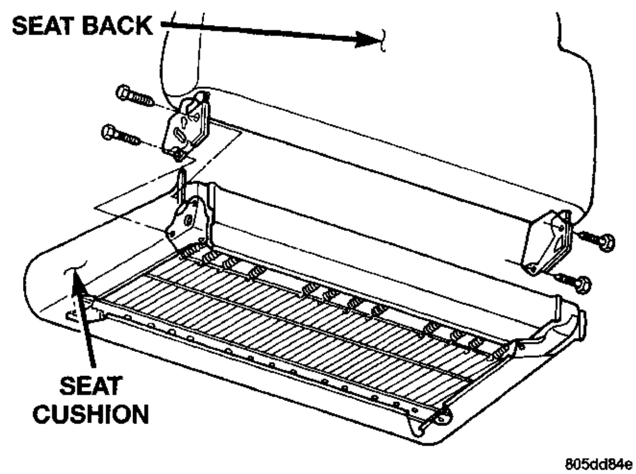

Fig. 2 Seat Back Removal/Installation

INSTALLATION

(1) Align seat cushion with seat back.
(2) Install bolts through seat back latch into seat cushion frame. Tighten bolts to 25 N·m (18 ft.lbs.) torque.
(3) Pull side of cover (corner flap) facing rear of the cushion over and secure J-Strap (Fig. 3).
(4) Plastic cover on side cover (corner flap) at rear of cushion must be over the pin on the inertia latches.

REMOVAL AND INSTALLATION (Continued)

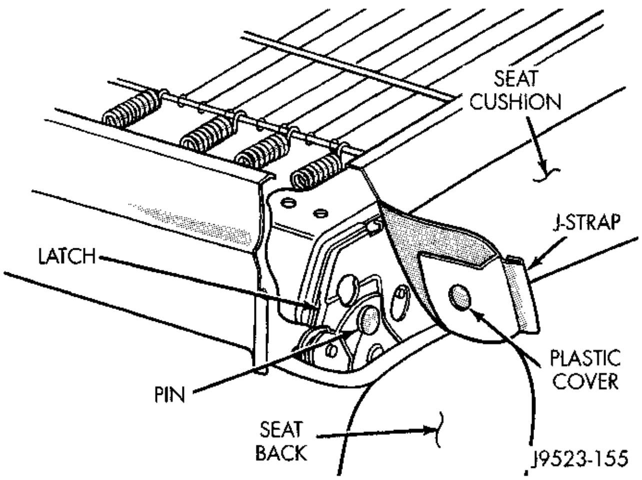

Fig. 3 J-Strap Corner Removal/Installation

BENCH SEAT BACK COVER

REMOVAL

(1) Remove seat back from vehicle.
(2) Disengage J-Straps from base of seat back.
(3) Remove hogrings, if equipped.
(4) With seat back in a normal vertical position, roll cover upwards and remove.

INSTALLATION

(1) With seat back in a normal vertical position, roll cover downwards over seat back.
(2) Install hogrings, if equipped.
(3) Secure J-Straps at base of seat back.
(4) Install seat back.

BENCH SEAT CUSHION COVER

REMOVAL

(1) Remove seat from vehicle.
(2) Remove seat back.
(3) Position seat cushion on a suitable work surface with frame side up.
(4) Remove seat track.
(5) Remove left and right side J-Straps.
(6) Remove rear J-Strap.
(7) Remove front J-Strap.
(8) Roll trim cover off of front and rear corners and separate from foam cushion.

INSTALLATION

(1) Position cushion cover on cushion and roll cover over front and rear corners.
(2) Secure front J-Strap (Fig. 4).
(3) Install seat back.
(4) Secure rear J-Strap.
(5) Secure left and right side J-Straps.
(6) Verify stitching lines are straight, correct as necessary.
(7) Install seat track.
(8) Install seat.

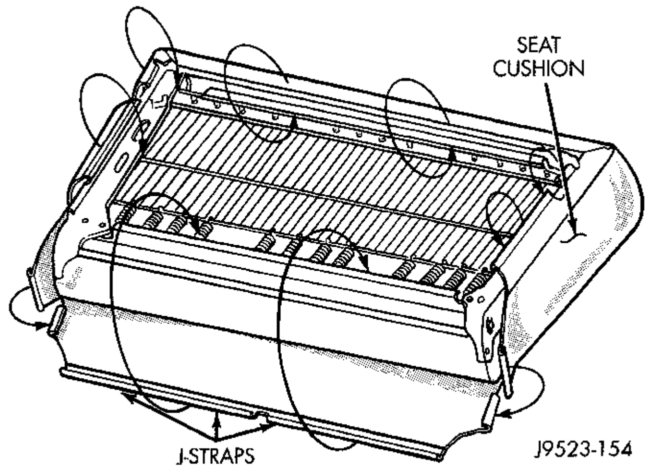

Fig. 4 J-Strap Installation

SPLIT BENCH SEAT TRACK-STD CAB

REMOVAL

(1) Disconnect power seat switch connector, if equipped.
(2) Remove seat from vehicle.
(3) Remove bolts attaching center seat to seat frame and remove center seat.
(4) Remove bolts attaching seat track to seat frame (Fig. 5) and (Fig. 6).

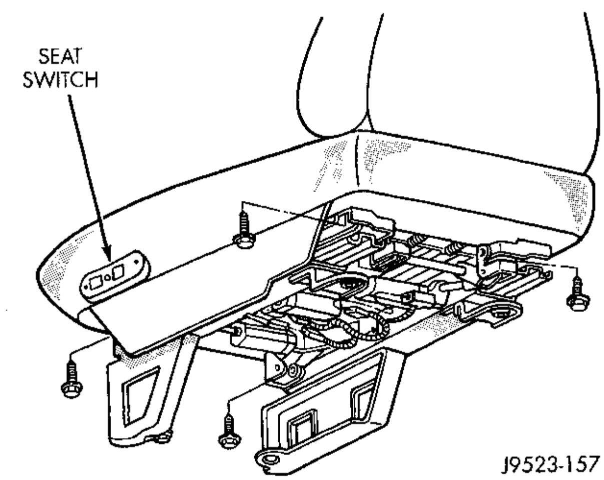

Fig. 5 Power Seat Track Removal/Installation

INSTALLATION

(1) Install bolts attaching seat track to seat frame. Tighten bolts to 25 N·m (18 ft. lbs.) torque.
(2) Install bolts attaching center seat to seat frame. Tighten bolts to 25 N·m (18 ft. lbs.) torque.
(3) Install seat.
(4) Connect power seat switch connector, if equipped.

AUTHENTIC RESTORATION PRODUCT

REMOVAL AND INSTALLATION (Continued)

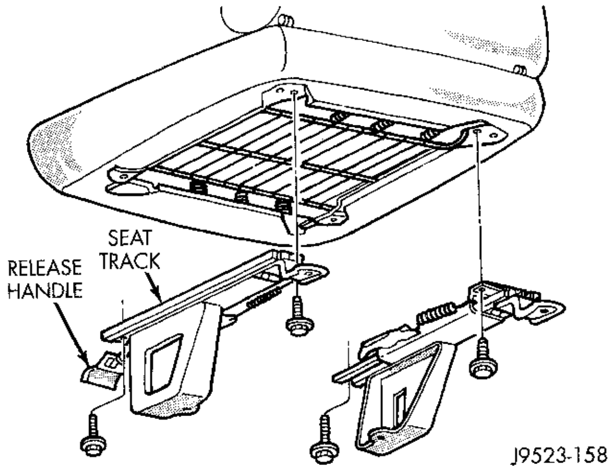

Fig. 6 Seat Track Removal/Installation

(5) Power adjuster on power seat must be cycled in all 6 functions to ensure the adjuster if working properly.

SPLIT BENCH SEAT BACK—STD CAB

REMOVAL

(1) Disconnect power seat switch connector, if equipped.

(2) Remove center seat/console armrest.

(3) Disconnect rear end flap J-Straps and peel back rear J-Strap.

(4) Remove bolts attaching seat back to seat cushion frame.

(5) Separate seat back from seat cushion (Fig. 7).

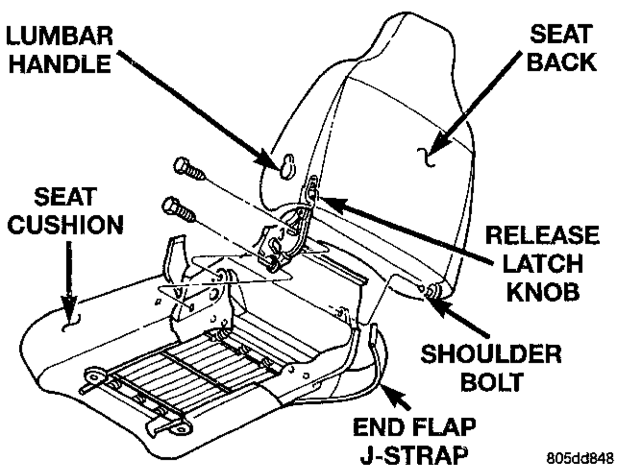

Fig. 7 Seat Back Removal

INSTALLATION

(1) Align seat cushion with seat back and install shoulder bolt through seat back into seat cushion frame on inboard side. Tighten bolt to 49 N·m (36 ft.lbs.) torque.

(2) Install bolts through seat back latch into seat cushion frame. Tighten bolts to 25 N·m (18 ft.lbs.) torque.

(3) Connect rear end flap J-Straps and pull rear J-Strap up and secure to frame.

(4) Install seat in vehicle.

(5) Connect power seat switch connector, if equipped.

SPLIT BENCH SEAT BACK COVER—STD CAB

REMOVAL

(1) Using a trim stick or equivalent tool, pry off lumbar handle, if equipped (Fig. 8). (Damage to lumbar handle may occur during removal, verify availability of replacement handle before removing.)

(2) Remove latch release knob (Fig. 8).

(3) Remove latch release bezel.

(4) Disengage J-Straps from base of seat back.

(5) Remove hogrings, if equipped.

(6) With seat back in a normal vertical position, roll cover upwards and remove.

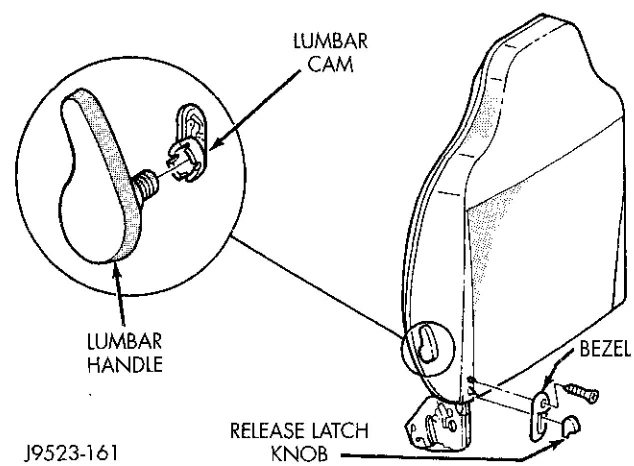

Fig. 8 Lumbar Handle Removal

INSTALLATION

(1) With seat back in a normal vertical position, roll cover downwards over seat back.

(2) Install hogrings, if equipped.

(3) Engage J-Straps at base of seat back.

(4) Align lumbar handle with lumbar cam and tap on with rubber mallet until seated.

(5) Install latch release bezel.

(6) Install latch release knob.

(7) Install seat back on seat cushion.

(8) Install seat.

REMOVAL AND INSTALLATION (Continued)

SPLIT BENCH SEAT CUSHION COVER—STD CAB

REMOVAL

(1) Remove seat from vehicle.
(2) Remove center seat/console armrest.
(3) Remove seat tracks.
(4) Remove left and right J-straps.
(5) Remove seat back.
(6) Position seat cushion on a suitable work surface with frame side up.
(7) Remove rear J-strap.
(8) Remove front J-strap.
(9) Roll cushion cover off of foam cushion.

INSTALLATION

(1) Position cushion cover on cushion and roll cover over front and rear corners. Verify stitching lines are straight, correct as necessary.
(2) Pull front J-strap up, align cover to foam notches and secure front J-strap to frame (Fig. 9).
(3) Install seat back.
(4) Pull the left J-strap up and secure to frame. Verify cover is straight.
(5) Pull the right side J-strap up and secure to frame.
(6) Install seat tracks.
(7) Install seat.

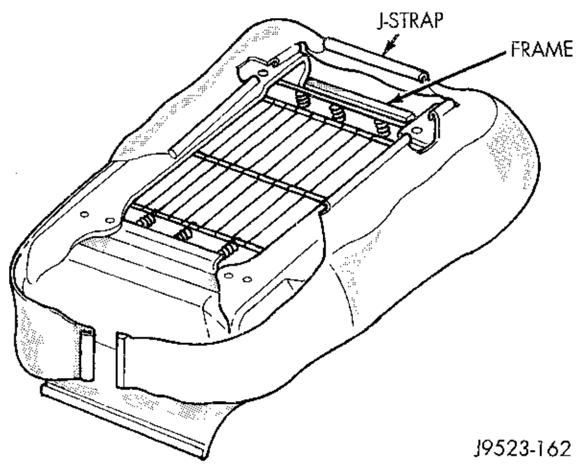

Fig. 9 J-Strap Installation

FRONT SEAT RISER—QUAD CAB

REMOVAL

(1) Disconnect seat harness connector.
(2) Remove the seat from the vehicle.
(3) Remove the bolts attaching the seat track adjuster to the seat riser (Fig. 10).
(4) Separate the seat track adjuster from the riser.

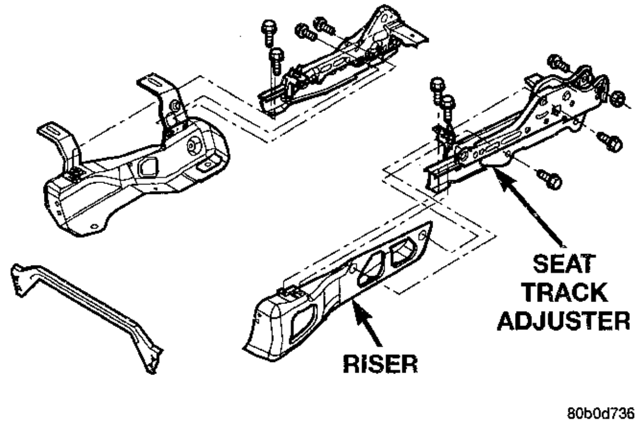

Fig. 10 Seat Riser

INSTALLATION

(1) Position the seat track adjuster on the riser.
(2) Install the bolts attaching the seat track adjuster to the seat riser. Tighten front bolts to 17 N·m (12 ft. lbs.) torque. Tighten rear inboard bolt to 22 N·m (16 ft. lbs.) torque. Tighten rear outboard bolt to 45 N·m (33 ft. lbs.) torque.
(3) Install the seat in the vehicle.
(4) Connect seat harness connector.

FRONT SEAT TRACK ADJUSTER—QUAD CAB

REMOVAL

(1) Disconnect seat harness connector.
(2) Remove seat from vehicle.
(3) Remove bolts attaching center seat to seat frame and remove center seat.
(4) Disconnect seat belt control timer module harness connector (SCTM).
(5) Remove bolts attaching seat track adjuster to riser (Fig. 10).
(6) Remove bolts attaching seat track adjuster to seat frame.

INSTALLATION

(1) Install bolts attaching seat track adjuster to seat frame. Tighten recliner bolt to seat track adjuster to 45 N·m (33 ft. lbs.) torque. Tighten inboard and outboard pivot bolts to 51 N·m (37 ft. lbs.) torque.
(2) Install bolts attaching seat track adjuster to riser.
(3) Install center seat to seat frame.
(4) Connect seat belt control timer module harness connector (SCTM).
(5) Install seat in vehicle.
(6) Connect seat harness connector.

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REMOVAL AND INSTALLATION (Continued)

EZ ENTRY SEAT TRACK—CLUB CAB

REMOVAL

(1) Remove front passenger seat.
(2) Remove recliner handle.
(3) Remove side shield.
(4) Disengage seat track latch release cables.
(5) Remove bolts attaching seat track/riser to EZ entry seat track (Fig. 11).
(6) Remove screws attaching EZ entry track to seat cushion frame.
(7) Remove nut attaching inboard seat belt buckle to EZ entry seat track.
(8) Remove nut attaching seat/shoulder belt to EZ entry seat track.
(9) Remove bolts attaching recliner/seat back to EZ entry seat track.
(10) Remove inboard seat back pivot bolt.
(11) Disengage latch release cable from pulley.
(12) Separate EZ entry seat track from seat back.

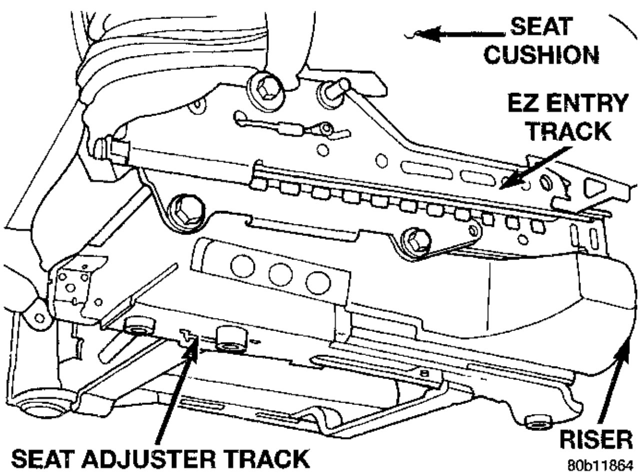

Fig. 11 EZ Entry Seat Track

INSTALLATION

(1) Position inboard EZ entry seat track at seat back.
(2) Engage latch release cable around pulley.
(3) Install bolts attaching recliner/seat back to EZ entry seat track. Tighten bolts to 45 N·m (33 ft. lbs.) torque.
(4) Install inboard seat back pivot bolt. Tighten bolt to 50 N·m (36 ft. lbs.) torque.
(5) Install nut attaching inboard seat belt buckle to EZ entry seat track. Tighten nut to 45 N·m (33 ft. lbs.) torque.
(6) Install screws attaching EZ entry track to seat cushion frame. Tighten screws to 25 N·m (18 ft. lbs.) torque.
(7) Install bolts attaching seat track/riser to EZ entry seat track. Tighten front bolts to 17 N·m (12 ft. lbs.) torque. Tighten rear inboard bolts to 21 N·m (16 ft. lbs.) torque. Tighten rear outboard bolts to 45 N·m (33 ft. lbs.) torque.
(8) Engage seat track latch release cables.
(9) Install front passenger seat.
(10) Install nut attaching seat/shoulder belt to EZ entry seat track. Tighten nut to 45 N·m (33 ft. lbs.) torque.
(11) Install side shield.
(12) Install recliner handle.

FRONT SEAT BACK—QUAD CAB

REMOVAL

(1) Remove screw attaching recliner handle and pull handle to remove.
(2) Remove seat dump handle, 2–door "BE" vehicles only.
(3) Remove screws attaching side shield to seat track adjuster.
(4) Remove seat dump handle.
(5) Pull shoulder belt out completely and clamp shoulder belt to prevent shoulder belt from retracting (Fig. 12).
(6) Remove shoulder belt anchor bolt.
(7) From the underside of the seat, remove the inboard pivot bolt (Fig. 13).
(8) From the underside of the seat, disengage the seat/shoulder belt harness connector

WARNING: DO NOT REMOVE UPPER RECLINER HANDLE, PULL ON UPPER RECLINER HANDLE OR RECLINER CABLE END. THE RECLINER LEAD SCREW IS SPRING LOADED AND WILL EJECT IF EITHER THE HANDLE OR CABLE IS PULLED BEFORE THE LEAD SCREW IS REMOVED.

(9) Remove clip attaching recliner cable (Fig. 14) to seat track adjuster and separate the cable from the seat track adjuster.
(10) Remove the inboard and outboard pivot bolts attaching the frame to the seat track adjuster (Fig. 15).
(11) Remove recliner lower bolt.
(12) Separate seat back from seat track adjuster.

INSTALLATION

(1) Position seat back on seat track adjuster.
(2) Install the inboard and outboard pivot bolts attaching the frame to the seat track adjuster (Fig. 15).
(3) Install the bolt attaching the lower recliner to the seat track adjuster.
(4) Position the recliner cable on seat track adjuster and install **new** clip.
(5) From the underside of the seat, engage the seat/shoulder belt harness connector.

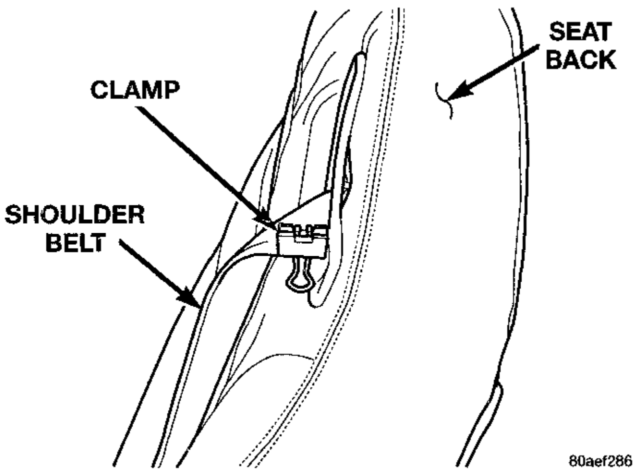

Fig. 12 Shoulder Belt Clamp

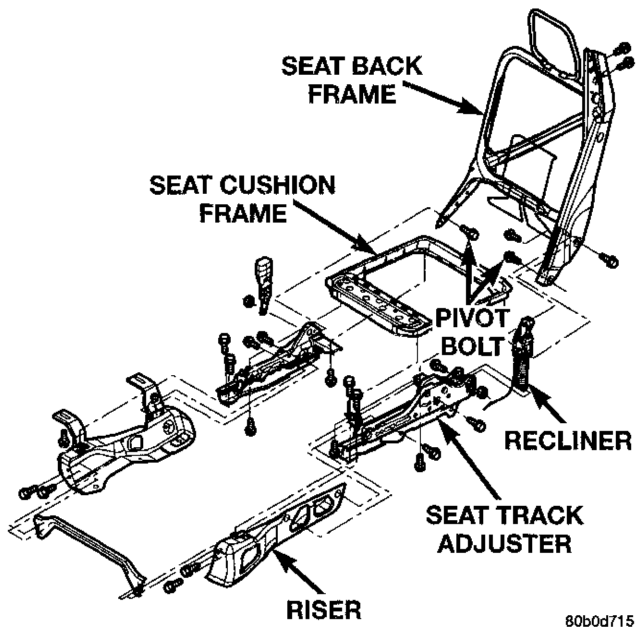

Fig. 13 Pivot Bolt

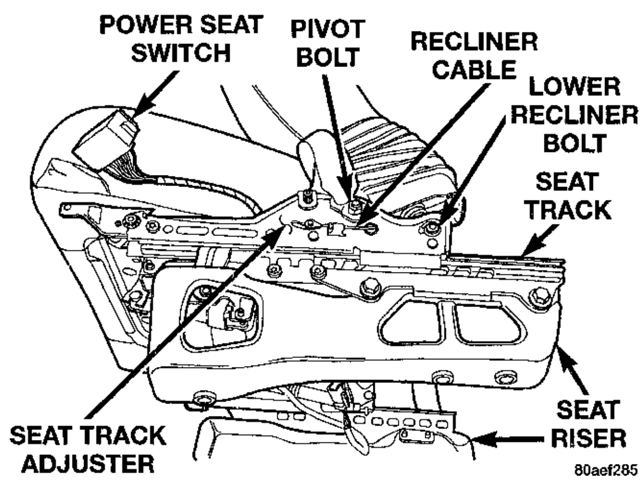

Fig. 14 Recliner Cable

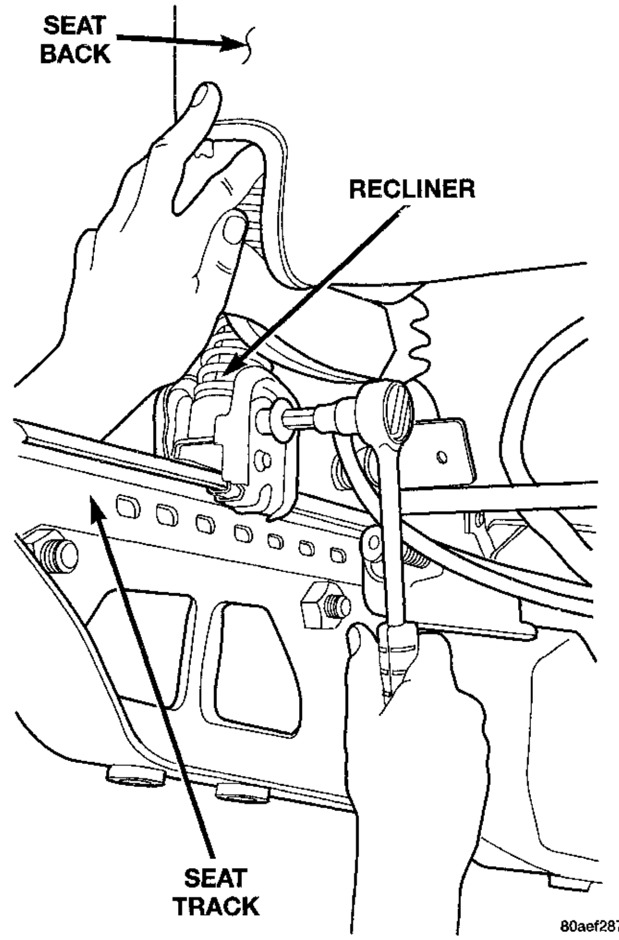

Fig. 15 Recliner

(6) Install shoulder belt anchor bolt. Tighten bolt to 45 N·m (33 ft. lbs.) torque.
(7) Remove clamp (Fig. 12).
(8) Install side shield.
(9) Install recliner handle.
(10) Install seat dump handle, if removed.

FRONT SEAT RECLINER—QUAD CLUB

REMOVAL

(1) Remove seat back.
(2) Disengage J-straps at base of seat back and roll seat back cover upward to access rubber bellows push-in fasteners.

NOTE: Notice the routing of the recliner cable for installation.

(3) Remove the push-in fasteners attaching upper rubber bellows to the seat back frame.
(4) Remove rubber bellows.
(5) Remove seat dump handle, 2–door "BE" vehicles only.

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REMOVAL AND INSTALLATION (Continued)

WARNING: Do not pull on upper recliner handle or recliner cable end. The recliner lead screw is spring loaded and will eject if either the handle or cable is pulled before the lead screw is removed.

(6) Remove the bolts attaching upper recliner to seat back frame (Fig. 16).

Separate the recliner from the seat back.

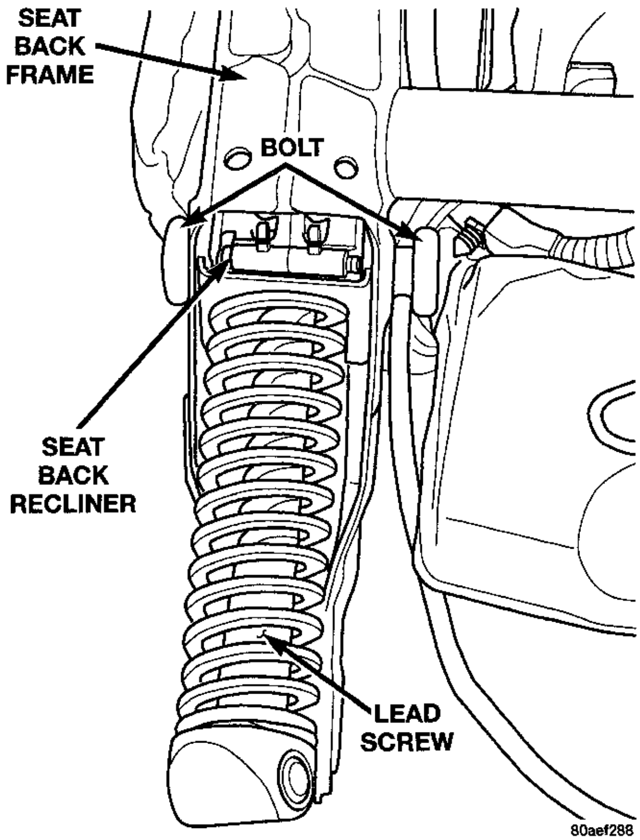

Fig. 16 Seat Back Recliner

INSTALLATION

(1) Install seat dump handle, if removed.

Position the recliner in the seat back.

(2) Install the bolts attaching upper recliner to seat back frame (Fig. 16).

(3) Install rubber bellows.

(4) Roll seat back cover upward and engage J-straps at base of seat back.

(5) Ensure recliner cable is correctly routed.

(6) Install seat back.

FRONT SEAT CUSHION—QUAD CAB

REMOVAL

The seat cushion can be removed with the seat in the vehicle.

(1) From the underside of the seat, remove the bolts attaching the cushion frame to the mounting brackets.

(2) Remove the cushion from the seat tracks.

INSTALLATION

(1) Position the cushion frame on the seat tracks.

(2) Ensure that the cushion frame is aligned with the mounting brackets (Fig. 17).

(3) Install the bolts attaching the seat cushion frame to the mounting brackets. Tighten bolts to 25 N·m (18 ft. lbs.) torque.

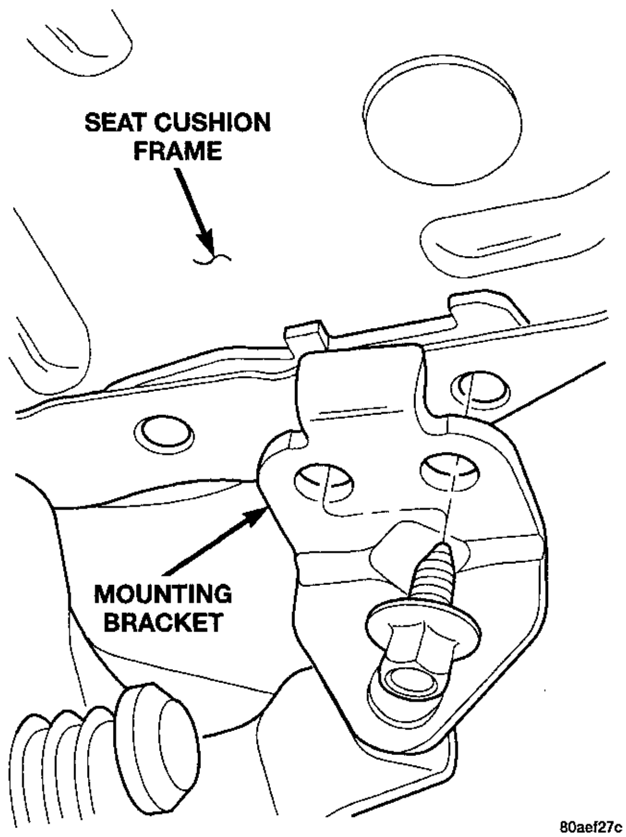

Fig. 17 Seat Cushion Mounting Frame

FRONT SEAT BACK COVER—QUAD CAB

REMOVAL

(1) Remove recliner handle.

(2) Remove dump handle, if equipped.

(3) Remove side shield.

(4) Clamp belt to prevent from retracting.

(5) Remove the bolt attaching the seat belt anchor to the seat track adjuster.

(6) Remove the assist handle on the backside of the seat, if equipped.

(7) Disengage the J-strap at the base of the seat back (Fig. 18).

(8) Roll cover upward.

(9) Disengage hog rings attaching the cover to the seat back frame (Fig. 19).

(10) Using a trim stick, carefully pry shoulder belt guide bezel from seat back.

(11) Route the shoulder belt and guide bezel through the seat back cover.

REMOVAL AND INSTALLATION (Continued)

(12) Roll the cover upward and separate from the seat back.

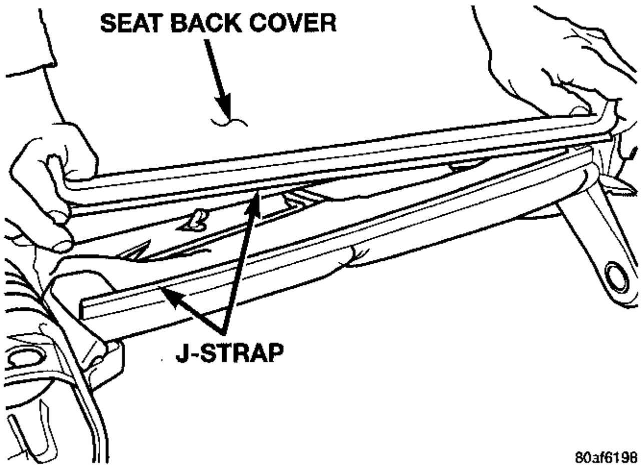

Fig. 18 Seat Back J-Strap

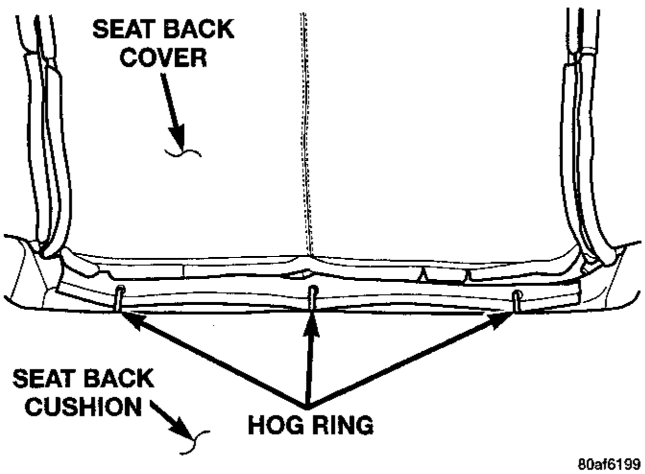

Fig. 19 Seat Back Hog Rings

INSTALLATION

(1) Position the seat back cover on the seat back and roll the cover downward.
(2) Route the shoulder belt and guide bezel through the seat back cover.
(3) Engage hog rings attaching the cover to the seat back frame.
(4) Align the shoulder belt guide bezel and press into place.
(5) Roll cover downward.
(6) Engage the J-strap at the base of the seat back.
(7) Install the assist handle on the backside of the seat, if equipped.
(8) Install the bolt attaching the seat belt anchor to the seat track adjuster.
(9) Install side shield.
(10) Install dump handle, if equipped.
(11) Install recliner handle.

FRONT SEAT CUSHION COVER—QUAD CAB

REMOVAL

(1) Remove seat cushion.
(2) Disengage the J-straps attaching the cushion cover to the cushion frame (Fig. 20).
(3) Peel the cushion cover and disengage the hook and loop fasteners (Fig. 21).
(4) Disengage the hog rings attaching the cushion cover to the cushion frame (Fig. 22).
(5) Separate the cover from the cushion.

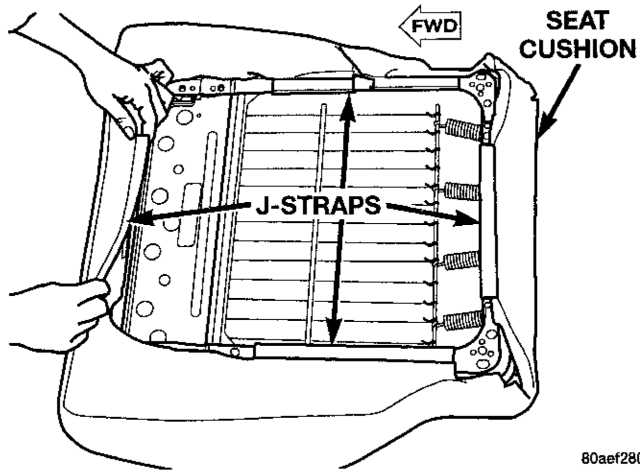

Fig. 20 Seat Cushion J-Straps

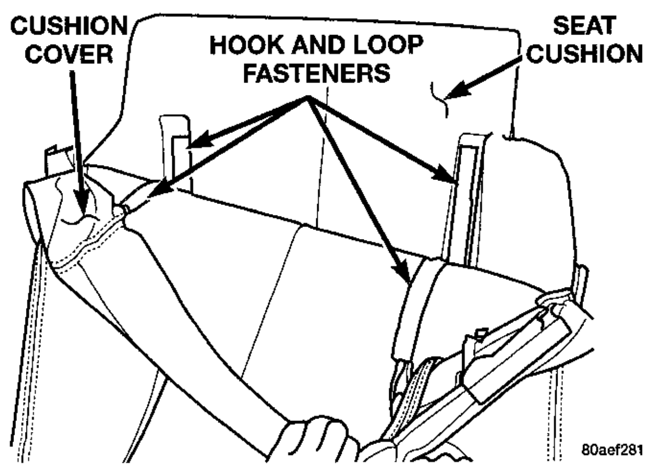

Fig. 21 Seat Cushion Cover Hook and Loop

REMOVAL AND INSTALLATION (Continued)

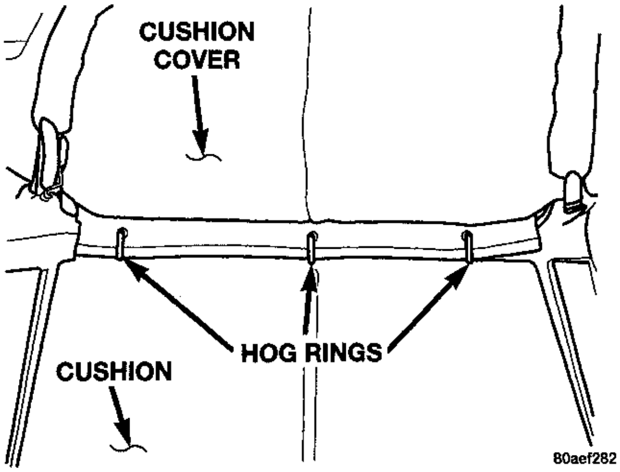

Fig. 22 Seat Cushion Cover Hog Rings

INSTALLATION

(1) Position the cover on the cushion.

(2) Engage the hog rings attaching the cushion cover to the cushion frame.

(3) Engage the hook and loop fasteners.

(4) Engage the J-straps attaching the cushion cover to the cushion frame.

(5) Install seat cushion.

AUTHENTIC RESTORATION PRODUCT

BODY COMPONENT SERVICE

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GENERAL INFORMATION

INTERIOR TRIM PANELS

CAUTION: Do not attempt to remove interior trim panels/mouldings without first removing the necessary adjacent panels.

To avoid damaging the panels, ensure that all the screws and clips are removed before attempting to remove an interior trim panel/moulding. **Trim panels are somewhat flexible but can be damaged if handled improperly.**

REMOVAL AND INSTALLATION

GRILLE

REMOVAL

(1) Release primary hood latch.
(2) Release hood safety catch and open hood.
(3) Remove bolt holding bottom of grille to frame.
(4) Remove bolts holding sides of grille to frame.
(5) Remove nuts holding grille to hood (Fig. 1).
(6) Separate grille from vehicle.

INSTALLATION

Reverse the preceding operation.

GRILLE FRAME

REMOVAL

(1) Release primary hood latch.
(2) Release hood safety catch and open hood.
(3) Remove bolts holding guide loop for hood safety catch release rod to grille frame.
(4) Remove grille.
(5) Remove screws holding grille frame to hood (Fig. 2).

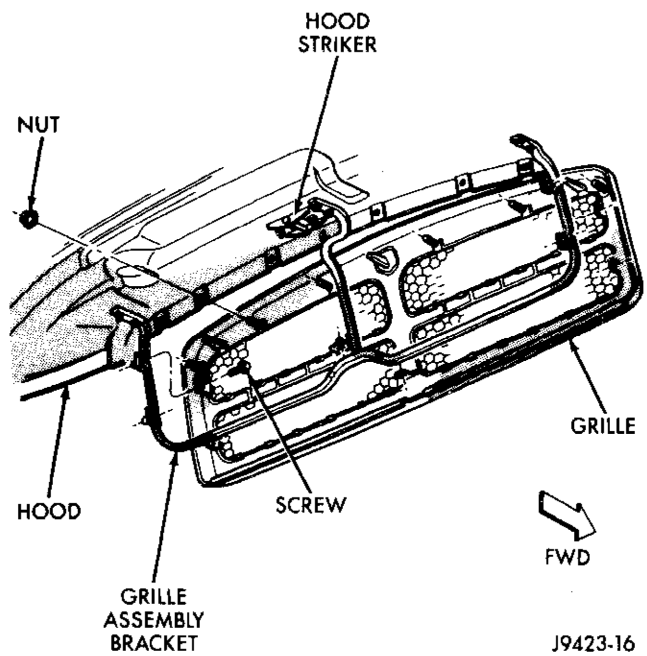

Fig. 1 Grille

(6) Separate grille frame from vehicle.

INSTALLATION

Reverse the preceding operation.

HOOD

REMOVAL

(1) Release primary hood latch.
(2) Release hood safety catch and open hood.
(3) Disconnect the under hood lamp wire connector.
(4) Mark all bolt and hinge attachment locations with a grease pencil or other suitable device to provide reference marks for installation.

REMOVAL AND INSTALLATION (Continued)

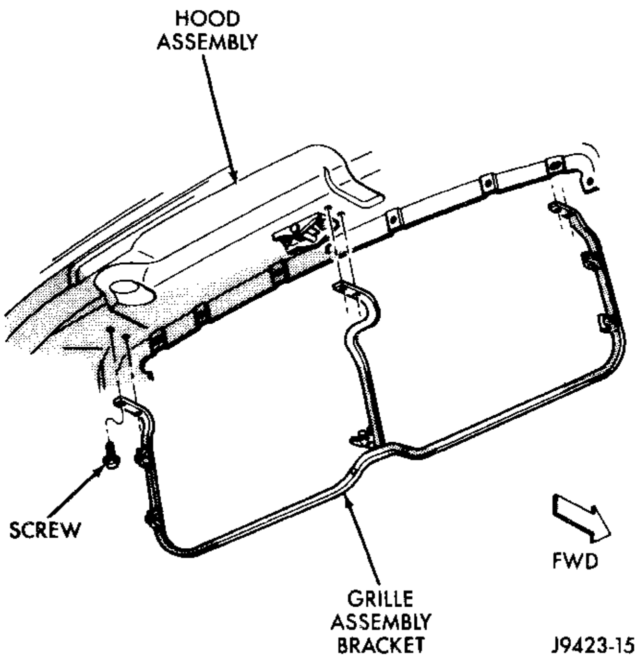

Fig. 2 Grille Mounting Frame

(5) Remove the top hood to hinge attaching bolts and loosen the bottom bolts until they can be removed by hand (Fig. 3).

(6) With assistance of a helper at the opposite side of the vehicle to support the hood, remove the bottom hood to hinge attaching bolts. Separate the hood from the vehicle.

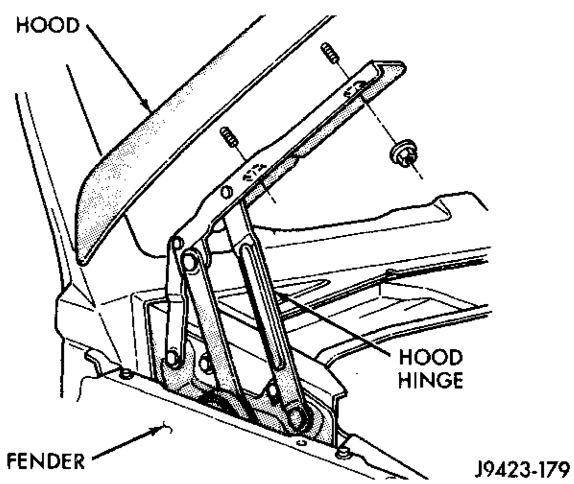

Fig. 3 Hood

INSTALLATION

Align all marks and secure bolts. The hood should be aligned to 5 mm (0.2 in.) gap to the front fenders and flush across the top surfaces along fenders.

Reverse the preceding operation.

HOOD SILENCER

REMOVAL

(1) Release primary hood latch.

(2) Release hood safety catch and open hood.

(3) Remove push-in fasteners holding silencer to hood (Fig. 4).

(4) Separate hood silencer from vehicle.

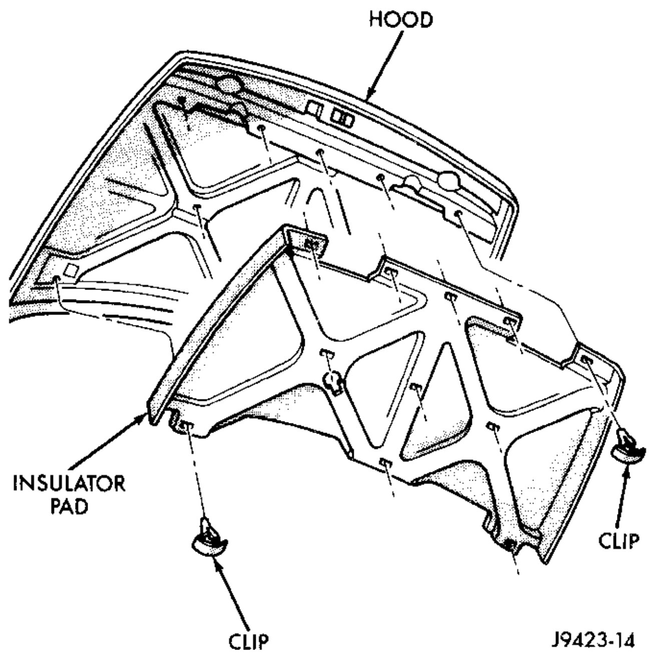

Fig. 4 Hood Silencer

INSTALLATION

Reverse the preceding operation.

HOOD HINGE

REMOVAL

(1) Open hood and support the side that requires hinge replacement.

(2) Mark all bolt and hinge attachment locations with a grease pencil or other suitable device to provide reference marks for installation. When installing hood hinge, align all marks and secure bolts. The hood should be aligned to 5 mm (0.2 in.) gap to the front fenders and flush across the top surfaces along fenders. Shims can be added or removed under hood hinge to achieve proper hood height.

(3) Remove hood to hinge attaching bolts (Fig. 5).

(4) Remove hood hinge to cowl panel attaching bolts and separate hinge from vehicle.

INSTALLATION

Reverse the preceding operation. If necessary, paint new hinge before installation.

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REMOVAL AND INSTALLATION (Continued)

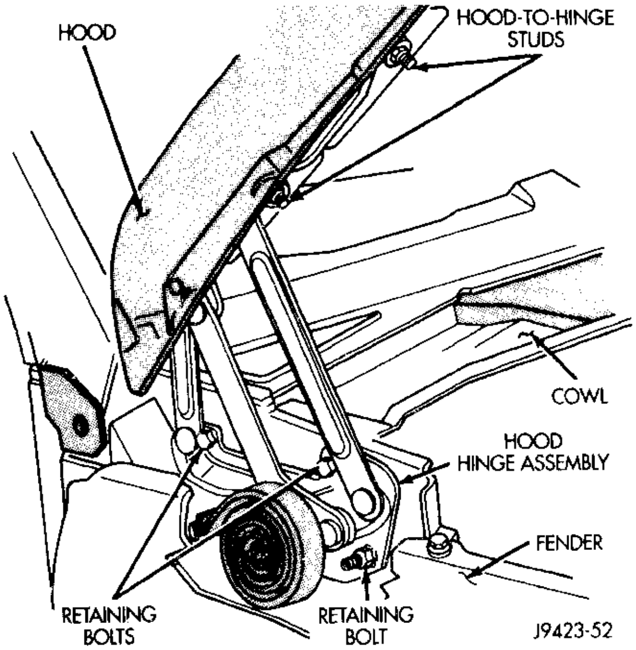

Fig. 5 Hood Hinge

HOOD SAFETY CATCH

REMOVAL

(1) Release primary hood latch.
(2) Release hood safety catch and open hood.
(3) Remove bolts holding hood safety catch to hood (Fig. 6).
(4) Separate safety catch from vehicle.

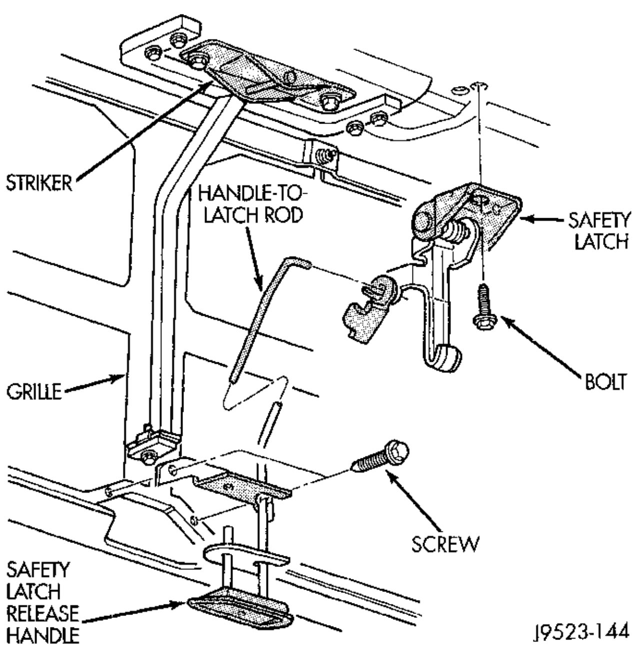

Fig. 6 Hood Safety Catch and Latch Striker

INSTALLATION

Reverse the preceding operation.

HOOD LATCH STRIKER

REMOVAL

(1) Release primary hood latch.
(2) Release hood safety catch and open hood.
(3) Remove bolts holding hood latch striker to hood (Fig. 6).
(4) Separate hood latch striker from vehicle.

INSTALLATION

Reverse the preceding operation.

HOOD LATCH

REMOVAL

(1) Release primary hood latch.
(2) Release hood safety catch and open hood.
(3) Remove bolts holding hood latch to radiator closure panel crossmember (Fig. 7).
(4) Separate hood latch from crossmember.
(5) Disconnect release cable from hood latch.

INSTALLATION

Reverse the preceding operation.

HOOD RELEASE CABLE

REMOVAL

(1) Release primary hood latch.
(2) Release hood safety catch and open hood.
(3) Remove hood latch.
(4) Disconnect release cable from hood latch.
(5) Detach the release cable from the retainer clips in the engine compartment.
(6) Separate the release cable grommet from the dash panel hole.
(7) From the inside of the vehicle, remove the screws attaching the hood release handle to the bottom of the instrument panel.
(8) Pull/route the hood release cable through the dash panel hole and remove it via the inside of the vehicle.

INSTALLATION

NOTE: If replacement hood latch is also being installed, ensure that it is thoroughly lubricated.

(1) From inside the vehicle, pull/route the hood release cable through the dash panel hole and into the engine compartment.
(2) Install the hood release handle.
(3) Install the cable grommet in the dash panel hole.
(4) Attach the release cable to the retainer clips in the engine compartment.
(5) Attach release cable to hood latch.
(6) Install hood latch.

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REMOVAL AND INSTALLATION (Continued)

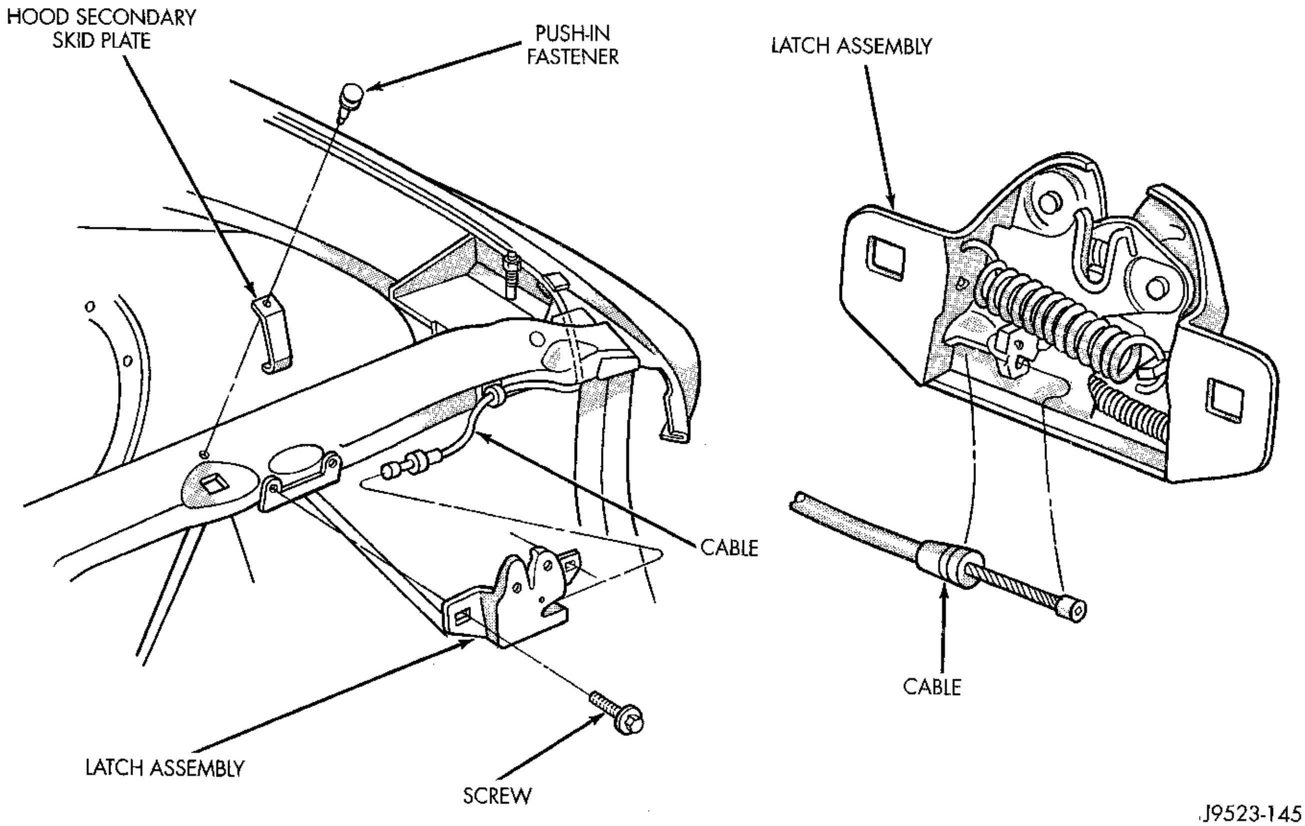

Fig. 7 Hood Latch

(7) Test the hood latch release cable for proper operation.

COWL COVER

REMOVAL

(1) Release primary hood latch.
(2) Release hood safety catch and open hood.
(3) Remove wiper arms, refer to Group 8K, Windshield Wipers and Washers.
(4) Disconnect windshield washer tubing from coupling near left hood hinge.
(5) Remove retainers holding cowl cover to cowl box (Fig. 8).
(6) Pull cowl seal from pinch flange a front of cowl.
(7) Separate cowl cover from vehicle.

INSTALLATION

Reverse the preceding operation.

FRONT WHEELHOUSE LINER

REMOVAL

(1) Hoist and support vehicle on safety stands.
(2) Remove front wheel.
(3) Remove plastic rivets holding wheelhouse liner to fender at the edge of wheel opening.

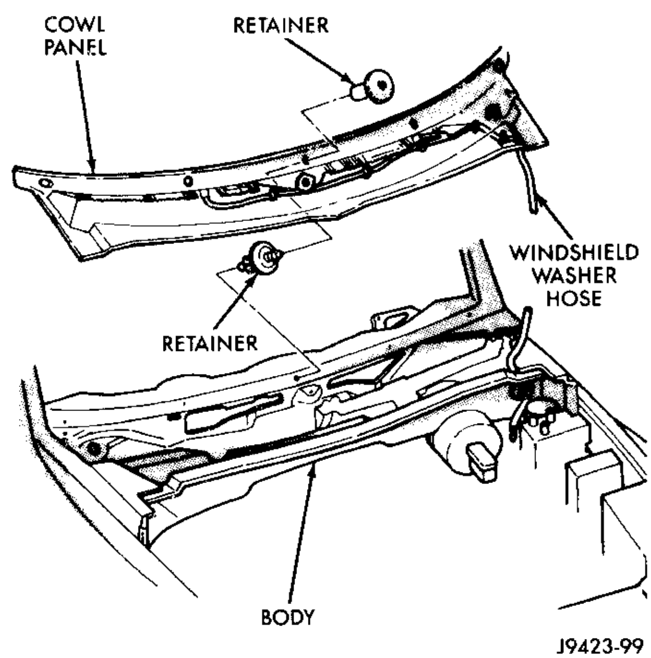

Fig. 8 Cowl Cover

(4) Remove plastic rivets holding liner to the wheelhouse (Fig. 9).
(5) Separate front wheelhouse liner from vehicle.

REMOVAL AND INSTALLATION (Continued)

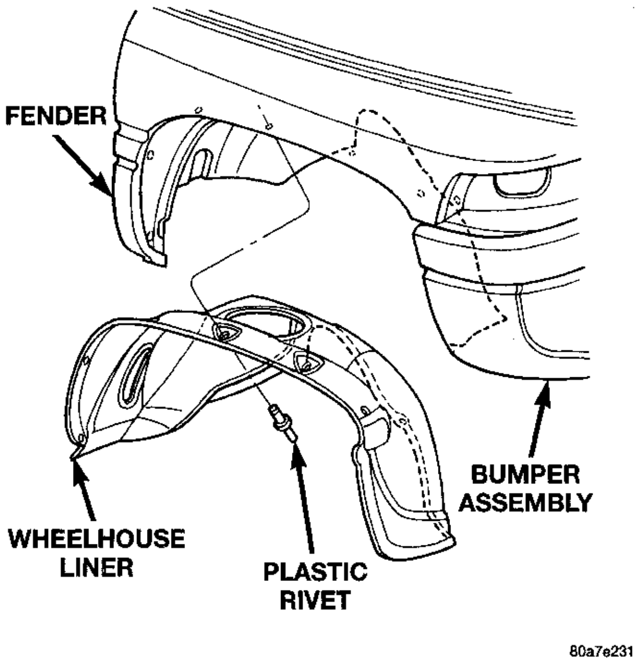

Fig. 9 Front Wheelhouse Liner

INSTALLATION

Reverse the preceding operation.

LEFT FRONT FENDER

REMOVAL

(1) Release primary hood latch.
(2) Release hood safety catch and open hood.
(3) Remove front bumper, refer to Group 13, Bumpers and Frame for procedures.
(4) Remove air cleaner from wheelhouse (DIESEL ONLY).
(5) Remove coolant overflow bottle (V-10 ONLY).
(6) Remove battery and tray, refer to Group 8B, Battery/Starter/Generator Service for procedures.
(7) Remove screws holding power distribution center to left wheelhouse (Fig. 10).
(8) Disengage wire harness tie-downs from wheelhouse.
(9) Disconnect wiring harness to headlamp connector.
(10) Disconnect wiring harness to airbag sensor and remove airbag sensor from wheelhouse.
(11) Remove bolts holding anti-lock brake controller to wheelhouse (Fig. 10), if equipped. Refer to Group 5, Brakes for procedures.
(12) Disengage windshield washer tubing tie-downs from wheelhouse (Fig. 10).
(13) Remove bolts holding front fender to cowl reinforcement (Fig. 11).
(14) Remove bolts holding front fender to radiator closure panel (Fig. 12).
(15) Remove bolts holding bottom of front fender to rocker panel lower flange (Fig. 13).
(16) Open left door.
(17) Remove bolt holding front fender to hinge pillar mounting bracket (Fig. 13).
(18) Remove bolts holding top of fender to radiator closure panel (Fig. 13).
(19) Separate left front fender from vehicle.

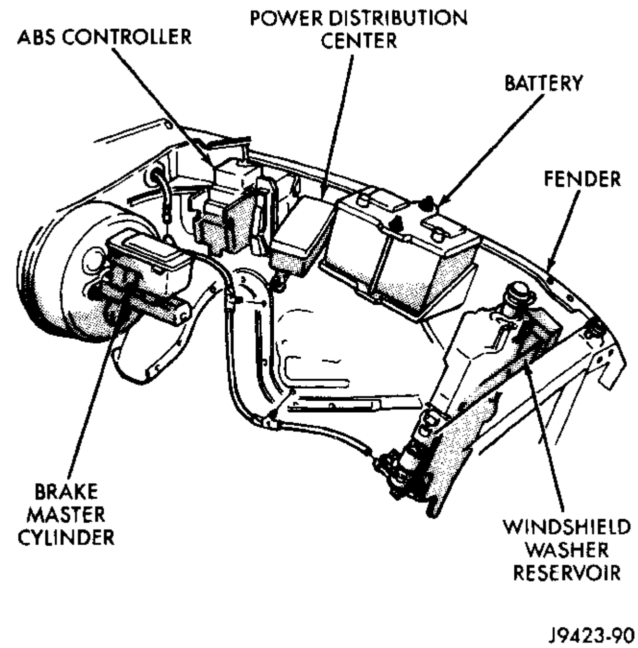

Fig. 10 Left Front Fender Access Components

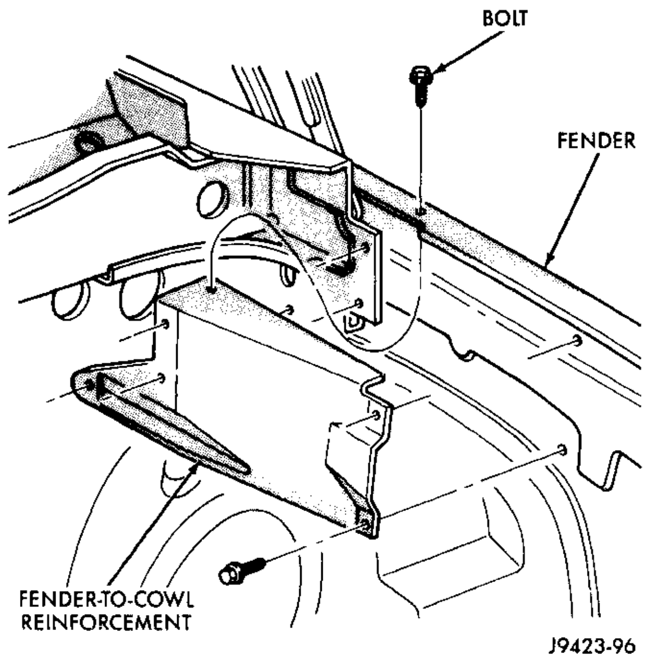

Fig. 11 Fender to Cowl Reinforcement—Typical

REMOVAL AND INSTALLATION (Continued)

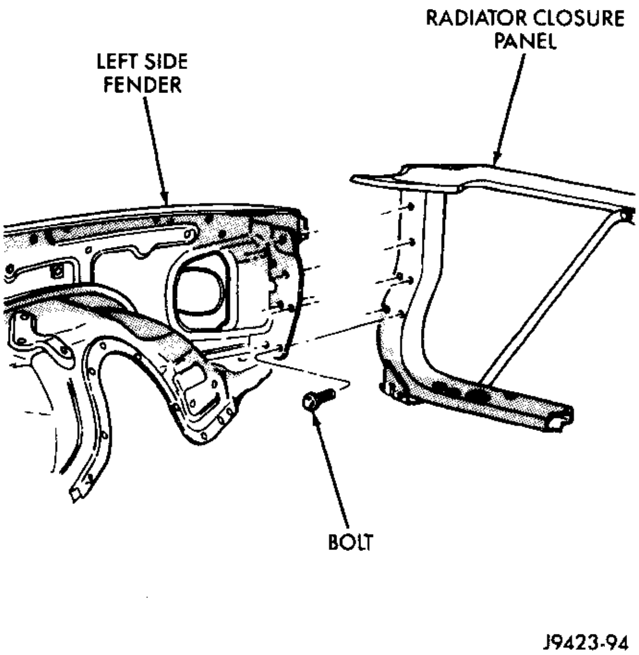

Fig. 12 Left Fender to Radiator Closure Panel Fasteners

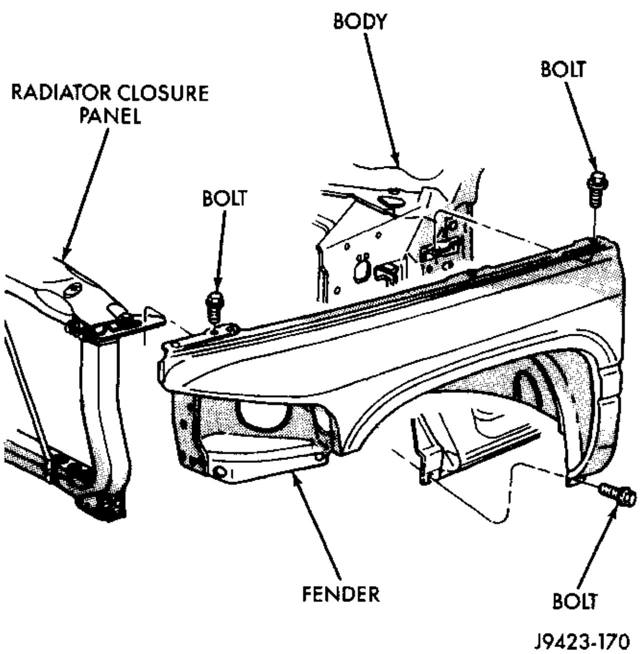

Fig. 13 Left Front Fender

INSTALLATION

Reverse the preceding operation.

RIGHT FRONT FENDER

REMOVAL

engage

(1) Remove front bumper, refer to Group 13, Bumpers and Frame for procedures.

(2) Remove auxiliary battery and tray on right side, if equipped. Refer to Group 8B, Battery/Starter/Generator Service for procedures.

(3) Disengage wire harness tie-downs from wheelhouse.

(4) Disconnect wiring harness to headlamp connector.

(5) Disconnect wiring harness to airbag sensor and remove airbag sensor from wheelhouse.

(6) Remove front wheelhouse liner (Fig. 9).

(7) Disengage air conditioning tubing from inner fender clips.

(8) Remove bolts holding front fender to cowl reinforcement (Fig. 11).

(9) Remove bolts holding front fender to radiator closure panel (Fig. 14).

(10) Remove bolts holding bottom of front fender to rocker panel lower flange (Fig. 15).

(11) Open right door.

(12) Remove bolt holding front fender to hinge pillar mounting bracket (Fig. 15).

(13) Remove bolts holding top of fender to radiator closure panel (Fig. 15).

(14) Separate right front fender from vehicle.

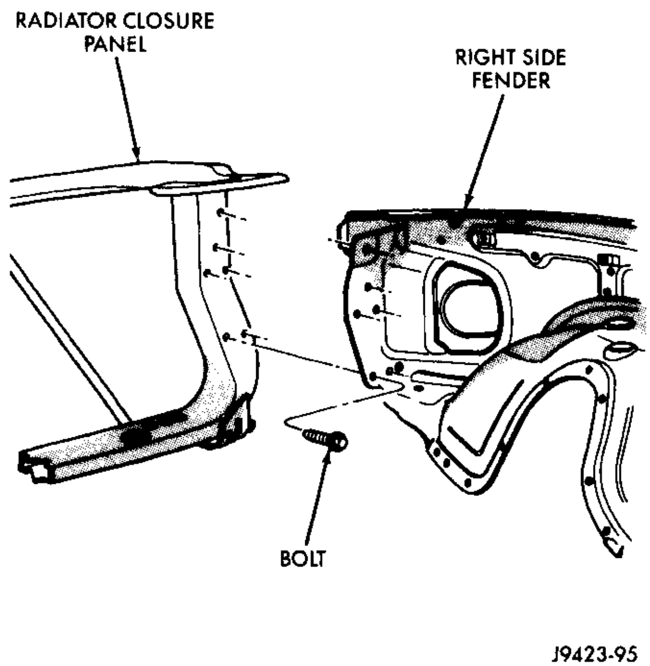

Fig. 14 Right Fender to Radiator Closure Panel Fasteners

INSTALLATION

Reverse the preceding operation.

EXTERIOR NAMEPLATES

REMOVAL

(1) Insert a plastic trim stick or a hard wood wedge behind the emblem to separate the adhesive

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REMOVAL AND INSTALLATION (Continued)

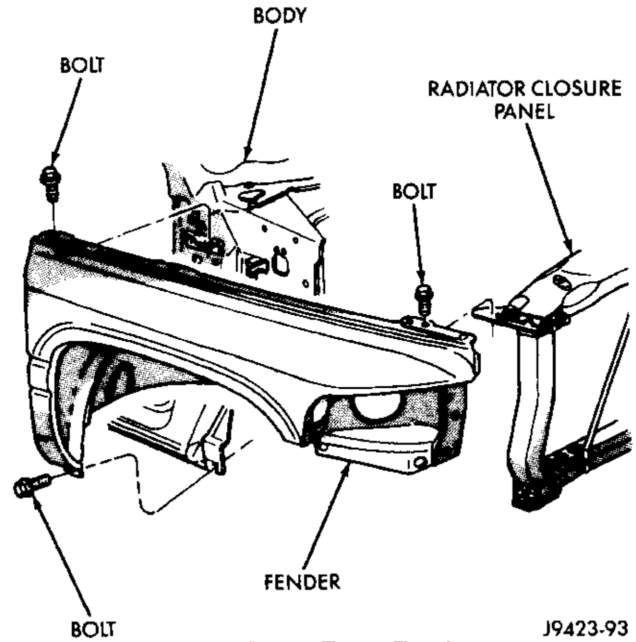

Fig. 15 Right Front Fender

backing from the body (Fig. 16) and (Fig. 17).

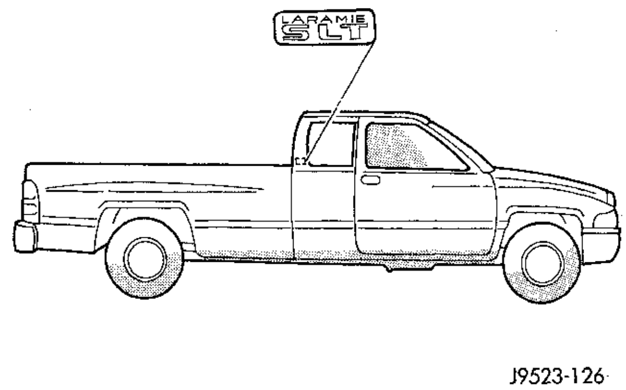

Fig. 17 Exterior Nameplates—Club Cab

(2) Clean adhesive residue from body with MOPAR Super Clean solvent or equivalent.

INSTALLATION

(1) Remove protective cover from adhesive tape on back of emblem.

(2) Position emblem properly on body.

(3) Press emblem firmly to body with palm of hand.

(4) If temperature is below 21°C (70°F) warm emblem with a heat lamp or gun to assure adhesion. Do not exceed 52°C (120°F) when heating emblem.

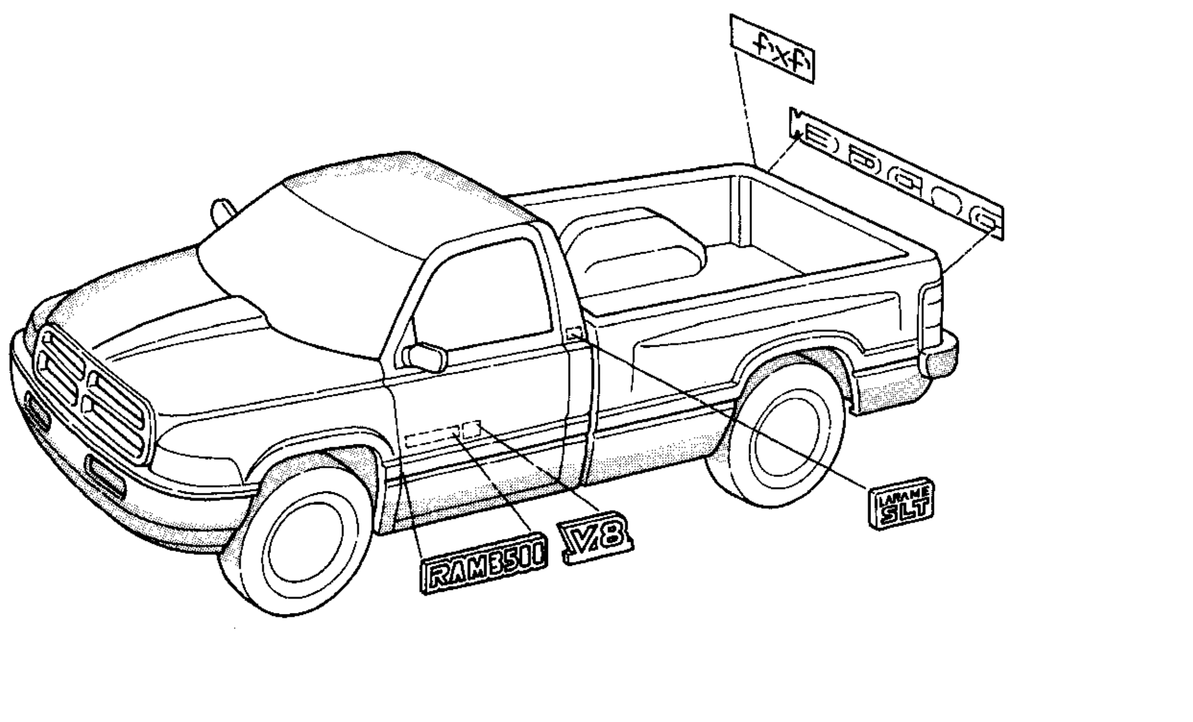

Fig. 16 Exterior Nameplates

REMOVAL AND INSTALLATION (Continued)

B-PILLAR APPLIQUE

REMOVAL

(1) Using a heat lamp, warm B-pillar to 38° C (100° F).

(2) Remove B-pillar secondary seal, BE vehicles only.

(3) Remove inner and outer belt weatherstrip.

(4) Remove glass run weatherstrip.

(5) Using an even pressure pull, peel B-pillar applique away from the B-pillar.

INSTALLATION

Installation equipment needed:

- Lint free applicator cloth
- six inch applicator squeegee
- Piercing pin

(1) Clean B-pillar using Mopar Super Kleen or equivalent.

(2) Wipe surface with a lint free cloth.

(3) Using a heat gun, warm surface to 22°C (70° F).

(4) Fold down, up/down locator tab (1a or 1b) (Fig. 18) along crease.

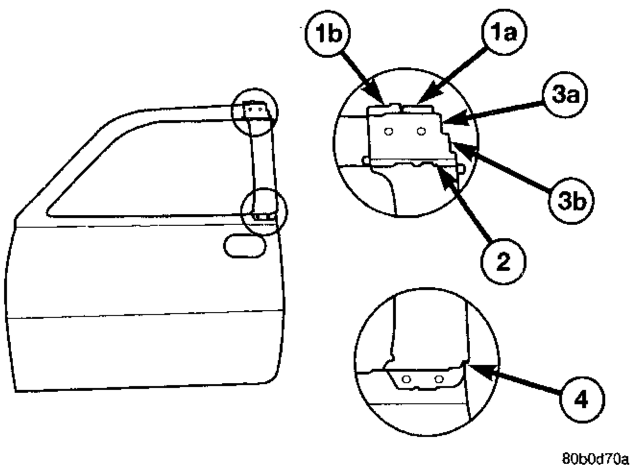

Fig. 18 B-Pillar Applique

1A = Club Cab - Up/Down
1B = Quad Cab - Up/Down
2 = Adhesion Strip
3A = Club Cab - For/Aft
3B= Quad Cab - For/Aft
4 = Rear Edge Locator

(5) Remove carrier from adhesion strip (2).

(6) Using up/down locator tab (1a or 1b) and fore/aft locator tab (3a or 3b), position the applique on the upper portion of the B-pillar.

(7) Using the lower edge locator (4), position the applique on the lower portion of the B-pillar.

(8) Verify the applique is positioned correctly and press the adhesion strip (2) to the door to temporarily secure it in place.

(9) Remove the carrier for the applique.

(10) Holding the applique from the surface, apply firm downward pressure with a six inch applicator squeegee. Ensure the lower rear edge (4) is aligned correctly.

(11) Wrap edges around door to at least a 90° angle.

(12) Remove premask by pulling in a firm continuous manner from top down at 180°.

(13) Complete wrapping applique around the door edges.

(14) Inspect for air bubbles. Small bubbles can be pierced with a sharp pin and smoothed out.

(15) Install glass run weatherstrip.

(16) Install inner and outer belt weatherstrip.

(17) Install B-pillar secondary seal, BE vehicles only.

SIDEVIEW MIRROR

REMOVAL

(1) Remove door trim panel.

(2) Remove mirror flag door seal (Fig. 19).

(3) Disengage power mirror wire connector from door harness, if equipped (Fig. 20).

(4) Remove nuts attaching sideview mirror to door frame (Fig. 21).

(5) Separate harness grommet form door frame, if equipped.

(6) Separate sideview mirror from vehicle.

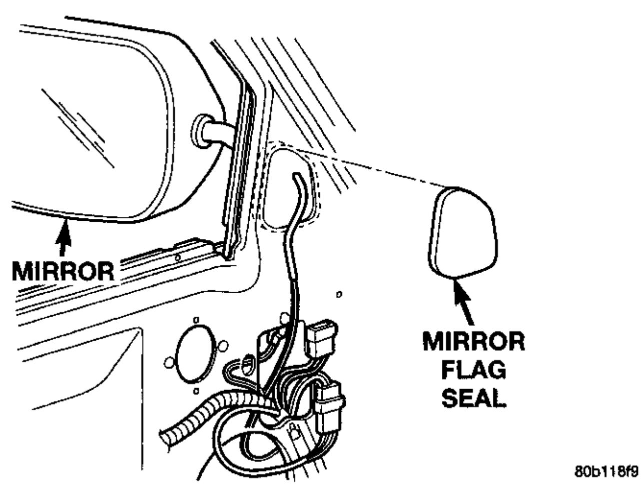

Fig. 19 Mirror Flag Door Seal

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REMOVAL AND INSTALLATION (Continued)

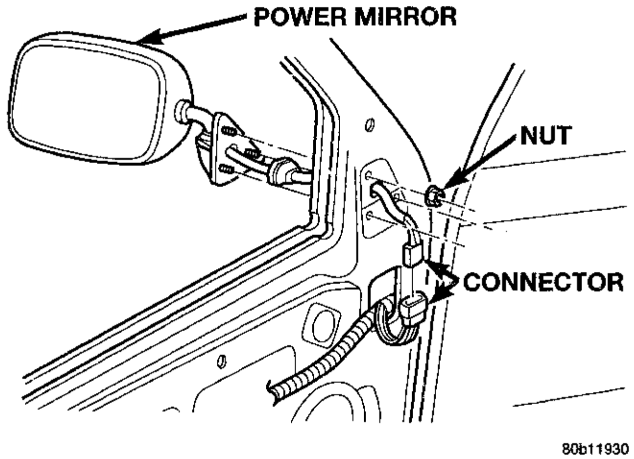

Fig. 20 Sideview Mirror—Power

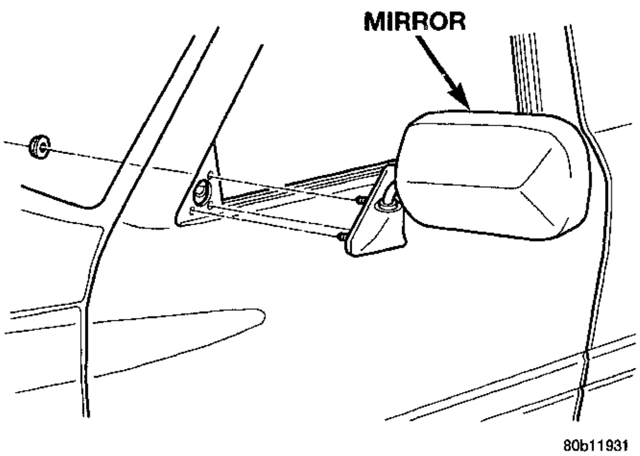

Fig. 21 Sideview Mirror

INSTALLATION

(1) Position sideview mirror on door.
(2) Install harness grommet in door frame, if equipped.
(3) Install nuts attaching sideview mirror to door (Fig. 21).
(4) Engage power mirror wire connector to harness, if equipped (Fig. 20).
(5) Install mirror flag door seal (Fig. 19).
(6) Install door trim panel.

MIRROR FLAG COVER

REMOVAL

(1) Remove door trim panel.
(2) Remove flag door seal.
(3) Remove nuts holding door flag cover to door frame (Fig. 22).
(4) Separate flag cover from vehicle.

INSTALLATION

Reverse the preceding operation.

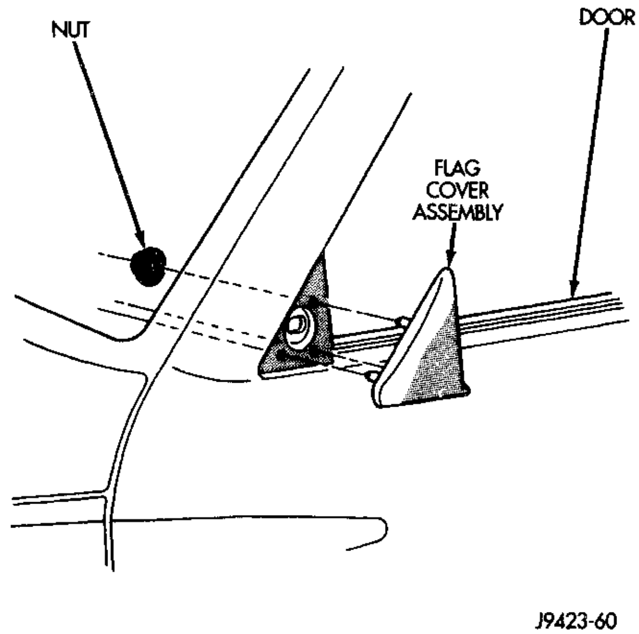

Fig. 22 Mirror Flag Cover

LOW MOUNTED SIDE VIEW MIRROR

REMOVAL

(1) Remove bolts holding lower support legs to outer door panel.
(2) Remove bolts holding upper support arms to outer door panel (Fig. 23).
(3) Separate mirror from vehicle.

INSTALLATION

Place insulation washers between support frame and painted door panel and reverse the preceding operation.

FRONT DOOR TRIM PANEL

REMOVAL

(1) Release door latch and open door.
(2) Roll window down.
(3) Remove window crank (Fig. 24), if equipped.
(4) Remove screws holding door trim panel to door from inside arm rest pull cup (Fig. 25).
(5) Disengage clips holding power window/lock switch panel to door trim panel (Fig. 26). Disengage wire connectors from switch panel, if equipped.
(6) Remove screw holding door trim to outside mirror frame.
(7) Using a trim panel removal tool, disengage clips holding door trim to door around perimeter of trim panel.
(8) Disengage power mirror wire connector, if equipped.

AUTHENTIC RESTORATION PRODUCT

REMOVAL AND INSTALLATION (Continued)

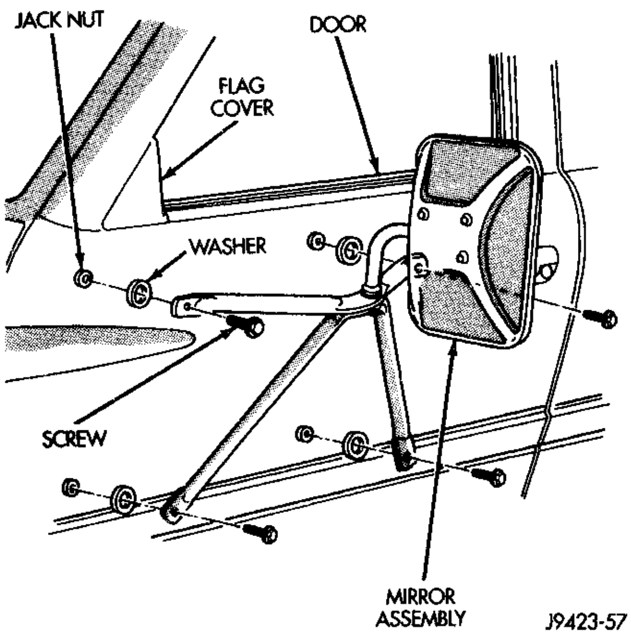

Fig. 23 Low Mounted Side View Mirror

(9) While holding bottom of trim panel away from door, simultaneously lift upward and forward.

(10) Separate door trim panel from inner belt weatherstrip.

(11) Disengage power outside mirror wire connector from control switch.

(12) Separate door trim panel from vehicle.

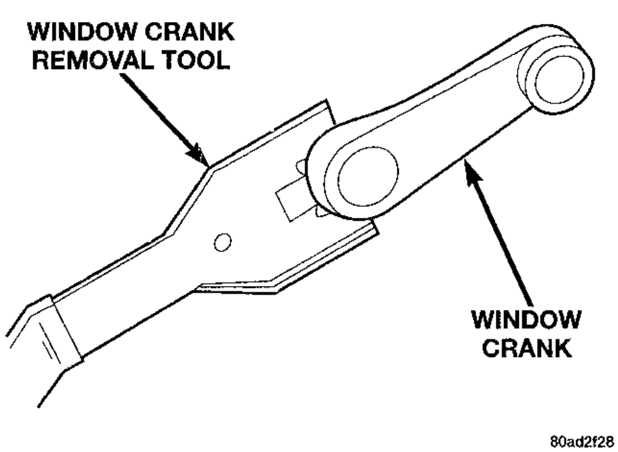

Fig. 24 Window Crank—Typical

INSTALLATION

Reverse the preceding operation.

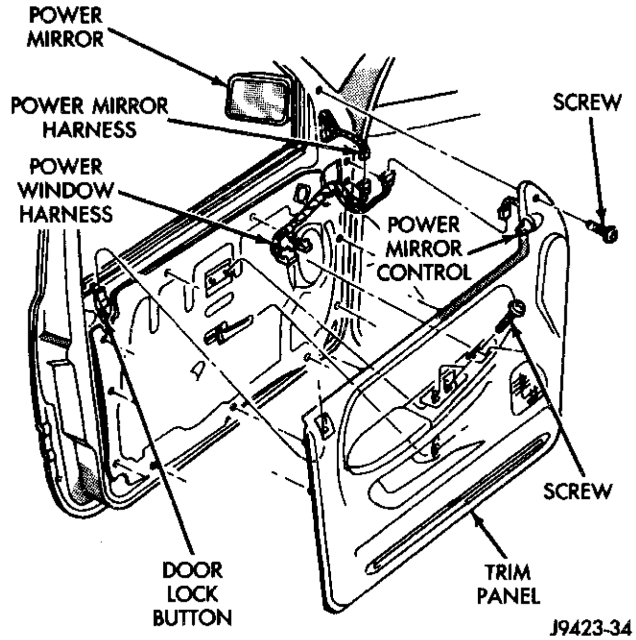

Fig. 25 Door Trim Panel

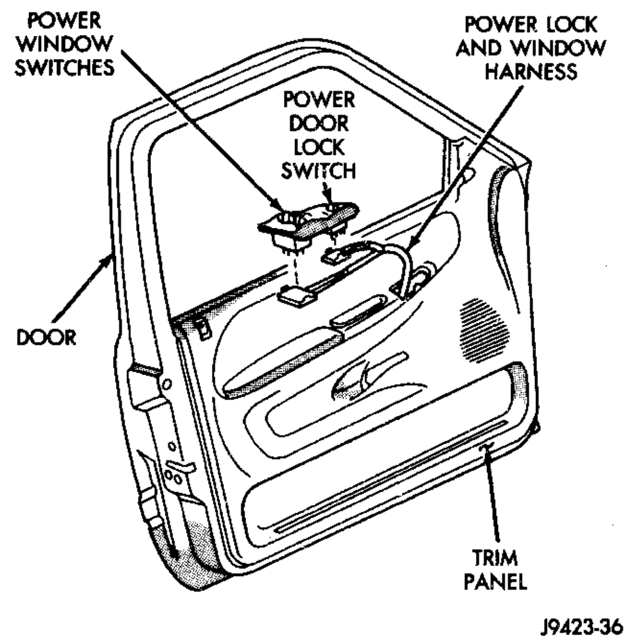

Fig. 26 Power Window/Lock Switch Panel

FRONT DOOR WATER DAM

REMOVAL

(1) Remove door trim panel.

(2) Peel water dam away from adhesive around perimeter of inner door panel (Fig. 27).

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REMOVAL AND INSTALLATION (Continued)

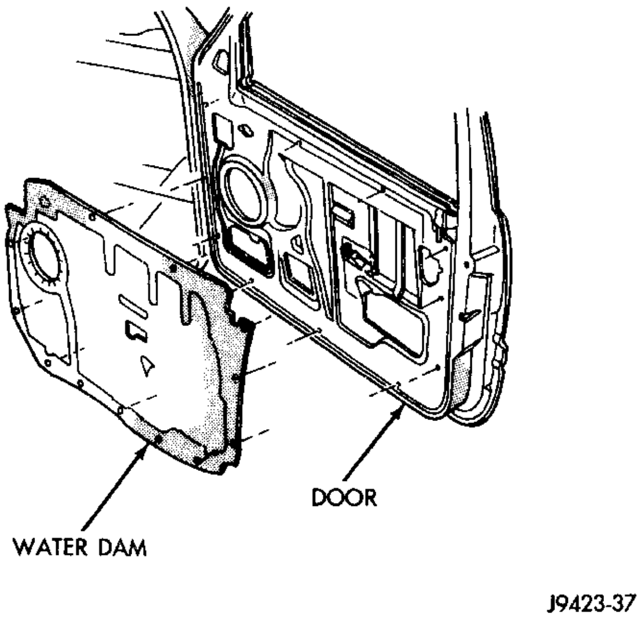

Fig. 27 Door Water Dam

INSTALLATION

Reverse the preceding operation.

FRONT DOOR

REMOVAL

(1) Release door latch and open door.
(2) Remove cowl trim panel.
(3) Disengage door wire harness connector of instrument panel harness and push door harness through access hole in pillar.
(4) Remove hidden bolts attaching door hinge to hinge pillar from behind cowl panel (Fig. 28).
(5) Using a suitable marker, mark the outline of the door hinges on the hinge pillar to aid installation.
(6) Support door on a suitable lifting device.
(7) Remove bolts attaching lower door hinge to hinge pillar (Fig. 29).
(8) While attaching the door steady on lift, remove bolts attaching upper door hinge to hinge pillar.
(9) Separate door from vehicle.

INSTALLATION

(1) While holding door steady on lift, position door at A-pillar.
(2) Align hinges using reference marks.
(3) Install bolts attaching upper door hinge to hinge pillar.
(4) Install bolts attaching lower door hinge to hinge pillar (Fig. 29).
(5) Install hidden bolts attaching door hinge to hinge pillar from behind cowl panel (Fig. 28).

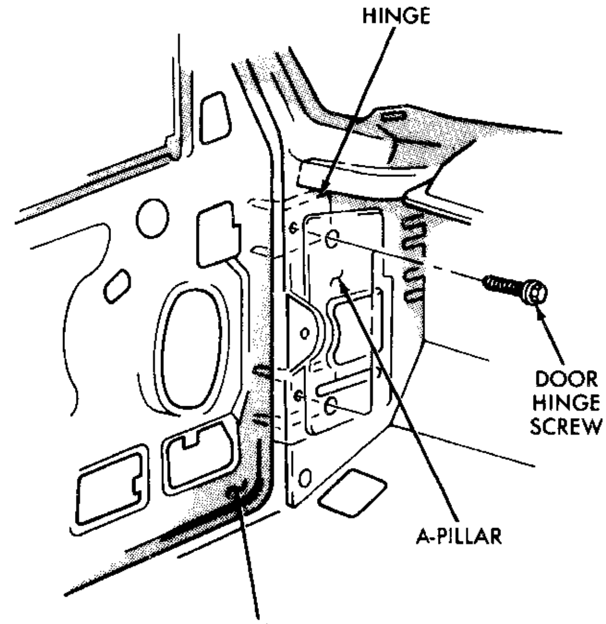

Fig. 28 Door Hinge Hidden Bolt

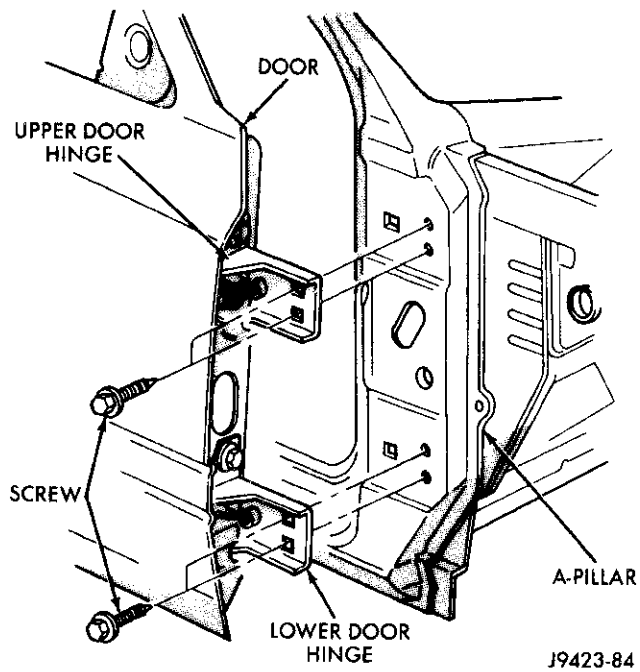

Fig. 29 Door

(6) Align door to achieve equal spacing on all sides and flush across the gaps.
(7) Tighten hinge bolts to 28 N·m (21 ft. lbs.) torque.
(8) Route harness through door and engage door wire harness connector.
(9) Install cowl trim panel.

REMOVAL AND INSTALLATION (Continued)

FRONT DOOR HINGE

REMOVAL

(1) Release door latch and open door.
(2) Remove cowl trim panel.
(3) Remove hidden bolt attaching door hinge to hinge pillar (Fig. 28).
(4) Support door on a suitable lifting device.
(5) Using a suitable marker, mark the outline of the door hinge on the hinge pillar to aid installation.
(6) Remove bolts attaching door hinge to hinge pillar (Fig. 29).
(7) Remove bolts attaching door hinge to door end frame (Fig. 30).
(8) Separate door hinge from vehicle.

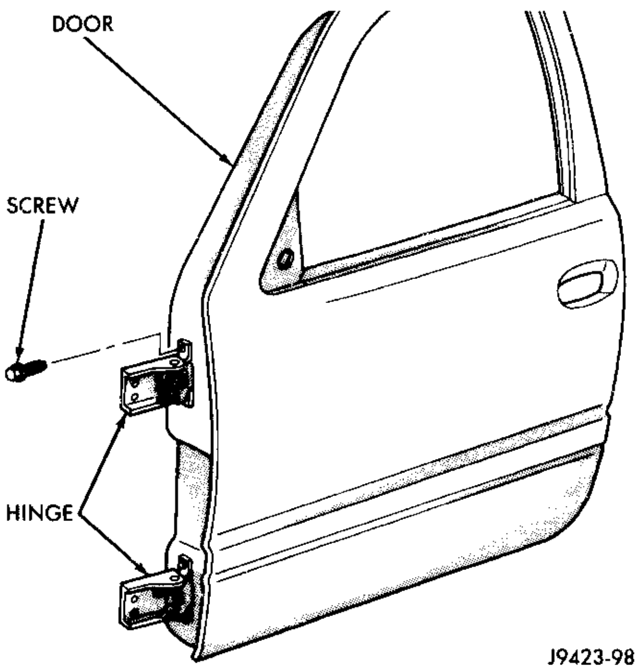

Fig. 30 Door Hinge

INSTALLATION

(1) If necessary, paint replacement door hinge before installation.
(2) Position hinge on door end frame.
(3) Align hinge using reference marks.
(4) Install bolts attaching door hinge to door end frame (Fig. 30).
(5) Install bolts attaching door hinge to hinge pillar (Fig. 29).
(6) Install hidden bolt attaching door hinge to hinge pillar (Fig. 28).
(7) Tighten hinge bolts to 28 N·m (21 ft. lbs.) torque.
(8) Remove support.
(9) Install cowl trim panel.

FRONT DOOR OUTSIDE HANDLE

REMOVAL

(1) Remove door trim panel.
(2) Remove water dam as necessary to gain access to door handle.
(3) Roll glass up.
(4) Remove fastener access plug from door end panel.
(5) Disengage clips holding latch and lock rods to door latch.
(6) Separate latch and lock rods from door latch.
(7) Remove nuts holding outside door handle retaining bracket to door handle (Fig. 31).
(8) Separate retaining bracket from door.
(9) Separate outside door handle from vehicle.

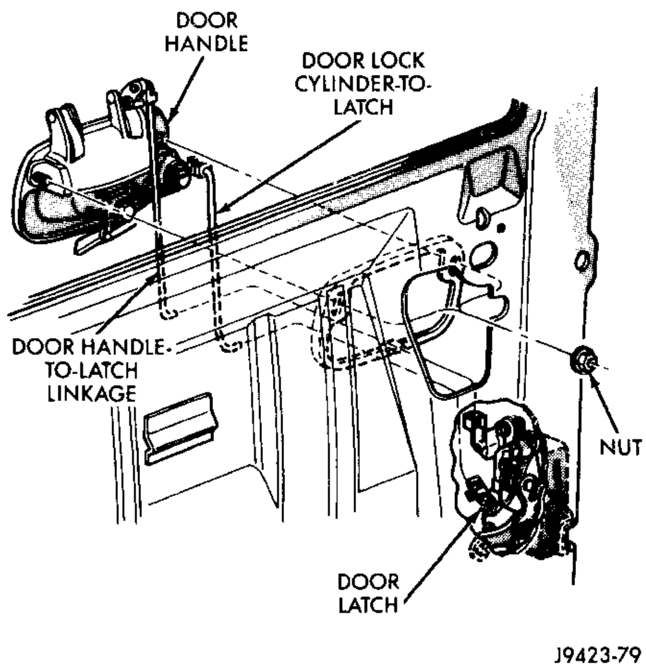

Fig. 31 Outside Door Handle

INSTALLATION

Reverse the preceding operation.

FRONT DOOR LOCK CYLINDER

REMOVAL

(1) Remove outside door handle.
(2) Remove clip holding lock cylinder to outside door handle (Fig. 32).
(3) Pull door lock from door handle.

INSTALLATION

Reverse the preceding operation.

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REMOVAL AND INSTALLATION (Continued)

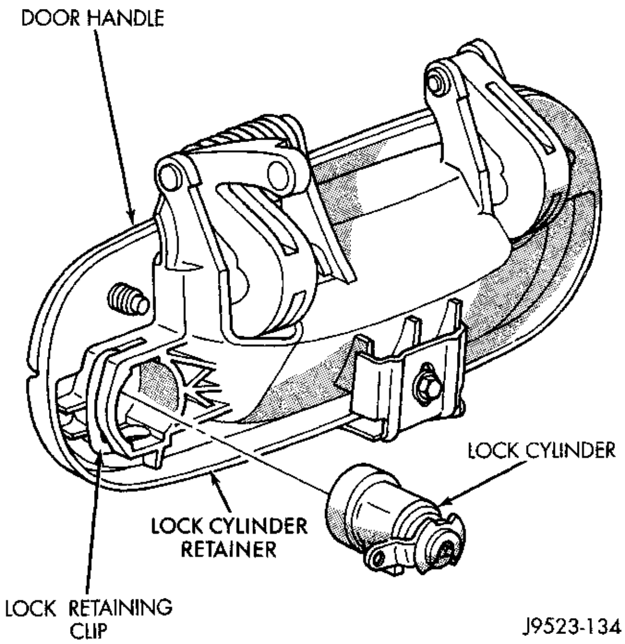

Fig. 32 Door Lock Cylinder

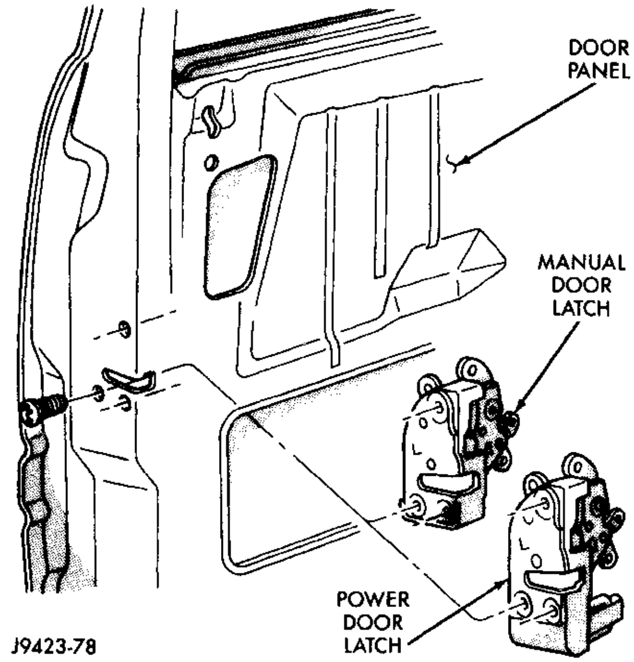

Fig. 33 Door Latch/Lock

FRONT DOOR LATCH

REMOVAL

(1) Remove door trim panel.
(2) Remove water dam.
(3) Disengage clips attaching lock and latch rods to door latch.
(4) Remove screws attaching door latch to door end panel (Fig. 33).
(5) Separate door latch/lock from vehicle.

INSTALLATION

(1) Position door latch/lock in door.
(2) Install screws attaching door latch to door end panel (Fig. 33). Tighten screws to 11 N·m (8 ft. lbs.) torque.
(3) Engage clips attaching lock and latch rods to door latch.
(4) Install water dam.
(5) Install door trim panel.

FRONT DOOR LATCH STRIKER

REMOVAL

(1) Release door latch and open door.
(2) Mark outline of striker base on B-pillar to aid installation.
(3) Remove screws attaching striker to B-pillar (Fig. 34).
(4) Separate striker from vehicle.

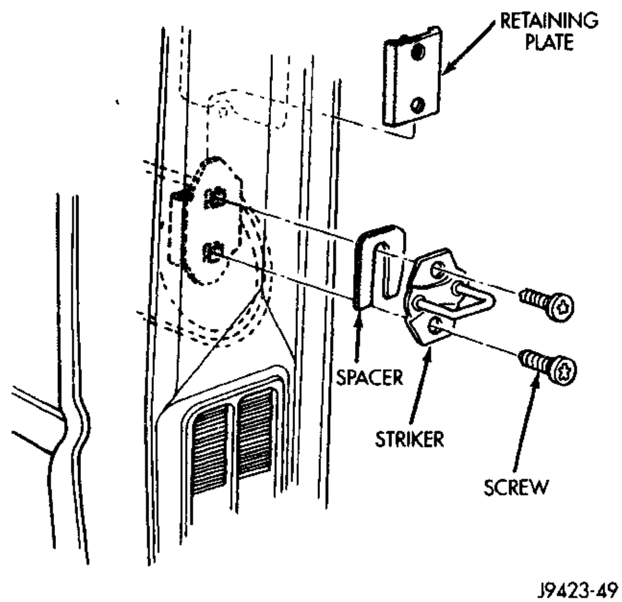

Fig. 34 Front Door Latch Striker

INSTALLATION

(1) Position striker on vehicle and align with reference marks.
(2) Install screws attaching striker to B-pillar. Tighten screws to 28 N·m (21 ft. lbs.) torque. (Fig. 34).

REMOVAL AND INSTALLATION (Continued)

FRONT DOOR INSIDE HANDLE ACTUATOR

REMOVAL

(1) Raise the window to the closed position.
(2) Remove the door trim panel and water dam.
(3) Remove the screws attaching the actuator to the door.

INSTALLATION

(1) Install the screws attaching the actuator to the door.
(2) Test handle for proper operation.
(3) Install the door water dam and trim panel.

FRONT DOOR INNER BELT WEATHERSTRIP

REMOVAL

(1) Remove door trim panel.
(2) Lift inner door belt weatherstrip upward (Fig. 35).
(3) Separate inner door belt weatherstrip from door.

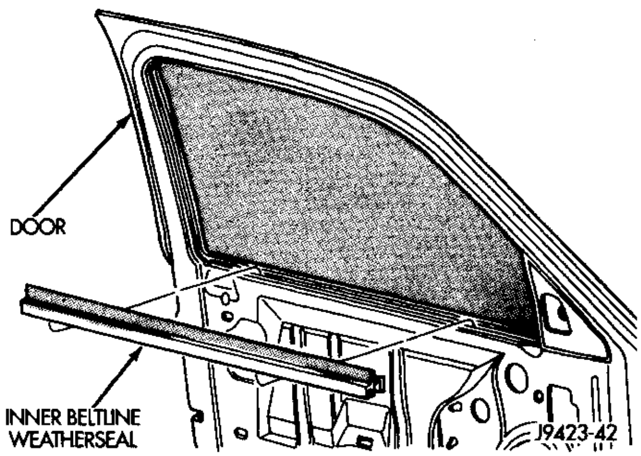

Fig. 35 Inner Door Belt Weatherstrip

INSTALLATION

Reverse the preceding operation.

FRONT DOOR OUTER BELT WEATHERSTRIP

REMOVAL

(1) Roll door glass down.
(2) Remove mirror.
(3) Using a hook tool inserted into the end of the belt weatherstrip, lift upward.
(4) Separate outer door belt weatherstrip from vehicle (Fig. 36).

INSTALLATION

Reverse the preceding operation.

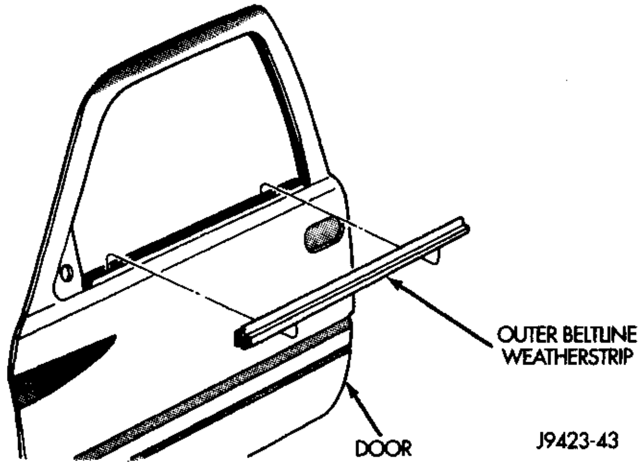

Fig. 36 Outer Door Belt Weatherstrip

FRONT DOOR GLASS

REMOVAL

(1) Remove door trim panel.
(2) Remove water dam as necessary to gain access to door glass lift plate.
(3) Remove inner door belt weatherstrip.
(4) Align door glass lift plate to access holes in inner door panel.
(5) Loosen bolts attaching front lower run channel to inner door panel.
(6) Remove nuts attaching door glass to lift plate (Fig. 37).
(7) Separate glass from lift plate.
(8) Lift glass upward and out of opening at top of door.

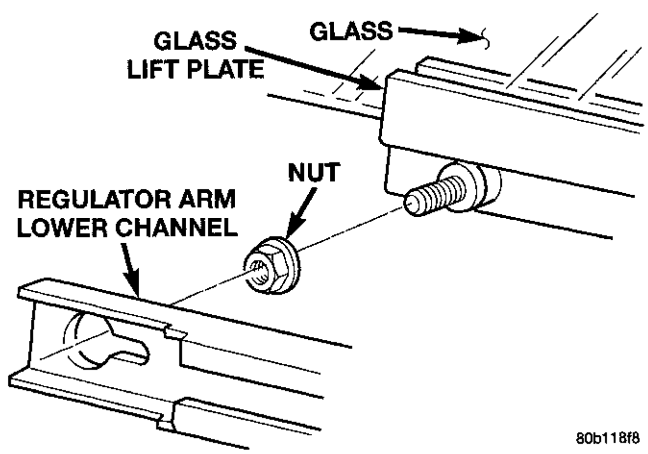

Fig. 37 Door Glass

INSTALLATION

(1) Position in door.
(2) Insert glass in lift plate.

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REMOVAL AND INSTALLATION (Continued)

CAUTION: Do not exceed 11 N·m (8 ft. lbs.) torque when tightening the nuts that attach the glass to the lift plate.

(3) Install nuts attaching glass to lift plate (Fig. 37). Tighten nuts to 9 N·m (7 ft. lbs.) torque.
(4) Tighten bolts attaching front lower run channel to inner door panel.
(5) Install inner door belt weatherstrip.
(6) Install water dam.
(7) Install door trim panel.

FRONT DOOR WINDOW REGULATOR

REMOVAL

(1) Remove door trim panel.
(2) Remove water dam.
(3) Remove nuts attaching door glass to window regulator.
(4) Remove glass from door or move glass to full up position and secure glass to door with tape.
(5) Disengage power window motor wire connector from door harness, if equipped.
(6) Remove bolts attaching window regulator to inner door panel.
(7) Separate window regulator from door panel (Fig. 38).
(8) Extract window regulator through access hole in inner door panel.

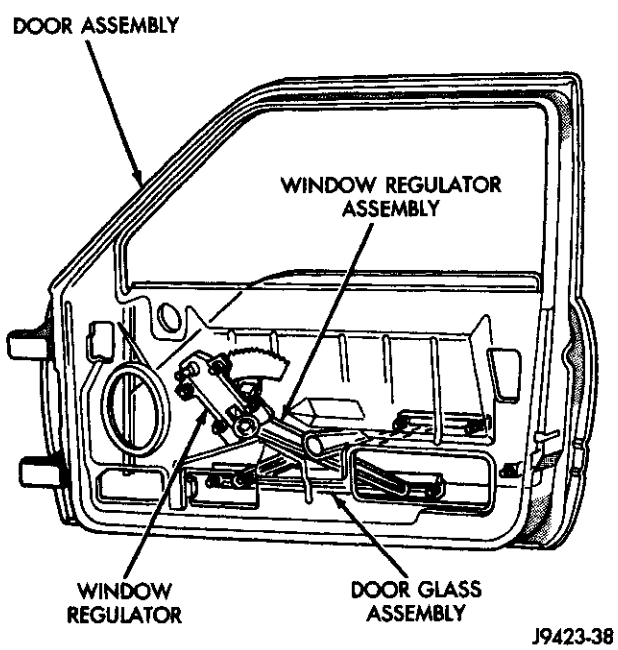

Fig. 38 Door Glass Window Regulator

INSTALLATION

(1) Position window regulator in door through access hole.
(2) Install bolts attaching window regulator to inner door panel.
(3) Engage power window motor wire connector to door harness, if equipped.
(4) Install glass in lift plate.
(5) Install water dam.
(6) Install door trim panel.

FRONT DOOR GLASS RUN LOWER CHANNELS

REMOVAL

(1) Remove door trim panel and waterdam.
(2) Roll door glass up.
(3) Remove bolts holding run channel to inner door panel (Fig. 39) and (Fig. 40).
(4) Slide channel downward to disengage it from the upper glass frame.
(5) Separate door glass run channel from door.

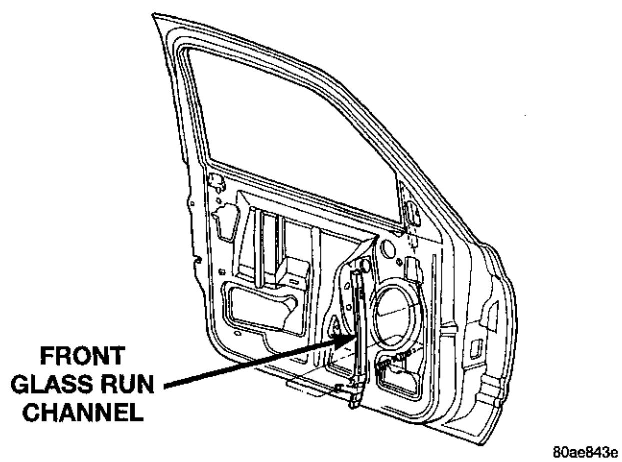

Fig. 39 Front Glass Run Lower Channel

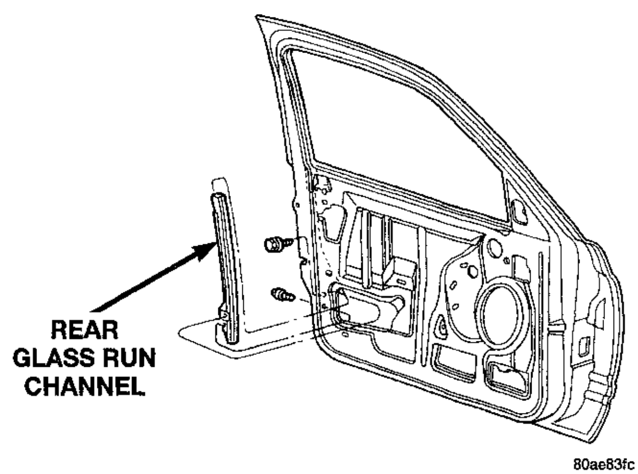

Fig. 40 Rear Glass Run Lower Channel

INSTALLATION

(1) Position door glass run channels on inner door panel.

REMOVAL AND INSTALLATION (Continued)

(2) Slide channel upward to engage it in the upper glass frame.
(3) Install bolts attaching run channels to inner door panel (Fig. 39) and (Fig. 40).
(4) Install door trim panel and waterdam.

FRONT DOOR GLASS RUN WEATHERSTRIP

REMOVAL

(1) Remove door trim panel.
(2) Remove inner door belt weatherstrip.
(3) Pull door glass run weatherstrip from channel around window opening (Fig. 41).

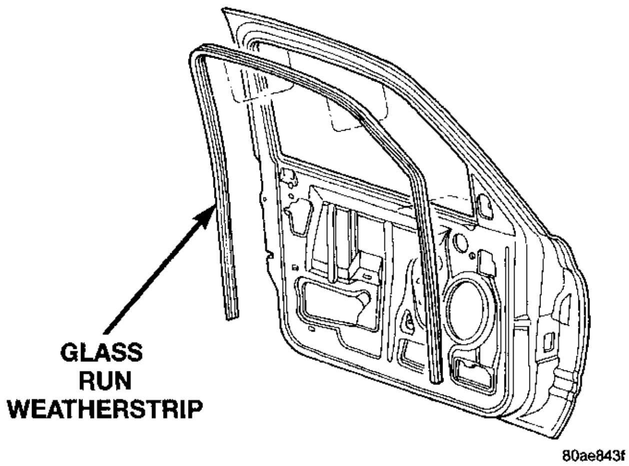

Fig. 41 Door Glass Run Weatherstrip

INSTALLATION

(1) Press door glass run weatherstrip into channel around window opening (Fig. 41).
(2) Install inner door belt weatherstrip.
(3) Install door trim panel.

DOOR OPENING SEAL

REMOVAL

(1) Remove A-pillar molding.
(2) Remove cowl panel and sill cover.
(3) Remove quarter trim panel, if equipped.
(4) Pull seal from pinch flange around door opening (Fig. 42) and (Fig. 43).

INSTALLATION

(1) Press seal onto pinch flange around door opening (Fig. 42).
(2) Connect the seal ends, if equipped.
(3) Install quarter trim panel, if equipped.
(4) Install cowl panel and sill cover.
(5) Install A-pillar molding.

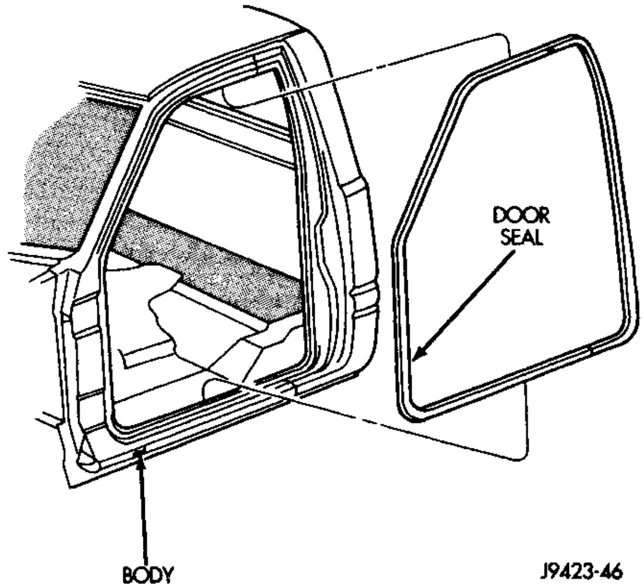

Fig. 42 Door Opening Seal—Club Cab

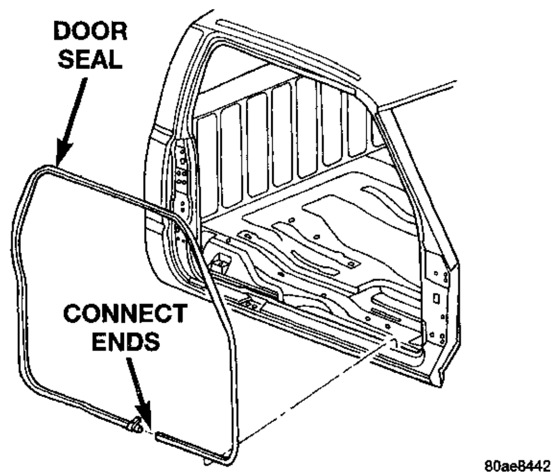

Fig. 43 Door Opening Seal—Quad Cab

B-PILLAR SECONDARY SEAL

REMOVAL

(1) Warm the seal and body metal to approximately 38°C (100°F) using a suitable heat lamp or heat gun.
(2) Pull seal from painted surface (Fig. 44).

INSTALLATION

(1) Remove adhesive tape residue from painted surface of vehicle.
(2) If seal is to be reused, remove tape residue from seal. Clean back of seal with MOPAR, Super

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REMOVAL AND INSTALLATION (Continued)

Kleen solvent or equivalent. Wipe seal dry with lint free cloth. Apply new body side moulding (two sided adhesive) tape to back of seal.

(3) Clean body surface with MOPAR, Super Kleen solvent or equivalent. Wipe surface dry with lint free cloth.

(4) Remove protective cover from tape on back of seal and apply seal to body.

(5) Heat body and seal, see step one. Firmly press seal to body surface to assure adhesion.

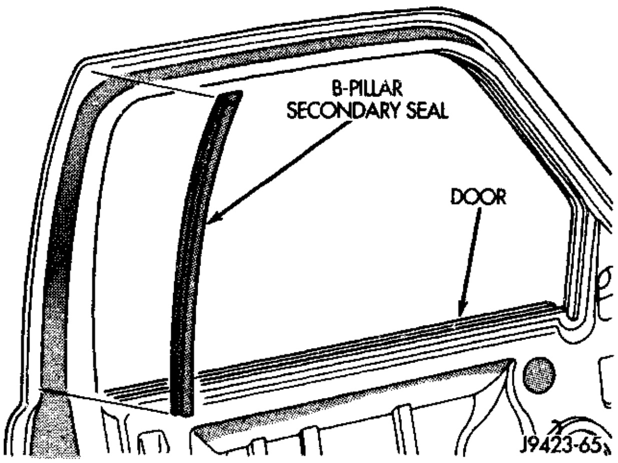

Fig. 44 B-Pillar Secondary Seal

FRONT DOOR SECONDARY SEAL

REMOVAL

(1) Remove the push-in fasteners attaching the secondary seal to the inner door panel.

(2) Separate the secondary seal from the inner door panel (Fig. 45).

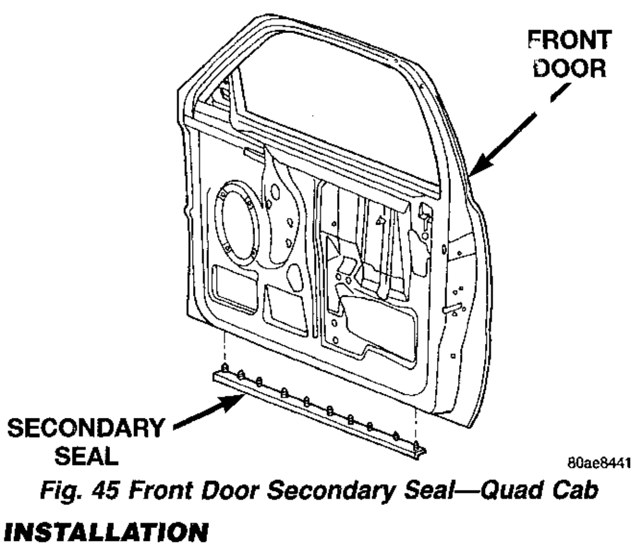

Fig. 45 Front Door Secondary Seal—Quad Cab

INSTALLATION

(1) Position the secondary seal on the inner door panel.

(2) Install the push-in fasteners attaching the secondary seal to the inner door panel.

FRONT DOOR UPPER CORNER SEAL

REMOVAL

(1) Remove the push-in fasteners attaching the upper corner seal to the front door (Fig. 46).

(2) Separate the upper corner seal from the door.

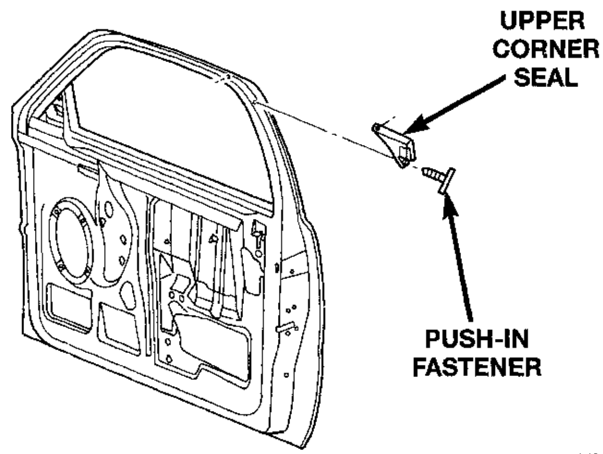

Fig. 46 Upper Corner Seal—Quad Cab

INSTALLATION

(1) Position the upper corner seal on the door.

(2) Install the push-in fasteners attaching the upper corner seal to the front door (Fig. 46).

CARGO DOOR TRIM PANEL

REMOVAL

(1) Remove the screws attaching the cargo door pull cup to the cargo door (Fig. 47).

(2) Remove the screw attaching the inside release handle to the cargo door.

NOTE: The cargo door trim panel is secured to the cargo door with spring clips and push-in fasteners (Fig. 48).

(3) Using a trim panel removal tool, remove the push-in fasteners attaching the trim panel to the cargo door.

(4) Pull the trim panel outward to disengage the spring clips.

(5) Separate the trim panel from the cargo door.

(6) Disengage the cargo door release cable from the inside release handle (Fig. 49).

INSTALLATION

(1) Engage the cargo door release cable to the inside release handle (Fig. 49).

(2) Position the trim panel on the cargo door.

(3) Align all fasteners and starting at the top of the panel, push into place to secure.

(4) Install the screw attaching the inside release handle to the cargo door.

REMOVAL AND INSTALLATION (Continued)

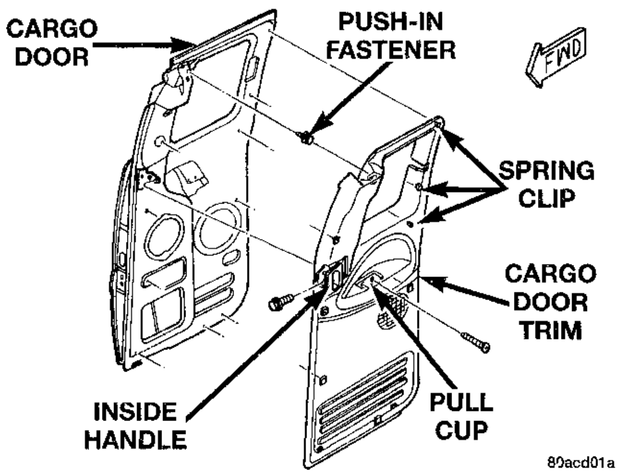

Fig. 47 Cargo Door Trim Panel

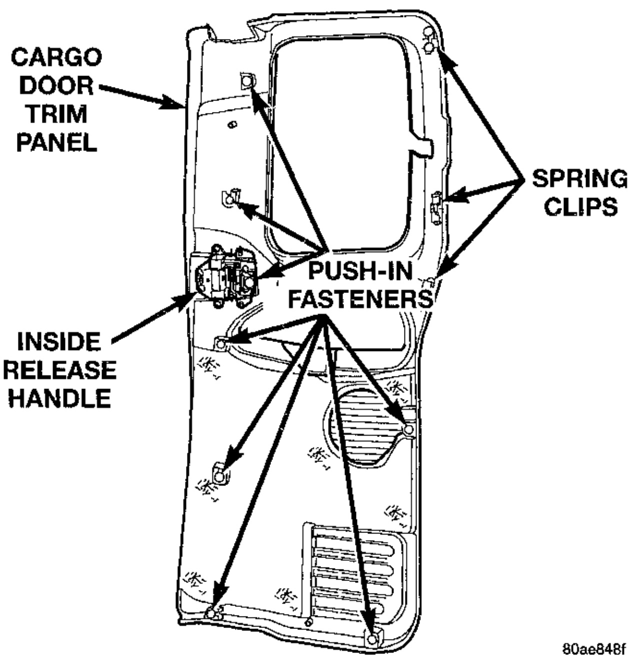

Fig. 48 Cargo Door Trim Panel Fasteners

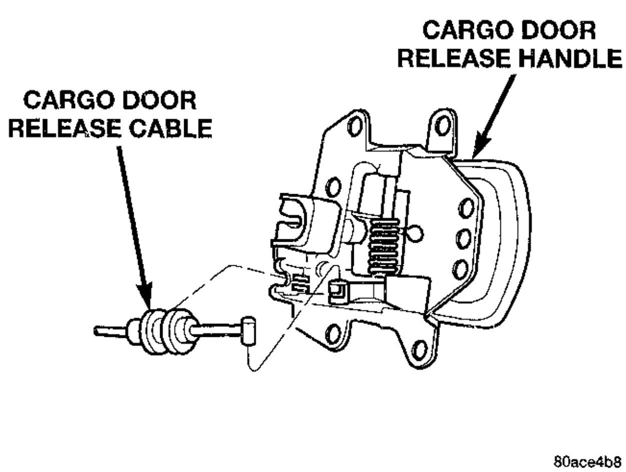

Fig. 49 Cargo Door Release Cable

(5) Install the screws attaching the cargo door pull cup to the cargo door (Fig. 47).

CARGO DOOR WATERDAM

REMOVAL

(1) Remove cargo door trim panel.
(2) Carefully peel waterdam from door (Fig. 50).

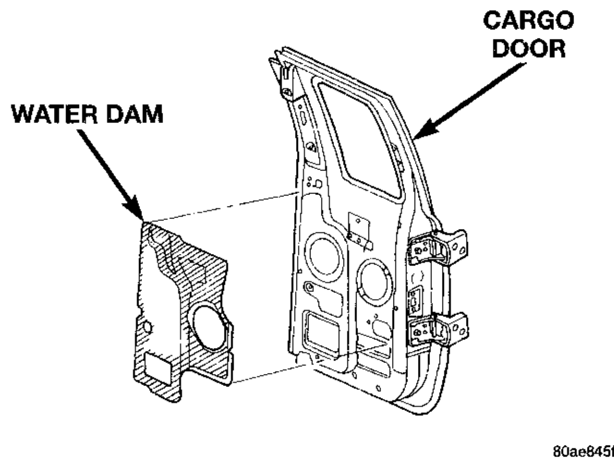

Fig. 50 Cargo Door Waterdam

INSTALLATION

If a replacement waterdam is being applied, clean cargo door inner panel with Mopar Super Clean or equivalent.

(1) Position waterdam on cargo door and press into place.
(2) install cargo door trim panel.

CARGO DOOR AIR EXHAUSTER

REMOVAL

(1) Remove cargo door trim panel.
(2) Peel back waterdam.
(3) Remove push-in fastener attaching air exhauster to cargo door inner panel (Fig. 51).
(4) Separate air exhauster from cargo door.

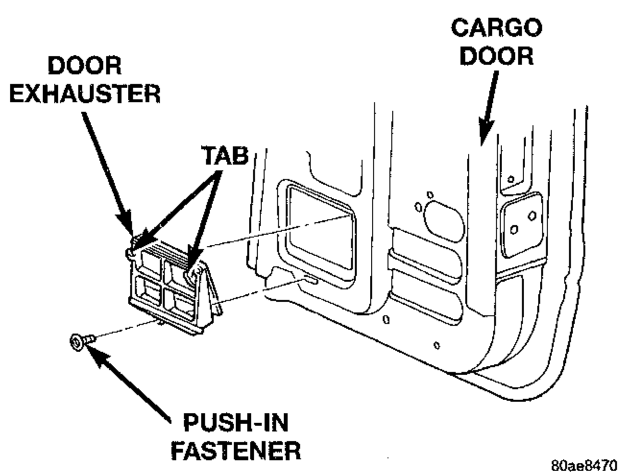

Fig. 51 Cargo Door Air Exhauster

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REMOVAL AND INSTALLATION (Continued)

INSTALLATION

(1) Position air exhauster in cargo door.
(2) Engage air exhauster upper tabs with cargo door inner panel.
(3) Install push-in fastener attaching air exhauster to cargo door inner panel (Fig. 51).
(4) Install waterdam.
(5) Install cargo door trim panel.

CARGO DOOR EXHAUST VENT

REMOVAL

(1) Using a trim stick, carefully pry bottom of vent to disengage from door (Fig. 52).
(2) Separate vent from door.

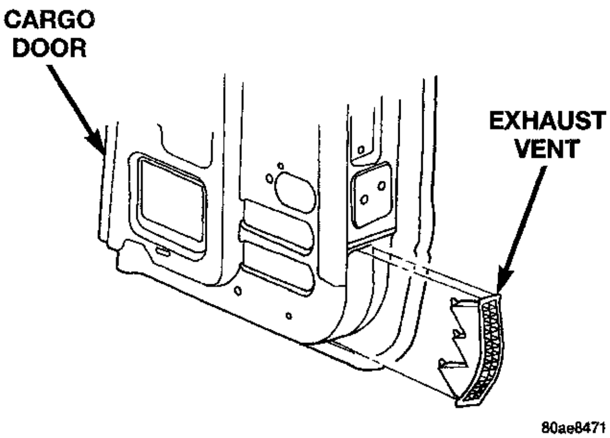

Fig. 52 Cargo Door Exhaust Vent

INSTALLATION

(1) Position upper side of vent in door opening.
(2) Slide upward until tabs on top edge are in place.
(3) Push the lower side of the vent towards the door until the tabs snap into place.
(4) Ensure vent is fully seated.

CARGO DOOR

REMOVAL

(1) Using a grease pencil or equivalent, mark the position of the hinge on the door.
(2) Remove the cargo door trim panel.
(3) Remove the cargo door check strap from the cab C-pillar.
(4) Using the access hole in the cargo door inner panel, disengage the speaker wire from the speaker and route the wire through the door.
(5) Support the cargo door on a suitable device.
(6) Remove the bolts attaching the hinges to the cargo door (Fig. 53).

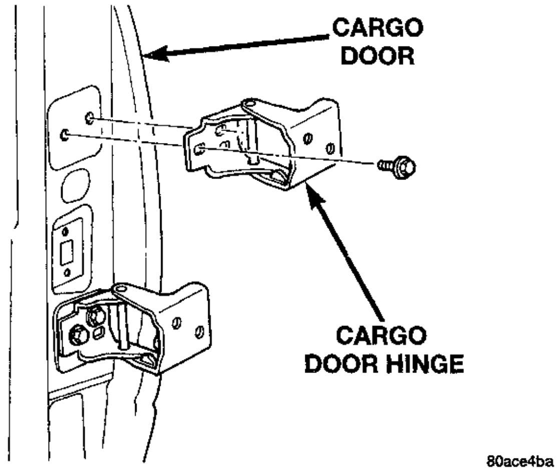

Fig. 53 Cargo Door

INSTALLATION

(1) Support the cargo door on a suitable device.
(2) Using the alignment marks, position the door at the hinge.
(3) Install the bolts attaching the hinges to the cargo door (Fig. 53). Tighten the bolts to 28 N·m (21 ft. lbs.) torque.
(4) Route the speaker wire through the door and using the access hole in the cargo door inner panel, engage the speaker wire at the speaker.
(5) Install the cargo door check strap at the cab C-pillar.
(6) Install the cargo door trim panel.

CARGO DOOR HINGE

REMOVAL

(1) Remove cargo door.
(2) Remove rear seat.
(3) Remove quarter trim panel.
(4) Remove bolts attaching hinge to C-pillar (Fig. 54).
(5) Separate hinge from vehicle.

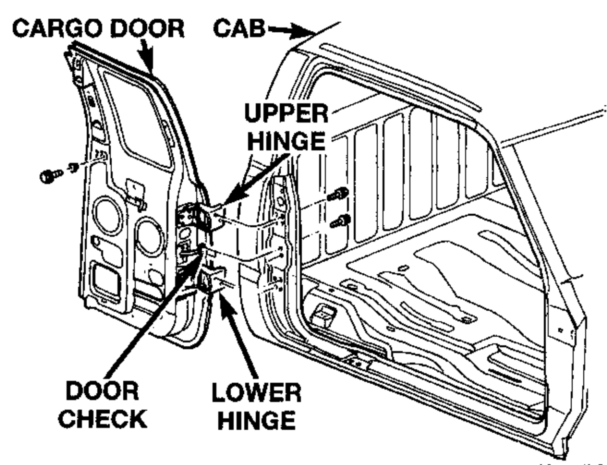

Fig. 54 Cargo Door Hinge

REMOVAL AND INSTALLATION (Continued)

INSTALLATION

(1) Position hinge on vehicle.

(2) Install bolts attaching hinge to C-pillar (Fig. 54). Tighten bolts to 28 N·m (21 ft. lbs.) torque.

(3) Install quarter trim panel.

(4) Install rear seat.

(5) Install cargo door.

CARGO DOOR DOOR CHECK

REMOVAL

(1) Remove cargo door trim panel.

(2) Remove the bolts attaching the door check to the cab C-pillar.

(3) Remove the nuts attaching the door check to the cargo door (Fig. 55).

(4) Remove the door check through the access hole in the cargo door.

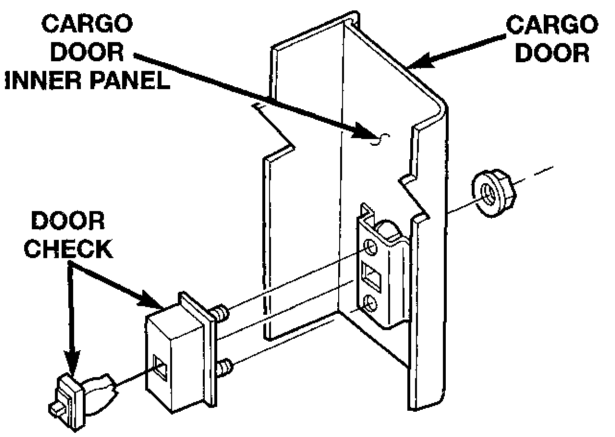

Fig. 55 Door Check

INSTALLATION

(1) Position the door check in the cargo door through the access hole.

(2) Install the nuts attaching the door check to the cargo door (Fig. 55).

(3) Install the bolts attaching the door check to the cab C-pillar.

(4) Install cargo door trim panel.

CARGO DOOR RELEASE CABLE

REMOVAL

(1) Remove cargo door trim panel.

(2) Disengage release cable from inside release handle (Fig. 56).

(3) Peel back waterdam

(4) Disengage release cable from shutface door handle (Fig. 57).

(5) Separate release cable from cargo door.

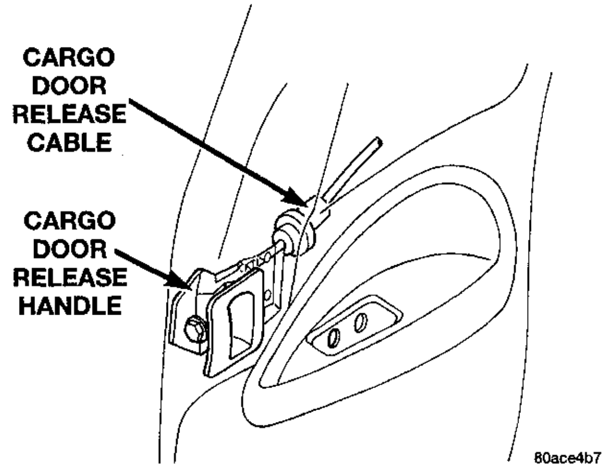

Fig. 56 Cargo Door Release Handle

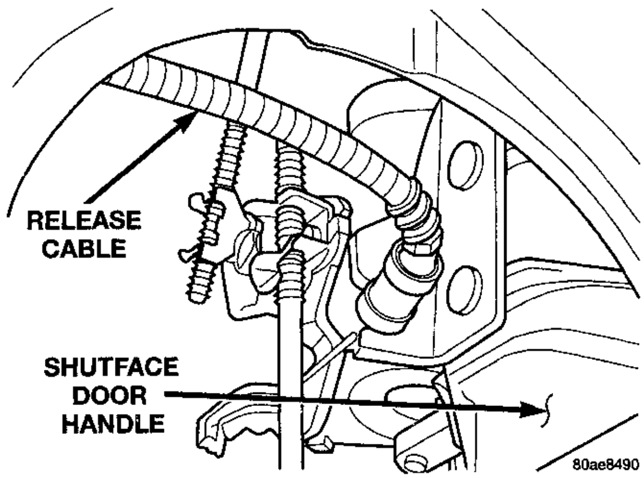

Fig. 57 Shutface Door Handle

INSTALLATION

(1) Position release cable in cargo door.

(2) Engage release cable to shutface door handle.

(3) Install waterdam

(4) Engage release cable to inside release handle.

(5) Install cargo door trim panel.

CARGO DOOR SHUTFACE HANDLE

REMOVAL

(1) Remove cargo door trim panel.

(2) Peel back waterdam.

(3) Disengage upper and lower latch release rods from shutface handle (Fig. 58).

(4) Disengage cargo door release cable.

(5) Remove screws attaching shutface handle to cargo door (Fig. 59).

(6) Separate handle from cargo door.

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REMOVAL AND INSTALLATION (Continued)

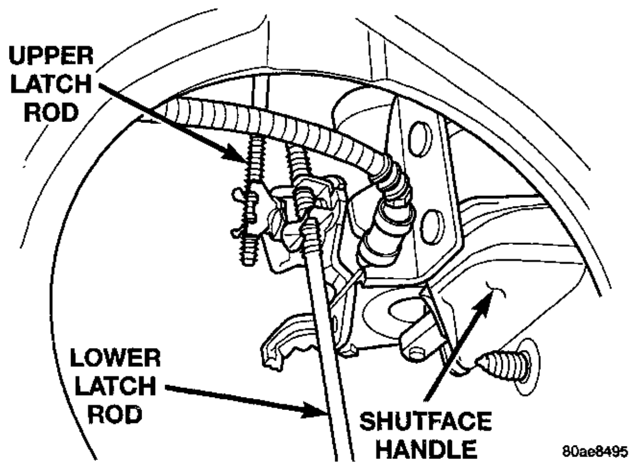

Fig. 58 Cargo Door Latch Rods

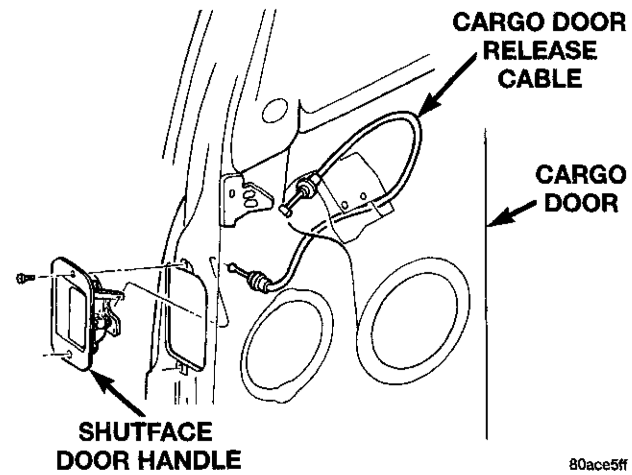

Fig. 59 Shutface Handle

INSTALLATION

(1) Position handle in cargo door.

(2) Install screws attaching shutface handle to cargo door (Fig. 59).

(3) Engage cargo door release cable.

CAUTION: When engaging upper and lower latch release rods to shutface handle, ensure the upper latch rod is pushed all the way up and the lower latch rod is pushed all the way down before engaging into the shutface handle.

(4) Engage upper and lower latch release rods to shutface handle.

(5) Cycle the shutface handle and verify operation.

(6) Install waterdam.

(7) Install cargo door trim panel.

CARGO DOOR UPPER LATCH

REMOVAL

(1) Remove cargo door trim panel.

(2) Using a grease pencil or equivalent, mark the position of the bolts.

(3) Disengage upper latch release rod from shutface handle.

(4) Remove the bolts attaching upper latch to cargo door (Fig. 60).

(5) Separate upper latch and latch rod from cargo door.

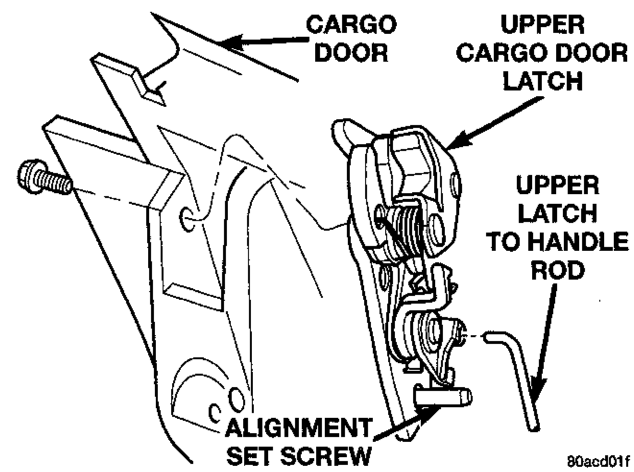

Fig. 60 Cargo Door Upper Latch

INSTALLATION

(1) The new replacement latch is supplied with an alignment set screw located in the lower mounting hole of the upper cargo door latch. If a new is latch is being installed, use the following procedure:

(a) Verify alignment set screw is fully seated in latch.

(b) Engage latch rod to latch.

(c) Position latch in cargo door with alignment set screw located in the lower hole.

(d) Align bolt with reference mark.

(e) Install upper bolt. Tighten bolt to 23 N·m (17 ft. lbs.) torque.

(f) Engage latch rod to shutface handle.

(g) Remove alignment set screw from lower hole.

(h) Align lower bolt with reference mark.

(i) Install bolt in lower hole. Tighten bolt to 23 N·m (17 ft. lbs.) torque.

CAUTION: When engaging upper latch release rod to shutface handle, ensure the latch rod is pushed all the way up before engaging into the shutface handle.

REMOVAL AND INSTALLATION (Continued)

(2) If the latch was not replaced and the existing latch is to be installed:

(a) Engage latch rod to latch.

(b) Position upper latch and latch rod in cargo door.

(c) Align bolts with reference marks.

(d) Install the bolts attaching upper latch to cargo door (Fig. 60). Tighten the bolts to 23 N·m (17 ft. lbs.) torque.

(e) Engage upper latch release rod to shutface handle.

(3) Cycle the shutface handle and verify latch operation.

(4) Install cargo door trim panel.

CARGO DOOR LOWER LATCH

REMOVAL

(1) Remove cargo door trim panel.

(2) Peel back waterdam to access air exhauster.

(3) Remove cargo door air exhauster.

(4) Disengage lower latch to shutface handle rod at shutface handle (Fig. 61).

(5) Remove nuts attaching lower latch to cargo door.

(6) Separate lower latch and latch rod from cargo door.

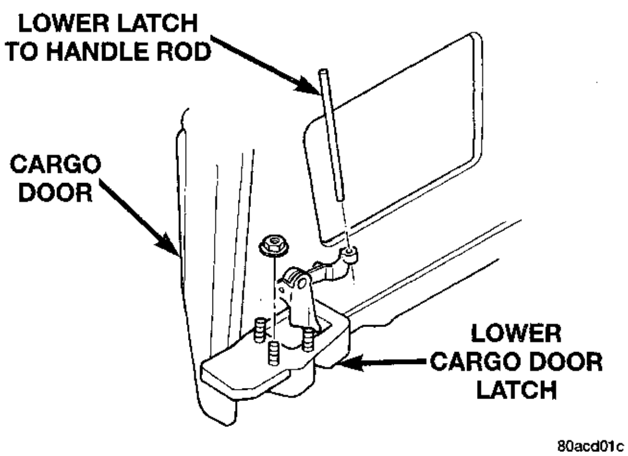

Fig. 61 Cargo Door Lower Latch

INSTALLATION

(1) If installing a new replacement latch:

(a) Engage latch rod to latch rod retaining clip in lower latch. Ensure "white" latch installation pin is in the position closest to the latch release lever (Fig. 62).

(2) If the latch was not replaced and the existing latch is to be installed:

(a) Slide "white" latch installation pin to the position closest to the latch release lever.

(3) Position lower latch and latch rod in cargo door.

(4) Install nuts attaching lower latch to cargo door. Tighten nuts to 12 N·m (9 ft. lbs.) torque (Fig. 61).

(5) Engage latch rod to latch rod retaining clip in lower latch.

CAUTION: When engaging lower latch release rod to shutface handle, ensure lower latch rod is pushed all the way down before engaging to the handle.

(6) Engage lower latch rod to shutface handle

(7) Cycle the shutface handle and verify latch operation.

(8) Install cargo door air exhauster.

(9) Install waterdam.

(10) Install cargo door trim panel.

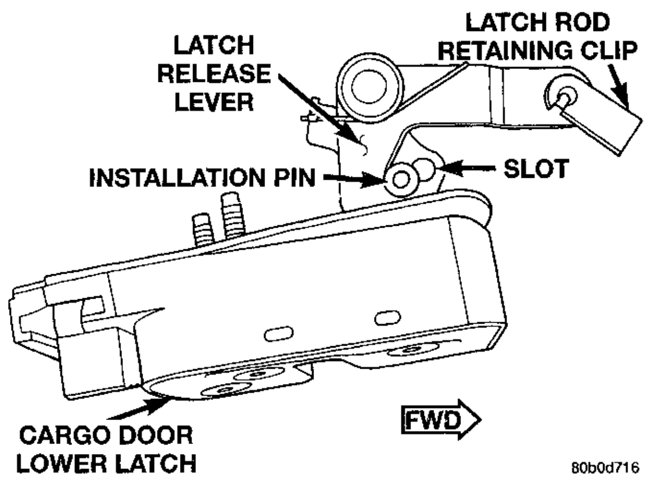

Fig. 62 Cargo Door Lower Latch Installation Pin

CARGO DOOR UPPER STRIKER

REMOVAL

(1) Remove screws attaching striker trim cover to roof.

(2) Remove bolts attaching striker to roof (Fig. 63).

(3) Separate upper striker from roof.

INSTALLATION

(1) Position upper striker on roof.

(2) Install bolts attaching striker to roof (Fig. 63). Tighten bolts to 23 N·m (17 ft. lbs.) torque.

(3) Install the screws attaching striker trim cover to roof.

CARGO DOOR LOWER STRIKER

REMOVAL

(1) Using a grease pencil or equivalent, mark the position of the lower striker on the sill.

(2) Remove the torx screws attaching the striker to the sill (Fig. 63).

(3) Separate striker from sill.

AUTHENTIC RESTORATION PRODUCT

REMOVAL AND INSTALLATION (Continued)

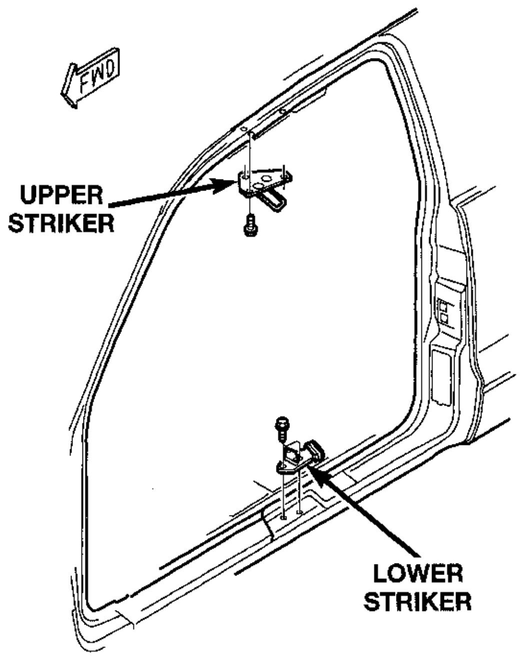

Fig. 63 Cargo Door Strikers

INSTALLATION

(1) Using the alignment marks, position striker on sill.

(2) Install the torx screws attaching the striker to the sill (Fig. 63). Tighten screws to 28 N·m (21 ft. lbs.) torque.

CARGO DOOR INSIDE HANDLE ACTUATOR

REMOVAL

NOTE: The cargo door inside handle actuator is heat staked to the trim panel (Fig. 64).

(1) Remove trim panel from cargo door.

(2) Disengage release cable from inside handle.

(3) Using a small file, drummel tool or die grinder, remove the melted material securing the handle to the trim panel.

(4) Separate the handle from the trim panel.

INSTALLATION

(1) Position the handle in the trim panel.

(2) Using a soldering gun, and using the additional studs, heat stake the handle to the trim panel.

(3) Engage release cable to inside handle.

(4) Install cargo door trim panel.

CARGO DOOR VENT WINDOW

REMOVAL

(1) Remove cargo door trim panel.

(2) Remove the screws attaching the latch to the cargo door (Fig. 65).

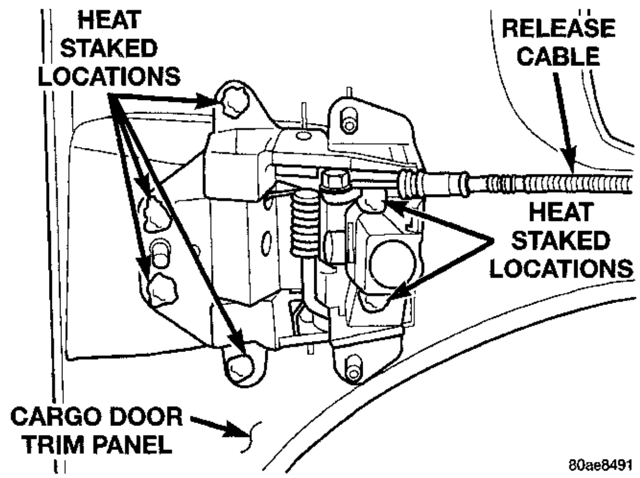

Fig. 64 Heat Staked Locations

(3) Remove the bolts attaching the vent glass to the cargo door (Fig. 66).

(4) Remove the glass from the door.

(5) If necessary, remove the latch from the glass.

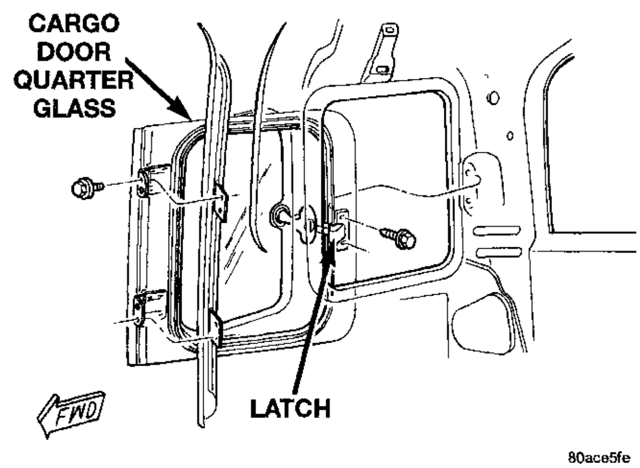

Fig. 65 Cargo Door Quarter Glass Vent Window Latch

INSTALLATION

(1) If removed, install the latch to the glass. Tighten the screw with 5 N·m (45 in. lbs.) torque.

(2) Center the glass in the cargo door opening.

(3) Install the bolts attaching the vent glass to the cargo door.

(4) Install the screws attaching the latch to the cargo door.

(5) Install cargo door trim panel.

CARGO DOOR VENT WINDOW WEATHERSTRIP

REMOVAL

(1) Remove the vent window.

(2) Peel the weatherstrip from the glass.

(3) Separate the weatherstrip from the cargo door.

AUTHENTIC RESTORATION PRODUCTS

REMOVAL AND INSTALLATION (Continued)

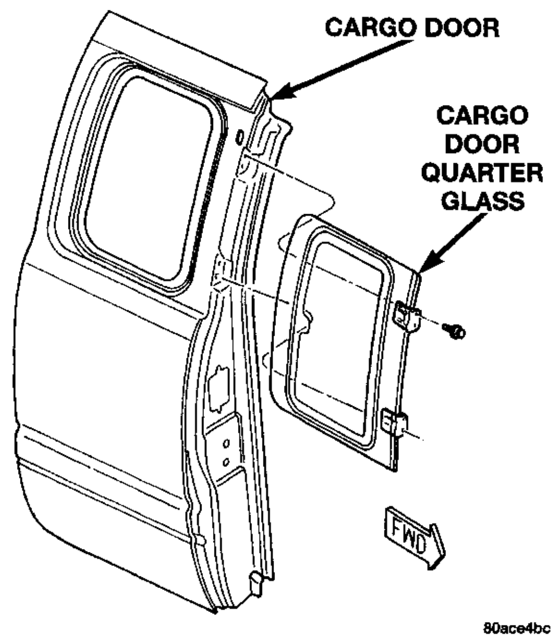

Fig. 66 Cargo Door Quarter Glass Vent Window

INSTALLATION

(1) Position the weatherstrip on the glass.
(2) Press the weatherstrip to seat.
(3) Install the vent window.

CARGO DOOR PRIMARY SEAL

REMOVAL

(1) Remove the push-in fasteners attaching the primary seal to the cargo door. (Fig. 67)
(2) Separate the seal from the door.

INSTALLATION

(1) Position the seal on the door.
(2) Install the push-in fasteners attaching the primary seal to the cargo door. (Fig. 67)

CARGO DOOR SECONDARY SEAL

REMOVAL

(1) Remove the push-in fasteners attaching the secondary seal to the inner cargo door panel.
(2) Separate the secondary seal from the inner cargo door panel (Fig. 68).

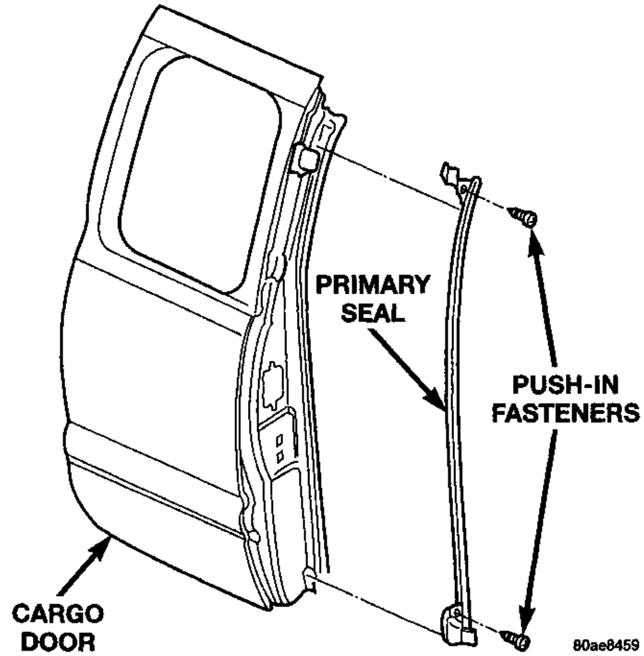

Fig. 67 Cargo Door Primary Seal

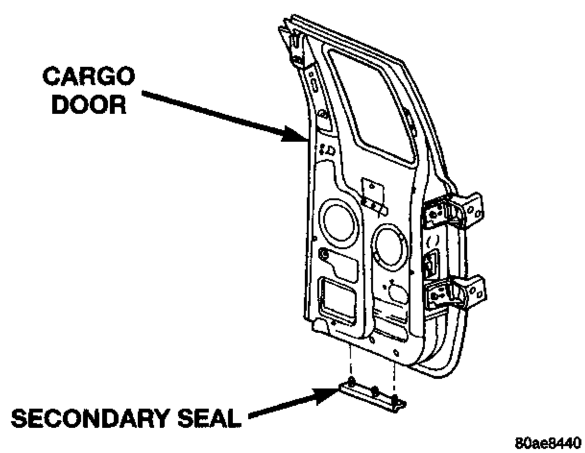

Fig. 68 Cargo Door Secondary Seal

INSTALATION

(1) Position the secondary seal on the inner cargo door panel.
(2) Install the push-in fasteners attaching the secondary seal to the inner cargo door panel.

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REMOVAL AND INSTALLATION (Continued)

ROOF RAIL WEATHERSTRIP AND RETAINER

REMOVAL

(1) Release door latch and open door(s).

(2) Starting from rearward end of weatherstrip, slide weatherstrip out of retainer (Fig. 69).

(3) Remove screws attaching retainer to roof rail (Fig. 70).

(4) Separate retainer from vehicle.

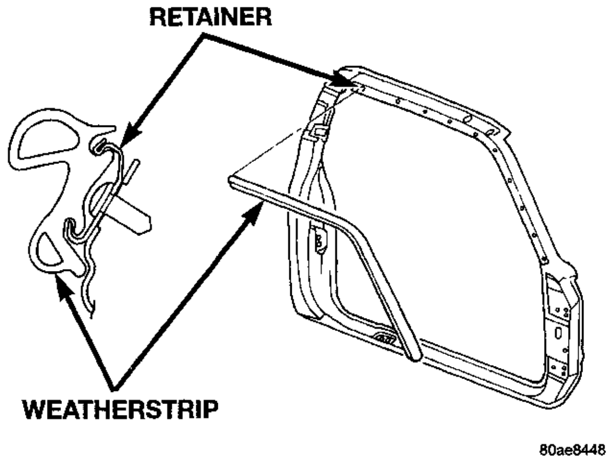

Fig. 69 Roof Rail Weatherstrip—Quad Cab

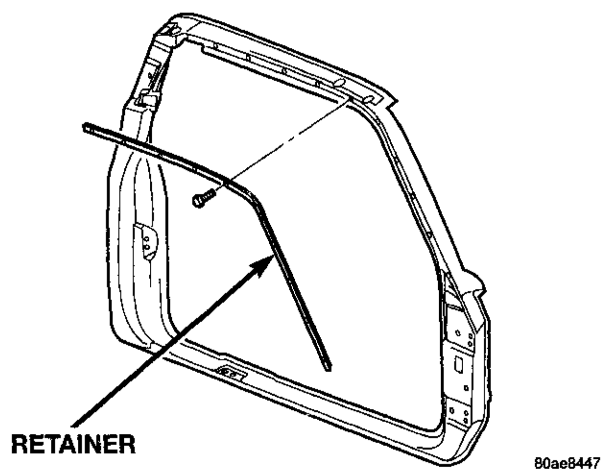

Fig. 70 Roof Rail Weatherstrip Retainer—Quad Cab

INSTALLATION

(1) If removed, install screws attaching retainer to roof rail (Fig. 70).

(2) Starting at the forward end of retainer and working rearward, slide weatherstrip into the retainer (Fig. 69).

(3) Peel the carrier from forward end of the weatherstrip and press to secure.

ROOF JOINT MOLDING

REMOVAL

(1) Warm the roof joint molding and roof panel to approximately 38°C (100°F) using a suitable heat lamp or heat gun.

(2) Pull molding from roof joint (Fig. 71), (Fig. 72) and (Fig. 73).

INSTALLATION

(1) Remove adhesive tape residue from roof joint.

(2) If molding is to be reused, remove tape residue from back of molding. Clean molding with MOPAR, Super Kleen solvent or equivalent. Wipe molding dry with lint free cloth. Apply new body side molding (two sided adhesive) tape to back of molding.

(3) Clean roof joint with MOPAR, Super Kleen solvent or equivalent. Wipe dry with lint free cloth.

(4) Remove protective cover from tape on back of molding and apply molding to roof joint.

(5) Heat roof and molding, see step one. Firmly press molding into roof joint to assure adhesion.

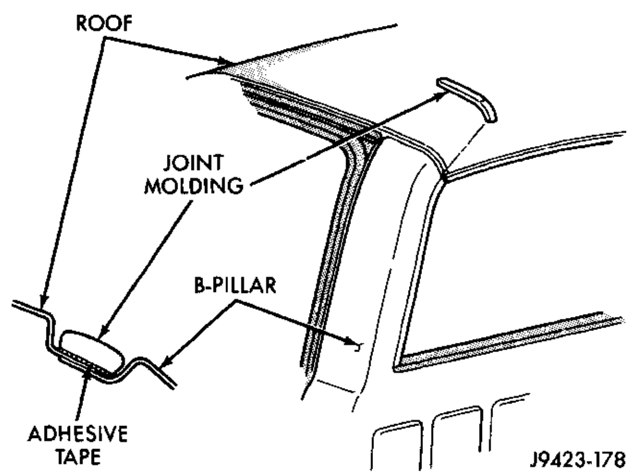

Fig. 71 Roof Joint Molding—Conventional Cab

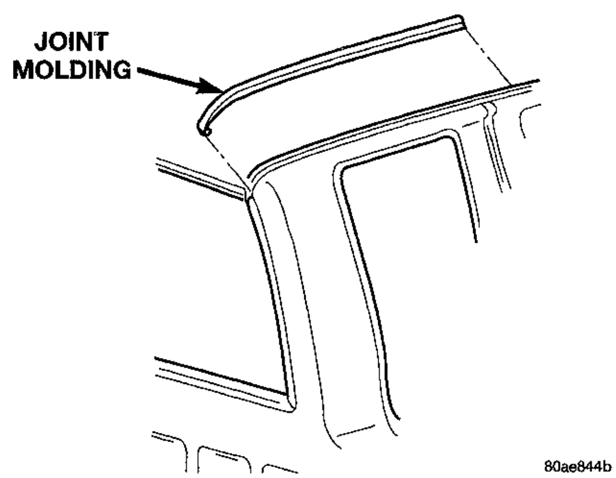

Fig. 72 Roof Joint Molding—Club Cab

AUTHENTIC RESTORATION

REMOVAL AND INSTALLATION (Continued)

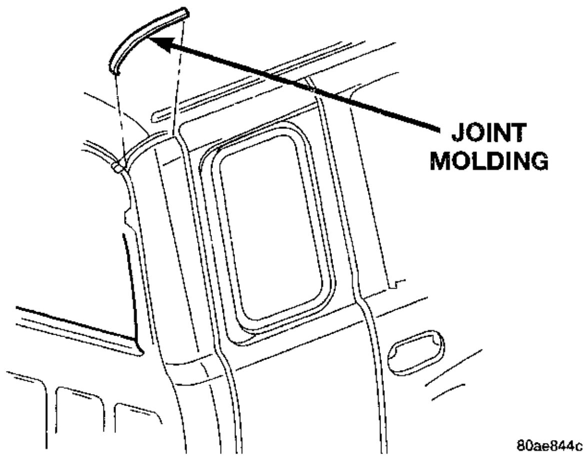

Fig. 73 Roof Joint Molding—Quad Cab

QUARTER VENT WINDOW—CLUB CAB

REMOVAL

(1) Remove quarter trim panel.
(2) Remove the latch retaining screws from the cab rear side panel (Fig. 74).
(3) Remove the frame/hinge retaining nuts from the B-pillar.
(4) Remove the window glass from the cab.
(5) If necessary, remove the latch from the glass.

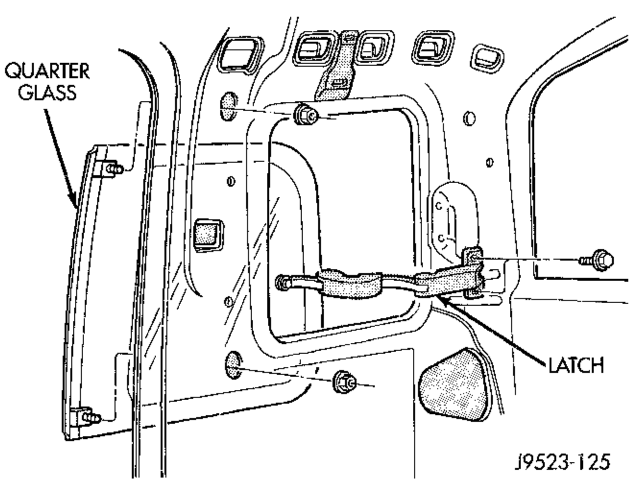

Fig. 74 Vent Window—Club Cab

INSTALLATION

(1) If removed, install the latch to the glass. Tighten the screw with 6 N·m (60 in. lbs.) torque.
(2) Center the window glass at the opening, insert the hinge studs in the B-pillar holes, and install the retaining nuts. Tighten the nuts with 11 N·m (95 in. lbs.) torque.
(3) Attach the latch to the rear side panel with the screws. Tighten the screws with the latch in the lock position and pushing rearward on the latch. Tighten the screws with 11 N·m (95 in. lbs.) torque.
(4) Test the vent window for water leaks.
(5) Install quarter trim panel.

QUARTER VENT WINDOW WEATHERSTRIP

REMOVAL

(1) Remove the window. If necessary, refer to the removal procedure.
(2) Pull the seal away from the flange around the perimeter of the window opening (Fig. 75).
(3) Clean the flange as necessary.

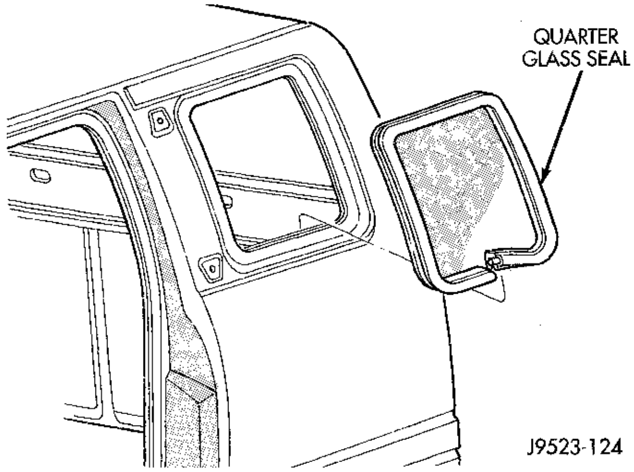

Fig. 75 Weatherstrip Seal Removal/Installation

INSTALLATION

(1) Center and butt the seal ends together at the bottom, centerline of the opening.
(2) Mate the seal with the bottom flange.
(3) Mate the seal with the front, vertical flange.
(4) Move upward and mate the seal with the top flange.
(5) Mate the seal with the rear, vertical flange.

BODY VENT

REMOVAL

(1) Release door latch and open door.
(2) Pull outward at top of vent to disengage clips holding vent to door jamb (Fig. 76).
(3) Separate vent from vehicle.

INSTALLATION

Reverse the preceding operation.

TAPE STRIPE

REMOVAL

(1) If the panel that is being serviced is not going to be refinished, apply a length of masking tape parallel to the edge of the original tape stripe to aid installation.
(2) Warm the panel to approximately 38°C (100°F) using a suitable heat lamp or heat gun.
(3) Peel tape stripe (Fig. 77) from body panel using an even pressure pull.

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REMOVAL AND INSTALLATION (Continued)

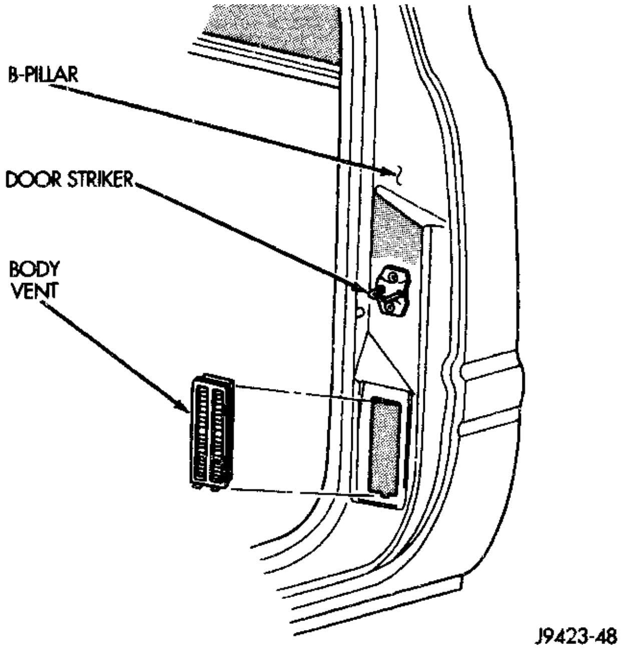

Fig. 76 Body Vent

(4) Remove adhesive residue from body panel using a suitable adhesive removing solvent.

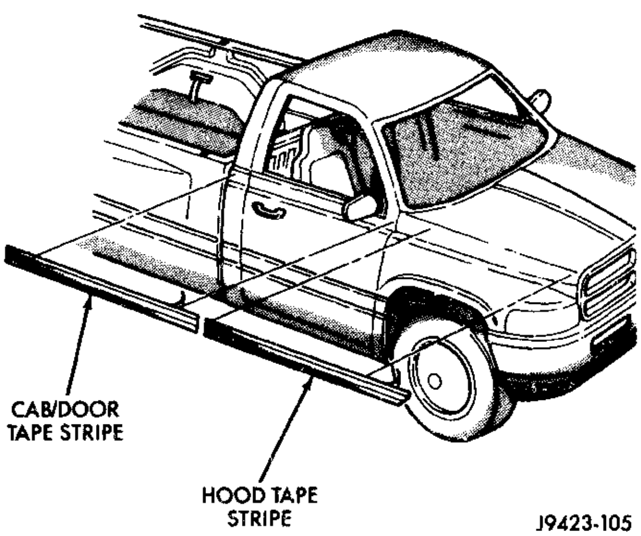

Fig. 77 Tape Stripe Overlay

INSTALLATION

The painted surface of the body panel to be covered by a tape stripe overlay must be smooth and completely cured before overlay can be applied. If painted surface is not smooth, wet sand with 600 grit wet/dry sand paper until surface is smooth. Ripples and feather edging will read through overlay if surface is not properly prepared. Clean all residue from surface.

Installation equipment:

- Pail filled with mild dish soap solution.
- Lint free applicator cloth or sponge.
- Body putty applicator squeegee.
- Heat gun or sun lamp.
- Razor knife.

(1) Spread replacement tape stripe overlay across a smooth flat work surface, finish side down.

(2) Peel paper backing away from overlay exposing adhesive back of overlay.

(3) Apply soap solution liberally to adhesive back of overlay.

(4) Apply soap solution liberally to body panel surface.

(5) Place overlay into position on body panel. Smooth out wrinkles by pulling lightly on edges of overlay until it lays flat on painted surface.

(6) Push air pockets from under overlay to the perimeter of the panel from the center of the overlay out.

(7) Squeegee soap solution and air bubbles from behind overlay from the center of the panel out using a body putty applicator squeegee (Fig. 78).

CAUTION: Do not cut into painted surface of body panel when trimming overlay to size.

(8) Trim overlay to size using a razor knife. Leave at least 13 mm (0.5 in.) for edges of doors and openings.

CAUTION: Do not overheat overlay when performing step 9.

(9) Apply heat to overlay to evaporate residual moisture from edges of overlay and to allow overlay to be stretched into concave surfaces.

(10) Edge turn overlay around doors or fenders.

(11) Install exterior trim if necessary.

(12) Small air or water bubbles under overlay can be pierced with a pin and smoothed out.

BODY SIDE MOLDINGS

REMOVAL

(1) Warm the effected stick-on molding and body metal to approximately 38°C (100°F) using a suitable heat lamp or heat gun.

(2) Pull stick-on molding from painted surface (Fig. 79), (Fig. 80) and (Fig. 81).

INSTALLATION

(1) Clean body surface with MOPAR Super Kleen solvent or equivalent. Wipe surface dry with lint free cloth.

REMOVAL AND INSTALLATION (Continued)

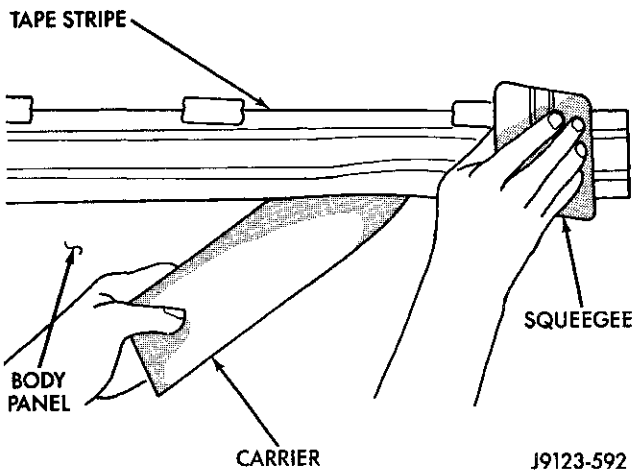

Fig. 78 Tape Stripe Application

(2) Apply a length of masking tape on the body, parallel to the top edge of the molding to use as a guide, if necessary.

(3) Remove protective cover from tape on back of molding. Apply molding to body below the masking tape guide.

(4) Remove masking tape guide and heat body and molding, see step one. Firmly press molding to body surface to assure adhesion.

FUEL FILL DOOR

REMOVAL

(1) Open fuel fill door.

(2) Remove bolts holding fuel fill door to cargo box quarter panel (Fig. 82).

(3) Separate fuel fill door from vehicle.

INSTALLATION

Reverse the preceding operation.

REAR SPLASH SHIELDS

REMOVAL

(1) Remove plastic rivets holding rear splash shield to rear wheel opening lip (Fig. 83).

(2) Remove plastic rivets holding rear splash shield to rear wheelhouse.

(3) Separate splash shield from vehicle.

INSTALLATION

(1) Position splash shield in wheelhouse opening.

(2) Install plastic rivets holding rear splash shield to rear wheelhouse.

(3) Install plastic rivets holding rear splash shield to rear wheel opening lip.

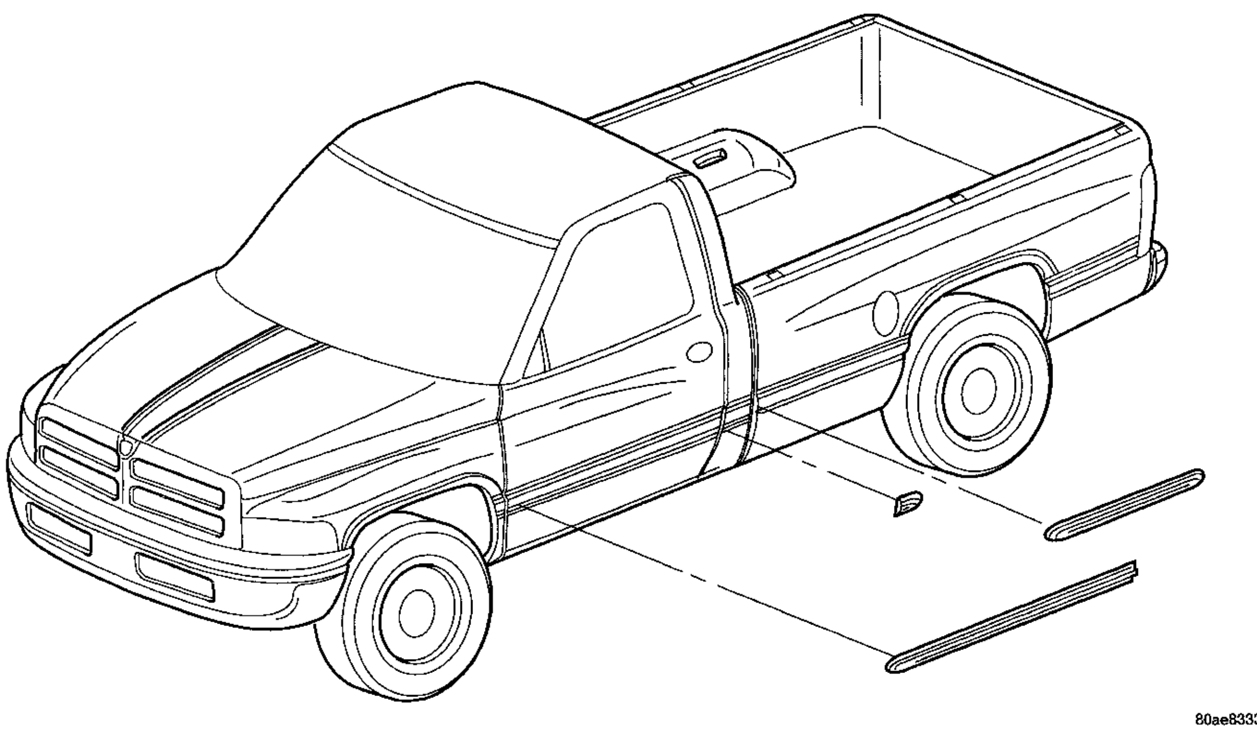

Fig. 79 Body Side Moldings—Conventional Cab

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REMOVAL AND INSTALLATION (Continued)

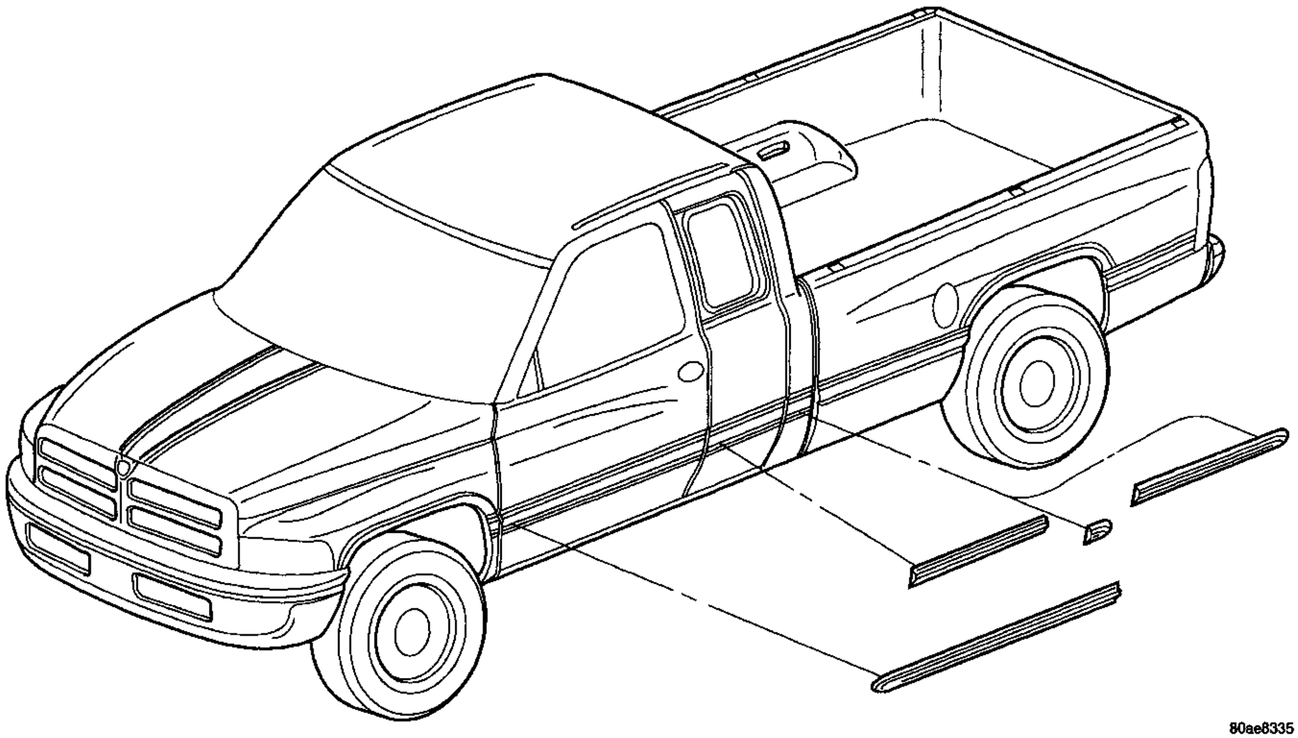

Fig. 80 Body Side Moldings—Club/Quad Cab

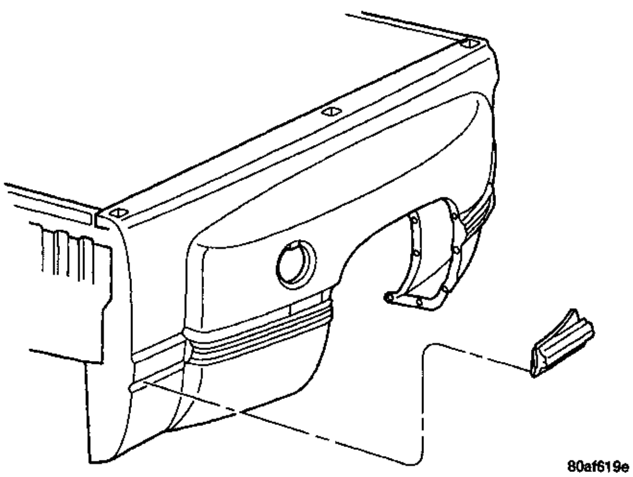

Fig. 81 Body Side Moldings—Dual Wheel

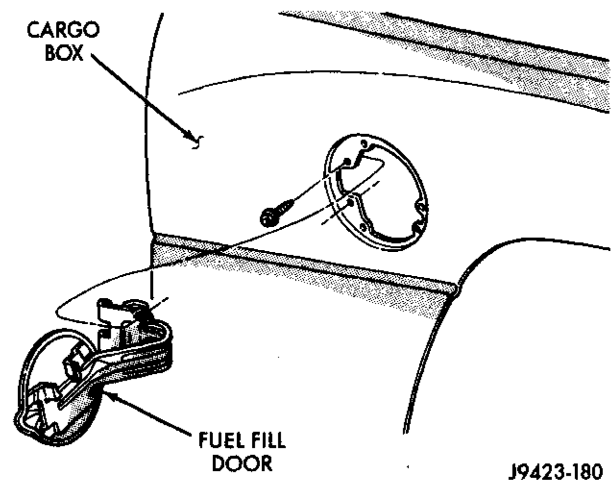

Fig. 82 Fuel Fill Door

REAR WHEELHOUSE LINER

REMOVAL

(1) Remove plastic rivets holding rear wheelhouse liner to rear wheel opening lip (Fig. 84).

(2) Remove plastic rivets holding rear wheelhouse liner to rear wheelhouse.

(3) Separate rear wheelhouse liner form vehicle.

INSTALLATION

(1) Position rear wheelhouse liner in wheelhouse opening.

(2) Install plastic rivets holding rear wheelhouse liner to rear wheelhouse.

(3) Install plastic rivets holding rear wheelhouse liner to rear wheel opening lip.

REMOVAL AND INSTALLATION (Continued)

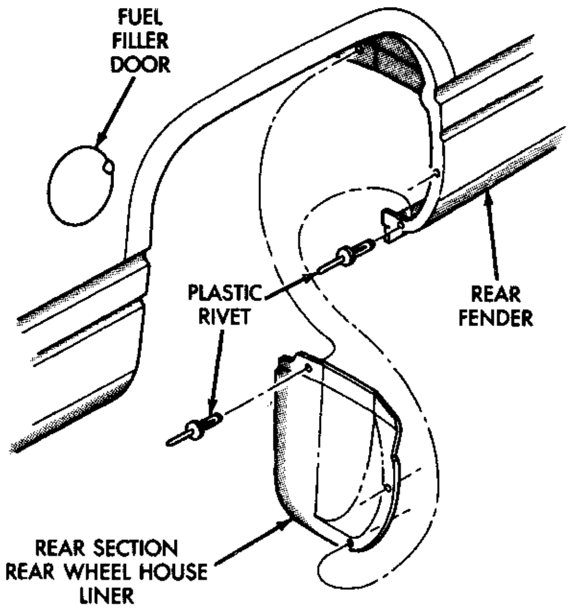

Fig. 83 Rear Splash Shields

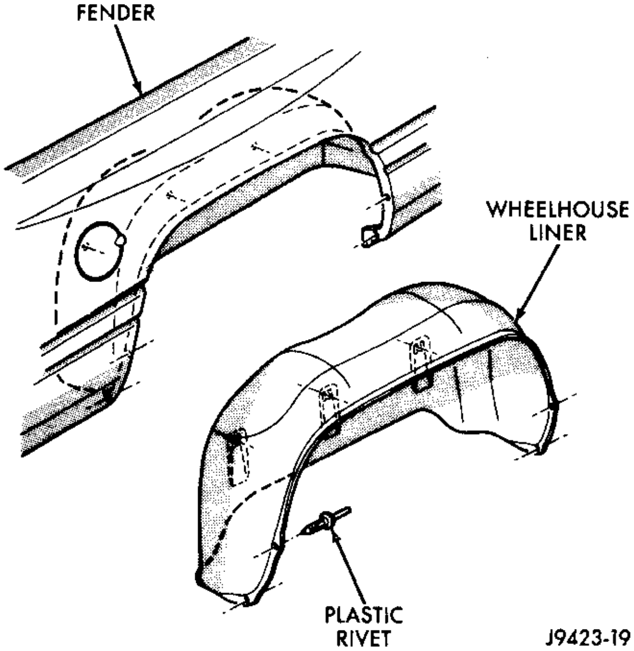

Fig. 84 Rear Wheelhouse Liner

REAR FENDER (DUAL REAR WHEELS)

REMOVAL

(1) Open fuel fill door, left side only.

(2) Remove screws holding fuel fill neck to rear fender opening.

(3) Remove tail lamp, refer to Group 8L, Lamps for proper procedures.

(4) Remove nuts holding rear fender to cargo box side panel through tail lamp opening.

(5) Remove clearance lamps, refer to Group 8L, Lamps for proper procedures.

(6) Remove sockets from clearance lamps.

(7) Remove bolts holding bottom of fender to cargo box forward of rear wheel.

(8) Remove bolts holding bottom of fender to cargo box rearward of rear wheel.

(9) Remove rear wheelhouse splash shields and liner

(10) Remove nuts holding front of rear fender to cargo box from behind side panel forward of wheelhouse.

(11) Remove screws holding access panel to top of wheelhouse.

(12) Remove nuts holding rear fender to cargo box through access hole in to of wheelhouse.

(13) Separate rear fender from cargo box side panel (Fig. 85).

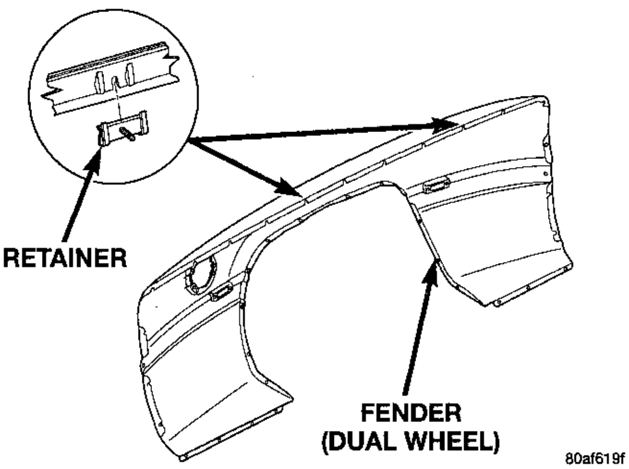

Fig. 85 Rear Fender—Dual Wheels

INSTALLATION

Ensure the retainers are in good condition.

Reverse the preceding operation.

TAILGATE CHECK CABLE

REMOVAL

(1) Release tailgate latch and open tailgate.

(2) Pry lock tab outward to clear stud head on cargo box (Fig. 86).

(3) Push cable end forward until stud head is in clearance hole portion of cable end.

(4) Separate cable end from stud.

(5) Remove screw holding cable to tailgate.

(6) Separate check cable from tailgate.

INSTALLATION

Reverse the preceding operation.

REMOVAL AND INSTALLATION (Continued)

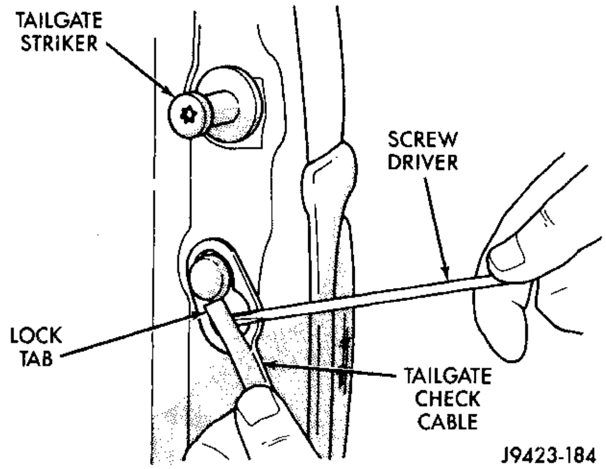

Fig. 86 Tailgate Check Cable

TAILGATE

REMOVAL

(1) Release tailgate latch and open tailgate.

(2) Disconnect tailgate marker light harness, if equipped.

(3) Disconnect tailgate check cable.

(4) Close tailgate until the notch in the right hand collar aligns with the pivot pin.

(5) Slip tailgate hinge collar from hinge pins.

(6) Slide tailgate to the right and separate left hand collar from the pivot pin.

(7) Separate tailgate from vehicle.

INSTALLATION

Reverse the preceding operation.

TAILGATE HANDLE ESCUTCHEON

REMOVAL

(1) Lift and hold tailgate latch release handle.

(2) Using a trim stick (C–4755), pry bottom of escutcheon outward to disengage clips.

(3) Rotate escutcheon upward to disengage clip above release handle.

(4) Lift escutcheon upward from behind release handle.

(5) Separate escutcheon from vehicle (Fig. 87).

INSTALLATION

Reverse the preceding operation.

TAILGATE LATCH HANDLE

REMOVAL

(1) Remove tailgate latch handle escutcheon.

(2) Disengage clips holding linkage rods to latch handle.

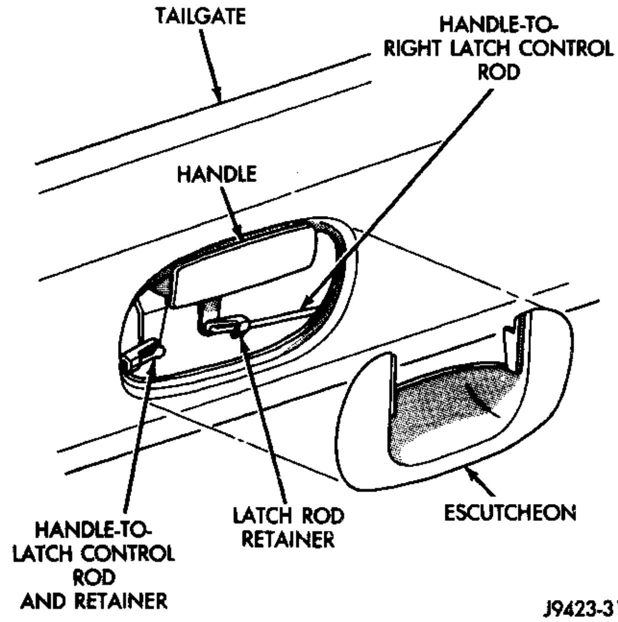

Fig. 87 Tailgate Handle Escutcheon

(3) Separate linkage rods from handle.

(4) Remove screws holding latch handle to tailgate (Fig. 88).

(5) Separate latch handle from vehicle.

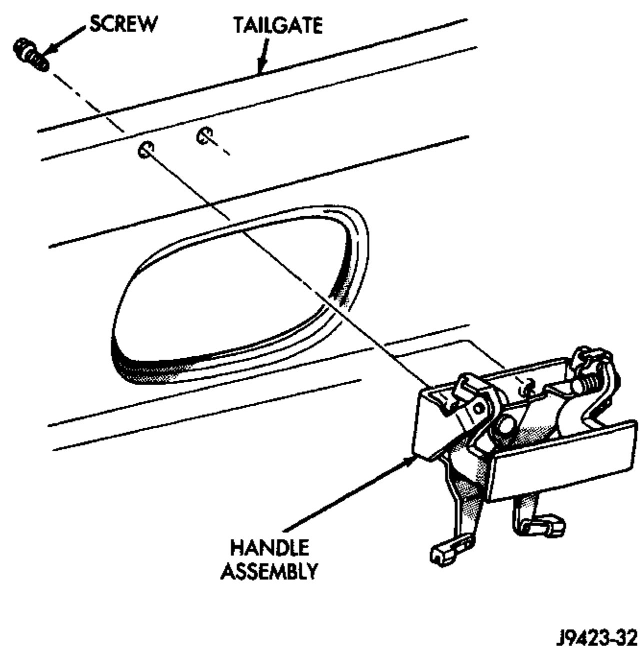

Fig. 88 Tailgate Latch Handle

INSTALLATION

Reverse the preceding operation.

REMOVAL AND INSTALLATION (Continued)

TAILGATE LATCH

REMOVAL

(1) Remove tailgate latch handle escutcheon.
(2) Release tailgate latch and open tailgate.
(3) Disengage linkage rod from latch handle (Fig. 89).
(4) Remove screws holding latch to tailgate.
(5) Separate latch from tailgate.
(6) Pull latch and linkage rod from tailgate.

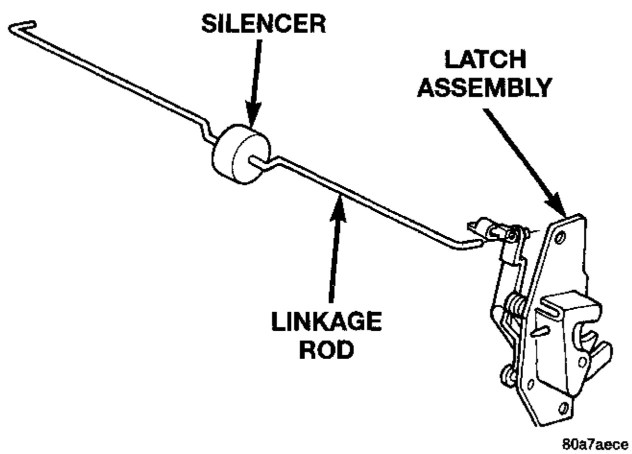

Fig. 89 Tailgate Latch

INSTALLATION

Reverse the preceding operation.

TAILGATE LATCH STRIKER

REMOVAL

(1) Open tailgate.
(2) Mark outline of striker on cargo box jamb to aid installation.
(3) Using a Torx drive wrench, remove striker from cargo box (Fig. 90).

INSTALLATION

Reverse the preceding operation.

TAILGATE SLAM BUMPER

REMOVAL

(1) Release tailgate latch and open tailgate.
(2) Remove screw holding slam bumper to cargo box (Fig. 91).
(3) Separate slam bumper from vehicle.

INSTALLATION

(1) Position slam bumper on vehicle.
(2) Install screw holding slam bumper to cargo box.
(3) Close tailgate and verify operation.

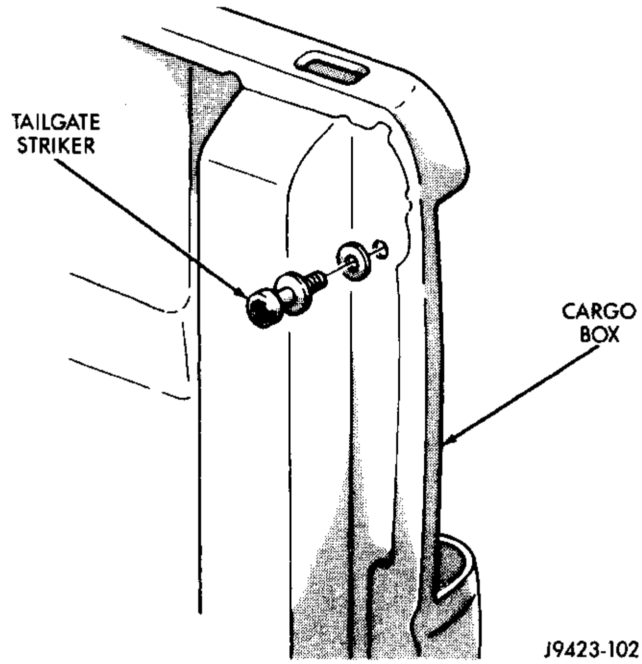

Fig. 90 Tailgate Latch

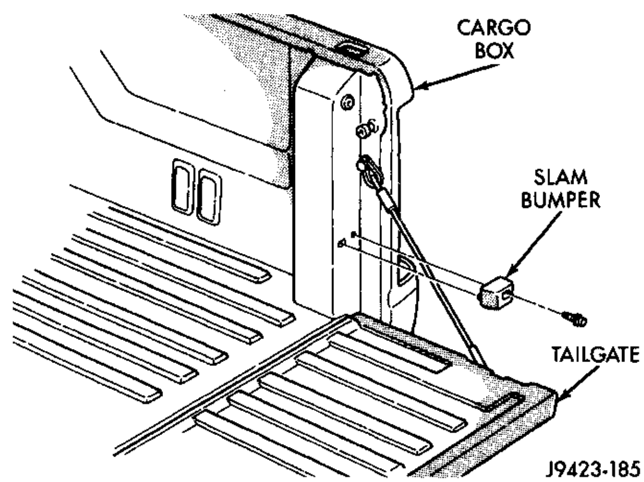

Fig. 91 Tailgate Slam Bumper

TAILGATE DECALS

REMOVAL

(1) Warm the panel to approximately 38°C (100°F) using a suitable heat lamp or heat gun.
(2) Peel tape stripe from body panel using an even pressure pull.
(3) Remove adhesive residue from body panel using a suitable adhesive removing solvent.

INSTALLATION

(1) Clean painted body surface with Mopar Super Clean solvent or equivalent and a lint free cloth.
(2) Remove protective cover from back side of decal.

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REMOVAL AND INSTALLATION (Continued)

(3) Position decal properly on body.
(4) Press decal firmly to body with palm of hand.
(5) If temperature is below 21°C (70°F) warm decal with a heat lamp or gun to assure adhesion. Do not exceed 65°C (150°F) when heating emblem.

TAILGATE APPLIQUE

REMOVAL

(1) Apply a length of masking tape on the body, parallel to the top edge of the applique to use as a guide, if necessary.
(2) Warm the tailgate applique and tailgate metal to approximately 38°C (100°F) using a suitable heat lamp or heat gun.
(3) Pull applique from tailgate (Fig. 92).

INSTALLATION

(1) Remove adhesive tape residue from painted surface of tailgate.
(2) If applique is to be reused, remove tape residue from applique. Clean back of applique with MOPAR, Super Kleen solvent or equivalent. Wipe molding dry with lint free cloth. Apply new body side molding (two sided adhesive) tape to back of applique.
(3) Clean tailgate surface with MOPAR, Super Kleen solvent or equivalent. Wipe surface dry with lint free cloth. An adhesion promoter must be applied to ensure proper applique adhesion.
(4) Remove protective cover from tape on back of applique. Apply applique to body below the masking tape guide.
(5) Remove masking tape guide and heat tailgate and applique, see step one. Firmly press applique to tailgate to assure adhesion.

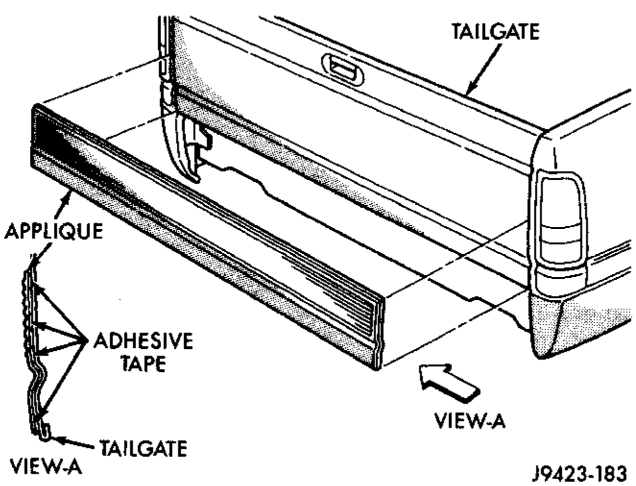

Fig. 92 Tailgate Applique

CARGO BOX

REMOVAL

(1) Open fuel fill door.
(2) Remove screws holding fuel fill neck adaptor to cargo box side wall.
(3) Separate fuel fill neck from cargo box.
(4) Disengage tail lamp wire connector from main body harness at left rear frame rail.
(5) Remove bolts holding cargo box to frame rails (Fig. 93).
(6) Using a suitable lifting device, separate cargo box from vehicle.

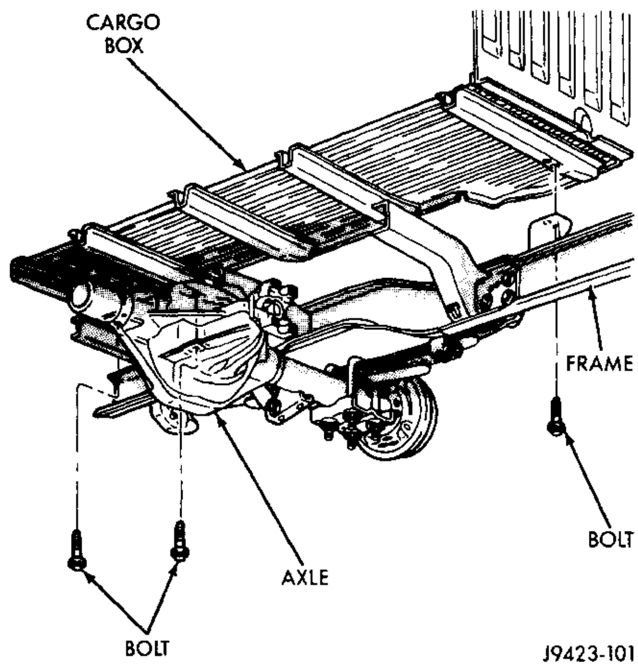

Fig. 93 Cargo Box

INSTALLATION

Reverse the preceding operation.

DOOR SILL TRIM COVER

REMOVAL

(1) Remove screws attaching door sill trim cover to door sill (Fig. 94) and (Fig. 95).
(2) Separate door sill trim cover from door sill.

INSTALLATION

(1) Position door sill trim cover on door sill.
(2) install screws attaching door sill trim cover to door sill.

REMOVAL AND INSTALLATION (Continued)

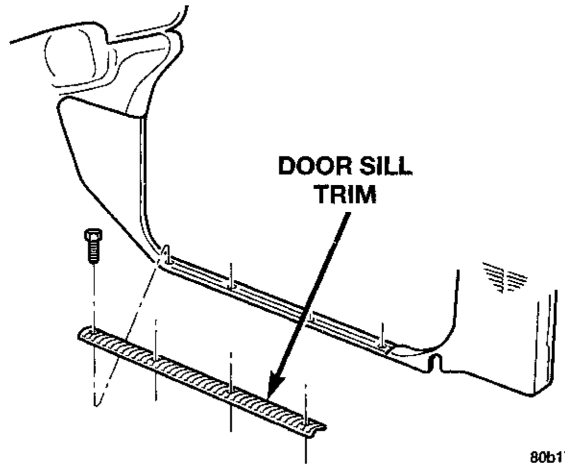

Fig. 94 Door Sill Trim Cover

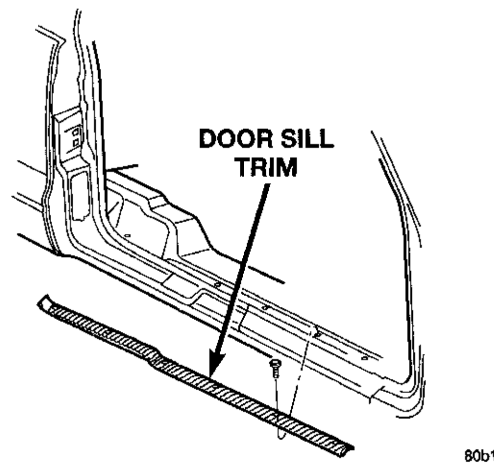

Fig. 95 Door Sill Trim Cover—Quad Cab

COWL TRIM COVER

REMOVAL

(1) Remove front door sill trim cover.

(2) Grasp center upper edge of cowl trim cover (Fig. 96) and pull outward allowing cowl trim cover to bow in the center releasing trim cover retaining tab (Fig. 97).

(3) Separate cowl trim cover from lower cowl.

INSTALLATION

(1) Position cowl trim cover on lower cowl.

(2) Press into place.

(3) Install front door sill trim cover.

A-PILLAR GRAB HANDLE

REMOVAL

(1) Using a small flat blade screw driver, pry trim plugs from A-pillar grab handle.

(2) Remove screws attaching grab handle to A-pillar (Fig. 98).

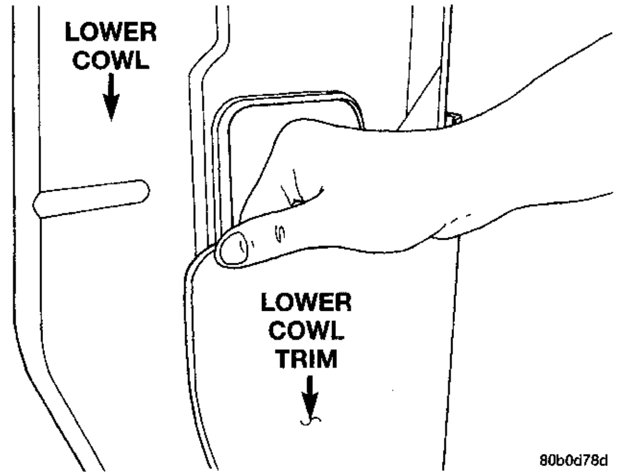

Fig. 96 Lower Cowl Trim Cover

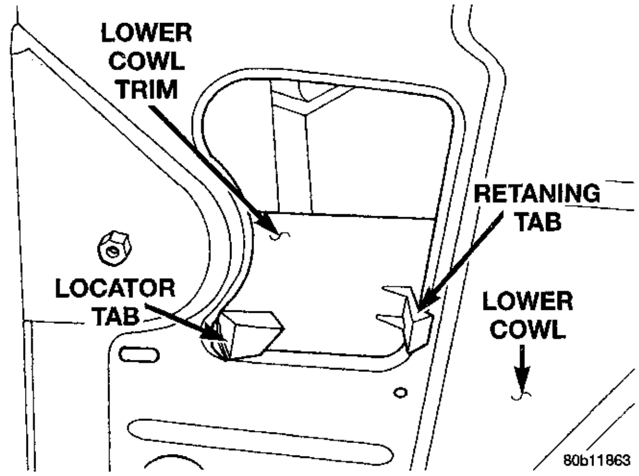

Fig. 97 Lower Cowl Trim Cover Retaining Tab

(3) Separate A-pillar grab handle from vehicle.

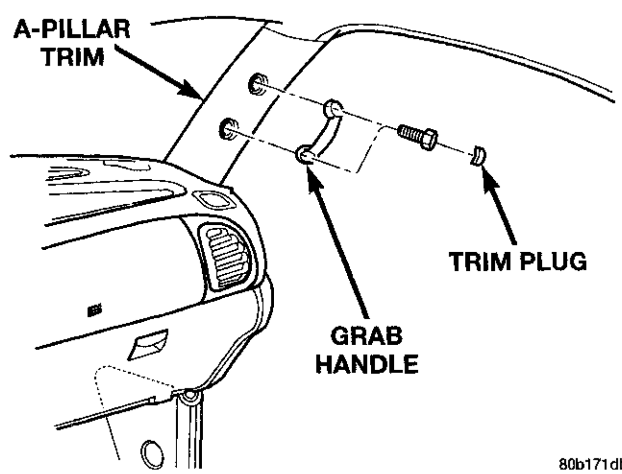

Fig. 98 A-pillar Grab Handle (4X4)

INSTALLATION

(1) Position grab handle on A-pillar.

(2) Install screws attaching grab handle to A-pillar (Fig. 98).

(3) Install trim plugs in A-pillar grab handle.

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REMOVAL AND INSTALLATION (Continued)

A-PILLAR TRIM

REMOVAL

(1) Remove A-pillar grab handle, if equipped.
(2) Grasp A-pillar trim at top and pull outward/downward to disengage upper spring clip (Fig. 99).
(3) Carefully pull bottom of A-pillar trim outward to disengage lower spring clip.
(4) Disengage speaker harness connector, if equipped.
(5) Separate A-pillar trim from vehicle.

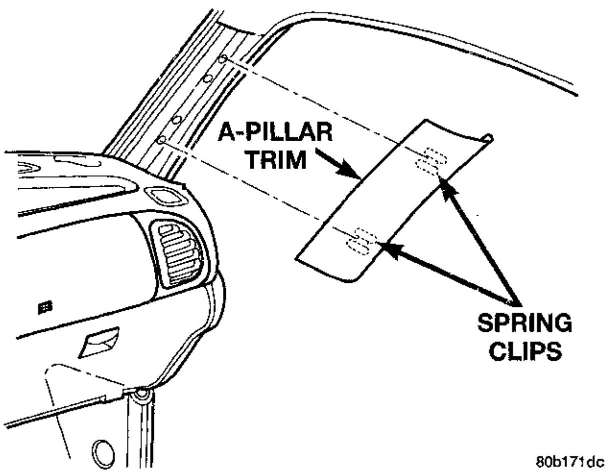

Fig. 99 A-pillar Trim

INSTALLATION

(1) Position A-pillar trim in vehicle.
(2) Engage speaker harness connector, if equipped.
(3) Align spring clips and press into place.
(4) Install A-pillar grab handle, if equipped.

B—PILLAR TRIM

REMOVAL

(1) Remove rear floor stowage tray.
(2) Remove door sill cover as necessary to clear B-pillar trim.
(3) Remove bolt attaching seat belt anchor to floor.
(4) Pull turning loop cover up and remove bolt attaching turning loop to B-pillar.
(5) Remove seat belt exit plug (Fig. 100).
(6) Disengage clips attaching B-pillar trim to upper B-pillar.
(7) Separate B-pillar trim from B-pillar.
(8) Route seat belt webbing through opening in B-pillar trim.

INSTALLATION

(1) Route seat belt webbing through opening in B-pillar trim.
(2) Position B-pillar trim at B-pillar.
(3) Starting at the top, engage clips attaching B-pillar trim to upper B-pillar.
(4) Install seat belt exit plug.

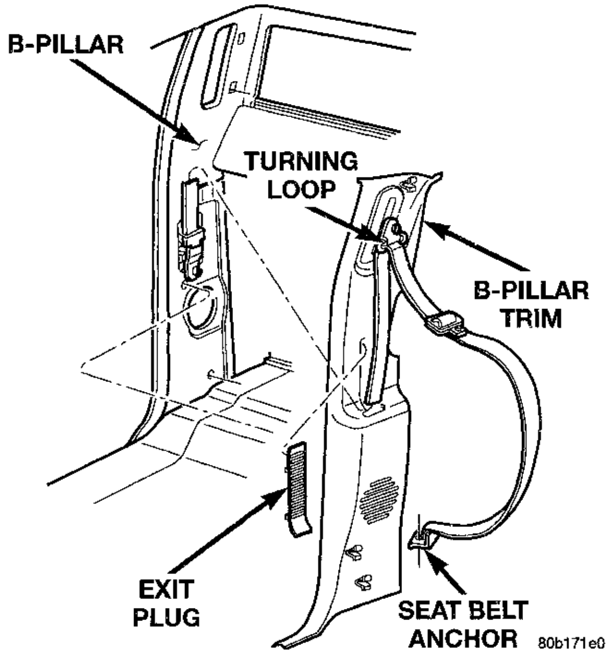

Fig. 100 B-Pillar Trim

(5) Install bolt attaching turning loop to B-pillar and install turning loop cover.
(6) Install bolt attaching seat belt anchor to floor.
(7) Install door sill cover.
(8) Install rear floor stowage tray.

C—PILLAR TRIM

REMOVAL

(1) Remove rear floor stowage tray.
(2) Remove door sill cover as necessary to clear C-pillar trim.
(3) Remove bolt attaching seat belt anchor to floor.
(4) Pull turning loop cover up and remove bolt attaching turning loop to C-pillar.
(5) Remove seat belt exit plug (Fig. 101).
(6) Disengage clips attaching C-pillar trim to upper C-pillar.
(7) Separate C-pillar trim from C-pillar.
(8) Route seat belt webbing through opening in C-pillar trim.

INSTALLATION

(1) Route seat belt webbing through opening in C-pillar trim.
(2) Position C-pillar trim at C-pillar.
(3) Starting at the top, engage clips attaching C-pillar trim to upper C-pillar.
(4) Install seat belt exit plug.
(5) Install bolt attaching turning loop to C-pillar and install turning loop cover.
(6) Install bolt attaching seat belt anchor to floor.
(7) Install door sill cover.
(8) Install rear floor stowage tray.

REMOVAL AND INSTALLATION (Continued)

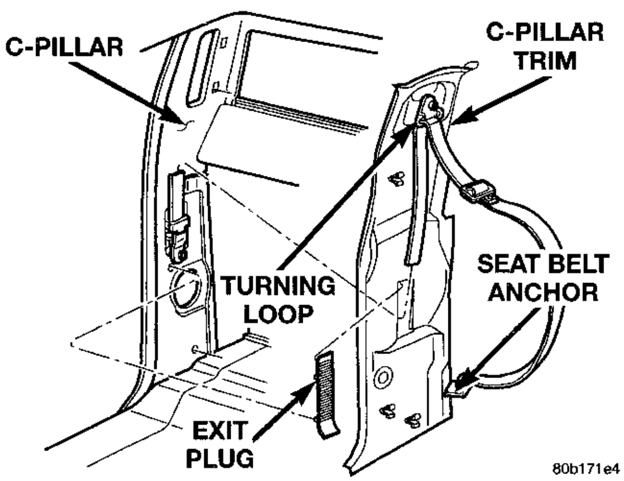

Fig. 101 C-pillar Trim

QUARTER TRIM PANEL—CLUB CAB

REMOVAL

(1) Remove rear seat. Refer to the removal procedure in this section, if necessary.

(2) Remove door sill cover as necessary to clear quarter trim.

(3) Remove lower seat belt anchor bolt (Fig. 102).

(4) Remove seat belt tuning loop anchor bolt.

(5) Disengage clips attaching quarter trim panel from quarter panel.

(6) Route seat belt webbing through opening in quarter trim panel and remove panel from vehicle.

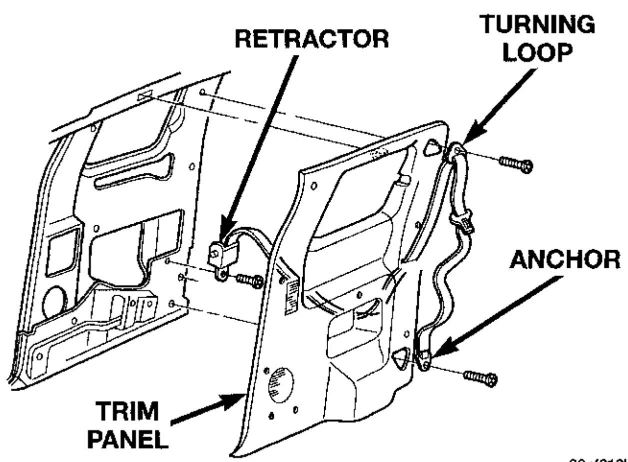

Fig. 102 Quarter Trim Panel—Club Cab

INSTALLATION

(1) Position trim panel in vehicle and route seat belt webbing through opening in quarter trim panel.

(2) Open quarter vent window.

(3) Position trim panel on quarter panel and engage clips on upper portion of panel.

(4) Engage clips attaching lower portion of quarter trim panel to quarter panel.

(5) Install lower seat belt anchor bolt.

(6) Install door sill cover as necessary.

(7) Install rear seat. Refer to the installation procedure in this section, if necessary.

REAR CLOSURE PANEL TRIM

REMOVAL

(1) Remove quarter trim panels.

(2) Remove rear floor stowage tray.

(3) Remove screws attaching bottom of rear closure panel trim to floor pan (Fig. 103).

(4) Remove screws attaching rear closure panel trim to cab back panel.

(5) Disengage clips attaching top of rear closure panel trim to cab back panel.

(6) Separate rear closure panel trim from vehicle.

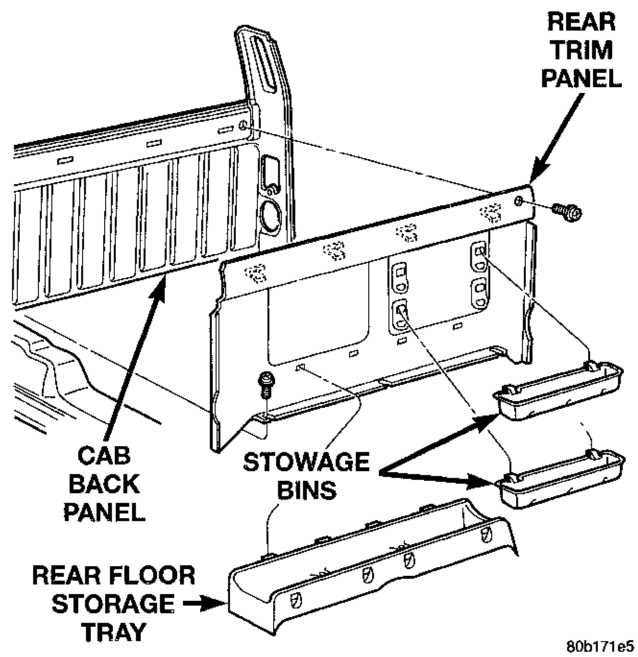

Fig. 103 Rear Closure Panel Trim

INSTALLATION

(1) Position rear closure panel trim in vehicle.

(2) Align and engage clips attaching top of rear closure panel trim to cab back panel.

(3) Install screws attaching rear closure panel trim to cab back panel.

(4) Install screws attaching bottom of rear closure panel trim to floor pan (Fig. 103).

(5) Install rear floor stowage tray.

(6) Install quarter trim panels.

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REMOVAL AND INSTALLATION (Continued)

SEAT BELT RETRACTOR—CONVENTIONAL CAB

WARNING: Inspect the shoulder belt, retractor and buckle. Replace the belt or buckle that is either cut, frayed, torn or damaged. Replace the belt if the retractor is inoperative.

REMOVAL

(1) Remove bolt attaching shoulder belt lower anchor to floor at base of quarter trim panel (Fig. 104).

(2) Remove quarter trim panel.

(3) Remove bolt attaching seat belt turning loop to B-pillar (Fig. 105).

(4) Separate turning loop from B-pillar.

(5) Disengage body harness wire connector from seat belt retractor (drivers side only).

(6) Remove bolt attaching seat belt retractor to quarter panel.

(7) Separate seat belt retractor from vehicle.

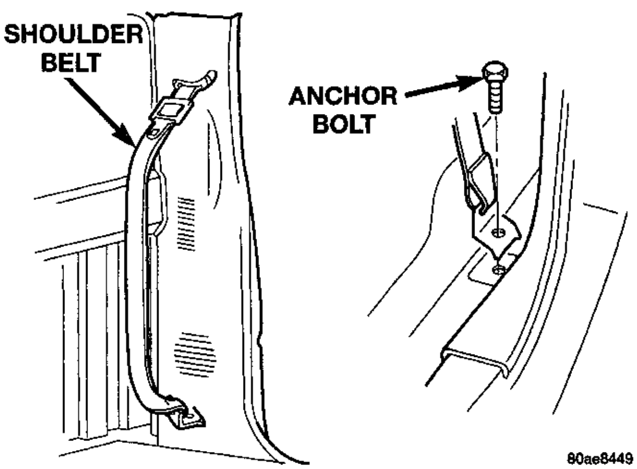

Fig. 104 Shoulder Belt Anchor

INSTALLATION

(1) Position seat belt retractor in vehicle.

(2) Install bolt attaching seat belt retractor to quarter panel. Tighten bolt to 39 N·m (28 ft. lbs.) torque.

(3) Engage body harness wire connector from seat belt retractor (drivers side only).

(4) Position turning loop on B-pillar.

(5) Install bolt attaching seat belt turning loop to B-pillar (Fig. 105). Tighten bolt to 39 N·m (28 ft. lbs.) torque.

(6) Install quarter trim panel.

(7) Install bolt attaching shoulder belt lower anchor to floor at base of quarter trim panel (Fig. 105). Tighten bolt to 39 N·m (28 ft. lbs.) torque.

FRONT SEAT BELT RETRACTOR—CLUB/QUAD CAB

The seat/shoulder belt and retractor is incorporated in each driver and passenger seat.

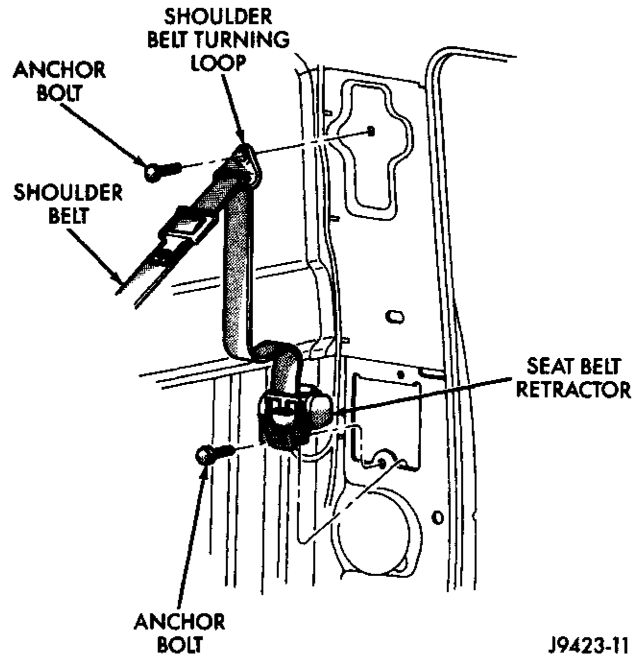

Fig. 105 Seat Belt Retractor

WARNING: Inspect the shoulder belt, retractor and buckle. Replace the belt or buckle that is either cut, frayed, torn or damaged. Replace the belt if the retractor is inoperative.

REMOVAL

(1) Remove the seat back cover.

(2) Remove the screws attaching the retractor cover to the seat back frame.

(3) Disengage the wire connectors from the retractor.

(4) Remove the bolts attaching the retractor to the seat back frame (Fig. 106).

(5) Separate the retractor from the seat back frame.

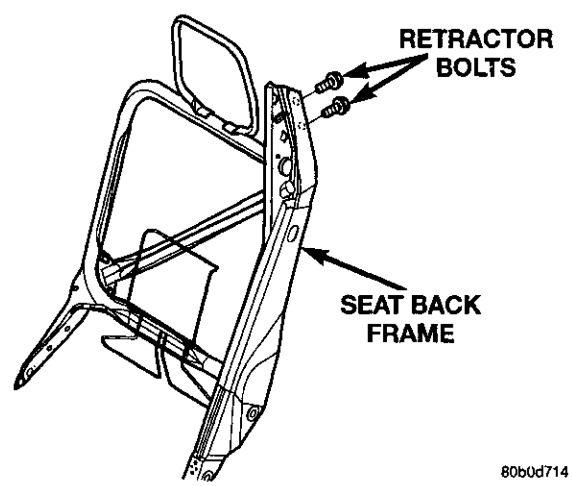

Fig. 106 Seat Belt Retractor

REMOVAL AND INSTALLATION (Continued)

INSTALLATION

(1) Position the retractor in the seat back frame.

(2) Install the bolts attaching the retractor to the seat back frame. Tighten the bolts to 16 N·m (11 ft. lbs.) torque.

(3) Engage the wire connectors to the retractor.

(4) Install screws attaching retractor cover to seat back frame.

(5) Install seat back cover.

SEAT BELT BUCKLE

REMOVAL

(1) Move seat to the forward position.

(2) Hinge seat backs forward.

(3) Remove bolt holding seat belt buckle to seat frame.

(4) Separate seat belt buckle from vehicle.

INSTALLATION

Reverse the preceding operation. Install the seat belt buckle anchor nuts. Tighten to 40 N·m (30 ft. lbs.) torque.

REAR SEAT BELT BUCKLE

REMOVAL

(1) Turn release handle on underside of rear seat to disengage seat cushion and move seat to the stowed position.

Access to rear seat belt buckle nuts can be obtained through an opening between the rear seat back and the floor.

(2) Remove seat belt buckle anchor nuts (Fig. 107).

(3) Separate seat belt buckle from vehicle.

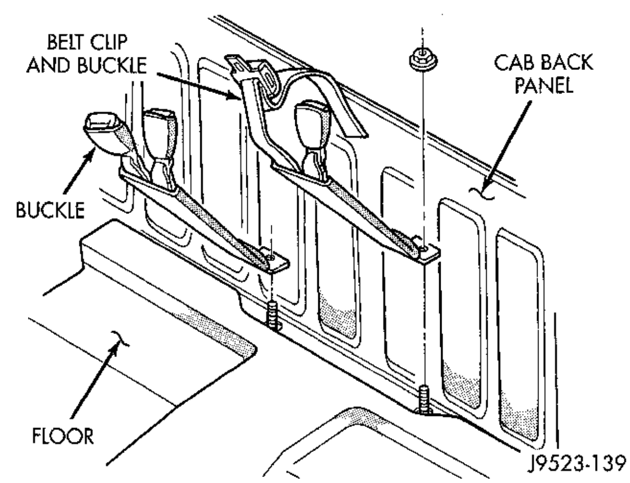

Fig. 107 Rear Seat Belt Buckle Removal

INSTALLATION

(1) Position the seat belt buckle on the anchoring studs.

(2) Install the seat belt buckle anchor nuts. Tighten to 40 N·m (30 ft. lbs.) torque.

(3) Route the belts and buckles between the seat back and seat cushion.

(4) Turn release handle to disengage seat from stowed position and push seat cushion downward to lock into place.

BENCH SEAT

REMOVAL

(1) Move seat track to forward position.

(2) Hinge seat backs forward.

(3) Remove nuts holding rear of seat tracks to floor (Fig. 108).

(4) Move seat track to rearward position.

(5) Remove bolts holding front of seat tracks to floor.

(6) Separate seat from vehicle.

INSTALLATION

Seat adjustment latch must be engaged prior to seat installation. Verify inboard and outboard seat latch operation.

Reverse the removal procedure.

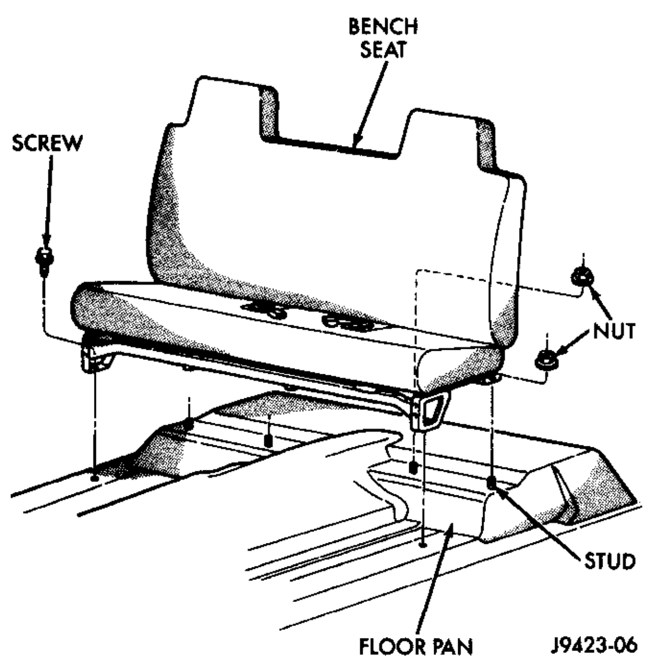

Fig. 108 Bench Seat

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REMOVAL AND INSTALLATION (Continued)

SPLIT BENCH SEAT—CONVENTIONAL CAB

REMOVAL

(1) Move seat track to forward position.
(2) Hinge seat back forward.
(3) Disengage power seat wire connector from body harness, if equipped (Fig. 109).
(4) Remove nuts holding outboard and inboard tracks to floor (Fig. 109).
(5) Move seat track to forward position.
(6) Remove bolt holding inboard seat track to bottom of center occupant seat.
(7) Remove bolts holding front of seat tracks to floor.
(8) Lift center occupant seat upward to clear rear attachment stud.
(9) Separate seat from vehicle.

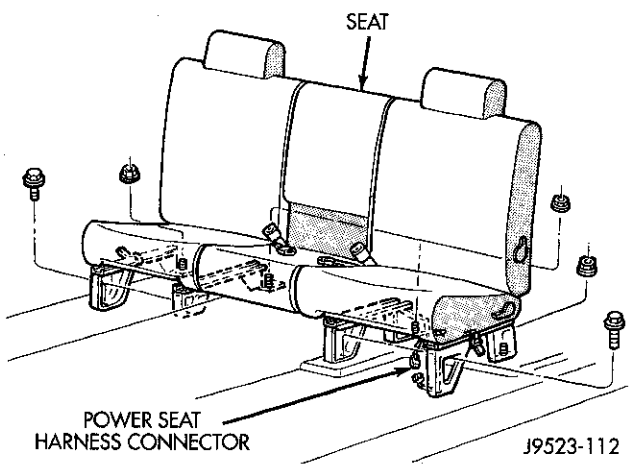

Fig. 109 Split Bench Seat

INSTALLATION

(1) Position seat in vehicle.
(2) Install bolts holding front of seat tracks to floor. Tighten the bolts with 28 N·m (250 in-lbs) torque.
(3) Install bolt holding inboard seat track to bottom of center occupant seat. Tighten the bolt with 28 N·m (250 in- lbs) torque.
(4) Install nuts holding outboard and inboard tracks to floor. Tighten the nuts with 40 N·m (30 ft. lbs.) torque.
(5) Connect power seat wire connector to body harness, if equipped.

SPLIT BENCH SEAT—CLUB/QUAD CAB

REMOVAL

(1) Clamp seat belt to prevent belt from retracting.
(2) Move seats to full rearward position.
(3) Remove bolts attaching front of seat tracks to floor.
(4) Move seats to full forward position.
(5) Remove bolts attaching rear of outboard seat tracks to floor (Fig. 110).
(6) Remove nuts attaching inboard seat tracks to floor.
(7) Disengage power seat wire connector from body harness, if equipped.
(8) Lift seats upward to clear rear studs.
(9) With the aid of a helper, separate seat from vehicle.

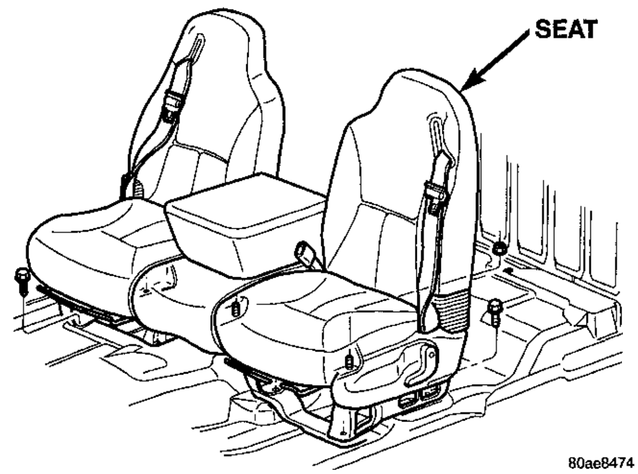

Fig. 110 Split Bench Seat—Club/Quad Cab

INSTALLATION

(1) Position seat in vehicle.
(2) Engage power seat wire connector to body harness, if equipped.
(3) Ensure seats are in full forward position.
(4) Install outboard bolts attaching rear of seat tracks to floor (Fig. 110). Tighten the bolts with 54 N·m (40 ft. lbs.) torque.
(5) Install nuts attaching inboard seat tracks to floor. Tighten the nuts with 40 N·m (30 ft. lbs.) torque.
(6) Move seats to full forward position.
(7) Install bolts attaching front of seat tracks to floor. Tighten the bolts with 54 N·m (40 ft. lbs.) torque.

REMOVAL AND INSTALLATION (Continued)

CENTER SEAT/CONSOLE

REMOVAL

(1) Remove bolts on driver and passenger seat inboard seat tracks.

(2) Separate center section.

INSTALLATION

(1) Position and align center section on driver and passenger seat inboard seat tracks.

(2) Install bolts. Tighten to 19.5 N·m (14 ft. lbs.) torque.

CONSOLE LID

REMOVAL

(1) Open console lid.

(2) Using a small flat blade screwdriver, disengage locking tabs located under the console lid trim bezel.

(3) Separate bezel from lid.

(4) Move driver and passenger seat to full forward position.

(5) Using a small drift and hammer, tap out console lid hinge pin.

(6) Separate lid from console.

INSTALLATION

(1) Align console lid with console. Verify lid tension spring is in position.

(2) Install hinge pin.

(3) Position trim bezel on lid and snap into place.

STANCHION COVER

REMOVAL

(1) Remove push-in fasteners attaching stanchion cover to seat stanchion (Fig. 111).

(2) Separate cover from seat stanchion.

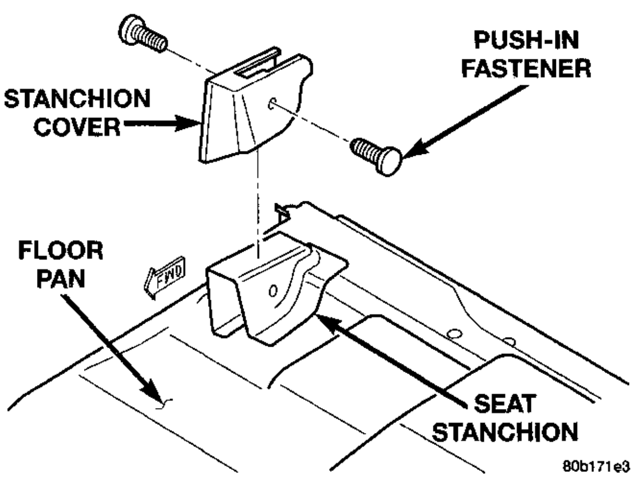

Fig. 111 Stanchion Cover

INSTALLATION

(1) Position cover on seat stanchion.

(2) Install push-in fasteners attaching stanchion cover to seat stanchion (Fig. 111).

REAR SEAT—CLUB CAB

REMOVAL

(1) Move front seat track to full forward position.

(2) Turn release handle on underside of rear seat (Fig. 112) to disengage seat cushion and move seat to the stowed position (Fig. 113).

(3) Remove side support bracket screws and lift seat to disengage from cab (Fig. 114).

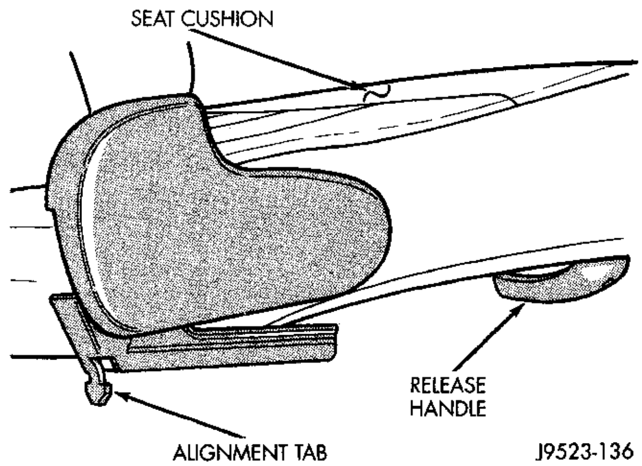

Fig. 112 Rear Seat Release Handle

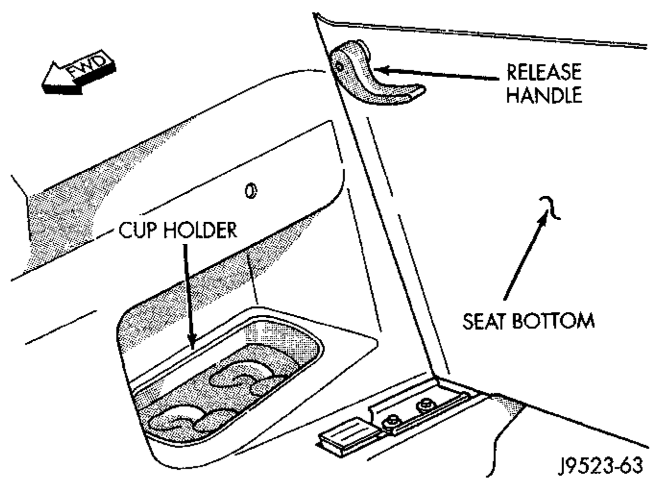

Fig. 113 Rear Seat Stowed

INSTALLATION

(1) Position seat in vehicle.

(2) Align seatback hooks with loops on cab rear panel (Fig. 114).

(3) Align side support alignment tabs, and lower seat into place.

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REMOVAL AND INSTALLATION (Continued)

(4) Install side support bracket screws. Tighten the screws to 28 N·m (250 in-lbs) torque.

(5) Turn release handle to disengage seat from stowed position and push seat cushion downward to lock into place.

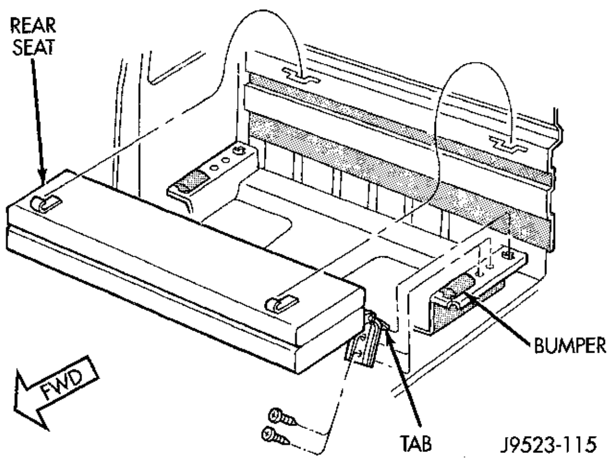

Fig. 114 Rear Seat Removal/Installation

FLOOR CONSOLE

REMOVAL

(1) Using a trim stick, pry the corner of the shift boot up and pull boot up to remove from console

(2) Remove the screws attaching the console to mounting brackets (Fig. 115).

(3) Lift the console upward.

(4) Disengage wire harness connector, if equipped.

(5) Route the shift boot(s) through the console.

(6) Separate console from vehicle.

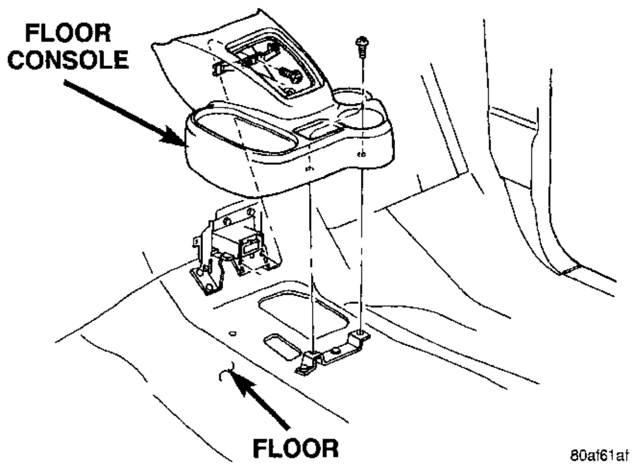

Fig. 115 Floor Console

INSTALLATION

(1) Position console in vehicle.

(2) Route the shift boot(s) through the console.

(3) Engage wire harness connector, if equipped.

(4) Position the console on the floor.

(5) Install shift boot on console

(6) Install the screws attaching the console to mounting brackets (Fig. 115).

FLOOR SHIFT BOOT—MANUAL TRANSMISSION

REMOVAL

(1) Pull edge of floor shift boot upward to expose fasteners (Fig. 116).

(2) Remove screws attaching floor shift boot to floor.

(3) Remove gear shift knob.

(4) Separate gear shift boot from floor.

(5) Lift floor shift boot off shifter.

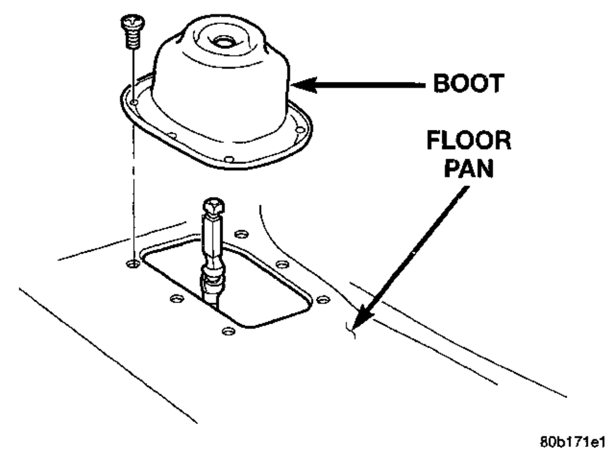

Fig. 116 Floor Shift Boot—Manual Transmission

INSTALLATION

(1) Position floor shift boot on shifter.

(2) Install gear shift knob.

(3) Install screws attaching floor shift boot to floor.

(4) Tuck edge of floor shift boot to secure.

4WD FLOOR SHIFT BOOT— MANUAL TRANSMISSION

REMOVAL

(1) Pull edge of floor shift boot upward to expose fasteners.

(2) Remove screws attaching floor shift boot to floor.

(3) Remove gear shift knob.

(4) Separate gear shift boot from floor.

(5) Lift floor shift boot off shifter.

INSTALLATION

(1) Position shift boot on shifter.

(2) Install gear shift knob.

(3) Install screws attaching floor shift boot to floor.

(4) Tuck edge of floor shift boot inward to cover fasteners.

REMOVAL AND INSTALLATION (Continued)

4WD FLOOR SHIFT BOOT— AUTOMATIC TRANSMISSION

REMOVAL

(1) Pull edge of floor shift boot upward to expose fasteners (Fig. 117).
(2) Remove screws holding floor shift boot to floor.
(3) Remove gear shift knob.
(4) Separate gear shift boot from floor.
(5) Lift floor shift boot off shifter.

INSTALLATION

Reverse the preceding operation.

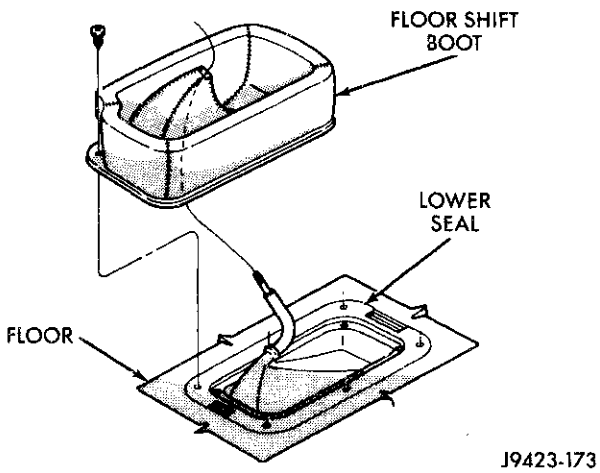

Fig. 117 4WD Floor Shift Boot—Automatic Transmission

REAR FLOOR STOWAGE TRAY

REMOVAL

(1) Move seat tracks to forward position.
(2) Remove screws holding rear floor stowage tray to floor (Fig. 118).
(3) Disengage hooks on stowage tray from slots in rear closure panel trim.
(4) Separate rear floor stowage tray from vehicle.

INSTALLATION

Reverse the preceding operation.

FLOOR CARPET OR MAT

REMOVAL

(1) Remove seat.
(2) Remove door sill and cowl trim covers.
(3) Remove bolts holding lower seat belt anchors to floor.
(4) Remove floor shift boot, if equipped.
(5) Remove rear stowage tray.
(6) Remove quarter trim panels.
(7) Remove rear closure panel trim.
(8) Fold carpet or mat toward center of cab.

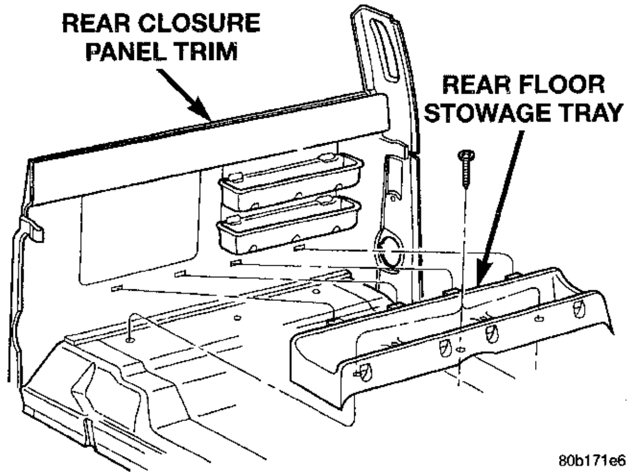

Fig. 118 Rear Floor Stowage Tray

(9) Remove carpet or mat through door opening (Fig. 119).

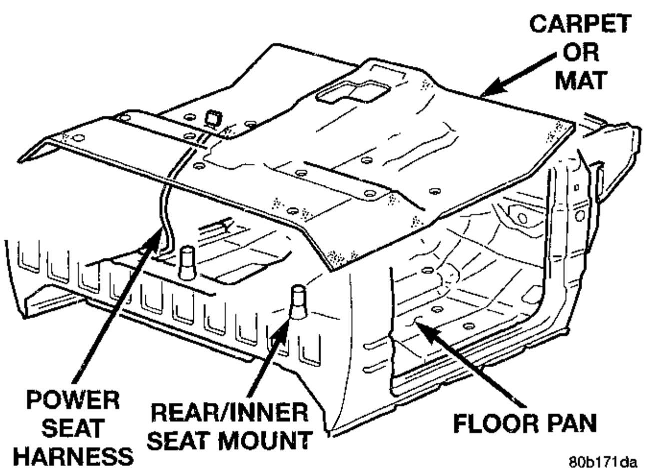

Fig. 119 Floor Carpet or Mat

INSTALLATION

(1) Position carpet or mat in vehicle and align all holes (Fig. 119).
(2) Install rear closure panel trim.
(3) Install rear stowage tray.
(4) Install floor shift boot, if equipped.
(5) Install bolts holding lower seat belt anchors to floor.
(6) Install cowl trim covers and door sill.
(7) Install seat.

FLOOR CARPET OR MAT—CLUB CAB

REMOVAL

(1) Remove front and rear seats.
(2) Remove door sill and cowl trim covers.
(3) Remove floor shift boot, if equipped.
(4) Remove emergency jack tool kit.
(5) Remove rear seat belt buckles.

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REMOVAL AND INSTALLATION (Continued)

(6) Remove quarter trim panels.
(7) Fold carpet or mat toward center of cab.
(8) Remove carpet or mat through door opening.

INSTALLATION

Reverse the preceding operation.

REARVIEW MIRROR

REMOVAL

(1) Loosen the mirror base setscrew (Fig. 120).
(2) Slide the mirror base upward and off the bracket.

INSTALLATION

(1) Position the mirror base at the bracket and slide it downward onto the support bracket.
(2) Tighten the setscrew securely.

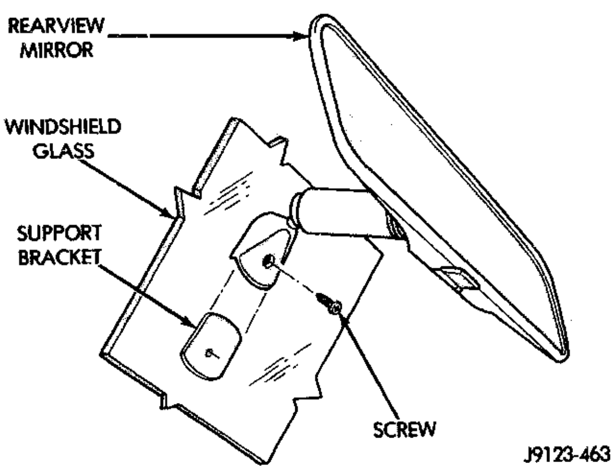

Fig. 120 Rearview Mirror

REARVIEW MIRROR SUPPORT BRACKET

INSTALLATION

(1) Mark the position for the mirror bracket on the outside of the windshield glass with a wax pencil.
(2) Clean the bracket contact area on the glass. Use a mild powdered cleanser on a cloth saturated with isopropyl (rubbing) alcohol. Finally, clean the glass with a paper towel dampened with alcohol.
(3) Sand the surface on the support bracket with fine grit-sandpaper. Wipe the bracket surface clean with a paper towel.
(4) Apply accelerator to the surface on the bracket according to the following instructions:
- Crush the vial to saturate the felt applicator.
- Remove the paper sleeve.
- Apply accelerator to the contact surface on the bracket.
- Allow the accelerator to dry for five minutes.
- Do not touch the bracket contact surface after the accelerator has been applied.

(5) Apply adhesive accelerator to the bracket contact surface on the windshield glass. Allow the accelerator to dry for one minute. Do not touch the glass contact surface after the accelerator has been applied.
(6) Install the bracket according to the following instructions:
- Apply one drop of adhesive at the center of the bracket contact-surface on the windshield glass.
- Apply an even coat of adhesive to the contact surface on the bracket.
- Align the bracket with the marked position on the windshield glass.
- Press and hold the bracket in place for at least one minute.

NOTE: Verify that the mirror support bracket is correctly aligned, because the adhesive will cure rapidly.

(7) Allow the adhesive to cure for 8-10 minutes. Remove any excess adhesive with an alcohol-dampened cloth.
(8) Allow the adhesive to cure for an additional 8-10 minutes before installing the mirror.

SUN VISOR

NOTE: All vehicles with driver and passenger side airbags must have a colored-coded, 5-bullet point airbag warning label applied to the sunvisor face surface (in the stored position). When replacing the sunvisor, verify label availability and ensure the label is installed.

REMOVAL

(1) Remove screws attaching sun visor to roof (Fig. 121).
(2) If equipped, disengage lighted vanity mirror connector.
(3) Separate sun visor from roof.
(4) Remove screw attaching sun visor hook to roof.
(5) Separate sun visor hook from roof.

INSTALLATION

(1) Position sun visor hook on roof.
(2) Install screw attaching sun visor hook to roof.
(3) Position sun visor on roof.
(4) If equipped, engage lighted vanity mirror connector.
(5) Install screws attaching sun visor to roof (Fig. 121).

REMOVAL AND INSTALLATION (Continued)

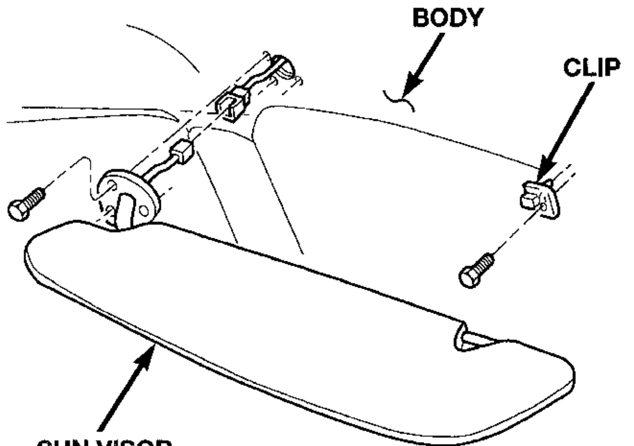

Fig. 121 Sun Visor

HEADLINER

REMOVAL

(1) Remove sun visors and visor hooks.
(2) Remove overhead assist handle.
(3) Remove coat hook(s).
(4) Remove overhead console, if equipped. Refer to Group 8V, Overhead Console for removal procedure.
(5) Remove A-pillar trim.
(6) Remove quarter trim panels.
(7) Remove dome lamp. Refer to Group 8L, Lamps for removal procedure.
(8) If equipped, disengage push-in fasteners attaching headliner to roof panel (Fig. 123).
(9) If equipped, remove upper latch striker cover.
(10) Separate headliner from roof panel (Fig. 122).
(11) Extract headliner through door opening.

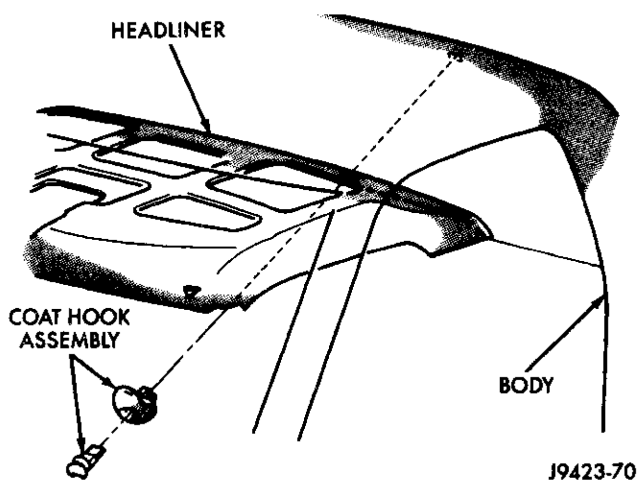

Fig. 122 Headliner

INSTALLATION

(1) Position headliner on roof panel (Fig. 122).
(2) Install passenger side sun visor hook.
(3) Install:
(a) Driver's side coat hook-BR vehicles.

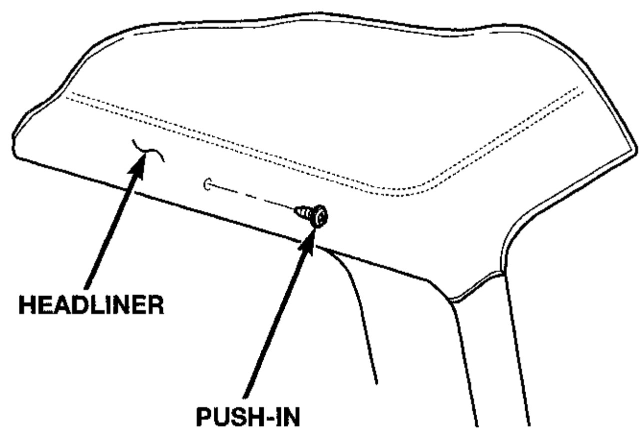

Fig. 123 Headliner Push-In Fasteners

(b) Driver's side rear push-in fasteners-BE vehicles.
(4) Install driver side sun visor hook.
(5) Install right rear push-in fastener-BE vehicles.
(6) Install left and right side coat hooks-BE vehicles.
(7) Install dome lamp.
(8) Install push-in fasteners on each side of dome lamp-BE vehicles.
(9) If equipped, install upper latch striker cover.
(10) Install quarter trim panels.
(11) Install A-pillar trim.
(12) Install overhead console, if equipped. Refer to Group 8V, Overhead Console for installation procedure.
(13) Install overhead assist handle.
(14) Install sun visors.

OVERHEAD ASSIST HANDLE

REMOVAL

(1) Disengage tabs attaching assist handle end covers to assist handle.
(2) Remove screws attaching overhead assist handle to roof rail (Fig. 124).
(3) Separate overhead assist handle from vehicle.

INSTALLATION

Reverse the preceding operation.
(1) Position assist handle on vehicle.
(2) Install screws attaching overhead assist handle to roof rail (Fig. 124).
(3) Install tabs attaching assist handle end covers to assist handle.

COAT HOOK

REMOVAL

(1) Grasp both sides of the coat hook base and firmly pull outward to disengage the coat hook cover from the base. (Fig. 125).

REMOVAL AND INSTALLATION (Continued)

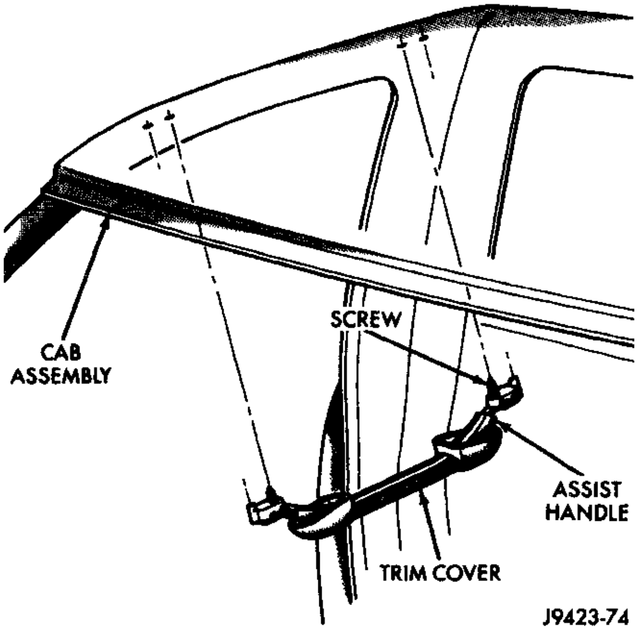

Fig. 124 Overhead Assist Handle

(2) Pull coat hook out of roof panel (Fig. 126).

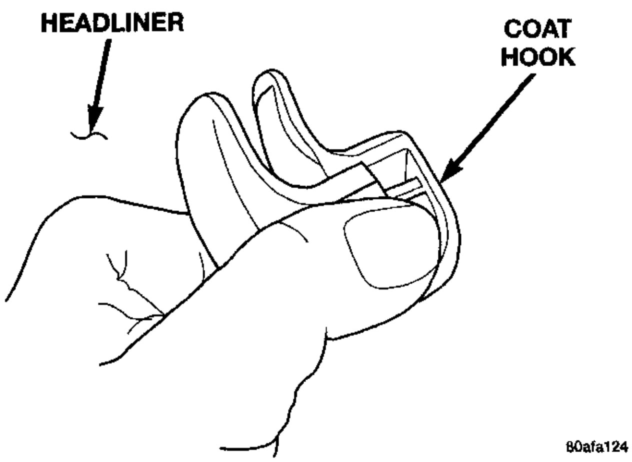

Fig. 125 Coat Hook Removal

INSTALLATION

(1) Position coat hook in roof panel.

(2) Push the coat hook cover inward and secure the coat hook to the roof panel.

ADJUSTMENTS

HOOD

(1) Loosen the hinge arm-to-hood panel bolts at each side of the vehicle.

(2) Loosen the hood latch screws.

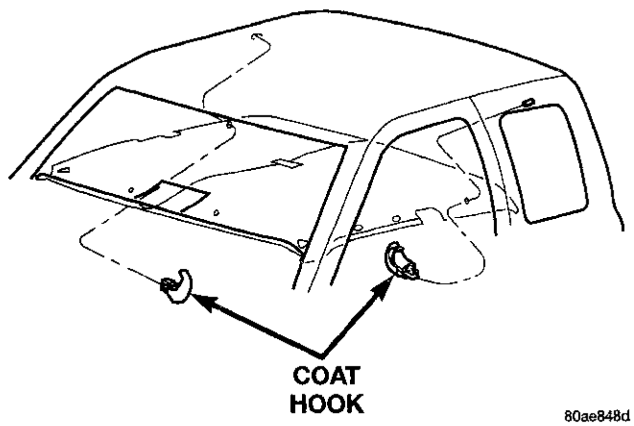

Fig. 126 Coat Hook—Club/Quad Cab

(3) Close the hood. Adjust the fore/aft position.

(4) Raise the hood. Tighten the hinge arm-to-hood panel bolts.

(5) Tighten the latch screws.

(6) Lower the hood. Inspect clearance between the hood and the cowl cover.

HOOD LATCH STRIKER

(1) Open the hood.

(2) Loosen the latch striker screws.

(3) Slowly close the hood and observe the latching operation.

(4) As necessary, re-adjust the striker position. Tighten the screws.

HOOD LATCH

(1) Open the hood.

(2) Loosen the hood latch screws.

(3) Move the latch to the correct location and lightly tighten the screws.

(4) Close the hood slowly and observe the latching operation.

(5) As necessary, re-adjust the latch position and tighten the screws.

FRONT DOOR LATCH

(1) Insert a hex-wrench through the elongated hole in the door end frame near the latch striker opening (Fig. 127).

(2) Loosen torx head screw on the side of the latch linkage.

(3) Lift upward on outside door handle and release it.

(4) Tighten torx head screw on latch.

(5) Verify latch operation.

ADJUSTMENTS (Continued)

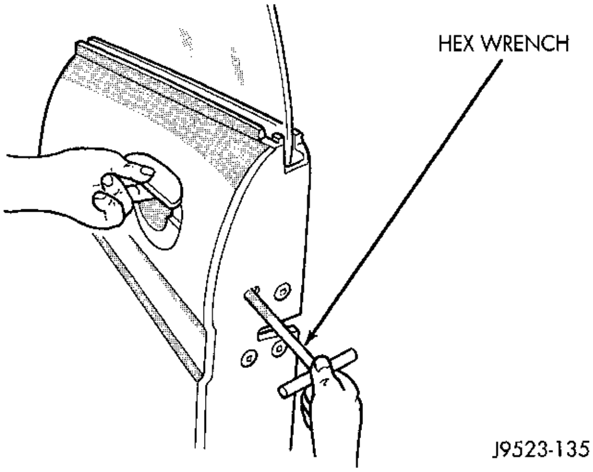

Fig. 127 Door Latch Adjustment

FRONT DOOR FORE/AFT

Fore/aft (lateral) door adjustment is done by loosening the hinge to cowl screws one hinge at a time. Then move the door to the correct position.

(1) Support the door with a padded floor jack.

(2) Loosen the hinge to cowl screws, if necessary, refer to the front door hinge removal/installation procedure for hinge fastener location. Move the door to the correct fore/aft position.

(3) Tighten the hinge to cowl screws.

(4) Remove the floor jack from the door.

FRONT DOOR IN/OUT

In/out door adjustment is done by loosening the hinge to door fasteners. Then move the door to the correct position.

(1) Support the door with a padded floor jack.

(2) Loosen the applicable hinge to door fasteners. Move the door to the correct in/out position.

(3) If necessary, loosen the other hinge to door fasteners and move the door to the correct in/out position.

(4) Tighten the hinge to door fasteners.

(5) Remove the floor jack from the door.

FRONT DOOR UP/DOWN

Up/down door adjustment is done by loosening the hinge to cowl fasteners at both hinges. Then move the door to the correct position.

(1) Support the door with a padded floor jack.

(2) Loosen hinge to cowl fasteners at both hinges. Move the door to the correct up/down position.

(3) Tighten the hinge to cowl fasteners.

(4) Remove the floor jack from the door.

CARGO DOOR

CARGO DOOR FORE/AFT AND UP/DOWN

(1) As applicable, remove the C-pillar trim to access the bolts attaching the cargo door to the C-pillar.

(2) Support the door with a padded floor jack.

(3) Loosen the applicable C-pillar to hinge bolts and move the door to the correct position.

If necessary, loosen the other C-pillar to hinge bolts and move the door to the correct position.

(4) Tighten the bolts to 28 N·m (21 ft. lbs.) torque.

(5) If necessary, loosen the bolts attaching the lower striker and move striker to the correct position.

If necessary, loosen the bolts attaching the upper latch to the cargo door and move to the correct position. (Fig. 128)

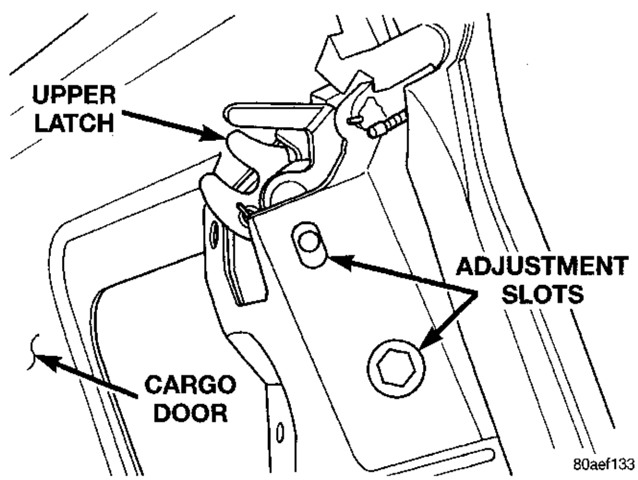

Fig. 128 Cargo Door Upper Latch

CARGO DOOR IN/OUT

(1) Loosen the applicable hinge to door fasteners and move the door to the correct position.

(2) Tighten the bolts to 28 N·m (21 ft. lbs.) torque.

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SPECIFICATIONS

TORQUE SPECIFICATIONS

BODY COMPONENTS

DESCRIPTION	TORQUE
Bench seat front anchor bolt	54 N·m (40 ft. lbs.)
Bench seat rear inboard anchor nut	40 N·m (30 ft. lbs.)
Bench seat rear outboard anchor nut	54 N·m (40 ft. lbs.)
Bench seat, rear seat track to frame bolt	25 N·m (18 ft. lbs.)
Bench seat, front seat track to frame bolt	25 N·m (18 ft. lbs.)
Bench seat, inboard belt/buckle anchor bolt	40 N·m (30 ft. lbs.)
Bench seat back to cushion pivot bolt	25 N·m (18 ft. lbs.)
Cab mounting bolt	81 N·m (60 ft. lbs.)
Cargo box bolt	27 N·m (20 ft. lbs.)
Cargo door to hinge bolt	28 N·m (21 ft. lbs.)
Cargo door hinge to C-pillar bolt	28 N·m (21 ft. lbs.)
Cargo door lower latch nut	12 N·m (9 ft. lbs.)
Cargo door upper latch bolt	23 N·m (17 ft. lbs.)
Cargo door upper striker bolt	23 N·m (17 ft. lbs.)
Cargo door lower striker screw	28 N·m (21 ft. lbs.)
Cargo door vent glass latch screw	5 N·m (45 in. lbs.)
EZ entry track to cushion frame screw	25 N·m (18 ft. lbs.)
EZ entry track to front riser bolt	17 N·m (12 ft. lbs.)
EZ entry track to rear inboard riser bolt	21 N·m (16 ft. lbs.)
EZ entry track to front inboard riser bolt	45 N·m (33 ft. lbs.)
Front shoulder belt upper anchor bolt (conv cab)	39 N·m (28 ft. lbs.)
Front belt buckle inboard anchor nut (conv cab)	45 N·m (33 ft. lbs.)
Front belt retractor anchor bolt (conv cab)	39 N·m (28 ft. lbs.)
Front belt retractor anchor bolt (club/quad cab)	16 N·m (11 ft. lbs.)
Front shoulder belt lower anchor bolt (conv cab)	39 N·m (28 ft. lbs.)
Front shoulder belt lower anchor bolt (club cab)	45 N·m (33 ft. lbs.)
Front door hinge to A-pillar bolt	28 N·m (21 ft. lbs.)
Front door latch screw	11 N·m (8 ft. lbs.)
Front door latch striker screw	28 N·m (21 ft. lbs.)
Front door glass to lift plate screw	9 N·m (7 ft. lbs.)
Rear seat belt anchor nut	40 N·m (30 ft. lbs.)
Rear seat to floor pan bolt	28 N·m (20 ft. lbs.)
Rear shoulder belt upper anchor bolt (quad cab)	40 N·m (30 ft. lbs.)
Rear belt retractor anchor bolt (quad cab)	40 N·m (30 ft. lbs.)
Rear shoulder belt lower anchor bolt (quad cab)	40 N·m (30 ft. lbs.)
Recliner to EZ entry seat track	45 N·m (33 ft. lbs.)
Split bench seat front anchor bolt	54 N·m (40 ft. lbs.)
Split bench seat front anchor bolt (quad cab)	54 N·m (40 ft. lbs.)
Split bench seat rear inboard anchor nut	40 N·m (30 ft. lbs.)
Split bench seat rear inboard anchor nut (quad cab)	40 N·m (30 ft. lbs.)
Split bench seat rear outboard anchor nut	54 N·m (40 ft. lbs.)
Split bench seat rear outboard anchor bolt (quad cab)	54 N·m (40 ft. lbs.)
Split bench seat track to frame bolt	25 N·m (18 ft. lbs.)
Split bench seat back to cushion pivot bolt	25 N·m (18 ft. lbs.)
Split bench seat back to cushion inboard pivot bolt (club cab)	50 N·m (36 ft. lbs.)

Mopar AUTHENTIC RESTORATION™ PRODUCT

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HEATING AND AIR CONDITIONING

CONTENTS

GENERAL INFORMATION

HEATER AND AIR CONDITIONER

All vehicles are equipped with a common heater-A/C housing assembly (Fig. 1). The system combines air conditioning, heating, and ventilating capabilities in a single unit housing mounted under the instrument panel. On heater-only systems, the evaporator coil is omitted from the housing and replaced with an air restrictor plate.

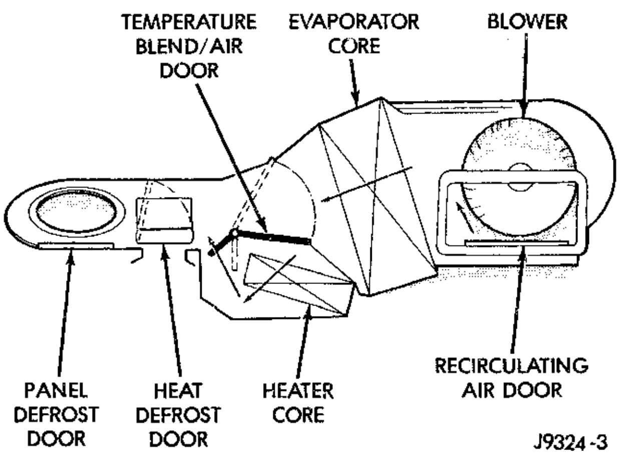

Fig. 1 Common Blend-Air Heater-Air Conditioner System

Outside fresh air enters the vehicle through the cowl top opening at the base of the windshield, and passes through a plenum chamber to the heater-A/C system blower housing (Fig. 2). Air flow velocity can then be adjusted with the blower motor speed selector switch on the heater-A/C control panel. The air intake openings must be kept free of snow, ice, leaves, and other obstructions for the heater-A/C system to receive a sufficient volume of outside air.

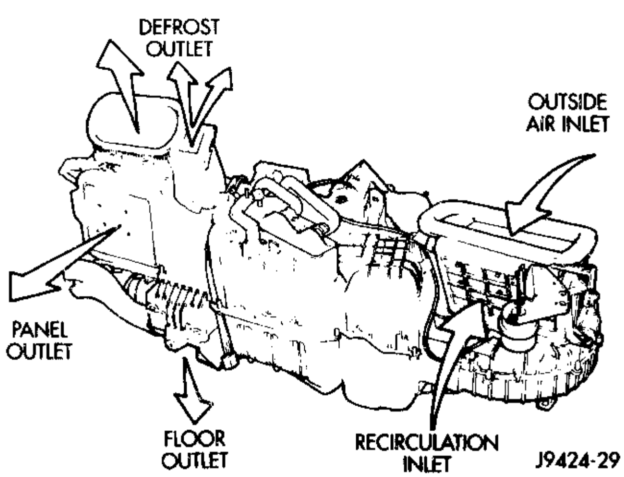

Fig. 2 Heater-A/C System Air Flow (Front View)

It is also important to keep the air intake openings clear of debris because leaf particles and other debris that is small enough to pass through the cowl plenum screen can accumulate within the heater-A/C housing. The closed, warm, damp and dark environment created within the heater-A/C housing is ideal for the growth of certain molds, mildews and other fungi. Any accumulation of decaying plant matter provides an additional food source for fungal spores, which enter the housing with the fresh air. Excess debris, as well as objectionable odors created by decaying plant matter and growing fungi can be discharged into the passenger compartment during heater-A/C system operation.

The heater and optional air conditioner are blend-air type systems. In a blend-air system, a blend-air door controls the amount of unconditioned air (or cooled air from the evaporator on models with air conditioning) that is allowed to flow through, or around, the heater core. A temperature control knob on the heater-A/C control panel determines the discharge air temperature by moving a cable, which operates the blend-air door. This allows an almost immediate manual control of the output air temperature of the system.

The mode control knob on the heater-only or heater-A/C control panel is used to direct the conditioned air to the selected system outlets. Both mode control switches use engine vacuum to control the mode doors, which are operated by vacuum actuator motors.

On air conditioned vehicles, the outside air intake can be shut off by selecting the recirculation mode (Max A/C) with the mode control knob. This will operate a vacuum actuated recirculating air door that closes off the outside fresh air intake and recirculates the air that is already inside the vehicle.

The optional air conditioner for all models is designed for the use of non-CFC, R-134a refrigerant. The air conditioning system has an evaporator to cool and dehumidify the incoming air prior to blending it with the heated air. This air conditioning system uses a fixed orifice tube in the liquid line between the condenser and the evaporator coil to meter refrigerant flow to the evaporator coil. To maintain minimum evaporator temperature and prevent evaporator freezing, a fixed pressure setting switch on the accumulator cycles the compressor clutch.

HEATER AND AIR CONDITIONER CONTROL

Both the heater-only and heater-A/C systems use a combination of mechanical, electrical, and vacuum controls. These controls provide the vehicle operator with a number of setting options to help control the climate and comfort within the vehicle. Refer to the owner's manual in the vehicle glove box for more

Mopar AUTHENTIC RESTORATION PRODUCT

GENERAL INFORMATION (Continued)

information on the features, use, and suggested operation of these controls.

The heater-only or heater-A/C control panel is located to the right of the instrument cluster on the instrument panel. The control panel contains a rotary-type temperature control knob, a rotary-type mode control switch knob, and a rotary-type blower motor speed switch knob. On models with the optional heated mirror system, a momentary push button switch and indicator lamp are located near the bottom of the heater-A/C control panel. Refer to Heated Mirror System in Group 8N - Electrically Heated Systems for more information on this feature.

The heater-only or heater-A/C control panel cannot be repaired. If faulty or damaged, the entire unit must be replaced. The control knobs and the illumination lamps are available for service replacement.

SERVICE WARNINGS AND PRECAUTIONS

WARNING:

- **THE AIR CONDITIONING SYSTEM CONTAINS REFRIGERANT UNDER HIGH PRESSURE. SEVERE PERSONAL INJURY MAY RESULT FROM IMPROPER SERVICE PROCEDURES. REPAIRS SHOULD ONLY BE PERFORMED BY QUALIFIED SERVICE PERSONNEL.**
- **AVOID BREATHING THE REFRIGERANT AND REFRIGERANT OIL VAPOR OR MIST. EXPOSURE MAY IRRITATE THE EYES, NOSE, AND/OR THROAT. WEAR EYE PROTECTION WHEN SERVICING THE AIR CONDITIONING REFRIGERANT SYSTEM. SERIOUS EYE INJURY CAN RESULT FROM DIRECT CONTACT WITH THE REFRIGERANT. IF EYE CONTACT OCCURS, SEEK MEDICAL ATTENTION IMMEDIATELY.**
- **DO NOT EXPOSE THE REFRIGERANT TO OPEN FLAME. POISONOUS GAS IS CREATED WHEN REFRIGERANT IS BURNED. AN ELECTRONIC LEAK DETECTOR IS RECOMMENDED.**
- **IF ACCIDENTAL SYSTEM DISCHARGE OCCURS, VENTILATE THE WORK AREA BEFORE RESUMING SERVICE. LARGE AMOUNTS OF REFRIGERANT RELEASED IN A CLOSED WORK AREA WILL DISPLACE THE OXYGEN AND CAUSE SUFFOCATION.**
- **THE EVAPORATION RATE OF R-134a REFRIGERANT AT AVERAGE TEMPERATURE AND ALTITUDE IS EXTREMELY HIGH. AS A RESULT, ANYTHING THAT COMES IN CONTACT WITH THE REFRIGERANT WILL FREEZE. ALWAYS PROTECT THE SKIN OR DELICATE OBJECTS FROM DIRECT CONTACT WITH THE REFRIGERANT.**
- **THE R-134a SERVICE EQUIPMENT OR THE VEHICLE REFRIGERANT SYSTEM SHOULD NOT BE PRESSURE TESTED OR LEAK TESTED WITH COMPRESSED AIR. SOME MIXTURES OF AIR AND R-134a HAVE BEEN SHOWN TO BE COMBUSTIBLE AT ELEVATED PRESSURES. THESE MIXTURES ARE POTENTIALLY DANGEROUS, AND MAY RESULT IN FIRE OR EXPLOSION CAUSING INJURY OR PROPERTY DAMAGE.**

CAUTION:

- **Liquid refrigerant is corrosive to metal surfaces. Follow the operating instructions supplied with the service equipment being used.**
- **Never add R-12 to a refrigerant system designed to use R-134a. Damage to the system will result.**
- **R-12 refrigerant oil must not be mixed with R-134a refrigerant oil. They are not compatible.**
- **Do not use R-12 equipment or parts on the R-134a system. Damage to the system will result.**
- **Do not overcharge the refrigerant system. This will cause excessive compressor head pressure and can cause noise and system failure.**
- **Recover the refrigerant before opening any fitting or connection. Open the fittings with caution, even after the system has been discharged. Never open or loosen a connection before recovering the refrigerant.**
- **Do not remove the secondary retention clip from any spring-lock coupler connection while the refrigerant system is under pressure. Recover the refrigerant before removing the secondary retention clip. Open the fittings with caution, even after the system has been discharged. Never open or loosen a connection before recovering the refrigerant.**
- **The refrigerant system must always be evacuated before charging.**
- **Do not open the refrigerant system or uncap a replacement component until you are ready to service the system. This will prevent contamination in the system.**
- **Before disconnecting a component, clean the outside of the fittings thoroughly to prevent contamination from entering the refrigerant system.**
- **Immediately after disconnecting a component from the refrigerant system, seal the open fittings with a cap or plug.**
- **Before connecting an open refrigerant fitting, always install a new seal or gasket. Coat the fitting and seal with clean refrigerant oil before connecting.**

Mopar AUTHENTIC RESTORATION

GENERAL INFORMATION (Continued)

- **Do not remove the sealing caps from a replacement component until it is to be installed.**
- **When installing a refrigerant line, avoid sharp bends that may restrict refrigerant flow. Position the refrigerant lines away from exhaust system components or any sharp edges, which may damage the line.**
- **Tighten refrigerant fittings only to the specified torque. The aluminum fittings used in the refrigerant system will not tolerate overtightening.**
- **When disconnecting a refrigerant fitting, use a wrench on both halves of the fitting. This will prevent twisting of the refrigerant lines or tubes.**
- **Refrigerant oil will absorb moisture from the atmosphere if left uncapped. Do not open a container of refrigerant oil until you are ready to use it. Replace the cap on the oil container immediately after using. Store refrigerant oil only in a clean, airtight, and moisture-free container.**
- **Keep service tools and the work area clean. Contamination of the refrigerant system through careless work habits must be avoided.**

COOLING SYSTEM REQUIREMENTS

To maintain the performance level of the heating-air conditioning system, the engine cooling system must be properly maintained. The use of a bug screen is not recommended. Any obstructions in front of the radiator or condenser will reduce the performance of the air conditioning and engine cooling systems.

The engine cooling system includes the heater core and the heater hoses. Refer to Group 7 - Cooling System for more information before the opening of, or attempting any service to the engine cooling system.

REFRIGERANT HOSES/LINES/TUBES PRECAUTIONS

Kinks or sharp bends in the refrigerant plumbing will reduce the capacity of the entire system. High pressures are produced in the system when it is operating. Extreme care must be exercised to make sure that all refrigerant system connections are pressure tight.

A good rule for the flexible hose refrigerant lines is to keep the radius of all bends at least ten times the diameter of the hose. Sharp bends will reduce the flow of refrigerant. The flexible hose lines should be routed so they are at least 80 millimeters (3 inches) from the exhaust manifold. It is a good practice to inspect all flexible refrigerant system hose lines at least once a year to make sure they are in good condition and properly routed.

There are two types of refrigerant fittings:

- All fittings with O-rings need to be coated with refrigerant oil before installation. Use only O-rings that are the correct size and approved for use with R-134a refrigerant. Failure to do so may result in a leak.
- Unified plumbing connections with gaskets cannot be serviced with O-rings. The gaskets are not reusable and new gaskets do not require lubrication before installing.

Using the proper tools when making a refrigerant plumbing connection is very important. Improper tools or improper use of the tools can damage the refrigerant fittings. Always use two wrenches when loosening or tightening tube fittings. Use one wrench to hold one side of the connection stationary, while loosening or tightening the other side of the connection with a second wrench.

The refrigerant must be recovered completely from the system before opening any fitting or connection. Open the fittings with caution, even after the refrigerant has been recovered. If any pressure is noticed as a fitting is loosened, tighten the fitting and recover the refrigerant from the system again.

Do not discharge refrigerant into the atmosphere. Use an R-134a refrigerant recovery/recycling device that meets SAE Standard J2210.

The refrigerant system will remain chemically stable as long as pure, moisture-free R-134a refrigerant and refrigerant oil is used. Dirt, moisture, or air can upset this chemical stability. Operational troubles or serious damage can occur if foreign material is present in the refrigerant system.

When it is necessary to open the refrigerant system, have everything needed to service the system ready. The refrigerant system should not be left open to the atmosphere any longer than necessary. Cap or plug all lines and fittings as soon as they are opened to prevent the entrance of dirt and moisture. All lines and components in parts stock should be capped or sealed until they are to be installed.

All tools, including the refrigerant recycling equipment, the manifold gauge set, and test hoses should be kept clean and dry. All tools and equipment must be designed for R-134a refrigerant.

DESCRIPTION AND OPERATION

ACCUMULATOR

The accumulator is mounted in the engine compartment between the evaporator coil outlet tube and the compressor inlet. Refrigerant enters the accumulator canister as a low pressure vapor through the inlet tube.

Any liquid, oil-laden refrigerant falls to the bottom of the canister, which acts as a separator. A desiccant bag is mounted inside the accumulator canister to absorb any moisture which may have entered and

DESCRIPTION AND OPERATION (Continued)

become trapped within the refrigerant system (Fig. 3)

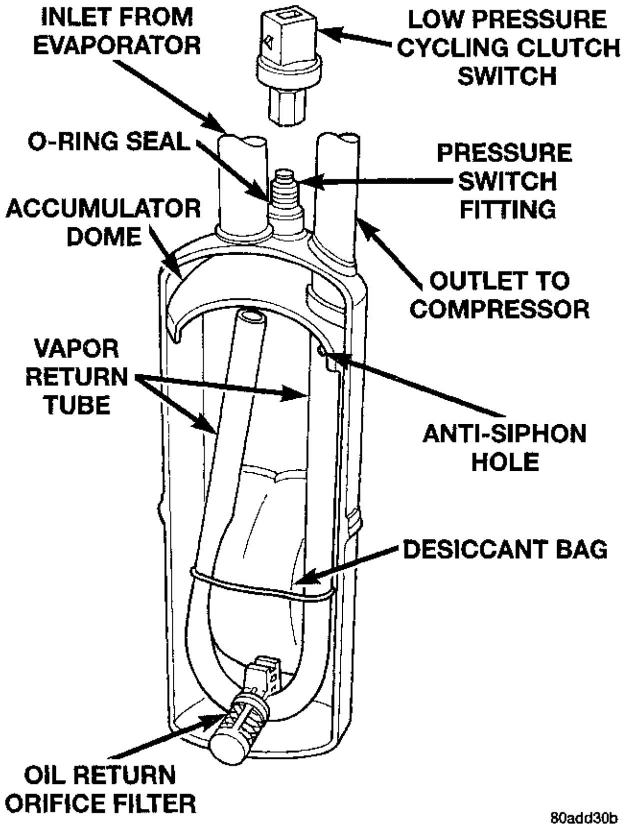

Fig. 3 Accumulator - Typical

BLOWER MOTOR

The blower motor and blower wheel are located in the passenger side end of the heater-A/C housing, below the glove box. The blower motor controls the velocity of the air flowing through the heater-A/C housing by spinning a squirrel cage-type blower wheel within the housing at the selected speed. The blower motor and blower wheel can be serviced from the passenger compartment side of the housing.

The blower motor will only operate when the ignition switch is in the On position, and the heater-A/C mode control switch knob is in any position, except Off. The blower motor receives a fused battery feed through the blower motor relay whenever the ignition switch is in the On position.

The blower motor battery feed circuit is protected by a fuse in the Power Distribution Center (PDC). The blower motor relay control circuit is protected by a fuse in the junction block. Blower motor speed is controlled by regulating the ground path through the heater-A/C mode control switch, the blower motor switch, and the blower motor resistor.

The blower motor and blower wheel cannot be repaired and, if faulty or damaged, they must be replaced. The blower motor and blower wheel are each serviced separately.

BLOWER MOTOR RELAY

The blower motor relay is a International Standards Organization (ISO)-type relay. The relay is a electromechanical device that switches battery current from a fuse in the Power Distribution Center (PDC) directly to the blower motor. The relay is energized when the relay coil is provided a voltage signal by the ignition switch. This arrangement reduces the amount of battery current that must flow through the ignition switch.

The blower motor relay control circuit is protected by a fuse located in the junction block. When the relay is de-energized, the blower motor receives no battery current. See Blower Motor Relay in the Diagnosis and Testing section of this group for more information.

The blower motor relay is located in the PDC in the engine compartment. Refer to the PDC label for blower motor relay identification and location.

The blower motor relay cannot be repaired and, if faulty or damaged, it must be replaced.

BLOWER MOTOR RESISTOR

The blower motor resistor is mounted to the bottom of the heater-A/C housing, under the instrument panel and just inboard of the blower motor. It can be accessed without removing any other components.

The resistor has multiple resistor wires, each of which will change the resistance in the blower motor ground path to change the blower motor speed. The blower motor switch directs the ground path through the correct resistor wire to obtain the selected blower motor speed.

With the blower motor switch in the lowest speed position, the ground path for the motor is applied through all of the resistor wires. Each higher speed selected with the blower motor switch applies the blower motor ground path through fewer of the resistor wires, increasing the blower motor speed. When the blower motor switch is in the highest speed position, the blower motor resistor is bypassed and the blower motor receives a direct path to ground.

The blower motor resistor cannot be repaired and, if faulty or damaged, it must be replaced.

BLOWER MOTOR SWITCH

The heater-only or heater-A/C blower motor is controlled by a four position rotary-type blower motor switch, mounted in the heater-A/C control panel. The switch allows the selection of one of four blower motor speeds, but can only be turned off by selecting the Off position with the heater-A/C mode control switch knob.

DESCRIPTION AND OPERATION (Continued)

The blower motor switch directs the blower motor ground path through the mode control switch to the blower motor resistor, or directly to ground, as required to achieve the selected blower motor speed.

The blower motor switch cannot be repaired and, if faulty or damaged, the entire heater-only or heater-A/C control unit must be replaced. The blower motor switch knob is serviced separately.

COMPRESSOR

The air conditioning system uses a Sanden SD7H15 seven cylinder, reciprocating wobble plate-type compressor on all models. This compressor has a fixed displacement of 150 cubic centimeters (9.375 cubic inches), and has both the suction and discharge ports located on the cylinder head. A label identifying the use of R-134a refrigerant is located on the compressor.

The compressor is driven by the engine through an electric clutch, drive pulley and belt arrangement. The compressor is lubricated by refrigerant oil that is circulated throughout the refrigerant system with the refrigerant.

The compressor draws in low-pressure refrigerant vapor from the evaporator through its suction port. It then compresses the refrigerant into a high-pressure, high-temperature refrigerant vapor, which is then pumped to the condenser through the compressor discharge port.

The compressor cannot be repaired. If faulty or damaged, the entire compressor assembly must be replaced. The compressor clutch, pulley and clutch coil are available for service.

COMPRESSOR CLUTCH

The compressor clutch assembly consists of a stationary electromagnetic coil, a hub bearing and pulley assembly, and a clutch plate (Fig. 4). The electromagnetic coil unit and the hub bearing and pulley assembly are each retained on the nose of the compressor front housing with snap rings. The clutch plate is mounted to the compressor shaft and secured with a nut.

These components provide the means to engage and disengage the compressor from the engine serpentine accessory drive belt. When the clutch coil is energized, it magnetically draws the clutch into contact with the pulley and drives the compressor shaft. When the coil is not energized, the pulley freewheels on the clutch hub bearing, which is part of the pulley. The compressor clutch and coil are the only serviced parts on the compressor.

The compressor clutch engagement is controlled by several components: the heater-A/C mode control switch, the low pressure cycling clutch switch, the high pressure cut-off switch, the compressor clutch

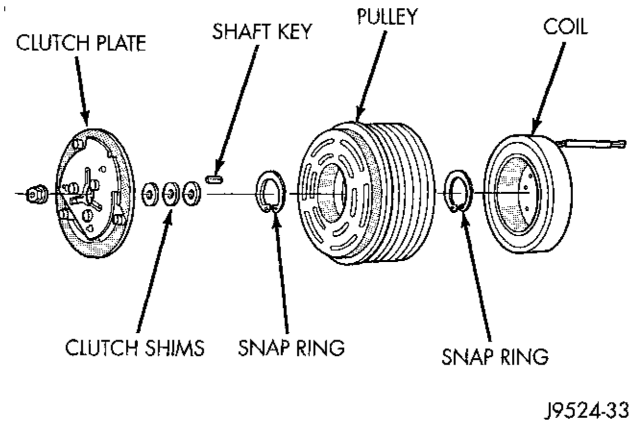

Fig. 4 Compressor Clutch - Typical

relay, and the Powertrain Control Module (PCM). The PCM may delay compressor clutch engagement for up to thirty seconds. Refer to Group 14 - Fuel System for more information on the PCM controls.

COMPRESSOR CLUTCH RELAY

The compressor clutch relay is a International Standards Organization (ISO) micro-relay. The terminal designations and functions are the same as a conventional ISO relay. However, the micro-relay terminal orientation (footprint) is different, the current capacity is lower, and the relay case dimensions are smaller than those of the conventional ISO relay.

The compressor clutch relay is a electromechanical device that switches battery current to the compressor clutch coil when the Powertrain Control Module (PCM) grounds the coil side of the relay. The PCM responds to inputs from the heater-A/C mode control switch, the low pressure cycling clutch switch, and the high pressure cut-off switch. See Compressor Clutch Relay in the Diagnosis and Testing section of this group for more information.

The compressor clutch relay is located in the Power Distribution Center (PDC) in the engine compartment. Refer to the PDC label for relay identification and location.

The compressor clutch relay cannot be repaired and, if faulty or damaged, it must be replaced.

CONDENSER

The condenser is located in the air flow in front of the engine cooling radiator. The condenser is a heat exchanger that allows the high-pressure refrigerant gas being discharged by the compressor to give up its heat to the air passing over the condenser fins. When the refrigerant gas gives up its heat, it condenses. When the refrigerant leaves the condenser, it has become a high-pressure liquid refrigerant.

The volume of air flowing over the condenser fins is critical to the proper cooling performance of the air

DESCRIPTION AND OPERATION (Continued)

conditioning system. Therefore, it is important that there are no objects placed in front of the radiator grille openings in the front of the vehicle or foreign material on the condenser fins that might obstruct proper air flow. Also, any factory-installed air seals or shrouds must be properly reinstalled following radiator or condenser service.

The condenser cannot be repaired and, if faulty or damaged, it must be replaced.

EVAPORATOR COIL

The evaporator coil is located in the heater-A/C housing, under the instrument panel. The evaporator coil is positioned in the heater-A/C housing so that all air that enters the housing must pass over the fins of the evaporator before it is distributed through the system ducts and outlets. However, air passing over the evaporator coil fins will only be conditioned when the compressor is engaged and circulating refrigerant through the evaporator coil tubes.

Refrigerant enters the evaporator from the fixed orifice tube as a low-temperature, low-pressure liquid. As air flows over the fins of the evaporator, the humidity in the air condenses on the fins, and the heat from the air is absorbed by the refrigerant. Heat absorption causes the refrigerant to boil and vaporize. The refrigerant becomes a low-pressure gas before it leaves the evaporator.

The evaporator coil cannot be repaired and, if faulty or damaged, it must be replaced.

FIXED ORIFICE TUBE

The fixed orifice tube is installed in the liquid line between the outlet of the condenser and the inlet of the evaporator. The fixed orifice tube is only serviced as an integral part of the liquid line.

The inlet end of the fixed orifice tube has a nylon mesh filter screen, which filters the refrigerant and helps to reduce the potential for blockage of the metering orifice by refrigerant system contaminants (Fig. 5). The outlet end of the tube has a nylon mesh diffuser screen. The O-rings on the plastic body of the fixed orifice tube seal the tube to the inside of the liquid line and prevent the refrigerant from bypassing the fixed metering orifice.

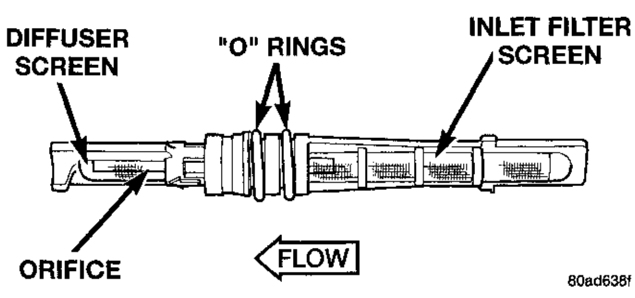

Fig. 5 Fixed Orifice Tube - Typical

The fixed orifice tube is used to meter the flow of liquid refrigerant into the evaporator coil. The high-pressure liquid refrigerant from the condenser expands into a low-pressure liquid as it passes through the metering orifice and diffuser screen of the fixed orifice tube.

The fixed orifice tube cannot be repaired and, if faulty or plugged, the liquid line assembly must be replaced.

HEATER CORE

The heater core is located in the heater-A/C housing, under the instrument panel. It is a heat exchanger made of rows of tubes and fins. Engine coolant is circulated through heater hoses to the heater core at all times. As the coolant flows through the heater core, heat removed from the engine is transferred to the heater core fins and tubes.

Air directed through the heater core picks up the heat from the heater core fins. The blend air door allows control of the heater output air temperature by controlling how much of the air flowing through the heater-A/C housing is directed through the heater core. The blower motor speed controls the volume of air flowing through the heater-A/C housing.

The heater core cannot be repaired and, if faulty or damaged, it must be replaced. Refer to Group 7 - Cooling System for more information on the engine cooling system, the engine coolant and the heater hoses.

HIGH PRESSURE CUT-OFF SWITCH

The high pressure cut-off switch is located on the discharge line near the compressor. The switch is screwed onto a fitting that contains a Schrader-type valve, which allows the switch to be serviced without discharging the refrigerant system. The discharge line fitting is equipped with an O-ring to seal the switch connection.

The high pressure cut-off switch is connected in series electrically with the low pressure cycling clutch switch between ground and the Powertrain Control Module (PCM). The switch contacts open and close causing the PCM to turn the compressor clutch on and off. This prevents compressor operation when the discharge line pressure approaches high levels.

The high pressure cut-off switch contacts are open when the discharge line pressure rises above about 3100 to 3375 kPa (450 to 490 psi). The switch contacts will close when the discharge line pressure drops to about 1860 to 2275 kPa (270 to 330 psi). When checking refrigerant system pressures with a manifold gauge set, keep in mind that the indicated pressures will be about 172 kpa (25 psi) below the actual switch pressure values due to the pressure

DESCRIPTION AND OPERATION (Continued)

drop that occurs in the refrigerant system between the switch and the high pressure service port.

The high pressure cut-off switch is a factory-calibrated unit. The switch cannot be adjusted or repaired and, if faulty or damaged, it must be replaced.

HIGH PRESSURE RELIEF VALVE

A high pressure relief valve is located on the compressor cylinder head, which is at the rear of the compressor. This mechanical valve is designed to vent refrigerant from the system to protect against damage to the compressor and other system components, caused by condenser air flow restriction or an overcharge of refrigerant.

The high pressure relief valve vents the system when a discharge pressure of 3445 to 4135 kPa (500 to 600 psi) or above is reached. The valve closes with a minimum discharge pressure of 2756 kPa (400 psi) is reached.

The high pressure relief valve vents only enough refrigerant to reduce the system pressure, and then re-seats itself. The majority of the refrigerant is conserved in the system. If the valve vents refrigerant, it does not mean the valve is faulty.

The high pressure relief valve is a factory-calibrated unit. The valve cannot be adjusted or repaired, and must not be removed or otherwise disturbed. The valve is only serviced as a part of the compressor assembly.

LOW PRESSURE CYCLING CLUTCH SWITCH

The low pressure cycling clutch switch is located on the top of the accumulator. The switch is screwed onto an accumulator fitting that contains a Schrader-type valve, which allows the switch to be serviced without discharging the refrigerant system. The accumulator fitting is equipped with an O-ring to seal the switch connection.

The low pressure cycling clutch switch is connected in series electrically with the high pressure cut-off switch and the heater-A/C controls, between ground and the Powertrain Control Module (PCM). The switch contacts open and close causing the PCM to turn the compressor clutch on and off. This regulates the refrigerant system pressure and controls evaporator temperature. Controlling evaporator temperature prevents condensate water on the evaporator fins from freezing and obstructing air conditioning system air flow.

The low pressure cycling clutch switch contacts are open when the suction pressure is about 172 kPa (25 psi) or lower. The switch contacts will close when the suction pressure rises to about 296 kPa (43 psi) or above. Lower ambient temperatures, below about -1° C (30° F), will also cause the switch contacts to open. This is due to the pressure/temperature relationship of the refrigerant in the system.

The low pressure cycling clutch switch is a factory-calibrated unit. It cannot be adjusted or repaired and, if faulty or damaged, it must be replaced.

REFRIGERANT

The refrigerant used in this air conditioning system is a HydroFluoroCarbon (HFC), type R-134a. Unlike R-12, which is a ChloroFluoroCarbon (CFC), R-134a refrigerant does not contain ozone-depleting chlorine. R-134a refrigerant is a non-toxic, non-flammable, clear, and colorless liquefied gas.

Even though R-134a does not contain chlorine, it must be reclaimed and recycled just like CFC-type refrigerants. This is because R-134a is a greenhouse gas and can contribute to global warming.

R-134a refrigerant is not compatible with R-12 refrigerant in an air conditioning system. Even a small amount of R-12 added to an R-134a refrigerant system will cause compressor failure, refrigerant oil sludge or poor air conditioning system performance. In addition, the PolyAlkylene Glycol (PAG) synthetic refrigerant oils used in an R-134a refrigerant system are not compatible with the mineral-based refrigerant oils used in an R-12 refrigerant system.

R-134a refrigerant system service ports, service tool couplers and refrigerant dispensing bottles have all been designed with unique fittings to ensure that an R-134a system is not accidentally contaminated with the wrong refrigerant (R-12). There are also labels posted in the engine compartment of the vehicle and on the compressor identifying to service technicians that the air conditioning system is equipped with R-134a.

REFRIGERANT LINE

The refrigerant lines and hoses are used to carry the refrigerant between the various air conditioning system components. A barrier hose design with a nylon tube inner hose liner is used for the R-134a air conditioning system on this vehicle. This nylon liner helps to further contain the R-134a refrigerant, which has a smaller molecular structure than R-12 refrigerant. The ends of the refrigerant hoses are made from lightweight aluminum, and use braze-less fittings.

Any kinks or sharp bends in the refrigerant plumbing will reduce the capacity of the entire air conditioning system. Kinks and sharp bends reduce the flow of refrigerant in the system. A good rule for the flexible hose refrigerant lines is to keep the radius of all bends at least ten times the diameter of the hose. In addition, the flexible hose refrigerant lines should be routed so they are at least 80 millimeters (3 inches) from the exhaust manifold.

Mopar AUTHENTIC RESTORATION PRODUCT

DESCRIPTION AND OPERATION (Continued)

High pressures are produced in the refrigerant system when the air conditioning compressor is operating. Extreme care must be exercised to make sure that each of the refrigerant system connections is pressure-tight and leak free. It is a good practice to inspect all flexible hose refrigerant lines at least once a year to make sure they are in good condition and properly routed.

The refrigerant lines and hoses cannot be repaired and, if faulty or damaged, they must be replaced.

REFRIGERANT LINE COUPLER

Spring-lock type refrigerant line couplers are used to connect many of the refrigerant lines and other components to the refrigerant system. These couplers require a special tool for disengaging the two coupler halves.

The spring-lock coupler is held together by a garter spring inside a circular cage on the male half of the fitting (Fig. 6). When the two coupler halves are connected, the flared end of the female fitting slips behind the garter spring inside the cage on the male fitting. The garter spring and cage prevent the flared end of the female fitting from pulling out of the cage

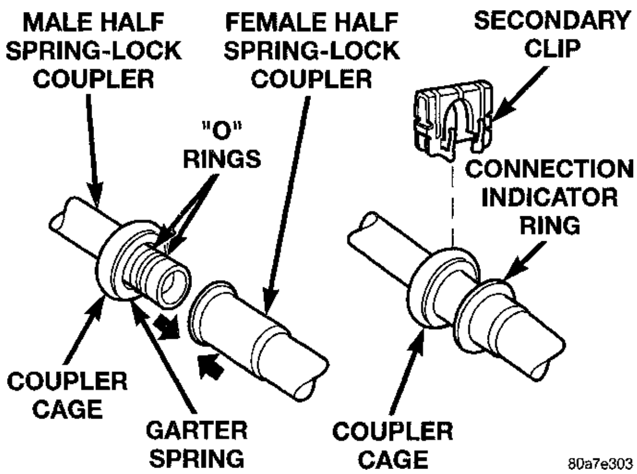

Fig. 6 Spring-Lock Coupler - Typical

Two O-rings on the male half of the fitting are used to seal the connection. These O-rings are compatible with R-134a refrigerant and must be replaced with O-rings made of the same material.

Secondary clips are installed over the two connected coupler halves at the factory for added blowoff protection. In addition, a plastic ring is used at the factory as a visual indicator to confirm that these couplers are connected. After the coupler is connected, the plastic indicator ring is no longer needed; however, it will remain on the refrigerant line near the coupler cage.

REFRIGERANT OIL

The refrigerant oil used in R-134a refrigerant systems is a synthetic-based, PolyAlkylene Glycol (PAG), wax-free lubricant. Mineral-based R-12 refrigerant oils are not compatible with PAG oils, and should never be introduced to an R-134a refrigerant system.

There are different PAG oils available, and each contains a different additive package. The SD7H15 compressor used in this vehicle is designed to use an SP-20 PAG refrigerant oil. Use only refrigerant oil of this same type to service the refrigerant system.

After performing any refrigerant recovery or recycling operation, always replenish the refrigerant system with the same amount of the recommended refrigerant oil as was removed. Too little refrigerant oil can cause compressor damage, and too much can reduce air conditioning system performance.

PAG refrigerant oil is much more hygroscopic than mineral oil, and will absorb any moisture it comes into contact with, even moisture in the air. The PAG oil container should always be kept tightly capped until it is ready to be used. After use, recap the oil container immediately to prevent moisture contamination.

REFRIGERANT SYSTEM SERVICE EQUIPMENT

WARNING: EYE PROTECTION MUST BE WORN WHEN SERVICING AN AIR CONDITIONING REFRIGERANT SYSTEM. TURN OFF (ROTATE CLOCKWISE) ALL VALVES ON THE EQUIPMENT BEING USED, BEFORE CONNECTING TO OR DISCONNECTING FROM THE REFRIGERANT SYSTEM. FAILURE TO OBSERVE THESE WARNINGS MAY RESULT IN PERSONAL INJURY.

When servicing the air conditioning system, a R-134a refrigerant recovery/recycling/charging station that meets SAE Standard J2210 must be used. Contact an automotive service equipment supplier for refrigerant recovery/recycling/charging equipment. Refer to the operating instructions supplied by the equipment manufacturer for the proper care and use of this equipment.

A manifold gauge set may be needed with some recovery/recycling/charging equipment (Fig. 7). The service hoses on the gauge set being used should have manual (turn wheel), or automatic back-flow valves at the service port connector ends. This will prevent refrigerant from being released into the atmosphere.

MANIFOLD GAUGE SET CONNECTIONS

CAUTION: Do not use an R-12 manifold gauge set on an R-134a system. The refrigerants are not compatible and system damage will result.

DESCRIPTION AND OPERATION (Continued)

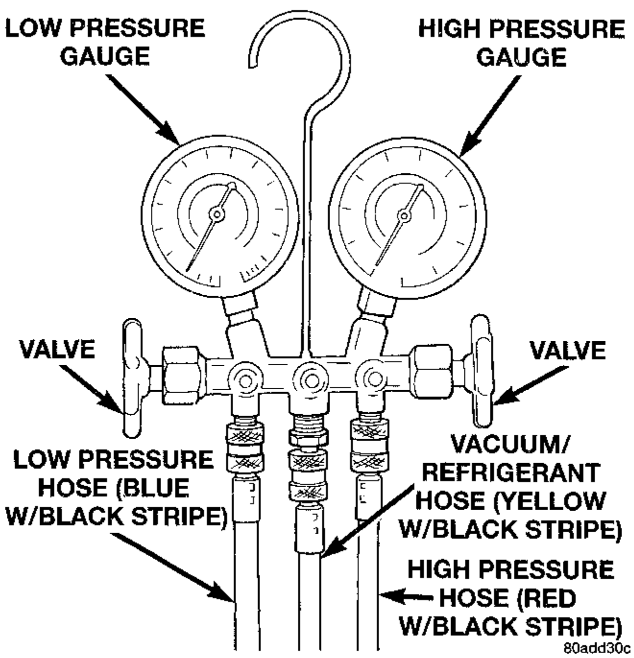

Fig. 7 Manifold Gauge Set - Typical

LOW PRESSURE GAUGE HOSE

The low pressure hose (Blue with Black stripe) attaches to the suction service port. This port is located on the suction line, near the accumulator outlet.

HIGH PRESSURE GAUGE HOSE

The high pressure hose (Red with Black stripe) attaches to the discharge service port. This port is located on the liquid line between the condenser and the evaporator, near the front of the engine compartment.

RECOVERY/RECYCLING/EVACUATION/CHARGING HOSE

The center manifold hose (Yellow, or White, with Black stripe) is used to recover, evacuate, and charge the refrigerant system. When the low or high pressure valves on the manifold gauge set are opened, the refrigerant in the system will escape through this hose.

REFRIGERANT SYSTEM SERVICE PORT

The two refrigerant system service ports are used to charge, recover/recycle, evacuate, and test the air conditioning refrigerant system. Unique service port coupler sizes are used on the R-134a system, to ensure that the refrigerant system is not accidentally contaminated by the use of the wrong refrigerant (R-12), or refrigerant system service equipment.

The high pressure service port is located on the liquid line between the condenser and the evaporator, near the front of the engine compartment. The low pressure service port is located on the suction line, near the accumulator outlet.

Each of the service ports has a threaded plastic protective cap installed over it from the factory. After servicing the refrigerant system, always reinstall both of the service port caps.

VACUUM CHECK VALVE

On models with a gasoline engine, a vacuum check valve is installed in the accessory vacuum supply line near the vacuum tap on the right side of the engine intake manifold. On models with a diesel engine, a vacuum check valve is installed on the engine vacuum pump. The vacuum check valve is designed to allow vacuum to flow in only one direction through the accessory vacuum supply circuits.

The use of a vacuum check valve helps to maintain the system vacuum needed to retain the selected heater-A/C mode and vehicle speed control settings. On gasoline engine models, it prevents the engine from bleeding down system vacuum through the intake manifold during extended heavy engine load (low engine vacuum) operation. On diesel engine models, it prevents oil from contaminating the vacuum supply system by maintaining vacuum in the pump after engine shut-off.

On gasoline engine models, a second vacuum check valve is installed in the accessory vacuum supply line at the tee fitting near the dash panel in the engine compartment. This check valve also helps to maintain the system vacuum needed to retain the selected heater-A/C mode settings, but isolates the heater-A/C vacuum circuit from the vehicle speed control vacuum circuit. It prevents the vehicle speed control servo from bleeding down the heater-A/C system vacuum during extended heavy engine load operation.

The vacuum check valve cannot be repaired and, if faulty or damaged, it must be replaced.

VACUUM RESERVOIR

Models equipped with a gasoline engine have a vacuum reservoir. The vacuum reservoir is mounted in the passenger side cowl plenum area, under the cowl plenum cover/grille panel. The cowl plenum cover/grille panel must be removed from the vehicle to access the vacuum reservoir for service.

Engine vacuum is stored in the vacuum reservoir. The stored vacuum is used to operate the vacuum-controlled vehicle accessories during periods of low engine vacuum such as when the vehicle is climbing a steep grade, or under other high engine load operating conditions.

The vacuum reservoir cannot be repaired and, if faulty or damaged, it must be replaced.

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DIAGNOSIS AND TESTING

A/C PERFORMANCE

The air conditioning system is designed to provide the passenger compartment with low temperature and low humidity air. The evaporator, located in the heater-A/C housing on the dash panel below the instrument panel, is cooled to temperatures near the freezing point. As warm damp air passes through the cooled evaporator, the air transfers its heat to the refrigerant in the evaporator tubes and the moisture in the air condenses on the evaporator fins. During periods of high heat and humidity, an air conditioning system will be more effective in the recirculation mode (Max-A/C). With the system in the recirculation mode, only air from the passenger compartment passes through the evaporator. As the passenger compartment air dehumidifies, the air conditioning system performance levels improve.

Humidity has an important bearing on the temperature of the air delivered to the interior of the vehicle. It is important to understand the effect that humidity has on the performance of the air conditioning system. When humidity is high, the evaporator has to perform a double duty. It must lower the air temperature, and it must lower the temperature of the moisture in the air that condenses on the evaporator fins. Condensing the moisture in the air transfers heat energy into the evaporator fins and tubing. This reduces the amount of heat the evaporator can absorb from the air. High humidity greatly reduces the ability of the evaporator to lower the temperature of the air.

However, evaporator capacity used to reduce the amount of moisture in the air is not wasted. Wringing some of the moisture out of the air entering the vehicle adds to the comfort of the passengers. Although, an owner may expect too much from their air conditioning system on humid days. A performance test is the best way to determine whether the system is performing up to standard. This test also provides valuable clues as to the possible cause of trouble with the air conditioning system.

Review the Service Warnings and Precautions in the General Information section near the front of this group before performing this procedure. The air temperature in the test room and in the vehicle must be a minimum of 21° C (70° F) for this test.

(1) Connect a tachometer and a manifold gauge set.

(2) Set the heater-A/C mode control switch knob in the recirculation mode (Max-A/C) position, the temperature control knob in the full cool position, and the blower motor switch in the highest speed position.

(3) Start the engine and hold the idle speed at 1,000 rpm with the compressor clutch engaged. If the compressor clutch does not engage, see the A/C Diagnosis chart in the Diagnosis and Testing section of this group.

(4) The engine should be at operating temperature. The doors and windows must be open and the hood must be mostly closed.

(5) Insert a thermometer in the driver side center A/C (panel) outlet. Operate the engine for five minutes.

(6) The compressor clutch may cycle, depending upon the ambient temperature and humidity. If the clutch cycles, unplug the low pressure cycling clutch switch wire harness connector from the switch located on the accumulator (Fig. 8). Place a jumper wire between the two cavities of the low pressure cycling clutch switch wire harness connector.

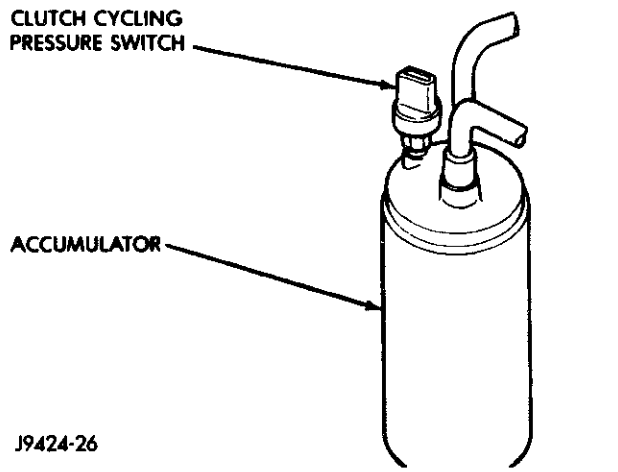

Fig. 8 Low Pressure Cycling Clutch Switch - Typical

(7) With the compressor clutch engaged, record the panel outlet discharge air temperature, the discharge pressure (high side), and the suction pressure (low side).

(8) Compare the panel outlet discharge air temperature reading to the Performance Temperature and Pressure chart. If the temperature reading is high, clamp off both heater hoses (inlet and outlet), wait five minutes and record the temperature again. Compare the second reading to the Performance Temperature and Pressure chart. If the temperature reading is now OK, see Temperature Control Cable in the Removal and Installation section and in the Adjustments section of this group. If the temperature reading is still too high, see Refrigerant System Leaks in the Diagnosis and Testing section of this group, and Refrigerant System Charge in the Service Procedures section of this group .

(9) Compare the discharge (high side) and suction (low side) pressure readings to the Performance Temperature and Pressure chart. If the pressures are abnormal, see the A/C Diagnosis chart in the Diagnosis and Testing section of this group.

Mopar AUTHENTIC RESTORATION PRODUCT

DIAGNOSIS AND TESTING (Continued)

Performance Temperature and Pressure						
Ambient Temperature	**21° C (70° F)**	**27° C (80° F)**	**32° C (90° F)**	**38° C (100° F)**	**43° C (110° F)**	**49° C (120° F)**
Center Panel OutletDischarge Air Temperature	5 to 7° C (40 to 45° F)	13 to 16° C (55 to 60° F)	16 to 21° C (60 to 70° F)	21 to 24° C (70 to 75° F)	27 to 29° C (80 to 85° F)	29 to 32° C (85 to 90° F)
*Suction Pressure (Low Side)	241 to 276 kPa (35 to 40 psi)	276 to 345 kPa (40 to 50 psi)	345 to 414 kPa (50 to 60 psi)	414 to 483 kPa (60 to 70 psi)	483 to 552 kPa (70 to 80 psi)	552 to 586 kPa (85 to 90 psi)
*Discharge Pressure (High Side)	931 to 1000 kPa (135 to 145 psi)	1207 to 1482 kPa (175 to 215 psi)	1482 to 1862 kPa (215 to 270 psi)	1862 to 2275 kPa (270 to 330 psi)	2344 to 2551 kPa (340 to 370 psi)	2758 to 2965 kPa (400 to 430 psi)
*Note: If pressures are lower than shown, but center panel outlet discharge air temperatures are OK, then the A/C system is OK.						

A/C Diagnosis		
Condition	**Possible Causes**	**Correction**
RAPID COMPRESSOR CLUTCH CYCLING (TEN OR MORE CYCLES PER MINUTE).	1. Low refrigerant system charge. 2. Faulty low pressure cycling clutch switch. 3. Faulty Powertrain Control Module (PCM).	1. See Refrigerant System Leaks in the Diagnosis and Testing section of this group. Test the refrigerant system for leaks. Repair, evacuate and charge the refrigerant system, if required. 2. See Low Pressure Cycling Clutch Switch in the Diagnosis and Testing section of this group. Test the low pressure cycling clutch switch and replace, if required. 3. Refer to the proper Diagnostic Procedures manual for testing of the PCM. Test the PCM and replace, if required.
EQUAL PRESSURES, BUT THE COMPRESSOR CLUTCH DOES NOT ENGAGE.	1. No refrigerant in the refrigerant system. 2. Faulty fuse. 3. Faulty compressor clutch coil. 4. Faulty compressor clutch relay. 5. Improperly installed or faulty low pressure cycling clutch switch. 6. Faulty high pressure cut-off switch. 7. Faulty Powertrain Control Module (PCM). 8. Faulty heater-A/C control.	1. See Refrigerant System Leaks in the Diagnosis and Testing section of this group. Test the refrigerant system for leaks. Repair, evacuate and charge the refrigerant system, if required. 2. Check the fuses in the Power Distribution Center and the junction block. Repair the shorted circuit or component and replace the fuses, if required. 3. See Compressor Clutch Coil in the Diagnosis and Testing section of this group. Test the compressor clutch coil and replace, if required. 4. See Compressor Clutch Relay in the Diagnosis and Testing section of this group. Test the compressor clutch relay and relay circuits. Repair the circuits or replace the relay, if required. 5. See Low Pressure Cycling Clutch Switch in the Diagnosis and Testing section of this group. Test the low pressure cycling clutch switch and tighten or replace, if required. 6. See High Pressure Cut-Off Switch in the Diagnosis and Testing section of this group. Test the high pressure cut-off switch and replace, if required. 7. Refer to the proper Diagnostic Procedures manual for testing of the PCM. Test the PCM and replace, if required. 8. See Heater-A/C Control in the Diagnosis and Testing section of this group. Test the heater-A/C control and replace, if required.

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DIAGNOSIS AND TESTING (Continued)

A/C Diagnosis		
Condition	**Possible Causes**	**Correction**
NORMAL PRESSURES, BUT A/C PERFORMANCE TEST AIR TEMPERATURES AT CENTER PANEL OUTLET ARE TOO HIGH.	1. Excessive refrigerant oil in system. 2. Temperature control cable improperly installed or faulty. 3. Blend-air door inoperative, obstructed or sealing improperly.	1. See Refrigerant Oil Level in the Service Procedures section of this group. Recover the refrigerant from the refrigerant system and inspect the refrigerant oil content. Restore the refrigerant oil to the proper level, if required. 2. See Temperature Control Cable in the Removal and Installation and Adjustments sections of this group. Inspect the temperature control cable for proper routing, operation and adjustment. Repair as required. 3. See Heater-A/C Housing Door in the Removal and Installation section of this group. Inspect the blend-air door for proper operation and sealing and correct, if required.
LOW SIDE PRESSURE IS NORMAL OR SLIGHTLY LOW, AND HIGH SIDE PRESSURE IS TOO LOW.	1. Low refrigerant system charge. 2. Refrigerant flow through the accumulator is restricted. 3. Refrigerant flow through the evaporator coil is restricted. 4. Faulty compressor.	1. See Refrigerant System Leaks in the Diagnosis and Testing section of this group. Test the refrigerant system for leaks. Repair, evacuate and charge the refrigerant system, if required. 2. See Accumulator in the Removal and Installation section of this group. Replace the restricted accumulator, if required. 3. See Evaporator Coil in the Removal and Installation section of this group. Replace the restricted evaporator coil, if required. 4. See Compressor in the Diagnosis and Testing section of this group. Replace the compressor, if required.
LOW SIDE PRESSURE IS NORMAL OR SLIGHTLY HIGH, AND HIGH SIDE PRESSURE IS TOO HIGH.	1. Condenser air flow restricted. 2. Inoperative cooling fan. 3. Refrigerant system overcharged. 4. Air in the refrigerant system. 5. Engine overheating.	1. Check the condenser for damaged fins, foreign objects obstructing air flow through the condenser fins, and missing or improperly installed air seals. Refer to Group 7 - Cooling System for more information on air seals. Clean, repair, or replace components as required. 2. Refer to Group 7 - Cooling System for more information. Test the cooling fan and replace, if required. 3. See Refrigerant System Charge in the Service Procedures section of this group. Recover the refrigerant from the refrigerant system. Charge the refrigerant system to the proper level, if required. 4. See Refrigerant System Leaks in the Diagnosis and Testing section of this group. Test the refrigerant system for leaks. Repair, evacuate and charge the refrigerant system, if required. 5. Refer to Group 7 - Cooling System for more information. Test the cooling system and repair, if required.
LOW SIDE PRESSURE IS TOO HIGH, AND HIGH SIDE PRESSURE IS TOO LOW.	1. Accessory drive belt slipping. 2. Fixed orifice tube not installed. 3. Faulty compressor.	1. Refer to Group 7 - Cooling System for more information. Inspect the accessory drive belt condition and tension. Tighten or replace the accessory drive belt, if required. 2. See Fixed Orifice Tube in the Diagnosis and Testing section of this group. Install the missing fixed orifice tube, if required. 3. See Compressor in the Diagnosis and Testing section of this group. Replace the compressor, if required.

AUTHENTIC RESTORATION PRODUCT

DIAGNOSIS AND TESTING (Continued)

A/C Diagnosis		
Condition	**Possible Causes**	**Correction**
LOW SIDE PRESSURE IS TOO LOW, AND HIGH SIDE PRESSURE IS TOO HIGH.	1. Restricted refrigerant flow through the refrigerant lines. 2. Restricted refrigerant flow through the fixed orifice tube. 3. Restricted refrigerant flow through the condenser.	1. See Liquid Line and Suction and Discharge Line in the Removal and Installation section of this group. Inspect the refrigerant lines for kinks, tight bends or improper routing. Correct the routing or replace the refrigerant line, if required. 2. See Fixed Orifice Tube in the Diagnosis and Testing section of this group. Replace the restricted fixed orifice tube, if required. 3. See Condenser in the Removal and Installation section of this group. Replace the restricted condenser, if required.

HEATER PERFORMANCE

Before performing the following tests, refer to Group 7 - Cooling System for the procedures to check the engine coolant level and flow, engine coolant reserve/recovery system operation, accessory drive belt condition and tension, radiator air flow and the fan drive operation. Also be certain that the accessory vacuum supply line is connected at the engine vacuum source.

MAXIMUM HEATER OUTPUT

Engine coolant is delivered to the heater core through two heater hoses. With the engine idling at normal operating temperature, set the temperature control knob in the full hot position, the mode control switch knob in the floor position, and the blower motor switch knob in the highest speed position. Using a test thermometer, check the temperature of the air being discharged at the heater-A/C housing floor outlets. Compare the test thermometer reading to the Temperature Reference chart.

If the floor outlet air temperature is too low, refer to Group 7 - Cooling System to check the engine coolant temperature specifications. Both of the heater hoses should be hot to the touch. The coolant return heater hose should be slightly cooler than the coolant supply heater hose. If the return hose is much cooler than the supply hose, locate and repair the engine coolant flow obstruction in the cooling system. Refer to Group 7 - Cooling System for the procedures.

An alternate method of checking heater performance is to use a DRB scan tool to monitor the engine coolant temperature. The floor outlet air temperature reading should be no more than 4.5° C (40° F) lower than the engine coolant temperature reading.

OBSTRUCTED COOLANT FLOW

Possible locations or causes of obstructed coolant flow:

- Faulty water pump.
- Faulty thermostat.
- Pinched or kinked heater hoses.
- Improper heater hose routing.
- Plugged heater hoses or supply and return ports at the cooling system connections.
- A plugged heater core.

If proper coolant flow through the cooling system is verified, and heater outlet air temperature is still low, a mechanical problem may exist.

MECHANICAL PROBLEMS

Possible locations or causes of insufficient heat:

- An obstructed cowl air intake.
- Obstructed heater system outlets.
- A faulty, obstructed or improperly installed blend-air door.
- The temperature control cable is not connected, or is not routed or adjusted properly.
- A faulty blower system.
- A faulty heater-A/C control.

Temperature Reference				
Ambient Air Temperature	15.5° C (60° F)	21.1° C (70° F)	26.6° C (80° F)	32.2° C (90° F)
Minimum Air Temperature at Floor Outlet	62.2° C (144° F)	63.8° C (147° F)	65.5° C (150° F)	67.2° C (153° F)

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DIAGNOSIS AND TESTING (Continued)

TEMPERATURE CONTROL

If the heater outlet air temperature cannot be adjusted with the temperature control knob on the heater-A/C control panel, the following could require service:

- A faulty heater-A/C control.
- The temperature control cable is not connected, or is not routed or adjusted properly.
- A faulty, obstructed or improperly installed blend-air door.
- An obstructed cowl air intake.
- The engine cooling system.

HEATER-A/C CONTROL

Satisfactory heater and air conditioner performance depends upon proper operation and adjustment of all operating controls and refrigeration system components. For circuit descriptions and diagrams, refer to 8W-42 - Air Conditioning/Heater in Group 8W - Wiring Diagrams. These inspections, tests, and adjustments should be used to locate the cause of a malfunction.

Operation must be tested as described in the following sequence:

(1) Move the temperature control knob quickly to the full hot and the full cold positions. There should be a distinct sound of the blend-air door hitting its stops within the heater-A/C housing at the end of knob travel in each direction, with no spring-back of the knob. If not OK, inspect the condition, routing, installation and adjustment of the temperature control cable. See Temperature Control Cable in the Removal and Installation section and in the Adjustments section of this group for more information.

(2) Inspect and adjust the serpentine drive belt. Refer to Group 7 - Cooling System for the procedures.

(3) Start the engine and hold the idle speed at 1,300 rpm.

(4) On vehicles with air conditioning, turn the temperature control knob to the extreme counterclockwise (Cool) position, and set the mode control switch knob in the Bi-Level (A/C) position. The outside (recirculation) air door should be open to outside air. If not OK, see Vacuum System in the Diagnosis and Testing section of this group.

(5) Open the vehicle windows. Test the blower motor operation in all speeds. If not OK, see Blower Motor in the Diagnosis and Testing section of this group. Leave the blower motor switch knob in the highest speed position.

(6) On vehicles with air conditioning, the compressor should be running and the air conditioning system in operation unless the ambient air temperature is below about -1° C (30° F). If not OK, see A/C Performance in the Diagnosis and Testing section of this group.

(7) Check the mode control switch operation. The heater and air conditioner systems should respond as

Heater Diagnosis		
Condition	**Possible Cause**	**Correction**
INSUFFICIENT HEATER OUTPUT.	1. Incorrect engine coolant level. 2. Air trapped in engine cooling system. 3. Incorrect engine coolant temperature. 4. Temperature control cable improperly installed or not adjusted. 5. Blend-air door not operating properly. 6. Insufficient air flow through heater housing. 7. Improper blower motor operation.	1. Check the engine coolant level. Refer to Group 7 - Cooling System for the procedures. 2. Check the operation of the coolant reserve/recovery system. Refer to Group 7 - Cooling System for the procedures. 3. Check the performance and operation of the engine cooling system including: thermostat, water pump, fan drive, accessory drive belt, coolant flow (plugged radiator or heater core, plugged or kinked coolant hoses), air flow (missing or improperly installed radiator air seals or fan shroud). Refer to Group 7 - Cooling System for the procedures. 4. See Temperature Control Cable in the Removal and Installation and in the Adjustments sections of this group. 5. Check for a damaged, obstructed or improperly installed blend-air door or seals. See Heater-A/C Housing Door in the Removal and Installation section of this group. 6. Remove foreign material or obstructions from cowl air intake. 7. See Blower Motor in the Diagnosis and Testing section of this group.

DIAGNOSIS AND TESTING (Continued)

described in the owner's manual in the vehicle glove box to each mode selected. Reduce the engine speed to normal idle. The vacuum will be high at low idle and the vacuum actuators should respond quickly. If not OK, see Vacuum System in the Diagnosis and Testing section of this group.

(8) If the vacuum tests, and the electrical component and circuit tests reveal no problems, disassemble the heater-A/C housing to inspect for mechanical misalignment or binding of the mode doors.

VACUUM SYSTEM

Vacuum control is used to operate the mode doors in the heater-only and heater-A/C housings. Testing of the heater-only and heater-A/C mode control switch operation will determine if the vacuum, electrical, and mechanical controls are functioning. However, it is possible that a vacuum control system that operates perfectly at engine idle (high engine vacuum) may not function properly at high engine speeds or loads (low engine vacuum). This can be caused by leaks in the vacuum system, or by a faulty or improperly installed vacuum check valve.

A vacuum system test will help to identify the source of poor vacuum system performance or vacuum system leaks. Before starting this test, stop the engine and make certain that the problem is not a disconnected vacuum supply tube at the engine vacuum source or the vacuum reservoir.

Use an adjustable vacuum test set (Special Tool C-3707) and a suitable vacuum pump to test the heater-A/C vacuum control system. With a finger placed over the end of the vacuum test hose probe (Fig. 9), adjust the bleed valve on the test set gauge to obtain a vacuum of exactly 27 kPa (8 in. Hg.). Release and block the end of the probe several times to verify that the vacuum reading returns to the exact 27 kPa (8 in. Hg.) setting. Otherwise, a false reading will be obtained during testing.

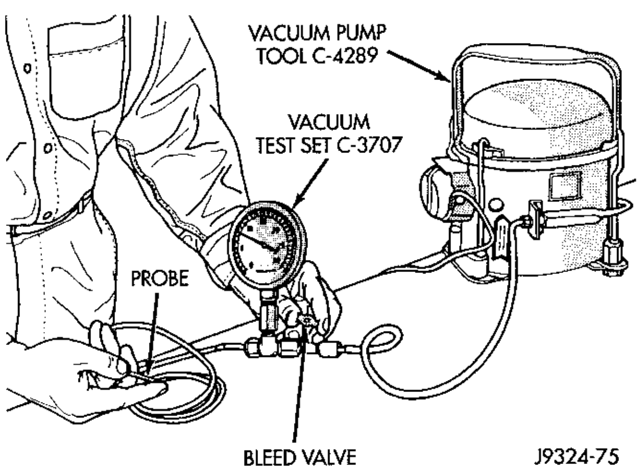


Fig. 9 Adjust Vacuum Test Bleed Valve

VACUUM CHECK VALVE

(1) Remove the vacuum check valve. On gasoline engines, one valve is located in the vacuum supply tube (black) at the intake manifold tap on the right side of the engine. A second check valve is located next to the tee fitting in the vacuum supply tube (black) near the dash panel in the engine compartment. On diesel engines, the vacuum check valve is integral to the engine vacuum pump nipple and is threaded into the vacuum pump. The vacuum check valve must be removed in order to perform the following tests. See Vacuum Check Valve in the Removal and Installation section of this group for the procedures.

(2) Connect the test set vacuum supply hose to the heater-A/C control side of the valve. When connected to this side of the check valve, no vacuum should pass and the test set gauge should return to the 27 kPa (8 in. Hg.) setting. If OK, go to step Step 3. If not OK, replace the faulty valve.

(3) Connect the test set vacuum supply hose to the engine vacuum side of the valve. When connected to this side of the check valve, vacuum should flow through the valve without restriction. If not OK, replace the faulty valve.

HEATER-A/C CONTROLS

(1) Connect the test set vacuum probe to the heater-A/C vacuum supply (black) tube in the engine compartment. Position the test set gauge so that it can be viewed from the passenger compartment.

(2) Place the heater-A/C mode control switch knob in each mode position, one position at a time, and pause after each selection. The test set gauge should return to the 27 kPa (8 in. Hg.) setting shortly after each selection is made. If not OK, a component or vacuum line in the vacuum circuit of the selected mode has a leak. See Locating Vacuum Leaks in the Diagnosis and Testing section of this group.

CAUTION: Do not use lubricant on the switch ports or in the holes in the plug, as lubricant will ruin the vacuum valve in the switch. A drop of clean water in the connector plug holes will help the connector slide onto the switch ports.

DIAGNOSIS AND TESTING (Continued)

LOCATING VACUUM LEAKS

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(1) Disconnect the vacuum harness connector located between the heater-A/C control and the heater-A/C housing under the instrument panel.

(2) Connect the test set vacuum hose probe to each port in the heater-A/C housing half of the vacuum harness connector, one port at a time, and pause after each connection (Fig. 10). The test set gauge should return to the 27 kPa (8 in. Hg.) setting shortly after each connection is made. If OK, replace the faulty heater-A/C control. If not OK, go to step Step 3.

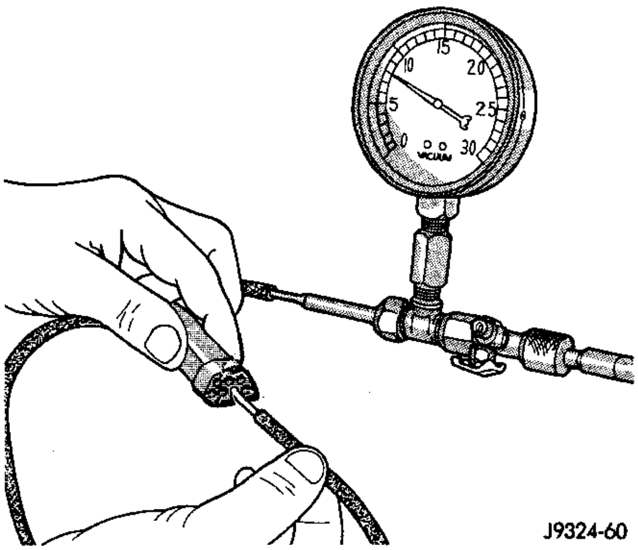


Fig. 10 Vacuum Circuit Test

(3) Determine the vacuum line color of the vacuum circuit that is leaking. To determine the vacuum line colors, see the Vacuum Circuits chart (Fig. 11).

(4) Disconnect and plug the vacuum line from the component (fitting, actuator, valve, switch, or reservoir) on the other end of the leaking circuit. Instrument panel disassembly or removal may be necessary to gain access to some components. See the Removal and Installation section of this group for more information.

(5) Connect the test set hose or probe to the open end of the leaking circuit. The test set gauge should return to the 27 kPa (8 in. Hg.) setting shortly after each connection is made. If OK, replace the faulty disconnected component. If not OK, go to Step 6.

(6) To locate a leak in a vacuum line, leave one end of the line plugged and connect the test set hose or probe to the other end of the line. Run your fingers slowly along the line while watching the test set gauge. The vacuum reading will fluctuate when your fingers contact the source of the leak. To repair the vacuum line, cut out the leaking section of the line. Then, insert the loose ends of the line into a suitable length of 3 millimeter (0.125 inch) inside diameter rubber hose.

BLOWER MOTOR

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

For circuit descriptions and diagrams, refer to 8W-42 - Air Conditioning/Heater in Group 8W - Wiring Diagrams. Possible causes of an inoperative blower motor include:

- Faulty fuse
- Faulty blower motor circuit wiring or wire harness connectors
- Faulty blower motor resistor
- Faulty blower motor relay
- Faulty blower motor switch
- Faulty heater-A/C mode control switch
- Faulty blower motor.

Possible causes of the blower motor not operating in all speeds include:

- Faulty fuse
- Faulty blower motor switch
- Faulty blower motor resistor
- Faulty blower motor relay
- Faulty blower motor circuit wiring or wire harness connectors.

VIBRATION

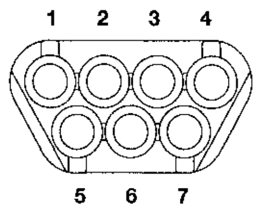
Possible causes of blower motor vibration include:

- Improper blower motor mounting
- Improper blower wheel mounting
- Blower wheel out of balance or deformed
- Blower motor faulty.

NOISE

To verify that the blower is the source of the noise, unplug the blower motor wire harness connector and

DIAGNOSIS AND TESTING (Continued)



HEATER-A/C VACUUM HARNESS CONNECTOR – HOUSING HALF (VIEWED FROM ENGAGEMENT END)

VACUUM CIRCUIT LEGEND		
ID	FUNCTION	COLOR
1	RECIRCULATION ACTUATOR	GREEN
2	DEFROST/FLOOR ACTUATOR	RED
3	VACUUM RESERVOIR	BLACK
4	NOT USED	N/A
5	DEFROST/FLOOR ACTUATOR	BROWN
6	PANEL/DEFROST ACTUATOR	YELLOW
7	NOT USED	N/A

HEATER ONLY

MODE KNOB POSITION	PORTS/TUBE COLOR						
	DK GRN	RED	BLK	LT BLU	BRN	YEL	LT GRN
	1	2	3	4	5	6	7
OFF	●	❍	●	N	❍	●	N
				O			O
				T			T
BI-LEVEL	❍	●	●	/	❍	●	/
PANEL	❍	❍	●	U	❍	●	U
FLOOR	❍	●	●	S	●	❍	S
FLOOR/DEFROST	❍	●	●	E	❍	❍	E
DEFROST	❍	❍	●	D	❍	❍	D

● = VACUUM
❍ = VENTED

HEATER - A/C

MODE KNOB POSITION	PORTS/TUBE COLOR							CLUTCH RELAY
	DK GRN	RED	BLK	LT BLU	BRN	YEL	LT GRN	
	1	2	3	4	5	6	7	
OFF	●	❍	●	N	❍	●	N	OFF
MAX A/C	●	❍	●	O	❍	●	O	ON
PANEL A/C	❍	❍	●	T	❍	●	T	ON
BI-LEVEL A/C	❍	●	●	/	❍	●	/	ON
PANEL	❍	❍	●	U	❍	●	U	OFF
FLOOR	❍	●	●	S	●	❍	S	OFF
FLOOR/DEFROST	❍	●	●	E	❍	❍	E	ON
DEFROST	❍	❍	●	D	❍	❍	D	ON

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Fig. 11 Vacuum Circuits

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DIAGNOSIS AND TESTING (Continued)

operate the heater-A/C system. If the noise goes away, possible causes include:

- Foreign material in the heater-A/C housing
- Improper blower motor mounting
- Improper blower wheel mounting
- Blower motor faulty.

BLOWER MOTOR RELAY

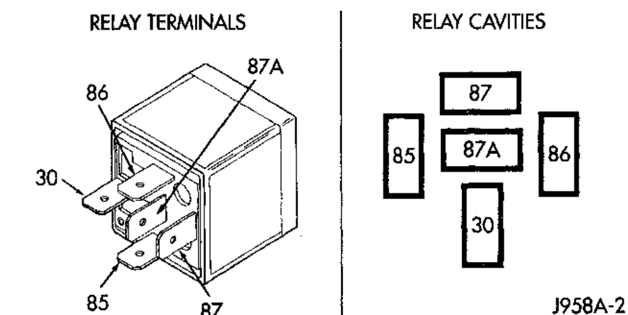
RELAY TEST

The blower motor relay (Fig. 12) is located in the Power Distribution Center (PDC). Remove the blower motor relay from the PDC as described in this group to perform the following tests:

(1) A relay in the de-energized position should have continuity between terminals 87A and 30, and no continuity between terminals 87 and 30. If OK, go to Step 2. If not OK, replace the faulty relay.

(2) Resistance between terminals 85 and 86 (electromagnet) should be 75 ± 5 ohms. If OK, go to Step 3. If not OK, replace the faulty relay.

(3) Connect a battery to terminals 85 and 86. There should now be continuity between terminals 30 and 87, and no continuity between terminals 87A and 30. If OK, see Relay Circuit Test in the Diagnosis and Testing section of this group. If not OK, replace the faulty relay.



TERMINAL LEGEND	
NUMBER	IDENTIFICATION
30	COMMON FEED
85	COIL GROUND
86	COIL BATTERY
87	NORMALLY OPEN
87A	NORMALLY CLOSED

Fig. 12 Blower Motor Relay

RELAY CIRCUIT TEST

For circuit descriptions and diagrams, refer to 8W-42 - Air Conditioning/Heater in Group 8W - Wiring Diagrams.

(1) The relay common feed terminal cavity (30) is connected to fused battery feed directly from a fuse in the Power Distribution Center (PDC), and should be hot at all times. Check for battery voltage at the PDC cavity for relay terminal 30. If OK, go to Step 2. If not OK, repair the open circuit to the PDC fuse as required.

(2) The relay normally closed terminal cavity (87A) is not used for this application. Go to Step 3.

(3) The relay normally open terminal cavity (87) is connected to the blower motor. When the relay is energized, terminal 87 is connected to terminal 30 and provides full battery current to the blower motor feed circuit. There should be continuity between the PDC cavity for terminal 87 and the blower motor relay output circuit cavity of the blower motor wire harness connector at all times. If OK, go to Step 4. If not OK, repair the open circuit to the blower motor as required.

(4) The coil battery terminal cavity (86) is connected to the ignition switch. When the ignition switch is placed in the On position, fused ignition switch output is directed from a fuse in the junction block to the relay electromagnetic coil to energize the relay. There should be battery voltage at the PDC cavity for relay terminal 86 with the ignition switch in the On position. If OK, go to Step 5. If not OK, repair the open circuit to the junction block fuse as required.

(5) The coil ground terminal cavity (85) is connected to ground. This terminal supplies the ground for the relay electromagnetic coil. There should be continuity between the PDC cavity for relay terminal 85 and a good ground at all times. If not OK, repair the open circuit as required.

BLOWER MOTOR RESISTOR

For circuit descriptions and diagrams, refer to 8W-42 - Air Conditioning/Heater in Group 8W - Wiring Diagrams.

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(1) Disconnect and isolate the battery negative cable.

(2) Unplug the wire harness connector from the blower motor resistor.

(3) Check for continuity between each of the blower motor switch input terminals of the resistor and the resistor output terminal. In each case there should be continuity. If OK, repair the wire harness circuits between the blower motor switch and the blower motor resistor or blower motor as required. If not OK, replace the faulty blower motor resistor.

DIAGNOSIS AND TESTING (Continued)

BLOWER MOTOR SWITCH

For circuit descriptions and diagrams, refer to 8W-42 - Air Conditioning/Heater in Group 8W - Wiring Diagrams.

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(1) Check for battery voltage at the fuse in the Power Distribution Center (PDC). If OK, go to Step 2. If not OK, repair the shorted circuit or component as required and replace the faulty fuse.

(2) Turn the ignition switch to the Off position. Disconnect and isolate the battery negative cable. Remove the heater-A/C control from the instrument panel. Check for continuity between the ground circuit cavity of the heater-A/C control wire harness connector and a good ground. There should be continuity. If OK, go to Step 3. If not OK, repair the open circuit to ground as required.

(3) With the heater-A/C control wire harness connector unplugged, place the heater-A/C mode control switch knob in any position except the Off position. Check for continuity between the ground circuit terminal and each of the blower motor driver circuit terminals of the heater-A/C control as you move the blower motor switch knob to each of the four speed positions. There should be continuity at each driver circuit terminal in only one blower motor switch speed position. If OK, test and repair the blower driver circuits between the heater-A/C control connector and the blower motor resistor as required. If not OK, replace the faulty heater-A/C control unit.

COMPRESSOR

When investigating an air conditioning related noise, you must first know the conditions under which the noise occurs. These conditions include: weather, vehicle speed, transmission in gear or neutral, engine speed, engine temperature, and any other special conditions. Noises that develop during air conditioning operation can often be misleading. For example: What sounds like a failed front bearing or connecting rod, may be caused by loose bolts, nuts, mounting brackets, or a loose compressor clutch assembly.

Drive belts are speed sensitive. At different engine speeds and depending upon belt tension, belts can develop noises that are mistaken for a compressor noise. Improper belt tension can cause a misleading noise when the compressor clutch is engaged, which may not occur when the compressor clutch is disengaged. Check the serpentine drive belt condition and tension as described in Group 7 - Cooling System before beginning this procedure.

(1) Select a quiet area for testing. Duplicate the complaint conditions as much as possible. Switch the compressor on and off several times to clearly identify the compressor noise. Listen to the compressor while the clutch is engaged and disengaged. Probe the compressor with an engine stethoscope or a long screwdriver with the handle held to your ear to better localize the source of the noise.

(2) Loosen all of the compressor mounting hardware and retighten. Tighten the compressor clutch mounting nut. Be certain that the clutch coil is mounted securely to the compressor, and that the clutch plate and pulley are properly aligned and have the correct air gap. See Compressor and Compressor Clutch in the Removal and Installation section of this group for the procedures.

(3) To duplicate a high-ambient temperature condition (high head pressure), restrict the air flow through the condenser. Install a manifold gauge set to be certain that the discharge pressure does not exceed 2760 kPa (400 psi).

(4) Check the refrigerant system plumbing for incorrect routing, rubbing or interference, which can cause unusual noises. Also check the refrigerant lines for kinks or sharp bends that will restrict refrigerant flow, which can cause noises. See Suction and Discharge Line in the Removal and Installation section of this group for more information.

(5) If the noise is from opening and closing of the high pressure relief valve, evacuate and recharge the refrigerant system. See Refrigerant System Evacuate and Refrigerant System Charge in the Service Procedures section of this group. If the high pressure relief valve still does not seat properly, replace the compressor.

(6) If the noise is from liquid slugging on the suction line, replace the accumulator. See Accumulator in the Removal and Installation section of this group for the procedures. Check the refrigerant oil level and the refrigerant system charge. See Refrigerant Oil Level and Refrigerant System Charge in the Service Procedures section of this group. If the liquid slugging condition continues following accumulator replacement, replace the compressor.

(7) If the noise continues, replace the compressor and repeat Step 1.

COMPRESSOR CLUTCH COIL

For circuit descriptions and diagrams, refer to 8W-42 - Air Conditioning/Heater in Group 8W - Wiring Diagrams. The battery must be fully-charged

DIAGNOSIS AND TESTING (Continued)

before performing the following tests. Refer to Group 8A - Battery for more information.

(1) Connect an ammeter (0 to 10 ampere scale) in series with the clutch coil terminal. Use a voltmeter (0 to 20 volt scale) with clip-type leads for measuring the voltage across the battery and the compressor clutch coil.

(2) With the heater-A/C mode control switch in any A/C mode, and the blower motor switch in the lowest speed position, start the engine and run it at normal idle.

(3) The compressor clutch coil voltage should read within two volts of the battery voltage. If there is voltage at the clutch coil, but the reading is not within two volts of the battery voltage, test the clutch coil feed circuit for excessive voltage drop and repair as required. If there is no voltage reading at the clutch coil, use a DRB scan tool and the proper Diagnostic Procedures manual for testing of the compressor clutch circuit. The following components must be checked and repaired as required before you can complete testing of the clutch coil:

- Fuses in the junction block and the Power Distribution Center (PDC)
- Heater-A/C mode control switch
- Compressor clutch relay
- High pressure cut-off switch
- Low pressure cycling clutch switch
- Powertrain Control Module (PCM).

(4) The compressor clutch coil is acceptable if the current draw measured at the clutch coil is 2.0 to 3.9 amperes with the electrical system voltage at 11.5 to 12.5 volts. This should only be checked with the work area temperature at 21° C (70° F). If system voltage is more than 12.5 volts, add electrical loads by turning on electrical accessories until the system voltage drops below 12.5 volts.

(a) If the clutch coil current reading is four amperes or more, the coil is shorted and should be replaced.

(b) If the clutch coil current reading is zero, the coil is open and should be replaced.

COMPRESSOR CLUTCH RELAY

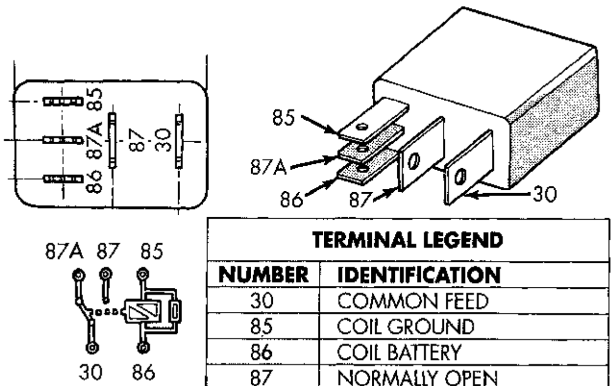
RELAY TEST

The compressor clutch relay (Fig. 13) is located in the Power Distribution Center (PDC). Refer to the PDC label for relay identification and location. Remove the relay from the PDC to perform the following tests:

(1) A relay in the de-energized position should have continuity between terminals 87A and 30, and no continuity between terminals 87 and 30. If OK, go to Step 2. If not OK, replace the faulty relay.

(2) Resistance between terminals 85 and 86 (electromagnet) should be 75 ± 5 ohms. If OK, go to Step 3. If not OK, replace the faulty relay.

(3) Connect a battery to terminals 85 and 86. There should now be continuity between terminals 30 and 87, and no continuity between terminals 87A and 30. If OK, see Relay Circuit Test in the Diagnosis and Testing section of this group. If not OK, replace the faulty relay.



TERMINAL LEGEND	
NUMBER	IDENTIFICATION
30	COMMON FEED
85	COIL GROUND
86	COIL BATTERY
87	NORMALLY OPEN
87A	NORMALLY CLOSED

9514-16

Fig. 13 Compressor Clutch Relay

RELAY CIRCUIT TEST

For circuit descriptions and diagrams, refer to 8W-42 - Air Conditioning/Heater in Group 8W - Wiring Diagrams.

(1) The relay common feed terminal cavity (30) is connected to fused battery feed. There should be battery voltage at the cavity for relay terminal 30 at all times. If OK, go to Step 2. If not OK, repair the open circuit to the fuse in the PDC as required.

(2) The relay normally closed terminal (87A) is not used in this application. Go to Step 3.

(3) The relay normally open terminal cavity (87) is connected to the compressor clutch coil. There should be continuity between this cavity and the A/C compressor clutch relay output circuit cavity of the compressor clutch coil wire harness connector. If OK, go to Step 4. If not OK, repair the open circuit as required.

(4) The relay coil battery terminal (86) is connected to the fused ignition switch output (run/start) circuit. There should be battery voltage at the cavity for relay terminal 86 with the ignition switch in the On position. If OK, go to Step 5. If not OK, repair the open circuit to the fuse in the junction block as required.

(5) The coil ground terminal cavity (85) is switched to ground through the Powertrain Control Module (PCM). There should be continuity between this cavity and the A/C compressor clutch relay control circuit cavity of the PCM wire harness connector C

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DIAGNOSIS AND TESTING (Continued)

(gray) at all times. If not OK, repair the open circuit as required.

FIXED ORIFICE TUBE

The fixed orifice tube can be checked for proper operation using the following procedure. However, the fixed orifice tube is only serviced as a part of the liquid line unit. If the results of this test indicate that the fixed orifice tube is obstructed or missing, the entire liquid line unit must be replaced.

WARNING: THE LIQUID LINE BETWEEN THE CONDENSER OUTLET AND THE FIXED ORIFICE TUBE CAN BECOME HOT ENOUGH TO BURN THE SKIN. USE EXTREME CAUTION WHEN PERFORMING THE FOLLOWING TEST.

(1) Confirm that the refrigerant system is properly charged. See Refrigerant System Charge in the Service Procedures section of this group.

(2) Start the engine. Turn on the air conditioning system and confirm that the compressor clutch is engaged.

(3) Allow the air conditioning system to operate for five minutes.

(4) Lightly and cautiously touch the liquid line near the condenser outlet at the front of the engine compartment. The liquid line should be hot to the touch.

(5) Touch the liquid line near the evaporator inlet at the rear of the engine compartment. The liquid line should be cold to the touch.

(6) If there is a distinct temperature differential between the two ends of the liquid line, the orifice tube is in good condition. If there is little or no detectable temperature differential between the two ends of the liquid line, the orifice tube is obstructed or missing and the liquid line must be replaced.

HIGH PRESSURE CUT-OFF SWITCH

Before performing diagnosis of the high pressure cut-off switch, verify that the refrigerant system has the correct refrigerant charge. See Refrigerant System Charge in the Service Procedures section of this group for more information.

For circuit descriptions and diagrams, refer to 8W-42 - Air Conditioning/Heater in Group 8W - Wiring Diagrams.

(1) Disconnect and isolate the battery negative cable.

(2) Unplug the high pressure cut-off switch wire harness connector from the switch on the refrigerant system fitting.

(3) Check for continuity between the two terminals of the high pressure cut-off switch. There should be continuity. If OK, test and repair the A/C switch sense circuit as required. If not OK, replace the faulty switch.

LOW PRESSURE CYCLING CLUTCH SWITCH

Before performing diagnosis of the low pressure cycling clutch switch, be certain that the switch is properly installed on the accumulator fitting. If the switch is too loose it may not open the Schrader-type valve in the accumulator fitting, which will prevent the switch from correctly monitoring the refrigerant system pressure. Also verify that the refrigerant system has the correct refrigerant charge. See Refrigerant System Charge in the Service Procedures section of this group for more information.

Remember that lower ambient temperatures, below about -1° C (30° F), during cold weather will open the switch contacts and prevent compressor operation due to the pressure/temperature relationship of the refrigerant. For circuit descriptions and diagrams, refer to 8W-42 - Air Conditioning/Heater in Group 8W - Wiring Diagrams.

(1) Disconnect and isolate the battery negative cable.

(2) Unplug the low pressure cycling clutch switch wire harness connector from the switch on the accumulator fitting.

(3) Install a jumper wire between the two cavities of the low pressure cycling clutch switch wire harness connector.

(4) Connect a manifold gauge set to the refrigerant system service ports. See Refrigerant System Service Equipment and Refrigerant System Service Ports in the Description and Operation section of this group for more information.

(5) Connect the battery negative cable.

(6) Place the heater-A/C mode control switch knob in any A/C position and start the engine.

(7) Check for continuity between the two terminals of the low pressure cycling clutch switch. There should be continuity with a suction pressure reading of 296 kPa (43 psi) or above, and no continuity with a suction pressure reading of 172 kPa (25 psi) or below. If OK, test and repair the A/C switch sense circuit as required. If not OK, replace the faulty switch.

REFRIGERANT SYSTEM LEAKS

WARNING: REVIEW THE WARNINGS AND CAUTIONS IN THE GENERAL INFORMATION SECTION NEAR THE FRONT OF THIS GROUP BEFORE LEAK TESTING THE SYSTEM.

If the air conditioning system does not cool properly, the A/C system performance should be tested. See A/C Performance in the Diagnosis and Testing section of this group for the procedures. If the A/C system refrigerant fill is found to be low or if the sys-

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DIAGNOSIS AND TESTING (Continued)

tem is empty; a leak at a refrigerant line, connector fitting, component, or component seal is likely.

An electronic leak detector designed for R-134a refrigerant, or a fluorescent R-134a leak detection dye and a black light are recommended for locating and confirming refrigerant system leaks. Refer to the operating instructions supplied by the equipment manufacturer for the proper care and use of this equipment.

An oily residue on or near refrigerant system lines, connector fittings, components, or component seals can indicate the general location of a possible refrigerant leak. However, the exact leak location should be confirmed with an electronic leak detector prior to component repair or replacement.

To detect a leak in the refrigerant system with an electronic leak detector, perform one of the following procedures:

SYSTEM EMPTY

(1) Evacuate the refrigerant system. See Refrigerant System Evacuate in the Service Procedures section of this group.

(2) Connect and dispense 0.283 kilograms (0.625 pounds or 10 ounces) of R-134a refrigerant into the evacuated refrigerant system. See Refrigerant System Charge in the Service Procedures section of this group.

(3) Position the vehicle in a wind-free work area. This will aid in detecting small leaks.

(4) With the engine not running, use a electronic R-134a leak detector and search for leaks. Because R-134a refrigerant is heavier than air, the leak detector probe should be moved slowly along the bottom side of all refrigerant lines, connector fittings and components.

(5) To inspect the evaporator coil for leaks, insert the electronic leak detector probe into the center instrument panel outlet and the floor duct outlet. Set the blower motor switch to the lowest speed position, and the mode control switch in the recirculation mode (Max-A/C).

SYSTEM LOW

(1) Position the vehicle in a wind-free work area. This will aid in detecting small leaks.

(2) Bring the refrigerant system up to operating temperature and pressure. This is done by allowing the engine to run with the air conditioning system turned on for five minutes.

(3) With the engine not running, use a electronic R-134a leak detector and search for leaks. Because R-134a refrigerant is heavier than air, the leak detector probe should be moved slowly along the bottom side of all refrigerant lines, connector fittings and components.

(4) To inspect the evaporator coil for leaks, insert the electronic leak detector probe into the center instrument panel outlet and the floor duct outlet. Set the blower motor switch to the lowest speed position, and the mode control switch in the recirculation mode (Max-A/C).

SERVICE PROCEDURES

REFRIGERANT RECOVERY

WARNING: REVIEW THE WARNINGS AND CAUTIONS IN THE GENERAL INFORMATION SECTION NEAR THE FRONT OF THIS GROUP BEFORE RECOVERING REFRIGERANT.

A R-134a refrigerant recovery/recycling/charging station that meets SAE Standard J2210 must be used to recover the refrigerant from an R-134a refrigerant system. Refer to the operating instructions supplied by the equipment manufacturer for the proper care and use of this equipment.

REFRIGERANT SYSTEM EVACUATE

WARNING: REVIEW THE WARNINGS AND CAUTIONS IN THE GENERAL INFORMATION SECTION NEAR THE FRONT OF THIS GROUP BEFORE EVACUATING THE SYSTEM.

If the refrigerant system has been open to the atmosphere, it must be evacuated before the system can be charged. If moisture and air enters the system and becomes mixed with the refrigerant, the compressor head pressure will rise above acceptable operating levels. This will reduce the performance of the air conditioner and damage the compressor. Evacuating the refrigerant system will remove the air and boil the moisture out of the system at near room temperature. To evacuate the refrigerant system, use the following procedure:

(1) Connect a R-134a refrigerant recovery/recycling/charging station that meets SAE Standard J2210 and a manifold gauge set to the refrigerant system of the vehicle.

(2) Open the low and high side valves and start the charging station vacuum pump. When the suction gauge reads 88 kPa (26 in. Hg.) vacuum or greater, close all of the valves and turn off the vacuum pump.

(a) If the refrigerant system fails to reach the specified vacuum, the system has a leak that must be corrected. See Refrigerant System Leaks in the Diagnosis and Testing section of this group for the procedures.

SERVICE PROCEDURES (Continued)

(b) If the refrigerant system maintains the specified vacuum for five minutes, restart the vacuum pump, open the suction and discharge valves and evacuate the system for an additional ten minutes.

(3) Close all of the valves, and turn off the charging station vacuum pump.

(4) The refrigerant system is now ready to be charged with R-134a refrigerant. See Refrigerant System Charge in the Service Procedures section of this group.

REFRIGERANT SYSTEM CHARGE

WARNING: REVIEW THE WARNINGS AND CAUTIONS IN THE GENERAL INFORMATION SECTION NEAR THE FRONT OF THIS GROUP BEFORE CHARGING THE REFRIGERANT SYSTEM.

After the refrigerant system has been tested for leaks and evacuated, a refrigerant charge can be injected into the system. See Refrigerant Charge Capacity in the Service Procedures section of this group for the proper amount of the refrigerant charge.

A R-134a refrigerant recovery/recycling/charging station that meets SAE Standard J2210 must be used to charge the refrigerant system with R-134a refrigerant. Refer to the operating instructions supplied by the equipment manufacturer for the proper care and use of this equipment.

REFRIGERANT CHARGE CAPACITY

The R-134a refrigerant system charge capacity for this vehicle is 0.907 kilograms (32 ounces).

REFRIGERANT OIL LEVEL

When an air conditioning system is assembled at the factory, all components except the compressor are refrigerant oil free. After the refrigerant system has been charged and operated, the refrigerant oil in the compressor is dispersed throughout the refrigerant system. The accumulator, evaporator, condenser, and compressor will each retain a significant amount of the needed refrigerant oil.

It is important to have the correct amount of oil in the refrigerant system. This ensures proper lubrication of the compressor. Too little oil will result in damage to the compressor. Too much oil will reduce the cooling capacity of the air conditioning system.

It will not be necessary to check the oil level in the compressor or to add oil, unless there has been an oil loss. An oil loss may occur due to a rupture or leak from a refrigerant line, a connector fitting, a component, or a component seal. If a leak occurs, add 30 milliliters (1 fluid ounce) of refrigerant oil to the refrigerant system after the repair has been made. Refrigerant oil loss will be evident at the leak point by the presence of a wet, shiny surface around the leak.

Refrigerant oil must be added when a accumulator, evaporator coil, or condenser are replaced. See the Refrigerant Oil Capacities chart. When a compressor is replaced, the refrigerant oil must be drained from the old compressor and measured. Drain all of the refrigerant oil from the new compressor, then fill the new compressor with the same amount of refrigerant oil that was drained out of the old compressor.

Refrigerant Oil Capacities		
Component	**ml**	**fl oz**
A/C System	240	8.1
Accumulator	60	2
Condenser	30	1
Evaporator	60	2
Compressor	drain and measure the oil from the old compressor - see text.	

REMOVAL AND INSTALLATION

REFRIGERANT LINE COUPLER

WARNING: REVIEW THE WARNINGS AND CAUTIONS IN THE GENERAL INFORMATION SECTION NEAR THE FRONT OF THIS GROUP BEFORE PERFORMING THE FOLLOWING OPERATION.

REMOVAL

(1) Recover the refrigerant from the refrigerant system. See Refrigerant Recovery in the Service Procedures section of this group.

(2) Remove the secondary clip from the spring-lock coupler.

(3) Fit the proper size A/C line disconnect tool (Special Tool Kit 7193) over the spring-lock coupler cage (Fig. 14).

(4) Close the two halves of the A/C line disconnect tool around the spring-lock coupler.

(5) Push the A/C line disconnect tool into the open side of the coupler cage to expand the garter spring. Once the garter spring is expanded and while still pushing the disconnect tool into the open side of the coupler cage, pull on the refrigerant line attached to the female half of the coupler fitting until the flange on the female fitting is separated from the garter spring and cage on the male fitting within the disconnect tool.

NOTE: The garter spring may not release if the A/C line disconnect tool is cocked while pushing it into the coupler cage opening.

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REMOVAL AND INSTALLATION (Continued)

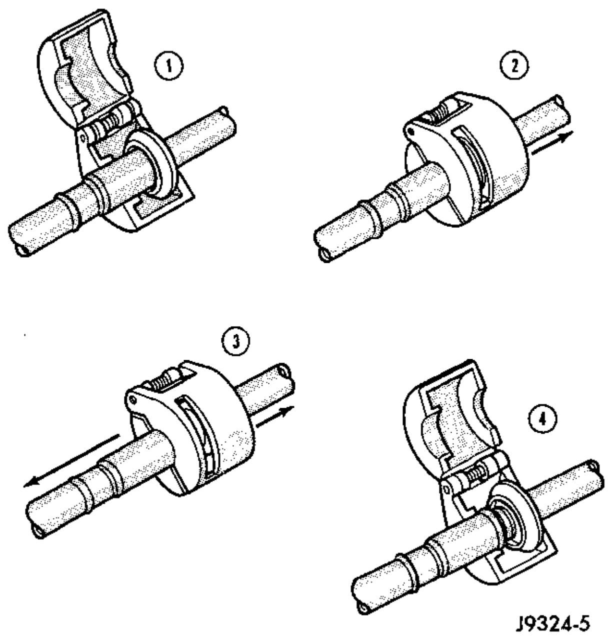

Fig. 14 Refrigerant Line Spring-Lock Coupler Disconnect

(6) Open and remove the A/C line disconnect tool from the disconnected spring-lock coupler.

(7) Complete the separation of the two halves of the coupler fitting.

INSTALLATION

(1) Check to ensure that the garter spring is located within the cage of the male coupler fitting, and that the garter spring is not damaged.

(a) If the garter spring is missing, install a new spring by pushing it into the coupler cage opening.

(b) If the garter spring is damaged, remove it from the coupler cage with a small wire hook (DO NOT use a screwdriver) and install a new garter spring.

(2) Clean any dirt or foreign material from both halves of the coupler fitting.

(3) Install new O-rings on the male half of the coupler fitting.

CAUTION: Use only the specified O-rings as they are made of a special material for the R-134a system. The use of any other O-rings may allow the connection to leak intermittently during vehicle operation.

(4) Lubricate the male fitting and O-rings, and the inside of the female fitting with clean R-134a refrigerant oil. Use only refrigerant oil of the type recommended for the compressor in the vehicle.

(5) Fit the female half of the coupler fitting over the male half of the fitting.

(6) Push together firmly on the two halves of the coupler fitting until the garter spring in the cage on the male half of the fitting snaps over the flanged end on the female half of the fitting.

(7) Ensure that the spring-lock coupler is fully engaged by trying to separate the two coupler halves. This is done by pulling the refrigerant lines on either side of the coupler away from each other.

(8) Reinstall the secondary clip over the spring-lock coupler cage.

HIGH PRESSURE CUT-OFF SWITCH

REMOVAL

(1) Disconnect and isolate the battery negative cable.

(2) Unplug the wire harness connector from the high pressure cut-off switch, which is mounted to a fitting on the discharge line between the compressor and the condenser inlet (Fig. 15).

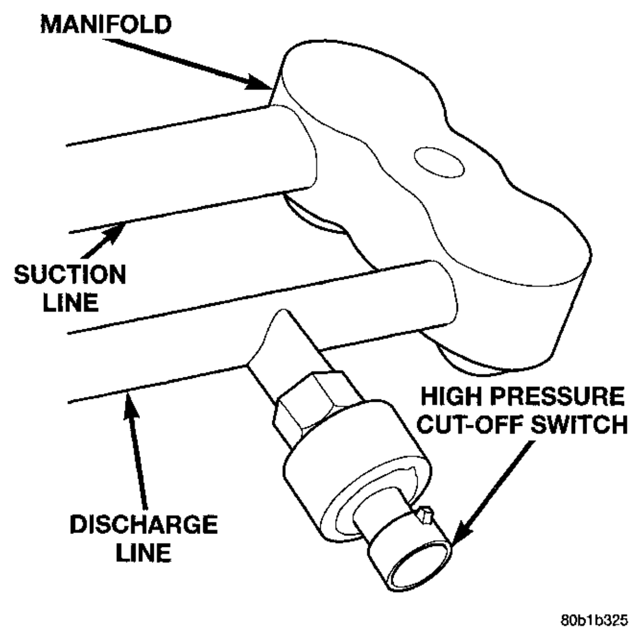

Fig. 15 High Pressure Cut-Off Switch Remove/Install

(3) Unscrew the high pressure cut-off switch from the discharge line fitting.

(4) Remove the high pressure cut-off switch from the vehicle.

(5) Remove the O-ring seal from the discharge line fitting and discard.

INSTALLATION

(1) Lubricate a new O-ring seal with clean refrigerant oil and install it on the discharge line fitting. Use only the specified O-rings as they are made of a special material for the R-134a system. Use only

REMOVAL AND INSTALLATION (Continued)

refrigerant oil of the type recommended for the compressor in the vehicle.

(2) Install and tighten the high pressure cut-off switch on the discharge line fitting.

(3) Plug the wire harness connector into the high pressure cut-off switch.

(4) Connect the battery negative cable.

SUCTION AND DISCHARGE LINE

Any kinks or sharp bends in the refrigerant plumbing will reduce the capacity of the entire air conditioning system. Kinks and sharp bends reduce the flow of refrigerant in the system. A good rule for the flexible hose refrigerant lines is to keep the radius of all bends at least ten times the diameter of the hose. In addition, the flexible hose refrigerant lines should be routed so they are at least 80 millimeters (3 inches) from the exhaust manifold.

High pressures are produced in the refrigerant system when the air conditioning compressor is operating. Extreme care must be exercised to make sure that each of the refrigerant system connections is pressure-tight and leak free. It is a good practice to inspect all flexible hose refrigerant lines at least once a year to make sure they are in good condition and properly routed.

WARNING: REVIEW THE WARNINGS AND CAUTIONS IN THE GENERAL INFORMATION SECTION NEAR THE FRONT OF THIS GROUP BEFORE PERFORMING THE FOLLOWING OPERATION.

REMOVAL

(1) Disconnect and isolate the battery negative cable.

(2) Recover the refrigerant from the refrigerant system. See Refrigerant Recovery in the Service Procedures section of this group.

(3) Unplug the wire harness connector from the high pressure cut-off switch.

(4) Disconnect the suction line refrigerant line coupler at the accumulator. See Refrigerant Line Coupler in the Removal and Installation section of this group for the procedures. Install plugs in, or tape over all of the opened refrigerant line fittings.

(5) Remove the nut that secures the block fitting to the stud on the condenser inlet and disconnect the discharge line from the condenser. Install plugs in, or tape over all of the opened refrigerant line fittings.

(6) On models with a gasoline engine, remove the nut that secures the refrigerant line support bracket to the stud on the compressor mounting bracket.

(7) Remove the screw that secures the refrigerant line manifold to the compressor (Fig. 16) or (Fig. 17). Install plugs in, or tape over all of the opened refrigerant line fittings.

(8) Remove the suction and discharge line assembly from the vehicle.

INSTALLATION

(1) Remove the tape or plugs from all of the refrigerant line fittings. Connect the suction line refrigerant line coupler to the accumulator. See Refrigerant Line Coupler in the Removal and Installation section of this group for the procedures.

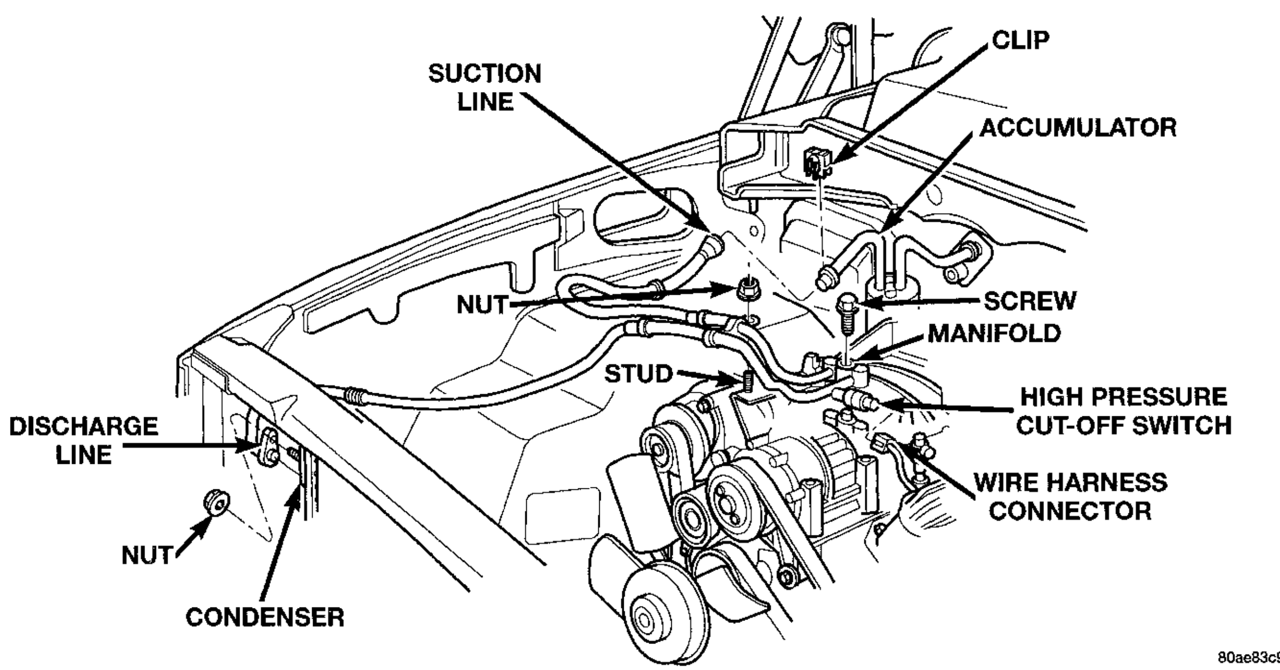

Fig. 16 Suction and Discharge Line Remove/Install - Gasoline Engine

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REMOVAL AND INSTALLATION (Continued)

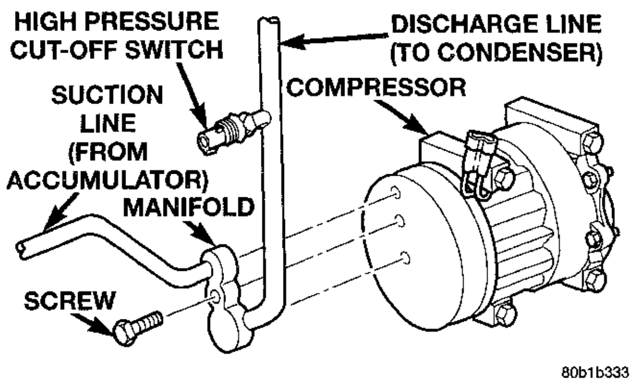

Fig. 17 Suction and Discharge Line Remove/Install - Diesel Engine

(2) Install a new gasket and the discharge line block fitting over the stud on the condenser inlet. Tighten the mounting nut to 20 N·m (180 in. lbs.).

(3) Install the refrigerant line manifold to the compressor. Tighten the mounting screw to 22 N·m (200 in. lbs.).

(4) On models with a gasoline engine, install the nut that secures the refrigerant line support bracket to the stud on the compressor mounting bracket. Tighten the mounting nut to 22 N·m (200 in. lbs.).

(5) Plug in the wire harness connector to the high pressure cut-off switch.

(6) Connect the battery negative cable.

(7) Evacuate the refrigerant system. See Refrigerant System Evacuate in the Service Procedures section of this group.

(8) Charge the refrigerant system. See Refrigerant System Charge in the Service Procedures section of this group.

COMPRESSOR

The compressor may be removed and repositioned without disconnecting the refrigerant lines or discharging the refrigerant system. Discharging is not necessary if servicing the compressor clutch or clutch coil, the engine, the cylinder head, or the generator.

WARNING: REVIEW THE WARNINGS AND CAUTIONS IN THE GENERAL INFORMATION SECTION NEAR THE FRONT OF THIS GROUP BEFORE PERFORMING THE FOLLOWING OPERATION.

REMOVAL

(1) Recover the refrigerant from the refrigerant system. See Refrigerant Recovery in the Service Procedures section of this group.

(2) Disconnect and isolate the battery negative cable.

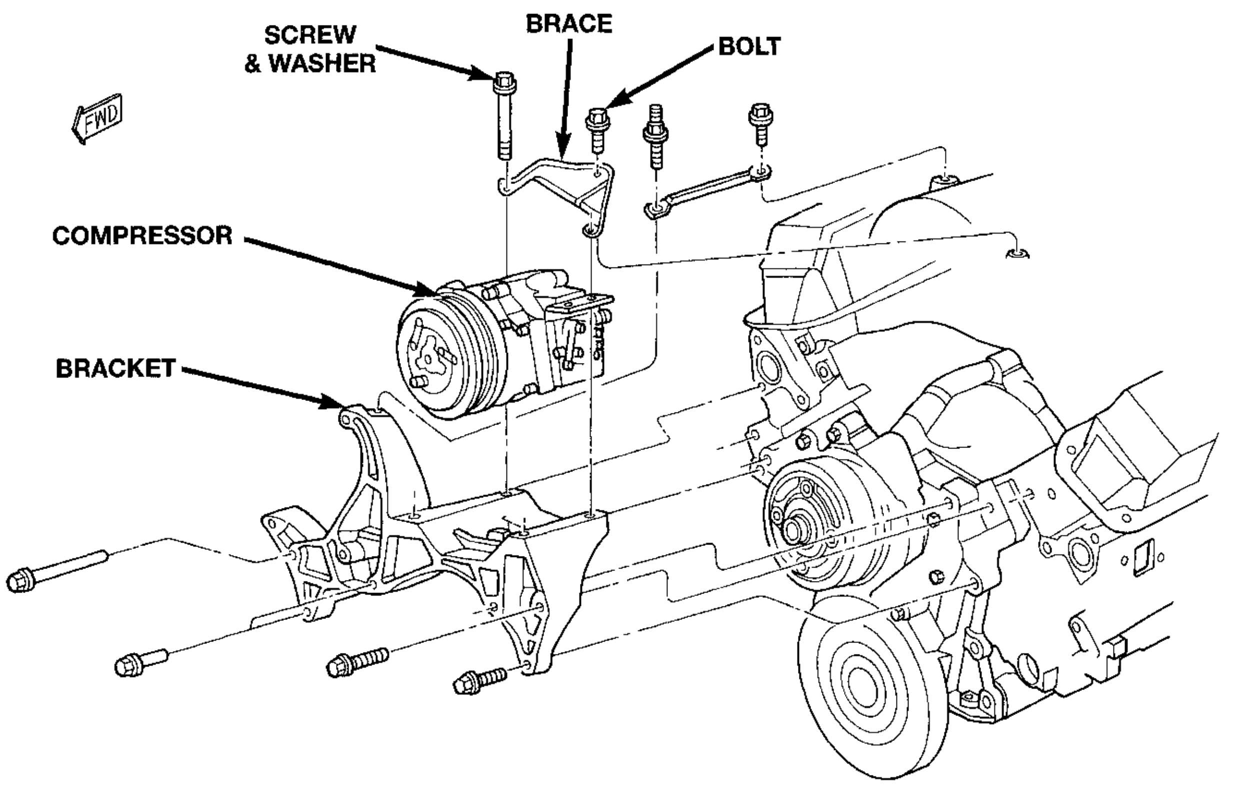

Fig. 18 Compressor Remove/Install - Gasoline Engine

REMOVAL AND INSTALLATION (Continued)

(3) Remove the serpentine drive belt. Refer to Group 7 - Cooling System for the procedures.

(4) Unplug the compressor clutch coil wire harness connector.

(5) Remove the suction and discharge refrigerant line manifold from the compressor. See Suction and Discharge Line in the Removal and Installation section of this group for the procedures. Install plugs in, or tape over all of the opened refrigerant line fittings.

(6) Remove the four screws that secure the compressor to the mounting bracket (Fig. 18) or (Fig. 19) .

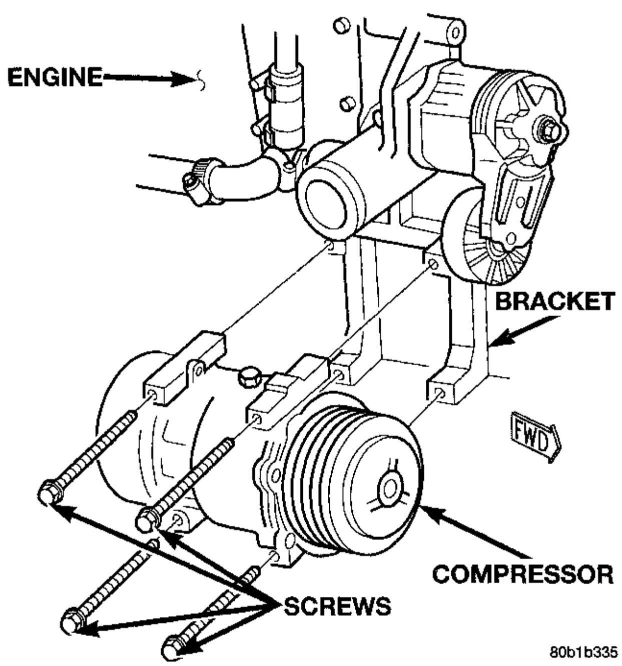

Fig. 19 Compressor Remove/Install - Diesel Engine

(7) Remove the compressor from the mounting bracket.

INSTALLATION

NOTE: If a replacement compressor is being installed, be certain to check the refrigerant oil level. See Refrigerant Oil Level in the Service Procedures section of this group. Use only refrigerant oil of the type recommended for the compressor in the vehicle.

(1) Install the compressor to the mounting bracket. Tighten the four mounting screws to 24 N·m (210 in. lbs.).

(2) Remove the tape or plugs from all of the opened refrigerant line fittings. Install the suction and discharge line manifold to the compressor. See Suction and Discharge Line in the Removal and Installation section of this group for the procedures.

(3) Install the serpentine drive belt. Refer to Group 7 - Cooling System for the procedures.

(4) Plug in the compressor clutch coil wire harness connector.

(5) Connect the battery negative cable.

(6) Evacuate the refrigerant system. See Refrigerant System Evacuate in the Service Procedures section of this group.

(7) Charge the refrigerant system. See Refrigerant System Charge in the Service Procedures section of this group.

COMPRESSOR CLUTCH

The refrigerant system can remain fully-charged during compressor clutch, pulley, or coil replacement. The compressor clutch can be serviced in the vehicle.

REMOVAL

(1) Disconnect and isolate the battery negative cable.

(2) On models with the diesel engine option, remove the compressor from the engine. Do not remove the refrigerant lines or fittings. See Compressor in the Removal and Installation section of this group for the procedures.

(3) Unplug the compressor clutch coil wire harness connector.

(4) Insert the two pins of the spanner wrench (Special Tool 6462 in Kit 6460) into the holes of the clutch plate. Hold the clutch plate stationary and remove the hex nut (Fig. 20).

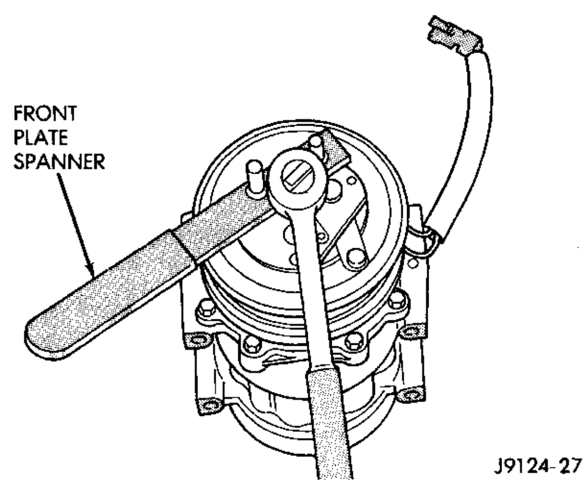

Fig. 20 Clutch Nut Remove

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REMOVAL AND INSTALLATION (Continued)

(5) Remove the clutch plate and clutch shims. On models with the diesel engine option, a puller (Special Tool 6461 in Kit 6460) is used to remove the clutch plate (Fig. 21). This compressor also uses a shaft key, which must be removed.

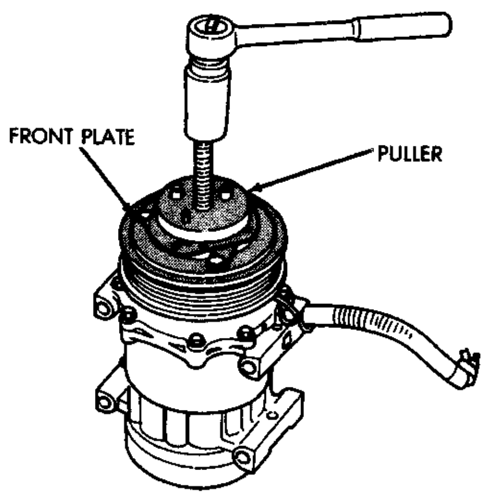

Fig. 21 Clutch Puller - Diesel Models

(6) Remove the external front housing snap ring with snap ring pliers (Fig. 22).

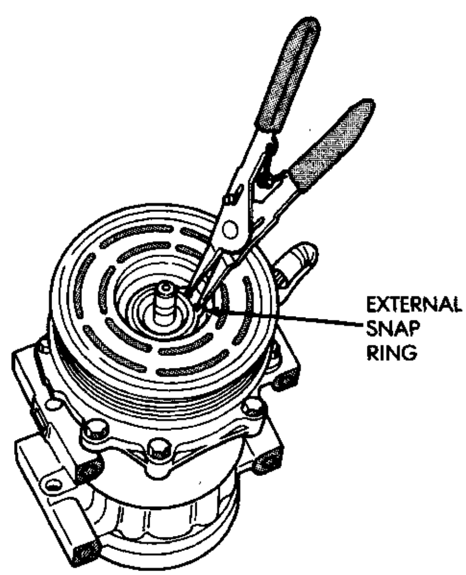

Fig. 22 External Snap Ring Remove

(7) Install the lip of the rotor puller (Special Tool C-6141-1 in Kit 6460) into the snap ring groove exposed in Step 6, and install the shaft protector (Special Tool C-6141-2 in Kit 6460) (Fig. 23).

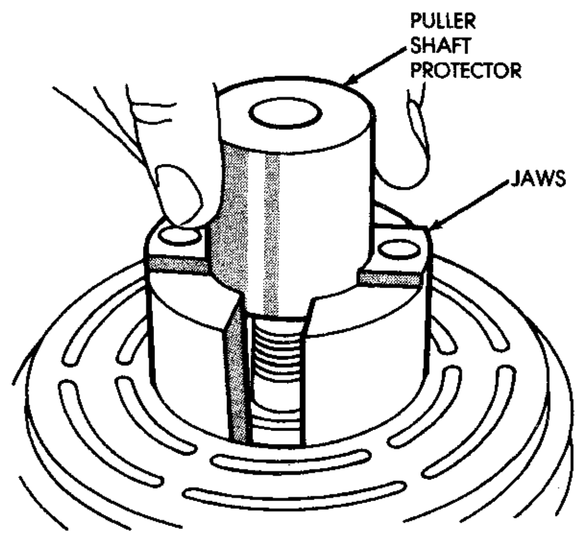

Fig. 23 Shaft Protector and Puller

(8) Install the puller through-bolts (Special Tool C-6461) through the puller flange and into the jaws of the rotor puller and tighten (Fig. 24). Turn the puller center bolt clockwise until the rotor pulley is free.

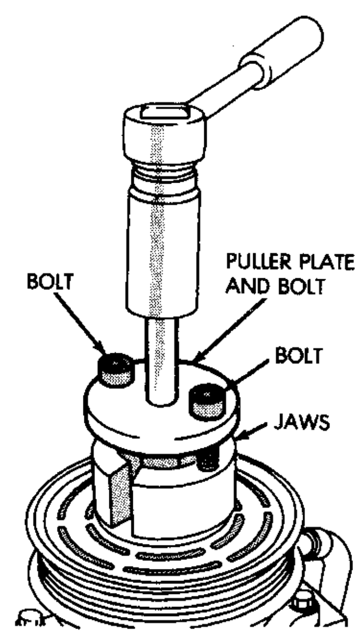

Fig. 24 Install Puller Plate

(9) Remove the screw and retainer from the clutch coil lead wire harness on the compressor front housing (Fig. 25).

REMOVAL AND INSTALLATION (Continued)

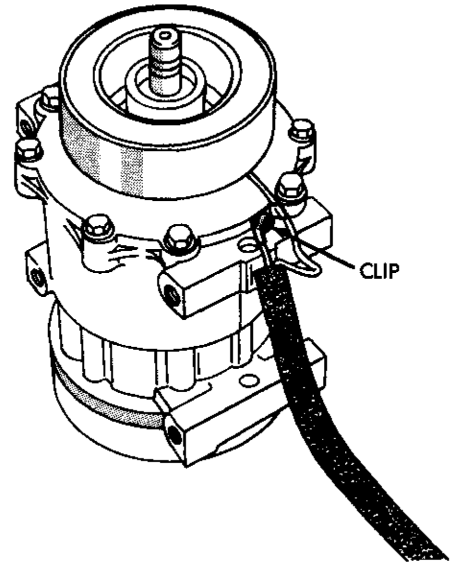

Fig. 25 Clutch Coil Lead Wire Harness

(10) Remove the snap ring from the compressor hub and remove the clutch field coil (Fig. 26). Slide the clutch field coil off of the compressor hub.

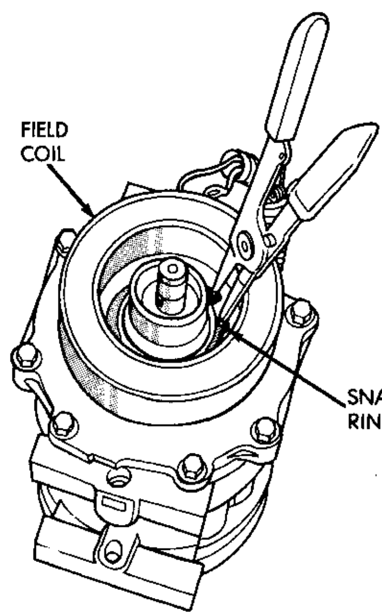

Fig. 26 Clutch Field Coil Snap Ring Remove

INSPECTION

Examine the friction surfaces of the clutch pulley and the front plate for wear. The pulley and front plate should be replaced if there is excessive wear or scoring.

If the friction surfaces are oily, inspect the shaft and nose area of the compressor for oil. Remove the felt from the front cover. If the felt is saturated with oil, the shaft seal is leaking and the compressor must be replaced.

Check the clutch pulley bearing for roughness or excessive leakage of grease. Replace the bearing, if required.

INSTALLATION

(1) Install the clutch field coil and snap ring.

(2) Install the clutch coil lead wire harness retaining clip on the compressor front housing and tighten the retaining screw.

(3) Align the rotor assembly squarely on the front compressor housing hub.

(4) Thread the handle (Special Tool 6464 in Kit 6460) into the driver (Special Tool 6143 in Kit 6460) (Fig. 27).

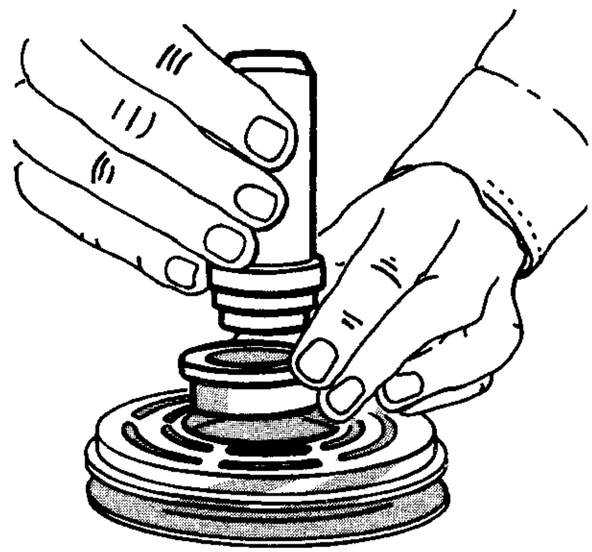

Fig. 27 Rotor Installer Set

(5) Place the driver tool assembly into the bearing cavity on the rotor. Make certain the outer edge of the tool rests firmly on the rotor bearing inner race (Fig. 28).

(6) Tap the end of the driver while guiding the rotor to prevent binding. Tap until the rotor bottoms against the compressor front housing hub. Listen for a distinct change of sound during the tapping process, to indicate the bottoming of the rotor.

(7) Install the external front rotor snap ring with snap ring pliers. The bevel side of the snap ring must be facing outward. Press the snap ring to make sure it is properly seated in the groove.

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REMOVAL AND INSTALLATION (Continued)

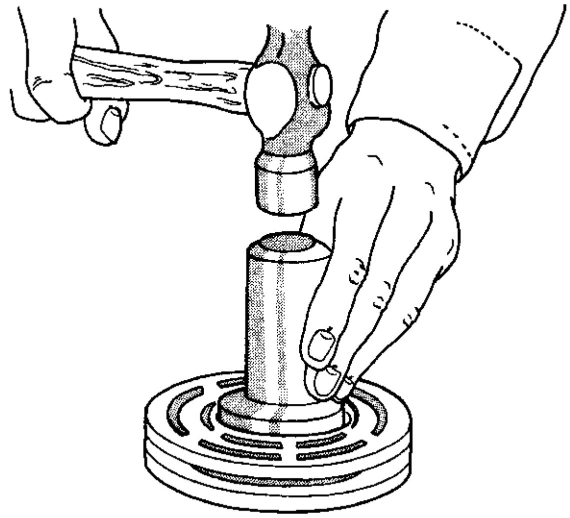

Fig. 28 Rotor Install

CAUTION: If the snap ring is not fully seated in the groove it will vibrate out, resulting in a clutch failure and severe damage to the front housing of the compressor.

(8) Install the original clutch shims on the compressor shaft.

(9) Install the clutch plate. On models with the diesel engine option, install the shaft key. Use the shaft protector (Special Tool 6141-2 in Kit 6460) to install the clutch plate on the compressor shaft (Fig. 29). Tap the clutch plate over the compressor shaft until it has bottomed against the clutch shims. Listen for a distinct change of sound during the tapping process, to indicate the bottoming of the clutch plate.

(10) Replace the compressor shaft hex nut. Tighten the nut to 14.4 N·m (10.5 ft. lbs.).

(11) Check the clutch air gap with a feeler gauge (Fig. 30). If the air gap does not meet the specification, add or subtract shims as required. The air gap specification is 0.41 to 0.79 millimeter (0.016 to 0.031 inch). If the air gap is not consistent around the circumference of the clutch, lightly pry up at the minimum variations. Lightly tap down at the points of maximum variation.

NOTE: The air gap is determined by the spacer shims. When installing an original, or a new clutch assembly, try the original shims first. When installing a new clutch onto a compressor that previously did not have a clutch, use 1.0, 0.50, and 0.13 millimeter (0.040, 0.020, and 0.005 inch) shims from the clutch hardware package that is provided with the new clutch.

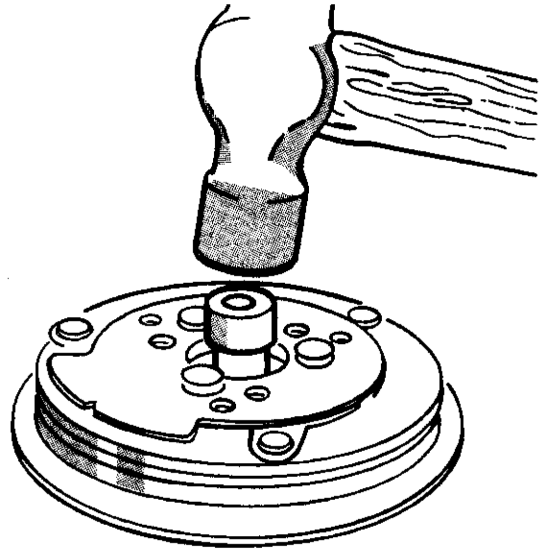

Fig. 29 Clutch Plate Install

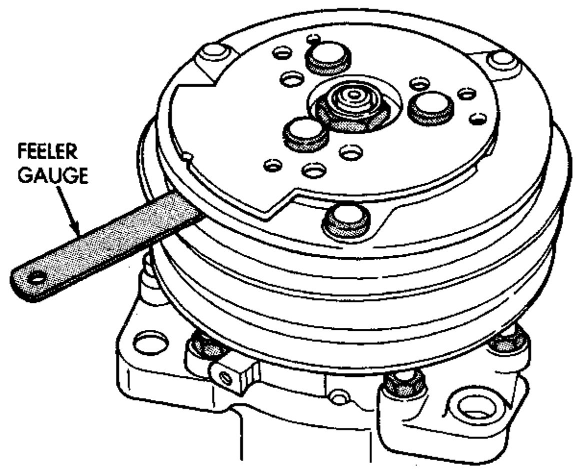

Fig. 30 Check Clutch Air Gap

(12) Reverse the remaining removal procedures to complete the installation.

CLUTCH BREAK-IN

After a new compressor clutch has been installed, cycle the compressor clutch approximately twenty times (five seconds on, then five seconds off). During this procedure, set the heater-A/C control to the recirculation mode (Max-A/C), the blower motor switch in the highest speed position, and the engine speed at 1500 to 2000 rpm. This procedure (burnishing) will seat the opposing friction surfaces and provide a higher compressor clutch torque capability.

REMOVAL AND INSTALLATION (Continued)

COMPRESSOR CLUTCH RELAY

(1) Disconnect and isolate the battery negative cable.

(2) Remove the cover from the Power Distribution Center (PDC) (Fig. 31).

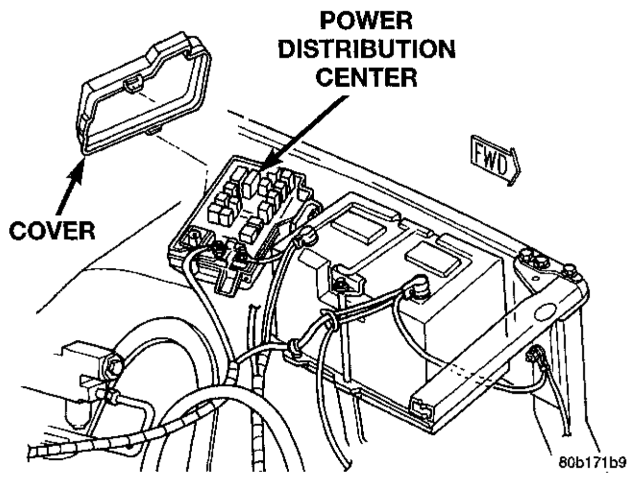

Fig. 31 Power Distribution Center

(3) Refer to the label on the PDC for compressor clutch relay identification and location.

(4) Unplug the compressor clutch relay from the PDC.

(5) Install the compressor clutch relay by aligning the relay terminals with the cavities in the PDC and pushing the relay firmly into place.

(6) Install the PDC cover.

(7) Connect the battery negative cable.

(8) Test the relay operation.

LIQUID LINE

Any kinks or sharp bends in the refrigerant plumbing will reduce the capacity of the entire air conditioning system. Kinks and sharp bends reduce the flow of refrigerant in the system. High pressures are produced in the refrigerant system when the air conditioning compressor is operating. Extreme care must be exercised to make sure that each of the refrigerant system connections is pressure-tight and leak free.

WARNING: REVIEW THE WARNINGS AND CAUTIONS IN THE GENERAL INFORMATION SECTION NEAR THE FRONT OF THIS GROUP BEFORE PERFORMING THE FOLLOWING OPERATION.

REMOVAL

(1) Disconnect and isolate the battery negative cable.

(2) Recover the refrigerant from the refrigerant system. See Refrigerant Recovery in the Service Procedures section of this group.

(3) Disconnect the liquid line refrigerant line couplers at the condenser outlet and the evaporator inlet. See Refrigerant Line Coupler in the Removal and Installation section of this group for the procedures. Install plugs in, or tape over all of the opened refrigerant line fittings.

(4) Disengage any clips that secure the liquid line to the inner fender shield and the dash panel (Fig. 32).

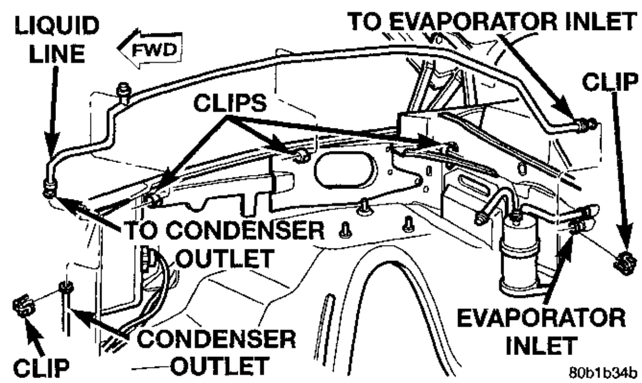

Fig. 32 Liquid Line Remove/Install

(5) Remove the liquid line from the vehicle.

INSTALLATION

(1) Install the liquid line into any clips on the inner fender shield and the dash panel.

(2) Remove the tape or plugs from the refrigerant line fittings on the liquid line, the condenser outlet, and the evaporator inlet. Connect the liquid line to the condenser and the evaporator. See Refrigerant Line Coupler in the Removal and Installation section of this group for the procedures.

(3) Connect the battery negative cable.

(4) Evacuate the refrigerant system. See Refrigerant System Evacuate in the Service Procedures section of this group.

(5) Charge the refrigerant system. See Refrigerant System Charge in the Service Procedures section of this group.

FIXED ORIFICE TUBE

The fixed orifice tube is located in the liquid line, between the condenser and the evaporator coil. The orifice has filter screens on the inlet and outlet ends of the tube body. If the fixed orifice tube is faulty or plugged, the liquid line assembly must be replaced. See Liquid Line in the Removal and Installation section of this group for the service procedures.

LOW PRESSURE CYCLING CLUTCH SWITCH

REMOVAL

(1) Disconnect and isolate the battery negative cable.

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REMOVAL AND INSTALLATION (Continued)

(2) Unplug the wire harness connector from the low pressure cycling clutch switch on the top of the accumulator (Fig. 33).

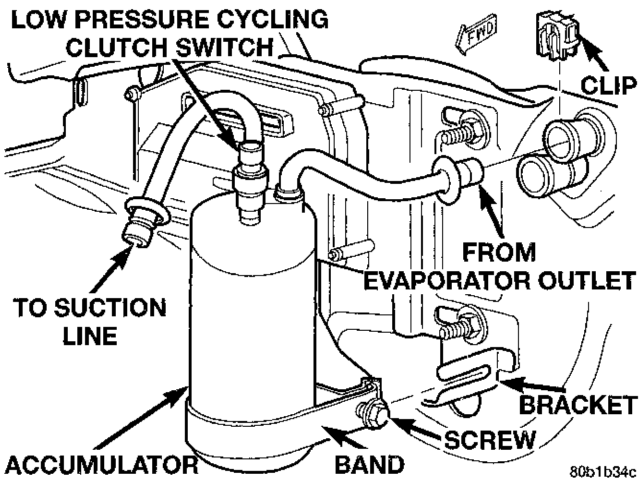

Fig. 33 Low Pressure Cycling Clutch Switch Remove/Install

(3) Unscrew the low pressure cycling clutch switch from the fitting on the top of the accumulator.

(4) Remove the O-ring seal from the accumulator fitting and discard.

INSTALLATION

(1) Lubricate a new O-ring seal with clean refrigerant oil and install it on the accumulator fitting. Use only the specified O-rings as they are made of a special material for the R-134a system. Use only refrigerant oil of the type recommended for the compressor in the vehicle.

(2) Install and tighten the low pressure cycling clutch switch on the accumulator fitting. The switch should be hand-tightened onto the accumulator fitting.

(3) Plug the wire harness connector into the low pressure cycling clutch switch.

(4) Connect the battery negative cable.

ACCUMULATOR

WARNING: REVIEW THE WARNINGS AND CAUTIONS IN THE GENERAL INFORMATION SECTION NEAR THE FRONT OF THIS GROUP BEFORE PERFORMING THE FOLLOWING OPERATION.

REMOVAL

(1) Disconnect and isolate the battery negative cable.

(2) Recover the refrigerant from the refrigerant system. See Refrigerant Recovery in the Service Procedures section of this group.

(3) Remove the low pressure cycling clutch switch from the accumulator. See Low Pressure Cycling Clutch Switch in the Removal and Installation section of this group for the procedures.

(4) Loosen the screw that secures the accumulator retaining band to the support bracket on the dash panel (Fig. 34).

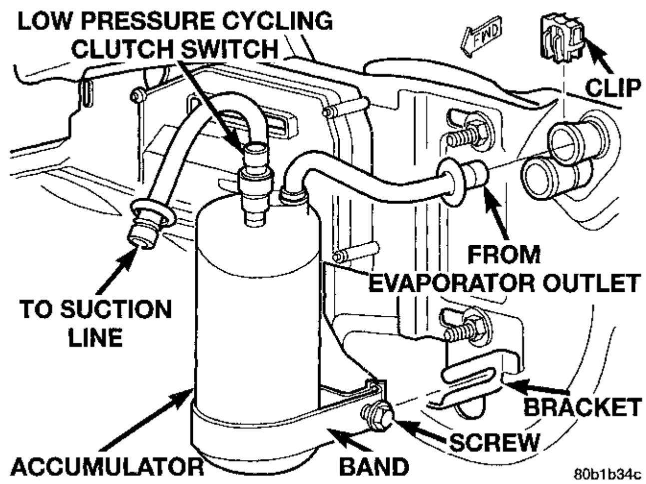

Fig. 34 Accumulator Remove/Install

(5) Disconnect the suction line refrigerant line fitting from the accumulator outlet. See Refrigerant Line Coupler in the Removal and Installation section of this group for the procedures. Install plugs in, or tape over all of the opened refrigerant line fittings.

(6) Disconnect the accumulator inlet refrigerant line fitting from the evaporator outlet. See Refrigerant Line Coupler in the Removal and Installation section of this group for the procedures. Install plugs in, or tape over all of the opened refrigerant line fittings.

(7) Pull the accumulator and retaining band unit forward until the screw in the band is clear of the slotted hole in the support bracket on the dash panel.

(8) Remove the accumulator from the engine compartment.

INSTALLATION

(1) Install the accumulator and retaining band as a unit by sliding the screw in the band into the slotted hole in the support bracket on the dash panel.

(2) Remove the tape or plugs from the refrigerant line fittings on the accumulator inlet and the evaporator outlet. Connect the accumulator inlet refrigerant line coupler to the evaporator outlet. See Refrigerant Line Coupler in the Removal and Installation section of this group for the procedures.

(3) Tighten the accumulator retaining band screw to 4.5 N·m (40 in. lbs.).

(4) Remove the tape or plugs from the refrigerant line fittings on the suction line and the accumulator

REMOVAL AND INSTALLATION (Continued)

outlet. Connect the suction line refrigerant line coupler to the accumulator outlet. See Refrigerant Line Coupler in the Removal and Installation section of this group for the procedures.

(5) Reinstall the low pressure cycling clutch switch on the accumulator. See Low Pressure Cycling Clutch Switch in the Removal and Installation section of this group for the procedures.

(6) Connect the battery negative cable.

(7) Evacuate the refrigerant system. See Refrigerant System Evacuate in the Service Procedures section of this group.

(8) Charge the refrigerant system. See Refrigerant System Charge in the Service Procedures section of this group.

NOTE: If the accumulator is replaced, add 60 milliliters (2 fluid ounces) of refrigerant oil to the refrigerant system. Use only refrigerant oil of the type recommended for the compressor in the vehicle.

CONDENSER

WARNING: REVIEW THE WARNINGS AND CAUTIONS IN THE GENERAL INFORMATION SECTION NEAR THE FRONT OF THIS GROUP BEFORE PERFORMING THE FOLLOWING OPERATION.

CAUTION: Before removing the condenser, note the location of each of the radiator and condenser air seals. These seals are used to direct air through the condenser and radiator. The air seals must be reinstalled in their proper locations in order for the air conditioning and engine cooling systems to perform as designed.

REMOVAL

(1) Disconnect and isolate the battery negative cable.

(2) Recover the refrigerant from the refrigerant system. See Refrigerant Recovery in the Service Procedures section of this group.

(3) Remove the nut that secures the block fitting to the stud on the condenser inlet and disconnect the discharge line from the condenser. Install plugs in, or tape over all of the opened refrigerant line fittings.

(4) Disconnect the refrigerant line fitting that secures the liquid line to the condenser outlet. See Refrigerant Line Coupler in the Removal and Installation section of this group for the procedures. Install plugs in, or tape over all of the opened refrigerant line fittings.

(5) On gasoline engine models:

(a) Remove the two screws that secure the condenser upper mounting brackets to the outside of the upper radiator crossmember (Fig. 35).

(b) Tilt the condenser away from the engine compartment far enough to grasp the top of the condenser with both hands.

(c) Lift the condenser far enough to remove the two lower condenser locators from the isolators in the holes of the lower crossmember.

(d) Remove the condenser from the vehicle.

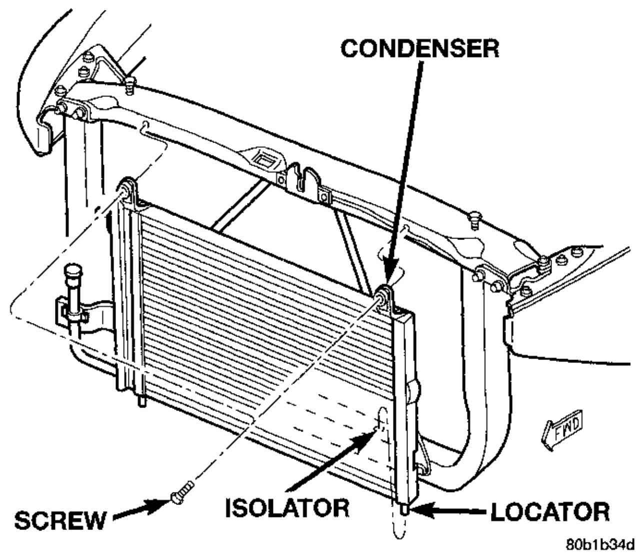

Fig. 35 Condenser Remove/Install - Gasoline Engine

(6) On diesel engine models:

(a) Remove the two screws that secure the brackets on the passenger side end of the condenser to the charge air cooler (Fig. 36).

(b) Remove the two nuts that secure the driver side end of the condenser to the studs on the charge air cooler.

(c) Remove the condenser from the vehicle.

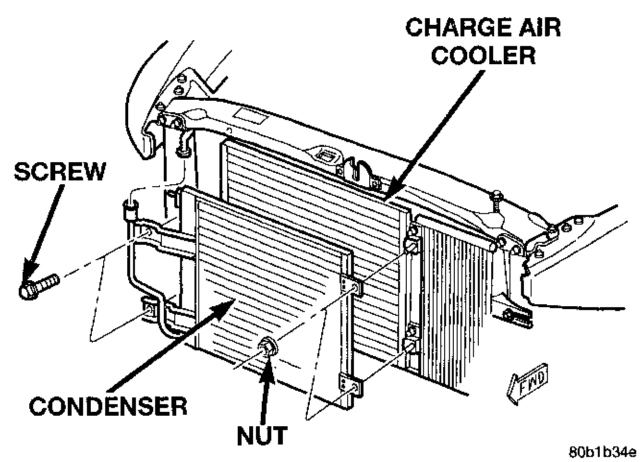

Fig. 36 Condenser Remove/Install - Diesel Engine

REMOVAL AND INSTALLATION (Continued)

INSTALLATION

(1) On gasoline engine models:

(a) Insert the two lower condenser locators into the isolators in the holes of the lower crossmember.

(b) Tilt the condenser up towards the engine compartment far enough to align the upper mounting bracket holes with the holes in the upper radiator crossmember.

(c) Install the two screws that secure the condenser upper mounting brackets to the outside of the upper radiator crossmember. Tighten the mounting screws to 10.5 N·m (95 in. lbs.).

(2) On diesel engine models:

(a) Install the driver side condenser mounting brackets over the two studs on the charge air cooler.

(b) Install the two screws that secure the brackets on the passenger side end of the condenser to the charge air cooler. Tighten the mounting screws to 10.5 N·m (95 in. lbs.).

(c) Install the two nuts that secure the driver side end of the condenser to the studs on the charge air cooler. Tighten the mounting nuts to 10.5 N·m (95 in. lbs.).

(3) Remove the plugs or tape from the refrigerant line fittings on the liquid line and the condenser outlet. Connect the liquid line to the condenser outlet. See Refrigerant Line Coupler in the Removal and Installation section of this group for the procedures.

(4) Install a new gasket and the discharge line block fitting over the stud on the condenser inlet. Tighten the mounting nut to 20 N·m (180 in. lbs.).

(5) Check that all of the condenser and radiator air seals are in their proper locations.

(6) Connect the battery negative cable.

(7) Evacuate the refrigerant system. See Refrigerant System Evacuate in the Service Procedures section of this group.

(8) Charge the refrigerant system. See Refrigerant System Charge in the Service Procedures section of this group.

NOTE: If the condenser is replaced, add 30 milliliters (1 fluid ounce) of refrigerant oil to the refrigerant system. Use only refrigerant oil of the type recommended for the compressor in the vehicle.

VACUUM CHECK VALVE

(1) On models with a gasoline engine, unplug the vacuum supply line connector at the vacuum check valve (Fig. 37). On models with a diesel engine, remove the clamp from the vacuum supply line connector and unplug the connector from the vacuum check valve (Fig. 38).

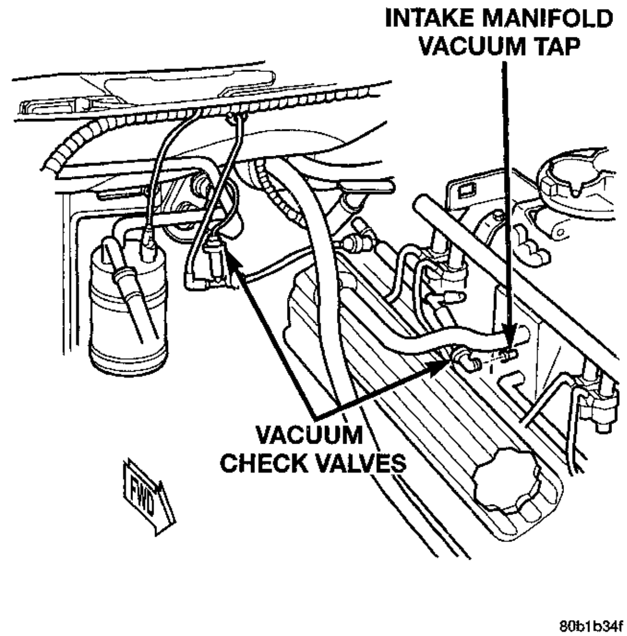

Fig. 37 Vacuum Check Valves - Gasoline Engine

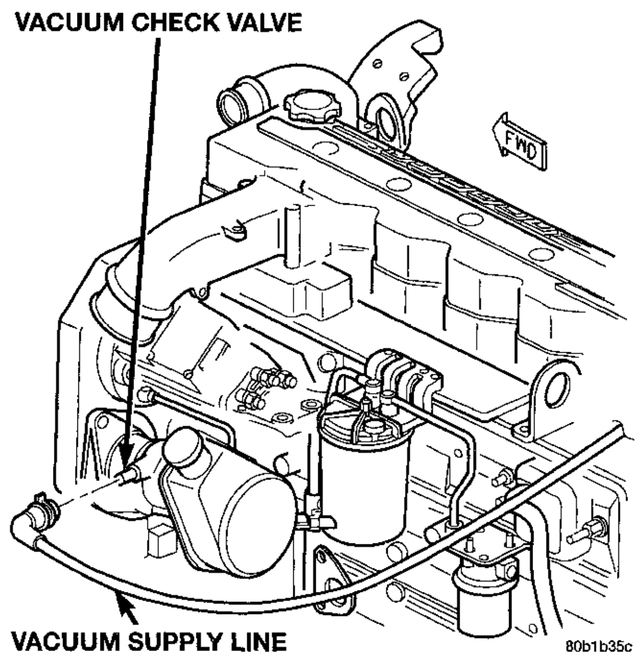

Fig. 38 Vacuum Check Valve - Diesel Engine

(2) On models with a gasoline engine, note the orientation of the check valve in the vacuum supply line for correct reinstallation.

(3) On models with a gasoline engine, unplug the vacuum check valve from the vacuum supply line fitting. On models with a diesel engine, unscrew the check valve and nipple unit from the engine vacuum pump.

REMOVAL AND INSTALLATION (Continued)

(4) Reverse the removal procedures to install. On models with a diesel engine, tighten the check valve and nipple unit to 24 N·m (18 ft. lbs.).

VACUUM RESERVOIR

(1) Disconnect and isolate the battery negative cable.

(2) Remove the wiper arms from the wiper pivots. Refer to Wiper Arm in the Removal and Installation section of Group 8K - Wiper and Washer Systems for the procedures.

(3) Remove the weatherstrip along the front edge of the cowl plenum cover/grille panel and the cowl plenum panel (Fig. 39).

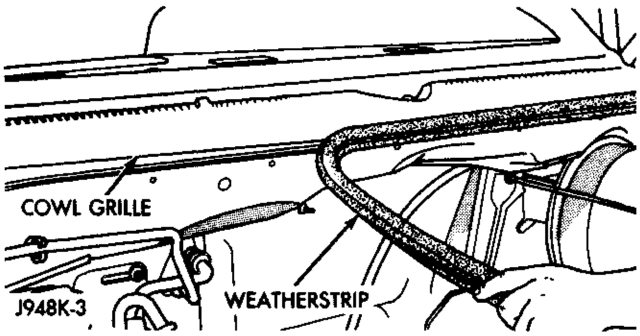

Fig. 39 Cowl Plenum Cover/Grille Panel Weatherstrip

(4) Remove the plastic screws that secure the cowl plenum cover/grille panel to the studs on the cowl top panel near the base of the windshield (Fig. 40).

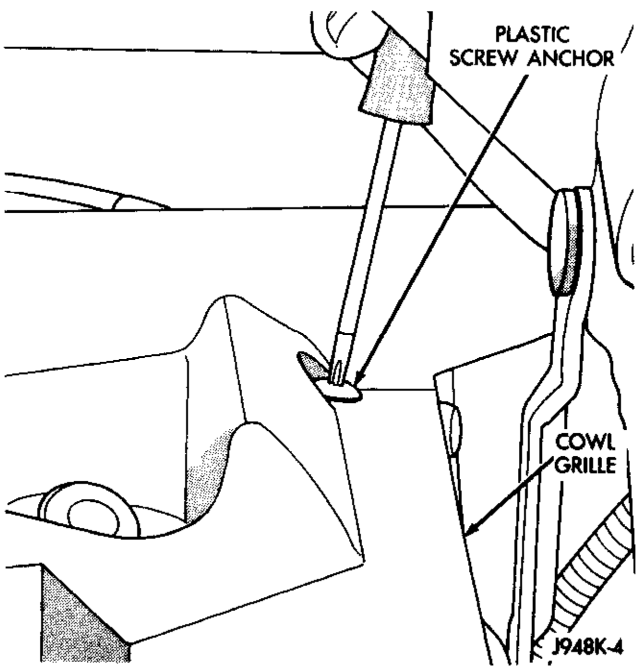

Fig. 40 Cowl Plenum Plastic Screws Remove/Install

(5) Lift the cowl plenum cover/grille panel from the cowl top far enough to access the vacuum reservoir near the right end of the cowl plenum.

(6) Disconnect the vacuum supply hose from the vacuum reservoir, which is secured to the dash panel near the right end of the cowl plenum (Fig. 41).

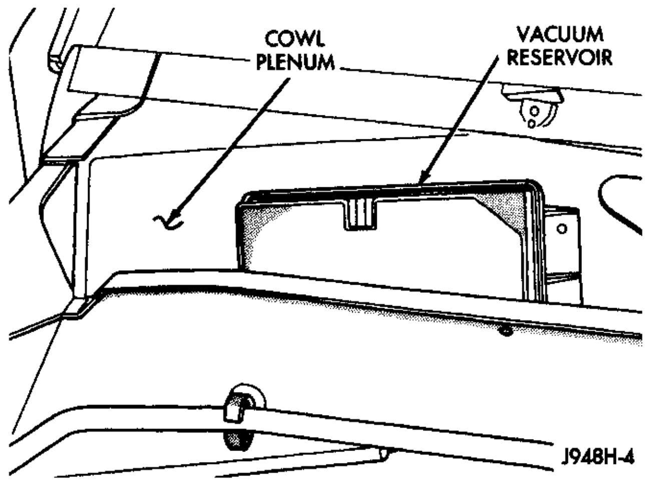

Fig. 41 Vacuum Reservoir

(7) Remove the two nuts that secure the reservoir to the studs on the dash panel near the right end of the cowl plenum.

(8) Remove the vacuum reservoir from the dash panel studs.

(9) Reverse the removal procedures to install. Tighten the mounting nuts to 2.8 N·m (25 in. lbs.).

HEATER-A/C CONTROL

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

REMOVAL

(1) Disconnect and isolate the battery negative cable.

(2) Reach under the instrument panel near the driver side of the floor panel transmission tunnel and unplug the heater-A/C control to heater-A/C housing vacuum harness connector.

(3) While still reaching under the instrument panel, disengage the retainer on the heater-A/C control half of the vacuum harness from the hole in the center distribution duct (Fig. 42).

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REMOVAL AND INSTALLATION (Continued)

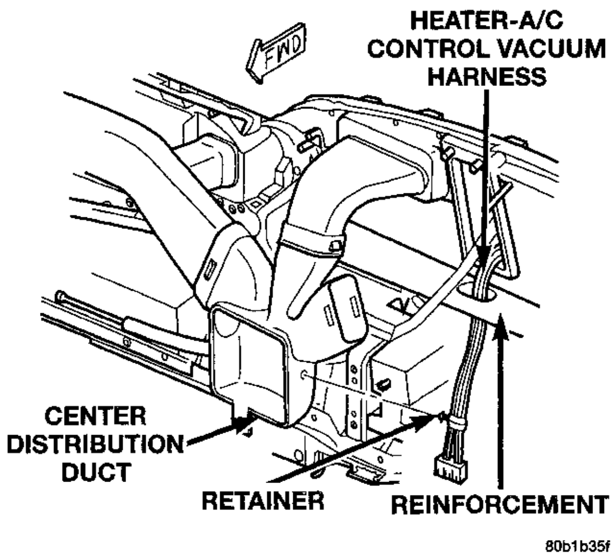

Fig. 42 Heater-A/C Control Vacuum Harness Routing

(4) Remove the cluster bezel from the instrument panel. Refer to Cluster Bezel in the Removal and Installation section of Group 8E - Instrument Panel Systems for the procedures.

(5) Remove the four screws that secure the heater-A/C control to the instrument panel (Fig. 43).

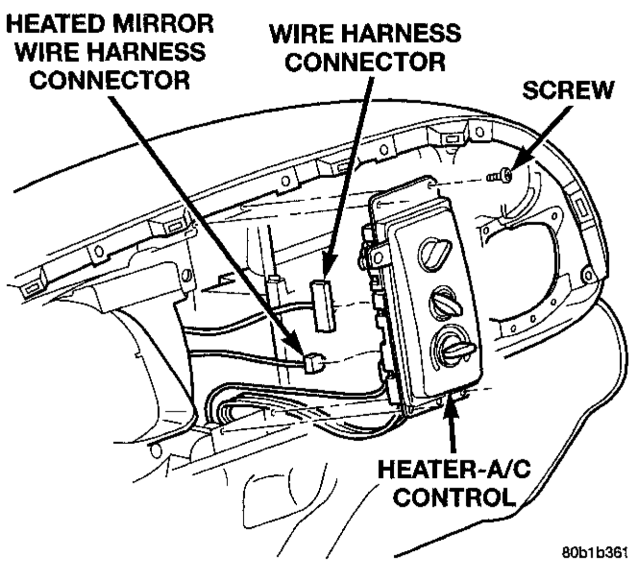

Fig. 43 Heater-A/C Control Remove/Install

(6) Pull the heater-A/C control assembly away from the instrument panel far enough to access the connections on the back of the control.

(7) Unplug the wire harness connector from the back of the heater-A/C control.

(8) On vehicles with heated mirrors, unplug the heated mirror wire harness connector from the back of the heater-A/C control.

(9) Release the temperature control cable housing flag retainer latch in the receptacle on the back of the heater-A/C control and disengage the flag retainer from the receptacle (Fig. 44).

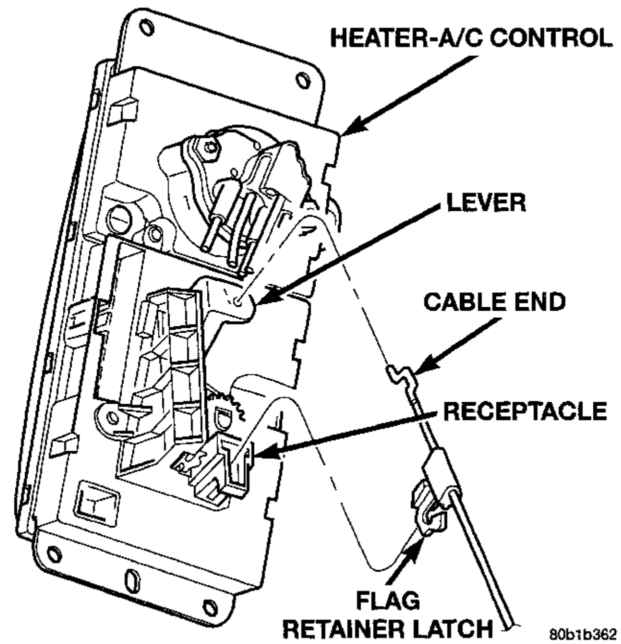

Fig. 44 Heater-A/C Control Temperature Control Cable Remove/Install

(10) Rotate the heater-A/C control assembly as needed to disengage the cable end from the hole on the end of the temperature control lever.

(11) Remove the heater-A/C control from the instrument panel.

INSTALLATION

(1) Connect the temperature control cable core end to the temperature control lever on the back of the heater-A/C control.

(2) Connect the temperature control cable housing flag retainer to the receptacle on the back of the heater-A/C control.

(3) Plug the wire harness connector(s) into the receptacle(s) on the back of the heater-A/C control.

(4) Route the heater-A/C vacuum harness through the hole in the reinforcement below the heater-A/C control opening of the instrument panel.

(5) Position the heater-A/C control in the instrument panel and secure it with four screws. Tighten the screws to 2.2 N·m (20 in. lbs.).

(6) Reinstall the cluster bezel to the instrument panel. Refer to Cluster Bezel in the Removal and Installation section of Group 8E - Instrument Panel Systems for the procedures.

(7) Reach under the instrument panel to reinstall the heater-A/C control vacuum harness retainer to the side of the center distribution duct.

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REMOVAL AND INSTALLATION (Continued)

(8) Plug in the two halves of the heater-A/C control to heater-A/C housing vacuum harness connector.
(9) Connect the battery negative cable.
(10) Adjust the temperature control cable. See Temperature Control Cable in the Adjustments section of this group for the procedures.

HEATER-A/C CONTROL KNOB

Each of the three heater-only or heater-A/C control knobs can be removed for service replacement.
(1) Rotate the control knob to its full clockwise position.
(2) Grasp the knob firmly and pull it straight out from the control.
(3) Reverse the removal procedures to install.

BLOWER MOTOR

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

REMOVAL

(1) Disconnect and isolate the battery negative cable.
(2) Disconnect the blower motor cooling tube from the nipple on the blower motor housing (Fig. 45).
(3) Disengage the blower motor wire harness from the wire harness retainer.
(4) Unplug the blower motor wire harness connector from the heater-A/C housing wire harness.
(5) Remove the three screws that secure the blower motor and blower wheel assembly to the heater-A/C housing.
(6) Lower the blower motor and wheel from the heater-A/C housing.
(7) Remove the blower wheel retainer clip and remove the wheel from the blower motor shaft (Fig. 46).

INSTALLATION

(1) Press the blower wheel hub onto the blower motor shaft. Be sure the flat on the blower motor shaft is indexed to the flat on the inside of the blower wheel hub.
(2) Install the retainer clip over the blower wheel hub. The ears of the retainer clip must be indexed over the flats on the blower motor shaft and blower wheel hub.

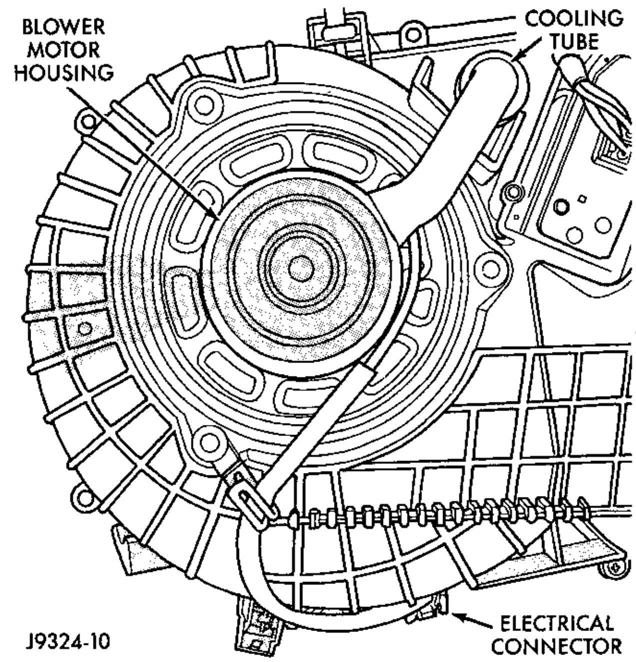

Fig. 45 Blower Motor Remove/Install

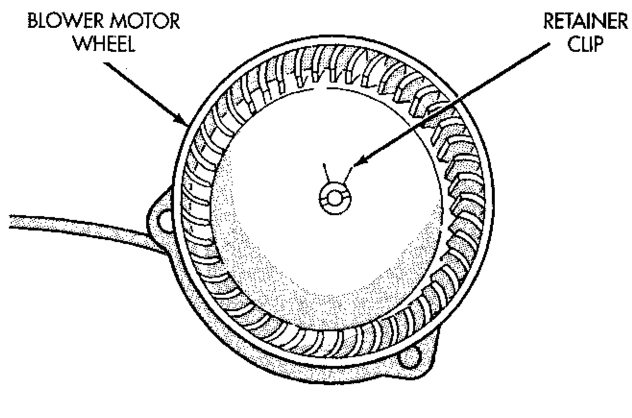

Fig. 46 Blower Motor Wheel Remove/Install

(3) Be certain that the blower motor seal is installed on the blower motor housing (Fig. 47).
(4) Install the blower motor in the heater-A/C housing with three mounting screws. Tighten the mounting screws to 2.2 N·m (20 in. lbs.).
(5) Plug the blower motor wire harness connector into the heater-A/C housing wire harness.
(6) Install the blower motor wire harness into the wire harness retainer.
(7) Connect the blower motor cooling tube to the nipple on the blower motor housing.
(8) Connect the battery negative cable.

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REMOVAL AND INSTALLATION (Continued)

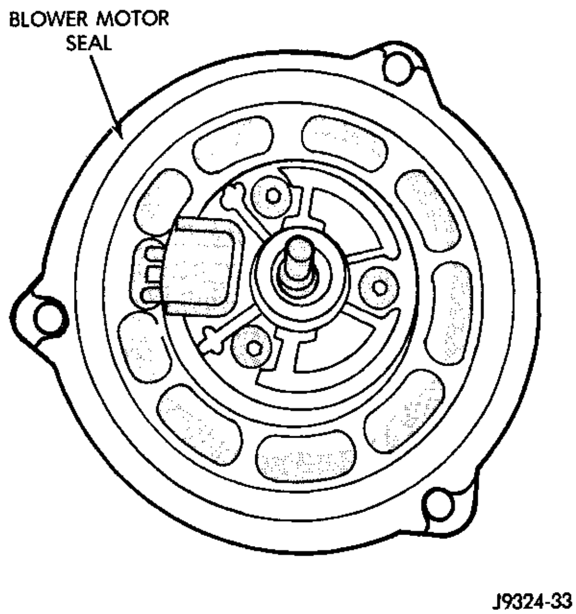

Fig. 47 Blower Motor Seal

BLOWER MOTOR RELAY

(1) Disconnect and isolate the battery negative cable.

(2) Remove the cover from the Power Distribution Center (PDC) (Fig. 48).

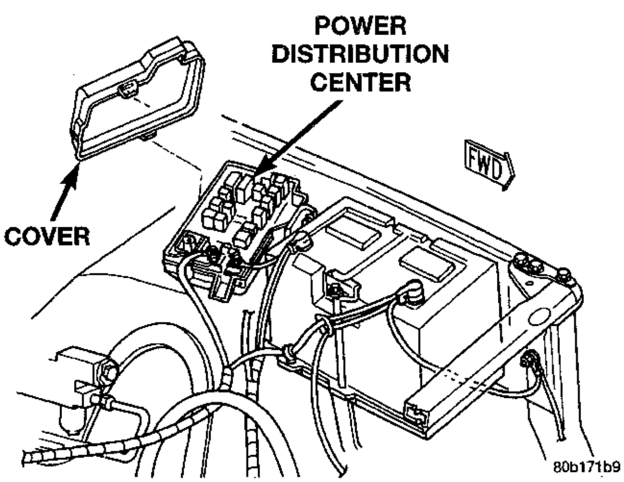

Fig. 48 Power Distribution Center

(3) Refer to the label on the PDC for blower motor relay identification and location.

(4) Unplug the blower motor relay from the PDC.

(5) Install the blower motor relay by aligning the relay terminals with the cavities in the PDC and pushing the relay firmly into place.

(6) Install the PDC cover.

(7) Connect the battery negative cable.

(8) Test the relay operation.

BLOWER MOTOR RESISTOR

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

REMOVAL

(1) Disconnect and isolate the battery negative cable.

(2) Reach under the passenger side end of the heater-A/C housing and unplug the wire harness connector from the blower motor resistor.

(3) Remove the screws that secure the blower motor resistor to the heater-A/C housing.

(4) Remove the blower motor resistor from the heater-A/C housing (Fig. 49).

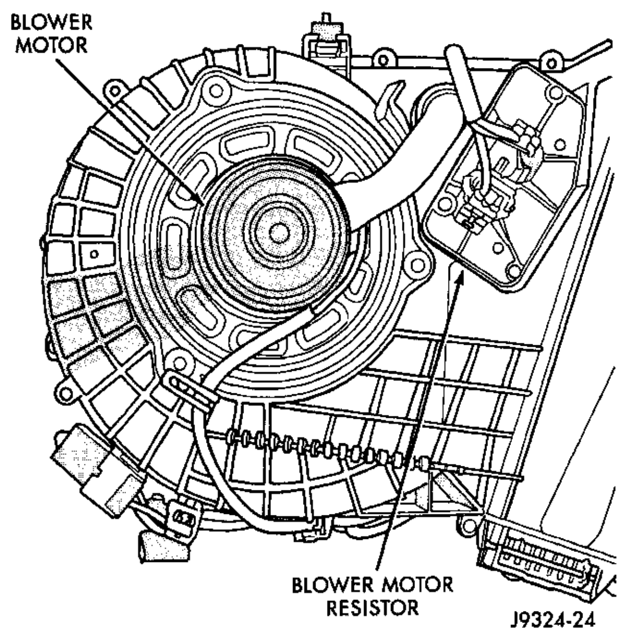

Fig. 49 Blower Motor Resistor - Typical

INSTALLATION

(1) Install the blower motor resistor into the heater-A/C housing and secure it with the mounting screws. Tighten the mounting screws to 2.2 N·m (20 in. lbs.).

(2) Plug the wire harness connector into the blower motor resistor.

(3) Connect the battery negative cable.

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REMOVAL AND INSTALLATION (Continued)

TEMPERATURE CONTROL CABLE

The temperature control cable self-adjuster clip can be accessed and repositioned on the cable core without removal of the temperature control cable from the heater-A/C housing by reaching through the glove box opening as described in the Removal procedures that follow. Reposition the self-adjuster clip as shown in (Fig. 51), then see Temperature Control Cable in the Adjustments section of this group for the procedures to complete the cable adjustment.

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

REMOVAL

(1) Disconnect and isolate the battery negative cable.

(2) Remove the glove box from the instrument panel. Refer to Glove Box in the Removal and Installation section of Group 8E - Instrument Panel Systems for the procedures.

(3) Disconnect the temperature control cable from the heater-A/C control. See Heater-A/C Control in the Removal and Installation section of this group for the procedures.

(4) Reach through the instrument panel glove box opening to disconnect the temperature control cable housing flag retainer from the receptacle on the top of the heater-A/C housing (Fig. 50).

(5) Pull the temperature control cable core self-adjuster clip off of the pin on the end of the blend-air door lever.

(6) Remove the temperature control cable from the vehicle.

INSTALLATION

Before installing the temperature control cable, be certain that the self-adjuster clip is properly positioned (Fig. 51). This measurement is made between the self-adjuster clip and the cable end on the heater-A/C housing end of the cable. If the self-adjuster clip is not properly positioned, slide the clip up or down the cable core as required to achieve the specified dimension.

(1) Push the temperature control cable core self-adjuster clip onto the pin on the end of the blend-air door lever.

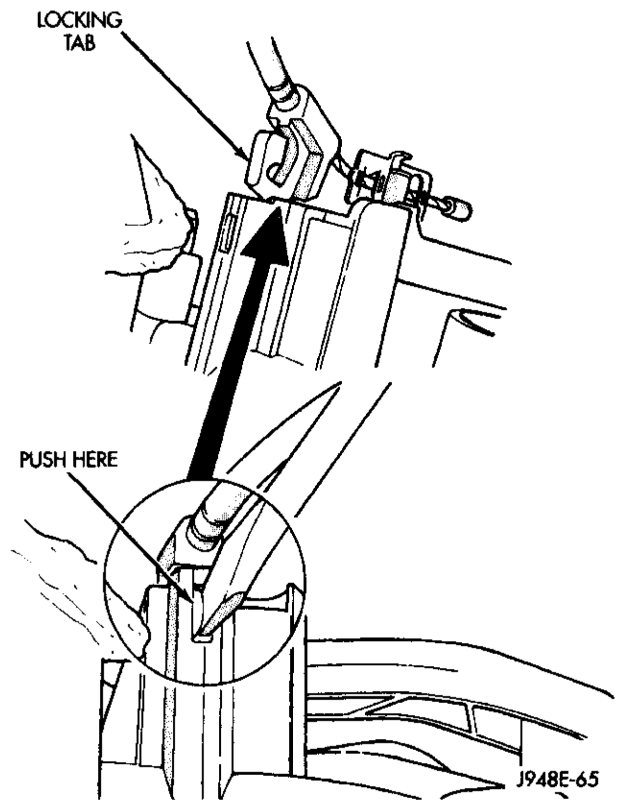

Fig. 50 Temperature Control Cable Remove/Install

(2) Snap the temperature control cable housing flag retainer into the receiver on the top of the heater-A/C housing.

(3) Reinstall the glove box in the instrument panel. Refer to Glove Box in the Removal and Installation section of Group 8E - Instrument Panel Systems for the procedures.

(4) Connect the temperature control cable to the heater-A/C control. See Heater-A/C Control in the Removal and Installation section of this group for the procedures.

(5) Connect the battery negative cable.

(6) Adjust the temperature control cable. See Temperature Control Cable in the Adjustments section of this group for the procedures.

HEATER-A/C HOUSING

The heater-A/C housing assembly must be removed from the vehicle and disassembled for service access of the heater core, evaporator coil, and each of the various mode control doors.

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REMOVAL AND INSTALLATION (Continued)

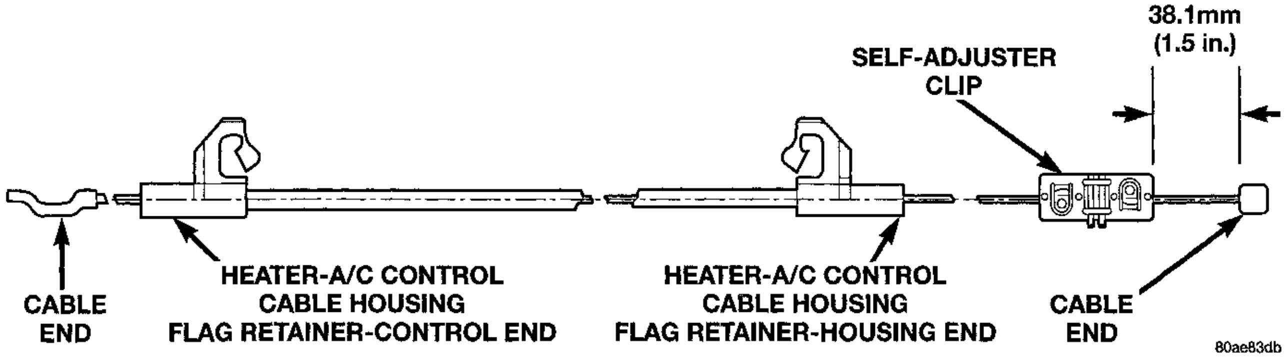

Fig. 51 Temperature Control Cable Self-Adjuster Clip

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

REMOVAL

(1) Disconnect and isolate the battery negative cable.

(2) Remove the instrument panel from the vehicle. Refer to Instrument Panel Assembly in the Removal and Installation section of Group 8E - Instrument Panel Systems for the procedures.

(3) If the vehicle is not equipped with air conditioning, go to Step 6. If the vehicle is equipped with air conditioning, recover the refrigerant from the refrigerant system. See Refrigerant Recovery in the Service Procedures section of this group.

(4) Disconnect the liquid line refrigerant line fitting from the evaporator inlet tube. See Refrigerant Line Coupler in the Removal and Installation section of this group for the procedures. Install plugs in, or tape over all of the opened refrigerant line fittings.

(5) Disconnect the accumulator inlet tube refrigerant line fitting from the evaporator outlet tube. See Refrigerant Line Coupler in the Removal and Installation section of this group for the procedures. Install plugs in, or tape over all of the opened refrigerant line fittings.

(6) Drain the engine cooling system. Refer to Group 7 - Cooling System for the procedures.

(7) Disconnect the heater hoses from the heater core tubes. Refer to Group 7 - Cooling System for the procedures. Install plugs in, or tape over the opened heater core tubes.

(8) Remove the Powertrain Control Module (PCM) from the dash panel and set it aside, but do not unplug the PCM wire harness connectors. Refer to Group 14 - Fuel Systems for the procedures.

(9) Remove the nuts from the heater-A/C housing mounting studs on the engine compartment side of the dash panel.

(10) Remove the nuts that secure the heater-A/C housing to the mounting studs on the passenger compartment side of the dash panel (Fig. 52).

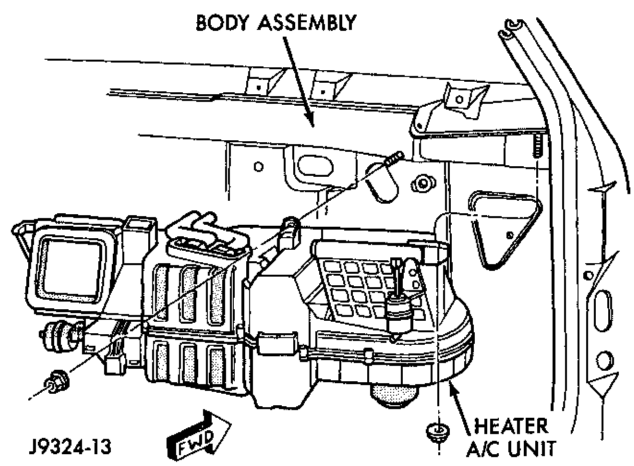

Fig. 52 Heater-A/C Housing Remove/Install

(11) Pull the heater-A/C housing rearward far enough for the mounting studs and the evaporator condensate drain tube to clear the dash panel holes.

(12) Remove the heater-A/C housing from the vehicle.

DISASSEMBLY

(1) Place the heater-A/C housing upside down on a work bench.

(2) Remove the screw that secures the floor duct to the bottom of the heater-A/C housing and slide the floor duct off of the center heat duct adaptor.

(3) Unsnap the center heat duct adaptor from the bottom of the heater-A/C housing and remove the screw that was hidden by the adaptor.

REMOVAL AND INSTALLATION (Continued)

(4) Remove the remaining screws on the bottom of the heater-A/C housing that secure the two housing halves together.

(5) Place the heater-A/C housing right side up on the work bench.

(6) Separate the top half of the heater-A/C housing from the bottom half and set it aside.

ASSEMBLY

(1) Position the top half of the heater-A/C housing over the bottom half. Be certain that the mode door pivot pins are properly inserted in their pivot holes.

(2) Place the heater-A/C housing upside down on the work bench.

(3) Install and tighten the screws on the bottom of the heater-A/C housing that secure the two housing halves together. Tighten the screws to 2.2 N·m (20 in. lbs.).

(4) Snap the center heat duct adaptor onto the bottom of the heater-A/C housing.

(5) Slide the floor duct onto the center heat duct adaptor and secure it with a screw to the bottom of the heater-A/C housing. Tighten the mounting screw to 2.2 N·m (20 in. lbs.).

(6) Reinstall the heater-A/C housing in the vehicle.

INSTALLATION

(1) Position the heater-A/C housing to the dash panel. Be certain that the evaporator condensate drain tube and the housing mounting studs are inserted into their correct mounting holes.

(2) Install the nuts that secure the heater-A/C housing to the mounting studs on the passenger compartment side of the dash panel. Tighten the nuts to 4.5 N·m (40 in. lbs.).

(3) Install and tighten the nuts onto the heater-A/C housing mounting studs on the engine compartment side of the dash panel. Tighten the nuts to 7 N·m (60 in. lbs.).

(4) Unplug or remove the tape from the heater core tubes. Connect the heater hoses to the heater core tubes and fill the engine cooling system. Refer to Group 7 - Cooling System for the procedures.

(5) If the vehicle is not equipped with air conditioning, go to Step 10. If the vehicle is equipped with air conditioning, unplug or remove the tape from the accumulator inlet tube and the evaporator outlet tube fittings. Connect the accumulator inlet tube coupler to the evaporator outlet tube. See Refrigerant Line Coupler in the Removal and Installation section of this group for the procedures.

(6) Unplug or remove the tape from the liquid line and the evaporator inlet tube fittings. Connect the liquid line coupler to the evaporator inlet tube. See Refrigerant Line Coupler in the Removal and Installation section of this group for the procedures.

(7) Evacuate the refrigerant system. See Refrigerant System Evacuate in the Service Procedures section of this group.

(8) Charge the refrigerant system. See Refrigerant System Charge in the Service Procedures section of this group.

(9) Reinstall the PCM to the dash panel. Refer to Group 14 - Fuel Systems for the procedures.

(10) Reinstall the instrument panel in the vehicle. Refer to Instrument Panel Assembly in the Removal and Installation section of Group 8E - Instrument Panel Systems for the procedures.

(11) Connect the battery negative cable.

(12) Start the engine and check for proper operation of the heating and air conditioning systems.

MODE DOOR VACUUM ACTUATOR

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

HEAT-DEFROST DOOR ACTUATOR

(1) Disconnect and isolate the battery negative cable.

(2) Remove the heater-A/C housing from the vehicle and place it on a work bench. See Heater-A/C Housing in the Removal and Installation section of this group for the procedures.

(3) Unplug the two vacuum harness connectors from the heat-defrost door actuator (Fig. 53).

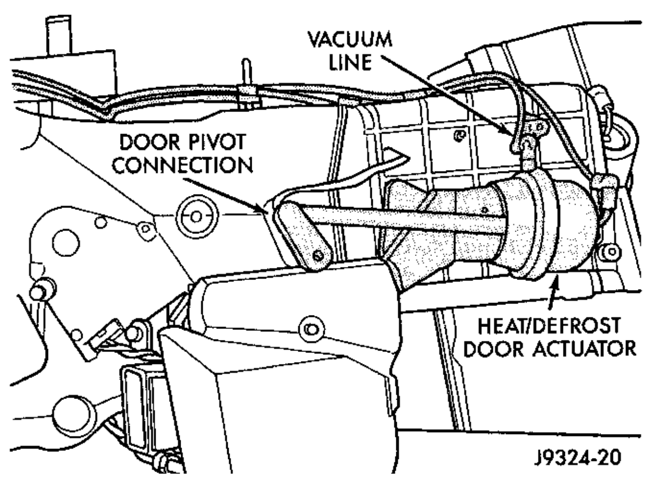

Fig. 53 Heat-Defrost Door Actuator

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REMOVAL AND INSTALLATION (Continued)

(4) Using a trim stick or another suitable wide flat-bladed tool, gently pry the heat-defrost door crank arm off of the heat-defrost door pivot.

(5) Remove the two screws that secure the heat-defrost door actuator to the heater-A/C housing.

(6) Remove the heat-defrost door actuator from the heater-A/C housing.

(7) Reverse the removal procedures to install. Tighten the heat-defrost door actuator mounting screws to 2.2 N·m (20 in. lbs.).

PANEL-DEFROST DOOR ACTUATOR

(1) Disconnect and isolate the battery negative cable.

(2) Remove the instrument panel assembly from the vehicle. Refer to Instrument Panel Assembly in the Removal and Installation section of Group 8E - Instrument Panel Systems for the procedures.

(3) Unplug the vacuum harness connector from the panel-defrost door actuator (Fig. 54).

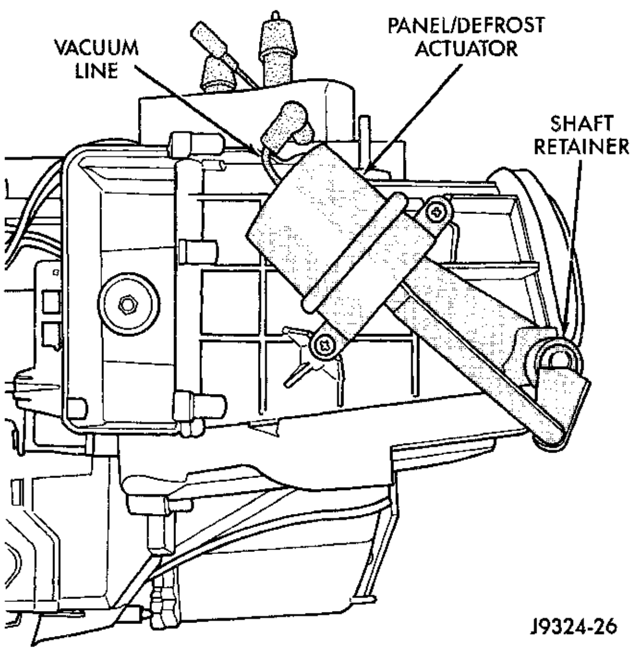

Fig. 54 Panel-Defrost Door Actuator

(4) Using a trim stick or another suitable wide flat-bladed tool, gently pry the panel-defrost door crank arm off of the panel-defrost door pivot.

(5) Remove the two screws that secure the panel-defrost door actuator to the heater-A/C housing.

(6) Remove the panel-defrost door actuator from the heater-A/C housing.

(7) Reverse the removal procedures to install. Tighten the panel-defrost door actuator mounting screws to 2.2 N·m (20 in. lbs.).

RECIRCULATION AIR DOOR ACTUATOR

(1) Disconnect and isolate the battery negative cable.

(2) Remove the glove box from the instrument panel. Refer to Glove Box in the Removal and Installation section of Group 8E - Instrument Panel Systems for the procedures.

(3) Reach through the glove box opening to access and unplug the vacuum harness connector from the recirculation air door actuator (Fig. 55).

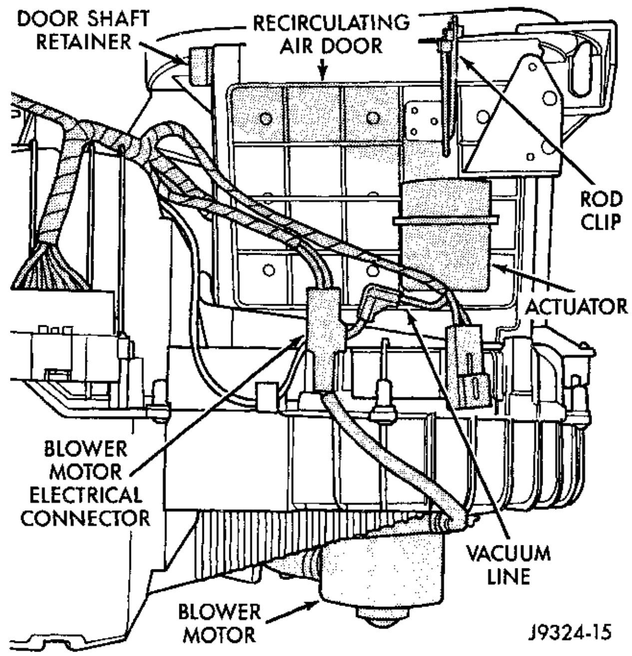

Fig. 55 Recirculation Air Door Actuator

(4) Loosen the two nuts on the studs that secure the recirculation air door actuator to the mounting bracket on the heater-A/C housing.

(5) Slide the two actuator mounting studs out of the slots in the actuator mounting bracket.

(6) Pull the recirculation actuator downward far enough to access the clip that retains the actuator link to the recirculation air door lever.

(7) Unsnap the clip from the recirculation actuator link and disengage the link from the recirculation air door lever.

(8) Remove the recirculation actuator from the heater-A/C housing.

(9) When reinstalling the recirculation actuator, insert a screwdriver or another suitable tool through the recirculation air intake grille to prop the recirculation air door up in the open position far enough to access the recirculation air door lever through the instrument panel glove box opening.

(10) Reverse the remaining removal procedures to install. Tighten the mounting nuts until the recirculation air door actuator is seated to the mounting bracket on the heater-A/C housing.

AUTHENTIC RESTORATION PRODUCT

REMOVAL AND INSTALLATION (Continued)

HEATER-A/C HOUSING DOOR

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

BLEND-AIR DOOR

(1) Remove the heater-A/C housing from the vehicle, and disassemble the housing halves. See Heater-A/C Housing in the Removal and Installation section of this group for the procedures.

(2) Lift the blend-air door pivot shaft out of the pivot hole in the bottom of the heater-A/C housing (Fig. 56).

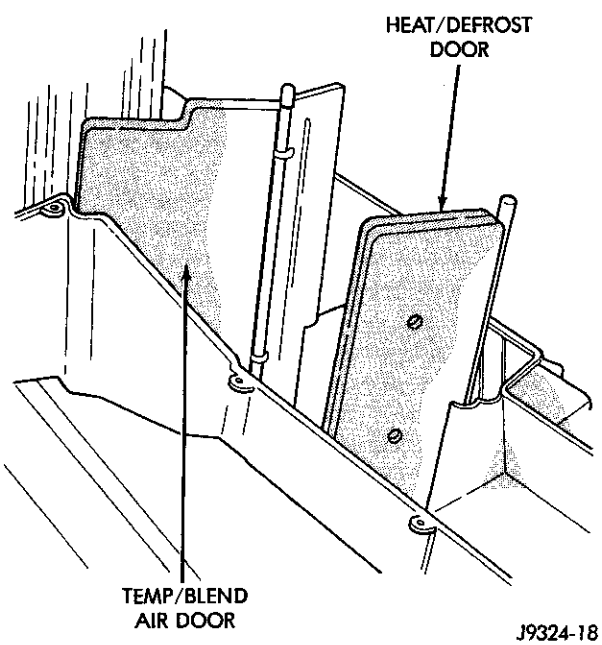

Fig. 56 Blend-Air Door

(3) Reverse the removal procedures to install.

HEAT-DEFROST DOOR

(1) Remove the heat-defrost door actuator from the heater-A/C housing. See Mode Door Vacuum Actuator in the Removal and Installation section of this group for the procedures.

(2) Disassemble the heater-A/C housing halves. See Heater-A/C Housing in the Removal and Installation section of this group for the procedures.

(3) Remove the heat-defrost door from the heater-A/C housing.

(4) Reverse the removal procedures to install.

PANEL-DEFROST DOOR

(1) Remove the panel-defrost door actuator from the heater-A/C housing. See Mode Door Vacuum Actuator in the Removal and Installation section of this group for the procedures.

(2) Remove the defroster and demister duct adapter from the heater-A/C housing. See Ducts and Outlets in the Removal and Installation section of this group for the procedures.

(3) Lift the panel-defrost door out of the top opening of the heater-A/C housing.

(4) Reverse the removal procedures to install.

RECIRCULATION AIR DOOR

(1) Remove the heater-A/C housing from the vehicle. See Heater-A/C Housing in the Removal and Installation section of this group for the procedures.

(2) Unsnap the recirculation air door vacuum actuator link clip and disengage the link from the recirculation air door lever. See Mode Door Vacuum Actuators in the Removal and Installation section of this group for the procedures.

(3) Using a trim stick or another suitable wide flat-bladed tool, gently pry the retainer off of the recirculation air door pivot shaft.

(4) Remove the recirculation air door through the outside air intake opening on the top of the heater-A/C housing.

(5) Reverse the removal procedures to install.

EVAPORATOR COIL

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

REMOVAL

(1) Remove the heater-A/C housing from the vehicle, and disassemble the housing halves. See Heater-A/C Housing in the Removal and Installation section of this group for the procedures.

(2) Lift the evaporator coil out of the heater-A/C housing (Fig. 57).

INSTALLATION

(1) Insert the evaporator coil into the bottom of the heater-A/C housing.

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REMOVAL AND INSTALLATION (Continued)

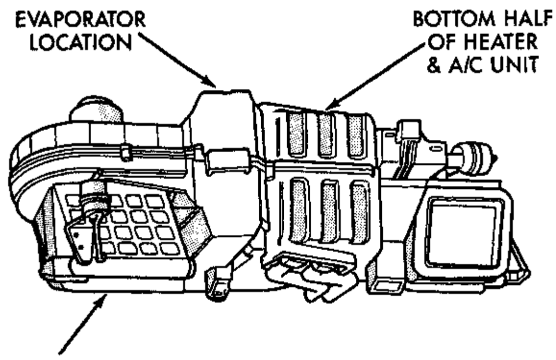

Fig. 57 Evaporator Coil Location in Heater-A/C Housing (Upside Down)

(2) Reassemble and reinstall the heater-A/C housing in the vehicle. See Heater-A/C Housing in the Removal and Installation section of this group for the procedures.

NOTE: If the evaporator is replaced, add 60 milliliters (2 fluid ounces) of refrigerant oil to the refrigerant system.

HEATER CORE

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

REMOVAL

(1) Remove the heater-A/C housing from the vehicle. See Heater-A/C Housing in the Removal and Installation section of this group for the procedures.

(2) Remove the screws and retainers that secure the heater core to the heater-A/C housing.

(3) Lift the heater core straight up and out of the heater-A/C housing (Fig. 58).

INSTALLATION

(1) Lower the heater core into the heater-A/C housing.

(2) Position the retainers over the heater core tubes. Install and tighten the screws that secure the heater core and retainers to the heater-A/C housing. Tighten the screws to 2.2 N·m (20 in. lbs.).

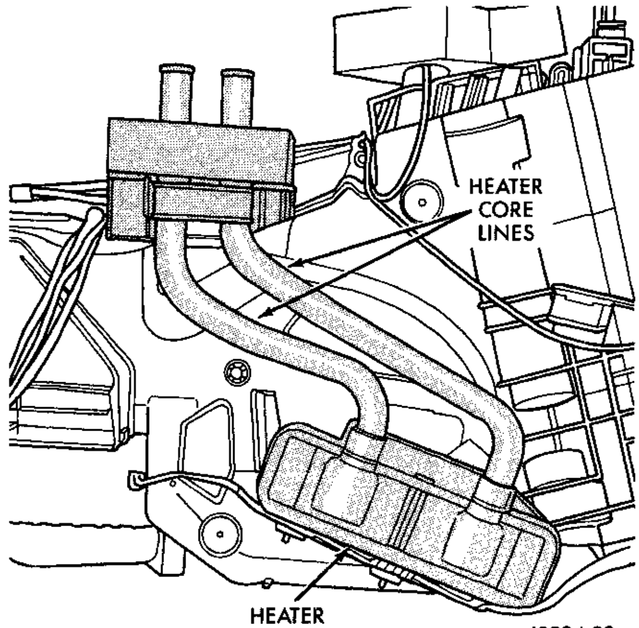

Fig. 58 Heater Core Remove/Install

(3) Reinstall the heater-A/C housing in the vehicle. See Heater-A/C Housing in the Removal and Installation section of this group for the procedures.

DUCTS AND OUTLETS

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

PANEL AND CENTER DISTRIBUTION DUCTS

The panel and center distribution ducts (Fig. 59) are only serviced as part of the instrument panel assembly. Refer to Instrument Panel Assembly in the Removal and Installation section of Group 8E - Instrument Panel Systems for the service procedures.

REMOVAL AND INSTALLATION (Continued)

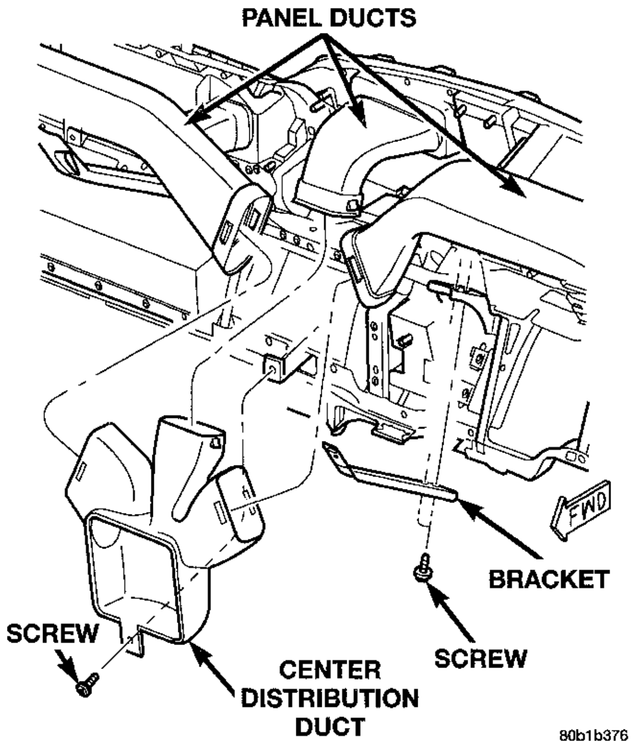

Fig. 59 Panel and Center Distribution Ducts

PANEL OUTLET BARRELS

WARNING: THE PANEL OUTLET BARRELS INSTALLED IN THE PASSENGER SIDE AIRBAG DOOR PANEL OUTLET HOUSINGS MUST NEVER BE REINSTALLED FOLLOWING REMOVAL FOR ANY REASON. THEY MUST BE REPLACED WITH NEW BARRELS. FAILURE TO OBSERVE THIS WARNING COULD RESULT IN OCCUPANT INJURIES UPON AIRBAG DEPLOYMENT.

(1) Using a trim stick or another suitable wide flat-bladed tool, gently pry near the center of either side of the panel outlet barrel to release the snap-fit pivots on the barrel from the pivot pins in the outlet housing of the passenger side airbag module or the instrument cluster bezel (Fig. 60).

(2) Remove the barrel from the panel outlet housing.

(3) To install a new panel outlet barrel, position the barrel in the outlet housing and press inwards firmly and evenly near the center of both sides of the panel outlet barrel until the pivots snap into place.

DEMISTER OUTLET GRILLES

(1) Using a trim stick or another suitable wide flat-bladed tool, gently pry at the perimeter edges of the demister grille to release the snap features from the instrument panel top cover.

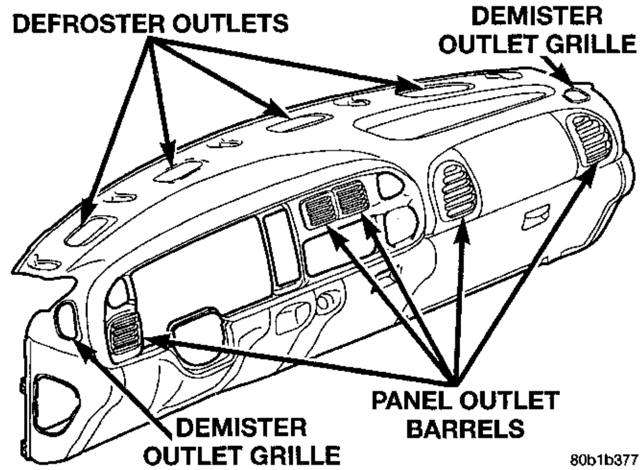

Fig. 60 Panel Outlet Barrels

(2) Remove the demister grille from the instrument panel.

(3) To install the demister grille, position the grille in the opening of the instrument panel top cover and press inwards firmly and evenly near the center of both sides of the grille until it snaps into place.

DEFROSTER AND DEMISTER DUCTS

The defroster duct and the main demister duct are a single molded plastic unit. The defroster outlet grilles are heat-staked to the defroster outlets and cannot be serviced separately. The demister tubes on each end of the main demister duct are only serviced in the instrument panel assembly.

(1) Remove the instrument panel top cover from the instrument panel. Refer to Instrument Panel Top Cover in the Removal and Installation section of Group 8E - Instrument Panel Systems for the procedures.

(2) Remove the screws that secure the defroster and demister ducts to the instrument panel brackets (Fig. 61).

(3) Disengage the demister tubes from each end of the main demister duct.

(4) Remove the defroster and demister duct unit from the instrument panel.

(5) Reverse the removal procedures to install. Tighten the mounting screws to 2.2 N·m (20 in. lbs.).

DEFROSTER AND DEMISTER DUCT ADAPTER

(1) Roll the instrument panel assembly down, but do not remove it from the vehicle. Refer to Instrument Panel Assembly in the Removal and Installation section of Group 8E - Instrument Panel Systems for the procedures.

(2) Using a trim stick or another suitable wide flat-bladed tool, gently pry at the perimeter edges of the defroster and demister duct adapter to release

REMOVAL AND INSTALLATION (Continued)

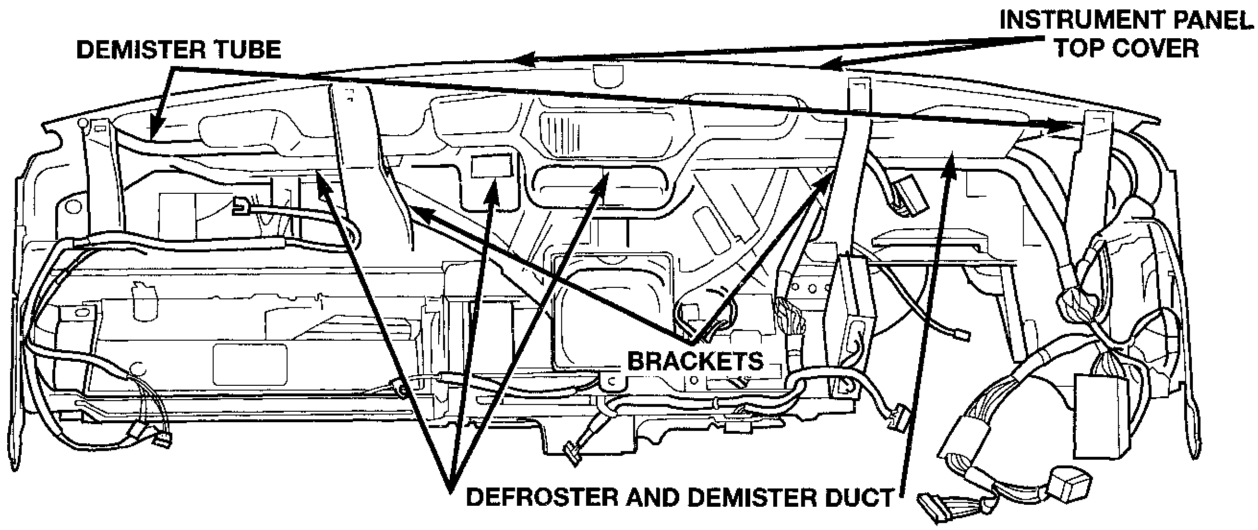

Fig. 61 Defroster and Demister Duct Remove/Install

the snap features from the top of the heater-A/C housing (Fig. 62).

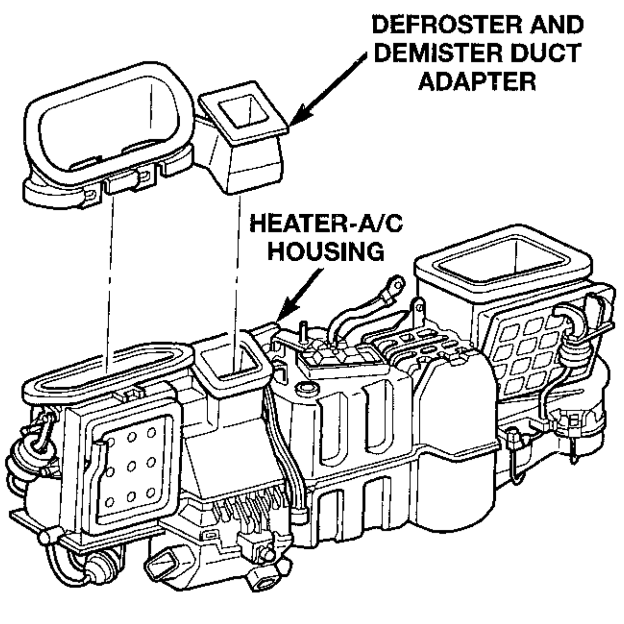

Fig. 62 Defroster and Demister Duct Adapter Remove/Install

(3) Remove the defroster and demister duct adapter from the top of the heater-A/C housing.

(4) Reverse the removal procedures to install.

HEATER-A/C HOUSING INLET BAFFLE

(1) Remove the heater-A/C housing from the vehicle. See Heater-A/C Housing in the Removal and Installation section of this group for the procedures.

(2) Slide the heater-A/C housing inlet baffle (Fig. 63) all the way to one side of the cowl plenum opening.

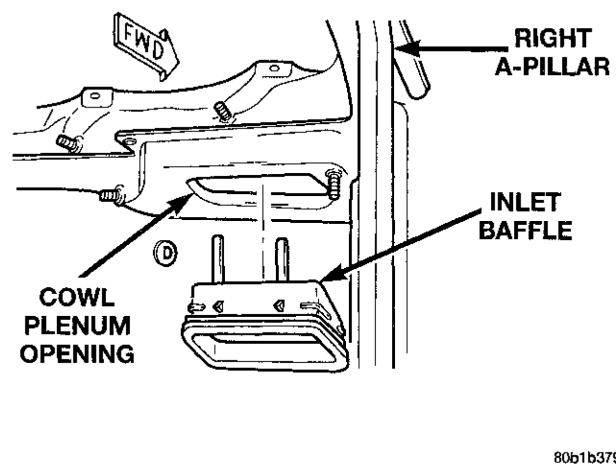

Fig. 63 Heater-A/C Housing Inlet Baffle Remove/Install

(3) Pull downwards sharply and firmly on the opposite side of the heater-A/C housing inlet baffle to disengage the snap features from the cowl plenum opening.

(4) Remove the heater-A/C housing inlet baffle from the cowl plenum panel.

(5) When reinstalling the heater-A/C housing inlet baffle to the cowl plenum panel opening, be certain that the snap features on each side of the adapter are fully engaged with the sides of the plenum panel opening. This must be a water tight connection to prevent leaks.

(6) Reverse the remaining removal procedures to complete the installation.

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ADJUSTMENTS

TEMPERATURE CONTROL CABLE

Any time the heater-A/C control or the temperature control cable are removed and/or replaced, the following procedure must be performed.

(1) The temperature control cable housing and core must be installed at both the heater-A/C control and the heater-A/C housing ends, and the heater-A/C control must be installed in the instrument panel. See Heater-A/C Control and Temperature Control Cable in the Removal and Installation section of this group for the procedures.

(2) Rotate the temperature control knob on the heater-A/C control so that the knob pointer is in the 3 o'clock position.

(3) Pull the temperature control knob straight out from the heater-A/C control base until the perimeter of the knob (not the knob pointer) protrudes about 6 millimeters (0.25 inch) from the face of the control base.

(4) Rotate the temperature control knob to its full counterclockwise stop. The knob pointer should be aimed at a position about 8 millimeters (0.315 inch) beyond the end of the graduated blue strobe temperature control graphic on the face of the heater-A/C control base. If the knob is not pointed to the correct position, go back to Step 2 and repeat the adjustment procedure.

(5) Rotate the temperature control knob clockwise until the knob pointer is in its full clockwise position again.

(6) Push the temperature control knob straight in towards the heater-A/C control base until the perimeter of the knob (not the knob pointer) is flush with the face of the heater-A/C control base.

(7) Rotate the knob to its full counterclockwise stop again. The knob pointer should be aimed at the end of the graduated blue strobe temperature control graphic on the face of the heater-A/C control base. If OK, go to Step 8. If not OK, go back to Step 2.

(8) Rotate the knob to its full clockwise stop and release the knob. If the knob springs back from the clockwise stop, the self-adjuster clip that secures the temperature control cable to the blend-air door lever is improperly installed. See Temperature Control Cable in the Removal and Installation section of this group for the procedures. If the knob does not spring back, the temperature control cable adjustment is complete.

(9) Rotate the temperature control knob quickly to the full hot and full cold positions. There should be a distinct sound of the blend-air door closing against its stops within the heater-A/C housing at each end of the temperature control knob travel. If not OK, check the blend air door for proper installation, obstructions or faulty seals. See Heater-A/C Mode Door in the Removal and Installation section of this group for the procedures.

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EMISSION CONTROL SYSTEMS

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GENERAL INFORMATION

INTRODUCTION

Throughout this group, references are made to particular vehicle models by alphabetical designation or by the particular vehicle nameplate. A chart showing a breakdown of the alphabetical designations is included in the Introduction section at the beginning of this manual.

All vehicles are equipped with either a 3.9L (V-6) engine, a 5.2L (V-8) engine, two different 5.9L (V-8) engines, two different 8.0L (V-10) engines, or a 5.9L Cummins in-line 6–cylinder, two-valve-per-cylinder diesel engine.

• The 3.9L (V-6) and 5.2L (V-8) engines will be referred to in this group as: LDC (Light Duty Emission Cycle) engines.

• The 5.9L (V-8) gas powered engine will be referred to as either: LDC (Light Duty Emission Cycle) or HDC (Heavy Duty Emission Cycle) engine.

• The 8.0L (V-10) engine will be referred to as either: MDC (Medium Duty Emission Cycle) or HDC (Heavy Duty Emission Cycle) engine.

• The diesel engine will be referred to as: HDC (Heavy Duty Emission Cycle) engine. When equipped with the California Emission Package, the diesel engine will use an Exhaust Gas Recirculation (EGR) system.

Either of the HDC gas powered engines can be easily identified by the use of an engine mounted air injection pump. The 3.9L/5.2L/5.9L LDC gas engines, the 8.0L MDC V-10 engine or the diesel engine will not use an air injection pump.

Maintenance requirements for LDC, MDC and HDC emission systems differ because of different load and operating conditions. For required part replacement or maintenance schedules in time or mileage intervals, refer to either Group 0, Lubrication and Maintenance in this manual, or the vehicle Owners Manual.

SERVICE REMINDER INDICATOR (SRI) LAMP

The Service Reminder Indicator (SRI) lamp is used with the 5.9L HDC V-8 gasoline powered engine only. The lamp is displayed on the instrument panel as the MAINT REQ'D lamp.

The SRI system is incorporated into the powertrain control module (PCM). The PCM records the vehicles mileage and stores it into memory. At that time, the PCM checks for certain mileage trip points. When the current mileage matches one of the trip points, the SRI lamp is activated.

Certain parts are to be replaced, or certain maintenance must be performed at either an indicated mileage or when the SRI lamp remains on when the key is in the ON position. After performing the part replacement or required maintenance, the SRI lamp must be reset to turn the lamp off. Use the DRB scan tool to reset the SRI lamp.

For required part replacement or maintenance schedules in time or mileage intervals, refer to either Group 0, Lubrication and Maintenance in this manual, or the vehicle Owners Manual.

Failure to perform the part replacement or required maintenance and only reset the SRI lamp may be a violation of federal law. Only after performing the part replacement or required maintenance, should the SRI lamp be reset.

ON-BOARD DIAGNOSTICS

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GENERAL INFORMATION

SYSTEM DESCRIPTION

The Powertrain Control Module (PCM) monitors many different circuits in the fuel injection, ignition, emission and engine systems. If the PCM senses a problem with a monitored circuit often enough to indicate an actual problem, it stores a Diagnostic Trouble Code (DTC) in the PCM's memory. If the problem is repaired or ceases to exist, the PCM cancels the code after 40 warm-up cycles. Diagnostic trouble codes that affect vehicle emissions illuminate the Malfunction Indicator (check engine) Lamp. Refer to Malfunction Indicator Lamp in this section.

Certain criteria must be met before the PCM stores a DTC in memory. The criteria may be a specific range of engine RPM, engine temperature, and/or input voltage to the PCM.

The PCM might not store a DTC for a monitored circuit even though a malfunction has occurred. This may happen because one of the DTC criteria for the circuit has not been met. **For example**, assume the diagnostic trouble code criteria requires the PCM to monitor the circuit only when the engine operates between 750 and 2000 RPM. Suppose the sensor's output circuit shorts to ground when engine operates above 2400 RPM (resulting in 0 volt input to the PCM). Because the condition happens at an engine speed above the maximum threshold (2000 rpm), the PCM will not store a DTC.

There are several operating conditions for which the PCM monitors and sets DTC's. Refer to Monitored Systems, Components, and Non-Monitored Circuits in this section.

Technicians must retrieve stored DTC's by connecting the DRB scan tool (or an equivalent scan tool) to the 16-way data link connector (Fig. 1). Refer to Diagnostic Trouble Codes in this section.

NOTE: Various diagnostic procedures may actually cause a diagnostic monitor to set a DTC. For instance, pulling a spark plug wire to perform a spark test may set the misfire code. When a repair is completed and verified, connect the DRB scan tool to the 16–way data link connector to erase all DTC's and extinguish the MIL (Check Engine Lamp).

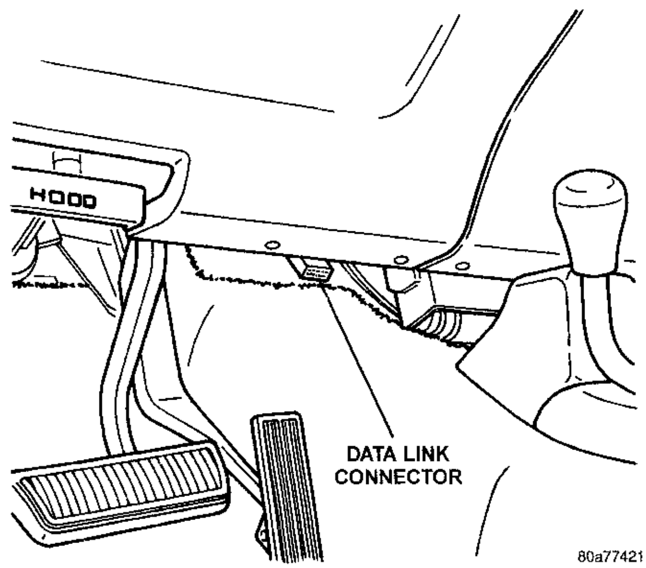

Fig. 1 16–Way Data Link (Diagnostic) Connector Location

DESCRIPTION AND OPERATION

MALFUNCTION INDICATOR LAMP (MIL)

As a functional test, the MIL (check engine) illuminates at key-on before engine cranking. Whenever the Powertrain Control Module (PCM) sets a Diagnostic Trouble Code (DTC) that affects vehicle emissions, it illuminates the MIL. If a problem is detected, the PCM sends a message to the instrument cluster to illuminate the lamp. The PCM illuminates the MIL only for DTC's that affect vehicle emissions. There are some monitors that may take two consecutive trips, with a detected fault, before the MIL is illuminated. The MIL stays on continu-

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DESCRIPTION AND OPERATION (Continued)

ously when the PCM has entered a Limp-In mode or identified a failed emission component. Refer to the Diagnostic Trouble Code charts in this group for emission related codes.

Also, the MIL either flashes or illuminates continuously when the PCM detects active engine misfire. Refer to Misfire Monitoring in this section.

Additionally, the PCM may reset (turn off) the MIL when one of the following occur:

- PCM does not detect the malfunction for 3 consecutive trips (except misfire and Fuel system Monitors).
- PCM does not detect a malfunction while performing three successive engine misfire or fuel system tests. The PCM performs these tests while the engine is operating within ± 375 RPM of and within 10 % of the load of the operating condition at which the malfunction was first detected.

STATE DISPLAY TEST MODE

The switch inputs to the Powertrain Control Module (PCM) have two recognized states; HIGH and LOW. For this reason, the PCM cannot recognize the difference between a selected switch position versus an open circuit, a short circuit, or a defective switch. If the State Display screen shows the change from HIGH to LOW or LOW to HIGH, assume the entire switch circuit to the PCM functions properly. Connect the DRB scan tool to the data link connector and access the state display screen. Then access either State Display Inputs and Outputs or State Display Sensors.

CIRCUIT ACTUATION TEST MODE

The Circuit Actuation Test Mode checks for proper operation of output circuits or devices the Powertrain Control Module (PCM) may not internally recognize. The PCM attempts to activate these outputs and allow an observer to verify proper operation. Most of the tests provide an audible or visual indication of device operation (click of relay contacts, fuel spray, etc.). Except for intermittent conditions, if a device functions properly during testing, assume the device, its associated wiring, and driver circuit work correctly. Connect the DRB scan tool to the data link connector and access the Actuators screen.

DIAGNOSTIC TROUBLE CODES

A Diagnostic Trouble Code (DTC) indicates the PCM has recognized an abnormal condition in the system.

Diagnostic trouble codes are the results of a system or circuit failure, but do not directly identify the failed component or components.

Technicians must retrieve stored DTC's by connecting the DRB scan tool (or an equivalent scan tool) to the 16–way data link connector (Fig. 1).

NOTE: For a list of DTC's, refer to the charts in this section.

OBTAINING DIAGNOSTIC TROUBLE CODES

WARNING: APPLY PARKING BRAKE AND/OR BLOCK WHEELS BEFORE PERFORMING ANY TEST ON AN OPERATING ENGINE.

(1) Connect the DRB scan tool to data link (diagnostic) connector.

(2) Turn the ignition switch on, access Read Fault Screen. Record all the DTC's shown on the DRB scan tool.

(3) To erase DTC's, use the Erase Trouble Code data screen on the DRB scan tool.

DIAGNOSTIC TROUBLE CODE DESCRIPTIONS

* Check Engine Lamp (MIL) will illuminate during engine operation if this Diagnostic Trouble Code was recorded.

Hex Code	Generic Scan Tool Code	DRB Scan Tool Display	Description of Diagnostic Trouble Code
00			DTC Error
*01	P0340	No Cam Signal at PCM	No camshaft signal detected during engine cranking.
*02	P0601	Internal Controller Failure	PCM Internal fault condition detected.
05	P0162	Charging System Voltage Too Low	Battery voltage sense input below target charging during engine operation. Also, no significant change detected in battery voltage during active test of generator output circuit.
06	P1594	Charging System Voltage Too High	Battery voltage sense input above target charging voltage during engine operation.

DESCRIPTION AND OPERATION (Continued)

Hex Code	Generic Scan Tool Code	DRB Scan Tool Display	Description of Diagnostic Trouble Code
0A	P1388	Auto Shutdown Relay Control Circuit	An open or shorted condition detected in the auto shutdown relay circuit.
0B	P0622	Generator Field Not Switching Properly	An open or shorted condition detected in the generator field control circuit.
*0C	P0743	Torque Converter Clutch Solenoid/Trans Relay Circuits	An open or shorted condition detected in the torque converter part throttle unlock solenoid control circuit (3 speed auto RH trans. only).
0F	P1595	Speed Control Solenoid Circuits	An open or shorted condition detected in the Speed Control vacuum or vent solenoid circuits.
10	P0645	A/C Clutch Relay Circuit	An open or shorted condition detected in the A/C clutch relay circuit.
*11	P0403	EGR Solenoid Circuit	An open or shorted condition detected in the EGR solenoid control circuit.
*12	P0443	EVAP Purge Solenoid Circuit	An open or shorted condition detected in the duty cycle purge solenoid circuit.
*13	P0203	Injector #3 Control Circuit	Injector #3 output driver does not respond properly to the control signal.
	or		
*14	P0202	Injector #2 Control Circuit	Injector #2 output driver does not respond properly to the control signal.
	or		
*15	P0201	Injector #1 Control Circuit	Injector #1 output driver does not respond properly to the control signal.
*19	P0505	Idle Air Control Motor Circuits	A shorted or open condition detected in one or more of the idle air control motor circuits.
*1A	P0122	Throttle Position Sensor Voltage Low	Throttle position sensor input below the minimum acceptable voltage
	or		
*1B	P0123	Throttle Position Sensor Voltage High	Throttle position sensor input above the maximum acceptable voltage.
*1E	P0117	ECT Sensor Voltage Too Low	Engine coolant temperature sensor input below minimum acceptable voltage.
	or		
*1F	P0118	ECT Sensor Voltage Too High	Engine coolant temperature sensor input above maximum acceptable voltage.
21	P1281	Engine Is Cold Too Long	Engine did not reach operating temperature within acceptable limits.
*24	P0107	MAP Sensor Voltage Too Low	MAP sensor input below minimum acceptable voltage.
	or		
*25	P0108	MAP Sensor Voltage Too High	MAP sensor input above maximum acceptable voltage.
*27	P1297	No Change in MAP From Start to Run	No difference recognized between the engine MAP reading and the barometric (atmospheric) pressure reading from start-up.

Mopar AUTHENTIC RESTORATION PRODUCT

DESCRIPTION AND OPERATION (Continued)

Hex Code	Generic Scan Tool Code	DRB Scan Tool Display	Description of Diagnostic Trouble Code
28	P0320	No Crank Reference Signal at PCM	No crank reference signal detected during engine cranking.
*29	P0353	Ignition Coil #3 Primary Circuit	Peak primary circuit current not achieved with maximum dwell time.
*2A	P0352	Ignition Coil #2 Primary Circuit	Peak primary circuit current not achieved with maximum dwell time.
2B	P0351	Ignition Coil #1 Primary Circuit	Peak primary circuit current not achieved with maximum dwell time.
*2C	P1389	No ASD Relay Output Voltage at PCM	An Open condition Detected In The ASD Relay Output Circuit.
31	P1696	PCM Failure EEPROM Write Denied	Unsuccessful attempt to write to an EEPROM location by the PCM.
*32	P0753	Trans 3-4 Shift Sol/Trans Relay Circuits	Current state of output port for the solenoid is different from expected state.
*37	P0209	INJ 9 Control Circuit	Injector #9 output driver stage does not respond properly to the control signal.
*38	P0210	INJ 10 Control Circuit	Injector #10 output driver stage does not respond properly to the control signal.
*39 *3A	P0112 or P0113	Intake Air Temp Sensor Voltage Low Intake Air Temp Sensor Voltage High	Intake air temperature sensor input below the maximum acceptable voltage. Intake air temperature sensor input above the minimum acceptable voltage.
*3D	P0204	Injector #4 Control Circuit	Injector #4 output driver does not respond properly to the control signal.
*3E	P0132	Left Upstream O2S Shorted to Voltage	Oxygen sensor input voltage maintained above the normal operating range.
*42	P0152	O2 2/1 Shorted high	Oxygen sensor input voltage sustained above the normal operating range.
*45 *46	P0205 or P0206	Injector #5 Control Circuit Injector #6 Control Circuit	Injector #5 output driver does not respond properly to the control signal. Injector #6 output driver does not respond properly to the control signal.
4A 4B	P0712 or P0713	Trans Temp Sensor Voltage Too Low Trans Temp Sensor Voltage Too High	Voltage less than 1.55 volts. Voltage greater than 3.76 volts.
*4C	P0354	Ignition coil #4 circuit	Peak primary circuit current not achieved with maximum dwell time (high impedance).
*4D	P0355	Ignition coil #5 circuit	Peak primary circuit current not achieved with maximum dwell time (high impedance).
*4F	P0207 or	Injector #7 Control Circuit	Injector #7 output driver does not respond properly to the control signal.

DESCRIPTION AND OPERATION (Continued)

Hex Code	Generic Scan Tool Code	DRB Scan Tool Display	Description of Diagnostic Trouble Code
*50	P0208	Injector #8 Control Circuit	Injector #8 output driver does not respond properly to the control signal.
52	P1683	S/C Power Circuit	An open or shorted condition detected in the speed control servo power control circuit.
56 57	P1596 or P1597	Speed Control Switch Always High Speed Control Switch Always Low	Speed control switch input above the maximum acceptable voltage. Speed control switch input below the minimum acceptable voltage.
65	P1282	Fuel Pump Relay Control Circuit	An open or shorted condition detected in the fuel pump relay control circuit.
*66 *67	P0133 or P0152 or P0135	Left Upstream O2S Slow Response Left Upstream O2S Heater Failure	Oxygen sensor response slower than minimum required switching frequency. Upstream oxygen sensor heating element circuit malfunction
*68	P0139	O2 1/1 Response	Oxygen sensor response slower than minimum required switching frequency.
*69	P0141	Downstream,Left Bank Downstream or Pre-Catalyst Heater Failure	Oxygen sensor heating element circuit malfunction.
*6A *6B *6C *6D *6E	P0300 or P0301 or P0302 or P0303 or P0304	Multiple Cylinder Mis-fire Cylinder #1 Mis-fire Cylinder #2 Mis-fire Cylinder #3 Mis-fire Cylinder #4 Mis-fire	Misfire detected in multiple cylinders. Misfire detected in cylinder #1. Misfire detected in cylinder #2. Misfire detected in cylinder #3. Misfire detected in cylinder #4.
*70	P0420	Left Bank Catalytic (or just) Catalytic Efficency Failure	Catalyst efficiency below required level.
*71	P0441	Evap Purge Flow Monitor Failure	Insufficient or excessive vapor flow detected during evaporative emission system operation.
*72	P1899	P/N Switch Stuck in Park or in Gear	Incorrect input state detected for the Park/Neutral switch, auto. trans. only.
*76	P0172	Left Bank or Fuel System Rich	A rich air/fuel mixture has been indicated by an abnormally lean correction factor.
*77	P0171	Right Rear (or just) Fuel System Lean	A lean air/fuel mixture has been indicated by an abnormally rich correction factor.
*78	P0175	Fuel system 2/1 rich	A rich air/fuel mixture has been indicated by an abnormally lean correction factor.
*79	P0174	Fuel system 2/1 lean	A lean air/fuel mixture has been indicated by an abnormally rich correction factor.

Mopar AUTHENTIC RESTORATION PRODUCT

DESCRIPTION AND OPERATION (Continued)

Hex Code	Generic Scan Tool Code	DRB Scan Tool Display	Description of Diagnostic Trouble Code
*7A	P0153	O2 2/1 slow response	Oxygen sensor response slower than mimimum required switching frequency.
*7B	P0159	O2 2/2 slow response	Oxygen sensor response slower than mimimum required switching frequency.
*7C	P0155	O2 2/1 heater circuit	Oxygen sensor heater element malfunction.
*7D	P0161	O2 2/2 heater circuit	Oxygen sensor heater element malfunction.
*7E	P0138	Left Bank Downstream or Downstream and Pre-Catalyst O2S Shorted to Voltage	Oxygen sensor input voltage maintained above the normal operating range.
*7F	P0158	O2 2/2 Shorted High	Oxygen sensor input voltage maintained above the normal operating range.
*80	P0125	Closed Loop Temp Not Reached	Engine does not reach 20°F within 5 minutes with a vehicle speed signal.
*84	P0121	TPS Voltage Does Not Agree With MAP	TPS signal does not correlate to MAP sensor
*87	P1296	No 5 Volts To MAP Sensor	5 Volt output to MAP sensor open.
*8A	P1294	Target Idle Not Reached	Actual idle speed does not equal target idle speed.
*8C	P0400	Diesel EGR system	PCM (Powertrain Control Module) not active or a fault condition of the dedicated EGR sensors and/or EGR solenoid was detected by the PCM.
*8D	P1756	Governor Pressure Not Equal to Target @ 15-20 PSI	Governor sensor input not between 10 and 25 psi when requested.
	or		
*8E	P1757	Governor Pressure Above 3 PSI In Gear With 0 MPH	Governor pressure greater than 3 psi when requested to be 0 psi.
*94	P0740	Torq Conv Clu, No RPM Drop At Lockup	Relationship between engine speed and vehicle speed indicates no torque converter clutch engagement (auto. trans. only).
95	P0462	Fuel Level Sending Unit Volts Too Low	Open circuit between PCM and fuel gauge sending unit.
	or		
96	P0463	Fuel Level Sending Unit Volts Too High	Circuit shorted to voltage between PCM and fuel gauge sending unit.
	or		
97	P0460	Fuel Level Unit No Change Over Miles	No movement of fuel level sender detected.
*99	P1493	Ambient/Batt Temp Sen VoltsToo Low	Battery temperature sensor input voltage below an acceptable range.
	or		
*9A	P1492	Ambient/Batt Temp Sensor VoltsToo High	Battery temperature sensor input voltage above an acceptable range.
*9B	P0131	Left Bank and Upstream O2S Shorted to Ground	O2 sensor voltage too low, tested after cold start.

DESCRIPTION AND OPERATION (Continued)

Hex Code	Generic Scan Tool Code	DRB Scan Tool Display	Description of Diagnostic Trouble Code
	or		
*9C	P0137	Downstream, Left Bank Downstream and Pre-Catalyst O2S Shorted to Ground	O2 sensor voltage too low, tested after cold start.
*9D	P1391	Intermittent Loss of CMP or CKP	Intermittent loss of either camshaft or crankshaft position sensor
A0	P0442	EVAP leak monitor Small leak detected	A small leak has been detected by the leak detection monitor.
A1	P0455	EVAP leak monitor Large leak detected	The leak detection monitor is unable to pressurize EVAP system indicating large leak.
A4	P0711	Trans Temp Sensor, No Rise After Start	Sump temp did not rise more than 16°F within 10 minutes when starting temp is below 40°F or sump temp is above 260°F with coolant below 100°F.
*A5	P0783	3-4 Shift Sol, No RPM Drop @ 3-4 Shift	The ratio of engine rpm/output shaft speed did not change beyond on the minimum required.
*A6	P0720	Low Ouput Spd Sensor RPM Above 15 mph	Output shaft speed is less than 60 rpm with vehicle speed above 15 mph.
*A7	P1764	Governor Pessure Sensor Volts Too Low	Voltage less than .10 volts.
	or		
*A8	P1763	Governor Pressure Sensor Volts Too HI	Voltage greater than 4.89 volts.
	or		
*A9	P1762	Governor Press Sen Offset Volts Too Lo or High	Sensor input greater or less than calibration for 3 consecutive Neutral/Park occurances.
*AB	P0748	Governor Pressure Sol Control/Trans Relay Circuits	Current state of solenoid output port is different than expected.
*AD	P1765	Trans 12 Volt Supply Relay Ctrl Circuit	Current state of solenoid output port is different than expeted.
*AE	P0305	Cylinder #5 Mis-fire	Misfire detected in cylinder #5.
	or		
*AF	P0306	Cylinder #6 Mis-fire	Misfire detected in cylinder #6.
	or		
*B0	P0307	Cylinder #7 Mis-fire	Misfire detected in cylinder #7.
	or		
*B1	P0308	Cylinder #8 Mis-fire	Misfire detected in cylinder #8.
*B2	P0309	Cylinder #9 Mis-fire	Misfire detected in cylinder #9.
*B3	P0310	Cylinder #10 Mis-fire	Misfire detected in cylinder #10.
*B4	P0432	Catalyst 2/1 EFFIC	Catalyst 2/1 efficiency below required level.
*B5	P0151	O2 2/1 Voltage Low	Oxygen sensor input voltage maintained below normal operating range.

Mopar AUTHENTIC RESTORATION PRODUCT

DESCRIPTION AND OPERATION (Continued)

Hex Code	Generic Scan Tool Code	DRB Scan Tool Display	Description of Diagnostic Trouble Code
*B6	P0157	O2 2/2 Voltage Low	Oxygen sensor input voltage maintained below normal operating range.
*BA	P1398	Mis-fire Adaptive Numerator at Limit	CKP sensor target windows have too much variation
BC	P0751	O/D Switch Pressed (LO) More Than 5 Min	Overdrive Off switch input too low for more than 5 minutes.
*C0	P1195 or P0133	Cat Mon slow O2 1/1	A slow switching oxygen sensor has been detected in bank 1/1 during catalyst monitor test.
*C1	P0153 or P1196	Cat Mon slow O2 2/1	A slow switching oxygen sensor has been detected in bank 2/1 during catalyst monitor test.
*C2	P0129 or P1197	Cat Mon slow O2 1/2	A slow switching oxygen sensor has been detected in bank 1/2 during catalyst monitor test.
*DE	P1694	No Engine Bus Msgs	
*DF	P1693	Flt in Comp Module	

MONITORED SYSTEMS

There are new electronic circuit monitors that check fuel, emission, engine and ignition performance. These monitors use information from various sensor circuits to indicate the overall operation of the fuel, engine, ignition and emission systems and thus the emissions performance of the vehicle.

The fuel, engine, ignition and emission systems monitors do not indicate a specific component problem. They do indicate that there is an implied problem within one of the systems and that a specific problem must be diagnosed.

If any of these monitors detect a problem affecting vehicle emissions, the Malfunction Indicator (Check Engine) Lamp will be illuminated. These monitors generate Diagnostic Trouble Codes that can be displayed with the check engine lamp or a scan tool.

The following is a list of the system monitors:

- Misfire Monitor
- Fuel System Monitor
- Oxygen Sensor Monitor
- Oxygen Sensor Heater Monitor
- Catalyst Monitor
- Leak Detection Pump Monitor (if equipped)

All these system monitors require two consecutive trips with the malfunction present to set a fault.

Refer to the appropriate Powertrain Diagnostics Procedures manual for diagnostic procedures.

The following is an operation and description of each system monitor:

OXYGEN SENSOR (O2S) MONITOR

Effective control of exhaust emissions is achieved by an oxygen feedback system. The most importantelement of the feedback system is the O2S. The O2S is located in the exhaust path. Once it reaches operating temperature 300° to 350°C (572° to 662°F), the sensor generates a voltage that is inversely proportional to the amount of oxygen in the exhaust. The information obtained by the sensor is used to calculate the fuel injector pulse width. This maintains a 14.7 to 1 Air Fuel (A/F) ratio. At this mixture ratio, the catalyst works best to remove hydrocarbons (HC), carbon monoxide (CO) and nitrogen oxide (NOx) from the exhaust.

The O2S is also the main sensing element for the Catalyst and Fuel Monitors.

The O2S can fail in any or all of the following manners:

- slow response rate
- reduced output voltage
- dynamic shift
- shorted or open circuits

Response rate is the time required for the sensor to switch from lean to rich once it is exposed to a richer than optimum A/F mixture or vice versa. As the sensor starts malfunctioning, it could take longer to detect the changes in the oxygen content of the exhaust gas.

The output voltage of the O2S ranges from 0 to 1 volt. A good sensor can easily generate any output voltage in this range as it is exposed to different concentrations of oxygen. To detect a shift in the A/F mixture (lean or rich), the output voltage has to change beyond a threshold value. A malfunctioning sensor could have difficulty changing beyond the threshold value.

OXYGEN SENSOR HEATER MONITOR

If there is an oxygen sensor (O2S) shorted to voltage DTC, as well as a O2S heater DTC, the O2S fault MUST be repaired first. Before checking the O2S fault, verify that the heater circuit is operating correctly.

DESCRIPTION AND OPERATION (Continued)

Effective control of exhaust emissions is achieved by an oxygen feedback system. The most important element of the feedback system is the O2S. The O2S is located in the exhaust path. Once it reaches operating temperature 300° to 350°C (572 ° to 662°F), the sensor generates a voltage that is inversely proportional to the amount of oxygen in the exhaust. The information obtained by the sensor is used to calculate the fuel injector pulse width. This maintains a 14.7 to 1 Air Fuel (A/F) ratio. At this mixture ratio, the catalyst works best to remove hydrocarbons (HC), carbon monoxide (CO) and nitrogen oxide (NOx) from the exhaust.

The voltage readings taken from the O2S sensor are very temperature sensitive. The readings are not accurate below 300°C. Heating of the O2S sensor is done to allow the engine controller to shift to closed loop control as soon as possible. The heating element used to heat the O2S sensor must be tested to ensure that it is heating the sensor properly.

The O2S sensor circuit is monitored for a drop in voltage. The sensor output is used to test the heater by isolating the effect of the heater element on the O2S sensor output voltage from the other effects.

LEAK DETECTION PUMP MONITOR (IF EQUIPPED)

The leak detection assembly incorporates two primary functions: it must detect a leak in the evaporative system and seal the evaporative system so the leak detection test can be run.

The primary components within the assembly are: A three port solenoid that activates both of the functions listed above; a pump which contains a switch, two check valves and a spring/diaphragm, a canister vent valve (CVV) seal which contains a spring loaded vent seal valve.

Immediately after a cold start, between predetermined temperature thresholds limits, the three port solenoid is briefly energized. This initializes the pump by drawing air into the pump cavity and also closes the vent seal. During non test conditions the vent seal is held open by the pump diaphragm assembly which pushes it open at the full travel position. The vent seal will remain closed while the pump is cycling due to the reed switch triggering of the three port solenoid that prevents the diaphragm assembly from reaching full travel. After the brief initialization period, the solenoid is de-energized allowing atmospheric pressure to enter the pump cavity, thus permitting the spring to drive the diaphragm which forces air out of the pump cavity and into the vent system. When the solenoid is energized and de energized, the cycle is repeated creating flow in typical diaphragm pump fashion. The pump is controlled in 2 modes:

Pump Mode: The pump is cycled at a fixed rate to achieve a rapid pressure build in order to shorten the overall test length.

Test Mode: The solenoid is energized with a fixed duration pulse. Subsequent fixed pulses occur when the diaphragm reaches the Switch closure point.

The spring in the pump is set so that the system will achieve an equalized pressure of about 7.5" H20. The cycle rate of pump strokes is quite rapid as the system begins to pump up to this pressure. As the pressure increases, the cycle rate starts to drop off. If there is no leak in the system, the pump would eventually stop pumping at the equalized pressure. If there is a leak, it will continue to pump at a rate representative of the flow characteristic of the size of the leak. From this information we can determine if the leak is larger than the required detection limit (currently set at .040" orifice by CARB). If a leak is revealed during the leak test portion of the test, the test is terminated at the end of the test mode and no further system checks will be performed.

After passing the leak detection phase of the test, system pressure is maintained by turning on the LDP's solenoid until the purge system is activated. Purge activation in effect creates a leak. The cycle rate is again interrogated and when it increases due to the flow through the purge system, the leak check portion of the diagnostic is complete.

The canister vent valve will unseal the system after completion of the test sequence as the pump diaphragm assembly moves to the full travel position.

Evaporative system functionality will be verified by using the stricter evap purge flow monitor. At an appropriate warm idle the LDP will be energized to seal the canister vent. The purge flow will be clocked up from some small value in an attempt to see a shift in the 02 control system. If fuel vapor, indicated by a shift in the 02 control, is present the test is passed. If not, it is assumed that the purge system is not functioning in some respect. The LDP is again turned off and the test is ended.

MISFIRE MONITOR

Excessive engine misfire results in increased catalyst temperature and causes an increase in HC emissions. Severe misfires could cause catalyst damage. To prevent catalytic convertor damage, the PCM monitors engine misfire.

The Powertrain Control Module (PCM) monitors for misfire during most engine operating conditions (positive torque) by looking at changes in the crankshaft speed. If a misfire occurs the speed of the crankshaft will vary more than normal.

FUEL SYSTEM MONITOR

To comply with clean air regulations, vehicles are equipped with catalytic converters. These converters

AUTHENTIC RESTORATION PRODUCT

DESCRIPTION AND OPERATION (Continued)

reduce the emission of hydrocarbons, oxides of nitrogen and carbon monoxide. The catalyst works best when the Air Fuel (A/F) ratio is at or near the optimum of 14.7 to 1.

The PCM is programmed to maintain the optimum air/fuel ratio of 14.7 to 1. This is done by making short term corrections in the fuel injector pulse width based on the O2S sensor output. The programmed memory acts as a self calibration tool that the engine controller uses to compensate for variations in engine specifications, sensor tolerances and engine fatigue over the life span of the engine. By monitoring the actual fuel-air ratio with the O2S sensor (short term) and multiplying that with the program long-term (adaptive) memory and comparing that to the limit, it can be determined whether it will pass an emissions test. If a malfunction occurs such that the PCM cannot maintain the optimum A/F ratio, then the MIL will be illuminated.

CATALYST MONITOR

To comply with clean air regulations, vehicles are equipped with catalytic converters. These converters reduce the emission of hydrocarbons, oxides of nitrogen and carbon monoxide.

Normal vehicle miles or engine misfire can cause a catalyst to decay. A meltdown of the ceramic core can cause a reduction of the exhaust passage. This can increase vehicle emissions and deteriorate engine performance, driveability and fuel economy.

The catalyst monitor uses dual oxygen sensors (O2S's) to monitor the efficiency of the converter. The dual O2S's sensor strategy is based on the fact that as a catalyst deteriorates, its oxygen storage capacity and its efficiency are both reduced. By monitoring the oxygen storage capacity of a catalyst, its efficiency can be indirectly calculated. The upstream O2S is used to detect the amount of oxygen in the exhaust gas before the gas enters the catalytic converter. The PCM calculates the A/F mixture from the output of the O2S. A low voltage indicates high oxygen content (lean mixture). A high voltage indicates a low content of oxygen (rich mixture).

When the upstream O2S detects a lean condition, there is an abundance of oxygen in the exhaust gas. A functioning converter would store this oxygen so it can use it for the oxidation of HC and CO. As the converter absorbs the oxygen, there will be a lack of oxygen downstream of the converter. The output of the downstream O2S will indicate limited activity in this condition.

As the converter loses the ability to store oxygen, the condition can be detected from the behavior of the downstream O2S. When the efficiency drops, no chemical reaction takes place. This means the concentration of oxygen will be the same downstream as upstream. The output voltage of the downstream O2S copies the voltage of the upstream sensor. The only difference is a time lag (seen by the PCM) between the switching of the O2S's.

To monitor the system, the number of lean-to-rich switches of upstream and downstream O2S's is counted. The ratio of downstream switches to upstream switches is used to determine whether the catalyst is operating properly. An effective catalyst will have fewer downstream switches than it has upstream switches i.e., a ratio closer to zero. For a totally ineffective catalyst, this ratio will be one-to-one, indicating that no oxidation occurs in the device.

The system must be monitored so that when catalyst efficiency deteriorates and exhaust emissions increase to over the legal limit, the MIL (check engine lamp) will be illuminated.

TRIP DEFINITION

The term "Trip" has different meanings depending on what the circumstances are. If the MIL (Malfunction Indicator Lamp) is OFF, a Trip is defined as when the Oxygen Sensor Monitor and the Catalyst Monitor have been completed in the same drive cycle.

When any Emission DTC is set, the MIL on the dash is turned ON. When the MIL is ON, it takes 3 good trips to turn the MIL OFF. In this case, it depends on what type of DTC is set to know what a "Trip" is.

For the Fuel Monitor or Mis-Fire Monitor (continuous monitor), the vehicle must be operated in the "Similar Condition Window" for a specified amount of time to be considered a Good Trip.

If a Non-Contiuous OBDII Monitor, such as:

- Oxygen Sensor
- Catalyst Monitor
- Purge Flow Monitor
- Leak Detection Pump Monitor (if equipped)
- EGR Monitor (if equipped)
- Oxygen Sensor Heater Monitor

fails twice in a row and turns ON the MIL, re-running that monitor which previously failed, on the next start-up and passing the monitor is considered to be a Good Trip.

If any other Emission DTC is set (not an OBDII Monitor), a Good Trip is considered to be when the Oxygen Sensor Monitor and Catalyst Monitor have been completed; or 2 Minutes of engine run time if the Oxygen Sensor Monitor or Catalyst Monitor have been stopped from running.

It can take up to 2 Failures in a row to turn on the MIL. After the MIL is ON, it takes 3 Good Trips to turn the MIL OFF. After the MIL is OFF, the PCM will self-erase the DTC after 40 Warm-up cycles. A Warm-up cycle is counted when the ECT (Engine Coolant Temperature Sensor) has crossed 160°F and has risen by at least 40°F since the engine has been started.

DESCRIPTION AND OPERATION (Continued)

COMPONENT MONITORS

There are several components that will affect vehicle emissions if they malfunction. If one of these components malfunctions the Malfunction Indicator Lamp (Check Engine) will illuminate.

Some of the component monitors are checking for proper operation of the part. Electrically operated components now have input (rationality) and output (functionality) checks. Previously, a component like the Throttle Position sensor (TPS) was checked by the PCM for an open or shorted circuit. If one of these conditions occurred, a DTC was set. Now there is a check to ensure that the component is working. This is done by watching for a TPS indication of a greater or lesser throttle opening than MAP and engine rpm indicate. In the case of the TPS, if engine vacuum is high and engine rpm is 1600 or greater and the TPS indicates a large throttle opening, a DTC will be set. The same applies to low vacuum if the TPS indicates a small throttle opening.

All open/short circuit checks or any component that has an associated limp in will set a fault after 1 trip with the malfunction present. Components without an associated limp in will take two trips to illuminate the MIL.

Refer to the Diagnostic Trouble Codes Description Charts in this section and the appropriate Powertrain Diagnostic Procedure Manual for diagnostic procedures.

NON-MONITORED CIRCUITS

The PCM does not monitor the following circuits, systems and conditions that could have malfunctions causing driveability problems. The PCM might not store diagnostic trouble codes for these conditions. However, problems with these systems may cause the PCM to store diagnostic trouble codes for other systems or components. For example, a fuel pressure problem will not register a fault directly, but could cause a rich/lean condition or misfire. This could cause the PCM to store an oxygen sensor or misfire diagnostic trouble code.

FUEL PRESSURE

The fuel pressure regulator controls fuel system pressure. The PCM cannot detect a clogged fuel pump inlet filter, clogged in-line fuel filter, or a pinched fuel supply or return line. However, these could result in a rich or lean condition causing the PCM to store an oxygen sensor or fuel system diagnostic trouble code.

SECONDARY IGNITION CIRCUIT

The PCM cannot detect an inoperative ignition coil, fouled or worn spark plugs, ignition cross firing, or open spark plug cables.

CYLINDER COMPRESSION

The PCM cannot detect uneven, low, or high engine cylinder compression.

EXHAUST SYSTEM

The PCM cannot detect a plugged, restricted or leaking exhaust system, although it may set a fuel system fault.

FUEL INJECTOR MECHANICAL MALFUNCTIONS

The PCM cannot determine if a fuel injector is clogged, the needle is sticking or if the wrong injector is installed. However, these could result in a rich or lean condition causing the PCM to store a diagnostic trouble code for either misfire, an oxygen sensor, or the fuel system.

EXCESSIVE OIL CONSUMPTION

Although the PCM monitors engine exhaust oxygen content when the system is in closed loop, it cannot determine excessive oil consumption.

THROTTLE BODY AIR FLOW

The PCM cannot detect a clogged or restricted air cleaner inlet or filter element.

VACUUM ASSIST

The PCM cannot detect leaks or restrictions in the vacuum circuits of vacuum assisted engine control system devices. However, these could cause the PCM to store a MAP sensor diagnostic trouble code and cause a high idle condition.

PCM SYSTEM GROUND

The PCM cannot determine a poor system ground. However, one or more diagnostic trouble codes may be generated as a result of this condition. The module should be mounted to the body at all times, also during diagnostic.

PCM CONNECTOR ENGAGEMENT

The PCM may not be able to determine spread or damaged connector pins. However, it might store diagnostic trouble codes as a result of spread connector pins.

HIGH AND LOW LIMITS

The PCM compares input signal voltages from each input device with established high and low limits for the device. If the input voltage is not within limits and other criteria are met, the PCM stores a diagnostic trouble code in memory. Other diagnostic trouble code criteria might include engine RPM limits or input voltages from other sensors or switches that must be present before verifying a diagnostic trouble code condition.

Mopar AUTHENTIC RESTORATION PRODUCT

DESCRIPTION AND OPERATION (Continued)

LOAD VALUE

ENGINE	IDLE/NEUTRAL	2500 RPM/NEUTRAL
All Engines	2% to 8% of Maximum Load	9% to 17% of Maximum Load

EVAPORATIVE EMISSION CONTROLS

INDEX

DESCRIPTION AND OPERATION

EVAPORATION (EVAP) CONTROL SYSTEM

The evaporation control system prevents the emission of fuel tank vapors into the atmosphere. When fuel evaporates in the fuel tank, the vapors pass through vent hoses or tubes into the two charcoal filled evaporative canisters. The canisters temporarily hold the vapors. The Powertrain Control Module (PCM) allows intake manifold vacuum to draw vapors into the combustion chambers during certain operating conditions.

All 3.9L/5.2L/5.9L/8.0L gasoline powered engines use a duty cycle purge system. The PCM controls vapor flow by operating the duty cycle EVAP purge solenoid. Refer to Duty Cycle EVAP Canister Purge Solenoid for additional information.

When equipped with certain emissions packages, a Leak Detection Pump (LDP) will be used as part of the evaporative system. This pump is used as part of OBD II requirements. Refer to Leak Detection Pump in this group for additional information.

NOTE: The hoses used in this system are specially manufactured. If replacement becomes necessary, it is important to use only fuel resistant hose.

ROLLOVER VALVE(S)

Diesel Powered Engine: One rollover valve is used. The valve is used only to vent the fuel tank to the atmosphere. A check valve is located within the rollover valve to prevent fuel flow from the fuel tank in the event of an accidental vehicle rollover. The rollover valve is located on the top of the fuel tank module (Fig. 1). The valve may be serviced separately. If replacement is necessary, refer to the Removal/Installation section of this group.

Gasoline Powered Engines: Two rollover valves are used. Fuel vapors from the fuel tank are drawn through these valves into both of the EVAP canisters by engine vacuum. A check valve is located within each of the rollover valves to prevent fuel flow from the fuel tank in the event of an accidental vehicle rollover.

If equipped with a 26 or 34 gallon fuel tank, two rollover valves are used. One of the valves is permanently mounted to the top of fuel tank (Fig. 2). If replacement of this particular valve is necessary, the fuel tank must be replaced. The other rollover valve is located on the top of the fuel pump module (Fig. 2). This valve may be serviced separately. If replacement is necessary, refer to the Removal/Installation section of this group.

If equipped with a 35 gallon fuel tank, two rollover valves are used. Both valves are permanently mounted to the top of fuel tank (Fig. 3). If replacement is necessary, the fuel tank must be replaced.

Mopar AUTHENTIC RESTORATION PRODUCT

DESCRIPTION AND OPERATION (Continued)

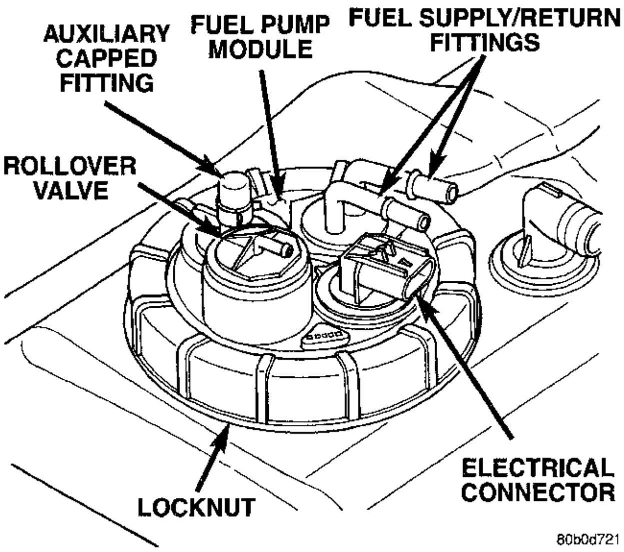

Fig. 1 Rollover Valve Location—Diesel Powered

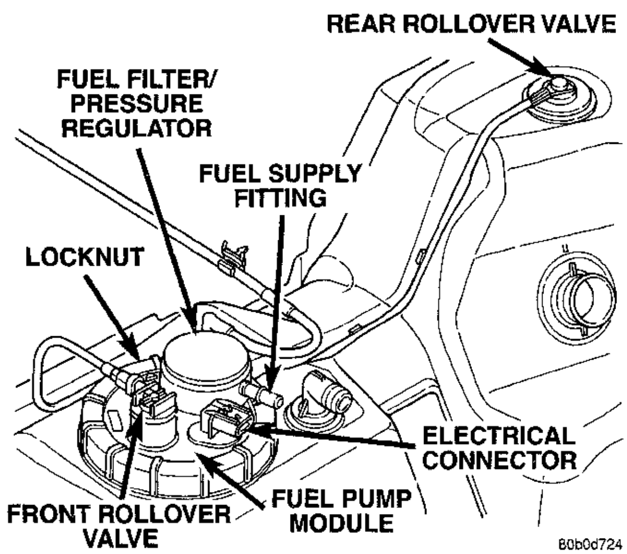

Fig. 2 Rollover Valve Locations—Gas Powered with 26 or 34 Gallon Tank

EVAPORATIVE (EVAP) CANISTER

Two, maintenance free, EVAP canisters are used with all 3.9L/5.2L/5.9L/8.0L gasoline powered engines. Both canisters are mounted to a bracket located below rear of vehicle cab on outside of right frame rail (Fig. 4). The EVAP canisters are filled with granules of an activated carbon mixture. Fuel vapors entering the EVAP canisters are absorbed by the charcoal granules.

Fuel tank pressure vents into the EVAP canisters. Fuel vapors are temporarily held in the canisters until they can be drawn into the intake manifold. The duty cycle EVAP canister purge solenoid allows the EVAP canisters to be purged at predetermined times and at certain engine operating conditions.

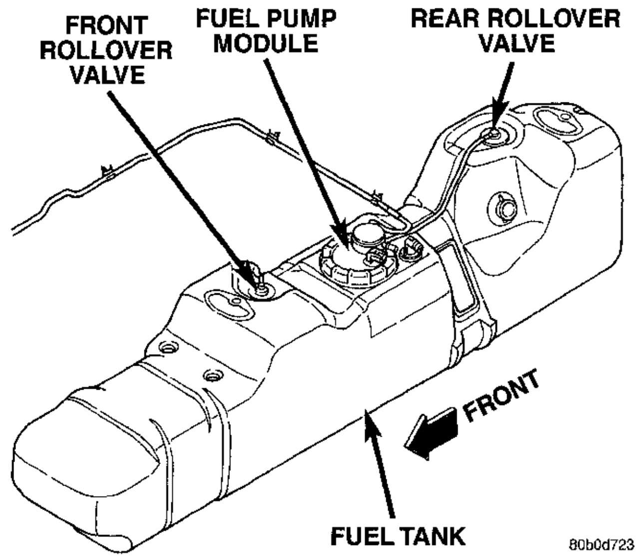

Fig. 3 Rollover Valve Locations—Gas Powered with 35 Gallon Tank

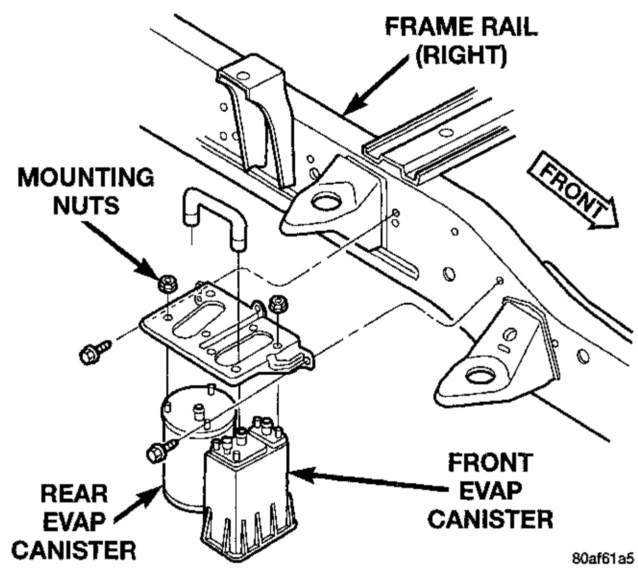

Fig. 4 Location of EVAP Canisters

DUTY CYCLE EVAP CANISTER PURGE SOLENOID

All 3.9L/5.2L/5.9L/8.0L gasoline powered engines use a duty cycle EVAP canister purge solenoid. The solenoid regulates the rate of vapor flow from the EVAP canister to the throttle body. The PCM operates the solenoid.

During the cold start warm-up period and the hot start time delay, the PCM does not energize the solenoid. When de-energized, no vapors are purged. The PCM de-energizes the solenoid during open loop operation.

The engine enters closed loop operation after it reaches a specified temperature and the time delay ends. During closed loop operation, the PCM energizes and de-energizes the solenoid 5 or 10 times per

DESCRIPTION AND OPERATION (Continued)

second, depending upon operating conditions. The PCM varies the vapor flow rate by changing solenoid pulse width. Pulse width is the amount of time the solenoid energizes. The PCM adjusts solenoid pulse width based on engine operating condition.

The solenoid attaches to a bracket mounted to the right inner fender (Fig. 5).

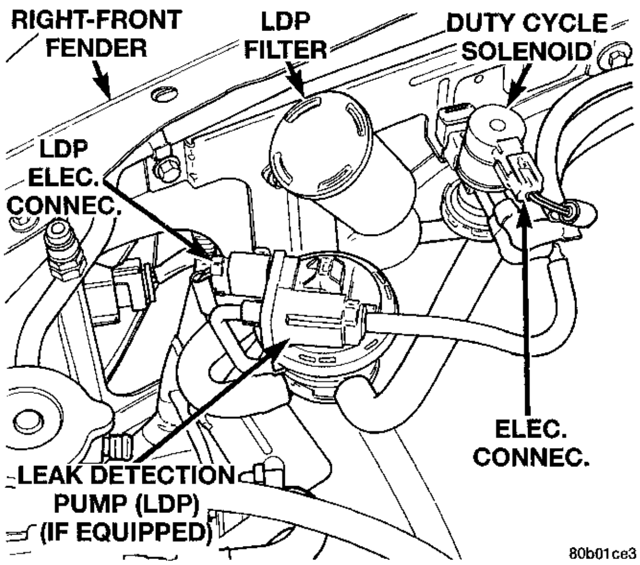

Fig. 5 EVAP Canister Purge Solenoid and LDP Location

LEAK DETECTION PUMP (LDP)

The Leak Detection Pump (LDP) is used only with certain emission packages. The LDP and LDP filter are located in the engine compartment on the right-inner fender (Fig. 5). The EVAP system test port is located in front of the Powertrain Control Module (PCM) (Fig. 6).

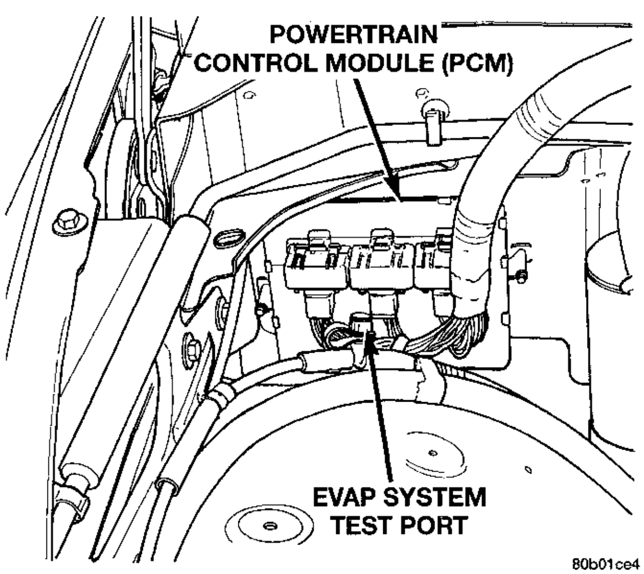

Fig. 6 EVAP System Test Port Location

The LDP is a device used to detect a leak in the evaporative system.

The pump contains a 3 port solenoid, a pump that contains a switch, a spring loaded canister vent valve seal, 2 check valves and a spring/diaphragm.

Immediately after a cold start, engine temperature between 40°F and 86°F, the 3 port solenoid is briefly energized. This initializes the pump by drawing air into the pump cavity and also closes the vent seal. During non-test test conditions, the vent seal is held open by the pump diaphragm assembly which pushes it open at the full travel position. The vent seal will remain closed while the pump is cycling. This is due to the operation of the 3 port solenoid which prevents the diaphragm assembly from reaching full travel. After the brief initialization period, the solenoid is de-energized, allowing atmospheric pressure to enter the pump cavity. This permits the spring to drive the diaphragm which forces air out of the pump cavity and into the vent system. When the solenoid is energized and de-energized, the cycle is repeated creating flow in typical diaphragm pump fashion. The pump is controlled in 2 modes:

PUMP MODE: The pump is cycled at a fixed rate to achieve a rapid pressure build in order to shorten the overall test time.

TEST MODE: The solenoid is energized with a fixed duration pulse. Subsequent fixed pulses occur when the diaphragm reaches the switch closure point.

The spring in the pump is set so that the system will achieve an equalized pressure of about 7.5 inches of water.

When the pump starts, the cycle rate is quite high. As the system becomes pressurized pump rate drops. If there is no leak the pump will quit. If there is a leak, the test is terminated at the end of the test mode.

If there is no leak, the purge monitor is run. If the cycle rate increases due to the flow through the purge system, the test is passed and the diagnostic is complete.

The canister vent valve will unseal the system after completion of the test sequence as the pump diaphragm assembly moves to the full travel position.

POSITIVE CRANKCASE VENTILATION (PCV) SYSTEM

All 3.9L V-6 and 5.2L/5.9L V-8 gas powered engines are equipped with a closed crankcase ventilation system and a positive crankcase ventilation (PCV) valve. The 8.0L V-10 engine is not equipped with a PCV valve. Refer to Crankcase Ventilation System—8.0L V-10 Engine for information.

This system consists of a PCV valve mounted on the cylinder head (valve) cover with a hose extending from the valve to the intake manifold. Another hose connects the opposite cylinder head (valve) cover to the air cleaner housing to provide a source of clean air for the system. A separate crankcase breather/filter is not used.

AUTHENTIC RESTORATION PRODUCT

DESCRIPTION AND OPERATION (Continued)

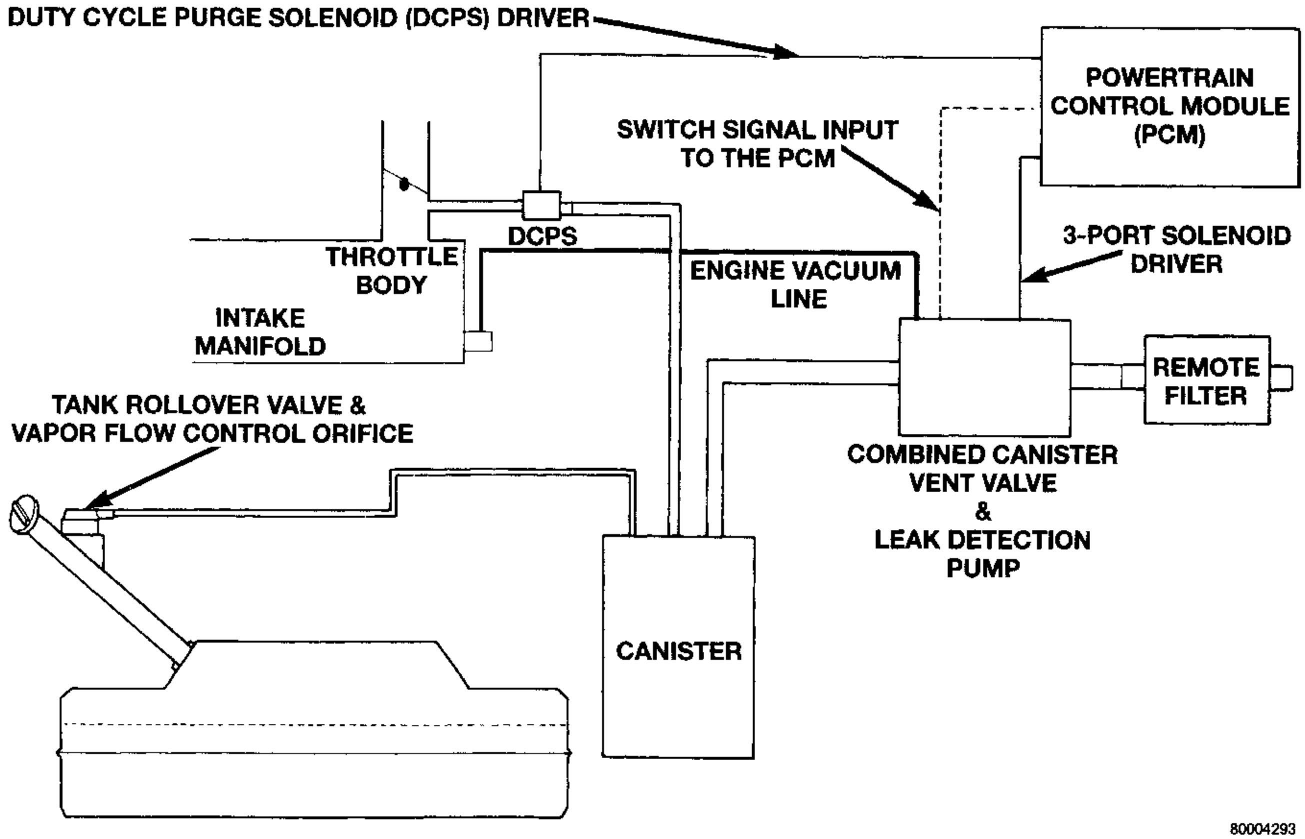

Fig. 7 Evaporative System Monitor Schematic—Typical

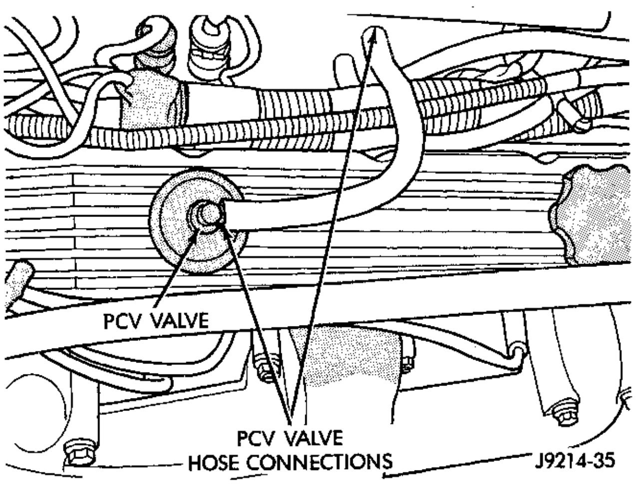

Fig. 8 PCV Valve/Hose—Typical

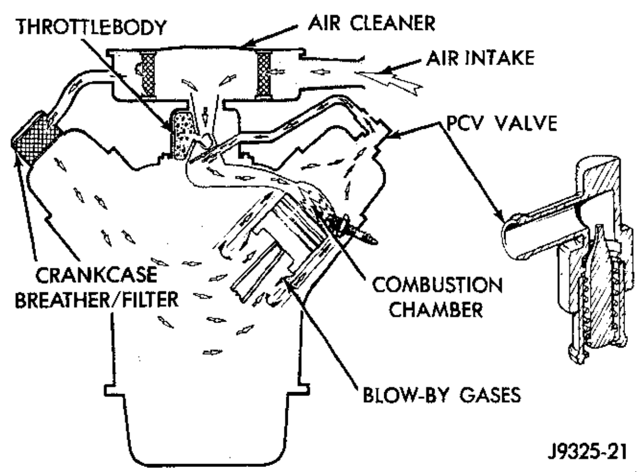

Fig. 9 Typical Closed Crankcase Ventilation System

The PCV system operates by engine intake manifold vacuum (Fig. 9). Filtered air is routed into the crankcase through the air cleaner hose. The metered air, along with crankcase vapors, are drawn through the PCV valve and into a passage in the intake manifold. The PCV system manages crankcase pressure and meters blow by gases to the intake system, reducing engine sludge formation.

The PCV valve contains a spring loaded plunger. This plunger meters the amount of crankcase vapors routed into the combustion chamber based on intake manifold vacuum.

When the engine is not operating or during an engine pop-back, the spring forces the plunger back against the seat. This will prevent vapors from flowing through the valve.

DESCRIPTION AND OPERATION (Continued)

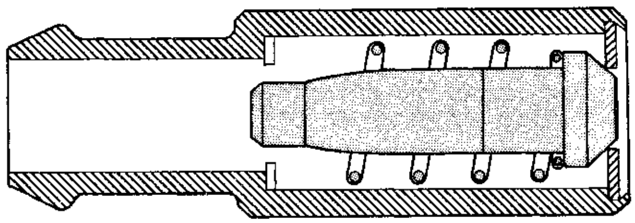

Fig. 10 Engine Off or Engine Pop-Back—No Vapor Flow

During periods of high manifold vacuum, such as idle or cruising speeds, vacuum is sufficient to completely compress spring. It will then pull the plunger to the top of the valve (Fig. 11). In this position there is minimal vapor flow through the valve.

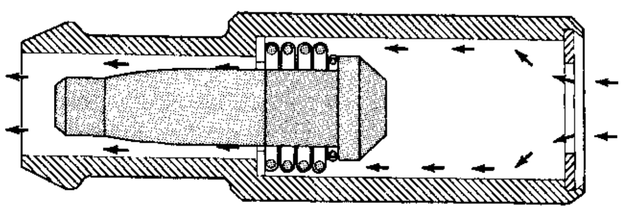

Fig. 11 High Intake Manifold Vacuum—Minimal Vapor Flow

During periods of moderate manifold vacuum, the plunger is only pulled part way back from inlet. This results in maximum vapor flow through the valve (Fig. 12).

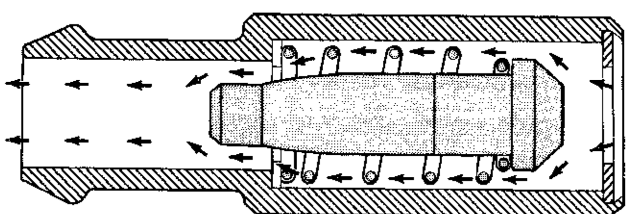

Fig. 12 Moderate Intake Manifold Vacuum—Maximum Vapor Flow

CRANKCASE VENTILATION SYSTEM—8.0L V-10 ENGINE

The 8.0L V-10 engine is equipped with a Crankcase Ventilation (CCV) system. The CCV system performs the same function as a conventional PCV system, but does not use a vacuum controlled valve (PCV valve).

A molded vacuum tube connects manifold vacuum to the top of the right cylinder head (valve) cover. The vacuum tube connects to a fixed orifice fitting (Fig. 13) of a calibrated size 2.6 mm (0.10 inches). It meters the amount of crankcase vapors drawn out of the engine. **The fixed orifice fitting is grey in color.** A similar fitting (but does not contain a fixed orifice) is used on the left cylinder head (valve) cover. This fitting is black in color. Do not interchange these two fittings.

When the engine is operating, fresh air enters the engine and mixes with crankcase vapors. Manifold vacuum draws the vapor/air mixture through the fixed orifice and into the intake manifold. The vapors are then consumed during engine combustion.

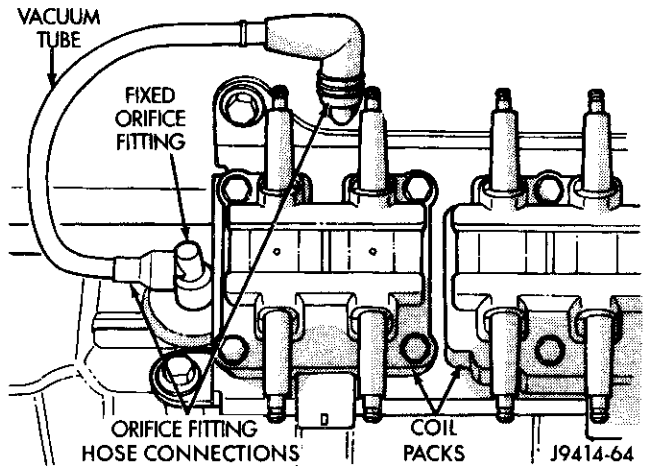

Fig. 13 Fixed Orifice Fitting—8.0L V-10 Engine—Typical

CRANKCASE BREATHER/FILTER

The crankcase breather/filter is no longer used with the 3.9L, 5.2L or 5.9L engine.

VEHICLE EMISSION CONTROL INFORMATION (VECI) LABEL

Vehicles equipped with 3.9L V-6 or 5.2L/5.9L V-8 LDC-gas powered engines have a VECI label.

The label combines both emission control information and vacuum hose routing. This label is located in the engine compartment in front of the radiator (Fig. 14) and contains the following:

- Engine family and displacement
- Evaporative family
- Emission control system schematic
- Certification application
- Engine timing specifications (if adjustable)
- Idle speeds (if adjustable)
- Spark plug and gap

The 5.9L HDC-gas powered engine will have two labels. One of the labels is located in front of the radiator in the engine compartment (Fig. 14) and will contain vacuum hose routing only. The other is attached to the drivers side of the engine air cleaner housing (Fig. 14) and will contain the following:

- Engine family and displacement
- Evaporative family
- Certification application

AUTHENTIC RESTORATION PRODUCT

DESCRIPTION AND OPERATION (Continued)

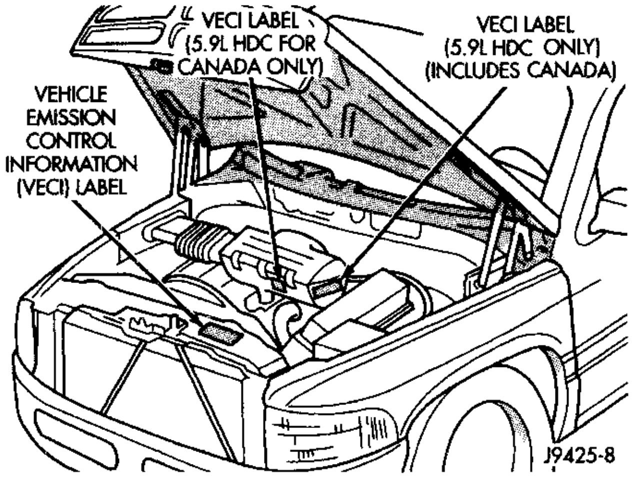

Fig. 14 VECI Label Location

- Engine timing specifications (if adjustable)
- Idle speeds (if adjustable)
- Spark plug and gap

The label for the 8.0L V-10 HDC-gas powered engine is also located in the engine compartment. It is attached to a riveted metal plate located to the right side of the generator (Fig. 15).

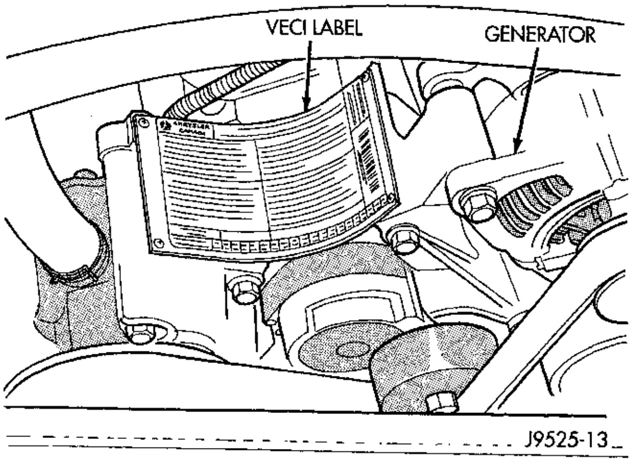

Fig. 15 VECI Label Location—8.0L V-10 Engine

There are unique labels for vehicles built for sale in the country of Canada and for both Light Duty Cycle (LDC) and Heavy Duty Cycle (HDC) engines. Canadian labels are written in both the English and French languages. For all Canadian vehicles, the label is split into two different labels.

The VECI labels are permanently attached and cannot be removed without defacing information and destroying label.

DIAGNOSIS AND TESTING

PCV VALVE TEST—3.9/5.2/5.9L ENGINE

(1) With engine idling, remove the PCV valve from cylinder head (valve) cover. If the valve is not plugged, a hissing noise will be heard as air passes through the valve. Also, a strong vacuum should be felt at the valve inlet (Fig. 16).

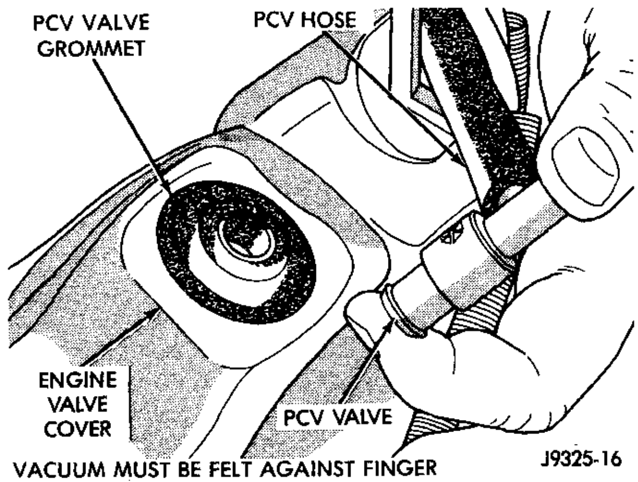

Fig. 16 Vacuum Check at PCV Valve—Typical

(2) Return the PCV valve into the valve cover. Remove the fitting and air hose at the opposite valve cover. Loosely hold a piece of stiff paper, such as a parts tag, over the opening (rubber grommet) at the valve cover (Fig. 17).

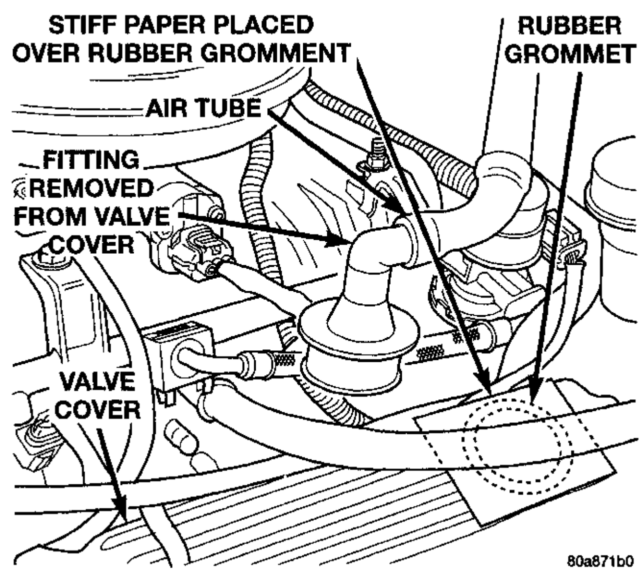

Fig. 17 Vacuum Check at Valve Cover Opening

DIAGNOSIS AND TESTING (Continued)

(3) The paper should be drawn against the opening in the valve cover with noticeable force. This will be after allowing approximately one minute for crankcase pressure to reduce.

(4) Turn engine off and remove PCV valve from valve cover. The valve should rattle when shaken (Fig. 18).

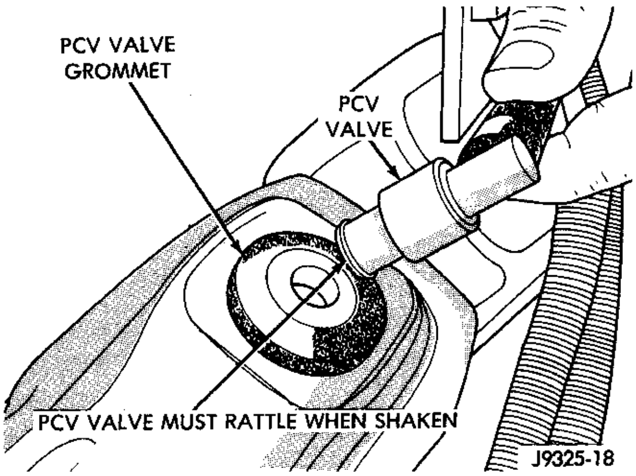

Fig. 18 Shake PCV Valve—Typical

(5) Replace the PCV valve and retest the system if it does not operate as described in the preceding tests. **Do not attempt to clean the old PCV valve.**

(6) If the paper is not held against the opening in valve cover after new valve is installed, the PCV valve hose may be restricted and must be replaced. The passage in the intake manifold must also be checked and cleaned.

(7) To clean the intake manifold fitting, turn a 1/4 inch drill (by hand) through the fitting to dislodge any solid particles. Blow out the fitting with shop air. If necessary, use a smaller drill to avoid removing any metal from the fitting.

VACUUM SCHEMATICS

A vacuum schematic for emission related items can be found on the VECI label. Refer to Vehicle Emission Control Information (VECI) Label in this group for label location.

LEAK DETECTION PUMP (LDP)

Refer to the appropriate Powertrain Diagnostic Procedures service manual for LDP testing procedures.

REMOVAL AND INSTALLATION

EVAPORATIVE (EVAP) CANISTER

Two EVAP canisters are used. Both canisters are mounted to a bracket located below rear of vehicle cab on outside of right frame rail (Fig. 19).

REMOVAL

(1) Remove fuel tubes/lines at each EVAP canister. Note location of tubes/lines before removal for easier installation.

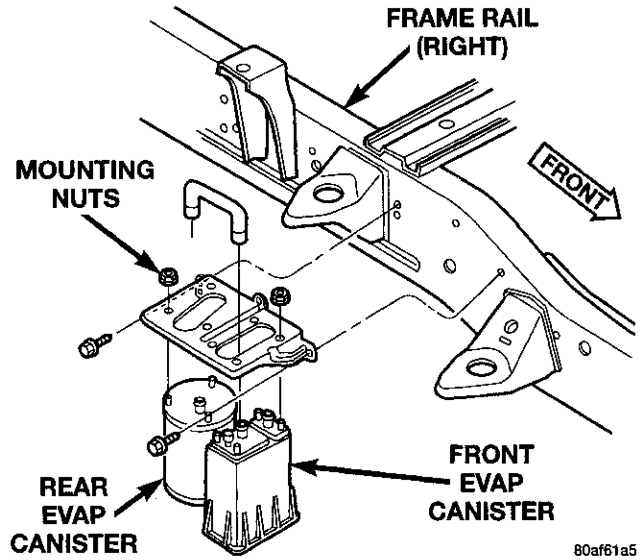

Fig. 19 EVAP Canister Location

(2) Remove mounting nuts at each canister (Fig. 19).

(3) Remove each canister from mounting bracket.

INSTALLATION

(1) Place each canister to mounting bracket (Fig. 19).

(2) Install nuts and tighten to 9 N·m (80 in. lbs.) torque.

(3) Install fuel tubes/lines to each canister.

DUTY CYCLE EVAP CANISTER PURGE SOLENOID

REMOVAL

The duty cycle solenoid is attached to a bracket mounted to the right inner fender (Fig. 20).

(1) Disconnect electrical wiring connector at solenoid (Fig. 20).

(2) Disconnect vacuum harness at solenoid.

(3) Remove solenoid from support bracket.

INSTALLATION

(1) Install solenoid assembly to support bracket.

(2) Connect vacuum harness.

(3) Connect wiring connector.

ROLLOVER VALVE(S)

REMOVAL

WARNING: THE FUEL SYSTEM IS UNDER A CONSTANT PRESSURE (EVEN WITH THE ENGINE OFF). BEFORE SERVICING THE ROLLOVER VALVE, FUEL SYSTEM PRESSURE MUST BE RELEASED (GASOLINE POWERED ENGINES ONLY). REFER TO THE FUEL PRESSURE RELEASE PROCEDURE IN GROUP 14, FUEL SYSTEM.

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REMOVAL AND INSTALLATION (Continued)

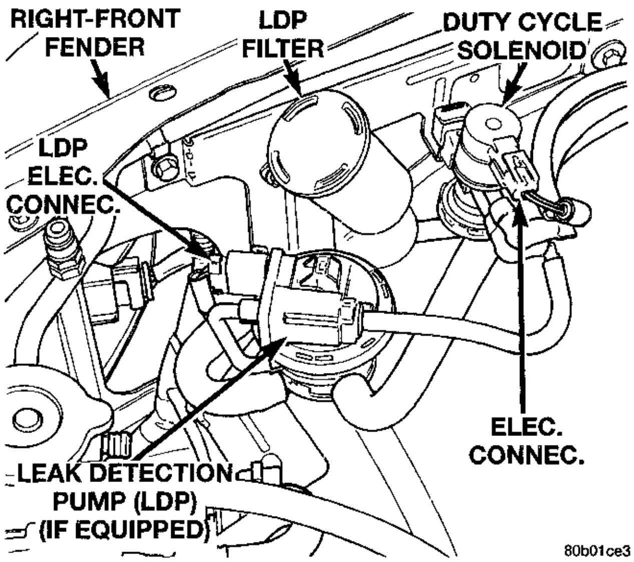

Fig. 20 Duty Cycle EVAP Canister Purge Solenoid Location

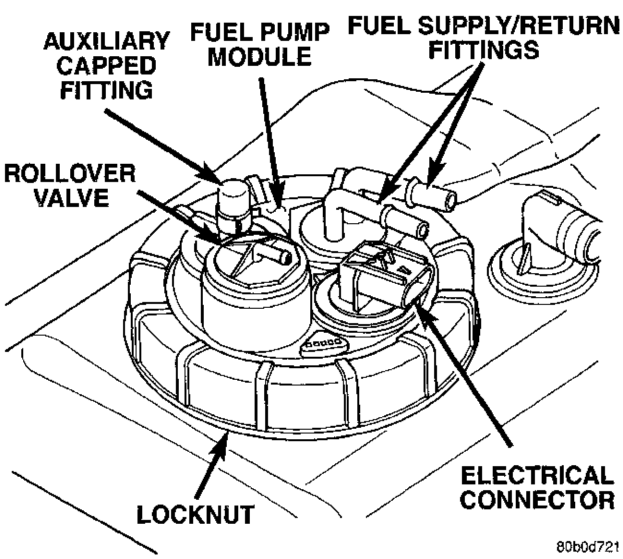

Fig. 21 Rollover Valve Location—Diesel Powered

(1) **Diesel Powered Engine:** One rollover valve is used. The valve is located on top of fuel tank module (Fig. 21) and may be serviced separately.

(a) Disconnect both negative battery cables at both batteries.

(b) Remove fuel filler cap and drain fuel tank.

(c) Remove fuel tank. Refer to Fuel Tank Removal/Installation in Group 14, Fuel System.

(d) The rollover valve is seated into a rubber grommet. Remove valve by prying one side upward and then roll valve out of grommet.

(e) Discard old grommet.

(2) **Gasoline Powered Engines:** If equipped with a 26 or 34 gallon fuel tank, two rollover valves are used. One of the valves is permanently mounted to top of fuel tank (Fig. 22). If replacement of this particular valve is necessary, fuel tank must be replaced. Refer to Fuel Tank Removal/Installation in Group 14, Fuel System. The other rollover valve is located on top of fuel pump module (Fig. 22). This valve may be serviced separately. Refer to following steps for procedures.

If equipped with a 35 gallon fuel tank, two rollover valves are also used, but both valves are permanently mounted to top of fuel tank (Fig. 23). If replacement is necessary, fuel tank must be replaced. Refer to Fuel Tank Removal/Installation in Group 14, Fuel System.

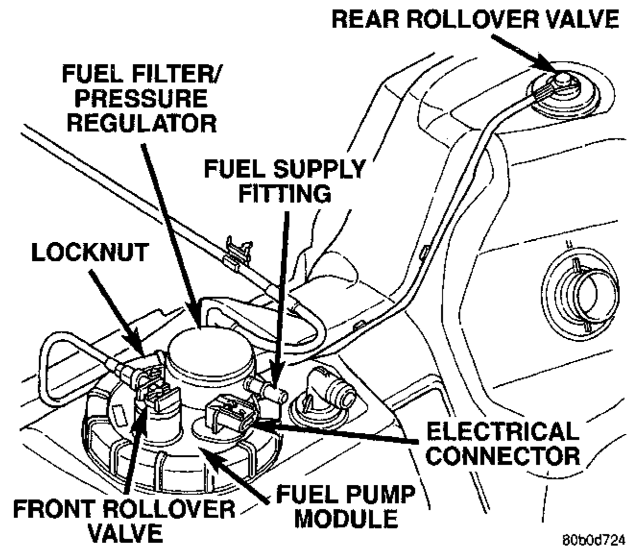

Fig. 22 Rollover Valve Locations—Gas Powered with 26 or 34 Gallon Tank

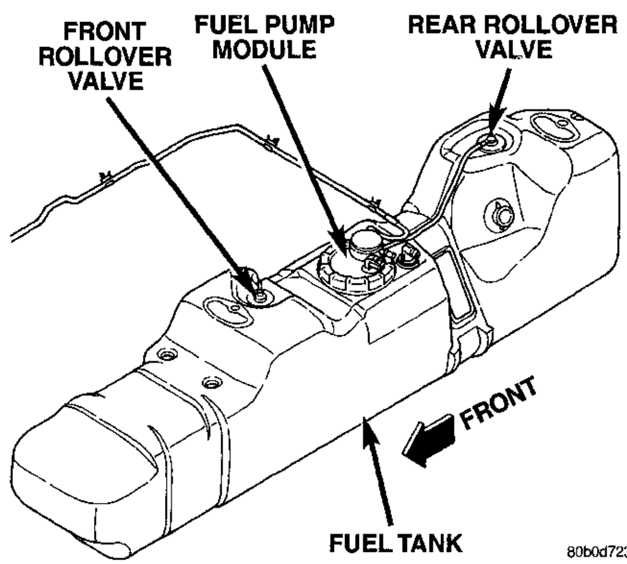

Fig. 23 Rollover Valve Locations—Gas Powered with 35 Gallon Tank

REMOVAL AND INSTALLATION (Continued)

(3)
(a) Disconnect negative battery cable at battery.
(b) Remove fuel filler cap and drain fuel tank.
(c) Remove fuel tank. Refer to Fuel Tank Removal/Installation in Group 14, Fuel System.
(d) Disconnect tube (line) at valve.
(e) The rollover valve is seated into a rubber grommet. Remove valve by prying one side upward and then roll valve out of grommet.
(f) Discard old grommet.

INSTALLATION

(1) Install new grommet into fuel pump (or fuel tank) module.
(2) Using finger pressure only, press valve into place.
(3) Install fuel tank. Refer to Fuel Tank Installation.
(4) Fill fuel tank. Install fuel tank filler cap.
(5) Connect negative battery cable(s).
(6) Start vehicle and check for leaks.

LEAK DETECTION PUMP (LDP)

The LDP and LDP filter are attached to a bracket mounted to the right-inner fender (Fig. 20). The LDP and LDP filter are replaced (serviced) as one unit.

REMOVAL

(1) Carefully remove hose at LDP filter.
(2) Remove LDP filter mounting bolt and remove from vehicle.
(3) Carefully remove vapor/vacuum lines at LDP.
(4) Disconnect electrical connector at LDP (Fig. 20).
(5) Remove LDP mounting screws and remove LDP from vehicle.

INSTALLATION

(1) Install LDP to mounting bracket. Tighten screws to 1 N·m (11 in. lbs.) torque.
(2) Install LDP filter to mounting bracket. Tighten bolt to 7 N·m (65 in. lbs.) torque.
(3) Carefully install vapor/vacuum lines to LDP, and install hose to LDP filter. **The vapor/vacuum lines and hoses must be firmly connected. Check the vapor/vacuum lines at the LDP, LDP filter and EVAP canister purge solenoid for damage or leaks. If a leak is present, a Diagnostic Trouble Code (DTC) may be set.**
(4) Connect electrical connector to LDP.

SPECIFICATIONS

TORQUE CHART

Description	Torque
EVAP Canister Mounting Nuts	9 N·m (80 in. lbs.)
Leak Detection Pump Mounting Screws	1 N·m (11 in. lbs.)
Leak Detection Pump Filter Mounting Bolt	7 N·m (65 in. lbs.)

AIR INJECTION SYSTEM-HDC GAS ENGINES

INDEX

GENERAL INFORMATION

GENERAL INFORMATION

The air injection system (Fig. 1), (Fig. 2) or (Fig. 3) is used on 5.9L V-8 and 8.0L V-10 heavy duty cycle (HDC) gas powered engines only. The air injection system consists of:

- A belt-driven air injection (AIR) pump
- Two air pressure relief valves
- Rubber connecting air injection hoses with clamps
- Metal connecting air tubes
- Two one-way check valves
- A replaceable injection pump air filter (8.0L V-10 engine only)

DESCRIPTION AND OPERATION

AIR INJECTION SYSTEM OPERATION

The air injection system adds a controlled amount of air to the exhaust gases aiding oxidation of hydrocarbons and carbon monoxide in the exhaust stream. The system does not interfere with the ability of the EGR system (if used) to control nitrous oxide (NOx) emissions.

5.9L HDC ENGINE: Air is drawn into the pump through a rubber tube that is connected to a fitting on the air cleaner housing (Fig. 2).

8.0L V-10 ENGINE: Air is drawn into the pump through a rubber tube that is connected to a fitting

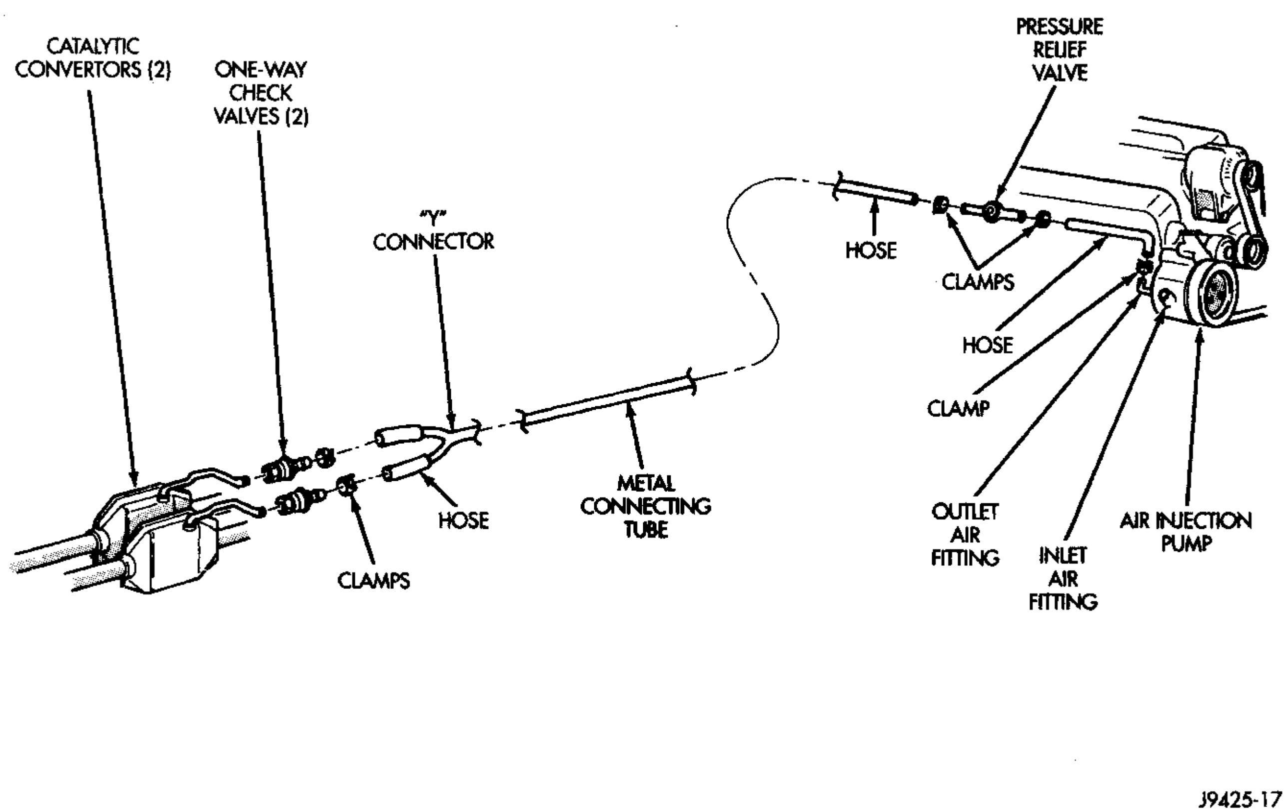

Fig. 1 Air Injection System Components—Typical

DESCRIPTION AND OPERATION (Continued)

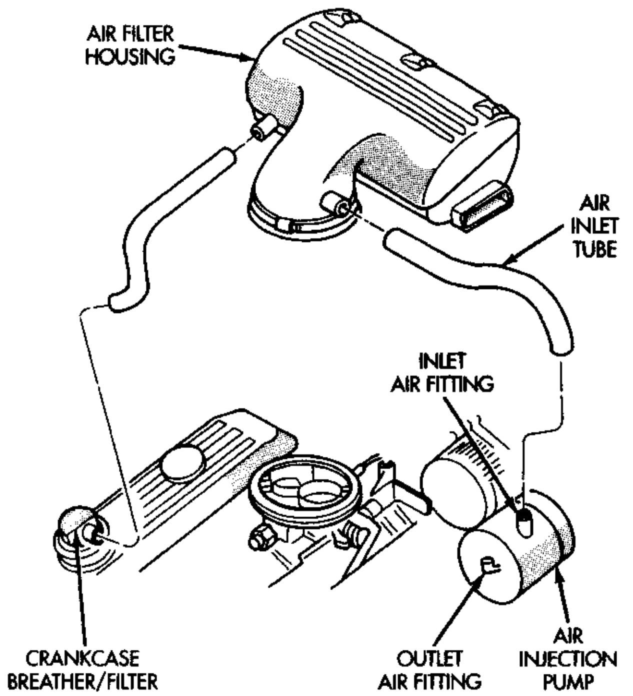

Fig. 2 Air Inlet for Air Pump—5.9L HDC Engine

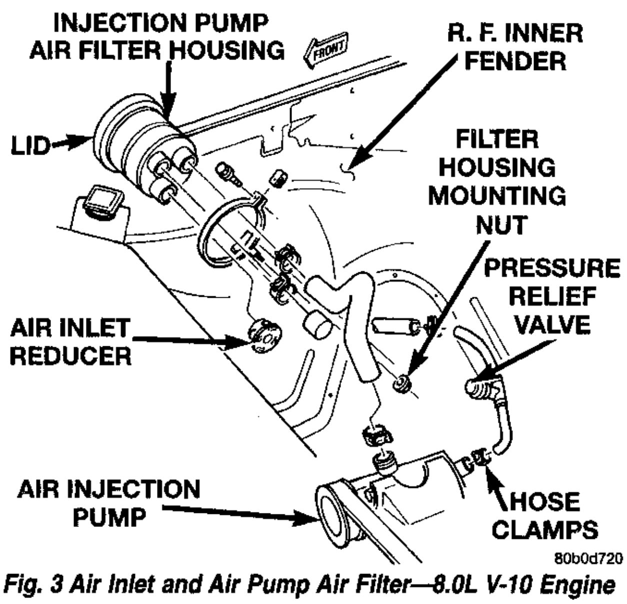

Fig. 3 Air Inlet and Air Pump Air Filter—8.0L V-10 Engine

on the air injection pump filter housing (Fig. 3). Air is drawn into the filter housing from the front of the vehicle with rubber tube. This tube is used as a silencer to help prevent air intake noise at the opening to the pump filter housing. An air filter is located within the air pump filter housing (Fig. 3).

Air is then compressed by the air injector pump. It is expelled from the pump and routed into a rubber tube where it reaches the air pressure relief valve (Fig. 1). Pressure relief holes in the relief valve will prevent excess downstream pressure. If excess downstream pressure occurs at the relief valve, it will be vented into the atmosphere.

Air is then routed (Fig. 1) from the relief valve, through a tube, down to a "Y" connector, through the two one-way check valves and injected at both of the catalytic convertors (referred to as downstream).

The two one-way check valves (Fig. 1) protect the hoses, air pump and injection tubes from hot exhaust gases backing up into the system. Air is allowed to flow through these valves in one direction only (towards the catalytic convertors).

Downstream air flow assists the oxidation process in the catalyst, but does not interfere with EGR operation (if EGR system is used).

AIR INJECTION PUMP

The air pump is mounted on the front of the engine and driven by a belt connected to the crankshaft pulley (Fig. 4).

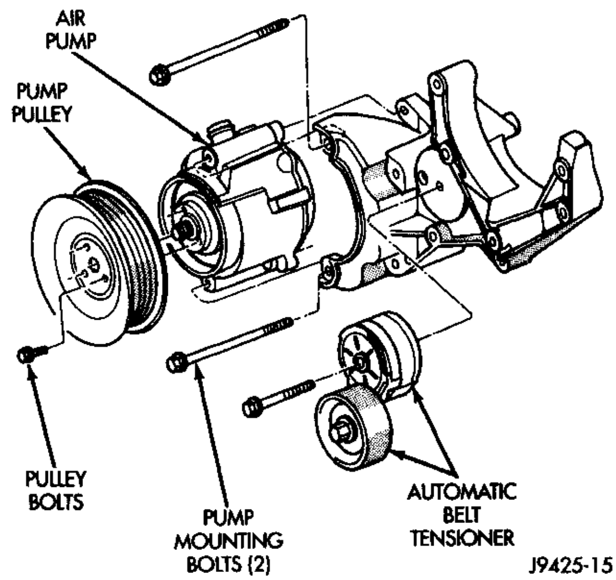

Fig. 4 Air Injection Pump Mounting—Typical

The air injection system is not completely noiseless. Under normal conditions, noise rises in pitch as engine speed increases. To determine if excessive noise is fault of air injection system, disconnect drive belt and operate engine.

CAUTION: Do not attempt to lubricate the air injection pump. Oil in the pump will cause rapid deterioration and failure.

Refer to the AIR PUMP DIAGNOSIS chart for additional information.

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DESCRIPTION AND OPERATION (Continued)

AIR PUMP DIAGNOSIS

EXCESSIVE BELT NOISE	1. Loose belt or defective automatic belt tensioner. 2. Seized pump.	1. Refer to Group 7, Cooling System. 2. Replace pump.
EXCESSIVE PUMP NOISE CHIRPING	1. Insufficient break-in.	1. Recheck for noise after 1600 km (1,000 miles) of operation.
EXCESSIVE PUMP NOISE CHIRPING, RUMBLING, OR KNOCKING	1. Leak in hose. 2. Loose hose. 3. Hose touching other engine parts. 4. Relief valve inoperative. 5. Check valve inoperative. 6. Pump mounting fasteners loose. 7. Pump failure.	1. Locate source of leak using soap solution and correct. 2. Reassemble and replace or tighten hose clamp. 3. Adjust hose position. 4. Replace relief valve. 5. Replace check valve. 6. Tighten mounting screws as specified. 7. Replace pump.
NO AIR SUPPLY. ACCELERATE ENGINE TO 1500 RPM AND OBSERVE AIR FLOW FROM HOSES. IF FLOW INCREASES AS RPM'S INCREASE, PUMP IS FUNCTIONING NORMALLY. IF NOT, CHECK POSSIBLE CAUSE.	1. Loose drive belt. 2. Leaks in supply hose. 3. Leak at fitting(s). 4. Check valve inoperative. 5. Plugged inlet air filter (8.0L).	1. Refer to Group 7, Cooling System. 2. Locate leak and repair or replace as required. 3. Tighten and replace clamps. 4. Replace check valve. 5. Replace filter

ONE-WAY CHECK VALVE

A check valve (Fig. 1) is located on each of the air injection downstream tubes.

Each check valve has a one-way diaphragm which prevents hot exhaust gases from backing up into the hose and pump. The check valve will protect the system if the air injection pump belt fails, an air hose ruptures or exhaust system pressure becomes abnormally high.

DIAGNOSIS AND TESTING

TESTING ONE-WAY CHECK VALVE

The one-way check valves are not repairable. To determine condition of valve, remove the rubber air tube from the inlet side of each check valve. Start the engine. If exhaust gas is escaping through the inlet side of check valve, it must be replaced.

REMOVAL AND INSTALLATION

AIR INJECTION PUMP

REMOVAL

The air injection pump does not have any internal serviceable parts.

(1) Disconnect both of the hoses (tubes) at the air injection pump.

(2) Loosen, but do not remove at this time, the three air pump pulley mounting bolts (Fig. 4).

(3) Relax the automatic belt tensioner and remove the engine accessory drive belt. Refer to Group 7, Cooling System. See Belt Removal/Installation.

(4) Remove the three air pump pulley bolts and remove pulley from pump.

(5) Remove the two air pump mounting bolts (Fig. 4) and remove pump from mounting bracket.

INSTALLATION

(1) Position air injection pump to mounting bracket.

(2) Install two pump mounting bolts to mounting bracket. Tighten bolts to 40 N·m (30 ft. lbs.) torque.

(3) Install pump pulley and three mounting bolts. Tighten bolts finger tight.

(4) Relax tension from automatic belt tensioner and install drive belt. Refer to Group 7, Cooling System. See Belt Removal/Installation.

(5) Tighten pump pulley bolts to 11 N·m (105 in. lbs.) torque.

(6) Install hoses and hose clamps at pump.

REMOVAL AND INSTALLATION (Continued)

AIR INJECTION PUMP AIR FILTER—8.0L V-10 ENGINE

The air filter for the air injection pump is located inside a housing located in right-front side of engine compartment (Fig. 3). A rubber hose connects the filter housing to air injection pump. The filter is used with 8.0L V-10 engines only.

For required maintenance schedules on the air pump filter (listed in time or mileage intervals), refer to Group 0, Lubrication and Maintenance. Also refer to the vehicle Owners Manual.

REMOVAL

(1) Remove rubber tubes at filter housing.

(2) Remove filter housing mounting nut and remove housing.

(3) Remove lid from filter housing (snaps off).

(4) Remove filter from housing.

INSTALLATION

(1) Clean inside of housing and lid before installing new filter.

(2) Install filter into housing.

(3) Install lid to filter housing (snaps on).

(4) Position filter housing to fender.

(5) Install mounting nut and tighten to 11 N·m (8 ft. lbs.) torque.

(6) Install rubber tubes and cap at filter housing.

ONE-WAY CHECK VALVE

REMOVAL

(1) Remove the hose clamp at inlet side of valve.

(2) Remove hose from valve.

(3) Remove valve from catalyst tube (unscrew). **To prevent damage to catalyst tube, a backup wrench must be used on the tube.**

INSTALLATION

(1) Install valve to catalyst tube. Tighten to 33 N·m (25 ft. lbs.) torque.

(2) Install hose and hose clamp to valve.

SPECIFICATIONS

TORQUE CHART

Description	Torque
Air Pump Filter Housing Nut	1 N·m (8 ft. lbs.)
Air Pump Mounting Bolts	40 N·m (30 ft. lbs.)
Air Pump Pulley Mounting Bolts	11 N·m (105 in. lbs.)
One-Way Check Valve to Catalyst Tube	33 N·m (25 ft. lbs.)

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EXHAUST GAS RECIRCULATION (EGR) SYSTEM-DIESEL ENGINE

INDEX

GENERAL INFORMATION

EXHAUST GAS RECIRCULATION (EGR) SYSTEM

The Transitional Low Emission Vehicle (TLEV) EGR system is used with the 5.9L diesel engine when equipped with a California emissions package only.

The EGR system reduces oxides of nitrogen (NOx) in the engine exhaust. This is accomplished by allowing a predetermined amount of hot exhaust gas to recirculate and dilute the incoming fuel/air mixture. This dilution reduces peak flame temperature during combustion.

DESCRIPTION AND OPERATION

EGR SYSTEM OPERATION

The system consists of:

• An EGR valve assembly. The valve assembly is located at the front of intake manifold (Fig. 1). The EGR valve is a poppet style valve (on/off only) and is controlled by an internal diaphragm.

• An EGR valve vacuum regulator solenoid. The solenoid is located at the front/top of cylinder head (Fig. 1) and will control the on-time and off-time of the EGR valve. A vacuum transducer is not used with this solenoid (EGR valve will be fully open or fully closed).

• The Powertrain Control Module (PCM) to operate the EGR valve vacuum regulator solenoid.

• The Engine Coolant Temperature (ECT) sensor (Fig. 2) to supply an engine coolant temperature input to the PCM.

• The Intake Manifold Air Temperature (IAT) sensor (Fig. 3) to supply an intake manifold air temperature input to the PCM.

• The Throttle Position Sensor (TPS) (Fig. 4) to supply a voltage reference input to the PCM. This will tell the PCM how far the throttle has been opened. If equipped with the California Emissions Package (with EGR system), the TPS will be used with **both automatic and manual transmissions.**

• Unique exhaust and intake manifolds.

• An EGR tube (Fig. 1) connecting a passage in the EGR valve to the rear of the exhaust manifold.

• A vacuum pump to supply vacuum for the EGR valve vacuum regulator solenoid and EGR valve. The pump also supplies vacuum for operation of the speed control servo and the heating/air conditioning system. The crankshaft gear driven pump is located at the front of engine and is attached to power steering pump (Fig. 5).

DESCRIPTION AND OPERATION (Continued)

- A quick-release one-way check valve (Fig. 1) to provide a fast release of engine vacuum from EGR valve diaphragm when EGR system is shut down.
- Vacuum lines and hoses to connect the various components.

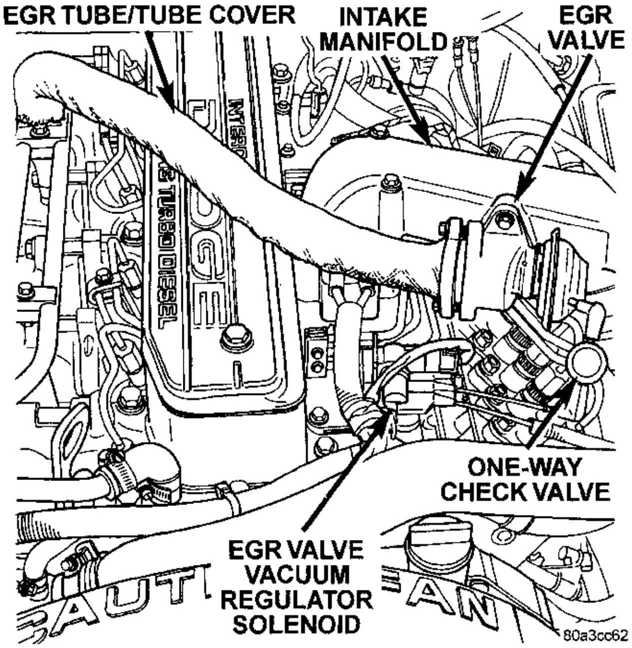

Fig. 1 EGR Valve and Components

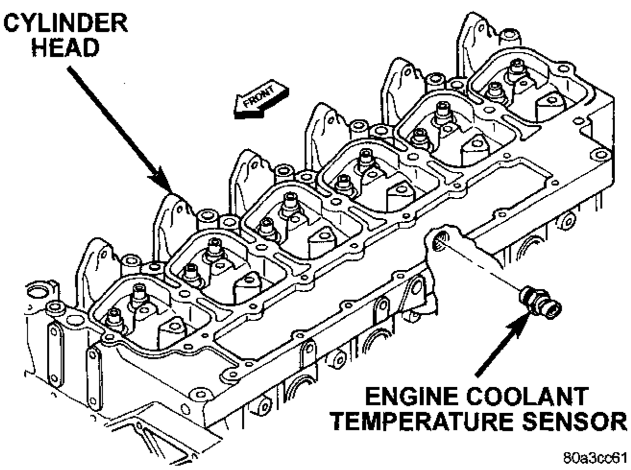

Fig. 2 Engine Coolant Temperature Sensor Location

When the PCM supplies a ground signal to the EGR valve vacuum regulator solenoid, EGR system operation starts to occur. The PCM will monitor and determine when to supply and remove this ground signal. This will depend on inputs from the engine coolant temperature, throttle position and intake manifold air temperature sensors.

When the ground signal is supplied to the EGR solenoid, vacuum from the vacuum pump will be

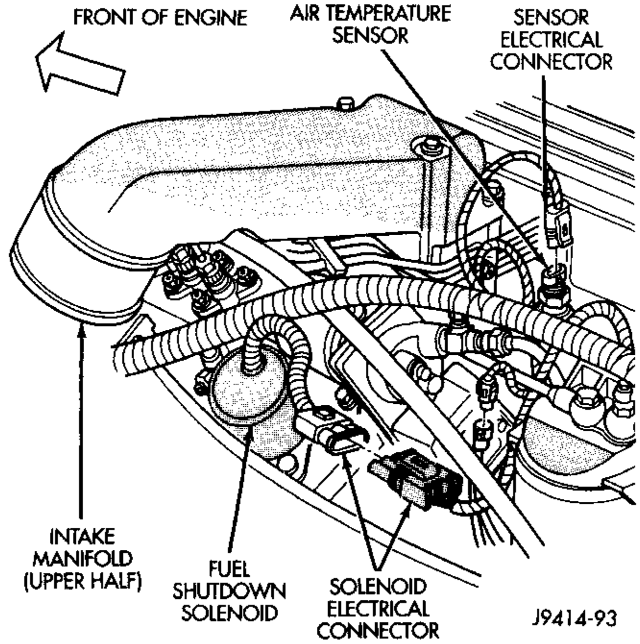

Fig. 3 Intake Manifold Air Temperature Sensor Location—Typical

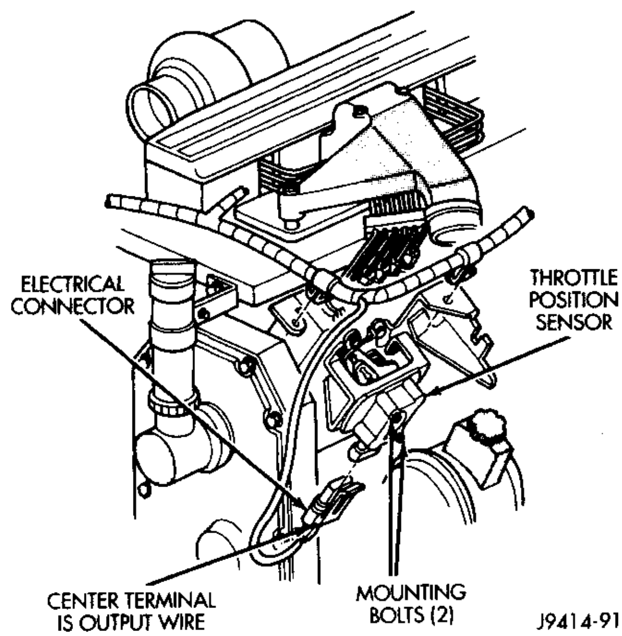

Fig. 4 Throttle Position Sensor Location—Typical

allowed to pass through the EGR solenoid and on to the EGR valve with a connecting hose.

Exhaust gas recirculation will begin in this order when:

- The engine is running to operate the vacuum pump.
- The powertrain control module (PCM) determines that engine coolant temperature is more than

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DESCRIPTION AND OPERATION (Continued)

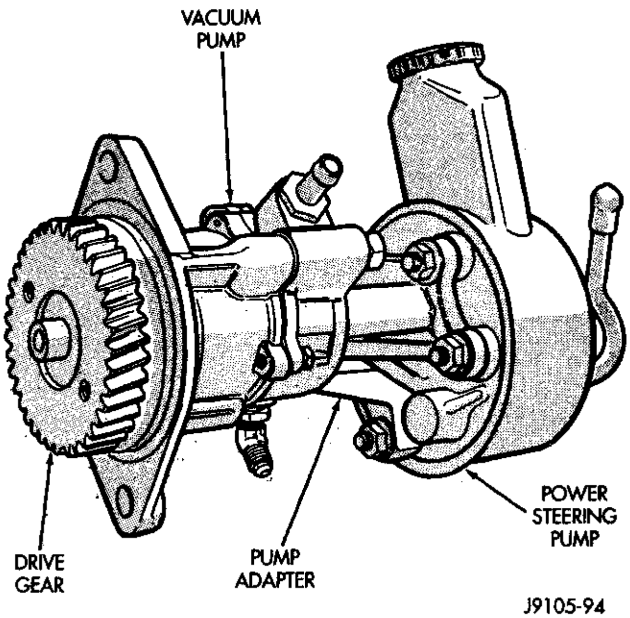

Fig. 5 Engine Vacuum Pump

140° F but less than 220° F, and intake manifold air temperature is more than 20° F but less than 170° F.

- A ground signal from the PCM is supplied to the EGR solenoid.
- Vacuum passes through the EGR solenoid to the EGR valve diaphragm.
- The inlet seat (poppet valve) at the bottom of the EGR valve opens to dilute and recirculate exhaust gas back into the intake manifold.

The EGR system will be activated at engine idle speed. This is if PCM operating parameters for EGR system operation have been met.

The EGR system will be shut down briefly if the PCM has determined that a rapid acceleration is occurring. This is determined by a change in TPS voltage (mechanical throttle movement). The PCM will leave the EGR system shut down for a few additional seconds after the throttle has been depressed.

The EGR system will also be shut down for wide open throttle (WOT) conditions.

The EGR system will also be shut down by the PCM if the PCM has not sensed a TPS voltage change (mechanical throttle movement) after 2 continuous minutes. This shut down may occur at either engine idle speed or normal cruising speeds.

Each time the engine is operated, an on-board diagnostic test will be run to verify EGR system operation. Certain failures will illuminate the MIL (Malfunction Indicator Lamp). The MIL is indicated on the instrument panel as the Check Engine Lamp. Refer to the On-Board Diagnostic section for additional information. Also refer to the appropriate Powertrain Diagnostic Procedures service manual.

DIAGNOSIS AND TESTING

EGR SYSTEM TEST

EGR system operation must first be checked with the DRB scan tool. To perform a test of the EGR system, refer to the appropriate Powertrain Diagnostic Procedures service manual. Check and correct any electrical malfunctions before proceeding.

Do not attempt to diagnose a defective EGR valve by applying vacuum to the EGR valve diaphragm fitting with engine running. Opening the EGR valve at idle speed will not change idle speed.

(1) Check operation of EGR valve vacuum regulator solenoid and EGR system with DRB scan tool.

(2) Start engine and verify that vacuum is available at inlet fitting of EGR valve vacuum regulator solenoid. Vacuum is supplied by an engine driven vacuum pump (Fig. 5). Refer to Group 9, Engines for vacuum pump specifications and test procedures.

(3) Check EGR valve for operation and leaks. Refer to EGR Valve Test.

(4) Check operation of one-way check valve (Fig. 1). Refer to Check Valve Test.

DIAGNOSIS AND TESTING (Continued)

EGR VALVE TEST

Use the following test procedure to determine if exhaust gas is flowing through the EGR valve. It can also be used to determine if the EGR tube is plugged, or the system passages in the intake or exhaust manifolds are plugged.

This is not to be used as a complete test of the EGR system.

(1) To verify EGR valve operation, it must be removed from intake manifold. Refer to EGR Valve Removal/Installation procedures.

(2) Examine the head of poppet valve at base opening on bottom of EGR valve. Look for heavy carbon build-up. A coating of carbon is normal with engine operation. Shine a bright light through valve opening and examine edge (seat) of poppet valve. No light should be evident at valve edge. If either condition exists, replace EGR valve. Do not attempt to clean the poppet valve within the EGR valve assembly.

(3) The EGR valve is equipped with a fitting located on the EGR valve vacuum motor (Fig. 6).

(4) Connect a hand–held vacuum pump equipped with a vacuum gauge to this fitting (Fig. 6).

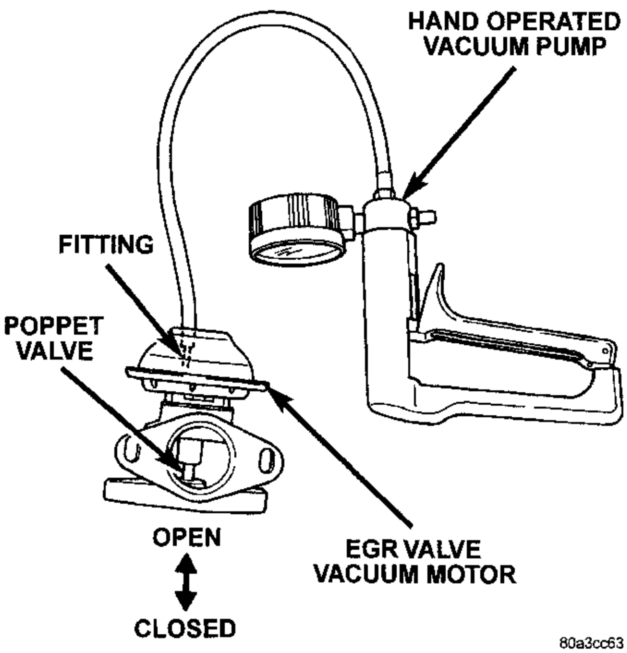

Fig. 6 Vacuum Pump at EGR Valve

(5) Slowly apply 10 inches HG of vacuum to the fitting on the EGR valve motor. The poppet valve (Fig. 6) should start to open at approximately 10 inches of vacuum. Vacuum should hold steady at 10 inches. If not, replace the EGR valve. If vacuum holds steady at 10 inches, and poppet valve has started to open, proceed to next step.

(6) Continue to apply vacuum until gauge reading is at 20 inches. The poppet valve should be fully open at approximately 20 inches of vacuum. Vacuum should also hold steady at 20 inches. If not, replace the EGR valve.

(7) If the EGR valve tested OK, the EGR tube may be plugged with carbon, or the passages in the intake and exhaust manifolds may be plugged with carbon.

(8) While the EGR valve is removed, check passages in EGR tube. Remove the EGR tube between the intake and exhaust manifolds. Check and clean the EGR tube and its related openings on the manifolds. Refer to EGR Tube Removal/Installation in this group for procedures.

(9) While the EGR valve is removed, check for carbon build-up at intake manifold openings. Clean carbon deposits as necessary.

Do not attempt to clean the poppet valve within the EGR valve assembly. If the valve shows evidence of heavy carbon build–up near the base or around poppet valve, replace it.

EGR VALVE VACUUM REGULATOR SOLENOID TEST

To perform an electrical test of this solenoid, refer to the DRB scan tool. Also refer to the appropriate Powertrain Diagnostic Procedures manual. Vacuum to the solenoid is supplied from an engine driven vacuum pump (Fig. 5). Refer to Group 9, Engines for vacuum pump specifications and test procedures.

CHECK VALVE TEST

This is not to be used as a test of the EGR system. Refer to DRB scan tool and appropriate Powertrain Diagnostic Procedures service manual.

A quick-release type, one-way check valve is located in the vacuum line between the EGR valve and the EGR valve vacuum regulator solenoid (Fig. 1). This check valve allows engine vacuum to be quickly bled from EGR valve. If the valve is defective, vacuum will be stored in the EGR valve diaphragm motor (EGR valve will remain open). If the valve is leaking, the EGR valve may not open.

(1) Attach a vacuum gauge with a "T" fitting into the vacuum line at EGR valve (between EGR valve and EGR vacuum regulator solenoid).

(2) Bring engine to operating temperature to allow EGR system operation.

(3) While driving at steady speed, high vacuum should be observed at gauge.

(4) Quickly open the throttle while observing gauge.

(5) Gauge should immediately drop to 0 inches. If any vacuum is being stored (gauge reading anything other than 0 inches), test EGR system electrical operation using the DRB scan tool. If EGR system electrical operation is OK, but gauge reading has not

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DIAGNOSIS AND TESTING (Continued)

dropped to 0 inches, proceed to next step before replacing check valve.

(6) Disconnect the vacuum lines at both ends of check valve and remove valve from vehicle.

(7) Attach a hand-operated vacuum pump equipped with a vacuum gauge to the inlet fitting on check valve (to solenoid). The inlet end of fitting is marked with an S (Fig. 7).

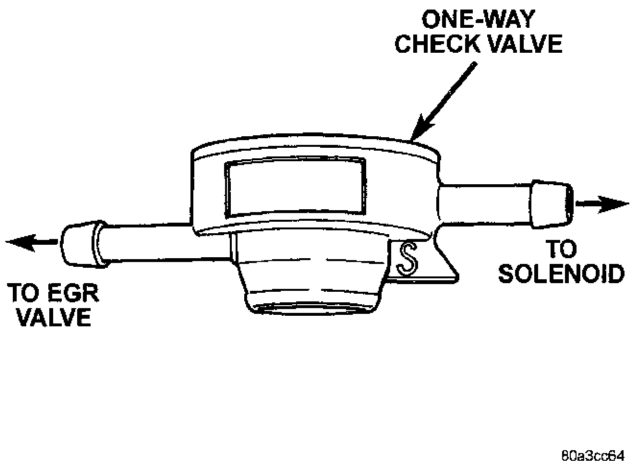

Fig. 7 One-Way Check Valve

(8) Apply a **minimum** of 20 in. vacuum or more to this fitting while plugging opposite fitting with a finger. Vacuum gauge should remain constant at 20 or more inches without any leakage. If not, replace check valve.

(9) Attach vacuum pump to the fitting at EGR valve end of check valve.

(10) Apply vacuum to this fitting while plugging opposite fitting with a finger. While operating vacuum pump, vacuum gauge should remain at or near 0 inches. If any vacuum is being stored, replace check valve.

VACUUM SUPPLY TEST

Vacuum for the EGR valve and EGR solenoid is provided by a vacuum pump. This pump is mounted to the gear housing at front of engine and attached to power steering pump (Fig. 8).

Refer to Group 9, Engines, for additional vacuum pump information and minimum/maximum vacuum specifications.

(1) Disconnect the vacuum supply line at EGR valve vacuum regulator solenoid.

(2) Attach a vacuum gauge at this point.

(3) Start the engine.

(4) If vacuum will not meet specifications as shown in Group 9, Engines, check for leaks in vacuum lines between solenoid and vacuum pump before condemning vacuum pump.

ENGINE COOLANT TEMPERATURE SENSOR—

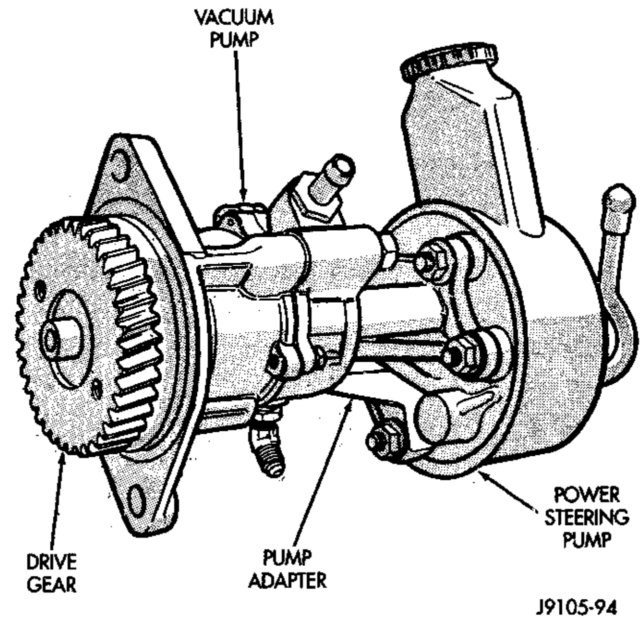

Fig. 8 Vacuum Pump

DIESEL ENGINE

To perform a complete test of the Engine Coolant Temperature (ECT) sensor and its circuitry, refer to DRB scan tool and appropriate Powertrain Diagnostics Procedures manual. To test the sensor only, refer to the following:

The ECT sensor is located on the left side of cylinder head behind fuel filter and below the intake manifold (Fig. 9).

(1) The ECT sensor is equipped with a 9 inch long jumper harness. This harness connects the ECT sensor to the main engine wiring harness. The end of the harness is located near the top of the fuel filter. It is used for sensor tests. Disconnect jumper harness connector from main engine wiring harness.

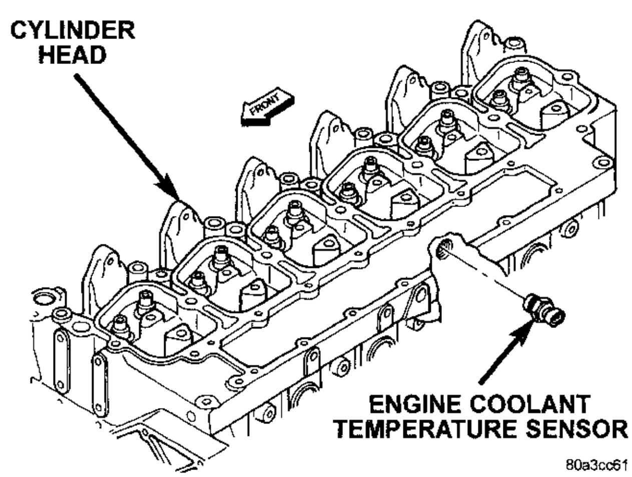

Fig. 9 ECT Sensor—Diesel Engine

DIAGNOSIS AND TESTING (Continued)

(2) Test resistance of sensor with a high input impedance (digital) volt-ohmmeter. The resistance (as measured across the jumper harness terminals) should be as shown in ECT SENSOR RESISTANCE (OHMS) chart. Replace sensor if it is not within range of resistance specified in chart.

ECT SENSOR RESISTANCE (OHMS)

TEMPERATURE		RESISTANCE (OHMS)	
°CEL.	°FAHR.	MIN.	MAX.
-40	-40	291,490	381,710
-20	-4	85,850	108,390
-10	14	49,250	61,430
0	32	29,330	35,990
10	50	17,990	21,810
20	68	11,370	13,610
25	77	9,120	10,880
30	86	7,370	8,750
40	104	4,900	5,750
50	122	3,330	3,880
60	140	2,310	2,670
70	158	1,630	1,870
80	176	1,170	1,340
90	194	860	970
100	212	640	720
110	230	480	540
120	248	370	410

(3) Test continuity of the wire harness between the PCM wire harness connector and the ECT sensor connector terminals. Refer to Group 8, Wiring for terminal/cavity locations. Repair the wire harness if an open circuit is indicated.

(4) After tests are completed, connect jumper harness.

REMOVAL AND INSTALLATION

EGR VALVE

REMOVAL

(1) Disconnect vacuum line at EGR valve vacuum supply fitting (Fig. 10).

(2) Remove the two bolts retaining EGR tube to side of EGR valve (Fig. 10).

(3) Remove the two EGR valve mounting bolts (Fig. 10) and remove EGR valve.

(4) Discard both of the old EGR mounting gaskets.

INSTALLATION

(1) Clean the intake manifold and EGR valve of any old gasket material.

(2) Clean the end of EGR tube of any old gasket material.

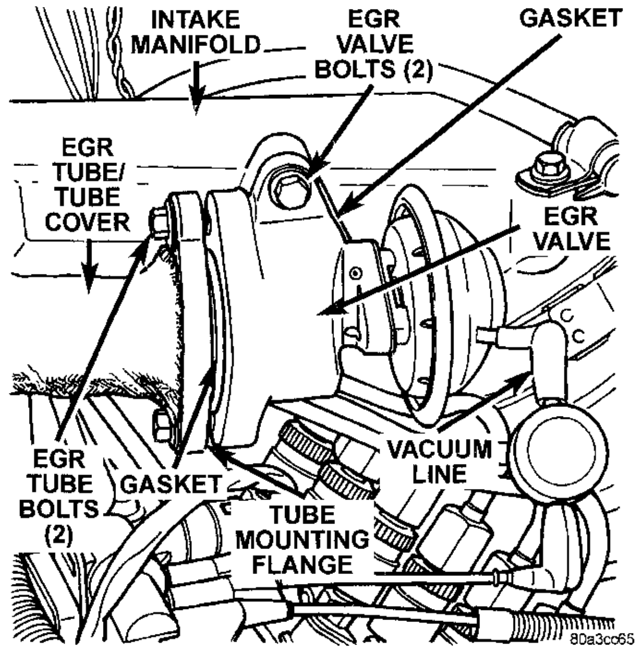

Fig. 10 EGR Valve Removal/Installation

(3) Position new gasket between EGR valve and EGR tube and position EGR valve to tube. Install 2 bolts finger tight only.

(4) Position new gasket between EGR valve and intake manifold.

(5) Install 2 EGR valve-to-intake manifold bolts finger tight only.

(6) A slotted mounting bolt hole is located at lower ear on EGR valve. Rotate EGR valve until square to EGR tube. Tighten 2 EGR valve-to-intake manifold bolts to 24 N·m (212 in. lbs.).

(7) Tighten 2 EGR tube-to-EGR valve mounting bolts to 24 N·m (212 in. lbs.). **When tightening these 2 bolts, alternate between the upper and lower bolt to allow face of EGR valve to remain square to tube mounting flange (Fig. 10) on EGR tube.**

(8) Connect vacuum line to EGR valve.

EGR TUBE

The EGR tube connects the EGR valve to the rear of the exhaust manifold (Fig. 10).

REMOVAL

(1) Remove 2 EGR tube mounting bolts at EGR valve end of tube (Fig. 10).

(2) Remove 2 EGR tube mounting nuts at exhaust manifold end of tube (Fig. 11).

(3) Remove EGR tube and discard old gaskets.

(4) Clean gasket mating surfaces and EGR tube flange gasket surfaces.

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REMOVAL AND INSTALLATION (Continued)

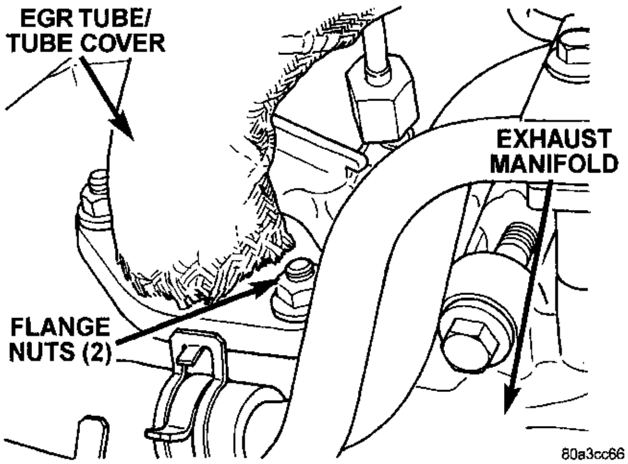

Fig. 11 EGR Tube Nuts at Exhaust Manifold

(5) Check for signs of leakage or cracked surfaces at both ends of tube, exhaust manifold and EGR valve.

INSTALLATION

(1) Install a new gasket to EGR valve end of EGR tube.

(2) Install a new gasket to manifold end of EGR tube.

(3) Position EGR tube to engine and install bolts/ nuts.

(4) Tighten all bolts/nuts to 24 N·m (212 in. lbs.) torque. **When tightening bolts at EGR valve end of tube, alternate between the upper and lower bolt to allow face of EGR valve to remain square to tube mounting flange (Fig. 10) on EGR tube.**

EGR VALVE VACUUM REGULATOR SOLENOID

The solenoid is located at the top/front of cylinder head (Fig. 12).

REMOVAL/INSTALLATION

(1) Disconnect electrical connector at solenoid.

(2) Disconnect vacuum harness at solenoid.

(3) Remove solenoid bracket bolt (Fig. 12).

(4) Remove solenoid and bracket from engine.

(5) Reverse the removal steps for installation. Tighten mounting bolt to 24 N·m (212 in. lbs.) torque.

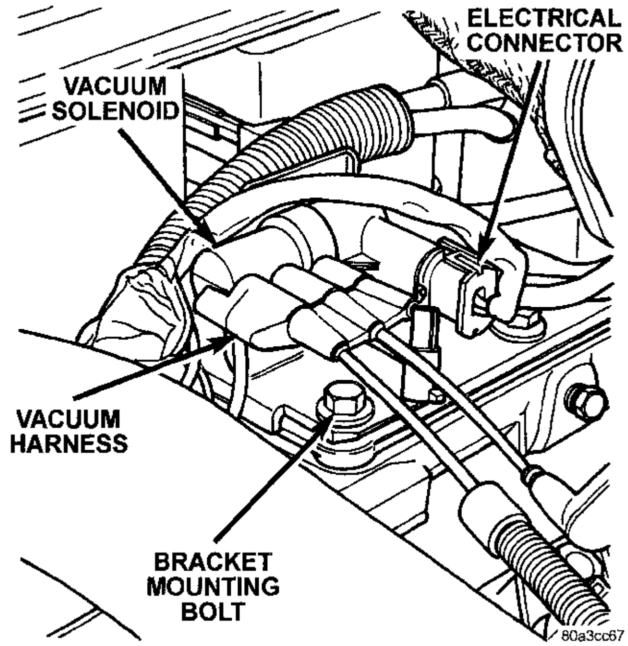

Fig. 12 EGR Valve Vacuum Regulator Solenoid

THROTTLE POSITION SENSOR

For removal, installation, testing and adjustment of the throttle position sensor (TPS), refer to the diesel sections of Group 14, Fuel System. The TPS may also be tested with the DRB scan tool. Refer to the appropriate Powertrain Diagnostic Procedures service manual.

ENGINE COOLANT TEMPERATURE SENSOR—DIESEL ENGINE

The Engine Coolant Temperature (ECT) sensor is located on the left side of the cylinder head behind the fuel filter and below the intake manifold (Fig. 13).

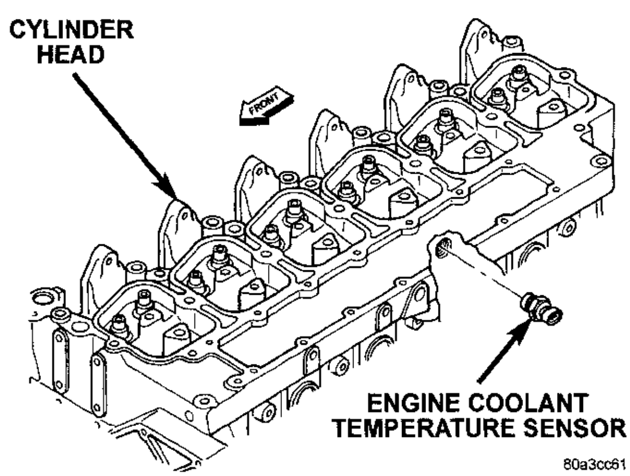

Fig. 13 ECT Sensor Location—Diesel Engine

REMOVAL AND INSTALLATION (Continued)

REMOVAL

WARNING: THE COOLING SYSTEM MAY BE UNDER PRESSURE. HOT COOLANT CAN CAUSE BURNS. OBSERVE THE WARNINGS IN GROUP 7, COOLING SYSTEM BEFORE PROCEEDING.

(1) Partially drain cooling system until coolant level is below cylinder head.

(2) Drain and remove fuel filter/water separator. Refer to Fuel Filter/Water Separator Removal/Installation in the Diesel section of Group 14, Fuel System for procedures.

(3) Disconnect ECT sensor pigtail harness connector from sensor.

(4) Remove ECT sensor from cylinder head.

INSTALLATION

(1) Apply sealant to sensor threads.

(2) Install ECT sensor into cylinder head. Tighten to 55 N·m (40 ft. lbs.) torque.

(3) Connect ECT sensor wire connector.

(4) Install fuel filter and bleed fuel. Refer to Group 14, Fuel System for procedures.

(5) Fill cooling system and check for coolant leaks. Refer to Group 7, Cooling System for procedures.

SPECIFICATIONS

TORQUE CHART

Description	Torque
EGR Valve Mounting Bolts	24 N·m (212 in. lbs.)
EGR Valve Vacuum Regulator Solenoid Mounting Bolt	24 N·m (212 in. lbs.)
EGR Tube Mounting Bolts/Nuts	24 N·m (212 in. lbs.)
Engine Coolant Temperature (ECT) Sensor	55 N·m (40 ft. lbs.)

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FOREWORD

This manual is designed as a supplement to be used along with the 1998 Ram Truck service manual, 81-370-8108. It includes information related to the 24 valve, electronically fuel injected, Cummins turbo diesel engine.

The information contained in this service manual has been prepared for the professional automotive technician involved in daily repair operations. This manual does not cover theory of operation, which is addressed in service training material. Information describing the operation and use of standard and optional equipment is included in the Owner's Manual provided with the vehicle.

This manual is designed as a supplement to be used along with the 1998 Ram Truck service manual. It includes information related to engineering changes made during the model year.

Information in this manual is divided into groups. These groups contain general information, diagnosis, testing, adjustments, removal, installation, disassembly, and assembly procedures for the systems and components. To assist in locating a group title page, use the Group Tab Locator on the following page. The solid bar after the group title is aligned to a solid tab on the first page of each group. The first page of the group has a contents section that lists major topics within the group. If you are not sure which Group contains the information you need, look up the Component/System in the alphabetical index located in the rear of this manual.

A Service Manual Comment form is included at the rear of this manual. Use the form to provide Chrysler Corporation with your comments and suggestions.

Tightening torques are provided as a specific value throughout this manual. This value represents the midpoint of the acceptable engineering torque range for a given fastener application. These torque values are intended for use in service assembly and installation procedures using the correct OEM fasteners. When replacing fasteners, always use the same type (part number) fastener as removed.

Chrysler Corporation reserves the right to change testing procedures, specifications, diagnosis, repair methods, or vehicle wiring at any time without prior notice or incurring obligation.

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Navigation Tools: Click on the “Table of Contents” below, or use the Bookmarks to the left.

GROUP TAB LOCATOR

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INTRODUCTION

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GENERAL INFORMATION

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GENERAL INFORMATION

VEHICLE IDENTIFICATION NUMBER

The Vehicle Identification Number (VIN) plate is located on the lower windshield fence near the left A-pillar (Fig. 1). The VIN contains 17 characters that provide data concerning the vehicle. Refer to the VIN decoding chart to determine the identification of a vehicle.

The Vehicle Identification Number is also imprinted on the:

- Body Code Plate.
- Equipment Identification Plate.
- Vehicle Safety Certification Label.
- Frame rail.

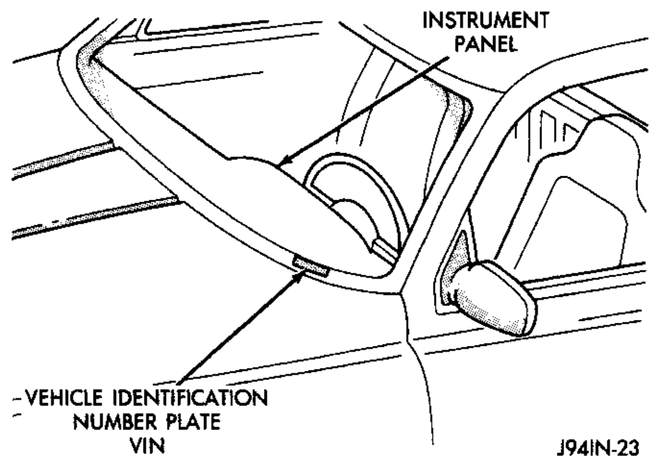

Fig. 1 Vehicle Identification Number (VIN) Location

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GENERAL INFORMATION (Continued)

To protect the consumer from theft and possible fraud the manufacturer is required to include a Check Digit at the ninth position of the Vehicle Identification Number. The check digit is used by the manufacturer and government agencies to verify the authenticity of the vehicle and official documentation. The formula to use the check digit is not released to the general public.

POSITION	INTERPRETATION	CODE = DESCRIPTION
1	Country of Origin	1 = United States 3 = Mexico
2	Make	B = Dodge
3	Vehicle Type	4 = Multipurpose Passenger 5 = Bus 6 = Incomplete 7 = Truck
4	Gross Vehicle Weight Rating	H = 6001-7000 J = 7001-8000 K = 8001-9000 L = 9001-10,000 M = 10,001-14,000 W = Hydraulic Brakes
5	Vehicle Line	C = Ram Cab Chassis/Ram Pick Up (4x2) F = Ram Cab Chassis/Ram Pick Up (4x4)
6	Series	1 = 1500 2 = 2500 3 = 3500
7	Body Style	2 = Club Cab 3 = Quad Cab 6 = Conventional Cab/Cab Chassis
8	Engine	6 = 5.9L 6cyl. 24 Valve Diesel D = 5.9L 6cyl. 12 Valve Diesel W = 8.0L 10 cyl. MPI X = 3.9L 6 cyl. MPI Y = 5.2L 8 cyl. MPI Z = 5.9L 8 cyl. MPI-LDC 5 = 5.9L 8cyl. MPI-HDC
9	Check Digit	
10	Model Year	W = 1998
11	Plant Location	J = St. Louis North S = Dodge City G = Saltillo M = Lago Alberto Assembly
12 thru 17	Vehicle Build Sequence	

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LUBRICATION AND MAINTENANCE

CONTENTS

GENERAL INFORMATION

INTRODUCTION

The following is a list of Maintenance Schedules for Diesel Engine equipped vehicles.

There are two maintenance schedules that show proper service based on the conditions that the vehicle is subjected to. Use the schedule that best describes these conditions.

Schedule—**A**, lists all the scheduled maintenance to be performed under normal operating conditions for Diesel Engine equipped vehicles.

Schedule—**B**, lists all the scheduled maintenance to be performed for Diesel Engine equipped vehicles that are operated under the following conditions:

- Frequent short trip driving less than 5 miles (8 km)
- Frequent driving in dusty conditions
- Frequent trailer towing
- Extensive idling
- More than 50% of your driving is at sustained high speeds during hot weather, above 90°F (32°C)

Where time and mileage are listed, follow the interval that occurs first.

UNSCHEDULED INSPECTION

At Each Stop For Fuel

- Check engine oil level, add as required.
- Check windshield washer solvent and add if required.
- Clean windshield and wiper blades as required.
- Drain water from fuel filter.

Once A Month

- Check tire pressure and look for unusual wear or damage.
- Inspect battery and clean and tighten terminals as required.
- Check fluid levels of coolant reservoir, brake master cylinder, power steering, and transmission. Add fluid as required.
- Check all lights and all other electrical items for correct operation.
- **Check Filter Minder®. Replace filter if necessary.**
- Inspect and clean wiper blades. Replace if required.

At Each Oil Change

- Inspect exhaust system.
- Inspect brake hoses.
- Adjust rear brakes.
- Rotate the tires at each oil change interval shown, 7,500 Miles (12 000 km) on Schedule —A or every other interval shown on Schedule—B.
- Check engine coolant level, hoses, and clamps.
- Lubricate steering linkage.

SCHEDULE—A

7,500 Miles (12 000 km) or at 6 months

- Change engine oil and filter.
- Adjust rear brakes.

15,000 Miles (24 000 km) or at 12 months

- Change engine oil and filter.
- Inspect water pump weep hole for blockage.
- Replace fuel filter.
- Adjust rear brakes.

22,500 Miles (36 000 km) or at 18 months

- Change engine oil and filter.
- Inspect drive belts, replace as necessary.
- Inspect brake linings.
- Adjust rear brakes.

30,000 Miles (48 000 km) or at 24 months

- Change engine oil and filter.
- Inspect fan hub.
- Inspect damper.
- Inspect water pump weep hole for blockage.
- Replace fuel filter and clean strainer.
- Drain and refill automatic transmission fluid. Replace filter and adjust bands.
- Inspect front wheel bearings. Clean and repack, if required (4x2).
- Adjust rear brakes.

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GENERAL INFORMATION (Continued)

• Flush and replace engine coolant at 24 months, regardless of mileage.

37,500 Miles (60 000 km) or at 30 months
- Change engine oil and filter.
- Adjust rear brakes.

45,000 Miles (72 000 km) or at 36 months
- Change engine oil and filter.
- Inspect drive belts, replace as necessary.
- Inspect water pump weep hole for blockage.
- Replace fuel filter.
- Drain and refill transfer case fluid.
- Inspect brake linings.
- Flush and replace engine coolant if not done at 24 months.
- Adjust rear brakes.

52,500 Miles (84 000 km) or at 42 months
- Change engine oil and filter.
- Adjust rear brakes.

60,000 Miles (96 000 km) or at 48 months
- Change engine oil and filter.
- Drain and refill automatic transmission fluid. Replace filter and adjust bands.
- Inspect fan hub.
- Inspect damper.
- Inspect front wheel bearings. Clean and repack, if required (4x2).
- Inspect water pump weep hole for blockage.
- Replace fuel filter and clean strainer.
- Adjust rear brakes.

67,500 Miles (108 000 km) or at 54 months
- Change engine oil and filter.
- Inspect drive belts, replace as necessary.
- Inspect brake linings.
- Adjust rear brakes.

75,000 Miles (120 000 km) or at 60 months
- Change engine oil and filter.
- Inspect water pump weep hole for blockage.
- Replace fuel filter and clean strainer.
- Flush and replace engine coolant if it has been 30,000 miles (48 000 km) or 24 months since last change.
- Adjust rear brakes.

82,500 Miles (132 000 km) or at 66 months
- Change engine oil and filter.
- Adjust rear brakes.

90,000 Miles (144 000 km) or at 72 months
- Change engine oil and filter.
- Inspect drive belts, replace as required.
- Drain and refill automatic transmission fluid. Replace filter and adjust bands.
- Drain and refill transfer case fluid.
- Inspect fan hub.
- Inspect damper.
- Inspect water pump weep hole for blockage.
- Replace fuel filter.
- Inspect front wheel bearings. Clean and repack, if required (4x2).
- Inspect brake linings.
- Adjust rear brakes.

97,500 Miles (156 000 km) or at 78 months
- Change engine oil and filter.
- Flush and replace engine coolant if it has been 30,000 miles (48 000 km) or 24 months since last change.
- Adjust rear brakes.

105,000 Miles (168 000 km) or at 84 months
- Change engine oil and filter.
- Inspect water pump weep hole for blockage.
- Replace fuel filter.
- Flush and replace engine coolant if it has been 30,000 miles (48 000 km) or 24 months since last change.
- Adjust rear brakes.

112,500 Miles (181 000 km)
- Change engine oil and filter.
- Inspect drive belts, replace if necessary.
- Inspect brake linings.
- Adjust rear brakes.

120,000 Miles (193 000 km) or at 96 months
- Change engine oil and filter.
- Drain and refill automatic transmission fluid. Replace filter and adjust bands.
- Inspect fan hub.
- Inspect damper.
- Inspect front wheel bearings. Clean and repack, if required (4x2).
- Inspect water pump weep hole for blockage.
- Replace fuel filter.
- Adjust rear brakes.

127,500 Miles (205 000 km) or at 102 months
- Change engine oil and filter.
- Adjust rear brakes.

135,000 Miles (217 000 km) or at 108 months
- Change engine oil and filter.
- Inspect drive belts, replace as necessary.
- Inspect water pump weep hole for blockage.
- Replace fuel filter.
- Drain and refill transfer case fluid.
- Inspect brake linings.

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GENERAL INFORMATION (Continued)

• Flush and replace engine coolant if it has been 30,000 miles (48 000 km) or 24 months since last change.
• Adjust rear brakes.

150,000 Miles (241 000 km) or at 150 months
• Change engine oil and filter.
• Drain and refill automatic transmission fluid. Replace filter and adjust bands.
• Inspect fan hub.
• Inspect damper.
• Inspect front wheel bearings. Clean and repack, if required (4x2).
• Inspect water pump weep hole for blockage.
• Adjust valve lash clearance.
• Replace fuel filter.
• Adjust rear brakes.

SCHEDULE—B

3,750 Miles (6 000 km)
• Change engine oil and filter.
• Adjust rear brakes.

7,500 Miles (12 000 km)
• Change engine oil and filter.
• Replace fuel filter.
• Adjust rear brakes.

11,250 Miles (18 000 km)
• Change engine oil and filter.
• Adjust rear brakes.

15,000 Miles (24 000 km)
• Change engine oil and filter.
• Inspect water pump weep hole for blockage.
• Replace fuel filter.
• Drain and refill automatic transmission fluid. Replace filter and adjust bands.
• Change rear axle fluid.
• Change front axle fluid (4x4).
• Inspect brake linings.
• Adjust rear brakes.

18,750 Miles (30 000 km)
• Change engine oil and filter.
• Adjust rear brakes.

22,500 Miles (36 000 km)
• Change engine oil and filter.
• Inspect drive belts, replace as necessary.
• Replace fuel filter.
• Adjust rear brakes.

26,250 Miles (42 000 km)
• Change engine oil and filter.
• Adjust rear brakes.

30,000 Miles (48 000 km)
• Change engine oil and filter.
• Inspect fan hub.
• Inspect damper.
• Inspect water pump weep hole for blockage.
• Replace fuel filter.
• Drain and refill automatic transmission fluid. Replace filter and adjust bands.
• Change rear axle fluid.
• Change front axle fluid (4x4).
• Inspect front wheel bearings. Clean and repack, if required (4x2).
• Inspect brake linings.
• Adjust rear brakes.

33,700 Miles (54 000 km)
• Change engine oil and filter.
• Adjust rear brakes.

37,500 Miles (60 000 km)
• Change engine oil and filter.
• Replace fuel filter.
• Adjust rear brakes.

41,250 Miles (66 000 km)
• Change engine oil and filter.
• Adjust rear brakes.

45,000 Miles (72 000 km)
• Change engine oil and filter.
• Inspect drive belts, replace as necessary.
• Inspect water pump weep hole for blockage.
• Replace fuel filter.
• Drain and refill automatic transmission fluid. Replace filter and adjust bands.
• Drain and refill transfer case fluid.
• Change rear axle fluid.
• Change front axle fluid (4x4).
• Inspect brake linings.
• Adjust rear brakes.

48,750 Miles (78,000 km)
• Change engine oil and filter.
• Adjust rear brakes.

52,500 Miles (84 000 km)
• Change engine oil and filter.
• Replace fuel filter.
• Adjust rear brakes.

56,250 Miles (90 000 km)
• Change engine oil and filter.
• Adjust rear brakes.

60,000 Miles (96 000 km)
• Change engine oil and filter.
• Inspect fan hub.

GENERAL INFORMATION (Continued)

- Inspect damper.
- Inspect water pump weep hole for blockage.
- Replace fuel filter.
- Drain and refill automatic transmission fluid. Replace filter and adjust bands.
- Change rear axle fluid.
- Change front axle fluid (4x4).
- Inspect front wheel bearings. Clean and repack if required (4x2).
- Inspect brake linings.
- Flush and replace engine coolant.
- Adjust rear brakes.

63,750 Miles (102 000 km)
- Change engine oil and filter.
- Adjust rear brakes.

67,500 Miles (108 000 km)
- Change engine oil and filter.
- Inspect drive belts, replace as necessary.
- Replace fuel filter.
- Adjust rear brakes.

71,250 Miles (114 000 km)
- Change engine oil and filter.
- Adjust rear brakes.

75,000 Miles (120 000 km)
- Change engine oil and filter.
- Inspect water pump weep hole for blockage.
- Replace fuel filter.
- Drain and refill automatic transmission fluid. Replace filter and adjust bands.
- Change rear axle fluid.
- Change front axle fluid (4x4).
- Inspect brake linings.
- Adjust rear brakes.

78,750 Miles (126 000 km)
- Change engine oil and filter.
- Adjust rear brakes.

82,500 Miles (132 000 km)
- Change engine oil and filter.
- Replace fuel filter and clean strainer.
- Adjust rear brakes.

86,250 Miles (138 000 km)
- Change engine oil and filter.
- Adjust rear brakes.

90,000 Miles (144 000 km)
- Change engine oil and filter.
- Inspect drive belts, replace as necessary.
- Inspect fan hub.
- Inspect damper.
- Inspect water pump weep hole for blockage.
- Replace fuel filter.
- Drain and refill automatic transmission fluid. Replace filter and adjust bands.
- Drain and refill transfer case fluid.
- Change rear axle fluid.
- Change front axle fluid (4x4).
- Inspect front wheel bearings. Clean and repack if required (4x2).
- Inspect brake linings.
- Adjust rear brakes.

93,750 Miles (150 000 km)
- Change engine oil and filter.
- Adjust rear brakes.

97,500 Miles (156 000 km)
- Change engine oil and filter.
- Flush and replace engine coolant.
- Replace fuel filter.
- Adjust rear brakes.

101,250 Miles (162 000 km)
- Change engine oil and filter.
- Adjust rear brakes.

105,000 Miles (168 000 km)
- Change engine oil and filter.
- Inspect water pump weep hole for blockage.
- Replace fuel filter.
- Drain and refill automatic transmission fluid. Replace filter and adjust bands.
- Change rear axle fluid.
- Change front axle fluid (4x4).
- Inspect brake linings.
- Adjust rear brakes.

108,750 Miles (174 000 km)
- Change engine oil and filter.
- Adjust rear brakes.

112,500 Miles (180 000 km)
- Change engine oil and filter.
- Inspect drive belts, replace as necessary.
- Replace fuel filter.
- Adjust rear brakes.

116,250 Miles (186 000 km)
- Change engine oil and filter.
- Adjust rear brakes.

120,000 Miles (192 000 km)
- Change engine oil and filter.
- Inspect fan hub.
- Inspect damper.
- Inspect water pump weep hole for blockage.
- Replace fuel filter.

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GENERAL INFORMATION (Continued)

- Drain and refill automatic transmission fluid. Replace filter and adjust bands.
- Change rear axle fluid.
- Change front axle fluid (4x4).
- Inspect front wheel bearings. Clean and repack if required (4x2).
- Inspect brake linings.
- Adjust rear brakes.

123,750 Miles (198 000 km)

- Change engine oil and filter.
- Adjust rear brakes.

127,500 Miles (204 000 km)

- Change engine oil and filter.
- Replace fuel filter.
- Adjust rear brakes.

131,250 Miles (210 000 km)

- Change engine oil and filter.
- Adjust rear brakes.

135,000 Miles (216 000 km)

- Change engine oil and filter.
- Clean engine air filter canister.
- Inspect drive belts, replace as necessary.
- Inspect water pump weep hole for blockage.
- Replace fuel filter.
- Drain and refill automatic transmission fluid. Replace filter and adjust bands.
- Drain and refill transfer case fluid.
- Change rear axle fluid.
- Change front axle fluid (4x4).
- Inspect brake linings.
- Flush and replace engine coolant.
- Adjust rear brakes.

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COOLING SYSTEM

CONTENTS

GENERAL INFORMATION

COOLING SYSTEM

The cooling system regulates engine operating temperature. It allows the engine to reach normal operating temperature as quickly as possible. It also maintains normal operating temperature and prevents overheating.

The cooling system also provides a means of heating the passenger compartment and cooling the automatic transmission fluid (when A/T equipped). The cooling system is pressurized and uses a centrifugal water pump to circulate coolant throughout the system.

COOLING SYSTEM COMPONENTS

The diesel engine cooling system consists of:

- Cross-flow radiator
- Belt driven water pump
- Belt driven mechanical cooling fan
- Thermal viscous fan drive
- Fan shroud
- Radiator pressure cap
- Vertically mounted thermostat
- Coolant reserve/recovery system
- Transmission oil cooler
- Coolant

COOLING SYSTEM CIRCULATION

Coolant is drawn from the radiator by the water pump. The coolant is then passed through the oil cooler cavity, cooling the engine oil that passes through the engine oil cooler element.

From the oil cooler cavity, the coolant travels through the engine block and circulates around each cylinder bore. The cylinder head gasket is orificed to regulate coolant flow through the cylinder head. Coolant entering the cylinder head on the right side of the block travels through the cylinder head lower cavity, across the valve seat area of the head.

It then joins the coolant entering the head on the left side of the block, which travels through the cylinder head upper cavity, cooling the valve bridges and injector bores. The coolant then travels down the exhaust manifold side of the engine, towards the thermostat. A tap point (fitting) in the cylinder head provides coolant to the cab heater core. This coolant returns from the heater core by way of a transfer pipe that delivers the coolant back to the water pump inlet.

When the engine is below operating temperature, the thermostat is closed, allowing coolant to by-pass the radiator and travel back to the water pump inlet through internal passages in the cylinder head and block.

When the engine reaches operating temperature, the thermostat opens, blocking the by-pass passage to the water pump, and allows coolant to circulate through the radiator.

Coolant flow circuits for the 5.9L diesel engine are shown in (Fig. 1).

COOLANT RESERVE/OVERFLOW SYSTEM

The coolant reserve/overflow system works in conjunction with the radiator pressure cap. It utilizes thermal expansion and contraction of coolant to keep coolant free of trapped air. It provides a volume for expansion and contraction of coolant. Refer to Description and Operation in this group for more information.

COOLANT

The cooling system is designed around the coolant. Coolant flows through the engine water jacket absorbing heat produced during engine operation. The coolant carries the heat to radiator and heater core. Here it is transferred to the ambient air passing through the radiator and heater core fins. The coolant also removes heat from the automatic transmission fluid in vehicles equipped with an automatic transmission.

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GENERAL INFORMATION (Continued)

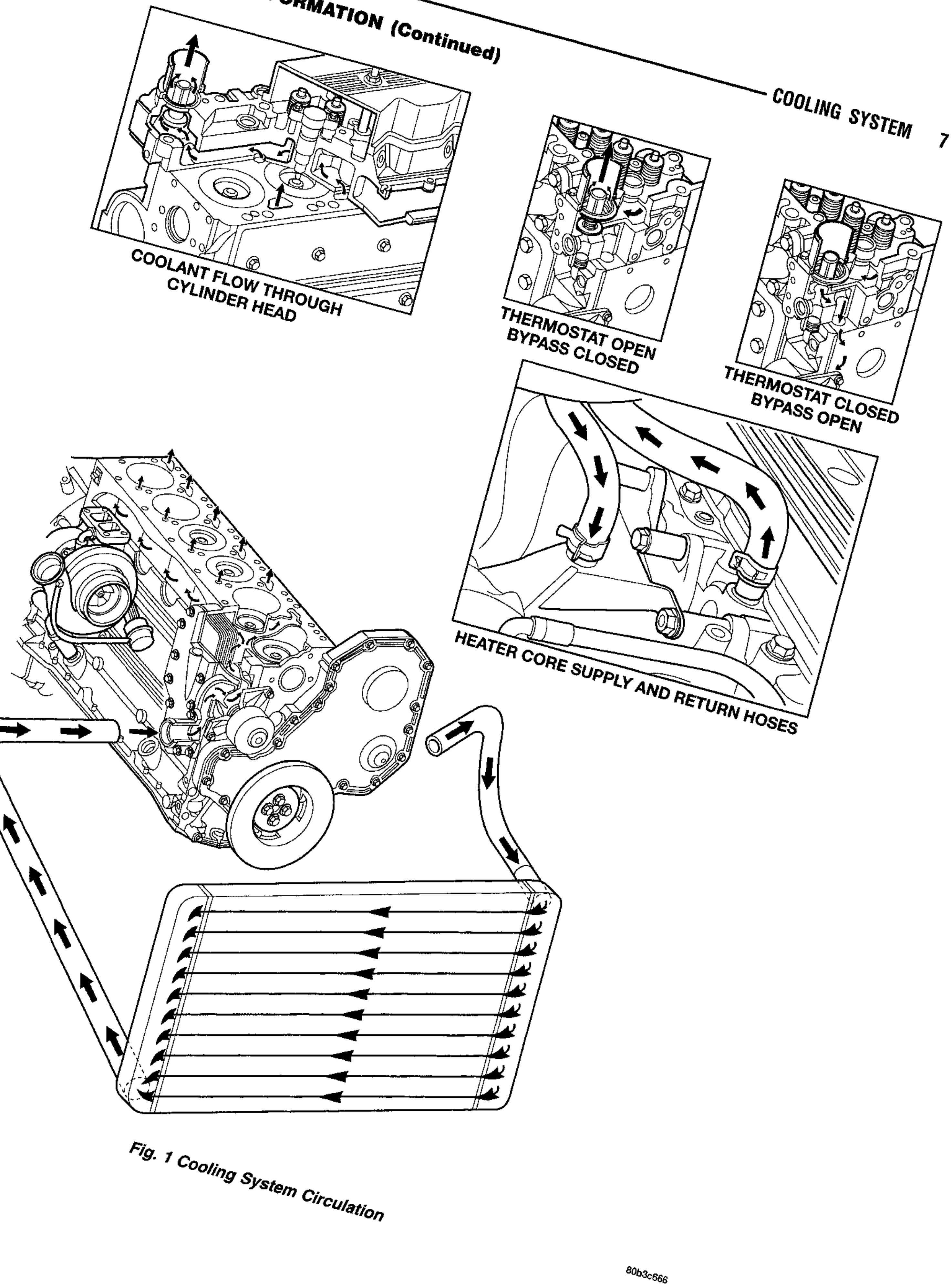

Fig. 1 Cooling System Circulation

GENERAL INFORMATION (Continued)

RADIATOR PRESSURE CAP

Radiators are equipped with a pressure cap, which releases pressure at some point within a range of 97-124 kPa (14-18 psi). The pressure relief point (in pounds) is engraved on top of cap. See Description and Operation in this group for more information.

RADIATOR

The radiator used on the diesel engine is of a cross-flow design with horizontal tubes through the radiator core and vertical side tanks. The radiator consists of an aluminum core and uses brass side tanks.

The radiator supplies sufficient heat transfer to cool the engine and automatic transmission (if equipped).

THERMOSTAT

The thermostat of the 5.9L diesel engine is located in the front of the cylinder head, underneath the water outlet connector (Fig. 2).

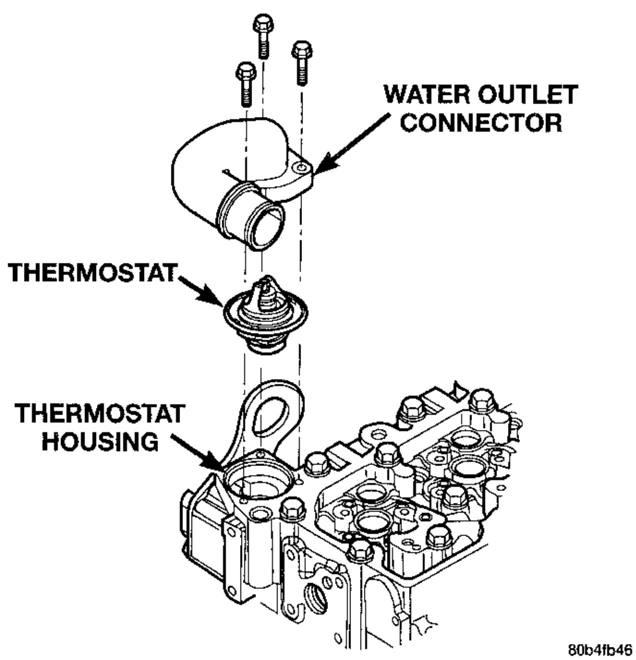

Fig. 2 Thermostat—5.9L Diesel—Typical

The same thermostat is used for winter and summer seasons. An engine should not be operated without a thermostat, except for servicing or testing. Operating without a thermostat causes longer engine warmup time, unreliable warmup performance, increased exhaust emissions and crankcase condensation that can result in sludge formation.

CAUTION: Do not operate an engine without a thermostat, except for servicing or testing. An engine with the thermostat removed will operate in the radiator bypass mode, causing an overheat condition.

ACCESSORY DRIVE BELT AND TENSION

The accessory drive components are driven by a single, crankshaft driven, serpentine accessory drive belt on all engines. An automatic belt tensioner is also used to maintain correct belt tension at all times. This is used on all engines. Refer to Automatic Belt Tensioner proceeding in this group.

Correct accessory drive belt tension is required to be sure of optimum performance of belt driven engine accessories. If specific tension is not maintained, belt slippage may cause; engine overheating, lack of power steering assist, loss of air conditioning capacity, reduced generator output rate and greatly reduced belt life.

It is not necessary to adjust belt tension on the diesel engine because it is equipped with an automatic belt tensioner. The tensioner maintains correct belt tension at all times. For other tensioner information and removal/installation procedures, refer to Accessory Drive Belt Tensioner proceeding in this group. Due to use of this belt tensioner, do not attempt to use a belt tension gauge to measure belt tension.

DESCRIPTION AND OPERATION

THERMOSTAT

The thermostat controls the operating temperature of the engine by controlling the amount of coolant flow to the radiator. When coolant temperature is below 83°C (181°F), the thermostat is closed (Fig. 3).

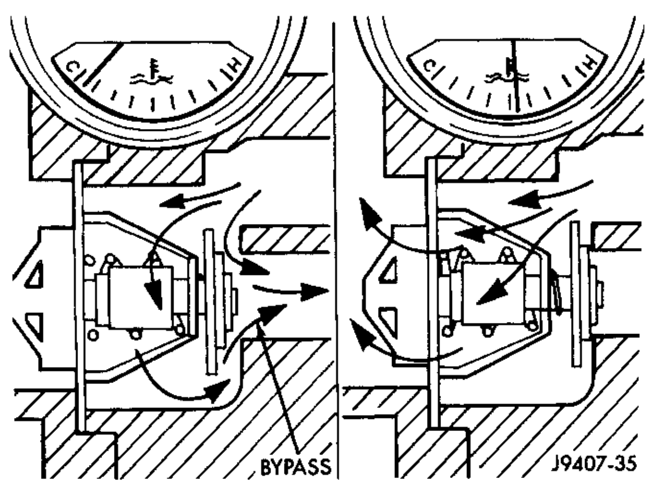

Fig. 3 Thermostat Operation—5.9L Diesel—Typical

DESCRIPTION AND OPERATION (Continued)

The thermostat is vertically mounted and uses caged vent balls (Fig. 4), which act as valves which bleed air from the system. They also quickly vent air when the system is being filled.

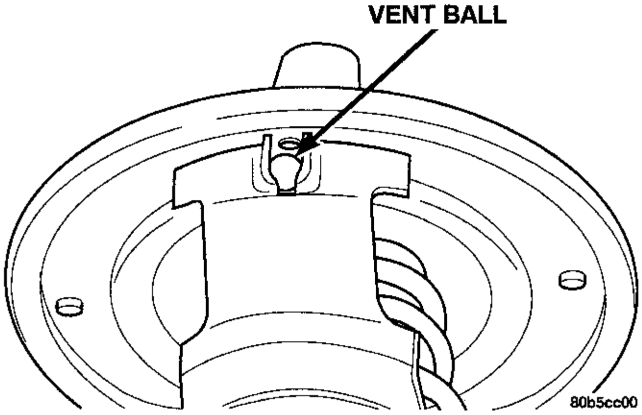

Fig. 4 Thermostat Vent Valve—Typical

When coolant temperature reaches 83°C (181°F), the thermostat begins to open allowing coolant flow to the radiator. This provides quick engine warm-up and overall temperature control. The thermostat is designed to provide a minimum engine operating temperature of 83°C (181°F) and to be fully open for maximum coolant flow at approximately 95°C (203°F). Above 95°C (203°F), coolant temperature is controlled by the radiator, fan and ambient temperature.

AUTOMATIC TRANSMISSION OIL COOLERS

All diesel models equipped with an automatic transmission are equipped with both a main water-to-oil cooler and a separate air-to-oil cooler. Both coolers are supplied as standard equipment on diesel engine powered models when equipped with an automatic transmission.

Transmission oil is cooled when it passes through these coolers.

The main water-to-oil transmission oil cooler is mounted to a bracket on the turbocharger side of the engine (Fig. 5).

The air-to-oil cooler is located in front of and to the left side of the radiator (Fig. 6).

The diesel engine is not equipped with an internal radiator mounted oil cooler.

ACCESSORY DRIVE BELT TENSIONER

Drive belts on all engines are equipped with a spring loaded automatic belt tensioner (Fig. 7). This tensioner maintains constant belt tension at all times and requires no maintenance or adjustment. Refer to Diagnosis and Testing for accessory drive belt and tensioner diagnostic procedures.

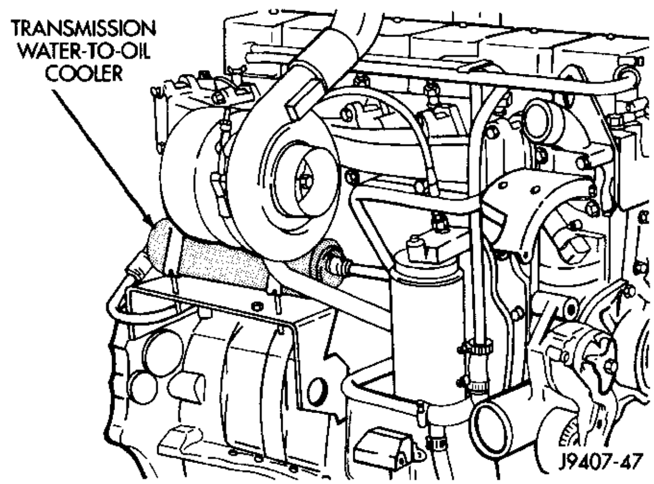

Fig. 5 Transmission Water-To-Oil Cooler—Diesel Engine—Typical

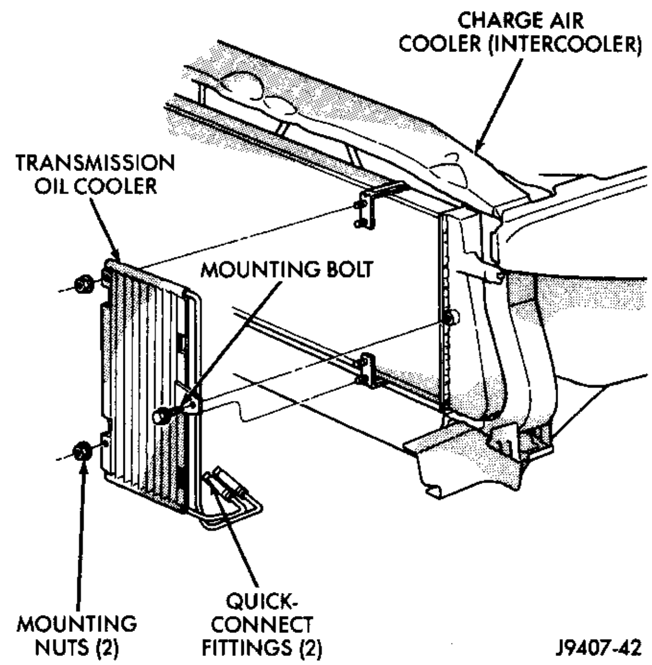

Fig. 6 Auxiliary Transmission Oil Cooler—Diesel Engine

CAUTION: Do not attempt to check belt tension with a belt tension gauge on vehicles equipped with an automatic belt tensioner.

BLOCK HEATER

An optional engine block heater is available on all models. The heater is equipped with a power cord. The cord is attached to an engine compartment component with tie-straps. The heater warms the engine providing easier engine starting and faster warm-up in low temperatures. The heater is mounted in a core hole of the engine cylinder block (in place of a freeze plug) with the heating element immersed in engine

DESCRIPTION AND OPERATION (Continued)

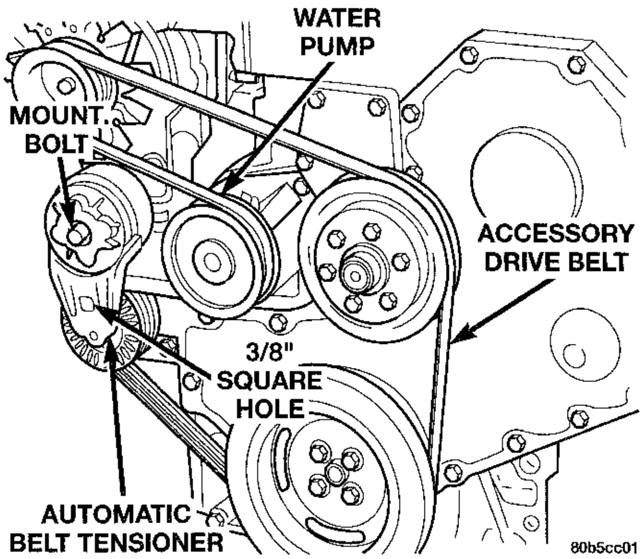

Fig. 7 Belt Tensioner—5.9L Diesel—Typical (non-A/C shown)

coolant. Connect the power cord to a grounded 110-120 volt AC electrical outlet with a grounded three wire extension cord.

WARNING: DO NOT OPERATE ENGINE UNLESS BLOCK HEATER CORD HAS BEEN DISCONNECTED FROM POWER SOURCE AND SECURED IN PLACE. THE POWER CORD MUST BE SECURED IN ITS RETAINING CLIPS AND ROUTED AWAY FROM EXHAUST MANIFOLDS AND MOVING PARTS.

The diesel engine block heater is located on the right side of the engine below the exhaust manifold, threaded into the block next to the oil cooler (Fig. 8).

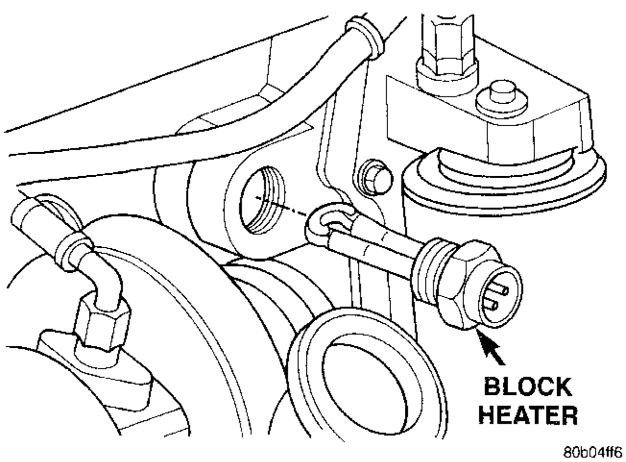

Fig. 8 Engine Block Heater—5.9L Diesel Engine

COOLANT PERFORMANCE

ETHYLENE-GLYCOL MIXTURES

The required ethylene-glycol (antifreeze) and water mixture depends upon the climate and vehicle operating conditions. The recommended mixture of 50/50 ethylene-glycol and water will provide protection against freezing to -37 deg. C (-35 deg. F). The antifreeze concentration **must always** be a minimum of 44 percent, year-round in all climates. **If percentage is lower than 44 percent, engine parts may be eroded by cavitation, and cooling system components may be severely damaged by corrosion.** Maximum protection against freezing is provided with a 68 percent antifreeze concentration, which prevents freezing down to -67.7 deg. C (-90 deg. F). A higher percentage will freeze at a warmer temperature. Also, a higher percentage of antifreeze can cause the engine to overheat because the specific heat of antifreeze is lower than that of water.

100 Percent Ethylene-Glycol—Should Not Be Used in Chrysler Vehicles

Use of 100 percent ethylene-glycol will cause formation of additive deposits in the system, as the corrosion inhibitive additives in ethylene-glycol require the presence of water to dissolve. The deposits act as insulation, causing temperatures to rise to as high as 149 deg. C (300) deg. F). This temperature is hot enough to melt plastic and soften solder. The increased temperature can result in engine detonation. In addition, 100 percent ethylene-glycol freezes at 22 deg. C (-8 deg. F).

Propylene-glycol Formulations—Should Not Be Used in Chrysler Vehicles

Propylene-glycol formulations do not meet Chrysler coolant specifications. It's overall effective temperature range is smaller than that of ethylene-glycol. The freeze point of 50/50 propylene-glycol and water is -32 deg. C (-26 deg. F). 5 deg. C higher than ethylene-glycol's freeze point. The boiling point (protection against summer boil-over) of propylene-glycol is 125 deg. C (257 deg. F) at 96.5 kPa (14 psi), compared to 128 deg. C (263 deg. F) for ethylene-glycol. Use of propylene-glycol can result in boil-over or freeze-up in Chrysler vehicles, which are designed for ethylene-glycol. Propylene glycol also has poorer heat transfer characteristics than ethylene glycol. This can increase cylinder head temperatures under certain conditions.

Propylene-glycol/Ethylene-glycol Mixtures—Should Not Be Used in Chrysler Vehicles

Propylene-glycol/ethylene-glycol Mixtures can cause the destabilization of various corrosion inhibitors, causing damage to the various cooling system

DESCRIPTION AND OPERATION (Continued)

components. Also, once ethylene-glycol and propylene-glycol based coolants are mixed in the vehicle, conventional methods of determining freeze point will not be accurate. Both the refractive index and specific gravity differ between ethylene glycol and propylene glycol.

CAUTION: Richer antifreeze mixtures cannot be measured with normal field equipment and can cause problems associated with 100 percent ethylene-glycol.

COOLANT SELECTION-ADDITIVES

The presence of aluminum components in the cooling system requires strict corrosion protection. Maintain coolant at specified level with a mixture of ethylene glycol based antifreeze and water. Only use an antifreeze containing ALUGARD 340-2 ® such as Mopar Antifreeze. If coolant becomes contaminated or looses color, drain and flush cooling system and fill with correctly mixed solution.

CAUTION: Do not use coolant additives that are claimed to improve engine cooling.

RADIATOR PRESSURE CAP

Radiators are equipped with a pressure cap, which releases pressure at some point within a range of 97-124 kPa (14-18 psi). The pressure relief point (in pounds) is engraved on top of cap.

The cooling system will operate at pressures slightly above atmospheric pressure. This results in a higher coolant boiling point allowing increased radiator cooling capacity. The cap (Fig. 9) contains a spring-loaded pressure relief valve that opens when system pressure reaches release range of 97-124 kPa (14-18 psi).

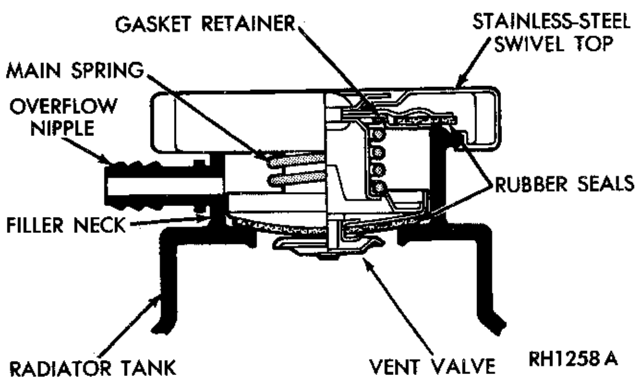

Fig. 9 Radiator Pressure Cap and Filler Neck—Typical

A vent valve in the center of cap allows a small coolant flow through cap when coolant is below boiling temperature. The valve is completely closed when boiling point is reached. As the coolant cools, it contracts and creates a vacuum in the cooling system. This causes the vacuum valve to open and coolant in the reserve/overflow tank to be drawn through its connecting hose into radiator. If the vacuum valve is stuck shut, the radiator hoses will collapse on cool-down. Clean the vent valve (Fig. 9).

A rubber gasket seals radiator filler neck to prevent leakage. This is done to keep system under pressure. It also maintains vacuum during coolant cool-down allowing coolant to return from reserve/overflow tank.

WATER PUMP

The diesel engine water pump draws coolant from radiator outlet and circulates it through engine, heater core and back to radiator inlet. The crankshaft pulley drives the water pump with a serpentine drive belt (Fig. 10). An automatic belt tensioner (Fig. 10) is used to prevent the belt from slipping.

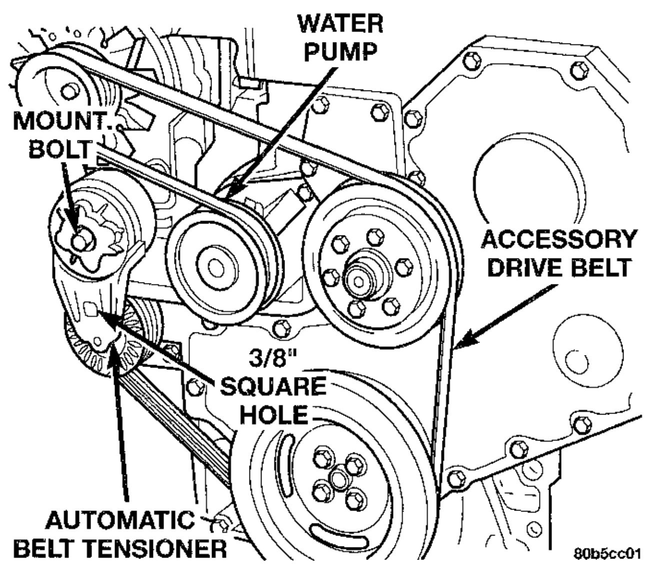

Fig. 10 Water Pump—5.9L Diesel—Typical (non-A/C shown)

COOLING SYSTEM HOSES AND CLAMPS

Rubber hoses route coolant to and from the radiator, intake manifold and heater core. Radiator lower hoses are spring-reinforced to prevent collapse from water pump suction at moderate and high engine speeds.

Inspect the hoses at regular intervals. Replace hoses that are cracked, feel brittle when squeezed or swell excessively when system is pressurized. The use of molded replacement hoses is recommended. When performing a hose inspection, inspect radiator lower hose for proper position and condition of spring.

DESCRIPTION AND OPERATION (Continued)

WARNING: CONSTANT TENSION HOSE CLAMPS ARE USED ON MOST COOLING SYSTEM HOSES. WHEN REMOVING OR INSTALLING, USE ONLY TOOLS DESIGNED FOR SERVICING THIS TYPE OF CLAMP, SUCH AS SPECIAL CLAMP TOOL (NUMBER 6094) (Fig. 11). SNAP-ON CLAMP TOOL (NUMBER HPC-20) MAY BE USED FOR LARGER CLAMPS. ALWAYS WEAR SAFETY GLASSES WHEN SERVICING CONSTANT TENSION CLAMPS.

CAUTION: A number or letter is stamped into the tongue of constant tension clamps (Fig. 12). If replacement is necessary, use only an original equipment clamp with a matching number or letter.

Ordinary worm gear type hose clamps (when equipped) can be removed with a straight screwdriver or a hex socket. **To prevent damage to hoses or clamps, the hose clamps should be tightened to 4 N·m (34 in. lbs.) torque. Do not over tighten hose clamps.**

For all vehicles: In areas where specific routing clamps are not provided, be sure that hoses are positioned with sufficient clearance. Check clearance from exhaust manifolds and pipe, fan blades, drive belts and sway bars. Improperly positioned hoses can be damaged, resulting in coolant loss and engine overheating.

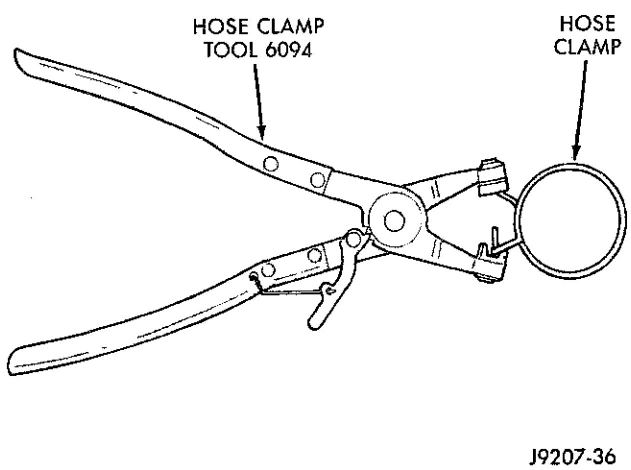

Fig. 11 Hose Clamp Tool—Typical

COOLANT RESERVE/OVERFLOW SYSTEM

The coolant reserve/overflow system works in conjunction with the radiator pressure cap. It utilizes thermal expansion and contraction of coolant to keep coolant free of trapped air. It provides a volume for expansion and contraction of coolant. It also provides a convenient and safe method for checking coolant level and adjusting level at atmospheric pressure. This is done without removing the radiator pressure cap. The system also provides some reserve coolant

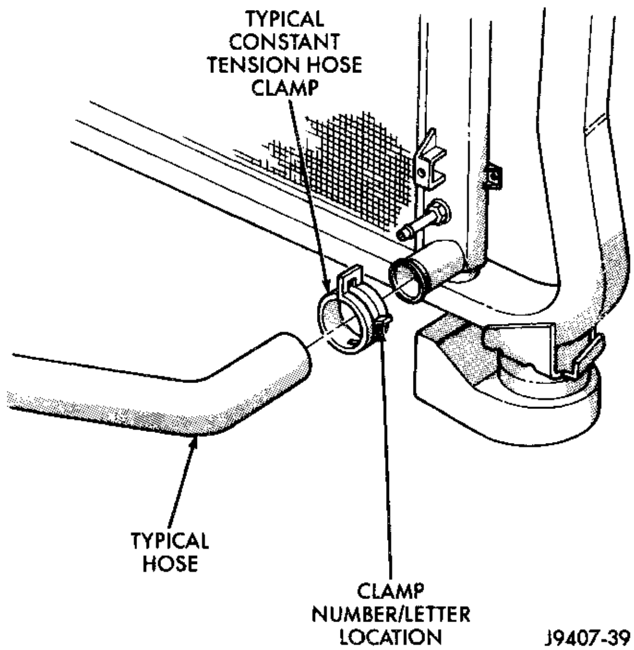

Fig. 12 Clamp Number/Letter Location

to the radiator to cover minor leaks and evaporation or boiling losses.

As the engine cools, a vacuum is formed in the cooling system of both the radiator and engine. Coolant will then be drawn from the coolant tank and returned to a proper level in the radiator.

On the 5.9L diesel engine, the coolant reserve/overflow tank is mounted to the side of the fan shroud (Fig. 13).

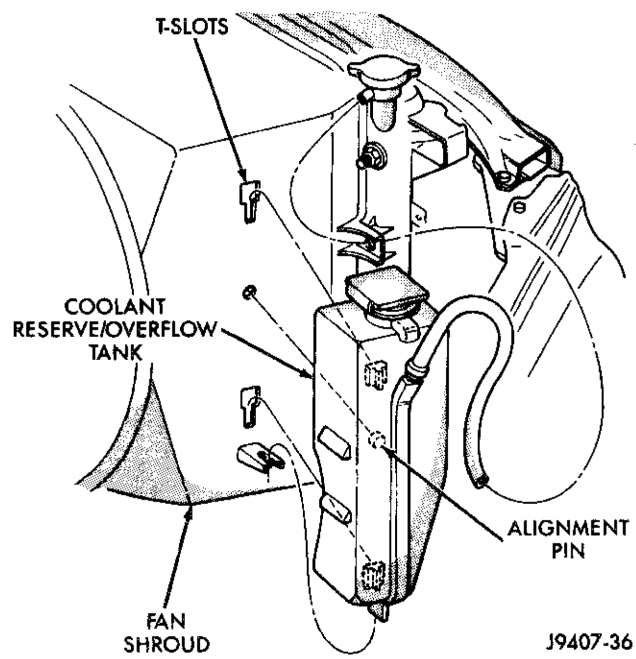

Fig. 13 Coolant Reserve/Overflow Tank

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DESCRIPTION AND OPERATION (Continued)

Refer to Coolant Level Check—Service, Deaeration and Radiator Pressure Cap sections in this group for coolant reserve/overflow system operation and service.

Should the reserve/overflow tank become coated with corrosion, it can be cleaned with detergent and water. Rinse tank thoroughly before refilling cooling system as described in the Coolant section of this group.

VISCOUS FAN DRIVE

The thermal viscous fan drive (Fig. 14) is a silicone-fluid- filled coupling used to connect the fan blades to the water pump shaft. The coupling allows the fan to be driven in a normal manner. This is done at low engine speeds while limiting the top speed of the fan to a predetermined maximum level at higher engine speeds.

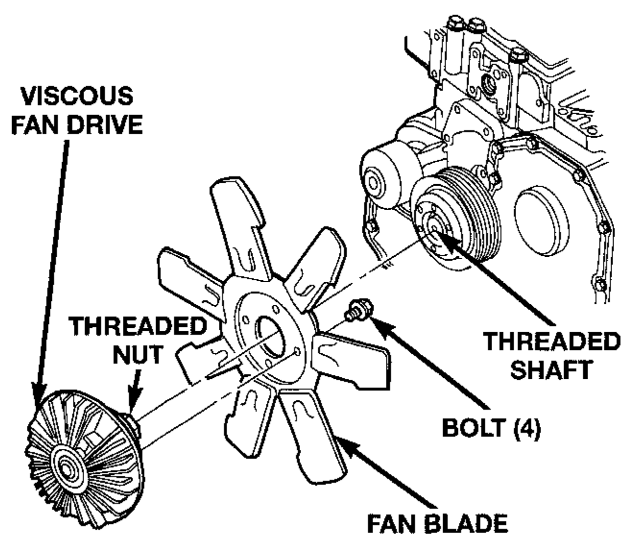

Fig. 14 Viscous Fan/Drive Assembly

A thermostatic bimetallic spring coil is located on the front face of the viscous fan drive unit (a typical viscous unit is shown in (Fig. 15). This spring coil reacts to the temperature of the radiator discharge air. It engages the viscous fan drive for higher fan speed if the air temperature from the radiator rises above a certain point. Until additional engine cooling is necessary, the fan will remain at a reduced rpm regardless of engine speed.

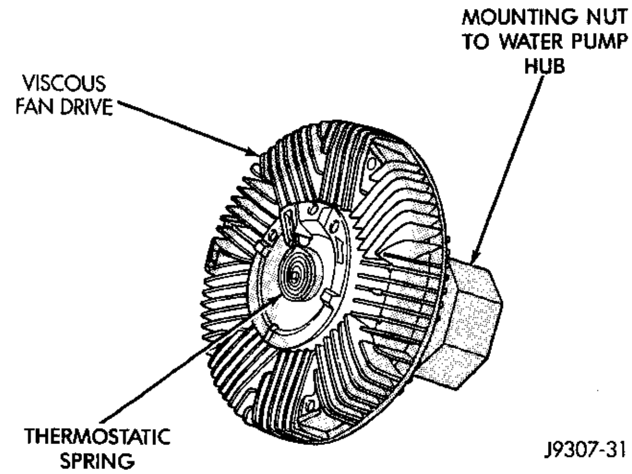

Fig. 15 Viscous Fan Drive—Typical

Only when sufficient heat is present, will the viscous fan drive engage. This is when the air flowing through the radiator core causes a reaction to the bimetallic coil. It then increases fan speed to provide the necessary additional engine cooling.

Once the engine has cooled, the radiator discharge temperature will drop. The bimetallic coil again reacts and the fan speed is reduced to the previous disengaged speed.

CAUTION: If the viscous fan drive is replaced because of mechanical damage, the cooling fan blades should also be inspected. Inspect for fatigue cracks, loose blades, or loose rivets that could have resulted from excessive vibration. Replace fan blade assembly if any of these conditions are found. Also inspect water pump bearing and shaft assembly for any related damage due to a viscous fan drive malfunction.

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DIAGNOSIS AND TESTING

PRELIMINARY CHECKS

ENGINE COOLING SYSTEM OVERHEATING

Establish what driving conditions caused the complaint. Abnormal loads on the cooling system such as the following may be the cause:

(1) PROLONGED IDLE, VERY HIGH AMBIENT TEMPERATURE, SLIGHT TAIL WIND AT IDLE, SLOW TRAFFIC, TRAFFIC JAMS, HIGH SPEED OR STEEP GRADES.

Driving techniques that avoid overheating are:

• Idle with A/C off when temperature gauge is at end of normal range.

• Increasing engine speed for more air flow is recommended.

(2) TRAILER TOWING:

Consult Trailer Towing section of owners manual. Do not exceed limits.

(3) AIR CONDITIONING; ADD-ON OR AFTER MARKET:

A maximum cooling package should have been ordered with vehicle if add-on or after market A/C is installed. If not, maximum cooling system components should be installed for model involved per manufacturer's specifications.

(4) RECENT SERVICE OR ACCIDENT REPAIR:

Determine if any recent service has been performed on vehicle that may effect cooling system. This may be:

• Engine adjustments (incorrect timing)

• Slipping engine accessory drive belt(s)

• Brakes (possibly dragging)

• Changed parts. Incorrect water pump or pump rotating in wrong direction due to belt not correctly routed

• Reconditioned radiator or cooling system refilling (possibly under filled or air trapped in system).

NOTE: If investigation reveals none of the previous items as a cause for an engine overheating complaint, refer to following Cooling System Diagnosis charts.

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DIAGNOSIS AND TESTING (Continued)

COOLING SYSTEM DIAGNOSIS

COOLING SYSTEM DIAGNOSIS—DIESEL ENGINE

CONDITION	POSSIBLE CAUSES	CORRECTION
TEMPERATURE GAUGE READS LOW	1. Diesel engines, due to their inherent efficiency are slower to warm up than gasoline powered engines, and will operate at lower temperatures when the vehicle is unloaded.	1. The low gauge reading may be normal. Refer to thermostats in the manual text for information. See Thermostat Diagnosis - Diesel Engine.
	2. Is the temperature gauge connected to the temperature gauge coolant sensor on the engine?	2. Check the engine temperature sensor connector in the engine compartment. Refer to Group 8E. Repair as necessary.
	3. Is the temperature gauge operating OK?	3. Check gauge operation. Refer to Group 8E. Repair as necessary.
	4. Coolant level low in cold ambient temperatures accompanied with poor heater performance.	4. Check coolant level in the coolant reserve/overflow tank and the radiator. Inspect system for leaks. Repair leaks as necessary. Refer to the Coolant section of the manual text for WARNINGS and precautions before removing the radiator cap.
	5. Improper operation of internal heater doors or heater controls.	5. Inspect heater and repair as necessary. Refer to Group 24, Heating and Air Conditioning for procedures.
TEMPERATURE GAUGE READS HIGH. COOLANT MAY OR MAY NOT BE LOST OR LEAKING FROM COOLING SYSTEM	1. Trailer is being towed, a steep hill is being climbed, vehicle is operated in slow moving traffic, or engine is being idled with very high ambient (outside) temperatures and the air conditioning is on. Higher altitudes could aggravate these conditions.	1. This may be a temporary condition and repair is not necessary. Turn off the air conditioning and attempt to drive the vehicle without any of the previous conditions. Observe the temperature gauge. The gauge should return to the normal range. If the gauge does not return to normal range, determine the cause for overheating and repair. Refer to POSSIBLE CAUSES (numbers 2 through 17).
	2. Is temperature gauge reading correctly?	2. Check gauge. Refer to Group 8E. Repair as necessary.
	3. Coolant low in coolant reserve/overflow tank and radiator?	3. Check for coolant leaks and repair as necessary. Refer to Testing Cooling System For Leaks in this group.
	4. Pressure cap not installed tightly. If cap is loose, boiling point of coolant will be lowered. Also refer to the following step 5.	4. Tighten cap.
	5. Poor seals at radiator cap.	5. (a) Check condition of cap and cap seals. Refer to Radiator Cap. Replace cap if necessary. (b) Check condition of radiator filler neck. If neck is bent or damaged, replace radiator.

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DIAGNOSIS AND TESTING (Continued)

COOLING SYSTEM DIAGNOSIS—DIESEL ENGINE—CONTINUED

CONDITION	POSSIBLE CAUSES	CORRECTION
TEMPERATURE GAUGE READS HIGH. COOLANT MAY OR MAY NOT BE LOST OR LEAKING FROM COOLING SYSTEM - CONT.	6. Coolant level low in radiator but not in coolant reserve/overflow tank. This means the radiator is not drawing coolant from the coolant reserve/overflow tank as the engine cools. As the engine cools, a vacuum is formed in the cooling system of the engine and radiator. If radiator cap seals are defective, or cooling system has leaks, a vacuum can not be formed.	6. (a) Check condition of radiator cap and cap seals. Refer to Radiator Cap in this group. Replace cap if necessary. (b) Check condition of radiator filler neck. If neck is bent or damaged, replace radiator. (c) Check the condition of the hose from the radiator to the coolant tank. It should fit tight at both ends without any kinks or tears. Replace hose if necessary. (d) Check coolant reserve/overflow tank and tank hoses for blockage. Repair as necessary.
	7. Freeze point of antifreeze not correct. Mixture may be too rich.	7. Check antifreeze. Refer to Coolant section of this group. Adjust antifreeze-to-water ratio as required.
	8. Coolant not flowing through system.	8. Check for coolant flow at radiator filler neck with some coolant removed, engine warm and thermostat open. Coolant should be observed flowing through radiator. If flow is not observed, determine reason for lack of flow and repair as necessary.
	9. Radiator or A/C condenser fins are dirty or clogged.	9. Clean insects or debris. Refer to Radiator Cleaning in this group.
	10. Radiator core is corroded or plugged.	10. Have radiator re-cored or replaced.
	11. Aftermarket A/C installed without proper radiator.	11. Install proper radiator.
	12. Dragging brakes.	12. Check and correct as necessary. Refer to Group 5, Brakes in the manual text.
	13. Bug screen is being used reducing airflow.	13. Remove bug screen.
	14. Thermostat partially or completely shut. This is more prevalent on high mileage vehicles.	14. Check thermostat operation and replace as necessary. Refer to Thermostats in this group.
	15. Thermal viscous fan drive not operating properly.	15. Check fan drive operation and replace if necessary. Refer to Viscous Fan Drive in this group.
	16. Cylinder head gasket leaking.	16. Check for cylinder head gasket leaks. Refer to Testing Cooling System For Leaks in this group. For repair, refer to Group 9, Engines.
	17. Heater core leaking.	17. Check heater core for leaks. Refer to Group 24, Heating and Air Conditioning. Repair as necessary.

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DIAGNOSIS AND TESTING (Continued)

COOLING SYSTEM DIAGNOSIS—DIESEL ENGINE—CONTINUED

CONDITION	POSSIBLE CAUSES	CORRECTION
TEMPERATURE GAUGE READING IS INCONSISTENT (FLUCTUATES, CYCLES OR IS ERRATIC)	1. During cold weather operation, with the heater blower in the high position, the gauge reading may drop slightly. Fluctuation is also influenced by loads, outside temperature and extended idle time with diesel engines.	1. A normal condition. No correction is necessary.
	2. Temperature gauge or engine mounted gauge sensor defective or shorted. Also, corroded or loose wiring in this circuit.	2. Check operation of gauge and repair if necessary. Refer to Group 8E, Instrument Panel And Gauges.
	3. Gauge reading rises when vehicle is brought to a stop after heavy use (engine still running).	3. A normal condition. No correction is necessary. Gauge reading should return to normal range after vehicle is driven.
	4. Gauge reading high after re-starting a warmed-up (hot) engine.	4. A normal condition. No correction is necessary. The gauge should return to normal range after a few minutes of engine operation.
	5. Coolant level low in radiator (air will build up in the cooling system causing the thermostat to open late).	5. Check and correct coolant leaks. Refer to Testing Cooling System For Leaks in this group.
	6. Cylinder head gasket leaking allowing exhaust gas to enter cooling system causing thermostat to open late.	6. (a) Check for cylinder head gasket leaks with a commercially available Block Leak Tester. Repair as necessary. (b) Check for coolant in the engine oil. Inspect for white steam emitting from exhaust system. Repair as necessary.
	7. Water pump impeller loose on shaft.	7. Check water pump and replace as necessary. Refer to Water Pumps in this group.
	8. Loose accessory drive belt (water pump slipping).	8. Refer to Engine Accessory Drive Belts in this group. Check and correct as necessary.
	9. Air leak on the suction side of water pump allows air to build up in cooling system causing thermostat to open late.	9. Locate leak and repair as necessary.
PRESSURE CAP IS BLOWING OFF STEAM AND/OR COOLANT TO COOLANT TANK. TEMPERATURE GAUGE READING MAY BE ABOVE NORMAL BUT NOT HIGH. COOLANT LEVEL MAY BE HIGH IN COOLANT RESERVE/OVERFLOW TANK	1. Pressure relief valve in radiator cap is defective.	1. Check condition of radiator cap and cap seals. Refer to Radiator Caps in this group. Replace cap as necessary.
COOLANT LOSS TO THE GROUND WITHOUT PRES-SURE CAP BLOWOFF. GAUGE IS READING HIGH OR HOT	1. Coolant leaks in radiator, cooling system hoses, water pump or engine.	1. Pressure test and repair as necessary. Refer to Testing Cooling System For Leaks in this group.

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DIAGNOSIS AND TESTING (Continued)

COOLING SYSTEM DIAGNOSIS—DIESEL ENGINE—CONTINUED

CONDITION	POSSIBLE CAUSES	CORRECTION
HOSE OR HOSES COLLAPSE WHEN ENGINE IS COOLING	1. Vacuum created in cooling system on engine cool-down is not being relieved through coolant reserve/overflow system.	1. (a) Radiator cap relief valve stuck. Refer to Radiator Cap in this group. Replace if necessary. (b) Hose between coolant reserve/overflow tank and radiator is kinked. Repair as necessary. (c) Vent at coolant reserve/overflow tank is plugged. Clean vent and repair as necessary. (d) Reserve/overflow tank is internally blocked or plugged. Check for blockage and repair as necessary.
NOISY FAN	1. Fan blades loose.	1. Replace fan blade assembly. Refer to Cooling System Fans in this group.
	2. Fan blades striking a surrounding object.	2. Locate point of fan blade contact and repair as necessary.
	3. Air obstructions at radiator or air conditioning condenser.	3. Remove obstructions and/or clean debris or insects from radiator or A/C condenser.
	4. Thermal viscous fan drive has defective bearing.	4. Replace fan drive. Bearing is not serviceable. Refer to Viscous Fan Drive in this group.
	5. A certain amount of fan noise (roaring) may be evident on models equipped with a thermal viscous fan drive. Some of this noise is normal.	5. Refer to Viscous Fan Drive in this group for an explanation of normal fan noise.
INADEQUATE AIR CONDITIONER PERFORMANCE (COOLING SYSTEM SUSPECTED)	1. Radiator and/or A/C condenser is restricted, obstructed or dirty (insects, leaves etc.).	1. Remove restriction and/or clean as necessary. Refer to Radiator Cleaning in this group.
	2. Thermal viscous fan drive is free-wheeling.	2. Refer to Viscous Fan Drive for diagnosis. Repair as necessary.
	3. Engine is overheating (heat may be transferred from radiator to A/C condenser. High underhood temperatures due to engine overheating may also transfer heat to A/C components).	3. Correct overheating condition. Refer to text in Group 7, Cooling.
	4. Some models with certain engines are equipped with air seals at the radiator and/or A/C condenser. If these seals are missing or damaged, not enough air flow will be pulled through the radiator and A/C condenser.	4. Check for missing or damaged air seals and repair as necessary.

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DIAGNOSIS AND TESTING (Continued)

COOLING SYSTEM DIAGNOSIS—DIESEL ENGINE—CONTINUED

CONDITION	POSSIBLE CAUSES	CORRECTION
INADEQUATE HEATER PERFORMANCE. MAY BE ACCOMPANIED BY LOW GAUGE READING	1. Diesel engines, due to their inherent efficiency are slower to warm up than gasoline powered engines, and will operate at lower temperatures when the vehicle is unloaded.	1. The low gauge reading may be normal. Refer to Thermostats in the manual text for information. See Thermostat Diagnosis - Diesel Engine.
	2. Coolant level low.	2. Refer to Testing Cooling System For Leaks in the manual text. Repair as necessary.
	3. Obstructions in heater hose fittings at engine.	3. Remove heater hoses at both ends and check for obstructions. Repair as necessary.
	4. Heater hose kinked.	4. Locate kinked area and repair as necessary.
	5. Water pump is not pumping water to heater core. When the engine is fully warmed up, both heater hoses should be hot to the touch. If only one of the hoses is hot, the water pump may not be operating correctly. The accessory drive belt may also be slipping causing poor water pump operation.	5. Refer to Water Pumps in this group. Repair as necessary. If a slipping belt is detected, refer to Engine Accessory Drive Belts in this group. Repair as necessary.
HEAT ODOR	1. Various heat shields are used at certain drive line components. One or more of these shields may be missing.	1. Locate missing shields and replace or repair as necessary.
	2. Is temperature gauge reading above the normal range?	2. Refer to the previous Temperature Gauge Reads High in these Diagnosis Charts. Repair as necessary.
	3. Is cooling fan operating correctly?	3. Refer to Cooling System Fan in this group for diagnosis. Repair as necessary.
	4. Has undercoating been applied to any unnecessary component?	4. Clean undercoating as necessary.

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DIAGNOSIS AND TESTING (Continued)

COOLING SYSTEM DIAGNOSIS—DIESEL ENGINE—CONTINUED

Condition	Possible Causes	Correction
STEAM IS COMING FROM FRONT OF VEHICLE NEAR GRILL AREA WHEN WEATHER IS WET, ENGINE IS WARMED UP AND RUNNING, AND VEHICLE IS STATIONARY. TEMPERATURE GAUGE IS IN NORMAL RANGE	1. During wet weather, moisture (snow, ice or rain condensation) on the radiator will evaporate when the thermostat opens. This opening allows heated water into the radiator. When the moisture contacts the hot radiator, steam may be emitted. This usually occurs in cold weather with no fan or airflow to blow it away.	1. Occasional steam emitting from this area is normal. No repair is necessary.
COOLANT COLOR	1. Coolant color is not necessarily an indication of adequate corrosion or temperature protection. Do not rely on coolant color for determining condition of coolant.	1. Refer to Coolant in this group for antifreeze tests. Adjust antifreeze-to-water ratio as necessary.
COOLANT LEVEL CHANGES IN COOLANT RESERVE/ OVERFLOW TANK. TEMPERATURE GAUGE IS IN NORMAL RANGE	1. Level changes are to be expected as coolant volume fluctuates with engine temperature. If the level in the tank was between the FULL and ADD marks at normal engine operating temperature, the level should return to within that range after operation at elevated temperatures.	1. A normal condition. No repair is necessary.

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DIAGNOSIS AND TESTING (Continued)

RADIATOR COOLANT FLOW TEST

Use the following procedure to determine if coolant is flowing through the cooling system.

(1) Idle engine until operating temperature is reached. If the upper radiator hose is warm to the touch, the thermostat is opening and coolant is flowing to the radiator.

WARNING: HOT, PRESSURIZED COOLANT CAN CAUSE INJURY BY SCALDING. USING A RAG TO COVER THE RADIATOR PRESSURE CAP, OPEN RADIATOR CAP SLOWLY TO THE FIRST STOP. THIS WILL ALLOW ANY BUILT-UP PRESSURE TO VENT TO THE RESERVE/OVERFLOW TANK. AFTER PRESSURE BUILD-UP HAS BEEN RELEASED, REMOVE CAP FROM FILLER NECK.

(2) Drain a small amount of coolant from the radiator until the ends of the radiator tubes are visible through the filler neck. Idle the engine at normal operating temperature. If coolant is flowing past the exposed tubes, the coolant is circulating.

TESTING COOLING SYSTEM FOR LEAKS

PRESSURE TESTER METHOD

The engine should be at normal operating temperature. Recheck the system cold if cause of coolant loss is not located during the warm engine examination.

WARNING: HOT, PRESSURIZED COOLANT CAN CAUSE INJURY BY SCALDING.

Carefully remove radiator pressure cap from filler neck and check coolant level. Push down on cap to disengage it from stop tabs. Wipe inside of filler neck and examine lower inside sealing seat for nicks, cracks, paint, dirt and solder residue. Inspect radiator-to- reserve/overflow tank hose for internal obstructions. Insert a wire through the hose to be sure it is not obstructed.

Inspect cams on outside of filler neck. If cams are bent, seating of pressure cap valve and tester seal will be affected. Replace cap if cams are bent.

Attach pressure tester (7700 or an equivalent) to radiator filler neck (Fig. 16).

Operate tester pump to apply 103.4 kPa (15 psi) pressure to system. If hoses enlarge excessively or bulges while testing, replace as necessary. Observe gauge pointer and determine condition of cooling system according to following criteria:

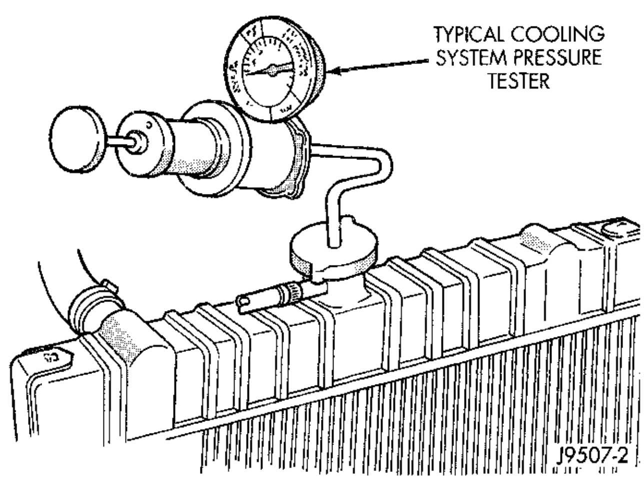

Fig. 16 Pressure Testing Cooling System—Typical

Holds Steady: If pointer remains steady for two minutes, serious coolant leaks are not present in system. However, there could be an internal leak that does not appear with normal system test pressure. If it is certain that coolant is being lost and leaks cannot be detected, inspect for interior leakage or perform Internal Leakage Test.

Drops Slowly: Indicates a small leak or seepage is occurring. Examine all connections for seepage or slight leakage with a flashlight. Inspect radiator, hoses, gasket edges and heater. Seal small leak holes with a sealer lubricant (or equivalent). Repair leak holes and inspect system again with pressure applied.

Drops Quickly: Indicates that serious leakage is occurring. Examine system for external leakage. If leaks are not visible, inspect for internal leakage. Large radiator leak holes should be repaired by a reputable radiator repair shop.

ULTRAVIOLET LIGHT METHOD

A leak detection additive is available through the parts department that can be added to cooling system. The additive is highly visible under ultraviolet light (black light). Pour one ounce of additive into cooling system. Place heater control unit in HEAT position. Start and operate engine until radiator upper hose is warm to touch. Aim the commercially available black light tool at components to be checked. If leaks are present, black light will cause additive to glow a bright green color.

DIAGNOSIS AND TESTING (Continued)

The black light can be used in conjunction with a pressure tester to determine if any external leaks exist (Fig. 17).

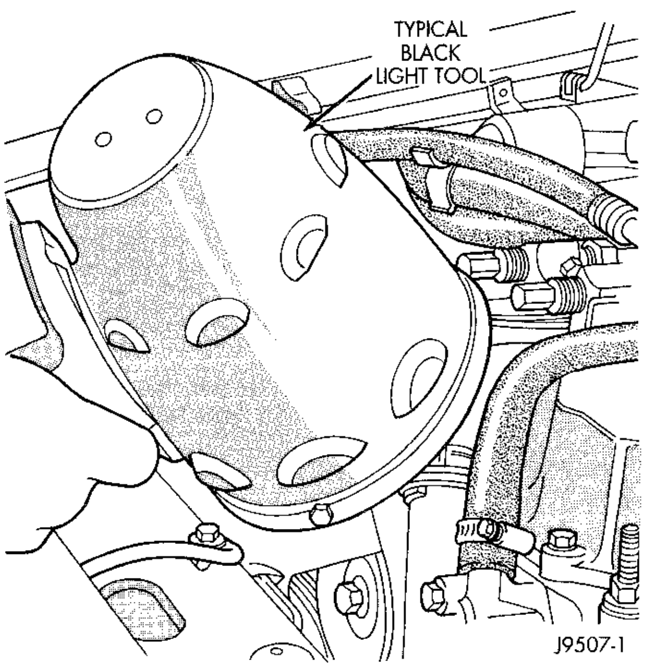

Fig. 17 Leak Detection Using Black Light—Typical

INTERNAL LEAKAGE TEST

Remove engine oil pan drain plug and drain a small amount of engine oil. If coolant is present in the pan, it will drain first because it is heavier than oil. An alternative method is to operate engine for a short period to churn the oil. After this is done, remove engine dipstick and inspect for water globules. Also inspect transmission dipstick for water globules and transmission fluid cooler for leakage.

WARNING: WITH COOLING SYSTEM PRESSURE TESTER TOOL INSTALLED ON RADIATOR, DO NOT ALLOW PRESSURE TO EXCEED 110 KPA (20 PSI). PRESSURE WILL BUILD UP QUICKLY IF A COMBUSTION LEAK IS PRESENT. TO RELEASE PRESSURE, ROCK TESTER FROM SIDE TO SIDE. WHEN REMOVING TESTER, DO NOT TURN TESTER MORE THAN 1/2 TURN IF SYSTEM IS UNDER PRESSURE.

Operate engine without pressure cap on radiator until thermostat opens. Attach a pressure tester to filler neck. If pressure builds up quickly it indicates a combustion leak exists. This is usually the result of a cylinder head gasket leak or crack in engine. Repair as necessary.

If there is not an immediate pressure increase, pump the pressure tester. Do this until indicated pressure is within system range of 110 kPa (16 psi). Fluctuation of gauge pointer indicates compression or combustion leakage into cooling system.

Because the vehicle is equipped with a catalytic converter, **do not** remove spark plug cables or short out cylinders (non-diesel engines) to isolate compression leak.

If the needle on dial of pressure tester does not fluctuate, race engine a few times to check for an abnormal amount of coolant or steam. This would be emitting from exhaust pipe. Coolant or steam from exhaust pipe may indicate a faulty cylinder head gasket, cracked engine cylinder block or cylinder head.

A convenient check for exhaust gas leakage into cooling system is provided by a commercially available Block Leak Check tool. Follow manufacturers instructions when using this product.

COMBUSTION LEAKAGE TEST—WITHOUT PRESSURE TESTER

DO NOT WASTE reusable coolant. If solution is clean, drain coolant into a clean container for reuse.

WARNING: DO NOT REMOVE CYLINDER BLOCK DRAIN PLUGS OR LOOSEN RADIATOR DRAINCOCK WITH SYSTEM HOT AND UNDER PRESSURE. SERIOUS BURNS FROM COOLANT CAN OCCUR.

Drain sufficient coolant to allow thermostat removal. Refer to Thermostat Replacement. Disconnect water pump drive belt.

Add coolant to radiator to bring level to within 6.3 mm (1/4 in) of top of thermostat housing.

CAUTION: Avoid overheating. Do not operate engine for an excessive period of time. Open draincock immediately after test to eliminate boil over.

Start engine and accelerate rapidly three times, to approximately 3000 rpm (2000 rpm for diesel) while observing coolant. If internal engine combustion gases are leaking into cooling system, bubbles will appear in coolant. If bubbles do not appear, internal combustion gas leakage is not present.

VISCOUS FAN DRIVE

NOISE

It is normal for fan noise to be louder (roaring) when:

• The underhood temperature is above the engagement point for the viscous drive coupling. This may occur when ambient (outside air temperature) is very high.

• Engine loads and temperatures are high such as when towing a trailer.

• Cool silicone fluid within the fan drive unit is being redistributed back to its normal disengaged (warm) position. This can occur during the first 15 seconds to one minute after engine start-up on a cold engine.

DIAGNOSIS AND TESTING (Continued)

LEAKS

Viscous fan drive operation is not affected by small oil stains near the drive bearing. If leakage appears excessive, replace the fan drive unit.

TESTING

If the fan assembly free-wheels without drag (the fan blades will revolve more than five turns when spun by hand), replace the fan drive. This spin test must be performed when the engine is cool.

For the following test, the cooling system must be in good condition. It also will ensure against excessively high coolant temperature.

WARNING: BE SURE THAT THERE IS ADEQUATE FAN BLADE CLEARANCE BEFORE DRILLING.

(1) Drill a 3.18-mm (1/8-in) diameter hole in the top center of the fan shroud.

(2) Obtain a dial thermometer with an 8 inch stem (or equivalent). It should have a range of -18°-to-105°C (0°-to-220° F). Insert thermometer through the hole in the shroud. Be sure that there is adequate clearance from the fan blades.

(3) Connect a tachometer and an engine ignition timing light. The timing light is to be used as a strobe light. This step cannot be used on the diesel engine.

(4) Block the air flow through the radiator. Secure a sheet of plastic in front of the radiator (or air conditioner condenser). Use tape at the top to secure the plastic and be sure that the air flow is blocked.

(5) Be sure that the air conditioner (if equipped) is turned off.

WARNING: USE EXTREME CAUTION WHEN THE ENGINE IS OPERATING. DO NOT STAND IN A DIRECT LINE WITH THE FAN. DO NOT PUT YOUR HANDS NEAR THE PULLEYS, BELTS OR FAN. DO NOT WEAR LOOSE CLOTHING.

(6) Start the engine and operate at 1500 rpm. Within ten minutes the air temperature (indicated on the dial thermometer) should be up to 88° C (190° F). Fan drive **engagement** should start to occur at/between 71° to 82° C (160° to 179° F)

Engagement is distinguishable by a definite **increase** in fan flow noise (roaring). The timing light also will indicate an increase in the speed of the fan (non-diesel only).

(7) When viscous drive engagement is verified, remove the plastic sheet. Fan drive **disengagement** should start to occur at between 57° to 79° C (135° to 175° F). A definite **decrease** of fan flow noise (roaring) should be noticed. If not, replace the defective viscous fan drive unit.

CAUTION: If the viscous fan drive is replaced because of mechanical damage, the cooling fan blades should also be inspected. Inspect for fatigue cracks, loose blades, or loose rivets that could have resulted from excessive vibration. Replace fan blade assembly if any of these conditions are found. Also inspect water pump bearing and shaft assembly for any related damage due to a viscous fan drive malfunction.

ACCESSORY DRIVE BELT DIAGNOSIS

VISUAL DIAGNOSIS

When diagnosing serpentine accessory drive belts, small cracks that run across the ribbed surface of the belt from rib to rib (Fig. 18), are considered normal. These are not a reason to replace the belt. However, cracks running along a rib (not across) are **not** normal. Any belt with cracks running along a rib must be replaced (Fig. 18). Also replace the belt if it has excessive wear, frayed cords or severe glazing.

Refer to the Accessory Drive Belt Diagnosis charts for further belt diagnosis.

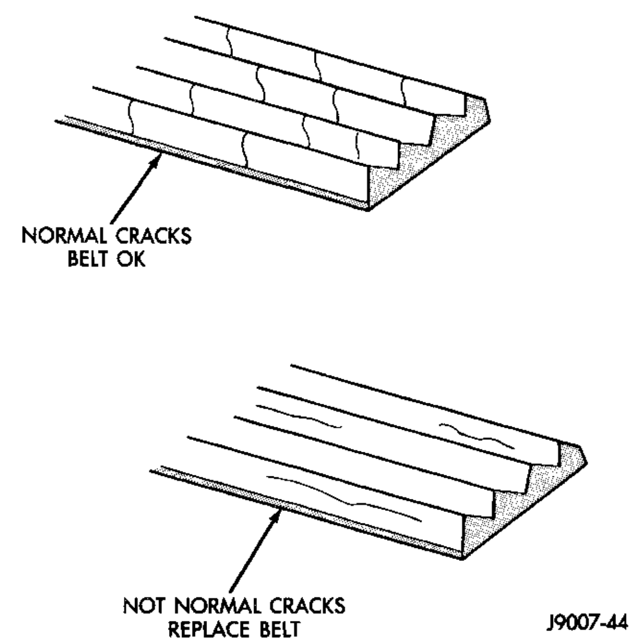

Fig. 18 Belt Wear Patterns

NOISE DIAGNOSIS

Noises generated by the accessory drive belt are most noticeable at idle. Before replacing a belt to resolve a noise condition, inspect all of the accessory drive pulleys for alignment, glazing, or excessive end play.

DIAGNOSIS AND TESTING (Continued)

ACCESSORY DRIVE BELT DIAGNOSIS CHART

CONDITION	POSSIBLE CAUSES	CORRECTION
RIB CHUNKING (One or more ribs has separated from belt body)	1. Foreign objects imbedded in pulley grooves.	1. Remove foreign objects from pulley grooves. Replace belt.
	2. Installation damage	2. Replace belt
RIB OR BELT WEAR	1. Pulley misaligned	1. Align pulley(s)
	2. Abrasive environment	2. Clean pulley(s). Replace belt if necessary
	3. Rusted pulley(s)	3. Clean rust from pulley(s)
	4. Sharp or jagged pulley groove tips	4. Replace pulley. Inspect belt.
	5. Belt rubber deteriorated	5. Replace belt
BELT SLIPS	1. Belt slipping because of insufficient tension	1. Inspect/Replace tensioner if necessary
	2. Belt or pulley exposed to substance that has reduced friction (belt dressing, oil, ethylene glycol)	2. Replace belt and clean pulleys
	3. Driven component bearing failure (seizure)	3. Replace faulty component or bearing
	4. Belt glazed or hardened from heat and excessive slippage	4. Replace belt.
LONGITUDAL BELT CRACKING	1. Belt has mistracked from pulley groove	1. Replace belt
	2. Pulley groove tip has worn away rubber to tensile member	2. Replace belt
"GROOVE JUMPING" (Belt does not maintain correct position on pulley)	1. Incorrect belt tension	1. Inspect/Replace tensioner if necessary
	2. Pulley(s) not within design tolerance	2. Replace pulley(s)
	3. Foreign object(s) in grooves	3. Remove foreign objects from grooves
	4. Pulley misalignment	4. Align component
	5. Belt cordline is broken	5. Replace belt
BELT BROKEN (Note: Identify and correct problem before new belt is installed)	1. Incorrect belt tension	1. Replace Inspect/Replace tensioner if necessary
	2. Tensile member damaged during belt installation	2. Replace belt
	3. Severe misalignment	3. Align pulley(s)
	4. Bracket, pulley, or bearing failure	4. Replace defective component and belt

AUTHENTIC RESTORATION

DIAGNOSIS AND TESTING (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
NOISE (Objectional squeal, spueak, or rumble is heard or felt while drive belt is in operation)	1. Incorrect belt tension	1. Inspect/Replace tensioner if necessary
	2. Bearing noise	2. Locate and repair
	3. Belt misalignment	3. Align belt/pulley(s)
	4. Belt to pulley mismatch	4. Install correct belt
	5. Driven component induced vibration	5. Locate defective driven component and repair
TENSION SHEETING FABRIC FAILURE (Woven fabric on outside, circumference of belt has cracked or separated from body of belt)	1. Tension sheeting contacting stationary object	1. Correct rubbing condition
	2. Excessive heat causing woven fabric to age	2. Replace belt
	3. Tension sheeting splice has fractured	3. Replace belt
CORD EDGE FAILURE (Tensile member exposed at edges of belt or separated from belt body)	1. Incorrect belt tension	1. Inspect/Replace tensioner if necessary
	2. Belt contacting stationary object	2. Replace belt
	3. Pulley(s) out of tolerance	3. Replace pulley
	4. Insufficient adhesion between tensile member and rubber matrix	4. Replace belt

THERMOSTAT

The cooling system used with the diesel engine provides the extra coolant capacity and extra cooling protection needed for higher GVWR (Gross Vehicle Weight Rating) and GCWR (Gross Combined Weight Rating) vehicles.

This system capacity will not effect warm up or cold weather operating characteristics if the thermostat is operating properly. This is because coolant will be held in the engine until it reaches the thermostat "set" temperature.

Diesel engines, due to their inherent efficiency are slower to warm up than gasoline powered engines, and will operate at lower temperatures when the vehicle is unloaded. Because of this, lower temperature gauge readings for diesel versus gasoline engines may, at times be normal.

Typically, complaints of low engine coolant temperature are observed as low heater output when combined with cool or cold outside temperatures.

To help promote faster engine warm-up, the electric engine block heater must be used with cool or cold outside temperatures. This will help keep the engine coolant warm when the vehicle is parked. Use the block heater if the outside temperature is below 4°C (40°F). **Do not use the block heater if the outside temperature is above 4°C (40°F).**

A "Cold Weather Cover" is available from the parts department through the Mopar® Accessories product line. This accessory cover is designed to block airflow entering the radiator and engine compartment to promote faster engine warm-up. It attaches to the front of the vehicle at the grill opening. **The cover is to be used with cool or cold temperatures only. If used with high outside temperatures, serious engine damage could result.** Refer to the literature supplied with the cover for additional information.

TESTING

The following test procedure is to be used for the **diesel engine only.**

(1) To determine if the thermostat is defective, it must be removed from the vehicle. Refer to Thermostats for removal and installation procedures.

(2) After the thermostat has been removed, examine the thermostat and inside of thermostat housing for contaminants. If contaminants are found, the thermostat may already be in a "stuck open" position. Flush the cooling system before replacing thermostat. Refer to Cooling System Cleaning/Reverse Flushing in this group for additional information.

(3) Place the thermostat into a container filled with water.

(4) Place the container on a hot plate or other suitable heating device.

(5) Place a commercially available radiator thermometer into the water.

DIAGNOSIS AND TESTING (Continued)

(6) Apply heat to the water while observing the thermostat and thermometer.

(7) When the water temperature reaches 83°C (181°F) the thermostat should start to open (valve will start to move). If the valve starts to move before this temperature is reached, it is opening too early. Replace thermostat. The thermostat should be fully open (valve will stop moving) at 95°C (203°F).

(7) If the valve is still moving when the water temperature reaches 203°, it is opening too late. Replace thermostat.

(7) If the valve refuses to move at any time, replace thermostat.

WATER PUMP

A quick test to determine if pump is working is to check if heater warms properly. A defective water pump will not be able to circulate heated coolant through the long heater hose to the heater core.

RADIATOR CAP-TO-FILLER NECK SEAL—PRESSURE RELIEF CHECK

The pressure cap upper gasket (seal) pressure relief can be tested by removing overflow hose from radiator filler neck nipple. Attach hose of pressure tester tool 7700 (or equivalent) to nipple. It will be necessary to disconnect hose from its adapter for filler neck. Pump air into radiator. The pressure cap upper gasket should relieve at 69-124 kPa (10-18 psi) and hold pressure at a minimum of 55 kPa (8 psi).

WARNING: THE WARNING WORDS —DO NOT OPEN HOT— ON RADIATOR PRESSURE CAP, ARE A SAFETY PRECAUTION. WHEN HOT, PRESSURE BUILDS UP IN COOLING SYSTEM. TO PREVENT SCALDING OR INJURY, RADIATOR CAP SHOULD NOT BE REMOVED WHILE SYSTEM IS HOT AND/OR UNDER PRESSURE.

Do not remove radiator cap at any time **except** for the following purposes:

- Check and adjust antifreeze freeze point
- Refill system with new antifreeze
- Conducting service procedures
- Checking for vacuum leaks

WARNING: IF VEHICLE HAS BEEN RUN RECENTLY, WAIT AT LEAST 15 MINUTES BEFORE REMOVING RADIATOR CAP. WITH A RAG, SQUEEZE RADIATOR UPPER HOSE TO CHECK IF SYSTEM IS UNDER PRESSURE. PLACE A RAG OVER CAP AND WITHOUT PUSHING CAP DOWN, ROTATE IT COUNTER-CLOCKWISE TO FIRST STOP. ALLOW FLUID TO ESCAPE THROUGH THE COOLANT RESERVE/OVERFLOW HOSE INTO RESERVE/ OVERFLOW TANK. SQUEEZE RADIATOR UPPER HOSE TO DETERMINE WHEN PRESSURE HAS BEEN RELEASED. WHEN COOLANT AND STEAM STOP BEING PUSHED INTO TANK AND SYSTEM PRESSURE DROPS, REMOVE RADIATOR CAP COMPLETELY.

RADIATOR CAPS—PRESSURE TESTING

Remove cap from radiator. Be sure that sealing surfaces are clean. Moisten rubber gasket with water and install cap on pressure tester 7700 or an equivalent (Fig. 19).

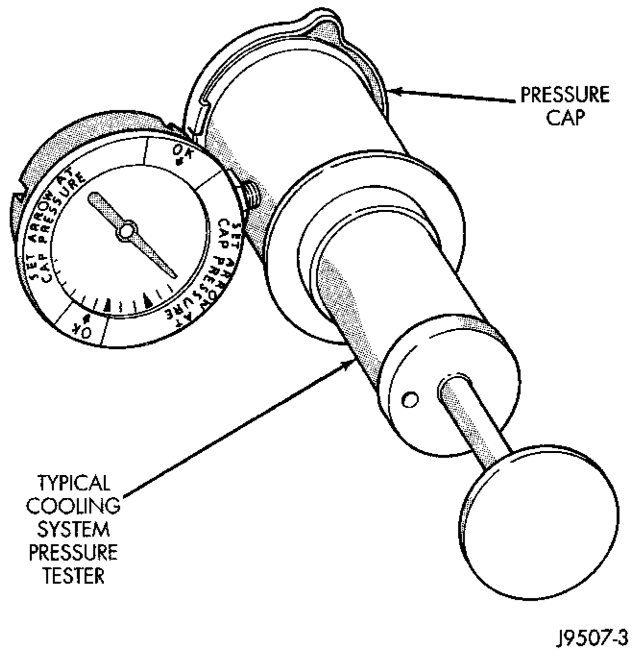

Fig. 19 Pressure Testing Radiator Cap—Typical Tester

Operate tester pump to bring pressure to 104 kPa (15 psi) on gauge. If pressure cap fails to hold pressure of at least 97 kPa (14 psi) replace cap. Refer to **CAUTION** below.

The pressure cap may test properly while positioned on tool 7700 (or equivalent). It may not hold pressure or vacuum when installed on radiator. If so, inspect radiator filler neck and cap's top gasket for damage. Also inspect for dirt or distortion that may prevent cap from sealing properly.

CAUTION: Radiator pressure testing tools are very sensitive to small air leaks, which will not cause cooling system problems. A pressure cap that does not have a history of coolant loss should not be replaced just because it leaks slowly when tested with this tool. Add water to tool. Turn tool upside down and recheck pressure cap to confirm that cap needs replacement.

DIAGNOSIS AND TESTING (Continued)

COOLANT—LOW LEVEL AERATION

If the coolant level in the radiator drops below the top of the radiator core tubes, air will enter the system.

Low coolant level can cause the thermostat pellet to be suspended in air instead of coolant. This will cause the thermostat to open later, which in turn causes higher coolant temperature. Air trapped in cooling system also reduces the amount of coolant circulating in the heater core. This may result in low heat output.

DEAERATION

As the engine operates, air trapped in the cooling system gathers under the radiator cap. The next time engine is operated, thermal expansion of coolant will push trapped air past radiator cap into coolant reserve/overflow tank. Here it escapes to atmosphere in the tank. When engine cools down the coolant, it will be drawn from reserve/overflow tank into radiator to replace removed air.

SERVICE PROCEDURES

COOLANT LEVEL CHECK—ROUTINE

NOTE: Do not remove radiator cap for routine coolant level inspections. The coolant level can be checked at the coolant reserve/overflow tank.

The coolant reserve/overflow system provides a quick visual method for determining the coolant level without removing the radiator pressure cap. With engine idling and at normal operating temperature, observe coolant level in coolant reserve/overflow tank. The coolant level should be between the ADD and FULL marks.

COOLANT SERVICE

Refer to your owner's manual for recommended coolant service intervals.

ADDING ADDITIONAL COOLANT—ROUTINE

Do not remove the radiator cap to add coolant to the system. When adding coolant to maintain the correct level, do so at the coolant reserve/overflow tank with a 50/50 mixture of ethylene glycol antifreeze (containing Alugard 340-2 ®) and water. Remove the radiator cap only for testing or when refilling the system after service. Removing cap unnecessarily can cause loss of coolant and allow air to enter system. This produces corrosion.

COOLANT LEVEL CHECK—SERVICE

The cooling system is closed and designed to maintain coolant level to the top of the radiator.

WARNING: DO NOT OPEN RADIATOR DRAINCOCK WITH ENGINE RUNNING OR WHILE ENGINE IS HOT AND COOLING SYSTEM IS UNDER PRESSURE.

When vehicle servicing requires a coolant level check in the radiator, drain several ounces of coolant from the radiator drain cock. Do this while observing the coolant reserve/overflow system tank. The coolant level in the reserve/overflow tank should drop slightly. If not, inspect for a leak between radiator and coolant reserve/overflow system connection. Remove radiator cap. The coolant level should be to the top of the radiator. If not and if coolant level in reserve/overflow tank is at the ADD mark, check for:

- An air leak in the coolant reserve/overflow tank
- An air leak in the radiator filler neck
- Leak in the pressure cap seal to the radiator filler neck

DRAINING COOLING SYSTEM

WARNING: DO NOT REMOVE THE CYLINDER BLOCK DRAIN PLUGS OR LOOSEN THE RADIATOR DRAIN PLUG WITH SYSTEM HOT AND UNDER PRESSURE. SERIOUS BURNS FROM COOLANT CAN OCCUR.

DO NOT WASTE reusable coolant. If the solution is clean, drain the coolant into a clean container for reuse.

(1) Start the engine and place the heater control temperature selector in the Full-On position. Engine vacuum is needed to actuate the heater controls.

(2) Turn the ignition off.

(3) Do not remove radiator cap when draining coolant from reserve/overflow tank. Open radiator drain plug and when tank is empty, remove radiator cap. If the coolant reserve/overflow tank does not drain, refer to the Testing Cooling System for Leaks section in this group. The coolant need not be removed from tank unless the system is being refilled with fresh mixture.

(4) Remove radiator pressure cap and allow system to drain completely.

REFILLING COOLING SYSTEM

Clean cooling system prior to refilling. Refer to Cooling System Cleaning section of this group.

(1) Install the cylinder block drain plugs (Fig.).

(2) Close radiator drain plug.

(3) Fill the cooling system with a 50/50 mixture of water and antifreeze.

(4) Fill coolant reserve/overflow tank to the FULL mark.

(5) Start and operate engine until thermostat opens. Upper radiator hose should be warm to touch.

SERVICE PROCEDURES (Continued)

(6) If necessary, add 50/50 water and antifreeze mixture to the coolant reserve/overflow tank to maintain coolant level. This level should be between the ADD and FULL marks. The level in the reserve/overflow tank may drop below the ADD mark after three or four warm-up and cool-down cycles.

COOLING SYSTEM CLEANING/REVERSE FLUSHING

CLEANING

Drain cooling system and refill with water. Run engine with radiator cap installed until upper radiator hose is hot. Stop engine and drain water from system. If water is dirty, fill system with water, run engine and drain system. Repeat until water drains clean.

REVERSE FLUSHING

Reverse flushing of cooling system is the forcing of water through the cooling system in the direction opposite of normal coolant flow. It is usually only necessary with very dirty systems with evidence of partial plugging.

REVERSE FLUSHING RADIATOR

Disconnect radiator hoses from radiator inlet and outlet. Attach a section of radiator hose to radiator bottom outlet fitting and insert flushing gun. Connect a water supply hose and air supply hose to flushing gun.

CAUTION: Internal radiator pressure must not exceed 138 kPa (20 psi) as damage to radiator may result.

Allow radiator to fill with water. When radiator is filled, apply air in short blasts. Allow radiator to refill between blasts. Continue this reverse flushing until clean water flows out through rear of radiator cooling tube passages. Have radiator cleaned more extensively by a radiator repair shop.

REVERSE FLUSHING ENGINE—DIESEL

(1) Drain the cooling system.

(2) Disconnect the radiator lower hose from the water inlet connection.

(3) Remove the heater core inlet hose from cylinder head fitting. .

(4) Attach water supply hose to cylinder head fitting.

(5) Back-flush the engine until clean water exits the water pump inlet.

CHEMICAL CLEANING

In some instances, use a radiator cleaner (Mopar Radiator Kleen or equivalent) before flushing. This will soften scale and other deposits and aid flushing operation.

CAUTION: Follow manufacturers instructions when using these products.

REMOVAL AND INSTALLATION

ACCESSORY DRIVE BELT

NOTE: The belt routing schematics are published from the latest information available at the time of publication. If anything differs between these schematics and the Belt Routing Label, use the schematics on Belt Routing Label. This label is located in the engine compartment.

CAUTION: Do not attempt to check belt tension with a belt tension gauge on vehicles equipped with an automatic belt tensioner. Refer to Automatic Belt Tensioner in this group.

Drive belts on diesel engines are equipped with a spring loaded automatic belt tensioner (Fig. 20). **(Fig. 20) displays the tensioner for vehicles without air conditioning.**

This belt tensioner will be used on all belt configurations, such as with or without air conditioning. For more information, refer to Automatic Belt Tensioner, proceeding in this group.

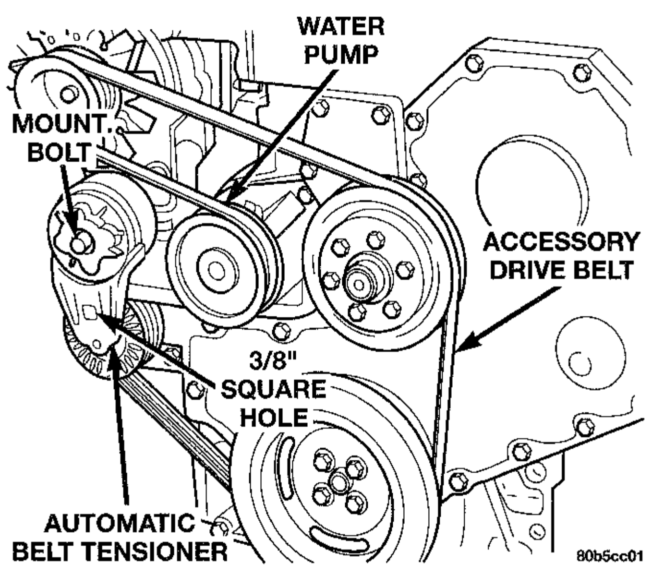

Fig. 20 Belt Tensioner—Typical (non-A/C shown)

REMOVAL

(1) A 3/8 inch square hole is provided in the automatic belt tensioner (Fig. 20). Attach a 3/8 inch drive-long handle ratchet to this hole.

(2) Rotate ratchet and tensioner assembly counterclockwise (as viewed from front) until tension has been relieved from belt.

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REMOVAL AND INSTALLATION (Continued)

(3) Remove belt from water pump pulley first.
(4) Remove belt from vehicle.

INSTALLATION

CAUTION: When installing the accessory drive belt, the belt must be routed correctly. If not, engine may overheat due to water pump rotating in wrong direction. Refer to (Fig. 21) (Fig. 22) for correct engine belt routing. The correct belt with correct length must be used.

(1) Position drive belt over all pulleys **except** water pump pulley.
(2) Attach a 3/8 inch ratchet to tensioner.
(3) Rotate ratchet and belt tensioner counterclockwise. Place belt over water pump pulley. Let tensioner rotate back into place. Remove ratchet. Be sure belt is properly seated on all pulleys.

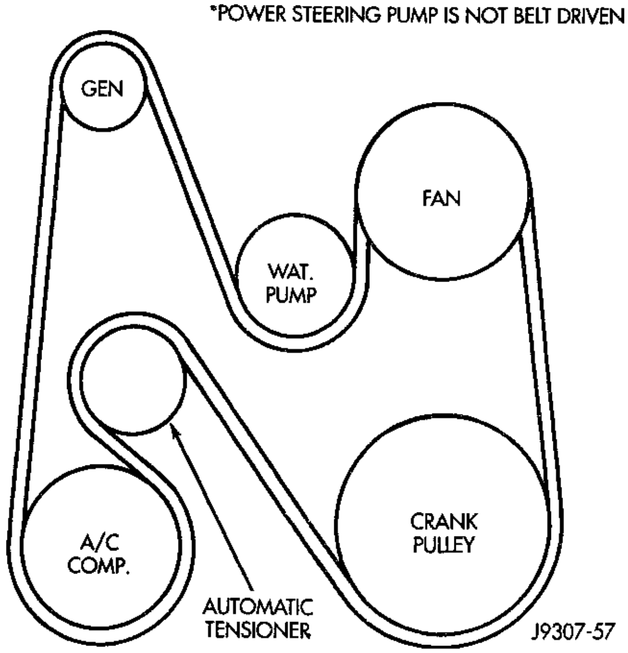

Fig. 21 Belt Routing—With A/C

ACCESSORY DRIVE BELT TENSIONER

REMOVAL

(1) Remove accessory drive belt. Refer to Belt Removal/Installation in this group.
(2) Remove tensioner mounting bolt and remove tensioner (Fig. 23).

WARNING: BECAUSE OF HIGH SPRING PRESSURE, DO NOT ATTEMPT TO DISASSEMBLE AUTOMATIC TENSIONER. UNIT IS SERVICED AS AN ASSEMBLY.

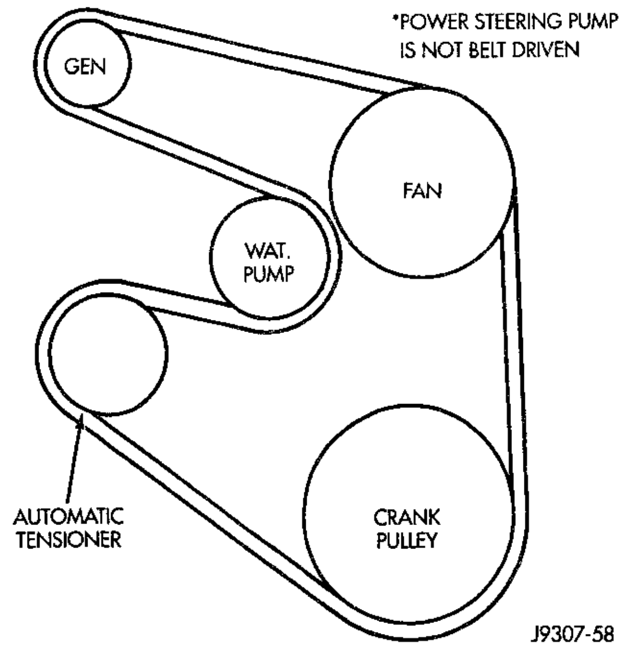

Fig. 22 Belt Routing—Without A/C

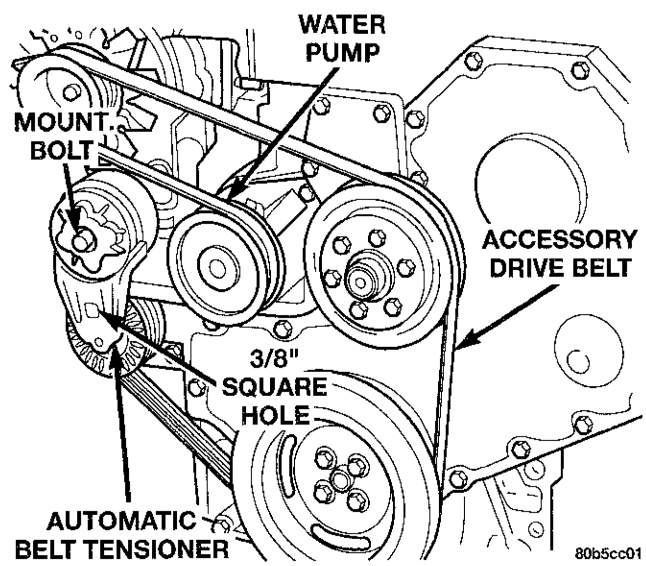

Fig. 23 Accessory Drive Belt Tensioner—Non A/C Shown

INSTALLATION

(1) Install tensioner assembly to mounting bracket. A dowel is located on back of tensioner. Align this dowel to hole in tensioner mounting bracket. Tighten bolt to 41 N·m (30 ft. lbs.) torque.
(2) Install drive belt. Refer to Belt Removal/Installation in this group.

REMOVAL AND INSTALLATION (Continued)

COOLANT RECOVERY BOTTLE

REMOVAL

(1) Remove overflow hose from radiator.

(2) Unsnap the coolant reserve/overflow tank from fan shroud. Lift straight up. The fan shroud is equipped with T-shaped slots (Fig. 24) to attach the tank. An alignment pin is located on the side of tank.

INSTALLATION

(1) Snap the tank into the two T-slots and the alignment pin on fan shroud.

(2) Connect overflow hose to radiator.

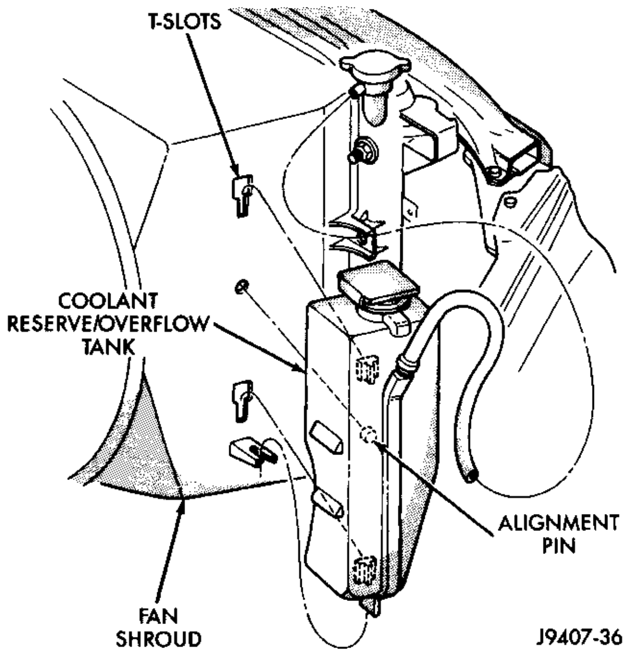

Fig. 24 Coolant Recovery Bottle

THERMOSTAT

REMOVAL

WARNING: DO NOT LOOSEN THE RADIATOR DRAINCOCK WITH THE SYSTEM HOT AND PRESSURIZED. SERIOUS BURNS FROM THE COOLANT CAN OCCUR.

Do not waste reusable coolant. If the solution is clean, drain the coolant into a clean container for reuse.

(1) Disconnect the battery negative cables.

(2) Remove accessory drive belt. Refer to procedure in this group.

(3) Drain cooling system until coolant level is below thermostat. Refer to Draining Cooling System in this section.

WARNING: CONSTANT TENSION HOSE CLAMPS ARE USED ON MOST COOLING SYSTEM HOSES. WHEN REMOVING OR INSTALLING, USE ONLY TOOLS DESIGNED FOR SERVICING THIS TYPE OF CLAMP, SUCH AS SPECIAL CLAMP TOOL (NUMBER 6094). SNAP-ON CLAMP TOOL (NUMBER HPC-20) MAY BE USED FOR LARGER CLAMPS. ALWAYS WEAR SAFETY GLASSES WHEN SERVICING CONSTANT TENSION CLAMPS.

CAUTION: A number or letter is stamped into the tongue of constant tension clamps. If replacement is necessary, use only an original equipment clamp with a matching number or letter.

(4) Remove radiator hose clamp and hose from thermostat housing.

(5) Remove the three (3) water outlet-to-cylinder head bolts and remove the water outlet connector (Fig. 25).

(6) Clean the mating surfaces of the water outlet connector and clean the thermostat seat groove at the top of the thermostat housing (Fig. 25).

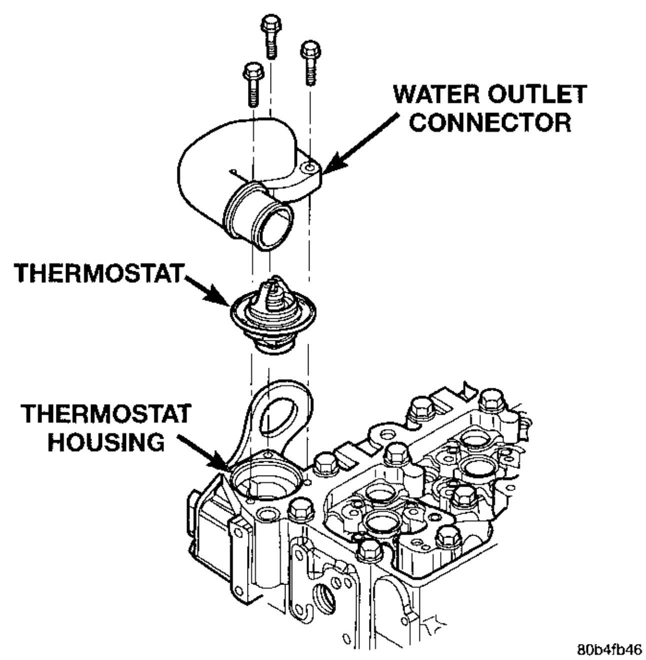

Fig. 25 Thermostat Removal/Installation

INSTALLATION

(1) Install the thermostat into the groove in the top of the thermostat housing (Fig. 25).

(2) Install the water outlet connector and bolts. Tighten the bolts to 24 N·m (18 ft. lbs.) torque.

(3) Install the radiator upper hose and clamp.

(4) Fill the cooling system with coolant.

(5) Connect the battery negative cables.

(6) Start the engine and check for coolant leaks. Run engine to check for proper thermostat operation.

REMOVAL AND INSTALLATION (Continued)

COOLING FAN AND VISCOUS DRIVE

REMOVAL

CAUTION: If the viscous fan drive is replaced because of mechanical damage, the cooling fan blades should also be inspected. Inspect for fatigue cracks, loose blades, or loose rivets that could have resulted from excessive vibration. Replace fan blade assembly if any of these conditions are found. Also inspect water pump bearing and shaft assembly for any related damage due to a viscous fan drive malfunction.

(1) Disconnect the battery negative cables.
(2) Remove the fan shroud mounting bolts. Position fan shroud towards engine.

CAUTION: Do not remove the fan pulley bolts. This pulley is under spring tension.

(3) The thermal viscous fan drive/fan blade assembly is attached (threaded) to the fan hub shaft (Fig. 26). Remove the fan blade/fan drive assembly from fan pulley by turning the mounting nut clockwise (as viewed from front). Threads on the viscous fan drive are **LEFT-HAND.** A Snap-On 36 MM Fan Wrench (number SP346 from Snap-On Cummins Diesel Tool Set number 2017DSP) can be used. Place a bar or screwdriver between the fan pulley bolts to prevent pulley from rotating.

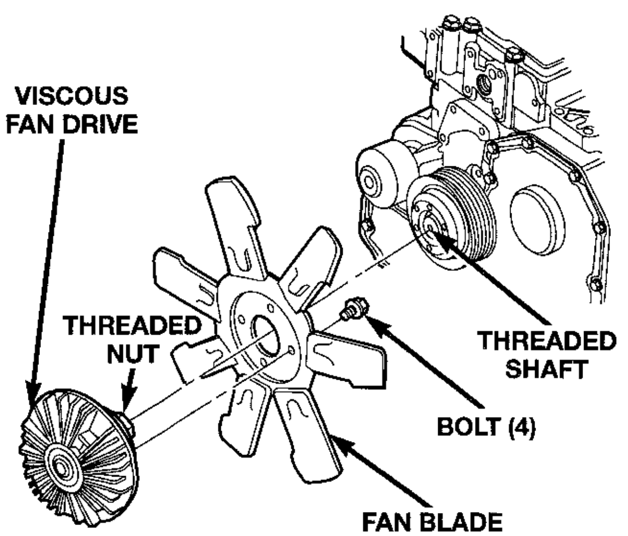

Fig. 26 Fan Blade/Viscous Fan Drive

(4) Remove the fan shroud and the fan blade/viscous drive as an assembly from vehicle.
(5) Remove fan blade-to-viscous fan drive mounting bolts.
(6) Inspect the fan for cracks, loose rivets, loose or bent fan blades.

CAUTION: Some engines equipped with serpentine drive belts have reverse rotating fans and viscous fan drives. They are marked with the word REVERSE to designate their usage. Installation of the wrong fan or viscous fan drive can result in engine overheating.

INSTALLATION

(1) Install fan blade assembly to viscous fan drive. Tighten mounting bolts to 23 N·m (17 ft. lbs.) torque.
(2) Position the fan shroud and fan blade/viscous fan drive to the vehicle as an assembly.
(3) Install viscous fan drive assembly on fan hub shaft (Fig. 26). Tighten mounting nut to 57 N·m (42 ft. lbs.) torque.
(4) Install fan shroud bolts into position and tighten the mounting bolts to 6 N·m (50 in. lbs.) torque.
(5) Connect the battery negative cables.

NOTE: Viscous Fan Drive Fluid Pump Out Requirement: After installing a **new** viscous fan drive, bring the engine speed up to approximately 2000 rpm and hold for approximately two minutes. This will ensure proper fluid distribution within the drive.

COOLING FAN SUPPORT/HUB

REMOVAL

(1) Disconnect the battery negative cables.
(2) Remove the cooling fan and viscous drive. Refer to procedure in this group.
(3) Remove the four (4) fan hub to block bolts (Fig. 27).
(4) If replacing the fan support/hub, transfer the pulley (Fig. 27) to the new component.

INSTALLATION

(1) If removed, install the fan drive pulley (Fig. 27) and tighten the bolts to 9 N·m (84 in. lbs.) torque.
(2) Install the support assy. to the block (Fig. 27), and tighten the bolts to 24 N·m (18. ft. lbs.) torque.
(3) Install the cooling fan and viscous drive. Refer to procedure in this group.
(4) Connect the battery negative cables.

WATER PUMP

REMOVAL

(1) Disconnect battery negative cables.
(2) Drain cooling system. Refer to Draining Cooling System in this section.

REMOVAL AND INSTALLATION (Continued)

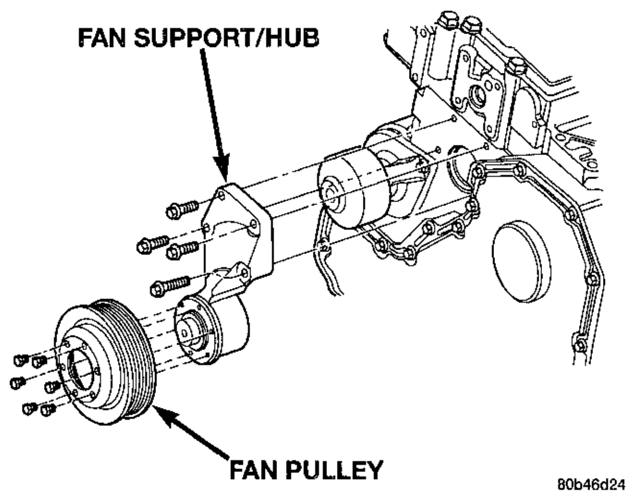

Fig. 27 Cooling Fan Support/Hub Assembly

(3) Remove the bolt retaining the wiring harness near the top of water pump. Position wire harness to the side.

(4) Remove the accessory drive belt. Refer to procedure in this group.

(5) Remove water pump mounting bolts (Fig. 28).

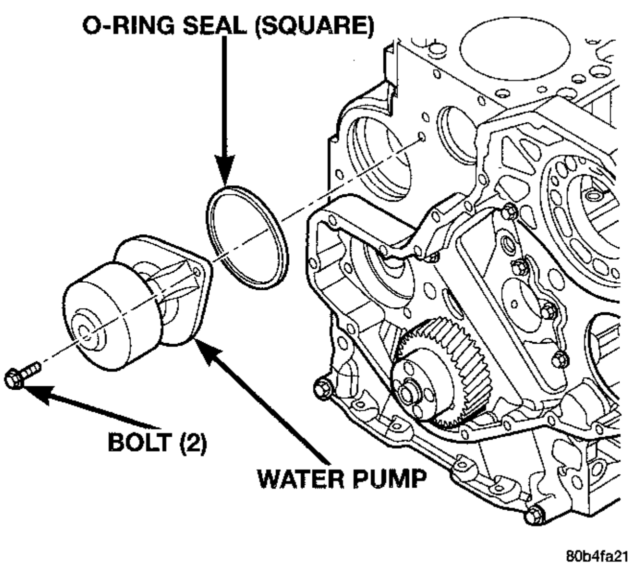

Fig. 28 Water Pump Removal/Installation

(6) Clean water pump sealing surface on cylinder block.

INSTALLATION

(1) Install new O-ring seal in groove on water pump (Fig. 29).

(2) Install water pump. Tighten mounting bolts to 24 N·m (18 ft. lbs.) torque.

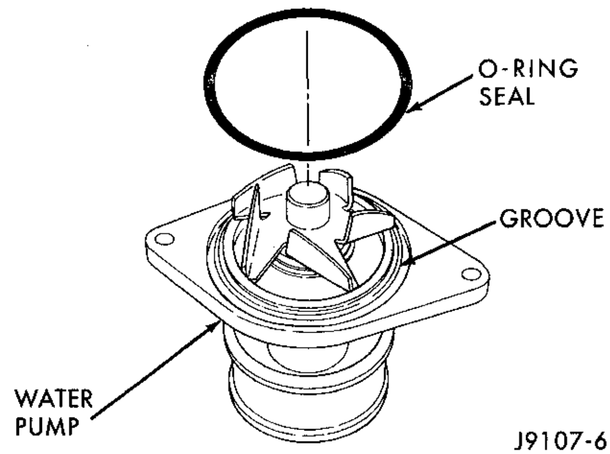

Fig. 29 Pump O-ring Seal

(3) Install accessory drive belt. Refer to procedure in this group.

(4) Install the bolt retaining the wiring harness near top of water pump.

(5) Fill cooling system. Refer to Refilling Cooling System in this section.

(6) Connect both battery cables.

(7) Start and warm the engine. Check for leaks.

RADIATOR

REMOVAL

(1) Disconnect the battery negative cables.

WARNING: DO NOT REMOVE THE CYLINDER BLOCK DRAIN PLUGS OR LOOSEN THE RADIATOR DRAINCOCK WITH THE SYSTEM HOT AND UNDER PRESSURE. SERIOUS BURNS FROM COOLANT CAN OCCUR.

(2) Drain the cooling system. Refer to Draining Cooling System in this group.

WARNING: CONSTANT TENSION HOSE CLAMPS ARE USED ON MOST COOLING SYSTEM HOSES. WHEN REMOVING OR INSTALLING, USE ONLY TOOLS DESIGNED FOR SERVICING THIS TYPE OF CLAMP, SUCH AS SPECIAL CLAMP TOOL (NUMBER 6094). SNAP-ON CLAMP TOOL (NUMBER HPC-20) MAY BE USED FOR LARGER CLAMPS. ALWAYS WEAR SAFETY GLASSES WHEN SERVICING CONSTANT TENSION CLAMPS.

CAUTION: A number or letter is stamped into the tongue of constant tension clamps. If replacement is necessary, use only an original equipment clamp with a matching number or letter.

(3) Remove the radiator upper hose and clamps.

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REMOVAL AND INSTALLATION (Continued)

(4) Disconnect the coolant recovery bottle hose from the radiator filler neck. Remove the coolant recovery bottle from the fan shroud (pull straight up). The tank slips into T-slots on the fan shroud. (Fig. 30).

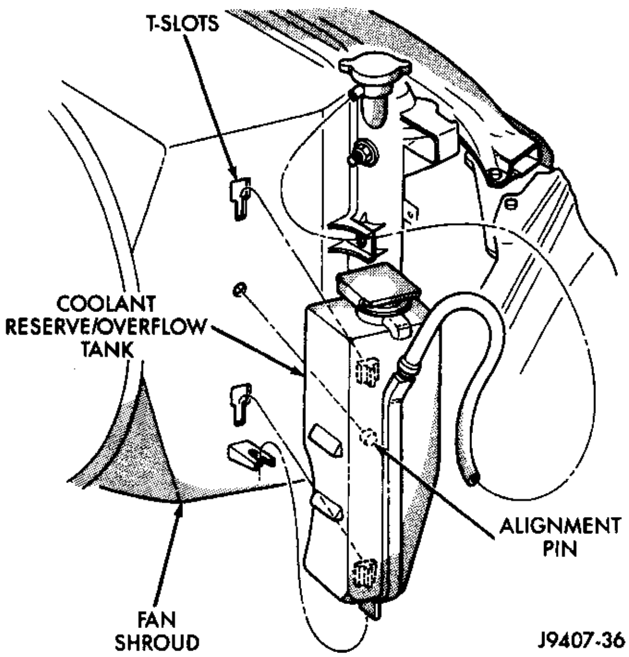

Fig. 30 Coolant Recovery Bottle

(5) Disconnect electrical connectors and supply hose from windshield washer bottle and remove tank. Refer to Group 8K, Windshield Wiper and Washer Systems for procedures.

(6) Remove the two metal clips retaining the upper part of fan shroud to the top of radiator.

(7) Remove the four fan shroud mounting bolts (Fig. 31). Position shroud rearward over the fan blades towards engine.

(8) Disconnect the radiator lower hose and clamp from the radiator.

(9) Remove the two radiator upper mounting bolts (Fig. 32).

(10) Lift radiator straight up and out of engine compartment. The bottom of the radiator is equipped with two alignment dowels that fit into holes in the lower radiator support panel (Fig. 32). Rubber biscuits (insulators) are installed to these dowels. Take care not to damage cooling fins or tubes on the radiator and air conditioning condenser when removing.

INSTALLATION

(1) Position fan shroud over the fan blades rearward towards engine.

(2) Install rubber insulators to alignment dowels at lower part of radiator.

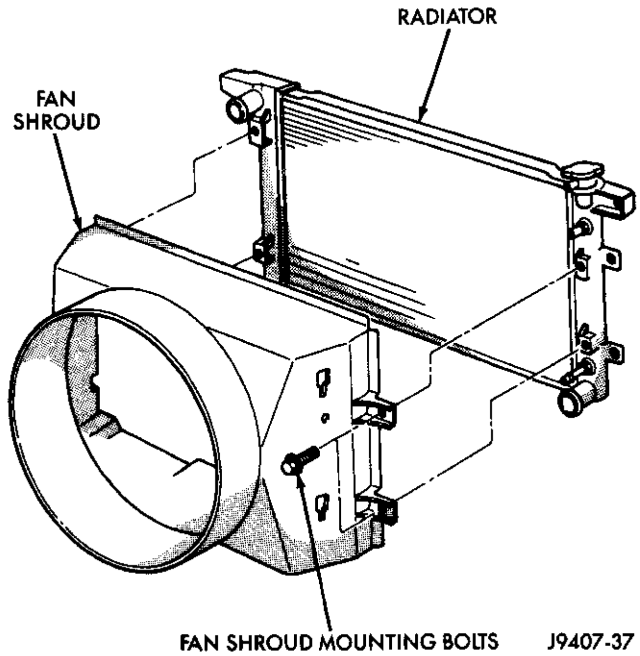

Fig. 31 Fan Shroud Mounting

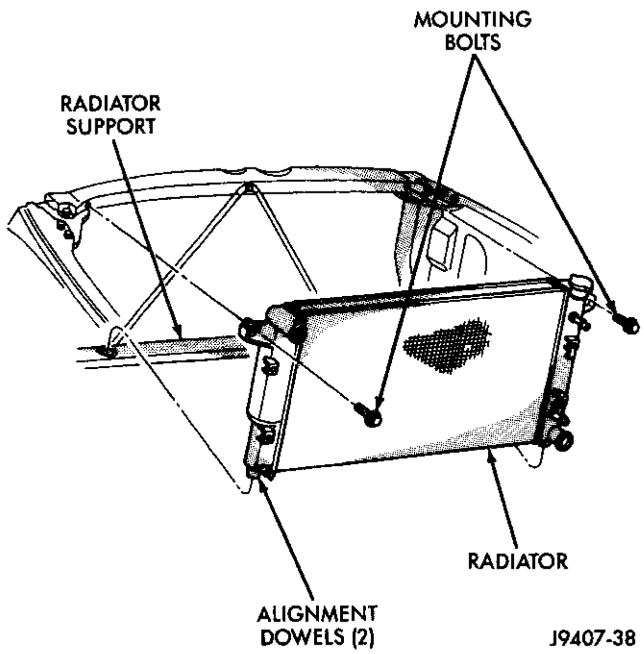

Fig. 32 Radiator Mounting

(3) Lower the radiator into position while guiding the two alignment dowels into lower radiator support (Fig. 32).

(4) Install two upper radiator mounting bolts. Tighten bolts to 11 N·m (95 in. lbs.) torque.

(5) Connect the radiator lower hose and clamp.

(6) Position fan shroud to flanges on sides of radiator. Install fan shroud mounting bolts (Fig. 31). Tighten bolts to 6 N·m (50 in. lbs.) torque.

REMOVAL AND INSTALLATION (Continued)

(7) Install windshield washer reservoir tank. Refer to Group 8K. Connect electrical connections and supply hose.
(8) Install metal clips to top of fan shroud.
(9) Install coolant recovery bottle to fan shroud (Fig. 30).
(10) Install coolant recovery bottle hose to radiator filler neck nipple.
(11) Install the radiator upper hose and clamps.
(12) Connect the battery negative cables.
(13) Fill cooling system with coolant. Refer to Refilling Cooling System in this group.
(14) Start engine and check for leaks.

BLOCK HEATER

WARNING: DO NOT REMOVE THE CYLINDER BLOCK DRAIN PLUGS OR LOOSEN THE RADIATOR DRAINCOCK WITH THE SYSTEM HOT AND UNDER PRESSURE. SERIOUS BURNS FROM COOLANT CAN OCCUR.

REMOVAL

(1) Disconnect the battery negative cables.
(2) Drain coolant from radiator and cylinder block.
(3) Unscrew the power cord retaining cap and disconnect cord from heater element.
(4) Using a suitable size socket, loosen and remove the block heater element (Fig. 33).

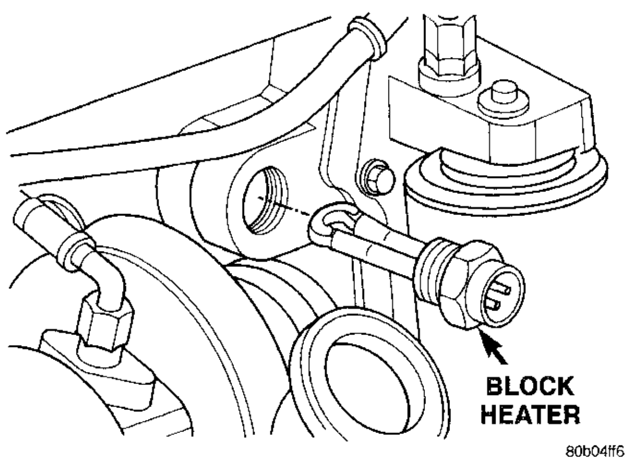

Fig. 33 Block Heater—Diesel Engine

INSTALLATION

(1) Clean and inspect the threads in the cylinder block.
(2) Coat heater element threads with Mopar® Thread Sealer with Teflon.
(3) Screw block heater into cylinder block and tighten to 43 N·m (32 ft. lbs.).
(4) Connect block heater cord and tighten retaining cap.
(5) Fill cooling system with recommended coolant. Refer to Refilling Cooling System section in this group.
(6) Start and warm the engine.
(7) Check block heater for leaks.

WATER INLET CONNECTOR

REMOVAL

(1) Disconnect battery negative cables.
(2) Drain cooling system. Refer to Draining Cooling System in this group.
(3) Remove the accessory drive belt. Refer to procedure in this group.
(4) Remove the generator. Refer to Group 8C, Charging System, for the correct procedure.
(5) If A/C equipped, recover the refrigerant and remove the A/C compressor. Refer to Group 24, Heating and Air Conditioning for the correct procedures.
(6) Disconnect the heater core and transmission oil cooler return hoses at the water inlet connector.
(7) Remove the six (6) water inlet connector-to-block bolts. Remove connector and o-ring (Fig. 34).

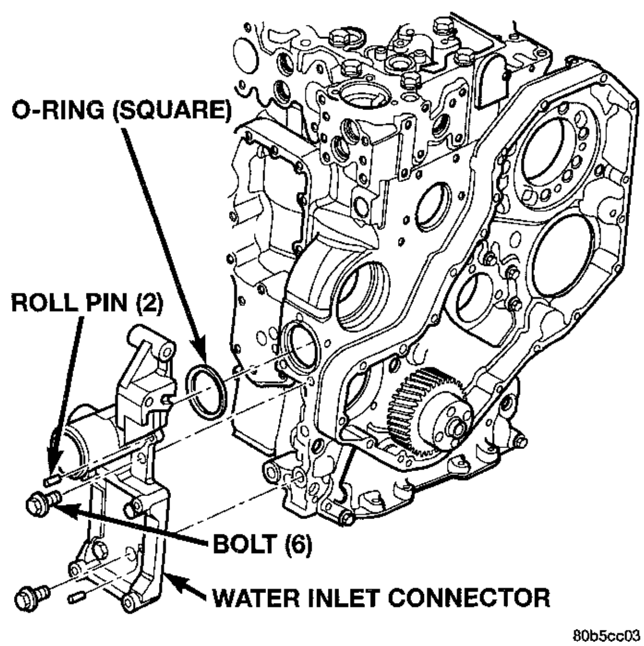

Fig. 34 Water Inlet Connector and O-ring

INSTALLATION

(1) Using a new o-ring, locate the water inlet connector on the roll pins (Fig. 34) and install and tighten all bolts to 24 N·m (18 ft. lbs.) torque.
(2) Install the heater core and transmission oil cooler return hoses and clamps to the connector.
(3) Install the A/C compressor. Refer to Group 24, Heating and Air Conditioning for the correct procedures.

REMOVAL AND INSTALLATION (Continued)

(4) Install the generator. Refer to Group 8C, Charging System for the correct procedures.

(5) Install the accessory drive belt. Refer to the procedure in this group.

(6) Add coolant. Refer to Refilling Cooling System in this group.

(7) Connect the battery negative cables.

(8) Start the engine and check for coolant leaks. Check and adjust the coolant level as necessary.

WATER-TO-OIL COOLER

REMOVAL

CAUTION: If a leak should occur in the water-to-oil cooler mounted to the side of the engine block, engine coolant may become mixed with transmission fluid. Transmission fluid may also enter engine cooling system. Both cooling system and transmission should be drained and inspected in case of oil cooler leakage.

(1) Disconnect both battery negative cables.

(2) Remove air cleaner assembly and air cleaner intake hoses. Refer to Group 14, Fuel System for procedures.

(3) Drain cooling system. Refer to Draining Cooling System in this group.

(4) Disconnect coolant lines from cooler.

(5) Disconnect transmission oil lines from cooler. Plug cooler lines to prevent oil leakage.

(6) Remove oil cooler mounting straps (Fig. 35).

(7) Lift oil cooler off of mounting bracket.

(8) If replacing cooler, make sure to transfer converter drain back valve to new cooler.

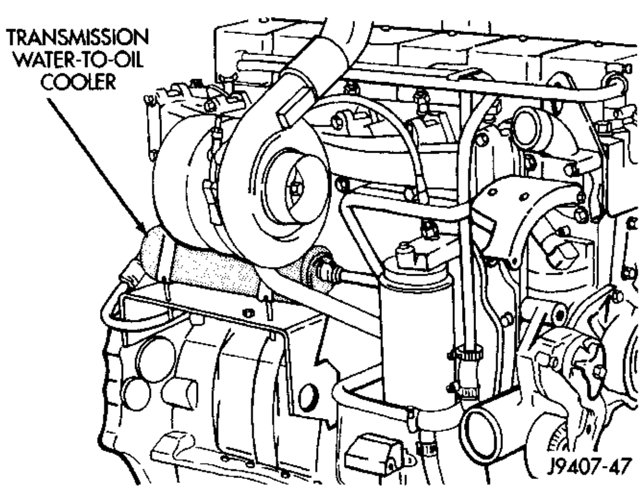

Fig. 35 Transmission Water-To- Oil Cooler—Diesel

INSTALLATION

(1) Position oil cooler on bracket.

(2) Install mounting straps.

(3) Connect transmission oil lines to cooler.

(4) Connect coolant hoses to cooler.

(5) Connect battery negative cables.

(6) Fill cooling system. Refer to Refilling Cooling System in this section.

(7) Check transmission oil level and fill as necessary.

(8) Install air cleaner assembly and air cleaner intake hoses. Refer to Group 14, Fuel System for procedures.

AUXILIARY TRANSMISSION OIL COOLER

REMOVAL

(1) Disconnect the battery negative cables.

(2) Remove front bumper. Refer to Group 13, Frame and Bumpers for the correct procedures.

(3) Place a drain pan under the oil cooler.

(4) Raise the vehicle.

(5) Using special tool #6931, disconnect the oil cooler quick-connect fittings from the transmission lines.

(6) Remove the charge air cooler-to-oil cooler bolt and the two mounting nuts (Fig. 36).

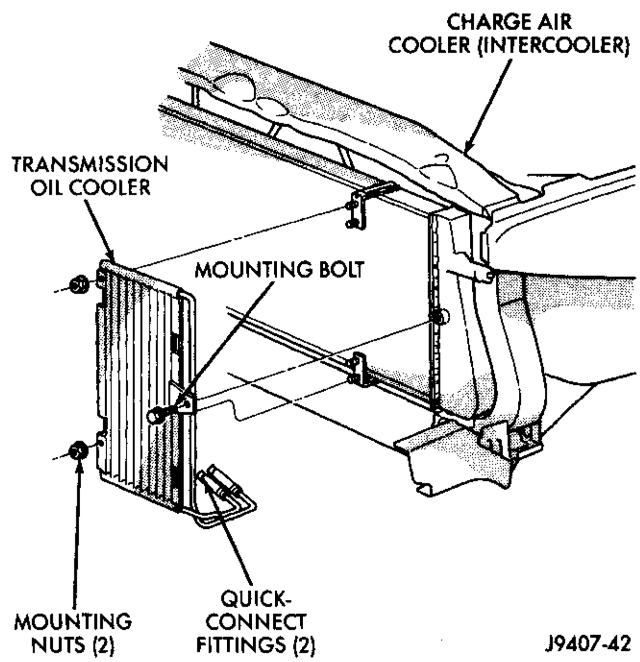

Fig. 36 Auxiliary Transmission Oil Cooler

(7) Remove the oil cooler and line assembly towards the front of vehicle. Cooler must be rotated and tilted into position while removing.

INSTALLATION

(1) Carefully position the oil cooler assembly to the vehicle.

(2) Install two nuts and one bolt (Fig. 36). Tighten to 11 N·m (95 in. lbs.) torque.

REMOVAL AND INSTALLATION (Continued)

(3) Connect the quick-connect fittings to the transmission cooler lines. Push together until an audible "click" is heard. Verify by pulling outward on the connection.

(4) Install front bumper. Refer to Group 13, Frame and Bumpers for the correct procedures.

(5) Connect the battery negative cables.

(6) Start the engine and check all connections for leaks.

(7) Check the fluid level in the automatic transmission. Refer to Group 21, Transmissions for for the correct procedures.

CLEANING AND INSPECTION

RADIATOR CLEANING

The radiator and air conditioning fins should be cleaned when an accumulation of bugs, leaves etc. has occurred. Clean radiator fins are necessary for good heat transfer. With the engine cold, apply cold water and compressed air to the back (engine side) of the radiator to flush the radiator and/or A/C condenser of debris.

COOLING FAN INSPECTION

The fan cannot be repaired. If fan is damaged, it must be replaced. Inspect fan as follows:

(1) Remove fan blade and viscous fan drive as an assembly from the engine. Refer to preceding Removal procedure.

(2) Remove fan blade assembly from viscous fan drive unit (four bolts).

(3) Lay fan on a flat surface with leading edge facing down. With tip of blade touching flat surface, replace fan if clearance between opposite blade and surface is greater than 2.0 mm (.090 inch). Rocking motion of opposite blades should not exceed 2.0 mm (.090 inch). Test all blades in this manner.

WARNING: DO NOT ATTEMPT TO BEND OR STRAIGHTEN FAN BLADES IF NOT WITHIN SPECIFICATIONS.

(4) Inspect fan assembly for cracks, bends, loose rivets or broken welds. Replace fan if any damage is found.

CAUTION: If fan blade assembly is replaced because of mechanical damage, water pump and viscous fan drive should also be inspected. These components could have been damaged due to excessive vibration.

Also refer to the Viscous Fan Drive section for additional information.

RADIATOR CAP INSPECTION

Hold cap at eye level, right side up. The vent valve (Fig. 37) at bottom of cap should open. If rubber gasket has swollen and prevents vent valve from opening, replace cap.

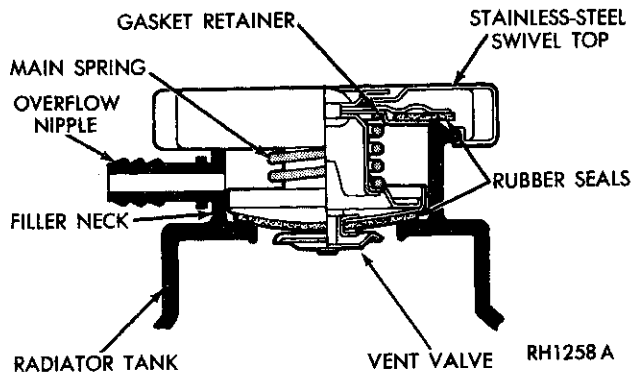

Fig. 37 Radiator Pressure Cap

Hold cap at eye level, upside down. If any light can be seen between vent valve and rubber gasket, replace cap. **Do not use a replacement cap that has a spring to hold vent shut.** A replacement cap must be the type designed for a coolant reserve/overflow system with a completely sealed diaphragm spring and a rubber gasket. This gasket is used to seal to radiator filler neck top surface. Use of proper cap will allow coolant return to radiator.

WATER PUMP INSPECTION

Visually inspect the water pump and replace if it has any of the following conditions:

- The body is cracked or damaged
- Water leaks from the shaft seal. This is evident by traces of coolant below the vent hole
- Loose or rough turning bearing. Also inspect thermal fan drive
- Impeller rubbing the pump body

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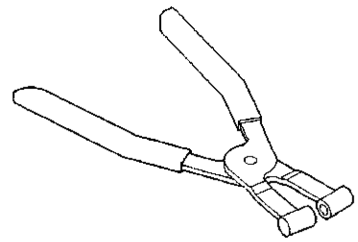
SPECIFICATIONS

TORQUE

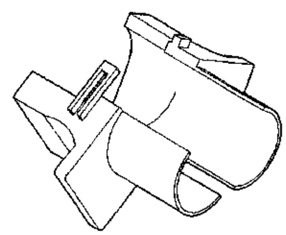
DESCRIPTION	TORQUE
Belt Tensioner	
Bolt	41 N·m (30 ft. lbs.)
Block Heater	
Hex	43 N·m (32 ft. lbs.)
Fan Blade-to-Viscous Drive	
Bolts	23 N·m (17 ft. lbs.)
Fan Drive Pulley-to-Fan Hub	
Bolts	9 N·m (84 in. lbs.)
Fan Shroud to Radiator Mounting	
Bolts	6 N·m (50 in. lbs.)
Fan Support/Hub Assy.	
Bolts	24 N·m (18 ft. lbs.)
Radiator Mounting	
Bolts	11 N·m (95 in. lbs.)
Thermal Viscous Fan-to-Hub	
Nut	57 N·m (42 ft. lbs.)
Water Inlet Connector-to-Block	
Bolts	24 N·m (18 ft. lbs.)
Water Outlet Connector (Therm. Housing)	
Bolts	24 N·m (18 ft. lbs.)
Water Pump-to-Block	
Bolts	24 N·m (18 ft. lbs.)

SPECIAL TOOLS

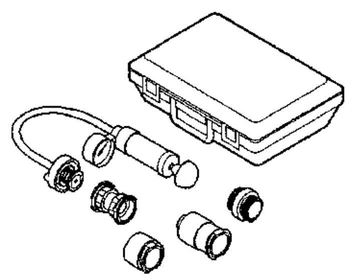
COOLING



Pliers 6094



1/2" Disconnect Tool—6931



Pressure Tester 7700–A

Mopar AUTHENTIC RESTORATION PRODUCT

CHARGING SYSTEM

CONTENTS

GENERAL INFORMATION

OVERVIEW

The battery, starting, and charging systems operate with one another, and must be tested as a complete system. To allow the vehicle to start and charge properly, all of the components involved in these three systems must perform within specifications.

Group 8A in this service manual covers the battery, Group 8B covers the starting system, and Group 8C covers the charging system. Refer to Group 8W, Wiring Diagrams for complete circuit descriptions and diagrams. When attempting to diagnose any of these systems, it is important to keep their interdependency in mind.

Certain charging system circuits are monitored by On-Board Diagnostics (OBD) built into the Powertrain Control Module (PCM) (Fig. 1). Each monitored circuit is assigned a Diagnostic Trouble Code (DTC). The PCM will store a DTC in electronic memory for certain failures it detects. Refer to On-Board Diagnostics in Group 25, Emission Control System for a complete list of DTC's and for information necessary to access a DTC.

DESCRIPTION AND OPERATION

CHARGING SYSTEM OPERATION

The charging system consists of:

- Generator
- Electronic Voltage Regulator (EVR) circuitry within the Powertrain Control Module (PCM) (Fig. 1).
- Ignition switch (refer to Group 8D, Ignition System for information)
- Battery (refer to Group 8A, Battery for information)
- Battery temperature sensor
- Generator Lamp (if equipped)

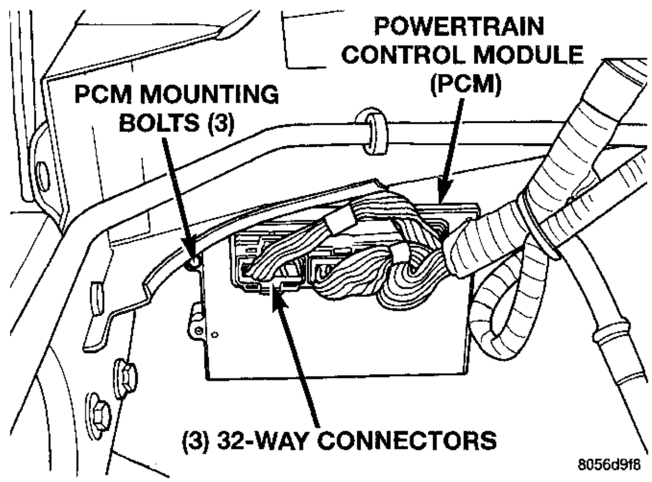


Fig. 1 Powertrain Control Module (PCM) Location

- Voltmeter (refer to Group 8E, Instrument Panel and Gauges for information)
- Wiring harness and connections (refer to Group 8W, Wiring for information)

The charging system is turned on and off with the ignition switch. The system is on when the engine is running and the ASD relay reacted. When the ASD relay is on, voltage is supplied to the ASD relay sense circuit at the PCM. This voltage is connected through the PCM and supplied to one of the generator field terminals (Gen. Source +) at the back of the generator.

The amount of DC current produced by the generator is controlled by the EVR (field control) circuitry contained within the PCM. This circuitry is connected in series with the second rotor field terminal and ground.

A battery temperature sensor, located in the battery tray housing, is used to sense battery temperature. This temperature data, along with data from monitored line voltage, is used by the PCM to vary the battery charging rate. This is done by cycling the

DESCRIPTION AND OPERATION (Continued)

ground path to control the strength of the rotor magnetic field. The PCM then compensates and regulates generator current output accordingly.

All vehicles are equipped with On-Board Diagnostics (OBD). Some OBD-sensed systems, including EVR (field control) circuitry, are monitored by the PCM. Each monitored circuit is assigned a Diagnostic Trouble Code (DTC). The PCM will store a DTC in electronic memory for certain failures it detects. Refer to On-Board Diagnostics in Group 25, Emission Control System for more DTC information.

Operation of the generator lamp is controlled by the PCM.

GENERATOR

The generator is belt-driven by the engine using a serpentine type drive belt. It is serviced only as a complete assembly. If the generator fails for any reason, the entire assembly must be replaced.

As the energized rotor begins to rotate within the generator, the spinning magnetic field induces a current into the windings of the stator coil. Once the generator begins producing sufficient current, it also provides the current needed to energize the rotor.

The Y type stator winding connections deliver the induced AC current to 3 positive and 3 negative diodes for rectification. From the diodes, rectified DC current is delivered to the vehicle electrical system through the generator battery and ground terminals.

Although the generators appear the same externally, different generators with different output ratings are used on this vehicle. Be certain that the replacement generator has the same output rating and part number as the original unit. Refer to Generator Ratings in the Specifications section at the back of this group for amperage ratings and part numbers.

Noise emitting from the generator may be caused by: worn, loose or defective bearings; a loose or defective drive pulley; incorrect, worn, damaged or misadjusted fan drive belt; loose mounting bolts; a misaligned drive pulley or a defective stator or diode.

BATTERY TEMPERATURE SENSOR

The battery temperature sensor is used to determine the battery temperature and control battery charging rate. This temperature data, along with data from monitored line voltage, is used by the Powertrain Control Module (PCM) (Fig. 1) to vary the battery charging rate. System voltage will be higher at colder temperatures and is gradually reduced at warmer temperatures. On diesel powered vehicles, only one sensor is used (dual batteries) and is located under the battery on the drivers side of vehicle.

ELECTRONIC VOLTAGE REGULATOR

The Electronic Voltage Regulator (EVR) is not a separate component. It is actually a voltage regulating circuit located within the Powertrain Control Module (PCM) (Fig. 1). The EVR is not serviced separately. If replacement is necessary, the PCM must be replaced.

Operation: The amount of DC current produced by the generator is controlled by EVR circuitry contained within the PCM. This circuitry is connected in series with the generators second rotor field terminal and its ground.

Voltage is regulated by cycling the ground path to control the strength of the rotor magnetic field. The EVR circuitry monitors system line voltage and battery temperature (refer to Battery Temperature Sensor for more information). It then compensates and regulates generator current output accordingly. Also refer to Charging System Operation for additional information.

REMOVAL AND INSTALLATION

GENERATOR

REMOVAL

WARNING: DISCONNECT BOTH NEGATIVE BATTERY CABLES FROM BOTH BATTERIES BEFORE REMOVING BATTERY OUTPUT WIRE (B+ WIRE) FROM REAR OF GENERATOR. FAILURE TO DO SO CAN RESULT IN INJURY OR DAMAGE TO ELECTRICAL SYSTEM.

(1) Disconnect both negative battery cables at both batteries.

(2) Remove generator drive belt. Refer to Group 7, Cooling System for procedure.

(3) Loosen (but do not remove) generator mounting bracket-to-engine bolt (Fig. 2).

(4) Remove upper generator mounting bolt and lower mounting bolt/nut (Fig. 2).

(5) Position generator for access to wire connectors.

(6) Remove nuts from harness holddown, battery (B+) terminal, ground terminal and 2 field terminals. Remove wire connectors (Fig. 3).

(7) Remove generator from vehicle.

INSTALLATION

(1) Position generator to engine and install wiring to rear of generator. Tighten all wiring fasteners as follows:

- Battery (B+) terminal nut—8.5 N·m (75 in. lbs.)
- Ground terminal nut—8.5 N·m (75 in. lbs.)
- Harness holddown nut—8.5 N·m (75 in. lbs.)

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REMOVAL AND INSTALLATION (Continued)

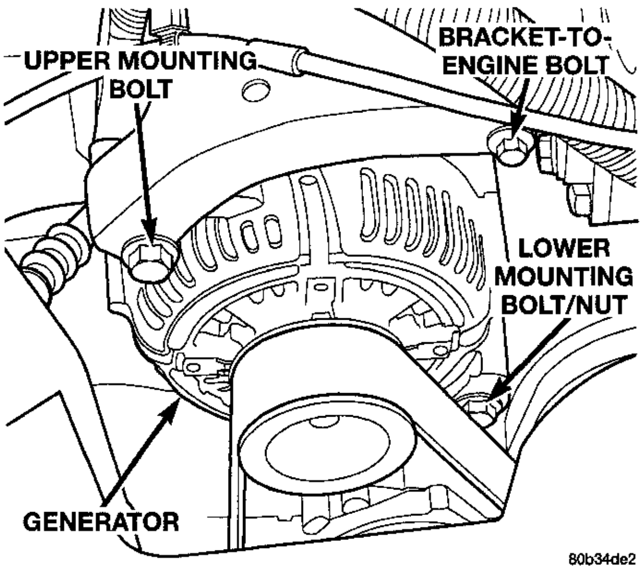

Fig. 2 Remove/Install Generator—Diesel Engine

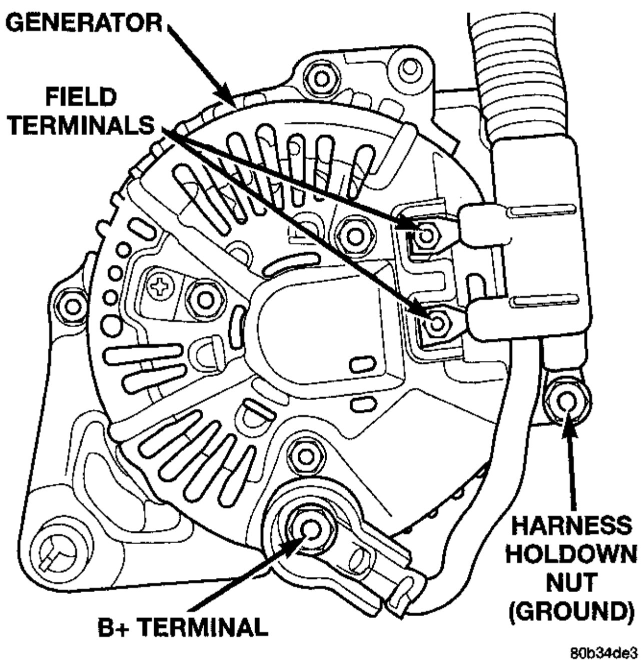

Fig. 3 Remove/Install Generator Electrical Connectors—Diesel Engine

- Field terminal nuts—2.8 N·m (25 in. lbs.)

(2) Install generator mounting fasteners and tighten as follows:

- Generator upper mounting bolt—Diesel powered engines—54 N·m (40 ft. lbs.)
- Generator pivot bolt/nut—Diesel powered engines—54 N·m (40 ft. lbs.)
- Generator mounting bracket-to-engine bolt—Diesel powered engines—24 N·m (18 ft. lbs.)

CAUTION: Never force a belt over a pulley rim using a screwdriver. The synthetic fiber of the belt can be damaged.

CAUTION: When installing a serpentine accessory drive belt, the belt MUST be routed correctly. The water pump will be rotating in the wrong direction if the belt is installed incorrectly, causing the engine to overheat. Refer to belt routing label in engine compartment, or refer to Belt Schematics in Group 7, Cooling System.

(3) Install generator drive belt. Refer to Group 7, Cooling System for procedure.

(4) Install both negative battery cables to both batteries.

BATTERY TEMPERATURE SENSOR

The battery temperature sensor is located under the vehicle battery (Fig. 4) and is attached (snapped into) a mounting hole on battery tray. On models equipped with a diesel engine (dual batteries), only one sensor is used. The sensor is located under the battery on drivers side of vehicle.

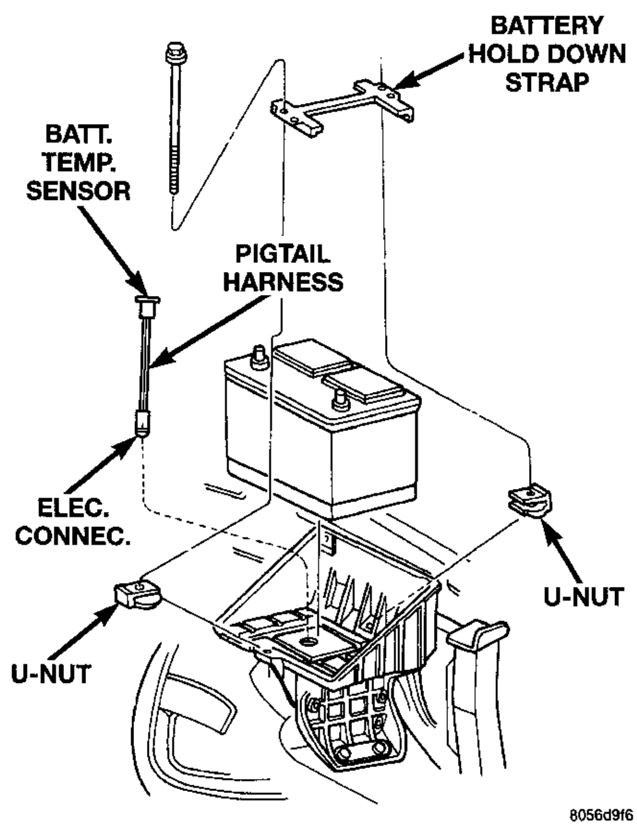

Fig. 4 Battery Temperature Sensor Location

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REMOVAL AND INSTALLATION (Continued)

REMOVAL

(1) Remove battery. Refer to Group 8A, Battery for procedures.

(2) Disconnect sensor pigtail harness from engine wire harness.

(3) Pry sensor straight up from battery tray mounting hole.

INSTALLATION

(1) Feed pigtail harness through mounting hole in top of battery tray and press sensor into top of tray (snaps in).

(2) Connect pigtail harness.

(3) Install battery. Refer to Group 8A, Battery for procedures.

SPECIFICATIONS

TORQUE CHART

DESCRIPTION	TORQUE
Generator Upper Mounting Bolt —Diesel Engine	54 N·m (40 ft. lbs.)
Generator Pivot Bolt/Nut —Diesel Engine	54 N·m (40 ft. lbs.)
Generator Mounting Bracket-to-Engine Bolt —Diesel Engine	24 N·m (18 ft. lbs.)
Battery Terminal Nut	8.5 N·m (75 in. lbs.)
Ground Terminal Nut	8.5 N·m (75 in. lbs.)
Harness Hold-down Nut	8.5 N·m (75 in. lbs.)
Field Terminal Nuts	2.8 N·m (25 in. lbs.)

GENERATOR RATINGS

TYPE	PART NUMBER	RATED SAE AMPS	ENGINES	MINIMUM TEST AMPS
DENSO	56027221	136	5.9L DIESEL	120

AUTHENTIC RESTORATION PRODUCT

SPEED CONTROL SYSTEM

CONTENTS

GENERAL INFORMATION

INTRODUCTION

The vehicle speed control system is electronically controlled by the Powertrain Control Module (Fig. 1) and vacuum operated by a servo. The system is designed to operate between approximately 35 and 85 mph (56 and 137 km/h). On diesel powered models, a separate vacuum reservoir **is not used** to supply the servo. Vacuum for the servo is supplied by an engine mounted vacuum pump. Vacuum from this pump is shared by the heating/air-conditioning system.

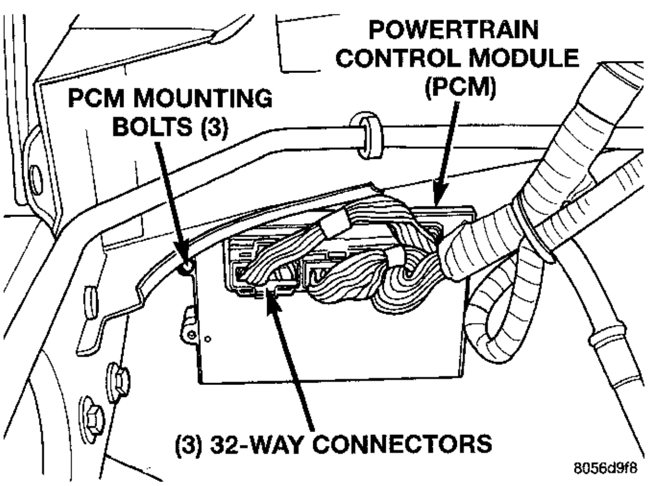

Fig. 1 Powertrain Control Module (PCM) Location

DESCRIPTION AND OPERATION

SPEED CONTROL SERVO

The servo unit consists of a solenoid valve body, a vacuum servo and the mounting bracket. The Powertrain Control Module (PCM) (Fig. 1) controls the solenoid valve body. The solenoid valve body controls the application and release of vacuum to the diaphragm of the vacuum servo. A cable connects the servo with the throttle linkage. The servo unit cannot be repaired and is serviced only as a complete assembly.

SPEED CONTROL SOLENOID CIRCUITS

When all of the speed control parameters are met, and the SET button is pressed, the Powertrain Control Module (PCM) (Fig. 1) actuates the vent solenoid and “duty-cycles” the vacuum solenoid to open the throttle and bring the vehicle up to target speed. When the vehicle is at target speed, it will actuate the vent solenoid with the vacuum solenoid de-activated to maintain the vehicle at target speed. When the vehicle is above target speed, the PCM will “duty-cycle” the vent solenoid with the vacuum solenoid still de-activated to close the throttle to return to target speed.

SPEED CONTROL SWITCHES

Two separate speed control switch modules are mounted on the steering wheel to the left and right side of the driver’s airbag module. Within the two switch modules, five **momentary** contact switches, supporting seven different speed control functions are used. The outputs from these switches are filtered into one input. The Powertrain Control Module (PCM) (Fig. 1) determines which output has been applied through **resistive multiplexing.** The input circuit voltage is measured by the PCM to determine which switch function has been selected.

A speed control indicator lamp, located on the instrument panel cluster is energized by the PCM via the CCD Bus. This occurs when speed control system power has been turned ON, and the engine is running.

AUTHENTIC RESTORATION

DESCRIPTION AND OPERATION (Continued)

The two switch modules are labeled: ON/OFF, SET, RESUME/ACCEL, CANCEL and COAST. Refer to the owner's manual for more information on speed control switch functions and setting procedures. The individual switches cannot be repaired. If one individual switch fails, the switch module must be replaced.

STOP LAMP SWITCH

Vehicles equipped with the speed control option use a dual function stop lamp switch. The switch is mounted on the brake pedal mounting bracket under the instrument panel. The Powertrain Control Module (PCM) (Fig. 1) monitors the state of the dual function stop lamp switch. Refer to Group 5, Brakes for more information on stop lamp switch service and adjustment procedures.

SERVO CABLE

The speed control servo cable is connected between the speed control vacuum servo diaphragm and the throttle control lever. This cable causes the throttle control linkage to open or close in response to movement of the vacuum servo diaphragm.

POWERTRAIN CONTROL MODULE (PCM)

Speed control electronic circuitry is integrated into the Powertrain Control Module (PCM). The PCM speed control functions are monitored by On-Board Diagnostics (OBD). Both the Engine Control Module (ECM), and the PCM monitor OBD-sensed systems. Each controller (PCM and ECM) monitor OBD functions with the PCM controlling operation of the Malfunction Indicator Lamp (MIL). Each controller (PCM and ECM) will store a Diagnostic Trouble Code (DTC) related to its monitor. Both modules will also set a "companion " module DTC when a fault is set in the other module.

The PCM is located in the engine compartment (Fig. 1). The PCM or the ECM cannot be repaired and must be replaced if faulty.

VACUUM SUPPLY

On diesel powered engines, an engine driven pump is used to supply vacuum for speed control operation. A vacuum reservoir is not used if equipped with a diesel powered engine. Refer to Vacuum Pump in Group 9, Engines for information.

VEHICLE SPEED INPUT

The Vehicle Speed Sensor (VSS) is no longer used for any Dodge Truck.

Vehicle speed and distance covered are measured by the Rear Wheel Speed Sensor. The sensor is mounted to the rear axle. A signal is sent from this sensor to the Controller Antilock Brake (CAB) computer. A signal is then sent from the CAB to the Powertrain Control Module (PCM) to determine vehicle speed and distance covered. The PCM will then determine strategies for speed control system operation.

REMOVAL AND INSTALLATION

SPEED CONTROL SERVO

REMOVAL

(1) Disconnect both negative battery cables at both batteries.

(2) Disconnect positive battery cable at battery (drivers side battery).

(3) Remove battery holddown bolts (Fig. 2).

(4) If equipped, pull up on battery heat shield to remove it (Fig. 3).

(5) Remove battery from vehicle.

(6) From under vehicle, and in front of left front wheelhouse, remove 2 lower battery tray nuts (Fig. 4).

(7) Remove 2 nuts and 2 bolts holding battery tray to vehicle (Fig. 5).

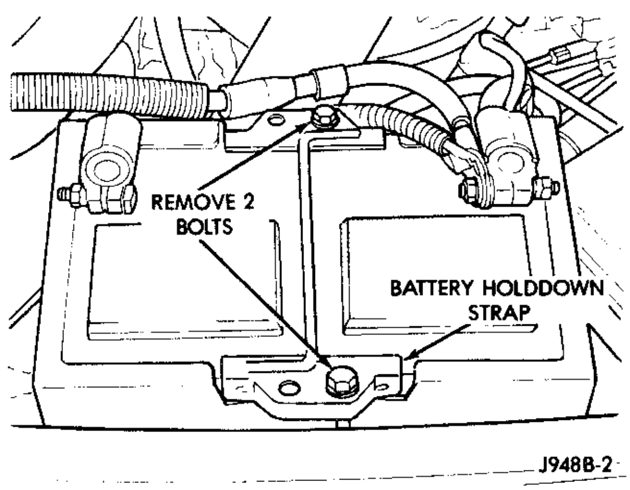

Fig. 2 Battery Holddown Bolts

REMOVAL AND INSTALLATION (Continued)

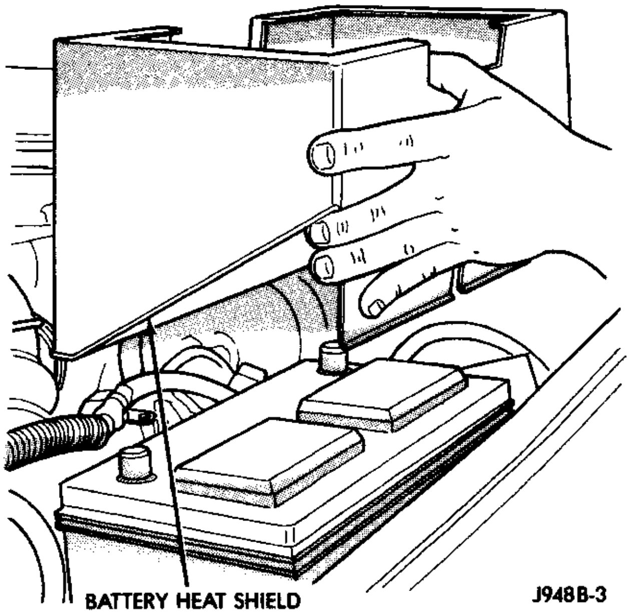

Fig. 3 Battery Heat Shield

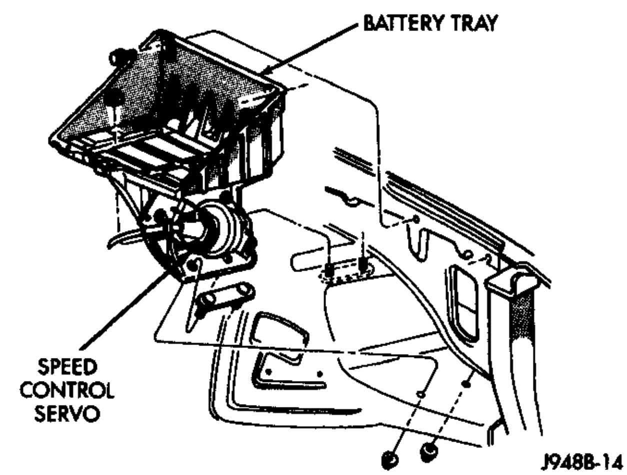

Fig. 4 Battery Tray Lower Mounting Nuts

(8) Remove cable cover (Fig. 6). Cable cover is attached with 2 Phillips screws, 2 plastic retention clips and 2 push tabs (Fig. 6). Remove 2 Phillips screws and carefully pry out 2 retention clips. After clip removal, push rearward on front tab, and upward on lower tab for cover removal.

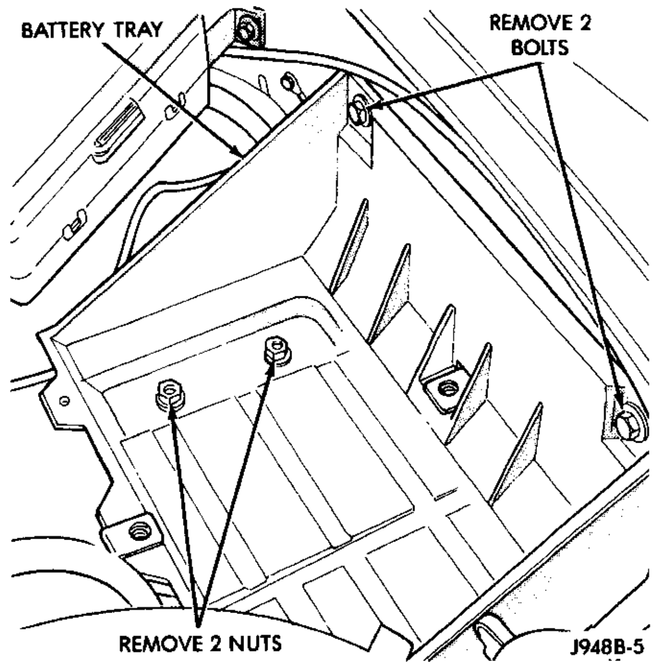

Fig. 5 Battery Tray Upper Mounting Bolts/Nuts

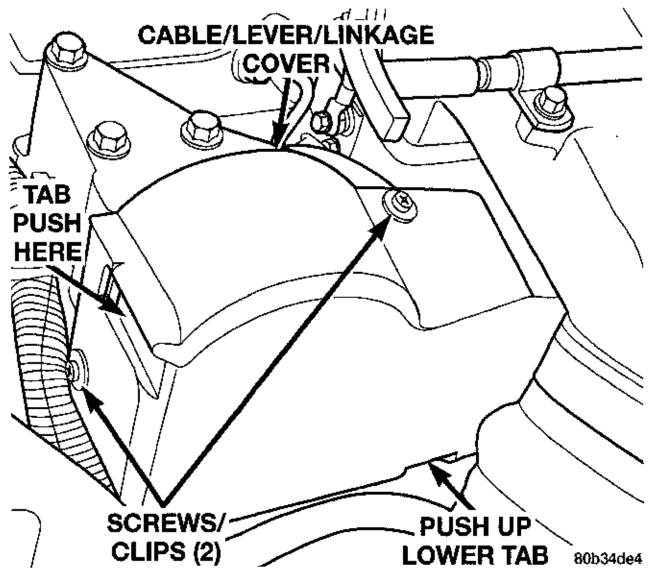

Fig. 6 Cable/Lever/Throttle Linkage Cover

(9) Using finger pressure only, disconnect end of servo cable from throttle lever pin by pulling forward on connector while holding lever rearward (Fig. 7).**DO NOT try to pull connector off perpendicular to lever pin. Connector will be broken.**

REMOVAL AND INSTALLATION (Continued)

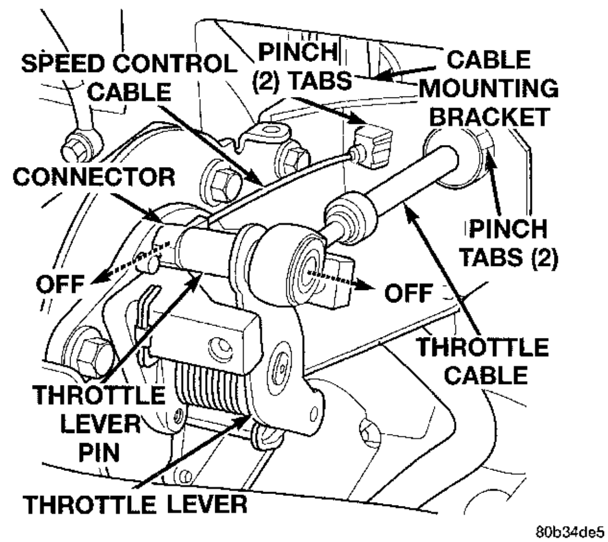

Fig. 7 Servo Cable at Throttle Lever

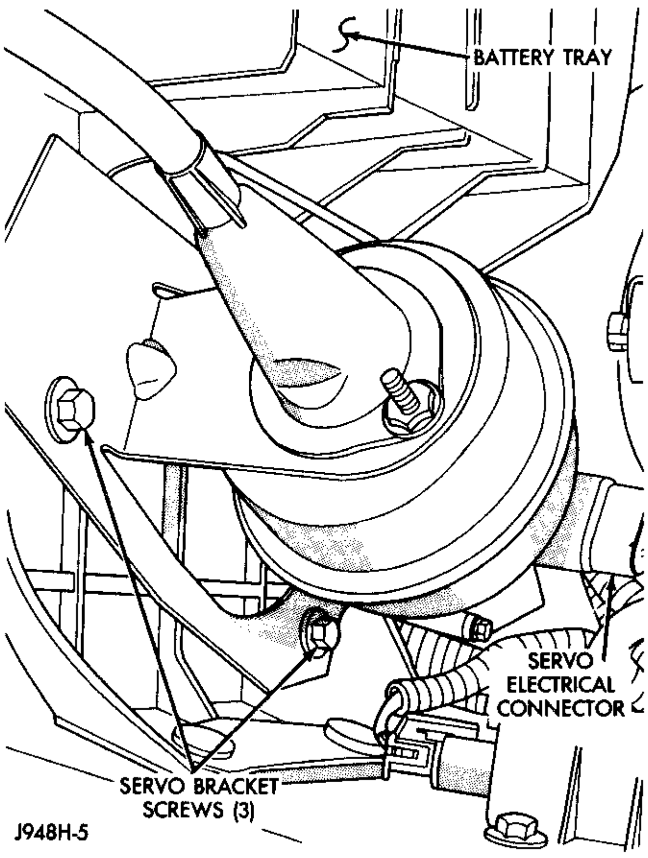

Fig. 8 Servo Location—Removal/Installation

(10) Position battery tray up far enough for access to speed control servo electrical connector and vacuum line.

(11) Disconnect electrical connector and vacuum line at servo.

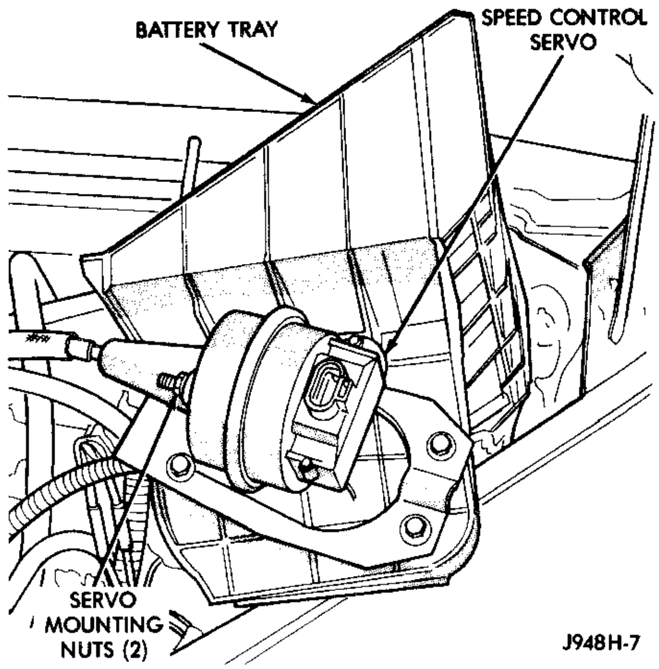

Fig. 9 Servo Mounting at Battery Tray

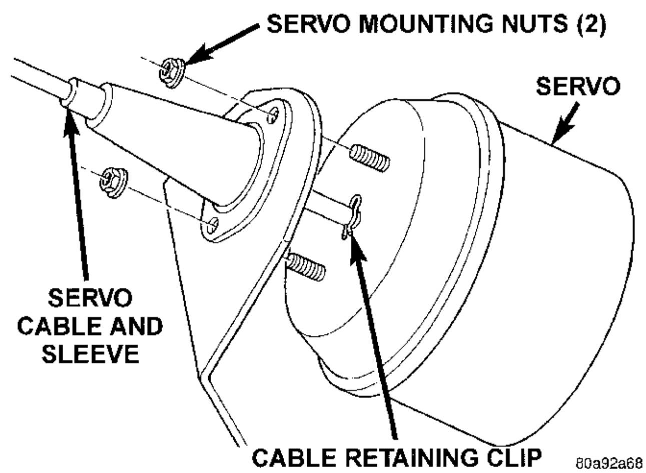

Fig. 10 Servo Cable Clip Remove/Install—Typical

(12) Position battery tray with attached servo assembly to gain access to 2 servo mounting nuts (Fig. 9) or (Fig. 10).

(13) Remove 2 mounting nuts holding servo cable sleeve to bracket (Fig. 10).

(14) Pull speed control cable sleeve and servo away from servo mounting bracket to expose cable retaining clip (Fig. 10) and remove clip. Note: The servo mounting bracket displayed in (Fig. 10) is a typical bracket and may/may not be applicable to this model vehicle.

(15) Remove servo from mounting bracket.

INSTALLATION

(1) Position servo to mounting bracket.

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REMOVAL AND INSTALLATION (Continued)

(2) Align hole in cable connector with hole in servo pin. Install cable-to-servo retaining clip.

(3) Insert servo studs through holes in servo mounting bracket.

(4) Insert servo studs through holes in servo cable sleeve.

(5) Install servo mounting nuts and tighten to 8.5 N·m (75 in. lbs.) torque.

(6) Connect vacuum line to servo.

(7) Connect electrical connector to servo terminals.

(8) Connect servo cable to throttle lever by pushing cable connector rearward onto lever pin while holding lever forward.

(9) Install battery tray. Tighten all battery tray mounting hardware to 16 N·m (140 in. lbs.) torque.

(10) Position battery into battery tray.

(11) If equipped, install battery heat shield.

(12) Install battery holddown clamp. Tighten bolt to 4 N·m (35 in. lbs.) torque.

(13) Connect negative battery cables to both batteries.

(14) Before starting engine, operate accelerator pedal to check for any binding.

(15) Install cable/lever cover.

SPEED CONTROL SWITCHES

REMOVAL

WARNING: BEFORE BEGINNING ANY AIRBAG SYSTEM COMPONENT REMOVAL OR INSTALLATION, REMOVE AND ISOLATE THE NEGATIVE (-) CABLE(S) FROM THE BATTERY. THIS IS THE ONLY SURE WAY TO DISABLE THE AIRBAG SYSTEM. THEN WAIT TWO MINUTES FOR SYSTEM CAPACITOR TO DISCHARGE BEFORE FURTHER SYSTEM SERVICE. FAILURE TO DO THIS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE INJURY.

(1) Disconnect and isolate negative battery cable(s).

(2) Remove airbag module. Refer to Group 8M, Passive Restraint Systems for procedures.

(3) Remove switch-to-steering wheel mounting screws (Fig. 11).

(4) Remove switch.

(5) Remove electrical connector at switch.

INSTALLATION

(1) Install electrical connector to switch.

(2) Install switch and mounting screws.

(3) Tighten screws to 3 N·m (26 in. lbs. +/– 2 in. lbs.) torque.

(4) Install airbag module. Refer to Group 8M, Passive Restraint Systems for procedures.

(5) Connect negative battery cable(s).

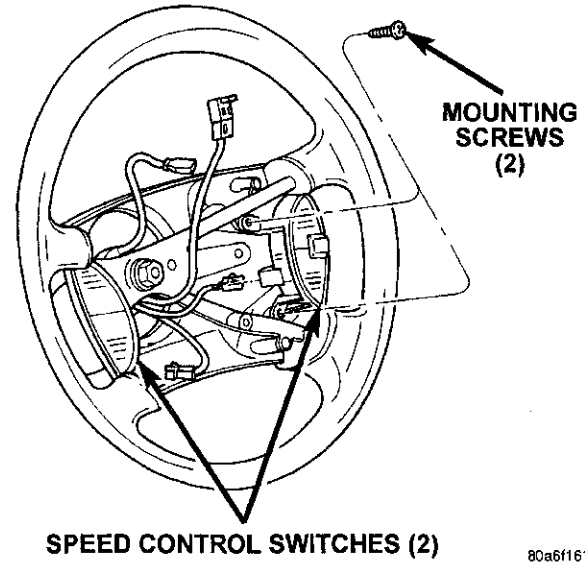

Fig. 11 Speed Control Switches

STOP LAMP SWITCH

Refer to Stop Lamp Switch in Group 5, Brakes for removal/installation and adjustment procedures.

SERVO CABLE

REMOVAL

(1) Disconnect both negative battery cables at both batteries.

(2) Remove cable/lever/linkage cover. Refer to Speed Control Servo Removal/Installation.

(3) Remove (disconnect) servo cable from servo. Refer to Speed Control Servo Removal/Installation.

(4) Using finger pressure only, disconnect end of servo cable from throttle lever pin by pulling forward on connector while holding lever rearward (Fig. 12).**DO NOT try to pull connector off perpendicular to lever pin. Connector will be broken.**

(5) Squeeze 2 pinch tabs (Fig. 12) on sides of speed control cable at mounting bracket and push cable rearward out of bracket.

(6) Remove cable from vehicle.

INSTALLATION

(1) Install (connect) end of speed control servo cable to speed control servo. Refer to Speed Control Servo Removal/Installation.

(2) Install cable through mounting hole on mounting bracket. Cable snaps into bracket.

(3) Connect servo cable to throttle lever by pushing cable connector rearward onto lever pin while holding lever forward.

(4) Connect negative battery cables to both batteries.

(5) Before starting engine, operate accelerator pedal to check for any binding.

(6) Install cable/lever cover.

SPECIFICATIONS (Continued)

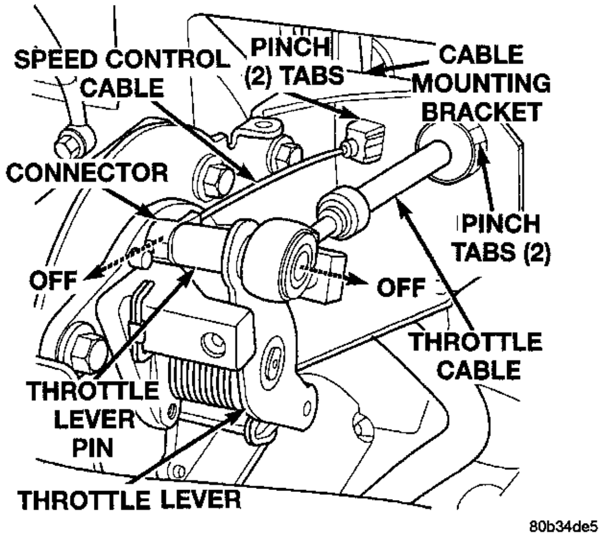

Fig. 12 Servo Cable at Throttle Lever

SPECIFICATIONS

TORQUE CHART

Description	Torque
Servo Mounting Bracket Nuts	8.5 N·m (75 in. lbs.)
Switch Module Mounting Screws	3 N·m (26 in. lbs. +/- 2 in. lbs.)

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WIRING DIAGRAMS

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8W-02 COMPONENT INDEX

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8W-10 POWER DISTRIBUTION

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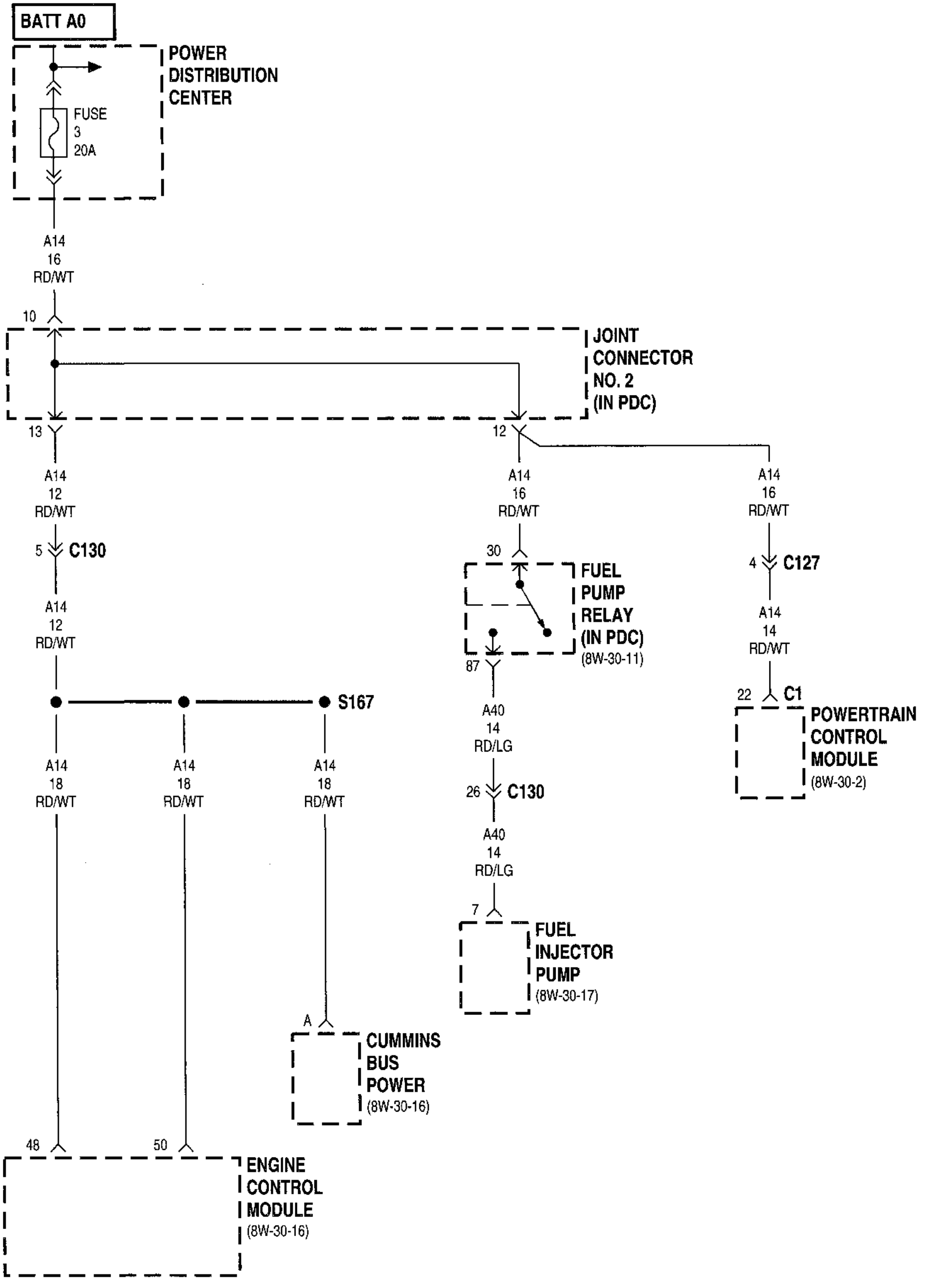

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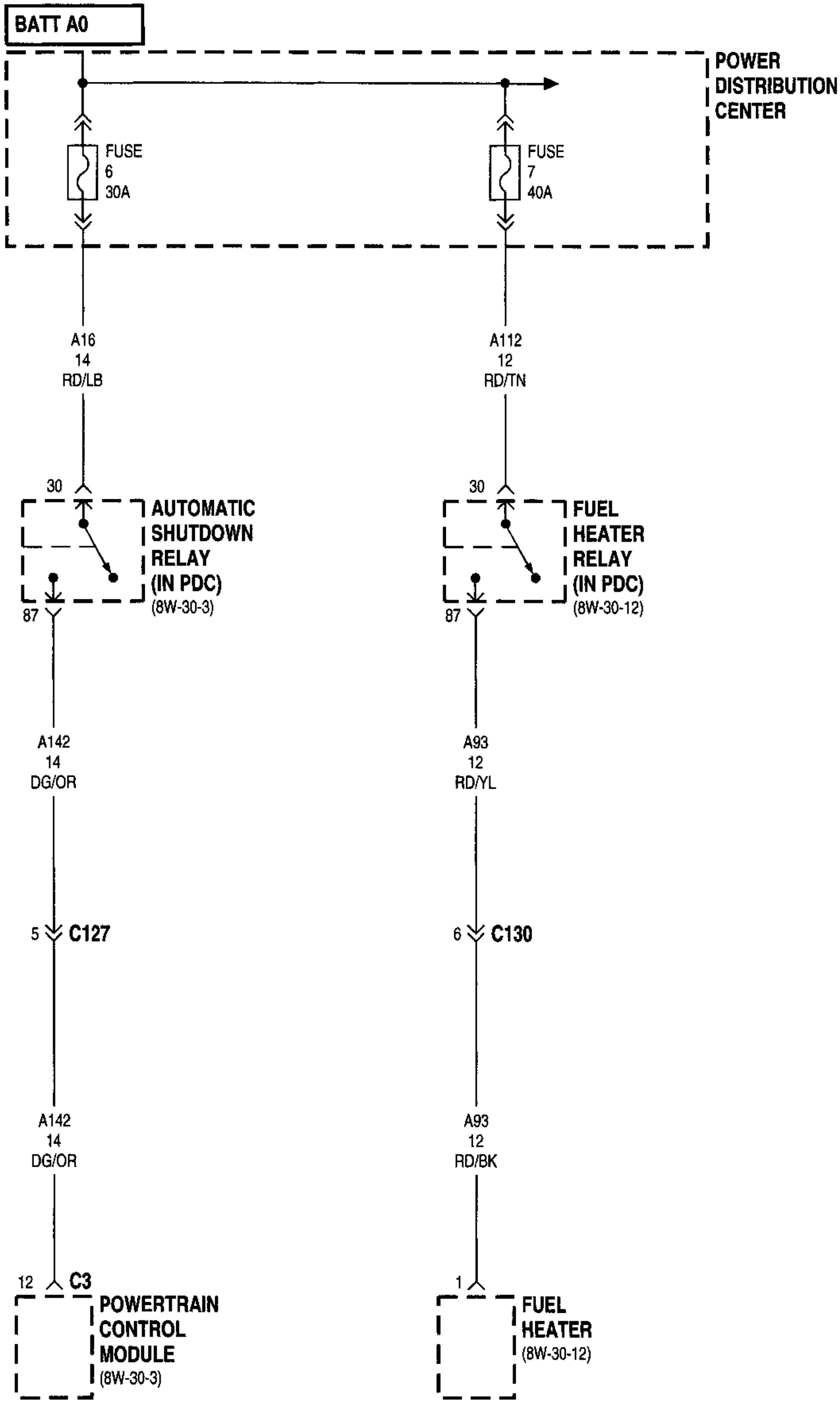

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8W-12 JUNCTION BLOCK

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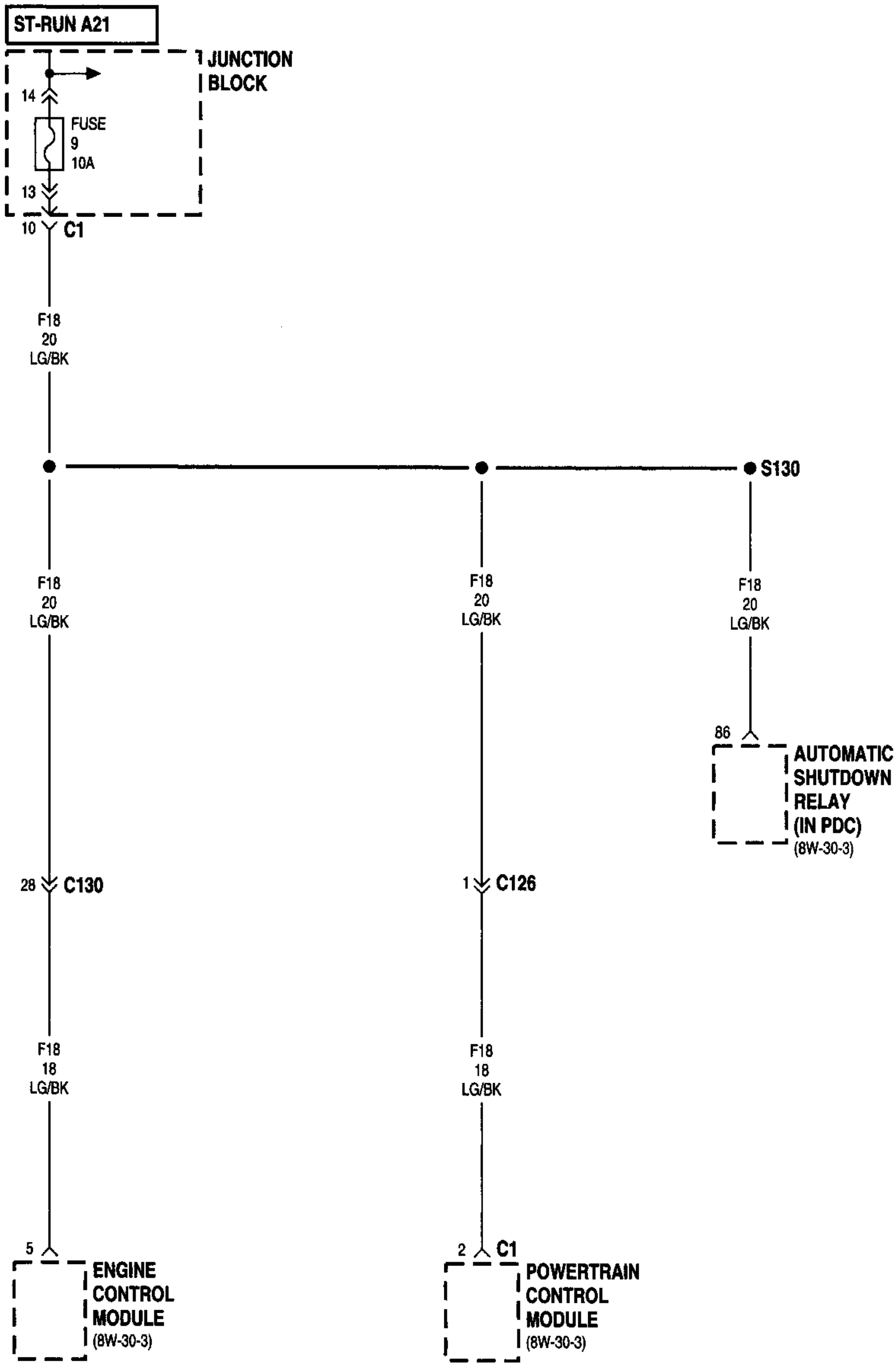

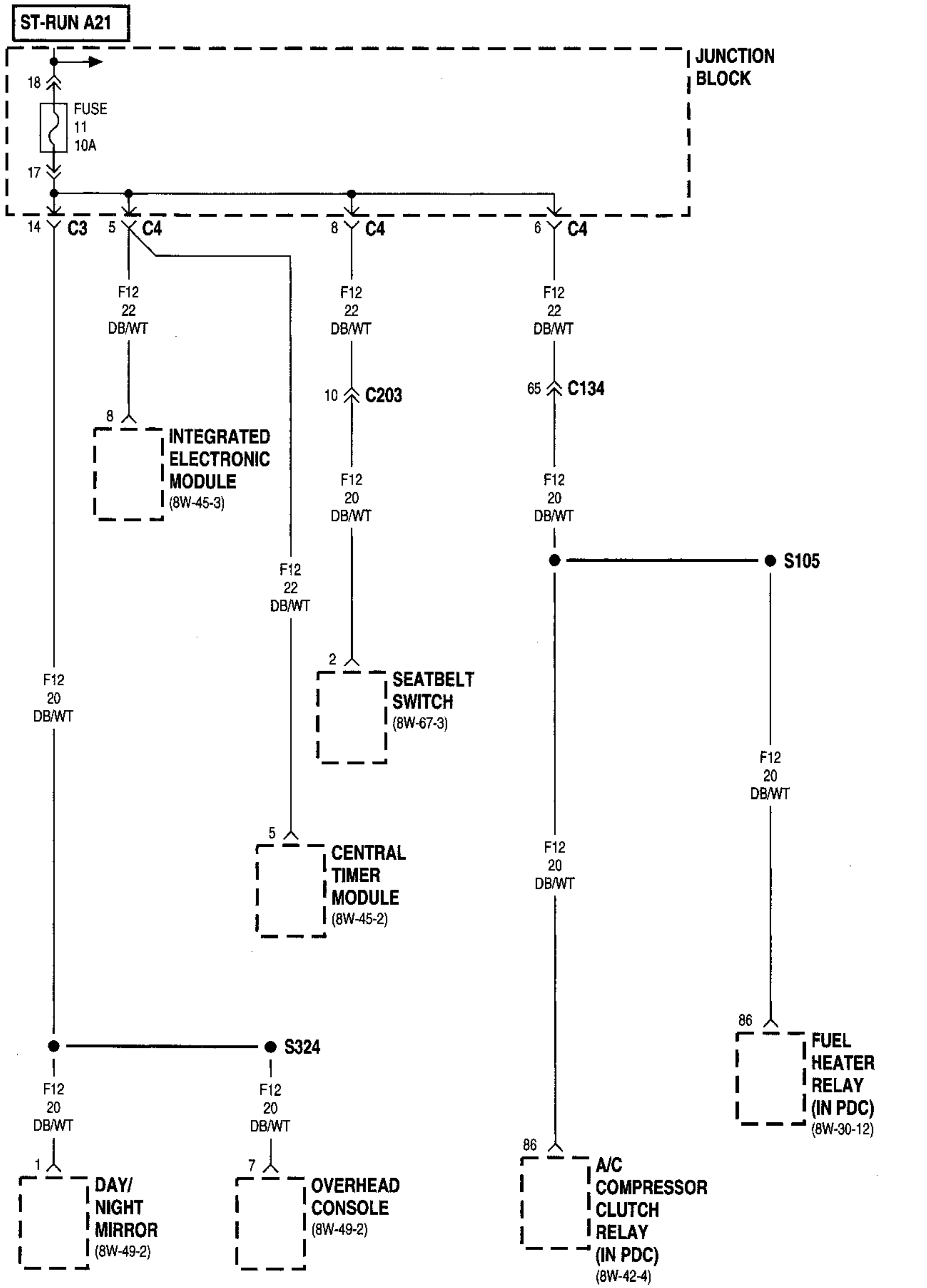
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JUNCTION BLOCK
18
FUSE
11
10A
17
14 C3
5 C4
8 C4
6 C4
F12
22
DB/WT
8
INTEGRATED ELECTRONIC MODULE
(8W-45-3)
10 C203
65 C134
F12
20
DB/WT
S105
2
SEATBELT SWITCH
(8W-67-3)
5
CENTRAL TIMER MODULE
(8W-45-2)
S324
1
DAY/ NIGHT MIRROR
(8W-49-2)
7
OVERHEAD CONSOLE
(8W-49-2)
86
A/C COMPRESSOR CLUTCH RELAY (IN PDC)
(8W-42-4)
86
FUEL HEATER RELAY (IN PDC)
(8W-30-12)

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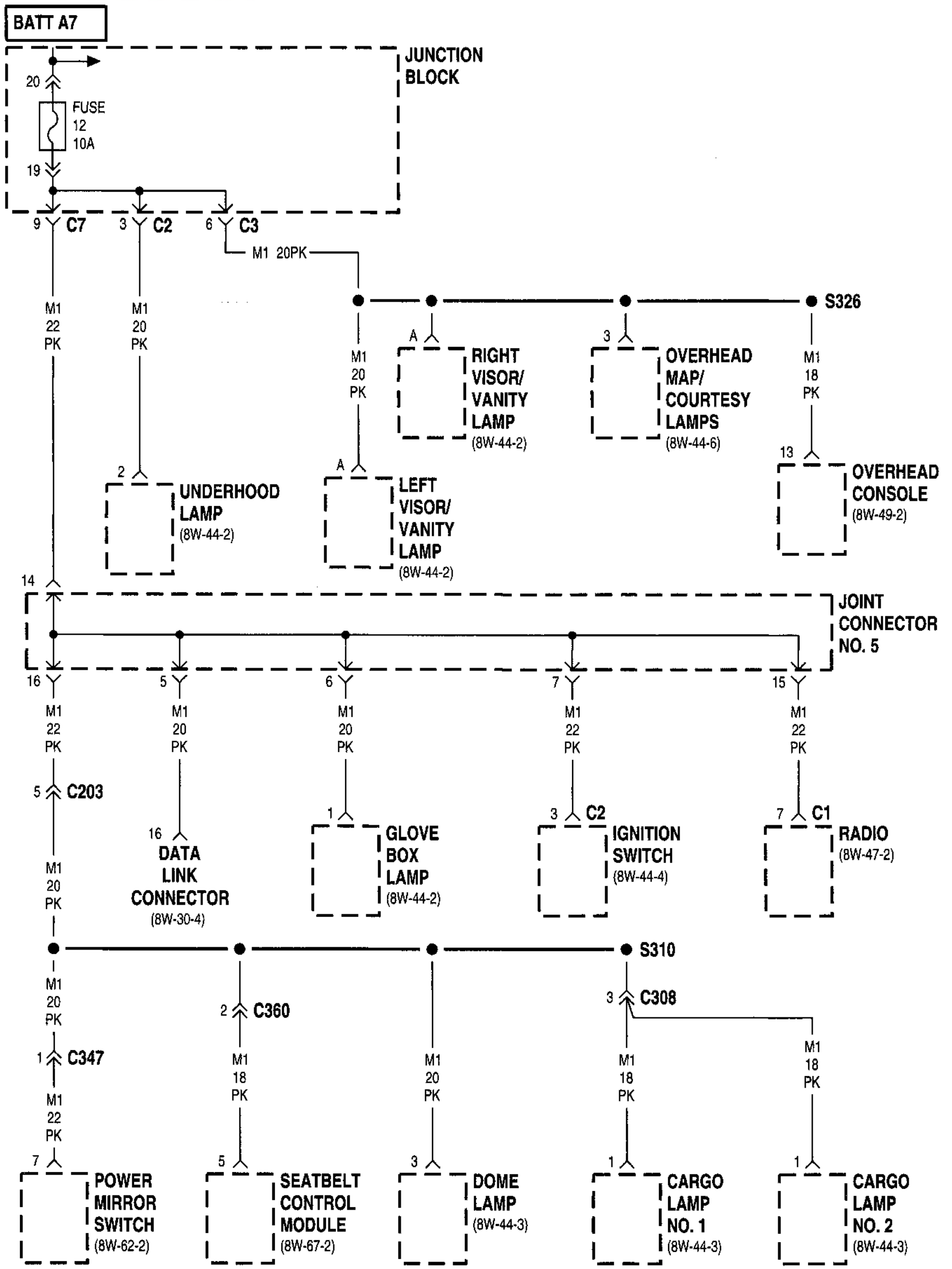

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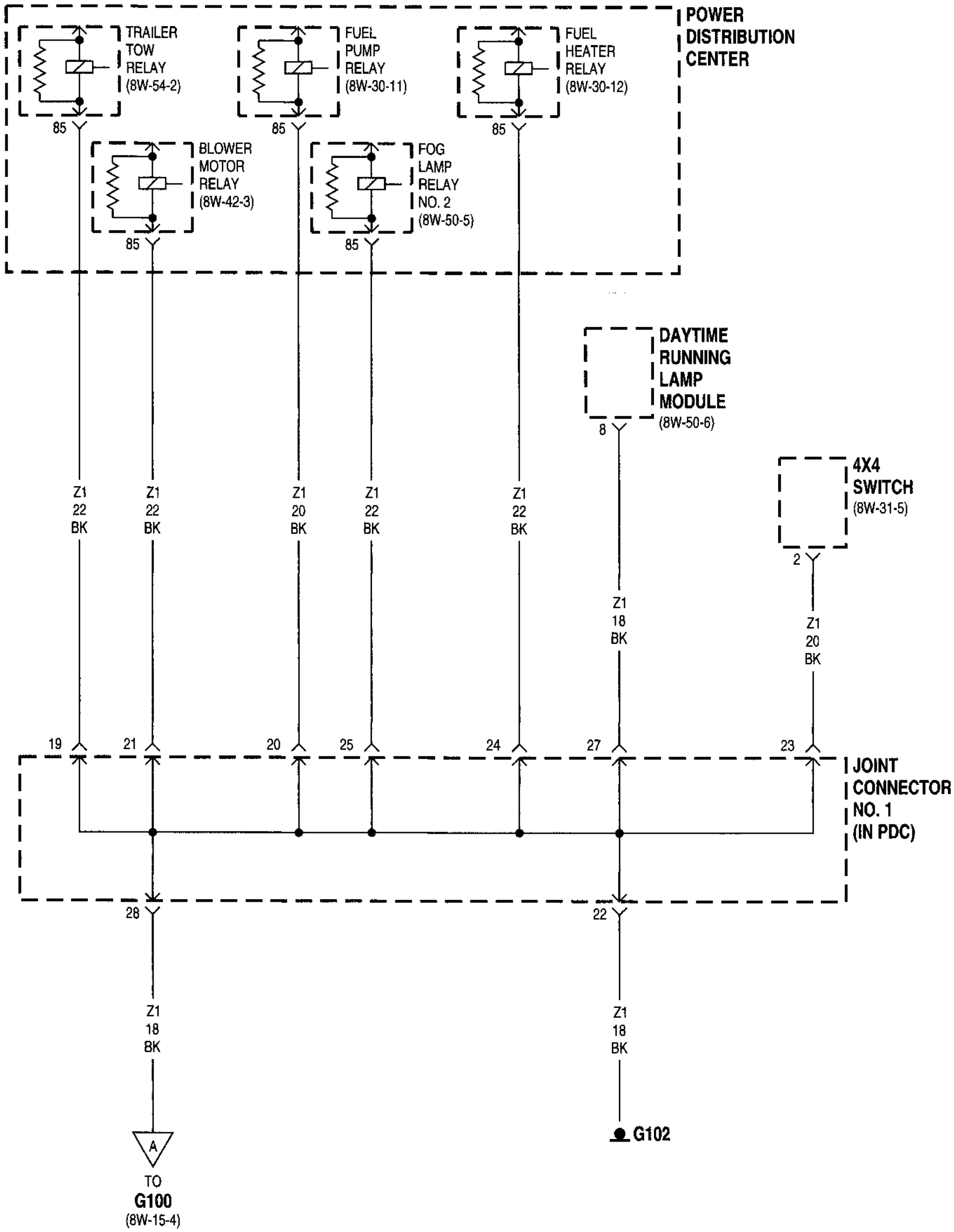
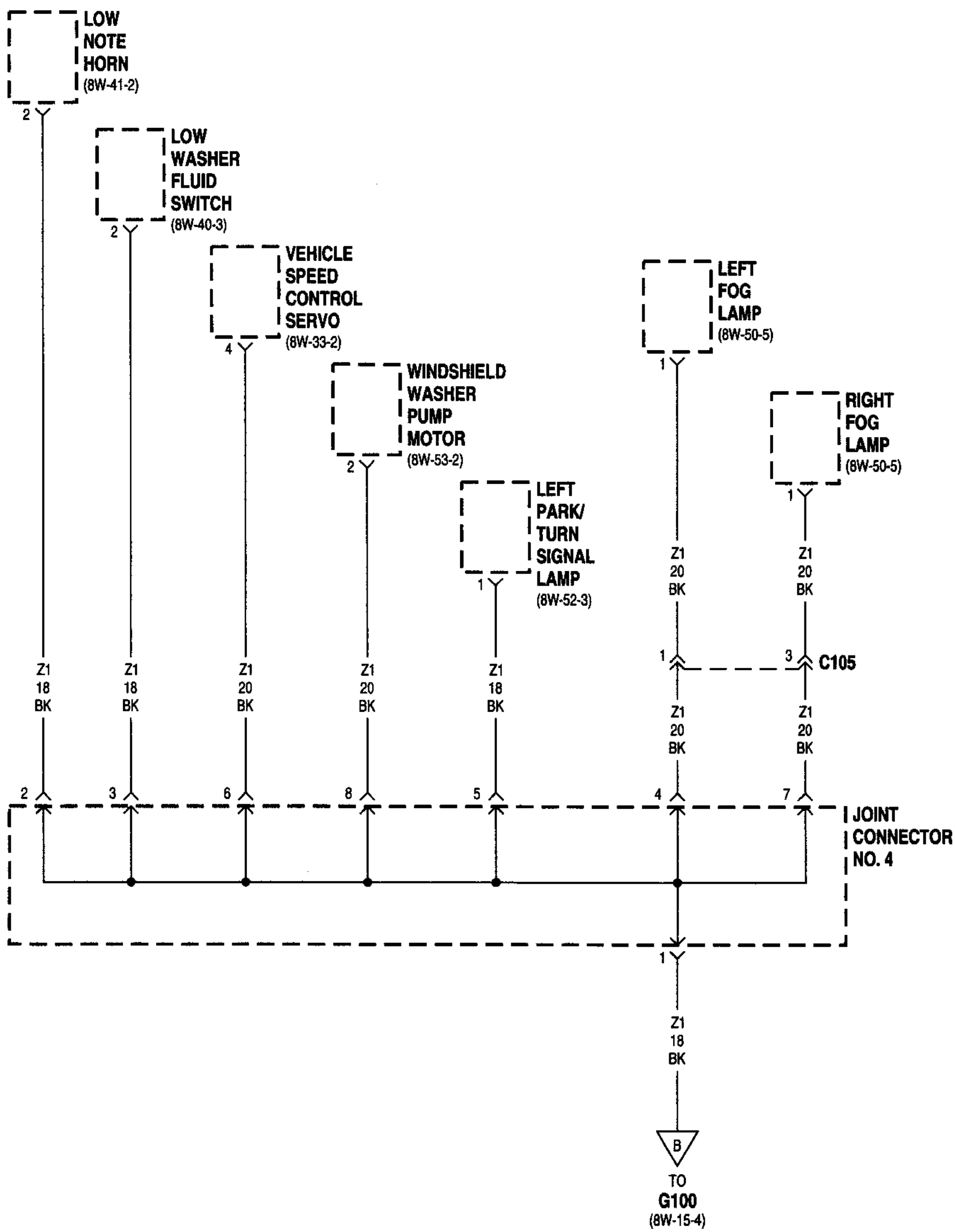
8W-15 GROUND DISTRIBUTION

Mopar AUTHENTIC RESTORATION PRODUCT

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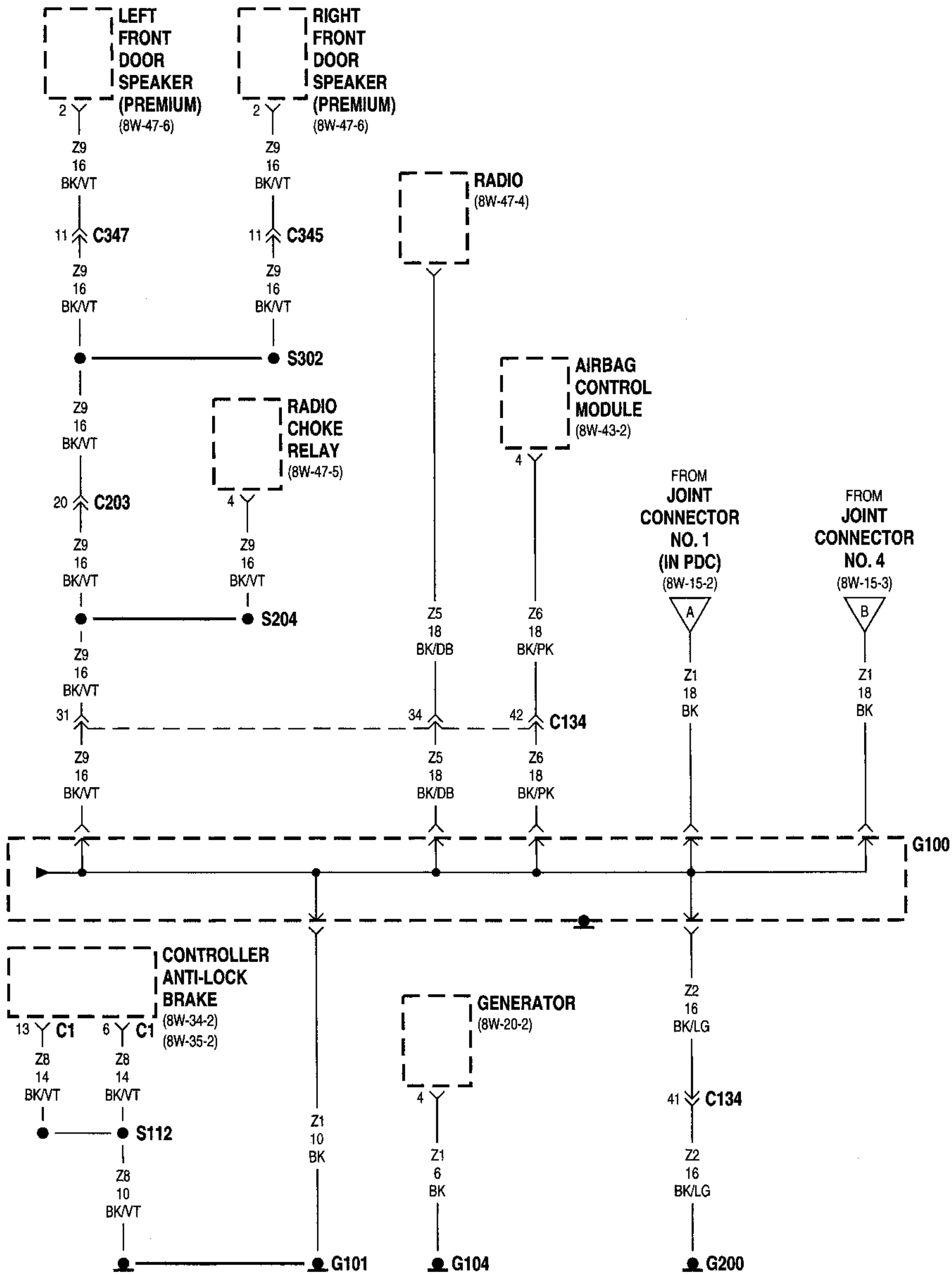
LOW WASHER FLUID SWITCH (8W-40-3)
2
VEHICLE SPEED CONTROL SERVO (8W-33-2)
4
WINDSHIELD WASHER PUMP MOTOR (8W-53-2)
2
LEFT PARK/ TURN SIGNAL LAMP (8W-52-3)
1
LEFT FOG LAMP (8W-50-5)
1
RIGHT FOG LAMP (8W-50-5)
1
Z1 18 BK
Z1 18 BK
Z1 20 BK
Z1 20 BK
Z1 18 BK
Z1 20 BK
Z1 20 BK
1
3
C105
Z1 20 BK
Z1 20 BK
2
3
6
8
5
4
7
JOINT CONNECTOR NO. 4
1
Z1 18 BK
B
TO G100 (8W-15-4)


LEFT FRONT DOOR SPEAKER (PREMIUM) (8W-47-6)
RIGHT FRONT DOOR SPEAKER (PREMIUM) (8W-47-6)
Z9 16 BK/VT
C347
C345
RADIO (8W-47-4)
S302
AIRBAG CONTROL MODULE (8W-43-2)
RADIO CHOKE RELAY (8W-47-5)
C203
FROM JOINT CONNECTOR NO. 1 (IN PDC) (8W-15-2)
FROM JOINT CONNECTOR NO. 4 (8W-15-3)
S204
Z5 18 BK/DB
Z6 18 BK/PK
Z1 18 BK
C134
G100
CONTROLLER ANTI-LOCK BRAKE (8W-34-2) (8W-35-2)
C1
GENERATOR (8W-20-2)
Z2 16 BK/LG
Z8 14 BK/VT
S112
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Z8 10 BK/VT
G101
G104
G200

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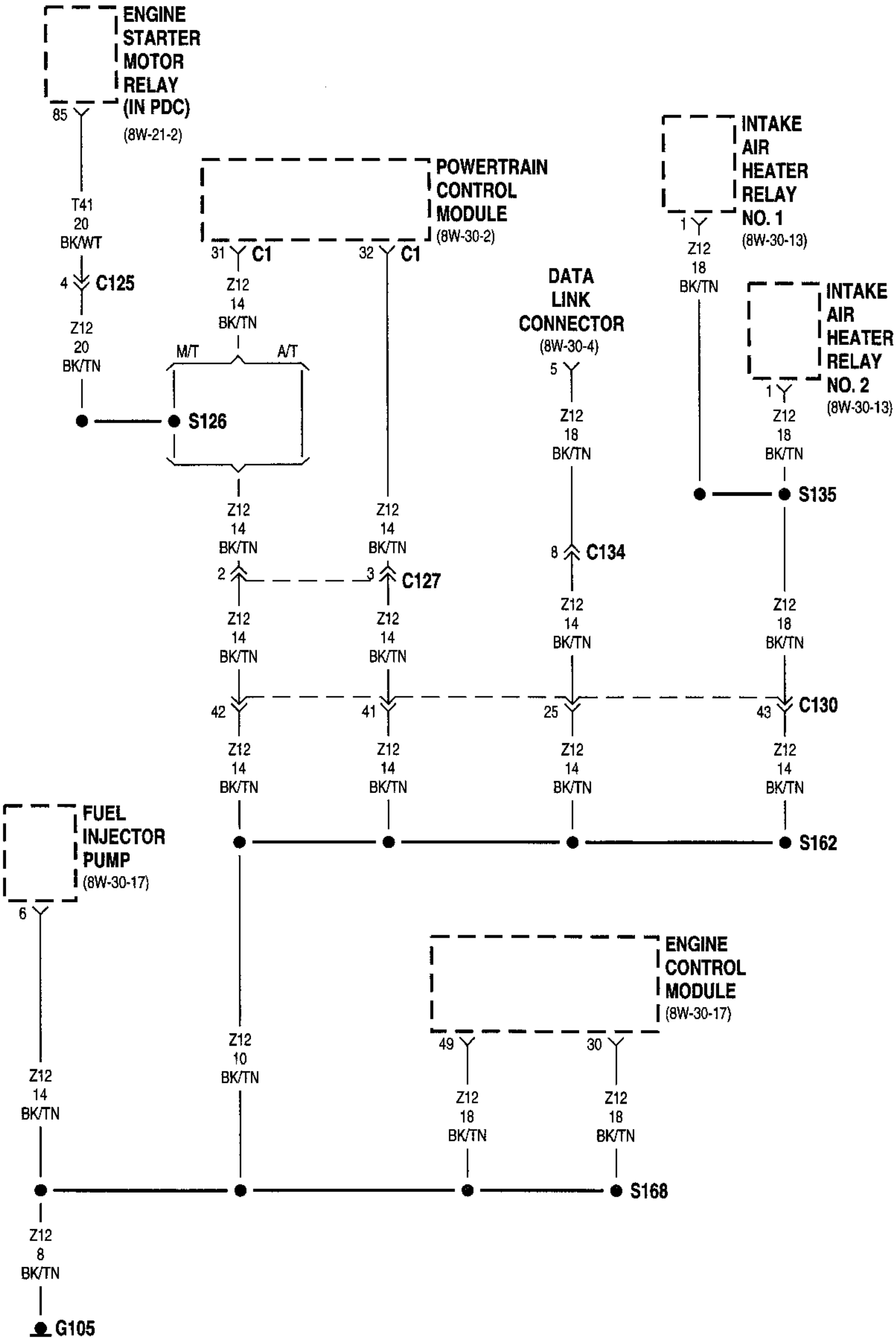

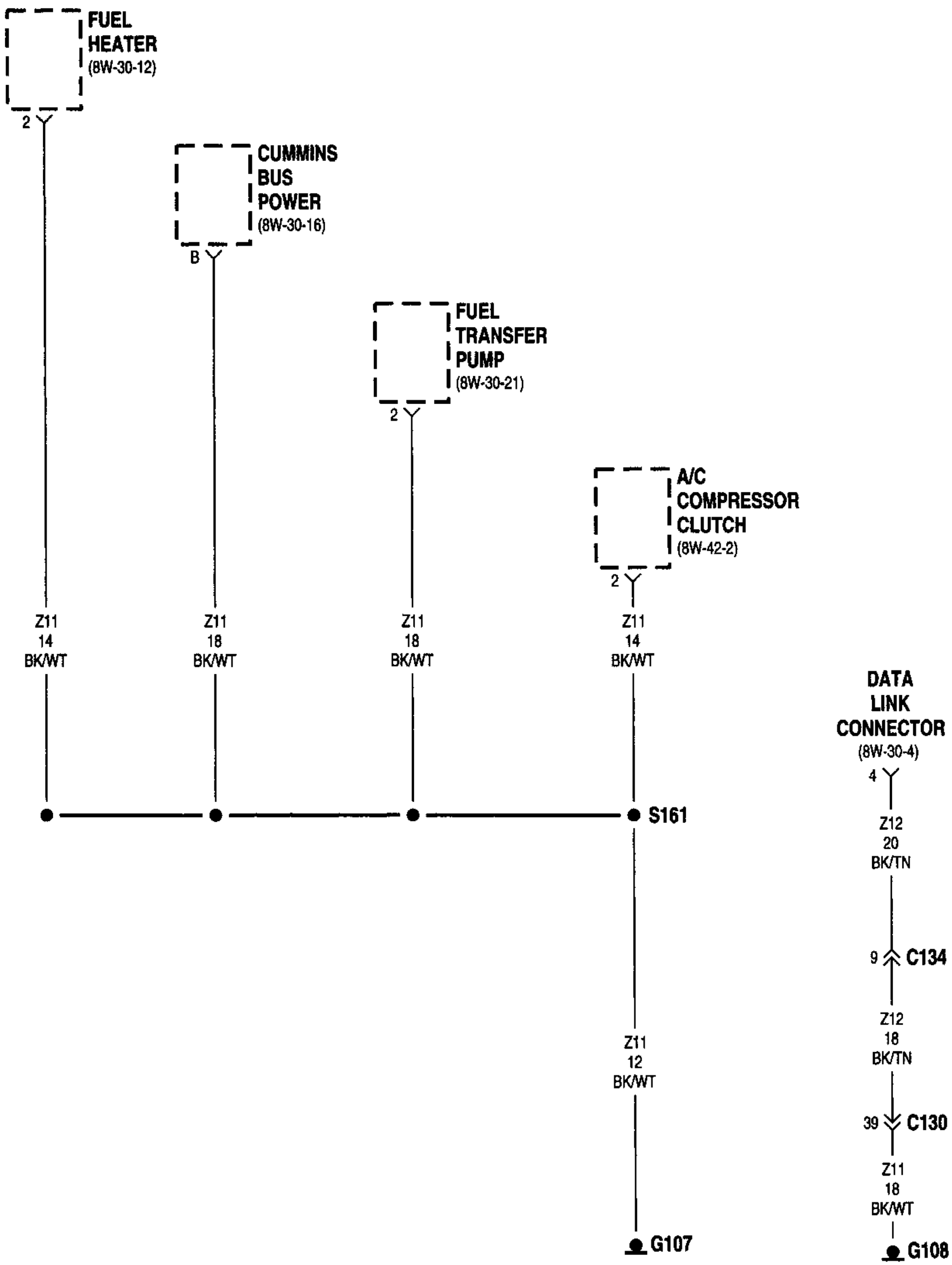
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POWER
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COMPRESSOR
CLUTCH
(8W-42-2)
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BK/WT
Z11
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BK/WT
Z11
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BK/WT
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14
BK/WT
S161
Z11
12
BK/WT
G107
DATA
LINK
CONNECTOR
(8W-30-4)
4
Z12
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BK/TN
9
C134
Z12
18
BK/TN
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C130
Z11
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BK/WT
G108

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8W-20 CHARGING SYSTEM

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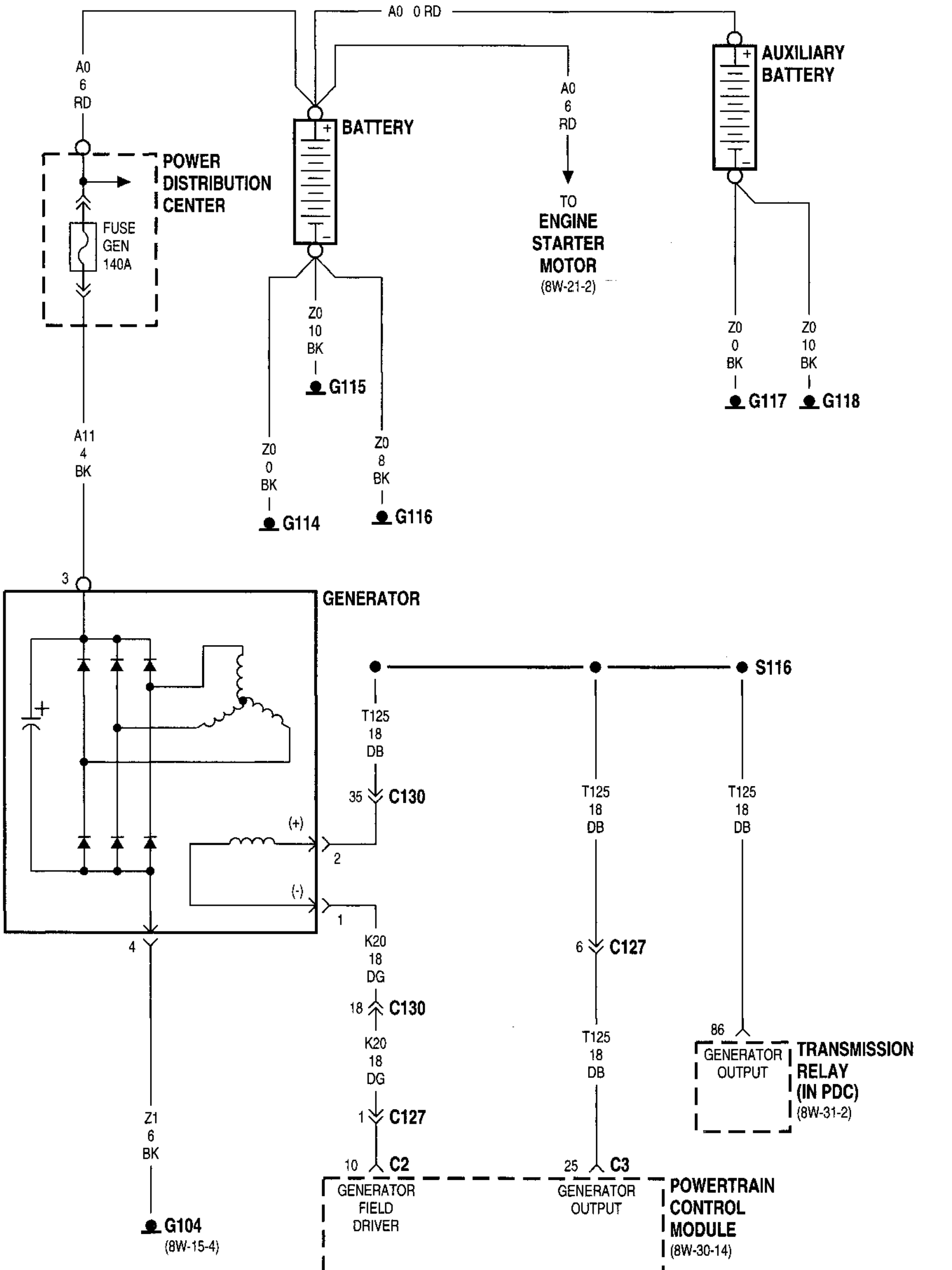

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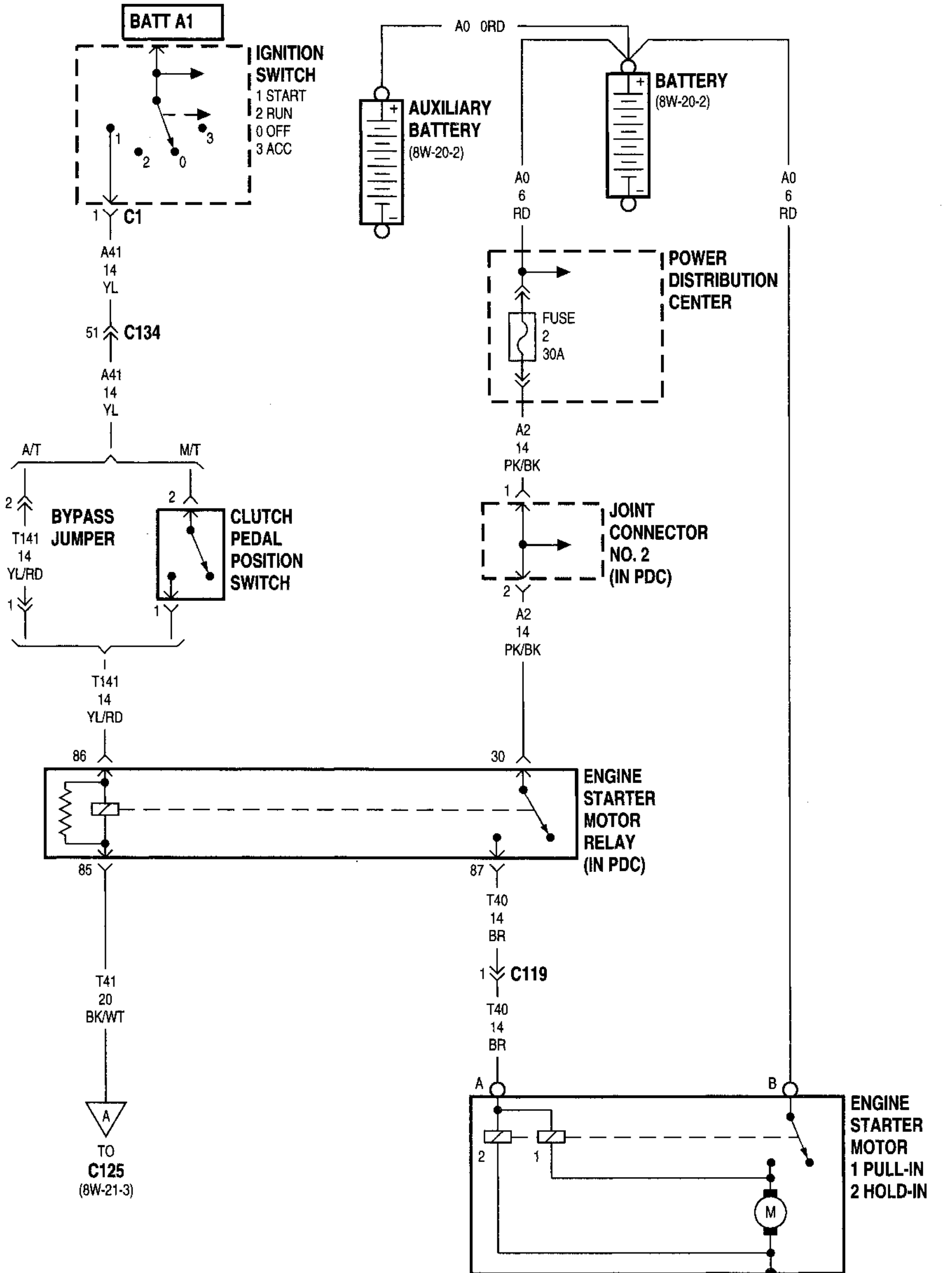
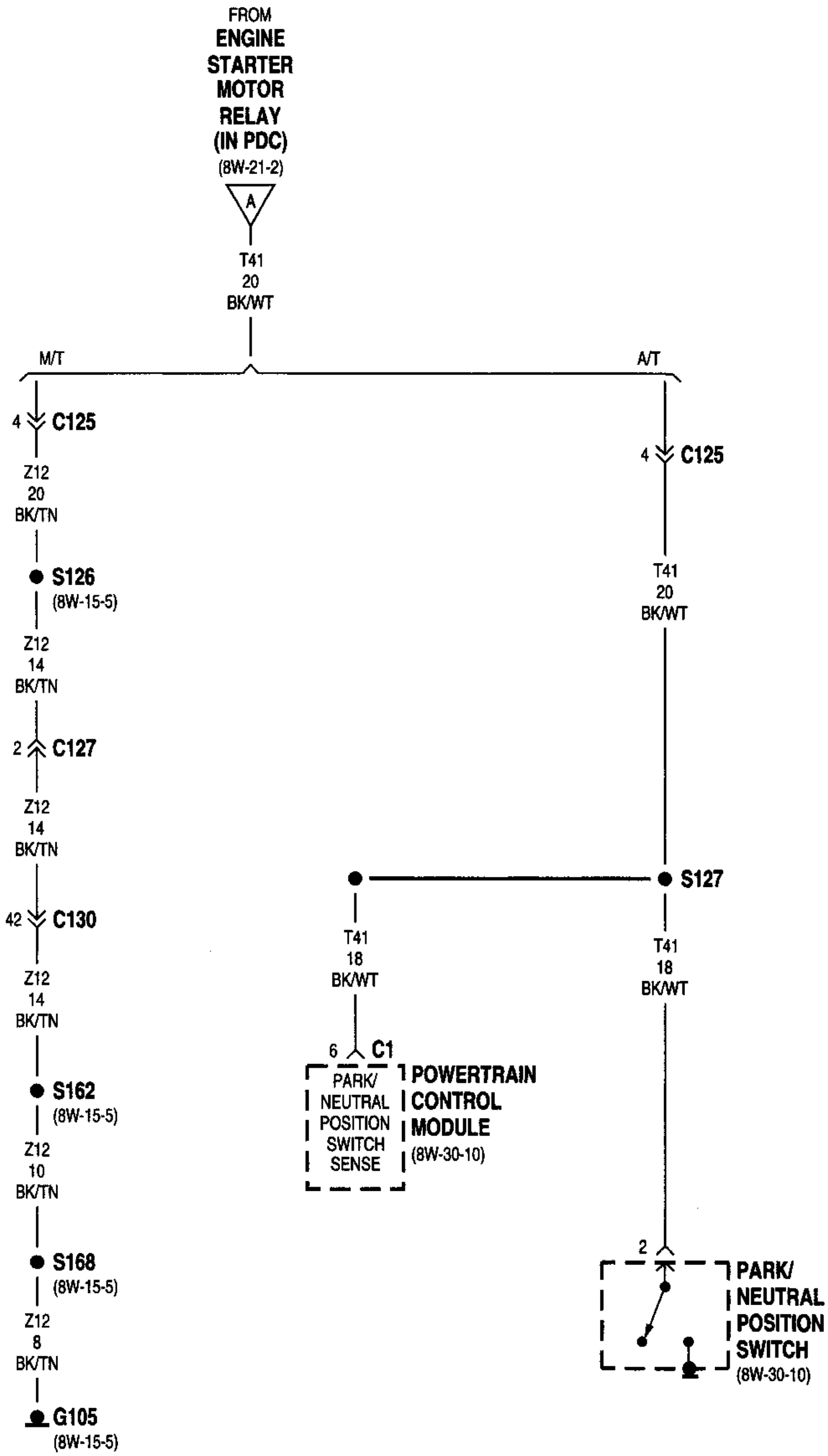
8W-21 STARTING SYSTEM

AUTHENTIC RESTORATION PRODUCT




FROM
ENGINE
STARTER
MOTOR
RELAY
(IN PDC)
(8W-21-2)
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T41
20
BK/WT
M/T
A/T
4 C125
Z12
20
BK/TN
S126
(8W-15-5)
Z12
14
BK/TN
2 C127
Z12
14
BK/TN
42 C130
Z12
14
BK/TN
S162
(8W-15-5)
Z12
10
BK/TN
S168
(8W-15-5)
Z12
8
BK/TN
G105
(8W-15-5)
4 C125
T41
20
BK/WT
S127
T41
18
BK/WT
T41
18
BK/WT
6 C1
PARK/
NEUTRAL
POSITION
SWITCH
SENSE
POWERTRAIN
CONTROL
MODULE
(8W-30-10)
2
PARK/
NEUTRAL
POSITION
SWITCH
(8W-30-10)

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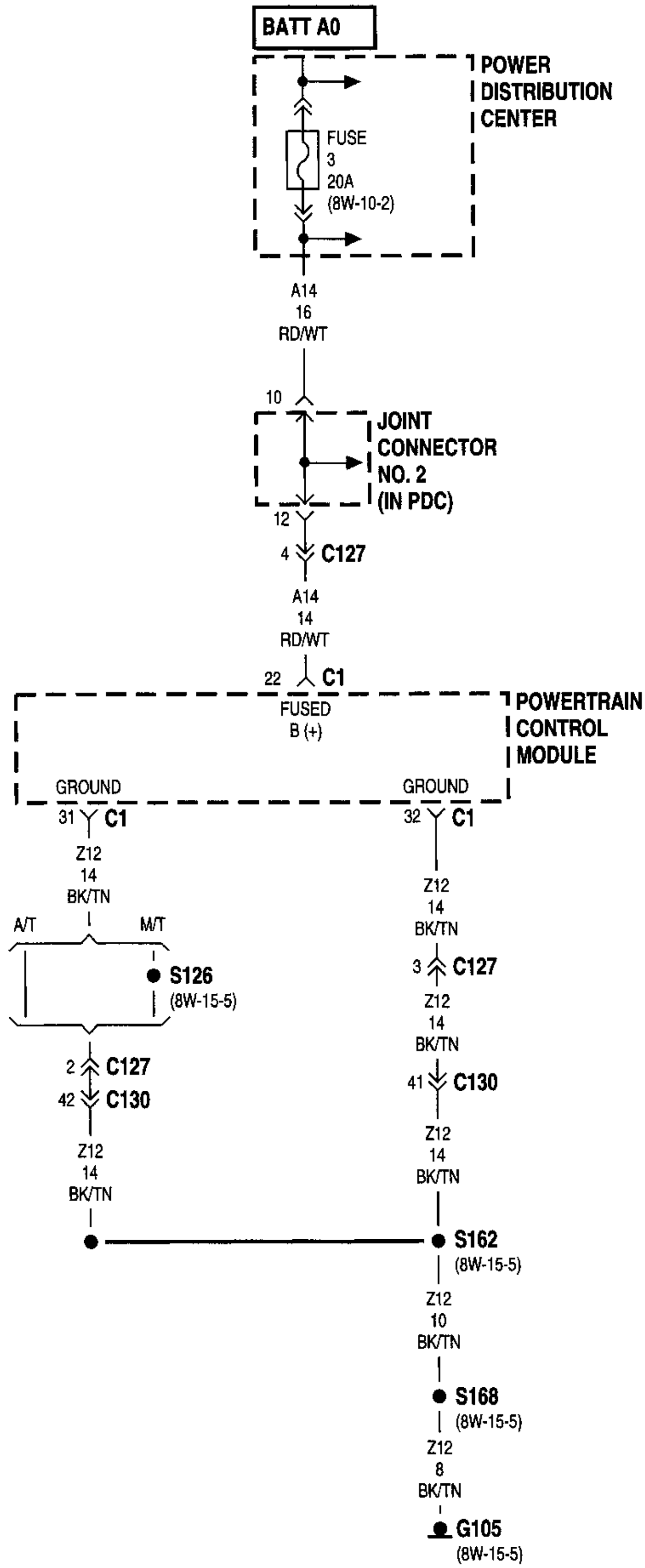
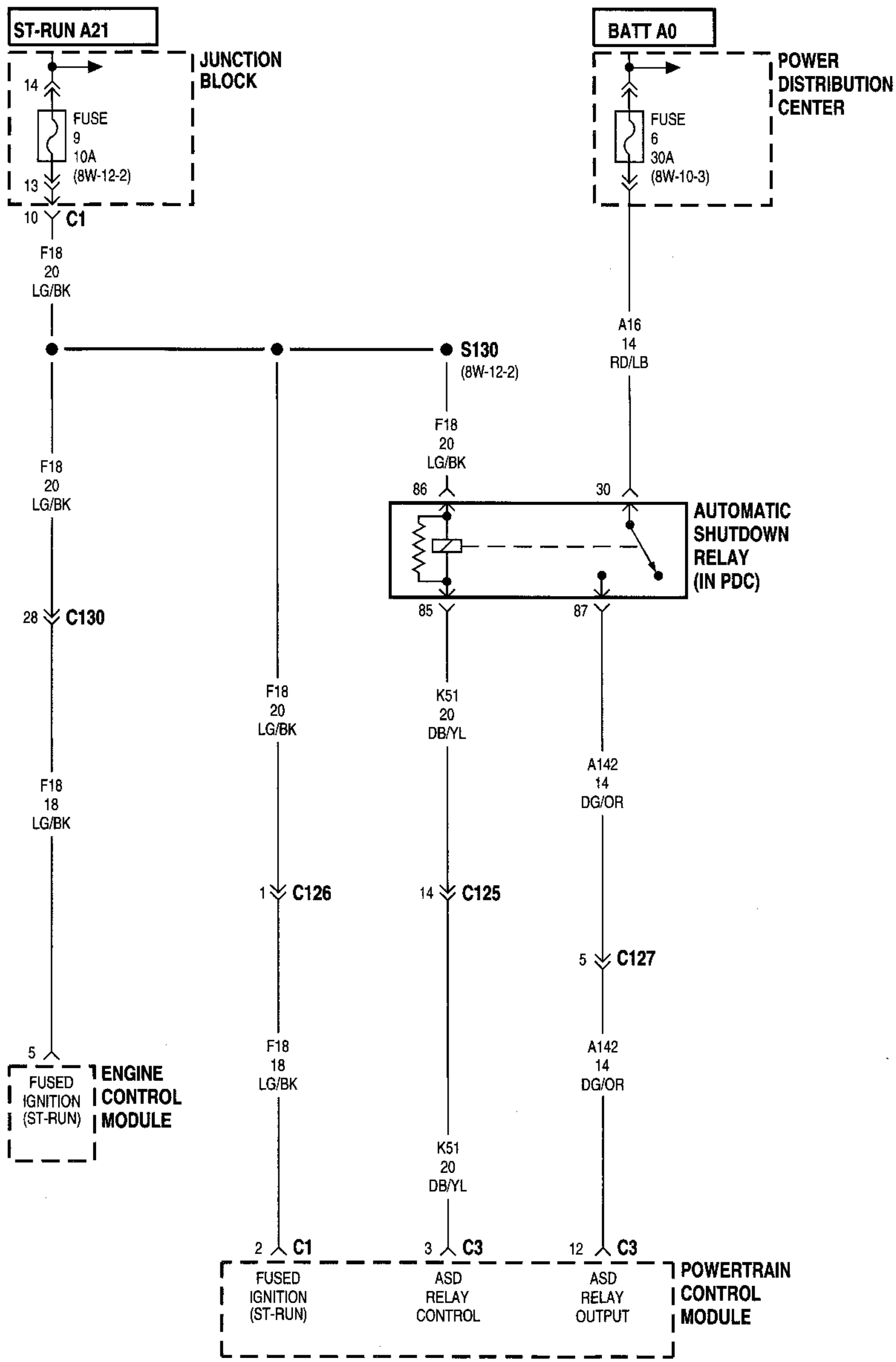
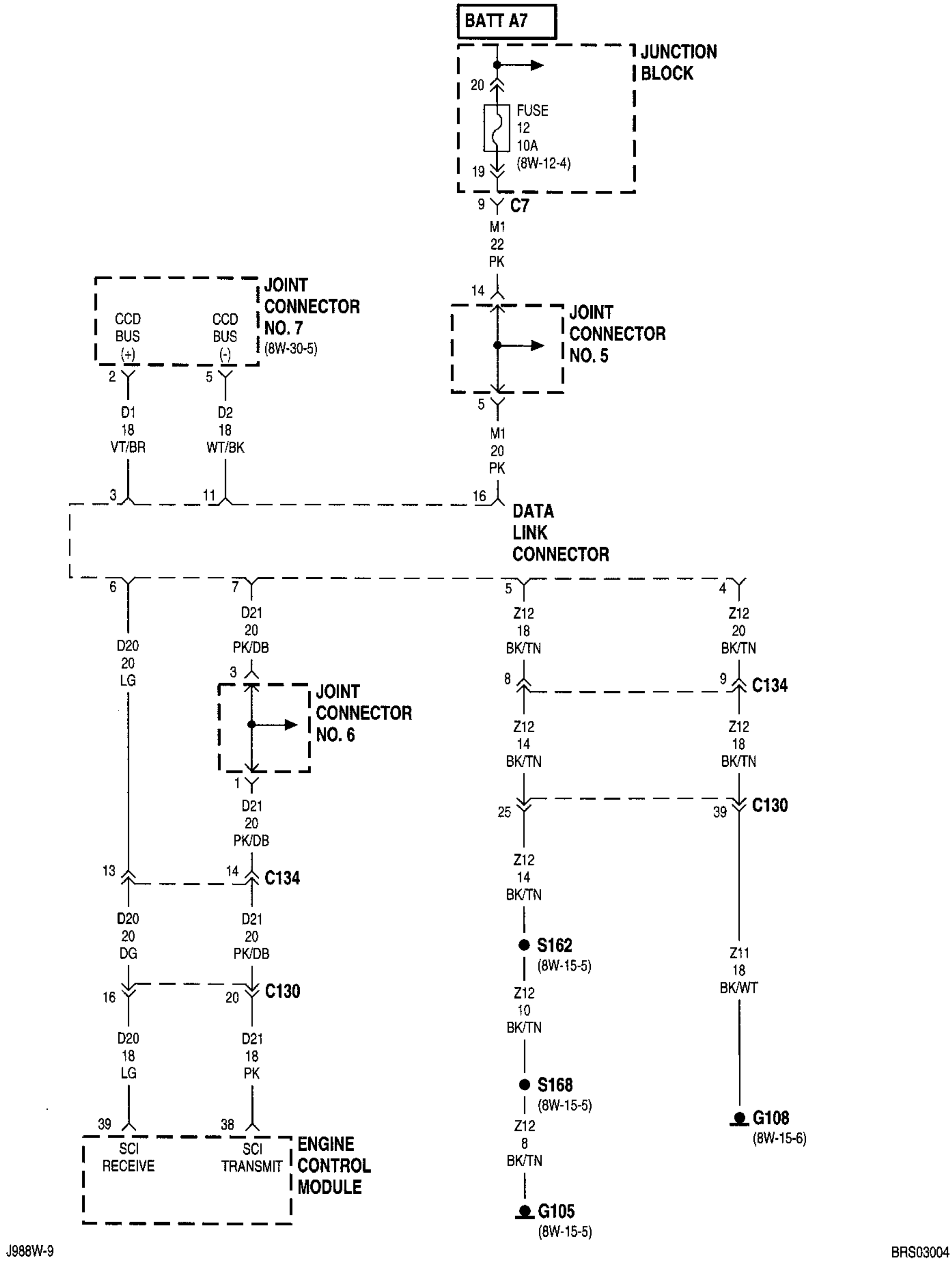
8W-30 FUEL/IGNITION SYSTEMS


BATT A0
POWER DISTRIBUTION CENTER
FUSE 3 20A (8W-10-2)
A14 16 RD/WT
10
JOINT CONNECTOR NO. 2 (IN PDC)
12
4 C127
A14 14 RD/WT
22 C1
FUSED B (+)
POWERTRAIN CONTROL MODULE
GROUND
GROUND
31 C1
32 C1
Z12 14 BK/TN
A/T
M/T
S126 (8W-15-5)
2 C127
42 C130
Z12 14 BK/TN
3 C127
Z12 14 BK/TN
41 C130
Z12 14 BK/TN
S162 (8W-15-5)
Z12 10 BK/TN
S168 (8W-15-5)
Z12 8 BK/TN
G105 (8W-15-5)


ST-RUN A21
JUNCTION BLOCK
14
FUSE 9 10A (8W-12-2)
13
10 C1
F18 20 LG/BK
BATT A0
POWER DISTRIBUTION CENTER
FUSE 6 30A (8W-10-3)
A16 14 RD/LB
S130 (8W-12-2)
F18 20 LG/BK
86
30
AUTOMATIC SHUTDOWN RELAY (IN PDC)
85
87
28 C130
F18 18 LG/BK
5
FUSED IGNITION (ST-RUN)
ENGINE CONTROL MODULE
1 C126
K51 20 DB/YL
14 C125
A142 14 DG/OR
5 C127
2 C1
3 C3
12 C3
FUSED IGNITION (ST-RUN)
ASD RELAY CONTROL
ASD RELAY OUTPUT
POWERTRAIN CONTROL MODULE

AUTHENTIC RESTORATION PRODUCT



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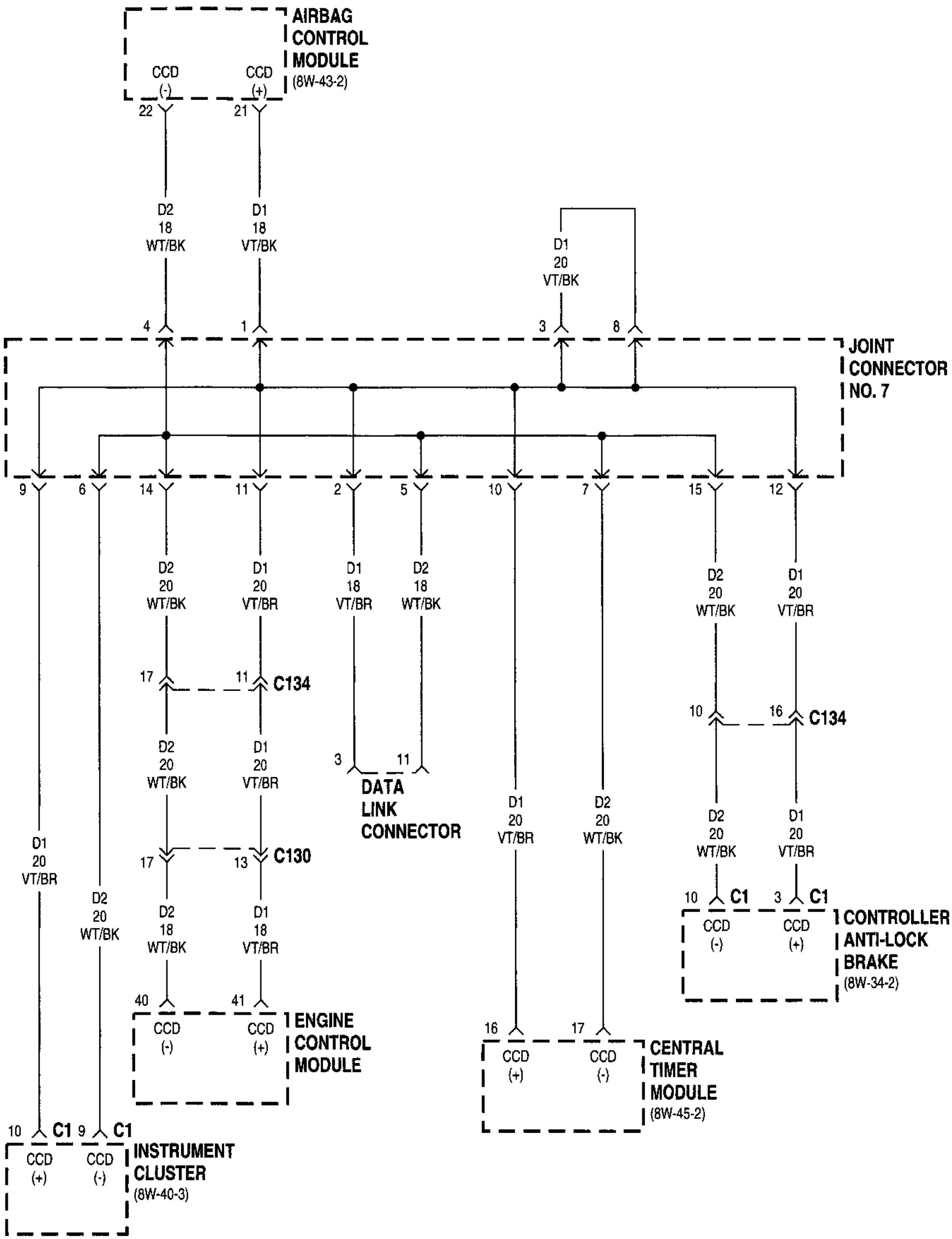
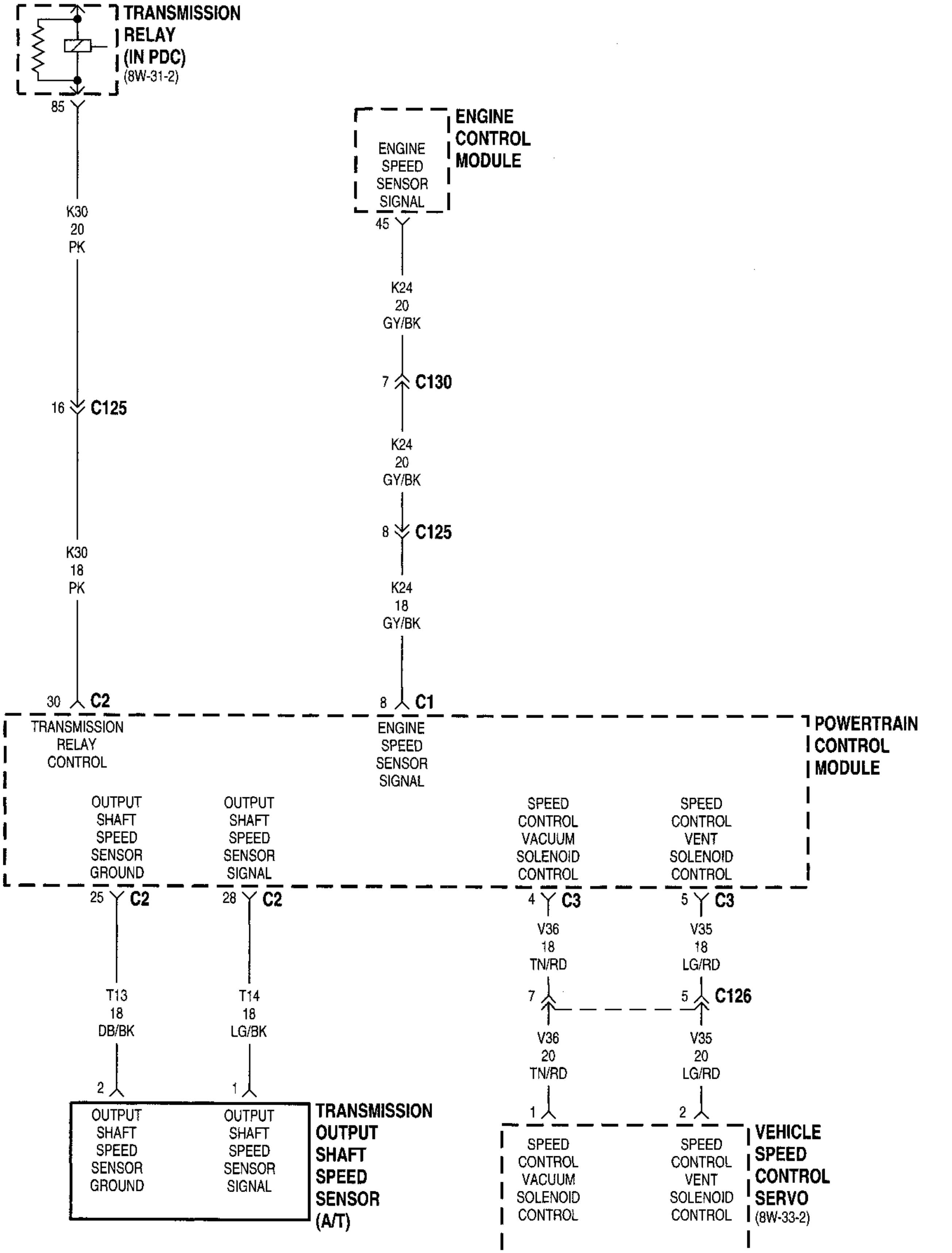


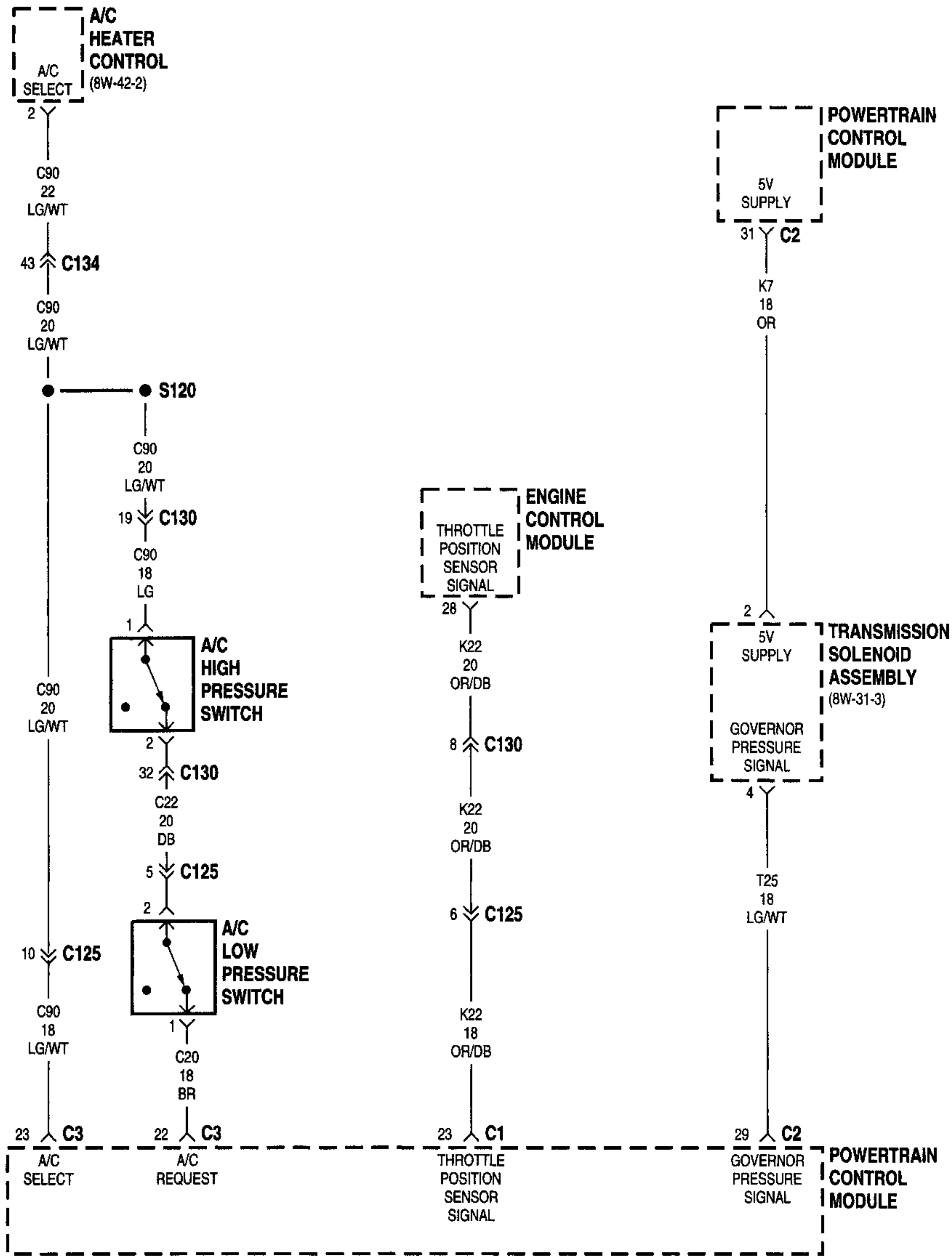
BRS03005 J988W-9

AUTHENTIC RESTORATION PRODUCT

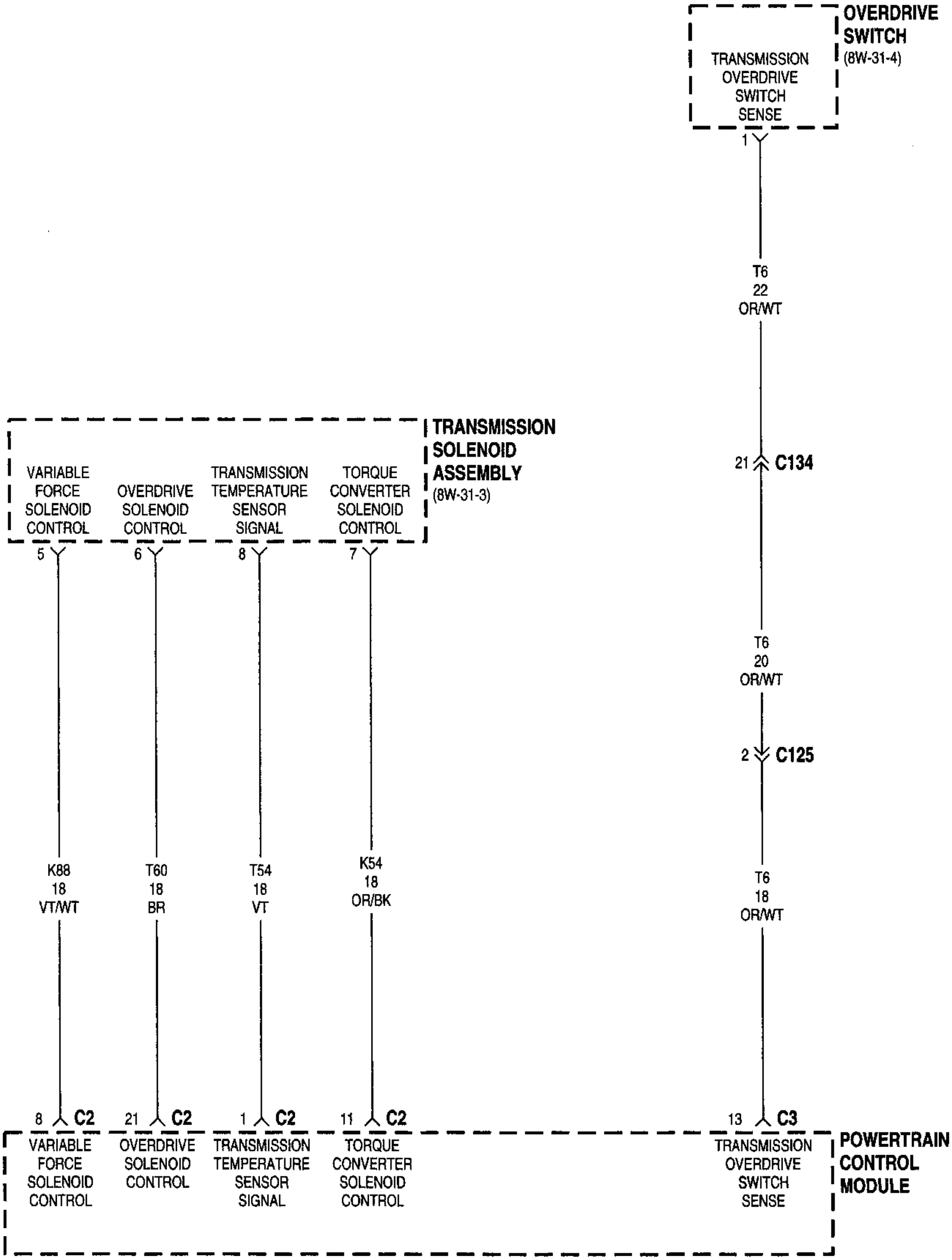


J988W-9

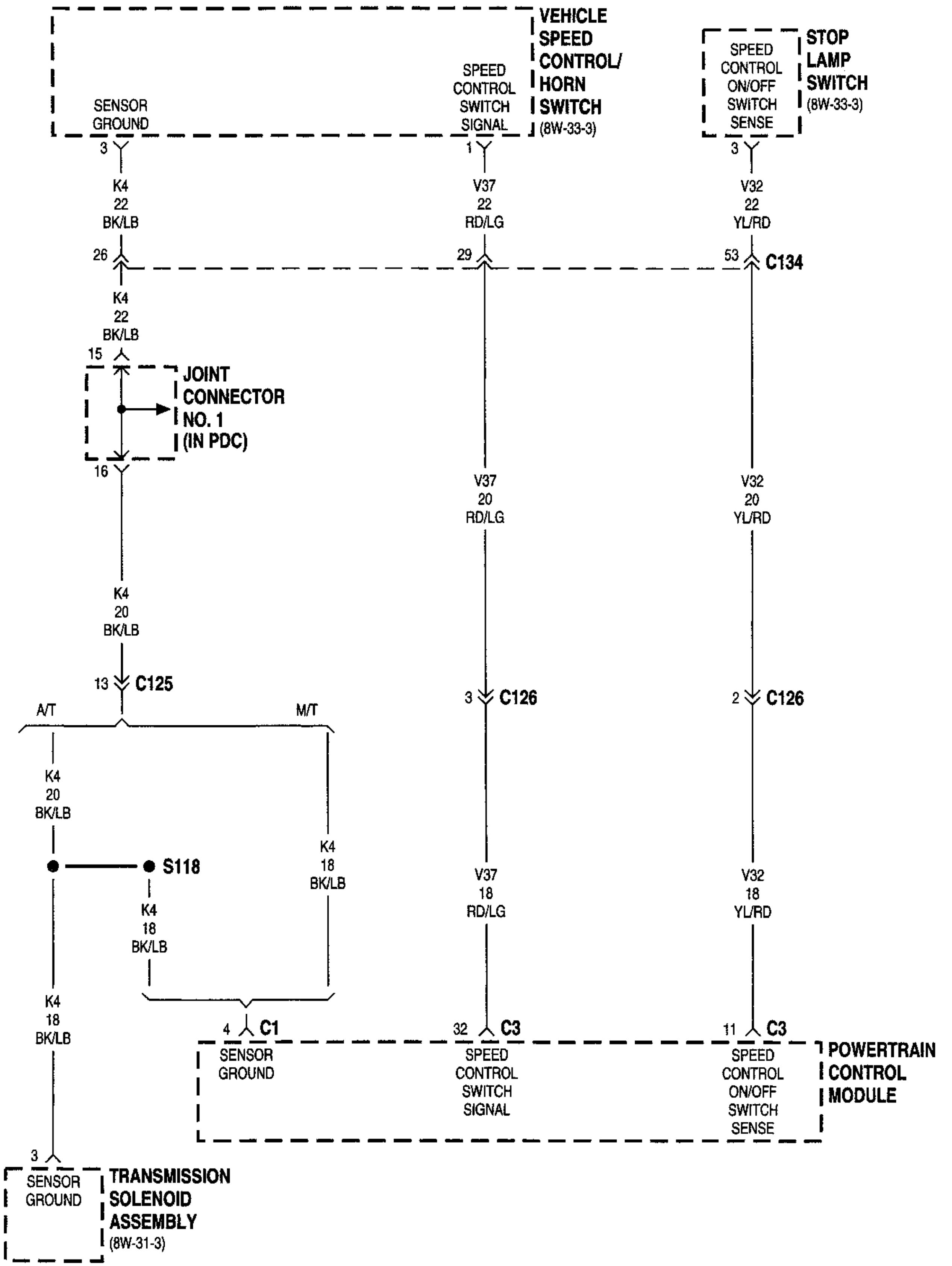
BRS03006


A/C HEATER CONTROL (8W-42-2)
A/C SELECT
2
C90 22 LG/WT
43 C134
C90 20 LG/WT
S120
C90 20 LG/WT
19 C130
C90 18 LG
1
A/C HIGH PRESSURE SWITCH
2
32 C130
C22 20 DB
5 C125
2
A/C LOW PRESSURE SWITCH
1
C20 18 BR
C90 20 LG/WT
10 C125
C90 18 LG/WT
ENGINE CONTROL MODULE
THROTTLE POSITION SENSOR SIGNAL
28
K22 20 OR/DB
8 C130
K22 20 OR/DB
6 C125
K22 18 OR/DB
POWERTRAIN CONTROL MODULE
5V SUPPLY
31 C2
K7 18 OR
2
TRANSMISSION SOLENOID ASSEMBLY (8W-31-3)
5V SUPPLY
GOVERNOR PRESSURE SIGNAL
4
T25 18 LG/WT
23 C3
22 C3
23 C1
29 C2
A/C SELECT
A/C REQUEST
THROTTLE POSITION SENSOR SIGNAL
GOVERNOR PRESSURE SIGNAL
POWERTRAIN CONTROL MODULE

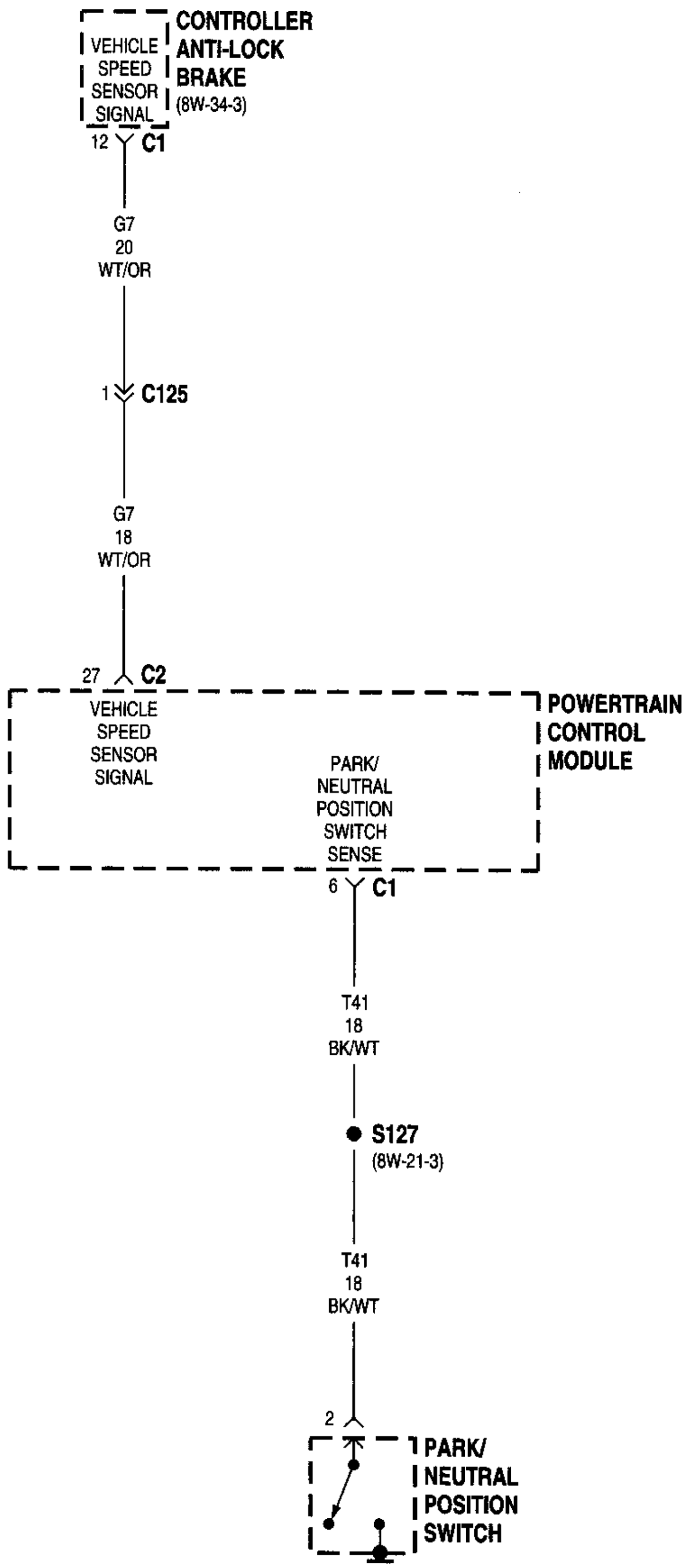
AUTHENTIC RESTORATION PRODUCT



J988W-9 BRS03008

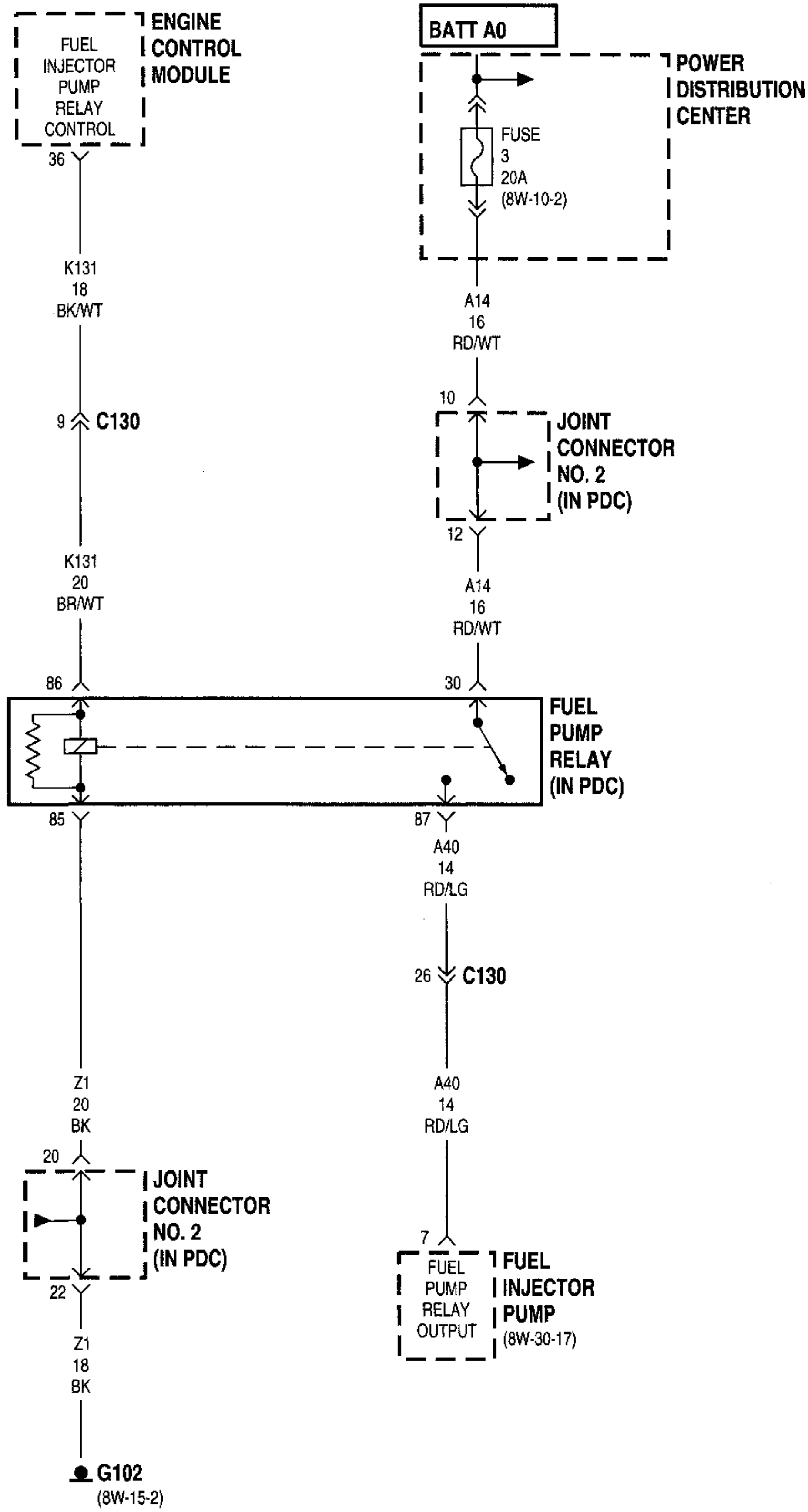

VEHICLE SPEED CONTROL/ HORN SWITCH (8W-33-3)
SENSOR GROUND
SPEED CONTROL SWITCH SIGNAL
STOP LAMP SWITCH (8W-33-3)
SPEED CONTROL ON/OFF SWITCH SENSE
K4 22 BK/LB
V37 22 RD/LG
V32 22 YL/RD
C134
JOINT CONNECTOR NO. 1 (IN PDC)
V37 20 RD/LG
V32 20 YL/RD
K4 20 BK/LB
C125
C126
A/T
M/T
S118
K4 18 BK/LB
V37 18 RD/LG
V32 18 YL/RD
C1
C3
POWERTRAIN CONTROL MODULE
SENSOR GROUND
SPEED CONTROL SWITCH SIGNAL
SPEED CONTROL ON/OFF SWITCH SENSE
TRANSMISSION SOLENOID ASSEMBLY (8W-31-3)
SENSOR GROUND

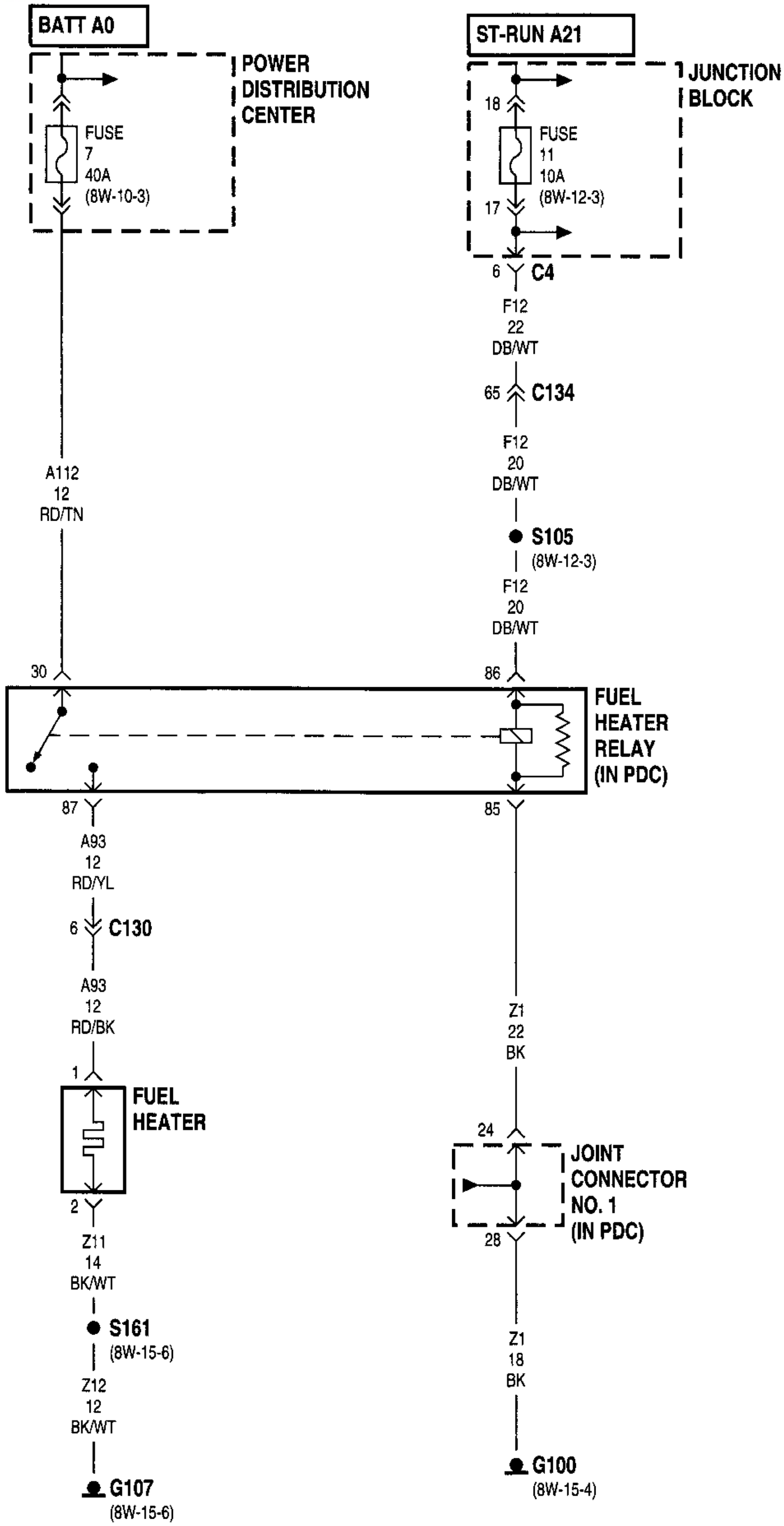
AUTHENTIC RESTORATION PRODUCT

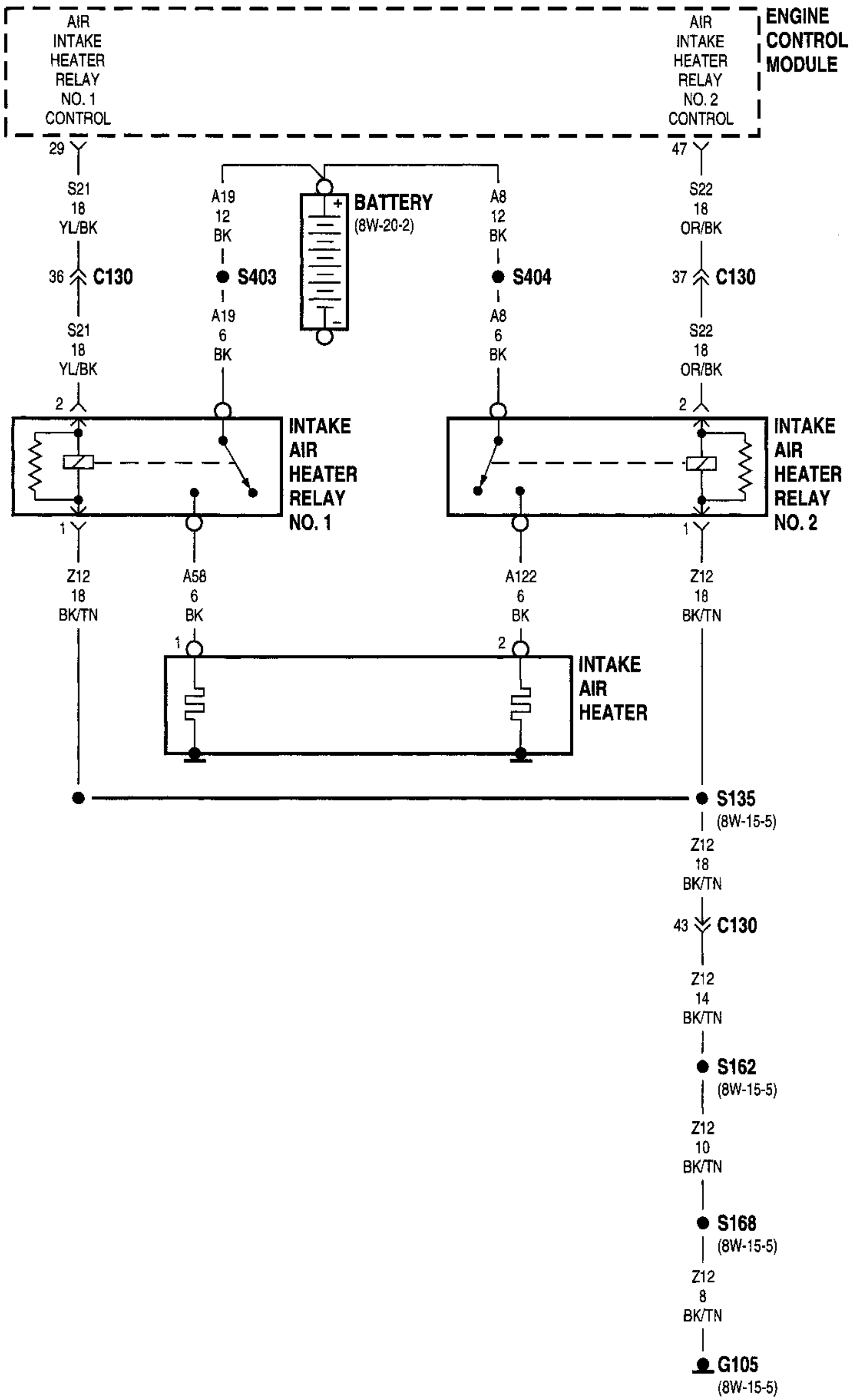


J988W-9

BRS03010


ENGINE CONTROL MODULE
FUEL INJECTOR PUMP RELAY CONTROL
36
K131
18
BK/WT
9
C130
K131
20
BR/WT
86
BATT A0
POWER DISTRIBUTION CENTER
FUSE
3
20A
(8W-10-2)
A14
16
RD/WT
10
JOINT CONNECTOR NO. 2 (IN PDC)
12
A14
16
RD/WT
30
FUEL PUMP RELAY (IN PDC)
85
87
A40
14
RD/LG
26
C130
A40
14
RD/LG
Z1
20
BK
20
JOINT CONNECTOR NO. 2 (IN PDC)
22
Z1
18
BK
G102
(8W-15-2)
7
FUEL PUMP RELAY OUTPUT
FUEL INJECTOR PUMP
(8W-30-17)


BATT A0
POWER DISTRIBUTION CENTER
FUSE 7 40A (8W-10-3)
ST-RUN A21
JUNCTION BLOCK
18
FUSE 11 10A (8W-12-3)
17
6 C4
F12 22 DB/WT
65 C134
F12 20 DB/WT
S105 (8W-12-3)
F12 20 DB/WT
A112 12 RD/TN
30
86
FUEL HEATER RELAY (IN PDC)
87
85
A93 12 RD/YL
6 C130
A93 12 RD/BK
1
FUEL HEATER
2
Z11 14 BK/WT
S161 (8W-15-6)
Z12 12 BK/WT
G107 (8W-15-6)
Z1 22 BK
24
JOINT CONNECTOR NO. 1 (IN PDC)
28
Z1 18 BK
G100 (8W-15-4)


ENGINE CONTROL MODULE
AIR INTAKE HEATER RELAY NO. 1 CONTROL
AIR INTAKE HEATER RELAY NO. 2 CONTROL
29
47
S21 18 YL/BK
A19 12 BK
BATTERY (8W-20-2)
A8 12 BK
S22 18 OR/BK
36 C130
S403
S404
37 C130
S21 18 YL/BK
A19 6 BK
A8 6 BK
S22 18 OR/BK
INTAKE AIR HEATER RELAY NO. 1
INTAKE AIR HEATER RELAY NO. 2
Z12 18 BK/TN
A58 6 BK
A122 6 BK
Z12 18 BK/TN
INTAKE AIR HEATER
S135 (8W-15-5)
Z12 18 BK/TN
43 C130
Z12 14 BK/TN
S162 (8W-15-5)
Z12 10 BK/TN
S168 (8W-15-5)
Z12 8 BK/TN
G105 (8W-15-5)

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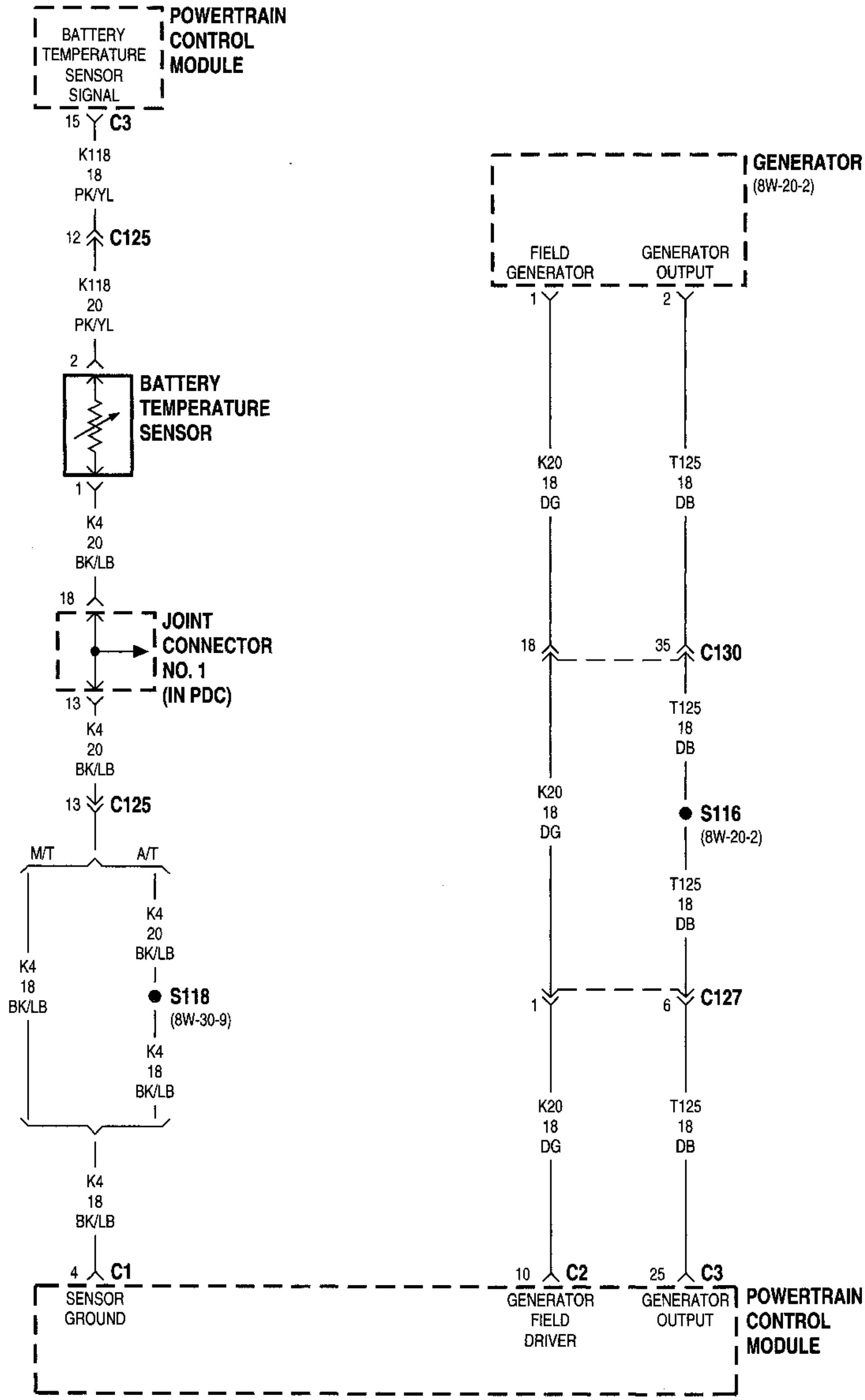
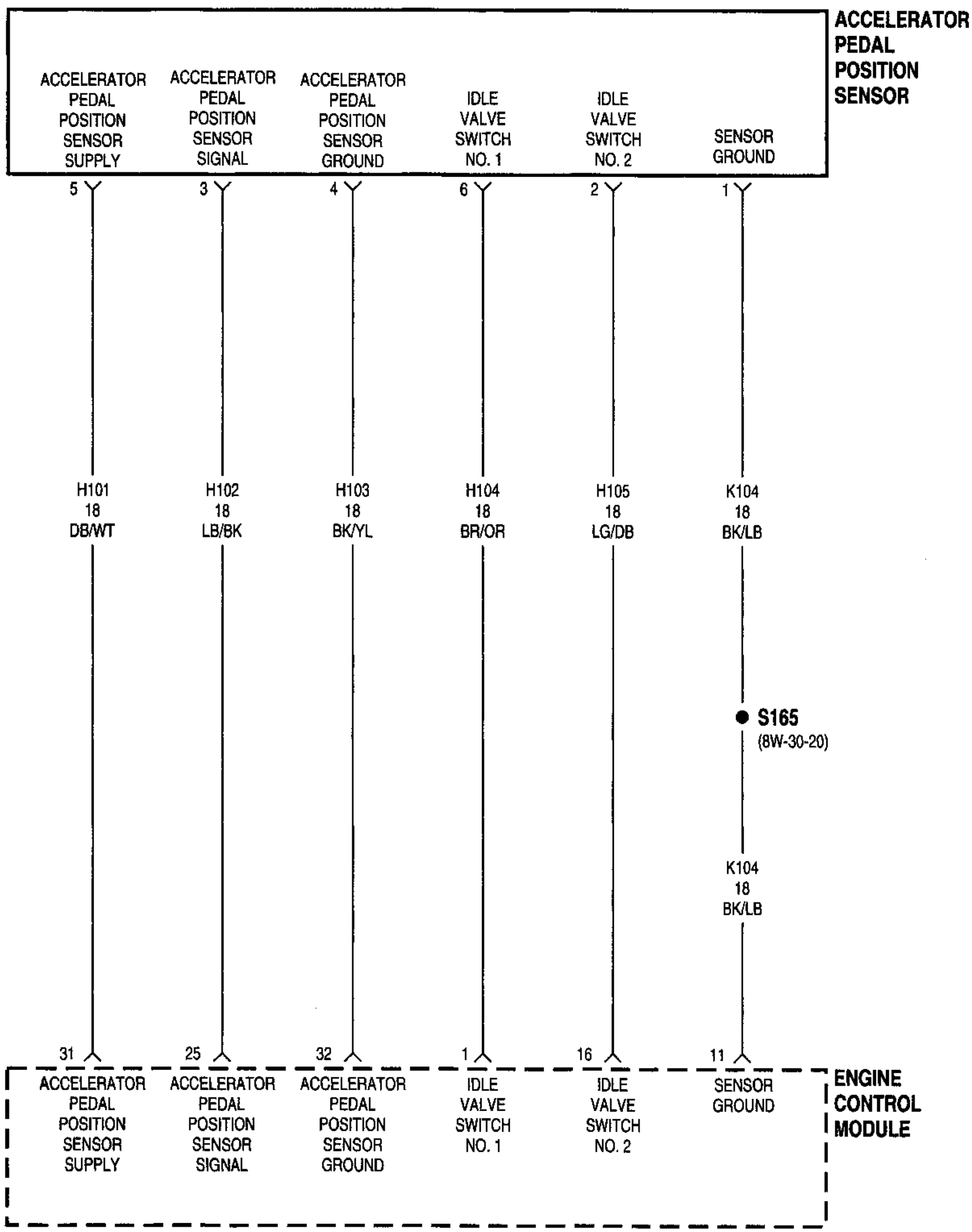
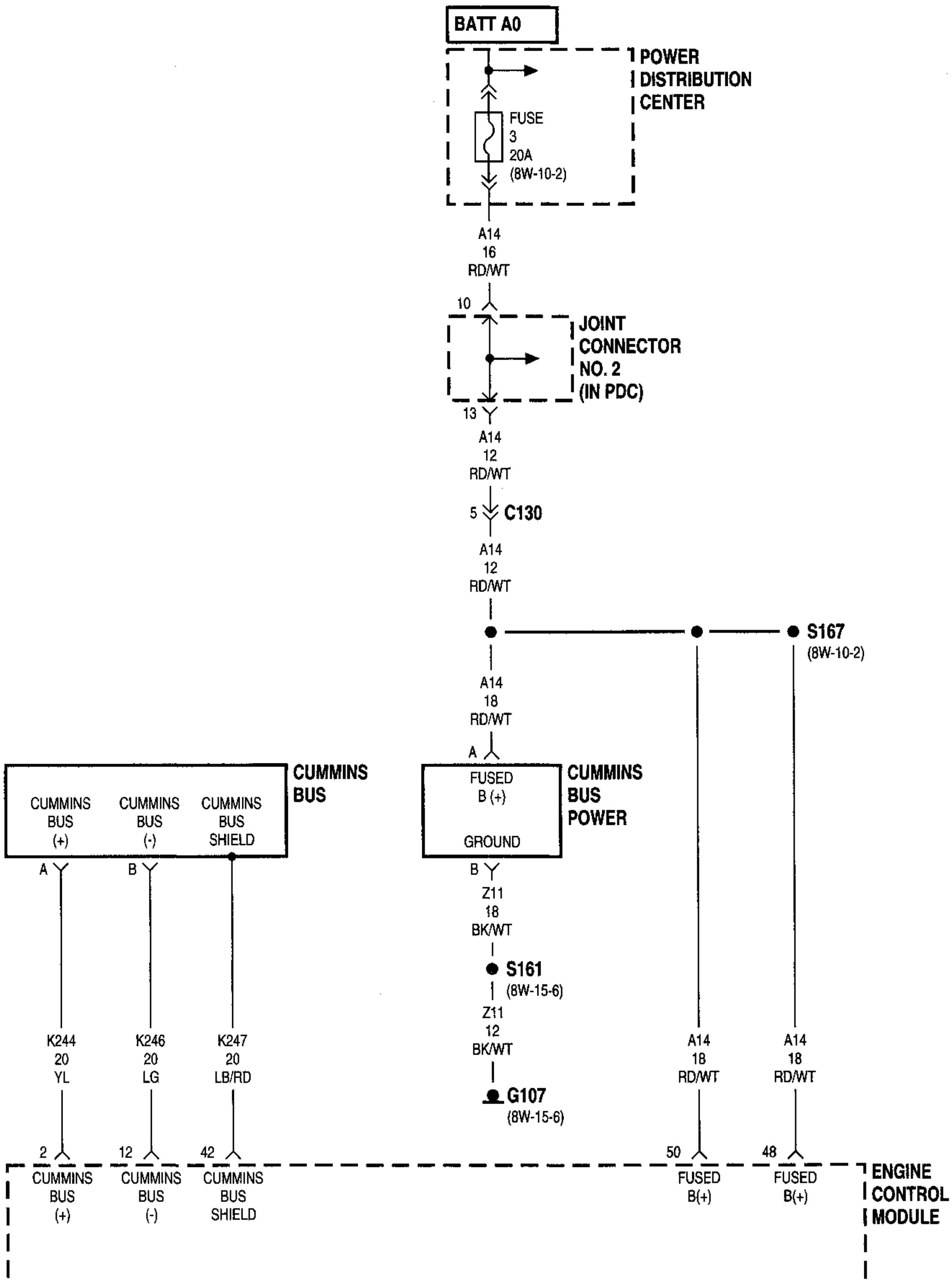


J988W-9 BRS03014


ACCELERATOR PEDAL POSITION SENSOR
ACCELERATOR PEDAL POSITION SENSOR SUPPLY
ACCELERATOR PEDAL POSITION SENSOR SIGNAL
ACCELERATOR PEDAL POSITION SENSOR GROUND
IDLE VALVE SWITCH NO. 1
IDLE VALVE SWITCH NO. 2
SENSOR GROUND
5
3
4
6
2
1
H101 18 DB/WT
H102 18 LB/BK
H103 18 BK/YL
H104 18 BR/OR
H105 18 LG/DB
K104 18 BK/LB
S165
(8W-30-20)
K104 18 BK/LB
31
25
32
1
16
11
ENGINE CONTROL MODULE
ACCELERATOR PEDAL POSITION SENSOR SUPPLY
ACCELERATOR PEDAL POSITION SENSOR SIGNAL
ACCELERATOR PEDAL POSITION SENSOR GROUND
IDLE VALVE SWITCH NO. 1
IDLE VALVE SWITCH NO. 2
SENSOR GROUND



J988W-9

BRS03016

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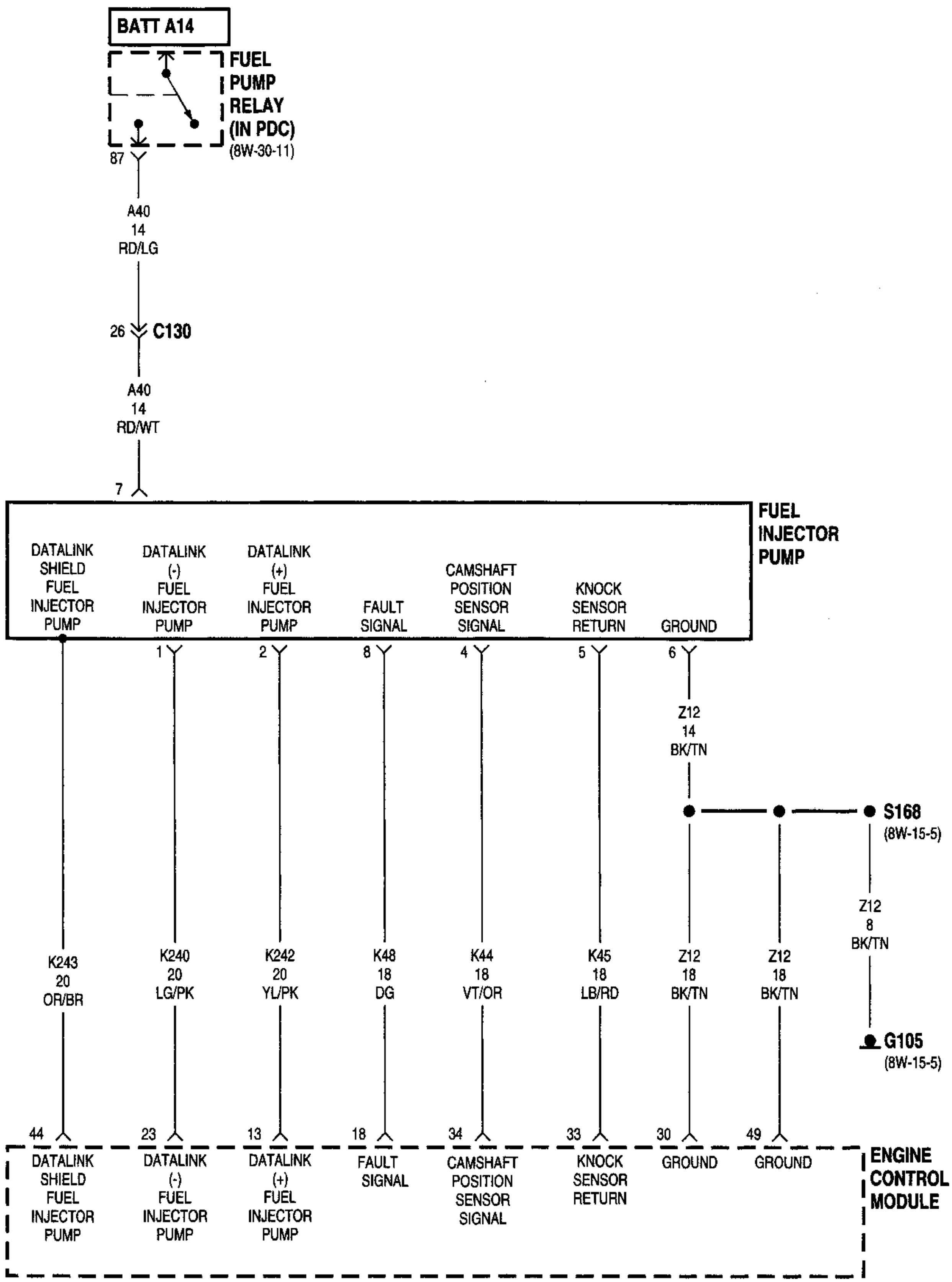
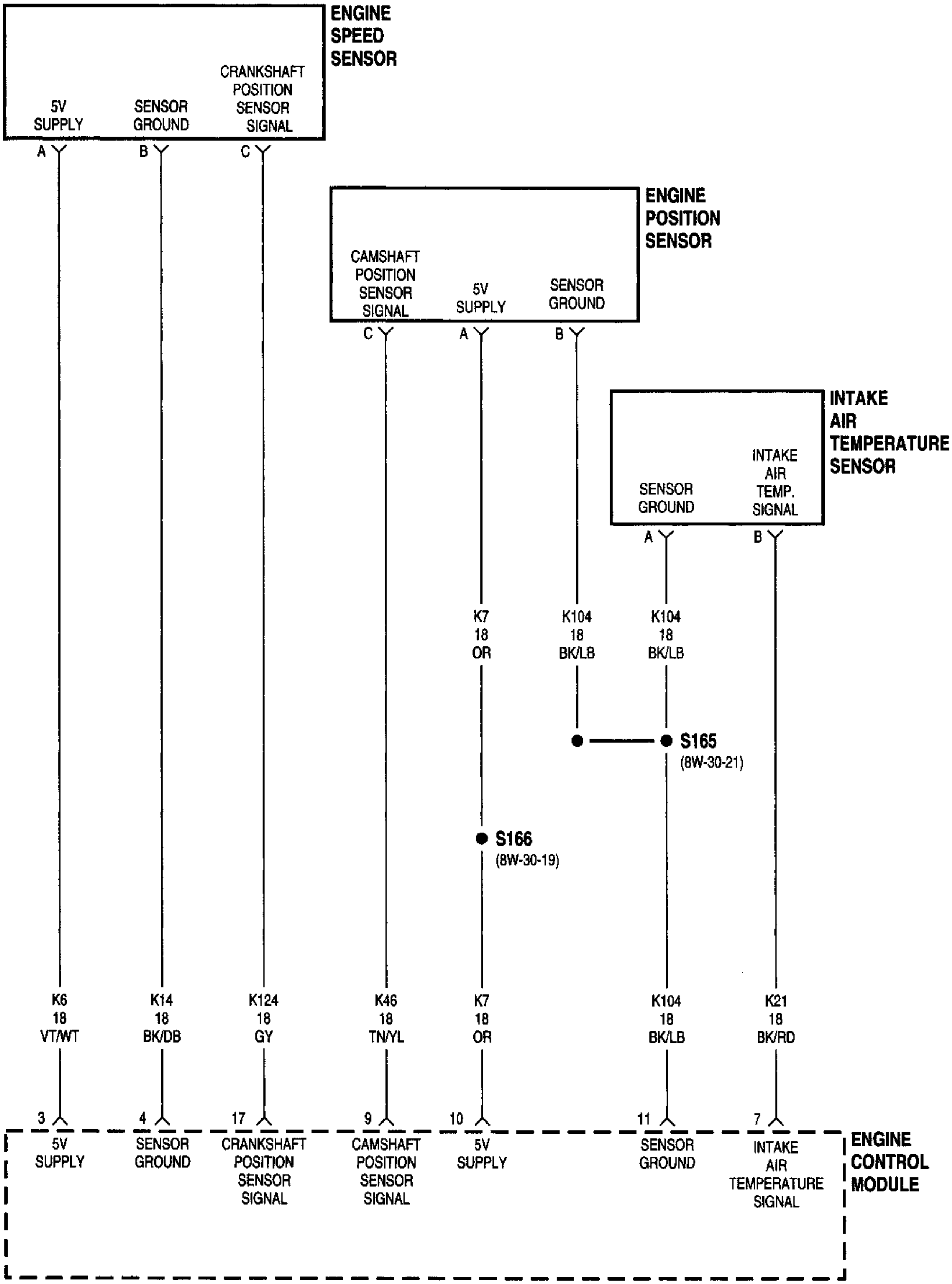


BRS03017 J988W-9


ENGINE SPEED SENSOR
5V SUPPLY
SENSOR GROUND
CRANKSHAFT POSITION SENSOR SIGNAL
A
B
C
ENGINE POSITION SENSOR
CAMSHAFT POSITION SENSOR SIGNAL
5V SUPPLY
SENSOR GROUND
C
A
B
INTAKE AIR TEMPERATURE SENSOR
SENSOR GROUND
INTAKE AIR TEMP. SIGNAL
A
B
K7 18 OR
K104 18 BK/LB
K104 18 BK/LB
S165
(8W-30-21)
S166
(8W-30-19)
K6 18 VT/WT
K14 18 BK/DB
K124 18 GY
K46 18 TN/YL
K7 18 OR
K104 18 BK/LB
K21 18 BK/RD
3
4
17
9
10
11
7
5V SUPPLY
SENSOR GROUND
CRANKSHAFT POSITION SENSOR SIGNAL
CAMSHAFT POSITION SENSOR SIGNAL
5V SUPPLY
SENSOR GROUND
INTAKE AIR TEMPERATURE SIGNAL
ENGINE CONTROL MODULE

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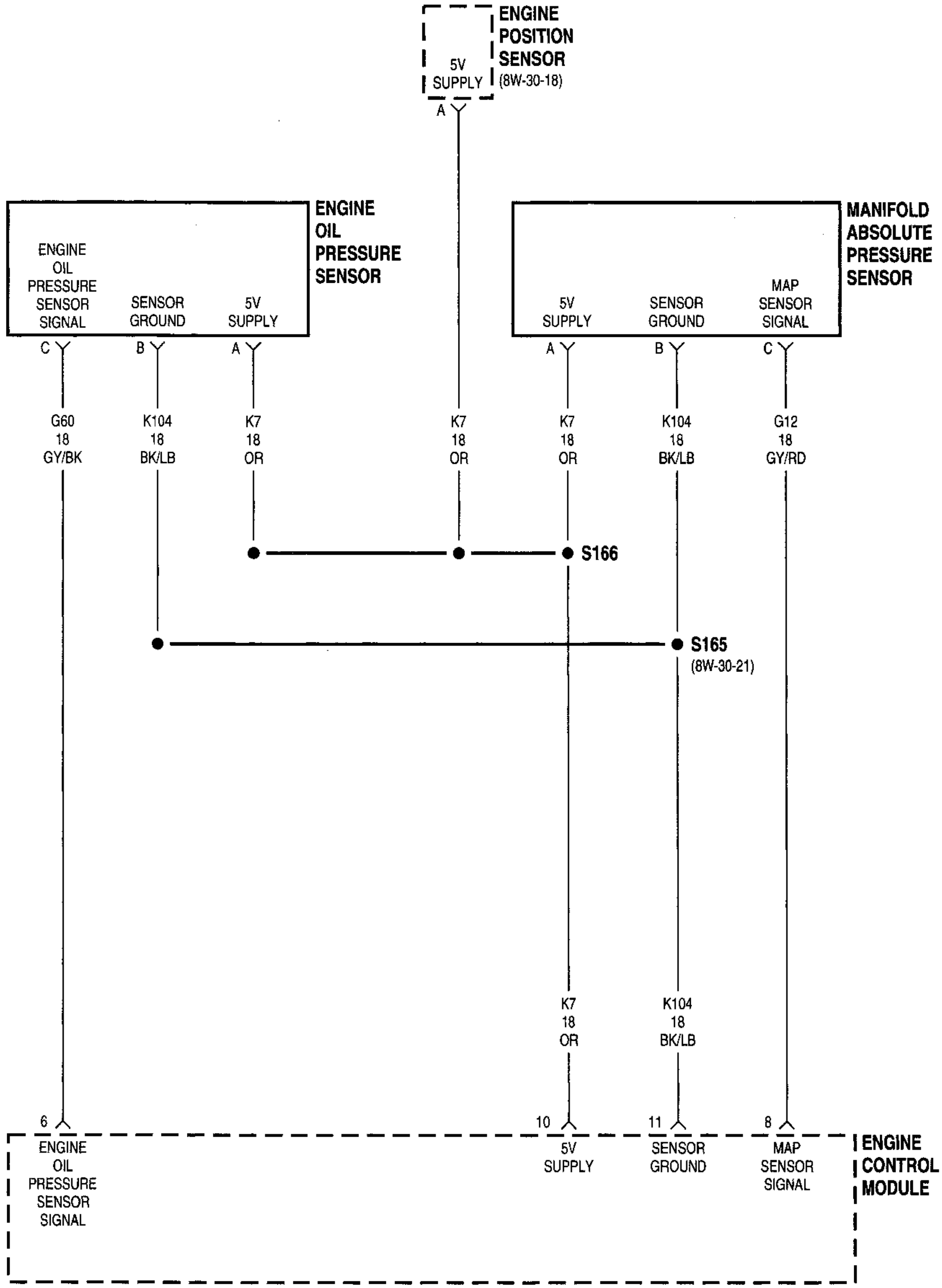
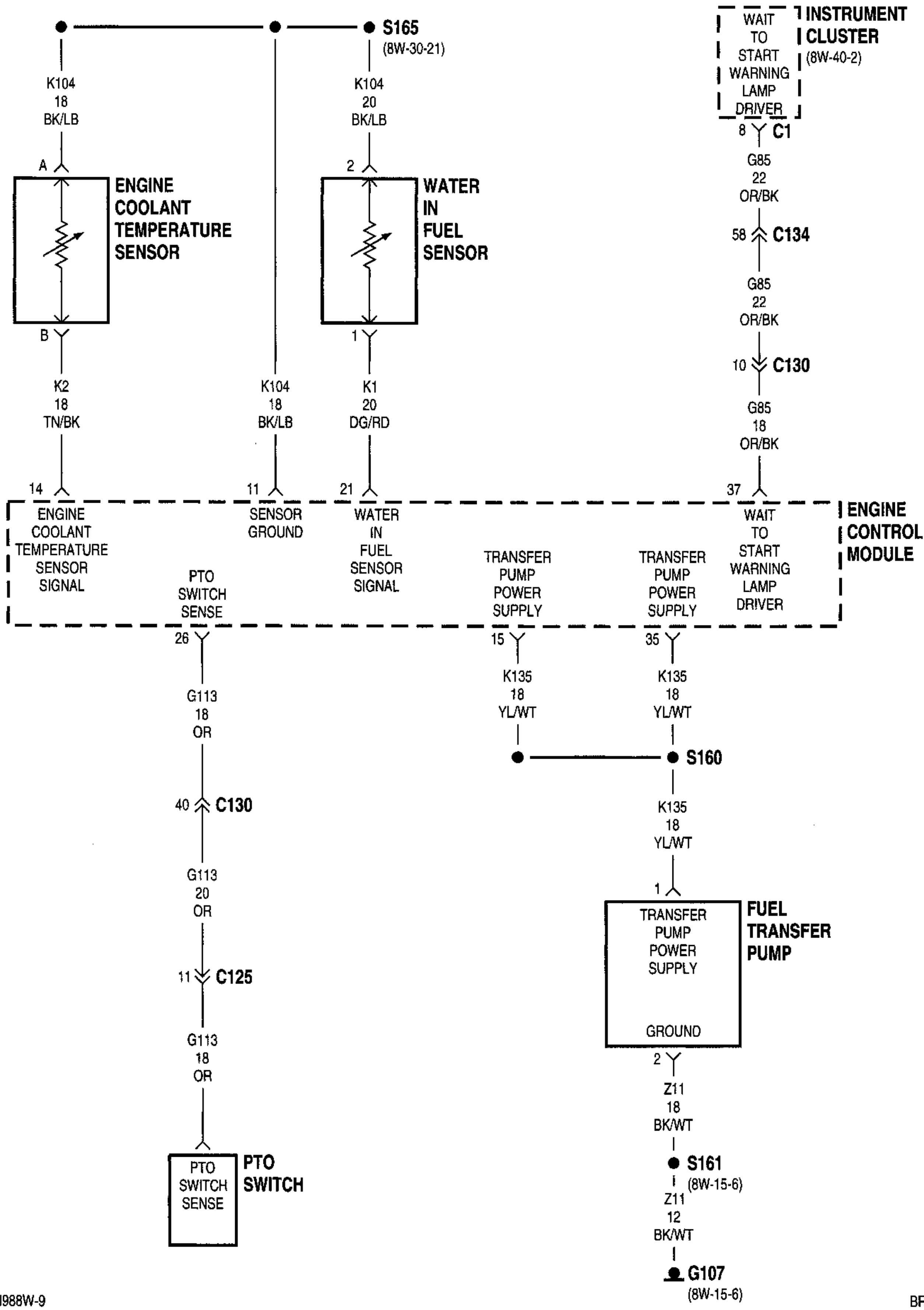
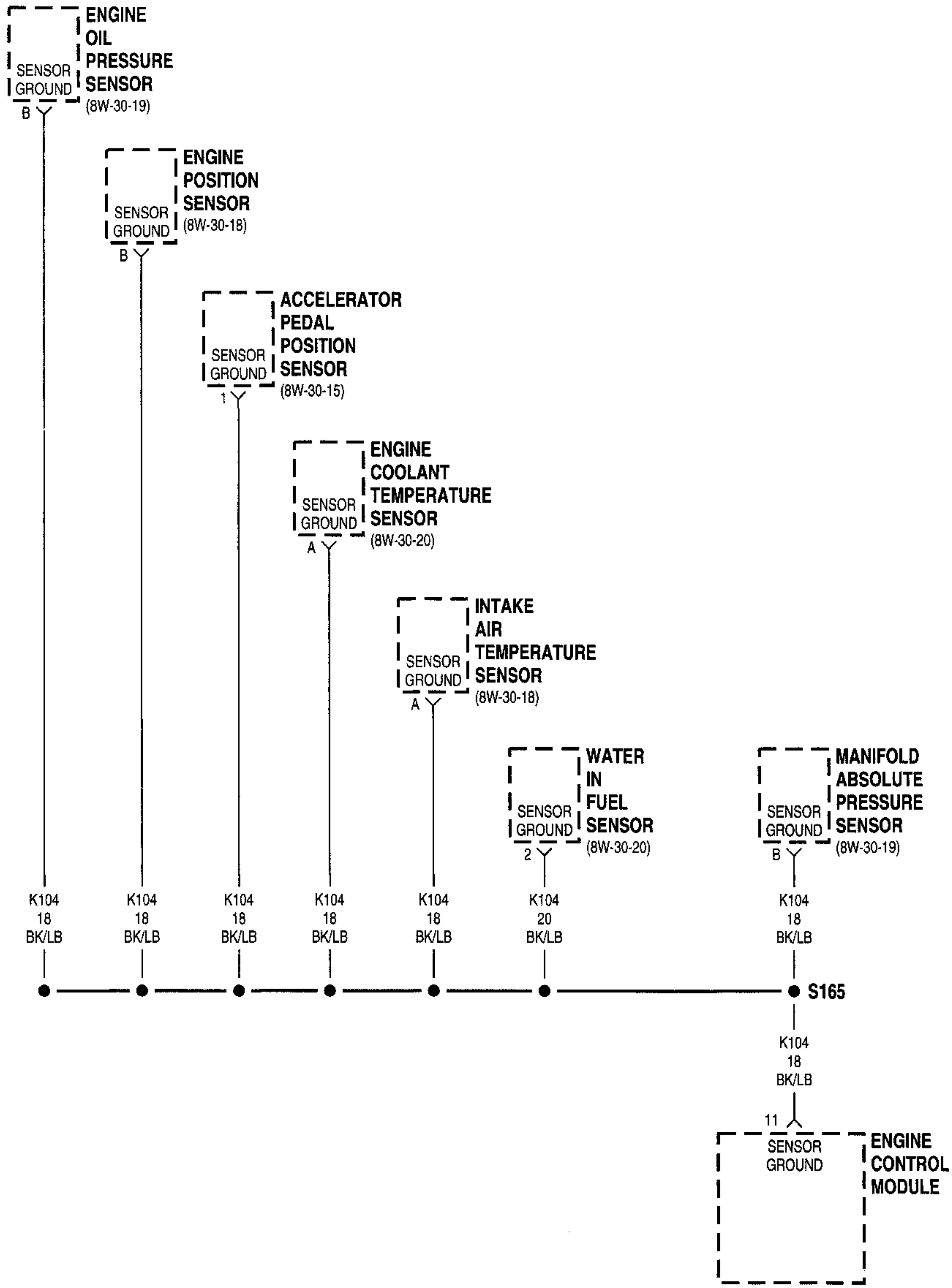



S165
(8W-30-21)
K104
18
BK/LB
K104
20
BK/LB
A
B
ENGINE
COOLANT
TEMPERATURE
SENSOR
2
1
WATER
IN
FUEL
SENSOR
WAIT
TO
START
WARNING
LAMP
DRIVER
INSTRUMENT
CLUSTER
(8W-40-2)
8 C1
G85
22
OR/BK
58 C134
G85
22
OR/BK
10 C130
G85
18
OR/BK
K2
18
TN/BK
K104
18
BK/LB
K1
20
DG/RD
14
11
21
37
ENGINE
COOLANT
TEMPERATURE
SENSOR
SIGNAL
SENSOR
GROUND
WATER
IN
FUEL
SENSOR
SIGNAL
PTO
SWITCH
SENSE
TRANSFER
PUMP
POWER
SUPPLY
TRANSFER
PUMP
POWER
SUPPLY
WAIT
TO
START
WARNING
LAMP
DRIVER
ENGINE
CONTROL
MODULE
26
15
35
G113
18
OR
K135
18
YL/WT
K135
18
YL/WT
S160
40 C130
K135
18
YL/WT
G113
20
OR
1
TRANSFER
PUMP
POWER
SUPPLY
GROUND
FUEL
TRANSFER
PUMP
11 C125
G113
18
OR
2
Z11
18
BK/WT
PTO
SWITCH
SENSE
PTO
SWITCH
S161
(8W-15-6)
Z11
12
BK/WT
G107
(8W-15-6)


ENGINE OIL PRESSURE SENSOR
(8W-30-19)
SENSOR GROUND
B
ENGINE POSITION SENSOR
(8W-30-18)
SENSOR GROUND
B
ACCELERATOR PEDAL POSITION SENSOR
(8W-30-15)
SENSOR GROUND
1
ENGINE COOLANT TEMPERATURE SENSOR
(8W-30-20)
SENSOR GROUND
A
INTAKE AIR TEMPERATURE SENSOR
(8W-30-18)
SENSOR GROUND
A
WATER IN FUEL SENSOR
(8W-30-20)
SENSOR GROUND
2
MANIFOLD ABSOLUTE PRESSURE SENSOR
(8W-30-19)
SENSOR GROUND
B
K104 18 BK/LB
K104 18 BK/LB
K104 18 BK/LB
K104 18 BK/LB
K104 18 BK/LB
K104 20 BK/LB
K104 18 BK/LB
S165
K104 18 BK/LB
11
SENSOR GROUND
ENGINE CONTROL MODULE

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8W-80 CONNECTOR PIN-OUTS

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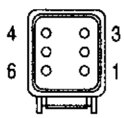
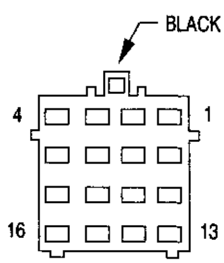


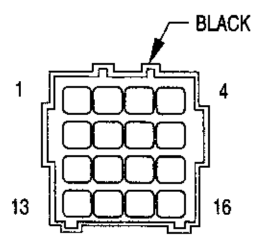
ACCELERATOR PEDAL POSITION SENSOR

CAV	CIRCUIT	FUNCTION
1	K104 18BK/LB	SENSOR GROUND
2	H105 18LG/DB	IDLE VALVE SWITCH NO. 2
3	H102 18LB/BK	ACCELERATOR PEDAL POSITION SENSOR SIGNAL
4	H103 18BK/YL	ACCELERATOR PEDAL POSITION SENSOR GROUND
5	H101 18DB/WT	ACCELERATOR PEDAL POSITION SENSOR SUPPLY
6	H104 18BR/OR	IDLE VALVE SWITCH NO. 1



C125

CAV	CIRCUIT
1	G7 18WT/OR
2	T6 18OR/WT
3	T18 18LG/OR
4	T41 20BK/WT
	Z12 20BK/TN
5	C22 18DB
6	K22 18OR/DB
7	C13 18DB/OR
8	K24 18GY/BK
9	V40 18WT/PK
10	C90 18LG/WT
11	G113 18OR
12	K118 18PK/YL
13	K4 20BK/LB **
	K4 18BK/LB *
14	K51 20DB/YL
15	T16 18RD
16	K30 18PK

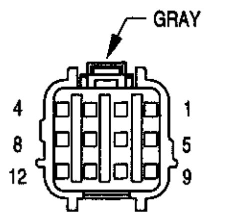


C125

CAV	CIRCUIT
1	G7 20WT/OR
2	T6 20OR/WT
3	T18 20LG/OR
4	T41 20BK/WT
5	C22 20DB
6	K22 20OR/DB
7	C13 20DB/OR
8	K24 20GY/BK
9	V40 20WT/PK
10	C90 20LG/WT
11	G113 20OR
12	K118 20PK/YL
13	K4 20BK/LB
14	K51 20DB/YL
15	T16 20RD
16	K30 20PK

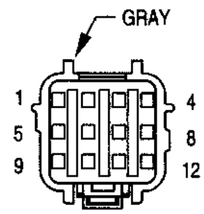
* M/T
** A/T

AUTHENTIC RESTORATION PRODUCT



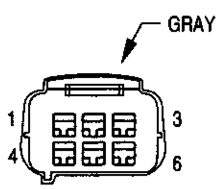
C126

CAV	CIRCUIT
1	F18 18LG/BK
2	V32 18YL/RD
3	V37 18RD/LG
4	L1 18VT/BK
5	V35 18LG/RD
6	K226 18DB/WT
7	V36 18TN/RD
8	L10 18BR/LG
9	D220 18LG
10	D21 18PK/DB
11	D1 18VT/BR
12	D2 18WT/BK



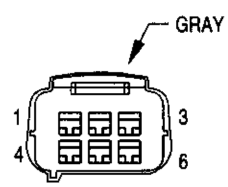
C126

CAV	CIRCUIT
1	F18 20LG/BK
2	V32 20YL/RD
3	V37 20RD/LG
4	L1 18VT/BK
5	V35 20LG/RD
6	K226 20DB/WT
7	V36 20TN/RD
8	L10 18BR/LG
9	D220 20LG
10	D21 20PK/DB
11	D1 20VT/BR
12	D2 20WT/BK



C127

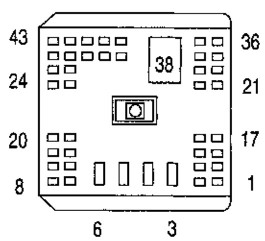
CAV	CIRCUIT
1	K20 18DG
2	Z12 14BK/TN
3	Z12 14BK/TN
4	A14 14RD/WT
5	A142 14DG/OR
6	T125 18DB



C127

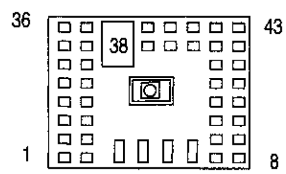
CAV	CIRCUIT
1	K20 18DG
2	Z12 14BK/TN
3	Z12 14BK/TN
4	A14 16RD/WT
5	A142 14DG/OR
6	T125 18DB

AUTHENTIC RESTORATION PRODUCT



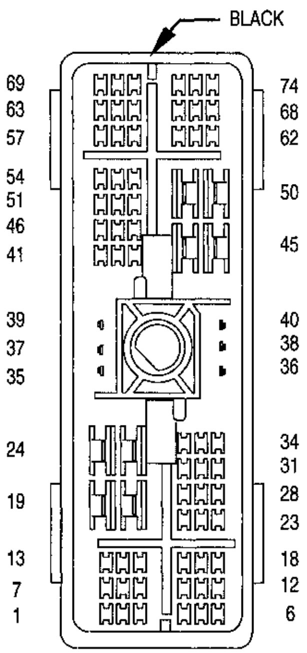
C130

CAV	CIRCUIT
1	-
2	-
3	-
4	-
5	A14 12RD/WT
6	A93 12RD/BK
7	K24 20GY/BK
8	K22 20OR/DB
9	K131 18BR/WT
10	G85 18OR/BK
11	-
12	-
13	D1 18VT/BR
14	-
15	-
16	D20 18LG
17	D2 18WT/BK
18	K20 18DG
19	C90 18LG
20	D21 18PK
21	C3 18DB/BK
22	-
23	-
24	-
25	Z12 14BK/TN
26	A40 14RD/WT
27	-
28	F18 18LG/BK
29	-
30	-
31	-
32	C22 20DB
33	-
34	-
35	T125 18DB
36	S21 18YL/BK
37	S22 18OR/BK
38	-
39	Z11 18BK/WT
40	G113 18OR
41	Z12 14BK/TN
42	Z12 14BK/TN
43	Z12 14BK/TN



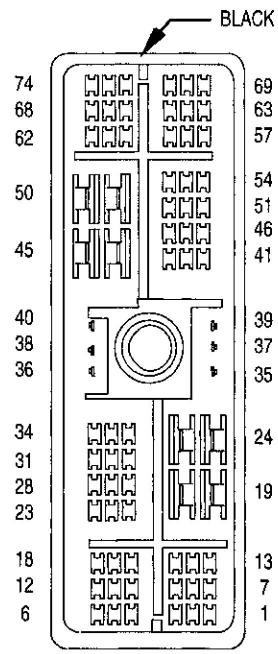
C130
(IN PDC)

CAV	CIRCUIT
1	V35 20LG/RD
2	V32 20YL/RD
3	A14 16RD/WT
4	A142 14DG/OR
5	A14 12RD/WT
6	A93 12RD/YL
7	K24 20GY/BK
8	K22 20OR/DB
9	K131 20BR/WT
10	G85 22OR/BK
11	V40 22WT/PK
12	L10 18BR/LG
13	D1 20VT/BR
14	K51 20DB/YL
15	C13 22DB/OR
16	D20 20DG
17	D2 20WT/BK
18	K20 18DG
19	C90 20LG/WT
20	D21 20PK/DB
21	C3 22DB/BK
22	V37 22RD/LG
23	K226 20DB/WT
24	V36 20TN/RD
25	Z12 14BK/TN
26	A40 14RD/LG
27	K31 20BR/WT
28	F18 20LG/BK
29	K30 22PK
30	T18 22LG/OR
31	T16 22RD
32	C22 20DB
33	G7 20WT/OR
34	T6 22OR/WT
35	T125 18DB
36	S21 18YL/BK
37	S22 18OR/BK
38	A18 10RD/BK
39	Z12 18BK/TN
40	G113 20OR
41	Z12 14BK/TN
42	Z12 14BK/TN
43	Z12 18BK/TN



C134

CAV	CIRCUIT
1	-
2	D21 20PK/DB
3	D220 20WT/VT
4	-
5	-
6	-
7	-
8	Z12 18BK/TN
9	Z12 20BK/TN
10	D2 20WT/BK
11	D1 20VT/BR
12	D2 20WT/BK
13	D20 20LG
14	D21 20PK/DB
15	-
16	D1 20VT/BR
17	D2 20WT/BK
18	D1 20VT/BR
19	L7 16BK/YL
20	A12 16RD/TN
21	T6 22OR/WT
22	L39 22LB
23	F15 20DB
23	F18 18DB
24	A3 12RD/WT
25	F32 16PK/DB
26	K4 22BK/LB
27	L35 22BR/YL
28	-
29	V37 22RD/LG
30	G11 22WT/LG
31	Z9 16BK/VT
32	X3 22BK/RD
33	-
34	Z5 18BK/DB
35	L3 16RD/OR
36	L4 16VT/WT
37	V4 16RD/YL
38	V49 16RD/BK
39	V3 16BR/WT
40	V5 16DG
41	Z2 16BK/LG
42	Z6 18BK/PK
43	C90 22LG/WT
44	A1 10RD
45	C1 12DG
46	-
47	G50 22RD/DB
48	V30 22DB/RD
49	-
50	A2 14PK/BK
51	A41 14YL
52	-
53	V32 22YL/RD



C134

CONTINUED

CAV	CIRCUIT
1	-
2	D21 20PK/DB
3	D220 20WT/VT
4	-
5	-
6	-
7	-
8	Z12 14BK/TN
9	Z12 18BK/TN
10	D2 20WT/BK
11	D1 20VT/BR
12	D2 20WT/BK
13	D20 20DG
14	D21 20PK/DB
15	-
16	D1 20VT/BR
17	D2 20WT/BK
18	D1 20VT/BR
19	L7 20BK/YL
20	A12 16RD/TN
21	T6 22OR/WT
21	T6 20OR/WT
22	L39 20LB
23	F15 22DB
24	A3 12RD/YL
25	F32 16PK/DB
26	K4 22BK/LB
27	L35 22BR/YL
28	-
29	V37 22RD/LG
29	V37 20RD/LG*
30	G11 20WT/LG
31	Z9 16BK/VT
32	X3 22BK/RD
33	-
34	Z5 18BK/DB
35	L3 16RD/OR
36	L4 16VT/WT
37	V4 16RD/YL
38	V49 16RD/BK
39	V3 16BR/WT
40	V5 16DG
41	Z2 16BK/LG
42	Z6 18BK/PK
43	C90 22LG/WT
43	C90 20LG/WT
44	A1 10RD
45	C1 12DG
46	-
47	G50 22RD/DB
48	V30 20DB/RD
49	-
50	A2 14PK/BK
51	A41 14YL
52	-
53	V32 20YL/RD
53	V32 20YL/RD

* DIESEL

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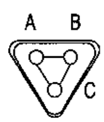
C134

CAV	CIRCUIT
54	-
55	V18 22YL/DG
56	V40 22WT/PK
57	L62 16BR/RD
58	G85 22OR/BK
59	G107 22BK/GY
60	T18 22LG/OR
61	G29 22BK/WT
62	G34 16RD/GY
63	L63 16DG/RD
64	L50 18WT/TN
65	F12 20DB/WT
66	L10 18BR/LG
67	Z3 18BK/OR
68	V10 16BR
69	-
70	-
71	-
72	-
73	-
74	-

CONTINUED

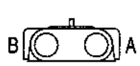
C134

CAV	CIRCUIT
54	-
55	V18 22YL/DG
56	V40 22WT/PK
57	L62 16BR/RD
58	G85 22OR/BK
59	G107 20GY
60	T18 22LG/OR
	T18 20LG/OR
61	G29 18BK/WT
62	G34 20RD/GY
	G34 16RD/GY
63	L63 16DG/RD
64	L50 18WT/TN
	L50 18WT/TN
65	F12 20DB/WT
66	L10 18BR/LG
	L10 18BR/LG
	L10 18BR/LG
67	Z3 18BK/OR
68	V10 16BR
69	-
70	-
71	-
72	-
73	-
74	-



CUMMINS BUS

CAV	CIRCUIT	FUNCTION
A	K244 20YL	CUMMINS BUS (+)
B	K246 20LG	CUMMINS BUS (-)
C	-	-



CUMMINS BUS POWER

CAV	CIRCUIT	FUNCTION
A	A14 18RD/WT	FUSED (B)+
B	Z11 18BK/WT	GROUND

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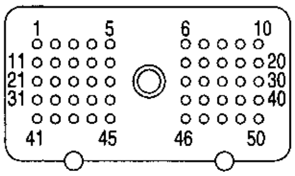

ENGINE CONTROL MODULE

CAV	CIRCUIT	FUNCTION
1	H104 18BR/OR	IDLE VALVE SWITCH NO. 1
2	K244 20YL	CUMMINS BUS (+)
3	K6 18VT/WT	5 VOLT SUPPLY
4	K14 18BK/DB	SENSOR GROUND
5	F18 18LG/BK	FUSED IGNITION (ST-RUN)
6	G60 18GY/BK	ENGINE OIL PRESSURE SENSOR SIGNAL
7	K21 18BK/RD	INTAKE AIR TEMPERATURE SIGNAL
8	G12 18GY/RD	MAP SENSOR SIGNAL
9	K46 18TN/YL	CAMSHAFT POSITION SENSOR SIGNAL
10	K7 18OR	5V SUPPLY
11	K104 18BK/LB	SENSOR GROUND
12	K246 20LG	CUMMINS BUS (-)
13	K242 20YL/PK	DATALINK (+) FUEL INJECTOR PUMP
14	K2 18TN/BK	ENGINE COOLANT TEMPERATURE SENSOR SIGNAL
15	K135 18YL/WT	TRANSFER PUMP POWER SUPPLY
16	H105 18LG/DB	IDLE VALVE SWITCH NO. 2
17	K124 18GY	CRANKSHAFT POSITION SENSOR SIGNAL
18	K48 18DG	FAULT SIGNAL
19	-	-
20		
21	K1 20DG/RD	WATER-IN-FUEL SENSOR SIGNAL
22		
23	K240 20LG/PK	DATALINK (-) FUEL INJECTOR PUMP
24	-	-
25	H102 18LB/BK	ACCELERATOR PEDAL POSITION SENSOR SIGNAL
26	G113 18OR	PTO SWITCH SENSE
27	-	-
28	K22 20OR/DB	THROTTLE POSITION SENSOR SIGNAL
29	S21 18YL/BK	AIR INTAKE HEATER RELAY NO. 1 CONTROL
30	Z12 18BK/TN	GROUND
31	H101 18DB/WT	ACCELERATOR PEDAL POSITION SENSOR SUPPLY
32	H103 18BK/YL	ACCELERATOR PEDAL POSITION SENSOR GROUND
33	K45 18LB/RD	KNOCK SENSOR RETURN
34	K44 18VT/OR	CAMSHAFT POSITION SENSOR SIGNAL
35	K135 18YL/WT	TRANSFER PUMP POWER SUPPLY
36	K131 18BR/WT	FUEL INJECTOR PUMP RELAY CONTROL
37	G85 18OR/BK	WAIT TO START WARNING LAMP DRIVER
38	D21 18PK	SCI TRANSMIT
39	D20 18LG	SCI RECEIVE
40	D2 18WT/BK	CCD BUS (-)
41	D1 18VT/BR	CCD BUS (+)
42	K247 20LB/RD	CUMMINS BUS SHIELD
43	-	-
44	K243 20OR/BR	DATALINK SHIELD FUEL INJECTOR PUMP
45	K24 20GY/BK	ENGINE SPEED SENSOR SIGNAL
46	-	-
47	S22 18OR/BK	AIR INTAKE HEATER RELAY NO. 2 CONTROL
48	A14 18RD/WT	FUSED B(+)
49	Z12 18BK/TN	GROUND
50	A14 18RD/WT	FUSED B(+)

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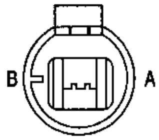
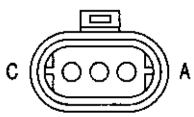


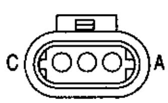
ENGINE COOLANT TEMPERATURE SENSOR

CAV	CIRCUIT	FUNCTION
A	K104 18BK/LB	SENSOR GROUND
B	K2 18TN/BK	ENGINE COOLANT TEMPERATURE SENSOR SIGNAL



ENGINE OIL PRESSURE SENSOR

CAV	CIRCUIT	FUNCTION
A	K7 18OR	5 VOLT SUPPLY
B	K104 18BK/LB	SENSOR GROUND
C	G60 18GY/BK	ENGINE OIL PRESSURE SENSOR SIGNAL



ENGINE POSITION SENSOR

CAV	CIRCUIT	FUNCTION
A	K7 18OR	5 VOLT SUPPLY
B	K104 18BK/LB	SENSOR GROUND
C	K46 18TN/YL	CAMSHAFT POSITION SENSOR SIGNAL

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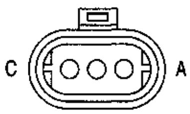
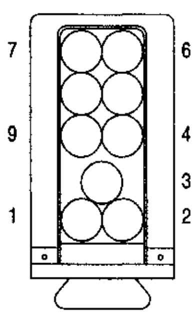


ENGINE SPEED SENSOR

CAV	CIRCUIT	FUNCTION
A	K6 18VT/WT	5 VOLT SUPPLY
B	K14 18BK/DB	SENSOR GROUND
C	K124 18GY	CRANKSHAFT POSITION SENSOR SIGNAL

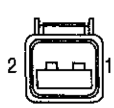
FUEL HEATER

CAV	CIRCUIT	FUNCTION
1	A93 12RD/BK	FUEL HEATER RELAY OUTPUT
2	Z11 14BK/WT	GROUND



FUEL INJECTOR PUMP

CAV	CIRCUIT	FUNCTION
1	K240 20LG/PK	DATALINK (-) FUEL INJECTOR PUMP
2	K242 20YL/PK	DATALINK (+) FUEL INJECTOR PUMP
3	-	-
4	K44 18VT/OR	CAMSHAFT POSITION SENSOR SIGNAL
5	K45 18LB/RD	KNOCK SENSOR RETURN
6	Z12 14BK/TN	GROUND
7	A40 14RD/WT	FUEL PUMP RELAY OUTPUT
8	K48 18DG	FAULT SIGNAL
9	-	-



FUEL TRANSFER PUMP

CAV	CIRCUIT	FUNCTION
1	K135 18YL/WT	TRANSFER PUMP POWER SUPPLY
2	Z11 18BK/WT	GROUND

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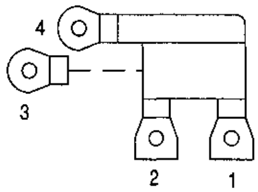
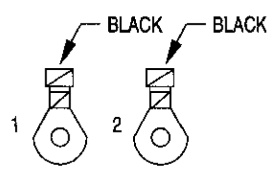


GENERATOR

CAV	CIRCUIT	FUNCTION
1	K20 18DG	GENERATOR FIELD DRIVER
2	T125 18DB	GENERATOR FIELD B(+)
3	A11 4BK	GENERATOR OUTPUT
4	Z1 6BK	GROUND



INTAKE AIR HEATER

CAV	CIRCUIT	FUNCTION
1	A58 6BK	FUSED B(+)
2	A122 6BK	FUSED B(+)

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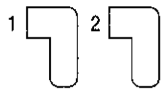
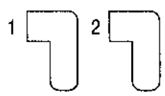


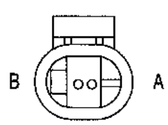
INTAKE AIR HEATER RELAY NO. 1

CAV	CIRCUIT	FUNCTION
1	Z12 18BK/TN	GROUND
2	S21 18YL/BK	AIR INTAKE HEATER RELAY NO. 1 CONTROL



INTAKE AIR HEATER RELAY NO. 2

CAV	CIRCUIT	FUNCTION
1	Z12 18BK/TN	GROUND
2	S22 18OR/BK	AIR INTAKE HEATER RELAY NO. 2 CONTROL



INTAKE AIR TEMPERATURE SENSOR

CAV	CIRCUIT	FUNCTION
A	K104 18BK/LB	SENSOR GROUND
B	K21 18BK/RD	INTAKE AIR TEMPERATURE SIGNAL

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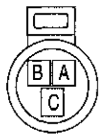
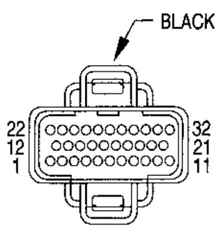


MANIFOLD ABSOLUTE PRESSURE SENSOR

CAV	CIRCUIT	FUNCTION
A	K7 18OR	5 VOLT SUPPLY
B	K104 18BK/LB	SENSOR GROUND
C	G12 18GY/RD	CHECK GAUGES LAMP DRIVER



POWERTRAIN CONTROL MODULE - C1

CAV	CIRCUIT	FUNCTION
1	-	-
2	F18 18LG/BK	FUSED IGN. (ST-RUN)
3	-	-
4	K4 18BK/LB	SENSOR GROUND
5	-	-
6	T41 18BK/WT	PARK/NEUTRAL POSITION SWITCH SENSE
7	-	-
8	K24 18GY/BK	ENGINE SPEED SENSOR SIGNAL
9	-	-
10	-	-
11	-	-
12	-	-
13	-	-
14	-	-
15	-	-
16	-	-
17	-	-
18	-	-
19	-	-
20	-	-
21	-	-
22	A14 14RD/WT	FUSED B(+)
23	K22 18OR/DB	THROTTLE POSITION SENSOR SIGNAL
24	-	-
25	-	-
26	-	-
27	K1 18DG/RD	WATER IN-FUEL SENSOR SIGNAL
28	-	-
29	-	-
30	-	-
31	Z12 14BK/TN	GROUND
31	Z12 14BK/TN	GROUND
32	Z12 14BK/TN	GROUND

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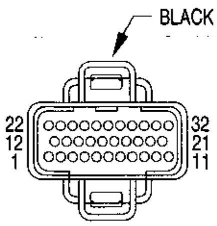

POWERTRAIN CONTROL MODULE - C2

CAV	CIRCUIT	FUNCTION
1	T54 18VT	TRANSMISSION TEMPERATURE SENSOR SIGNAL
2	-	-
3	-	-
4	-	-
5	-	-
6	-	-
7	-	-
8	K88 18VT/WT	TRANSMISSION VARIBLE FORCE SOLENOID
9	-	-
10	K20 18DG	GENERATOR FIELD DRIVER
11	K54 18OR/BK	TORQUE CONVERTOR CLUTCH SOLENOID/RELAY CONTROL
12	-	-
13	-	-
14	-	-
15	-	-
16	-	-
17	-	-
18	-	-
19	-	-
20	-	-
21	T60 18BR	OVERDRIVE SOLENOID CONTROL
22	-	-
23	-	-
24	-	-
25	T13 18DB/BK	OUTPUT SHAFT SPEED SENSOR GROUND
26	-	-
27	G7 18WT/OR	VEHICLE SPEED SENSOR SIGNAL
28	T14 18LG/BK	OUTPUT SHAFT SPEED SENSOR SIGNAL
29	T25 18LG/WT	GOVERNOR PRESSURE SIGNAL
30	K30 18PK	TRANSMISSION RELAY CONTROL
31	K7 18OR	5 VOLT SUPPLY
32	-	-

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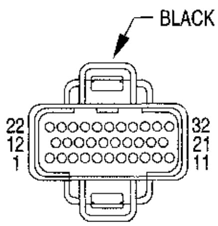

POWERTRAIN CONTROL MODULE - C3

CAV	CIRCUIT	FUNCTION
1	C13 18DB/OR	A/C COMPRESSOR CLUTCH RELAY CONTROL
2	-	-
3	K51 20DB/YL	AUTO SHUTDOWN RELAY CONTROL
4	V36 18TN/RD	SPEED CONTROL VACUUM SOLENOID CONTROL
5	V35 18LG/RD	SPEED CONTROL VENT SOLENOID CONTROL
6	T18 18LG/OR	OVERDRIVE LAMP DRIVER
7	-	-
8	-	-
9	-	-
10	-	-
11	V32 18YL/RD	SPEED CONTROL ON/OFF SWITCH SENSE
12	A142 14DG/OR	AUTOMATIC SHUT DOWN RELAY OUTPUT
13	T6 18OR/WT	TRANSMISSION O/D SWITCH SENSE
14	-	-
15	K118 18PK/YL	BATTERY TEMPERATURE SENSOR SIGNAL
16	-	-
17	-	-
18	-	-
19	-	-
20	-	-
21	-	-
22	C20 18BR	A/C SWITCH SENSE
23	C90 18LG/WT	A/C SELECT INPUT
24	V40 18WT/PK	BRAKE SWITCH SENSE
25	T125 18DB	GENERATOR OUTPUT
26	K226 18DB/WT	FUEL LEVEL SENSOR
27	D21 18PK/DB	SCI TRANSMIT
28	D2 18WT/BK	CCD BUS (-)
29	D220 18DG	SCI RECEIVE
30	D1 18VT/BR	CCD BUS(+)
31	-	-
32	V37 18RD/LG	SPEED CONTROL SWITCH SIGNAL

WATER IN FUEL SENSOR

CAV	CIRCUIT	FUNCTION
1	K1 20DG/RD	WATER IN FUEL SENSOR SIGNAL
2	K104 20BK/LB	SENSOR GROUND

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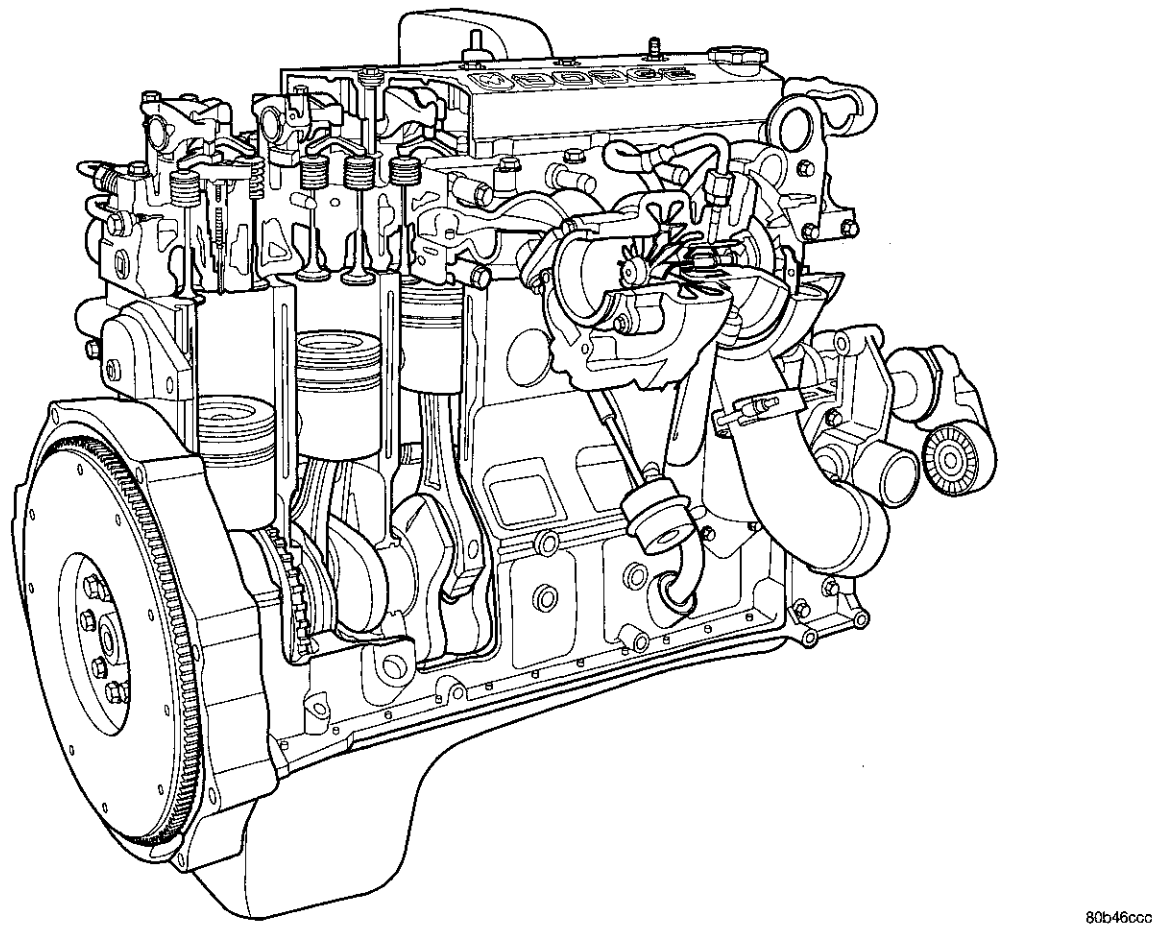
5.9L 24-VALVE TURBO DIESEL ENGINE

CONTENTS

DESCRIPTION AND OPERATION

5.9L DIESEL ENGINE

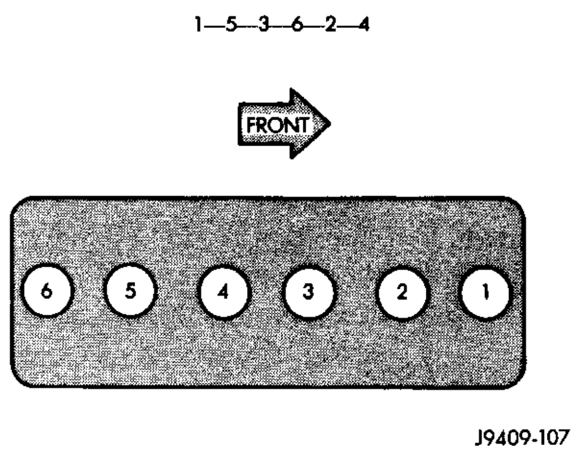


Cummins® 24 Valve Turbo Diesel Engine

5.9L DIESEL ENGINE DESCRIPTION

Engine type	In-line 6 (Diesel Turbo)
Bore and Stroke	102.0 x 120.0 (4.02 x 4.72 in.)
Displacement	5.9L (359 cu. in.)
Compression Ratio	16.5:1
Horsepower (A/T)	215 @ 2700 rpm
Horsepower (M/T)	235 @ 2700 rpm
Torque (A/T)	420 ft. lbs. @ 1600 rpm
Torque (M/T)	460 ft. lbs. @ 1600 rpm
Firing Order	1–5–3–6–2–4
Lubrication	Pressure Feed-Full Flow Filtration w/Bypass Valve
Cooling System	Liquid Cooled – Forced Circulation
Cylinder Block	Cast Iron
Crankshaft	Induction Hardened Forged Steel
Cylinder Head	Cast Iron
Combustion Chambers	High Swirl Bowl
Camshaft	Chilled Ductile Iron
Pistons	Cast Aluminum
Connecting Rods	Forged Steel

The cylinders are numbered from front to rear; 1 to 6. The firing order is 1-5-3-6-2-4.



Firing Order

DESCRIPTION AND OPERATION (Continued)

ENGINE IDENTIFICATION

ENGINE DATA PLATE

The engine data plate contains specific information that is helpful to servicing and obtaining parts for the engine. The data plate is located on the left side of the engine, affixed to the gear housing. Information that can be found on the data plate includes:

- Date of Engine Manufacture
- Engine Serial Number
- Control Parts List (CPL)
- Engine Rated Horsepower
- Engine Firing Order
- Engine Displacement
- Valve Lash Reset Specifications

ENGINE SERIAL NUMBER

If the engine data plate is missing or not legible, the engine serial number is used for engine identification. The engine serial number is stamped on the right side of the block, on top of the oil cooler cavity (Fig. 1).

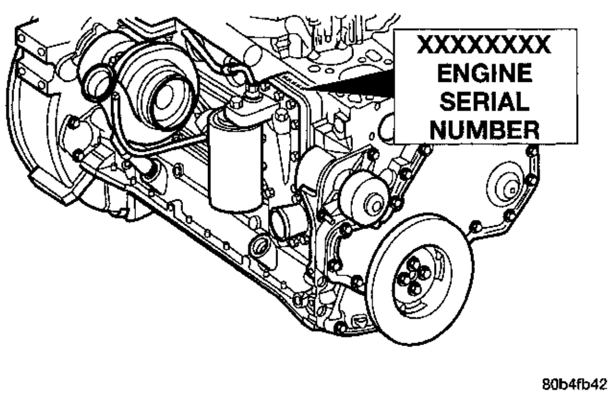


Fig. 1 Engine Serial Number Location

LUBRICATION SYSTEM

OIL CIRCUIT DESCRIPTION

NOTE: Refer to (Fig. 2) and (Fig. 3) for circuit illustrations.

A gerotor style oil pump draws oil from the crankcase through the suction tube and delivers it through the block where it enters the oil cooler cover and pressure regulator valve. When oil pressure exceeds 449 kPa (65 PSI), the valve opens exposing the dump port, which routes excess oil back to the inlet side of the oil pump.

At the same time, oil is directed to a cast in passage in the oil cooler cover, leading to the oil cooler element. As the oil travels through the element plates, it is cooled by engine coolant traveling past the outside of the plates. It is then routed to the oil filter head and through a full flow oil filter. If a plugged filter is encountered, the filter by-pass valve opens, allowing unfiltered oil to lubricate the engine. This condition can be avoided by frequent oil and filter changes, per the maintenance schedules found in the owners manual. The by-pass valve is calibrated to open when it sees a pressure drop of more than 172 kPa (25 PSI) across the filter head.

The oil filter head then divides the oil between the engine and the turbocharger. The turbocharger receives filtered, cooled and pressurized oil through a supply line from the filter head. The oil lubricates the turbocharger and returns to the pan by way of a drain line connecting the bottom of the turbocharger to a pressed in tube in the cylinder block.

Oil is then carried across the block to an angle drilling which intersects the main oil rifle. The main oil rifle runs the length of the block and delivers oil to the crankshaft main journals and valve train. Oil travels to the crankshaft through a series of transfer drillings (one for each main bearing) and lubricates a groove in the main bearing upper shell. From there another drilling feeds the camshaft main journals. The piston cooling nozzles are also supplied by the main bearing upper shell. Crankshaft internal cross-drillings supply oil to the connecting rod journals.

Another series of transfer drillings intersecting the main oil rifle supply the valve train components. Oil travels up the drilling, through a hole in the head gasket, and through a drilling in the cylinder head (one per cylinder), where it enters the rocker arm pedestal and is divided between the intake and exhaust rocker arm. Oil travels up and around the rocker arm mounting bolt, and lubricates the rocker shaft by cross drillings that intersect the mounting bolt hole. Grooves at both ends of the rocker shaft supply oil through the rocker arm where the oil travels to the push rod and socket balls.

5.9L DIESEL ENGINE COMPONENTS

CYLINDER BLOCK

The cylinder block is constructed of cast iron. The casting is a skirted design which incorporates longitudal ribs for superior strength and noise reduction. The block incorporates metric straight thread o-ring fittings at lubrication oil access points.

CRANKSHAFT

The crankshaft is a forged steel, integrally balanced unit. It is supported by seven main bearings, with position number six designated as the thrust journal. The crankshaft is held in place by main caps and 12 mm capscrews. The crankshaft also has a two-piece tone wheel, which supplies crankshaft

DESCRIPTION AND OPERATION (Continued)

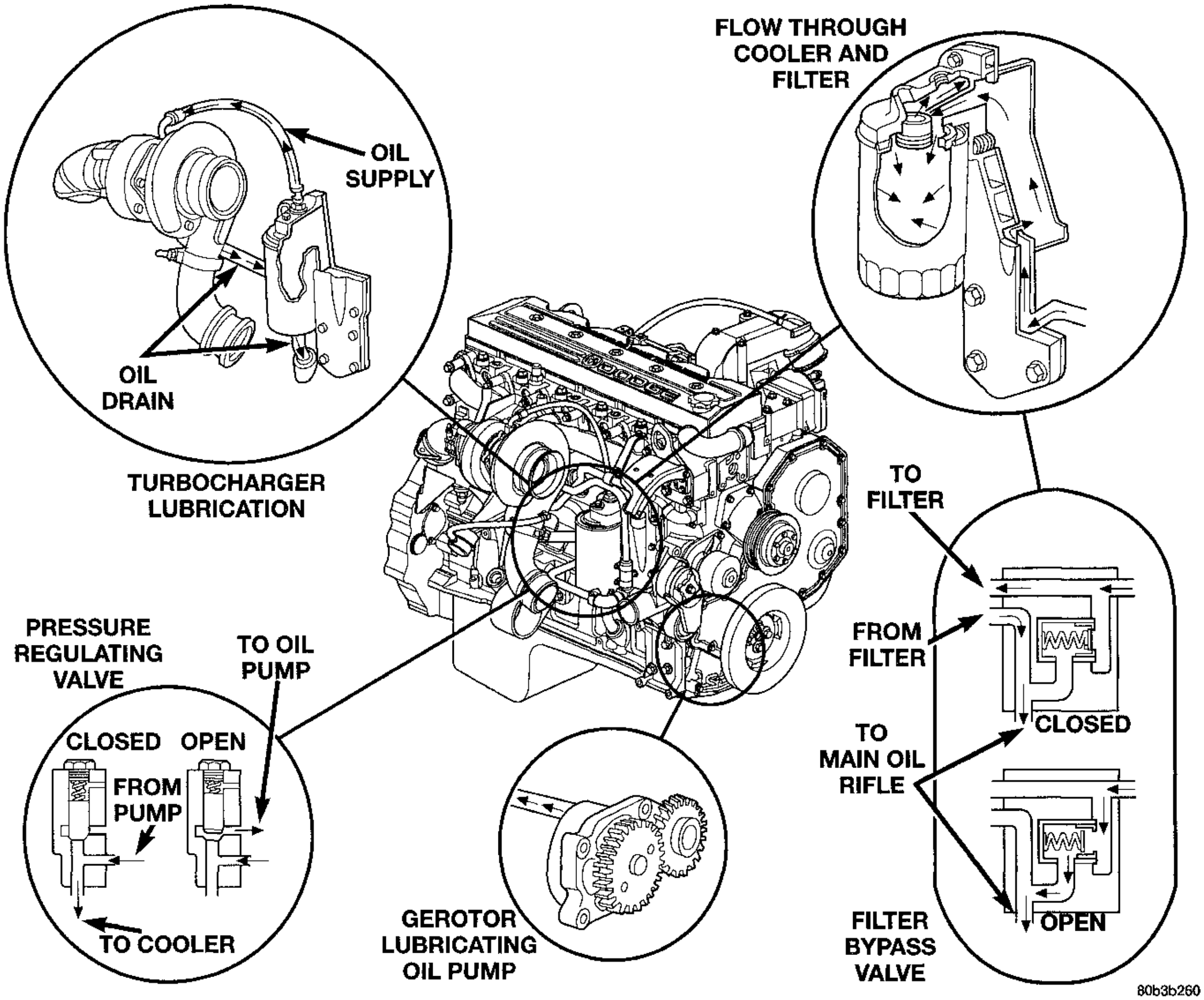


Fig. 2 Lubrication System Circulation

speed and position, mounted between the number five and six journals. Internal cross drillings supply the connecting rods with engine oil.

PISTONS AND CONNECTING RODS

The piston is constructed of aluminum and is gravity cast, free floating design. The piston incorporates a centrally located high swirl combustion bowl, and utilizes a “keystone” style top compression ring (Fig. 4), and a rectangular intermediate ring (Fig. 4), for superior cylinder wall scraping. Piston cooling nozzles cool the piston and pin with engine oil supplied by the crankshaft main journals.

The connecting rods are a split angle design constructed of forged steel construction. The rods have a pressed in place wrist pin bushing which is lubricated by the piston cooling nozzle oil spray.

CYLINDER HEAD

The cylinder head is constructed of cast iron and is a one piece cross flow design with four valves per cylinder. The arrangement of two intake and two exhaust valves per cylinder allows for a centrally located injector. The cylinder head also includes an integral intake manifold, an integral thermostat housing, and a longitudal fuel return rifle, which exits at the rear of the head. The 24 valve design also includes integrally cast valve guides and hardened intake and exhaust valve seats.

VALVES AND VALVE SPRINGS

The valves are made of heat resistant steel, and have chrome plated stems to prevent scuffing. The intake and exhaust valves are both similar in head diameter and overall length, but they have unique face angles which makes them non-interchangeable.

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DESCRIPTION AND OPERATION (Continued)

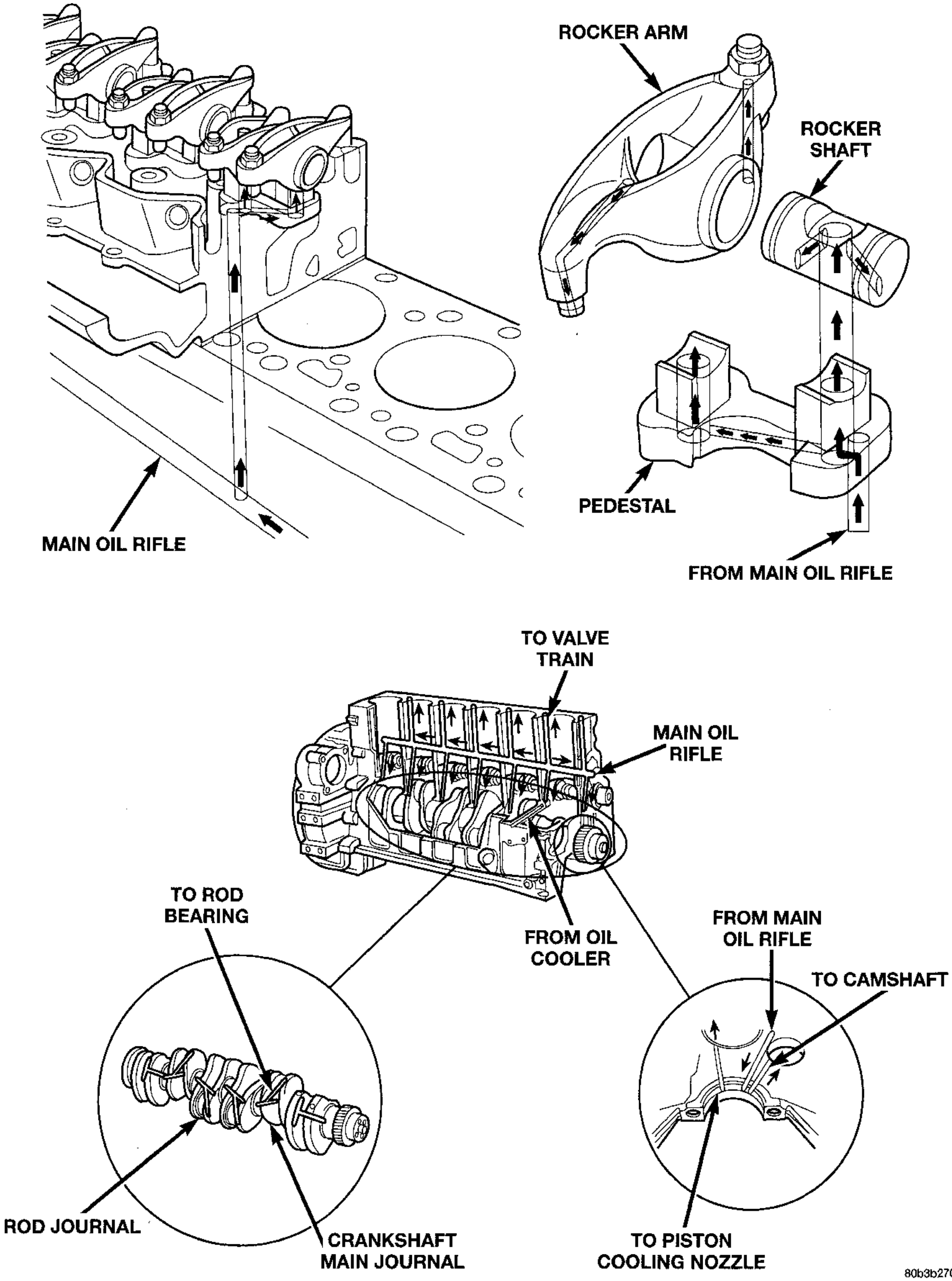

Fig. 3 Lubrication System Circulation—Cont'd

DESCRIPTION AND OPERATION (Continued)

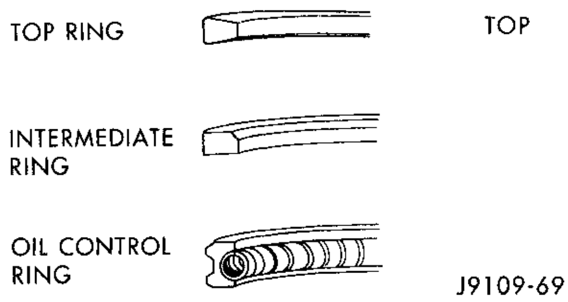

Fig. 4 Piston Ring Identification

The valves are distinguished by unique dimples on the exhaust valve head (Fig. 5).

The exhaust valve springs are made from high strength, chrome silicon steel. The exhaust valve springs are also exhaust brake compatible.

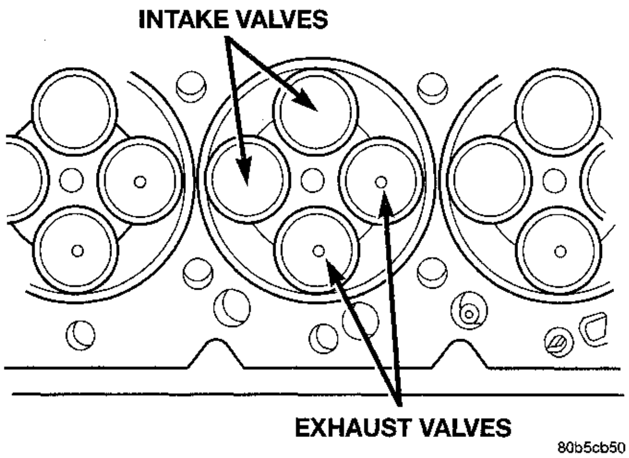

Fig. 5 Valve Identification

CAMSHAFT AND TAPPETS

The camshaft is constructed of ductile iron and is shot-peened in the #1 journal and valve lobe area for superior strength and durability. The camshaft is supported by a bushing at the #1 journal location, and is lubricated by a film of oil supplied by the crankshaft main journals. The camshaft is driven by a pressed on gear and its lateral movement is controlled by a thrust plate. The engine also uses solid "mushroom" style tappets to open and close the valves.

PUSH RODS, ROCKER ARMS, AND CROSSHEADS

The 24–valve overhead system incorporates rocker arms that are designed to allow fuel injector service without removing the rocker arms and pedestals. The unique intake and exhaust rocker arms have their own rocker shafts and are lubricated by passages intersecting the cylinder block main oil rifle. Crossheads are used (Fig. 6), which allow each rocker arm to operate two valves.

The solid push rods are hardened at the rocker arm and tappet contact areas for superior strength and durability.

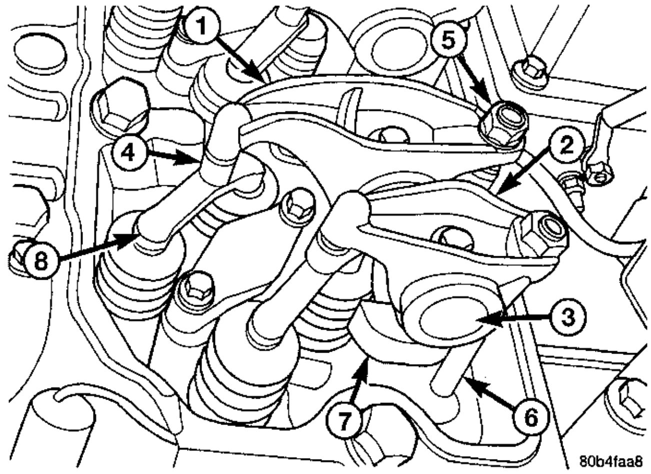

Fig. 6 Overhead System Components

1) Exhaust Rocker Arm	5) Adjusting Screw Lock Nut
2) Intake Rocker Arm	6) Push Rod
3) Rocker Shaft	7) Pedestal
4) Socket	8) Crosshead

ENGINE LUBRICATION

The lubrication system is a pressure fed, full flow filtration system. The oil pump is a gerotor style and is driven by the crankshaft gear. The lubrication system also incorporates a pressure regulator and an oil filter by-pass valve.

VACUUM PUMP

The vacuum pump and the power steering pump are combined into a single assembly on diesel engine models (Fig. 7). Both pumps are operated by a drive gear attached to the vacuum pump shaft. The shaft gear is driven by the camshaft gear.

The vacuum pump is a constant displacement, vane-type pump. Vacuum is generated by four vanes mounted in the pump rotor. The rotor is located in the pump housing and is pressed onto the pump shaft.

The vacuum and steering pumps are operated by a single drive gear pressed onto the vacuum pump shaft. The drive gear is operated by the engine camshaft gear.

The vacuum and power steering pump shafts are connected by a coupling. Each pump shaft has an adapter with drive lugs that engage in the coupling.

The vacuum pump rotating components are lubricated by engine oil. Lubricating oil is supplied to the

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DESCRIPTION AND OPERATION (Continued)

pump through an oil line at the underside of the pump housing.

The complete assembly must be removed in order to service either pump. However, the power steering pump can be removed and serviced separately when necessary.

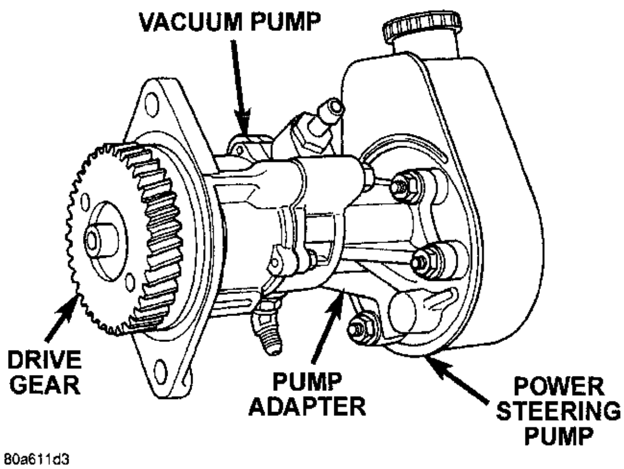

Fig. 7 Diesel Vacuum & Power Steering Pump Assembly

The vacuum pump is not a serviceable component. If diagnosis indicates a pump malfunction, the pump must be replaced as an assembly. Do not disassemble or attempt to repair the pump.

The combined vacuum and steering pump assembly must be removed for access to either pump. However, the vacuum pump can be removed without having to disassemble the power steering pump.

If the power steering pump requires service, simply remove the assembly and separate the two pumps. Refer to the pump removal and installation procedures in this section.

VACUUM PUMP OPERATION

Vacuum pump output is transmitted to the HEVAC, speed control, and EGR systems through a supply hose. The hose is connected to an outlet port on the pump housing and uses an in-line check valve to retain system vacuum when vehicle is not running.

Pump output ranges from a minimum of 8.5 to 25 inches vacuum.

The pump rotor and vanes are rotated by the pump drive gear. The drive gear is operated by the camshaft gear.

DIAGNOSIS AND TESTING

ENGINE OIL PRESSURE

(1) Remove the engine oil pressure sensor and install Oil Pressure Line and Gauge Tool C-3292 with a suitable adapter.

(2) Start engine and warm to operating temperature.

(3) Record engine oil pressure and compare with engine oil pressure chart.

CAUTION: If engine oil pressure is zero at idle, DO NOT RUN THE ENGINE.

Engine Oil Pressure (MIN)

At idle	68.9 kPa (10 psi)
At 2000 rpm	206.9 kPa (30 psi)

If minimum engine oil pressure is below these ranges, refer to the Engine Mechanical Diagnosis Charts in this section.

(4) Remove oil pressure gauge and install the oil pressure sensor. Tighten the sensor to 16 N·m (144 in. lbs.) torque.

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ENGINE DIAGNOSIS—MECHANICAL

MECHANICAL DIAGNOSIS CHART—DIESEL ENGINES

CONDITION	POSSIBLE CAUSES	CORRECTION
LUBRICATING OIL PRESSURE LOW	1. Low oil level.	1. A. Check and fill with clean engine oil. B. Check for a severe external oil leak that could reduce the pressure.
	2. Oil viscosity thin, diluted or wrong specification.	2. Verify the correct oil is being used. Check for oil dilution. Refer to Contaminated Lube Oil (Engine Diagnosis Mechanical).
	3. Improperly operating pressure switch/gauge.	3. Verify the pressure switch is functioning correctly. If not, replace switch/gauge.
	4. Relief valve stuck open.	4. Check/replace valve.
	5. Plugged oil filter.	5. Change oil filter. Oil filter change interval may need to be revised.
	6. If cooler was replaced, shipping plugs left in cooler.	6. Check/remove shipping plugs.
	7. Worn oil pump.	7. Check and replace oil pump.
	8. Suction tube loose or seal leaking.	8. Check and replace seal.
	9. Loose main bearing cap.	9. Check and install new bearing and tighten cap to proper torque.
	10. Worn bearings or wrong bearings installed.	10. Inspect and replace connecting rod or main bearings. Check and replace piston cooling nozzles.
	11. Oil jet under piston bad fit into main carrier.	11. Check oil jet position.
LUBRICATING OIL PRESSURE TOO HIGH	1. Pressure switch/gauge not operating properly.	1. Verify the pressure switch is functioning correctly. If not, replace switch/gauge.
	2. Engine running to cold.	2. Refer to Coolant Temperature Below Normal (Engine Diagnosis Performance).
	3. Oil viscosity too thick.	3. Make sure the correct oil being used, (Refer to Group 0, Lubrication and Maintenance).
	4. Oil pressure relief valve stuck closed or binding.	4. Check and replace valve.
LUBRICATING OIL LOSS	1. External leaks.	1. Visually inspect for oil leaks. Repair as required.
	2. Crankcase being overfilled.	2. Verify that the correct dipstick is being used.
	3. Incorrect oil specification or viscosity.	3. A. Make sure the correct oil is being used. B. Look for reduced viscosity from dilution with fuel. C. Review/reduce the oil change intervals.
	4. Oil cooler leak.	4. Check and replace the oil cooler.
	5. High blow-by forcing oil out the breather.	5. Check the breather tube area for signs of oil loss. Perform the required repairs.
	6. Turbocharger leaking oil to the air intake.	6. Inspect the air ducts for evidence of oil transfer. Repair as required.
	7. Piston rings not sealing (oil being consumed by the engine).	7. Perform blow-by check. Repair as required.

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DIAGNOSIS AND TESTING (Continued)

MECHANICAL DIAGNOSIS CHART—DIESEL ENGINES—CONT.

CONDITION	POSSIBLE CAUSES	CORRECTION
COMPRESSION KNOCKS	1. Air in the fuel system.	1. Bleed the fuel system (refer to Group 14, Fuel System).
	2. Poor quality fuel or water/ gasoline contaminated fuel.	2. Verify by operating from a temporary tank with good fuel. Clean and flush the fuel supply tanks. Replace fuel/water separator filter.
	3. Engine overloaded.	3. Verify the engine load rating is not being exceeded.
	4. Incorrect injection pump timing.	4. Check and time injection pump (refer to Group 14, Fuel System).
	5. Improperly operating injectors.	5. Check and replace inoperative injectors.
EXCESSIVE VIBRATION	1. Loose or broken engine mounts.	1. Replace engine mounts.
	2. Damaged fan or improperly operating accessories.	2. Check and replace the vibrating components.
	3. Improperly operating vibration damper.	3. Inspect/replace the vibration damper.
	4. Improperly operating viscous fan drive.	4. Inspect/replace the fan drive.
	5. Worn or damaged generator bearing.	5. Check/replace the generator.
	6. Flywheel housing misaligned.	6. Check/correct flywheel alignment.
	7. Loose or broken power component.	7. Inspect the crankshaft and rods for damage that causes an unbalance. repair/replace as required.
	8. Worn or unbalanced driveline components.	8. Check/repair driveline components.
EXCESSIVE ENGINE NOISES	1. Drive belt squeal, insufficient tension or abnormally high loading.	1. Check the automatic tensioner and inspect the drive belt. Make sure water pump, tensioner pulley, fan hub and generator turn freely.
	2. Intake air or exhaust leaks.	2. Refer to Excessive Exhaust smoke (Engine Diagnosis Performance).
	3. Excessive valve lash.	3. Adjust valves. Make sure the push rods are not bent and rocker levers or adjusting screws are not severely worn. Replace bent or severely worn pads.
	4. Turbocharger noise.	4. Check turbocharger impeller and turbine wheel for housing contact. Repair/replace as required.
	5. Gear train noise.	5. Visually inspect and measure gear backlash. Replace gears as required.
	6. Power function knock.	6. Check/replace rod and main bearings.
GENERATOR NOT CHARGING OR INSUFFICIENT CHARGING	1. Loose or corroded battery.	1. Clean/tighten battery connection.
	2. Generator belt slipping.	2. Check/replace automatic belt tensioner. Check/replace drive belt.
	3. Generator pulley loose on shaft.	3. Tighten pulley.
	4. Improperly operating generator.	4. Check/replace generator.

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DIAGNOSIS AND TESTING (Continued)

SMOKE DIAGNOSIS CHARTS

The following charts include possible causes and corrections for **excess or abnormal** exhaust smoke.

Small amounts of exhaust smoke (at certain times) are to be considered normal for a diesel powered engine.

EXCESSIVE BLACK SMOKE	
POSSIBLE CAUSE	**CORRECTION**
Air filter dirty or plugged.	Check Filter Minder® at air filter. Refer to Air Cleaner Housing/ Element Removal/Installation in Group 14, Fuel System. Replace filter if necessary.
Air intake system restricted.	Check entire air intake system including all hoses and tubes for restrictions, collapsed parts or damage. Repair/replace as necessary.
Diagnostic Trouble Codes (DTC's) active or multiple, intermittent DTC's.	Refer to Powertrain Diagnostic Procedures manual.
Engine Control Module (ECM) not calibrated or ECM has incorrect calibration.	Refer to Powertrain Diagnostic Procedures manual.
Exhaust system restriction is above specifications.	Check exhaust pipes for damage/restrictions. Repair as necessary. Refer to Group 11, Exhaust System and Turbocharger.
Fuel grade is not correct or fuel quality is poor.	Temporarily change fuel brands and note condition. Change brand if necessary.
Fuel injection pump malfunctioning.	A DTC should have been set. If so, refer to Powertrain Diagnostic Procedures manual.
Fuel injector malfunctioning.	A DTC should have been set. Perform "Cylinder Balance Test" using DRB scan tool to isolate individual cylinders. Also refer to Powertrain Diagnostic Procedures manual and, to Fuel Injector Testing in Group 14, Fuel System.
Fuel return system restricted.	Check fuel return line by checking overflow valve. Refer to Fuel Transfer Pump Pressure Test in Group 14, Fuel System.
Intake manifold restricted.	Remove restriction. Refer to Group 9, Engines.
Manifold Air Pressure (Boost) Sensor or sensor circuit malfunctioning.	A DTC should have been set. Refer to Powertrain Diagnostic Procedures manual. Also refer to Boost Pressure Test in Group 14, Fuel System.
Raw fuel in intake manifold.	Fuel injectors leaking on engine shutdown. Do Fuel Injector Test. Refer to Group 14, Fuel System.
Static timing not correct.	A DTC should have been set. If so, refer to Powertrain Diagnostic Procedures manual. Also refer to Fuel Injection Pump Timing in Group 14, Fuel System.
Turbocharger air intake restriction.	Refer to Group 11, Exhaust System and Turbocharger.
Turbocharger damaged.	Refer to Group 11, Exhaust System and Turbocharger.
Turbocharger has excess build up on compressor wheel and/or diffuser vanes.	Refer to Group 11, Exhaust System and Turbocharger.
Turbocharger wheel clearance out of specification.	Refer to Group 11, Exhaust System and Turbocharger.

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DIAGNOSIS AND TESTING (Continued)

EXCESSIVE WHITE SMOKE	
POSSIBLE CAUSE	**CORRECTION**
Air in fuel supply: Possible leak in fuel supply side (between transfer pump and fuel tank module).	Refer to Fuel Transfer Pump Pressure Test in Group 14, Fuel System.
Coolant leaking into combustion chamber.	Do pressure test of cooling system. Refer to Group 7, Cooling System
Diagnostic Trouble Codes (DTC's) active or multiple, intermittent DTC's.	Refer to Powertrain Diagnostic Procedures manual.
In very cold ambient temperatures, engine block heater is malfunctioning (if equipped).	Refer to Group 7, Cooling System.
Engine coolant temperature sensor malfunctioning.	A DTC should have been set. Refer to Powertrain Diagnostic Procedures manual. Also check thermostat operation. Refer to Group 7, Cooling System.
Engine Control Module (ECM) not calibrated or has incorrect calibration.	A DTC should have been set. Refer to Powertrain Diagnostic Procedures manual.
Fuel filter plugged.	Perform Fuel Pressure Drop Test. Refer to Fuel Transfer Pump Pressure Testing in Group 14, Fuel System.
Fuel grade not correct or fuel quality is poor.	Temporarily change fuel brands and note condition. Change brand if necessary.
Fuel heater element or fuel heater temperature sensor malfunctioning. This will cause wax type build-up in fuel filter.	Refer to Fuel Heater Testing in Group 14, Fuel System.
Fuel injector malfunctioning.	A DTC should have been set. Perform "Cylinder Balance Test" using DRB scan tool to isolate individual cylinders. Also refer to Powertrain Diagnostic Procedures manual and, to Fuel Injector Testing in Group 14, Fuel System.
Fuel injector protrusion not correct.	Check washer (shim) at bottom of fuel injector for correct thickness. Refer to Fuel Injector Removal/Installation in Group 14, Fuel System.
Fuel injection pump malfunctioning.	A DTC should have been set. Refer to Powertrain Diagnostic Procedures manual.
Fuel supply side restriction to transfer pump.	Refer to Fuel Transfer Pump Pressure Test in Group 14, Fuel System
Fuel transfer (lift) pump malfunctioning.	A DTC should have been set. Refer to Powertrain Diagnostic Procedures manual. Also refer to Fuel Transfer Pump Pressure Testing in Group 14, Fuel System.
Intake/Exhaust valve adjustments not correct (too tight).	Refer to Group 9, Engines.
Intake manifold air temperature sensor malfunctioning.	A DTC should have been set. Refer to Powertrain Diagnostic Procedures manual.
Intake manifold heater circuit not functioning correctly in cold weather.	A DTC should have been set. Refer to Powertrain Diagnostic Procedures manual. Also check heater elements for correct operation.
Intake manifold heater elements not functioning correctly in cold weather.	A diagnostic trouble code WILL NOT BE SET if heater elements are malfunctioning. Refer to NTC tests in Powertrain Diagnostic Procedures manual.
Internal engine damage (scuffed cylinder).	Analyze engine oil and inspect oil filter to locate area of probable damage.
Restriction in fuel supply side of fuel system.	Refer to Fuel Transfer Pump Pressure Testing in Group 14, Fuel System.
Static timing incorrect.	A DTC should have been set. If so, refer to Fuel injection Pump Timing in Group 14, Fuel System.

DIAGNOSIS AND TESTING (Continued)

EXCESSIVE BLUE SMOKE	
POSSIBLE CAUSE	**CORRECTION**
Dirty air cleaner or restricted turbocharger intake duct.	Check Filter Minder at air filter housing. Refer to Air Cleaner Housing/Element Removal/Installation in Group 14, Fuel System. Replace air remove obstruction and/or replace air cleaner element as necessary.
Air leak in boost system between turbocharger compressor outlet and intake manifold.	Refer to Turbocharger System Diagnostics in Group 11, Exhaust System and Turbocharger.
Obstruction in exhaust manifold.	Remove exhaust manifold and inspect for blockage. Refer to Group 11, Exhaust System and Turbocharger.
Restricted turbocharger drain tube.	Remove turbocharger drain tube and remove obstruction. Refer to Group 11, Exhaust System and Turbocharger.
Crankcase ventilation system plugged.	Inspect crankcase breather and vent tube for sludge formation or obstructions.
Valve seals are worn, brittle, or improperly installed.	Replace valve stem oil seals. Refer to Valve Spring and/or Seal Removal/Installation in this group.
Valve stems and/or guides are worn.	Remove valves and inspect valves and guides. Refer to procedure in this group.
Broken or Improperly installed piston rings.	Tear down engine and inspect piston rings.
Excessive piston ring end gap.	Remove pistons and measure piston ring end gap. Refer to Piston and Connecting Rod Removal/Installation in this group.
Excessive cylinder bore wear and taper.	Remove pistons and measure cylinder bore wear and taper. Refer to applicable procedures in this group.
Cylinder damage.	Remove pistons and inspect cylinder bore for cracks or porosity. Repair with cylinder liner if necessary. Refer to procedure in this group.
Piston damage.	Remove pistons and inspect for cracks, holes. Measure piston for out-of-round and taper. Refer to Piston and Connecting Rod Removal/Installation in this group.
Turbocharger failure.	Refer to Turbocharger Diagnostics in Group 11, Exhaust System and Turbocharger.

VACUUM PUMP OUTPUT

The vacuum pump supplies necessary vacuum to components in the following systems:

- HEVAC system
- Speed Control System

A quick check to determine if the vacuum pump is the cause of the problem in any of these systems is to road test the vehicle and verify that all of these systems are fuctioning properly. If only one of these has a vacuum related failure, then it is likely the vacuum pump is not the cause.

A standard vacuum gauge can be used to check pump output when necessary. Simply disconnect the pump supply hose and connect a vacuum gauge to the outlet port for testing purposes. With the engine running, vacuum output should be a minimum of 25 inches, depending on engine speed.

DIAGNOSING LOW VACUUM OUTPUT CONDITION

If the vacuum pump is suspected of low vacuum output, check the pump and vacuum harnesses as follows:

(1) Visually inspect the vacuum harness for obvious failures (i.e. disconnected, cracks, breaks etc.)

(2) Disconnect the vacuum supply hose at the vacuum pump check valve. Connect vacuum gauge to this valve and run engine at various throttle openings. Output should be a minimum 25 inches of vacuum. If vacuum is consistently below 25 inches, the vacuum pump should be replaced. If output is within specified limits, the vacuum harness should be suspected as the cause.

(3) Disconnect and isolate the vacuum supply harness. Cap off open ends and apply roughly 15 inches of vacuum to the harness. If the vacuum gauge does

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DIAGNOSIS AND TESTING (Continued)

not hold its reading, then there is an open in the harness and it should be repaired or replaced.

(4) If the vacuum loss is still not detected at this point, then the pump and harness are not the cause of the low vacuum condition. Apply vacuum to the related components of the vacuum supply system (i.e. valves, servos, solenoids, etc.) to find the source of the vacuum loss.

SERVICE PROCEDURES

ENGINE OIL / FILTER SERVICE

WARNING: NEW OR USED ENGINE OIL CAN BE IRRITATING TO THE SKIN. AVOID PROLONGED OR REPEATED SKIN CONTACT WITH ENGINE OIL. CONTAMINANTS IN USED ENGINE OIL, CAUSED BY INTERNAL COMBUSTION, CAN BE HAZARDOUS TO YOUR HEALTH. THOROUGHLY WASH EXPOSED SKIN WITH SOAP AND WATER. DO NOT WASH SKIN WITH GASOLINE, DIESEL FUEL, THINNER, OR SOLVENTS, HEALTH PROBLEMS CAN RESULT. DO NOT POLLUTE. DISPOSE OF USED ENGINE OIL PROPERLY.

ENGINE OIL SPECIFICATION

CAUTION: Do not use non-detergent or straight mineral oil when adding or changing crankcase lubricant. Engine failure can result.

API SERVICE GRADE CERTIFIED

Standard engine-oil identification notations have been adopted to aid in the proper selection of engine oil. The identifying notations are located on the label of engine oil plastic bottles and the top of engine oil cans.

In diesel engines, use an engine oil that conforms to API Service Grade CF-4 or CG-4/SH (Fig. 8). MOPAR® provides an engine oil that conforms to this particular grade.

Fig. 8 API Service Grade Certification Label—Diesel Engine Oil

SAE VISCOSITY

An SAE viscosity grade is used to specify the viscosity of engine oil. SAE 15W–40 specifies a multiple viscosity engine oil.

When choosing an engine oil, consider the range of temperatures the vehicle will be operated in before the next oil change. Select an engine oil that is best suited to your area's particular ambient temperature range and variation. For diesel engines, refer to (Fig. 9).

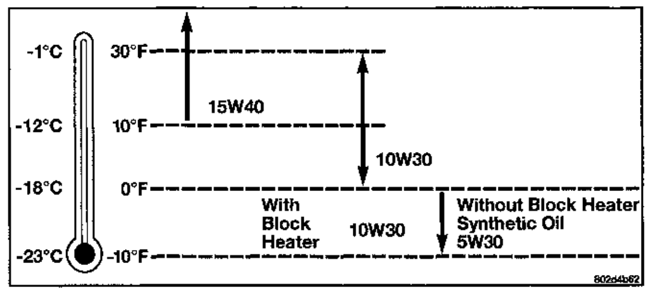

Fig. 9 Engine Oil Viscosity Recommendation—Diesel Engines

CRANKCASE OIL LEVEL INSPECTION

CAUTION: Do not overfill crankcase with engine oil, oil foaming and oil pressure loss can result.

To ensure proper lubrication of an engine, the engine oil must be maintained at an acceptable level. The acceptable oil level is in the SAFE RANGE on the engine oil dipstick (Fig. 10).

Unless the engine has exhibited loss of oil pressure, run the engine for about five minutes before checking oil level. Checking engine oil level of a cold engine is not accurate.

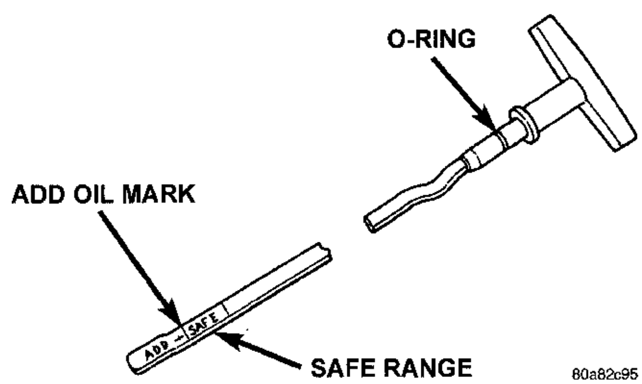

Fig. 10 Oil Level Indicator (Dipstick)

(1) Position vehicle on level surface.

(2) With engine OFF, allow approximately ten minutes for oil to settle to bottom of crankcase, remove engine oil dipstick.

(3) Wipe dipstick clean.

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SERVICE PROCEDURES (Continued)

(4) Replace dipstick and verify it is seated in the tube.
(5) Remove dipstick, with handle held above the tip, take oil level reading.
(6) Add oil only if level is below the SAFE RANGE area on the dipstick.
(7) Replace dipstick

ENGINE OIL AND FILTER CHANGE

WARNING: HOT OIL CAN CAUSE PERSONAL INJURY.

NOTE: Change engine oil and filter at intervals specified in the owner's manual.

(1) Operate the engine until the water temperature reaches 60°C (140°F). Shut the engine off.
(2) Use a container that can hold at least 14 liters (15 quarts) to hold the used oil. Remove the oil drain plug and drain the used engine oil into the container.
(3) Always check the condition of the used oil. This can give you an indication of engine problems that might exist.
- Thin, black oil indicates fuel dilution.
- Milky discoloration indicates coolant dilution.

(4) Clean the area around the oil filter head. Remove the filter using a 90-95 mm filter wrench.
(5) Clean the gasket surface of the filter head. The filter canister O-Ring seal can stick on the filter head. Make sure it is removed.
(6) Fill the oil filter element with clean oil before installation. Use the same type oil that will be used in the engine.
(7) Apply a light film of lubricating oil to the sealing surface before installing the filter.

CAUTION: Mechanical over-tightening may distort the threads or damage the filter element seal.

(8) Install the filter as specified by the filter manufacturer.
(9) Clean the drain plug and the sealing surface of the pan. Check the condition of the threads and sealing surface on the oil pan and drain plug.
(10) Install the drain plug. Tighten the plug to 60 N·m (44 ft. lbs.) torque.
(11) Use only High-Quality Multi-Viscosity lubricating oil in the Cummins Turbo Diesel engine. Choose the correct oil for the operating conditions outlined in Group 0, Lubrication and Maintenance.
(12) Fill the engine with the correct grade of new oil. Refer to Group 0, Lubrication and Maintenance for the correct oil fill capacity.
(13) Start the engine and operate it at idle for several minutes. Check for leaks at the filter and drain plug.
(14) Stop engine. Wait several minutes to allow the oil to drain back to the pan and check the level again.

USED ENGINE OIL DISPOSAL

Care should be exercised when disposing of used engine oil after it has been drained from a vehicle's engine.

VALVE LASH VERIFICATION & ADJUSTMENT

NOTE: To obtain accurate readings, valve lash measurements AND adjustments should only be performed when the engine coolant temperature is less than 60° C (140° F).

The 24–valve overhead system is a "low-maintenance" design. Routine adjustments are no longer necessary, however, measurement should still take place when trouble-shooting performance problems, or upon completion of a repair that includes removal and installation of the valve train components.
(1) Disconnect battery negative cables.
(2) Remove cylinder head cover (Fig. 11). Refer to procedure in this group.
(3) Remove the fuel pump gear access cover (Fig. 12).

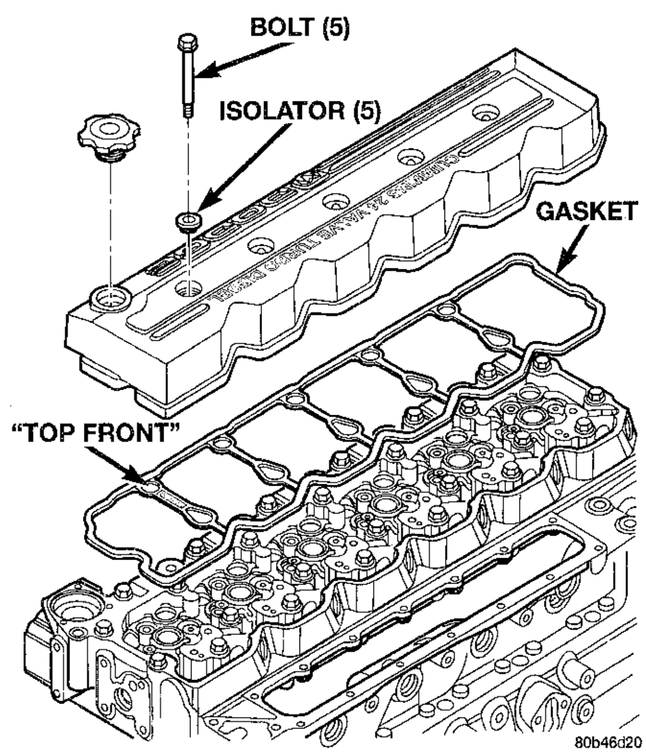

Fig. 11 Cylinder Head Cover and Gasket

(4) Using the crankshaft barring tool #7471B, rotate the engine and align the pump gear mark with

AUTHENTIC RESTORATION PRODUCT

SERVICE PROCEDURES (Continued)

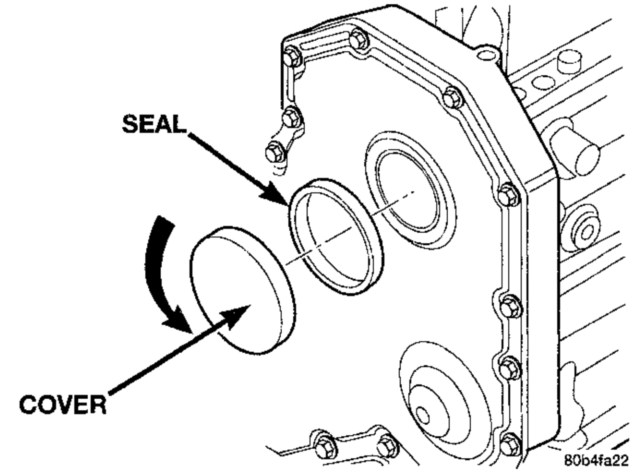

Fig. 12 Fuel Pump Gear Access Cover

the top dead center (TDC) mark on the gear housing cover (Fig. 13).

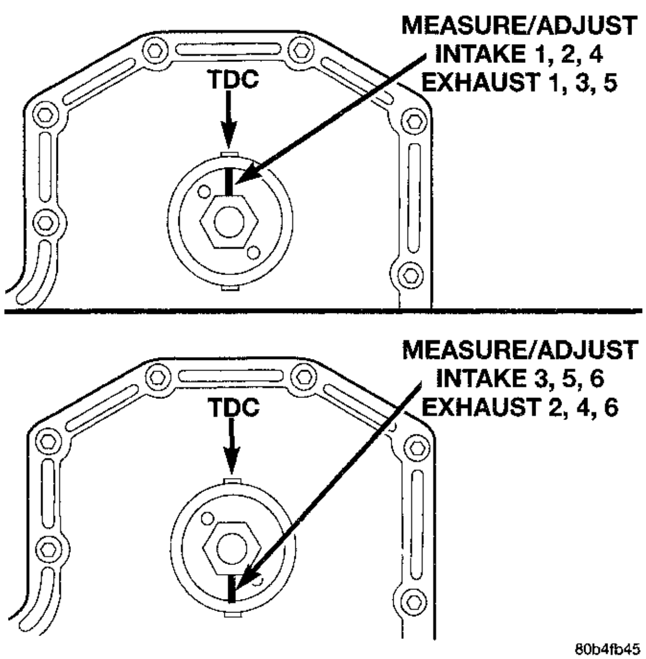

Fig. 13 Fuel Pump Gear Timing Mark Orientation

(5) With the engine in this position (pump gear mark at 12 o'clock), valve lash can be measured at the following rocker arms: **INTAKE 1-2-4 / EXHAUST 1-3-5**. Measure the valve lash by inserting a feeler gauge between the rocker arm socket and crosshead (Fig. 14). Refer to the Valve Lash Limit Chart for the correct specifications. If the measurement falls **within** the limits, adjustment/resetting **is not** necessary. If measurement finds the lash **outside**of the limits, adjustment/resetting **is** required.

VALVE LASH LIMIT CHART

INTAKE	EXHAUST
0.152 mm (0.006 in.) MIN.	0.381 mm (0.015 in.) MIN.
0.381 mm (0.015 in.) MAX.	0.762 mm (0.030 in.) MAX.

NOTE: If measured valve lash falls within these specifications, no adjustment/reset is necessary. Engine operation within these ranges has no adverse affect on performance, emissions, fuel economy or level of engine noise.

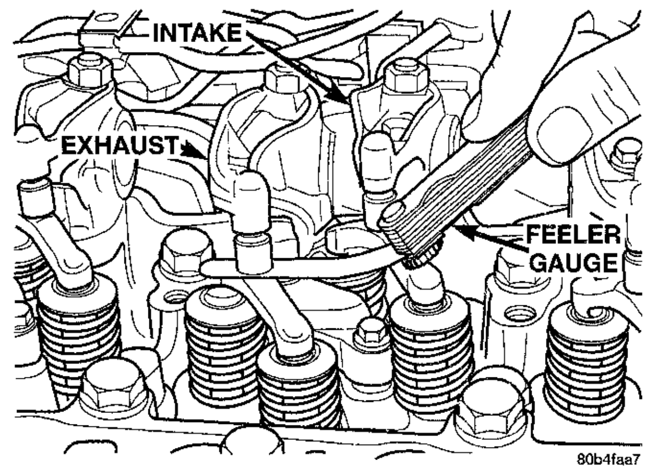

Fig. 14 Measuring Valve Lash

(6) If adjustment/resetting is required, loosen the lock nut on rocker arms and turn the adjusting screw until the desired lash is obtained:

- **INTAKE** 0.254 mm (0.010 in.)
- **EXHAUST** 0.508 mm (0.020 in.)

(6) Tighten the lock nut and re-check the valve lash.

(7) Using the crankshaft barring tool, rotate the **crankshaft** one revolution (360°) to align the pump gear mark to the 6 o'clock position in relation to the TDC mark on the gear housing cover (Fig. 13).

(8) With the engine in this position (pump gear mark at 6 o'clock), valve lash can be measured at the remaining rocker arms: **INTAKE 3-5-6 / EXHAUST 2-4-6**. Use the same method as above for determining whether adjustment is necessary, and adjust those that are found to be outside of the limits.

(9) Install the cylinder head cover (Fig. 11).

(10) Install the fuel pump gear access cover.

(11) Connect the battery negative cables.

CYLINDER BORES—DE-GLAZE

(1) New piston rings may not seat in glazed cylinder bores.

SERVICE PROCEDURES (Continued)

(2) De-glazing gives the bore the correct surface finish required to seat the rings. The size of the bore is not changed by proper de-glazing.

(3) Cover the lube holes in the top of the block with waterproof tape.

(4) A correctly honed surface will have a cross-hatch appearance with the lines at 15° to 25° angles (Fig. 15). For the rough hone, use 80 grit honing stones. To finish hone, use 280 grit honing stones.

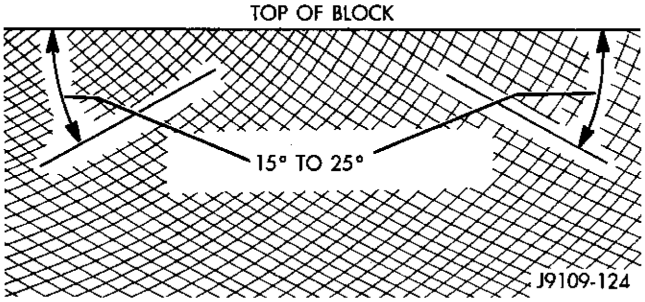

Fig. 15 Cylinder Bore Crosshatch Pattern

(5) Use a drill, a fine grit Flex-hone and a mixture of equal parts of mineral spirits and SAE 30W engine oil to de-glaze the bores.

(6) The crosshatch angle is a function of drill speed and how fast the hone is moved vertically (Fig. 16).

(7) Vertical strokes MUST be smooth continuous passes along the full length of the bore (Fig. 16).

(8) Inspect the bore after 10 strokes.

(9) Use a strong solution of hot water and laundry detergent to clean the bores. Clean the cylinder bores immediately after de-glazing.

(10) Rinse the bores until the detergent is removed and blow the block dry with compressed air.

(11) Check the bore cleanliness by wiping with a white, lint free, lightly oiled cloth. If grit residue is still present, repeat the cleaning process until all residue is removed. Wash the bores and the complete block assembly with solvent and dry with compressed air.

(12) Be sure to remove the tape covering the lube holes after the cleaning process is complete.

CYLINDER BLOCK REFACING

(1) The combustion deck can be refaced twice. The first reface should be 0.25 mm (0.0098 inch). If additional refacing is required, an additional 0.25 mm (0.0098 inch) can be removed. Total allowed refacing is 0.50 mm (0.0197 inch) - (Fig. 17).

(2) The upper right corner of the rear face of the block must be stamped with a X when the block is refaced to 0.25 mm (0.0098 inch). A second X must be stamped beside the first when the block is refaced to 0.50 mm (0.0197 inch) - (Fig. 18).

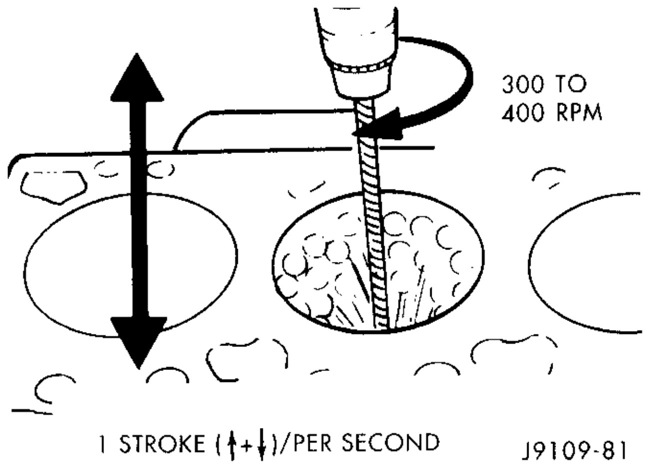

Fig. 16 De-Glazing Drill Speed and Vertical Speed

CYLINDER BLOCK REFACING DIMENSIONS

DIMENSION "A"		
1st Reface	0.25mm	(0.0098 in.)
2nd Reface	0.25mm	(0.0098 in.)
Dim (A) Total	0.50 mm	(0.0197 in.)
DIMENSION "B"		
Dim. "B" (STD.)	323.00 mm ± 0.10 mm	(12.7165 in. ± 0.0039 in.)
1st Reface	322.75 mm ± 0.10 mm	(12.7067 in. ± 0.0039 in.)
2nd Reface	322.50 mm ± 0.10 mm	(12.6968 in. ± 0.0039 in.)

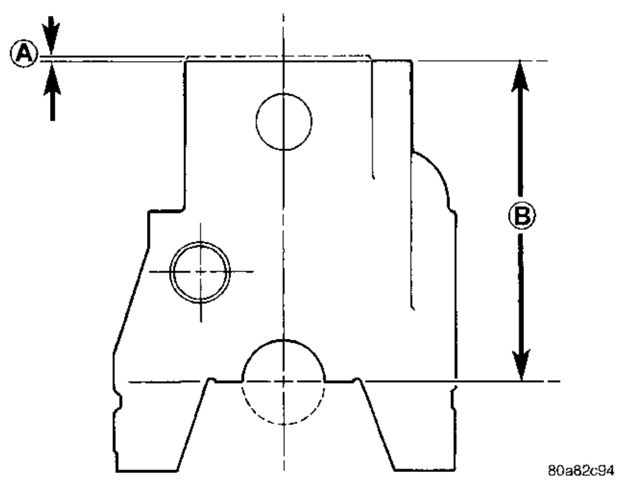

Fig. 17 Refacing Dimensions of the Cylinder Block

(3) Consult the parts catalog for the proper head gaskets which must be used with refaced blocks to ensure proper piston-to-valve clearance.

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SERVICE PROCEDURES (Continued)

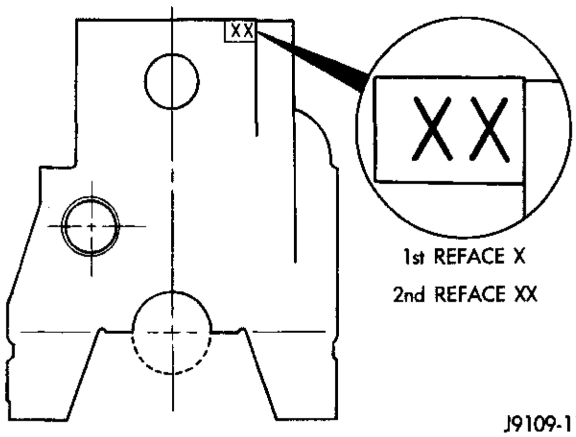


Fig. 18 Stamp Block after Reface

CYLINDER BORE REPAIR

Cylinder bore(s) can be repaired by one of two methods:

• Method 1:—Over boring and using oversize pistons and rings.

• Method 2:—Boring and installing a repair sleeve to return the bore to standard dimensions.

METHOD 1—OVERSIZE BORE

Oversize pistons and rings are available in two sizes - 0.50 mm (0.0197 inch) and 1.00 mm (0.0393 inch).

Any combination of standard, 0.50 mm (0.0197 inch) or 1.00 mm (0.0393 inch) overbore may be used in the same engine.

If more than 1.00 mm (0.0393 inch) overbore is needed, a repair sleeve can be installed (refer to Method 2—Repair Sleeve).

Cylinder block bores may be bored twice before use of a repair sleeve is required (Fig. 19). The first bore is 0.50 mm (0.0197 inch) oversize. The second bore is 1.00 mm (0.0393 inch) oversize.

After boring to size, use a honing stone to chamfer the edge of the bore (Fig. 19).

A correctly honed surface will have a crosshatch appearance with the lines at 15° to 25° angles with the top of the cylinder block (Fig. 20). For the rough hone, use 80 grit honing stones. To finish hone, use 280 grit honing stones.

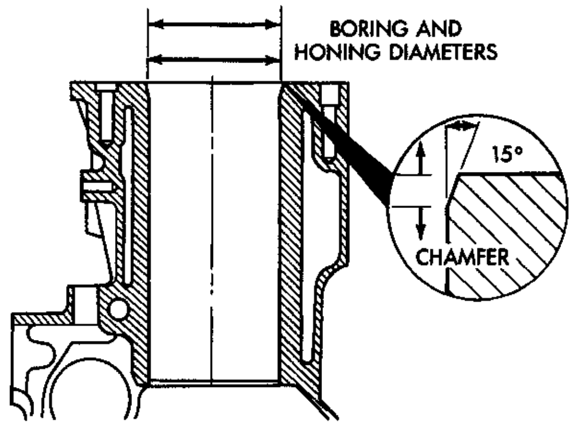
A maximum of 1.2 micrometer (48 microinch) surface finish must be obtained.

After finish honing is complete, immediately clean the cylinder bores with a strong solution of laundry detergent and hot water.

After rinsing, blow the block dry.

Check the bore cleanliness by wiping with a white, lint-free, lightly- oiled cloth. There should be no grit residue present.

If the block is not to be used right away, coat it with a rust- preventing compound.



BORING DIAMETER DIMENSION

1st REBORE – 102.469 mm
(4.0342 inch)
2nd REBORE – 102.969 mm
(4.0539 inch)

HONING DIAMETER DIMENSIONS

STANDARD 102.020 ±0.020 mm
(4.0165 ±0.0008 inch)
1st REBORE 102.520 ±0.020 mm
(4.0362 ±0.0008 inch)
2nd REBORE 103.020 ±0.020 mm
(4.0559 ±0.0008 inch)

CHAMFER DIMENSIONS

Approx. 1.25 mm (0.049 inch)
by 15°

J9109-119

Fig. 19 Cylinder Bore Dimensions

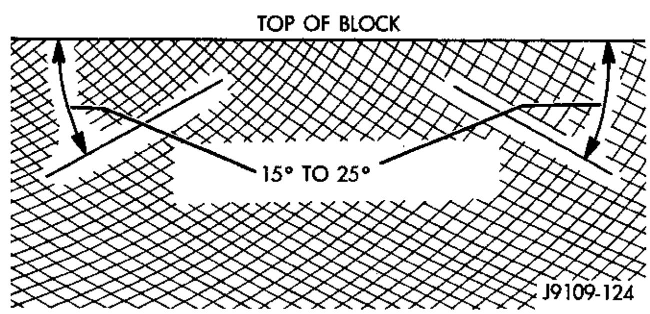


Fig. 20 Crosshatch Pattern of Repaired Sleeve(s)

METHOD 2—REPAIR SLEEVE

If more than a 1.00 mm (0.03937 inch) diameter oversize bore is required, the block must be bored and a repair sleeve installed.

Bore the block cylinder bore to 104.500-104.515 mm (4.1142-4.1148 inch) - (Fig. 21).

SERVICE PROCEDURES (Continued)

Repair sleeves can be replaced by using a boring bar to bore out the old sleeve. DO NOT cut the cylinder bore beyond the oversize limit.

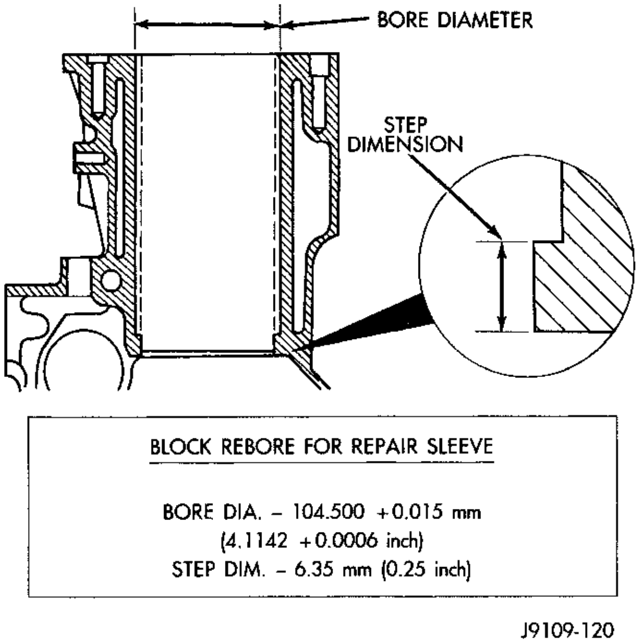


Fig. 21 Block Bore for Repair Sleeve Dimensions

After machining the block for the new repair sleeve, thoroughly clean the bore of all metal chips, debris and oil residue before installing the sleeve.

Cool the repair sleeve(s) to a temperature of -12°C (10°F) or below for a minimum of one hour. Be ready to install the sleeve immediately after removing it from the freezer.

Apply a coat of Loctite 620, or equivalent to the bore that is to be sleeved.

Wear protective gloves to push the cold sleeve into the bore as far as possible.

Using a sleeve driver, drive the sleeve downward until it contacts the step at the bottom of the bore (Fig. 22).

A sleeve driver can be constructed as follows (Fig. 23).

Set up a boring bar and machine the sleeve to 101.956 mm (4.014 inch) - (Fig. 24).

After removing the boring bar, use a honing stone to chamfer the corner of the repair sleeve(s) - (Fig. 24).

A correctly honed surface will have a crosshatch appearance with the lines at 15° to 25° angles with the top of the cylinder block. For the rough hone, use 80 grit honing stones. To finish hone, use 280 grit honing stones.

Finished bore inside dimension is 102.020 ±0.020 mm (4.0165 ±0.0008 inch).

A maximum of 1.2 micrometer (48 microinch) surface finish must be obtained.

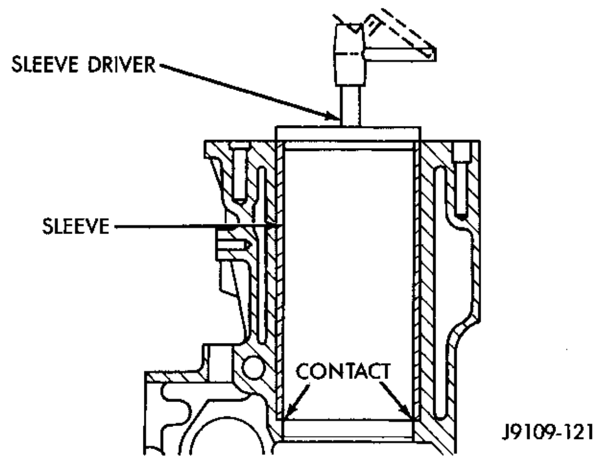


Fig. 22 Sleeve Installation

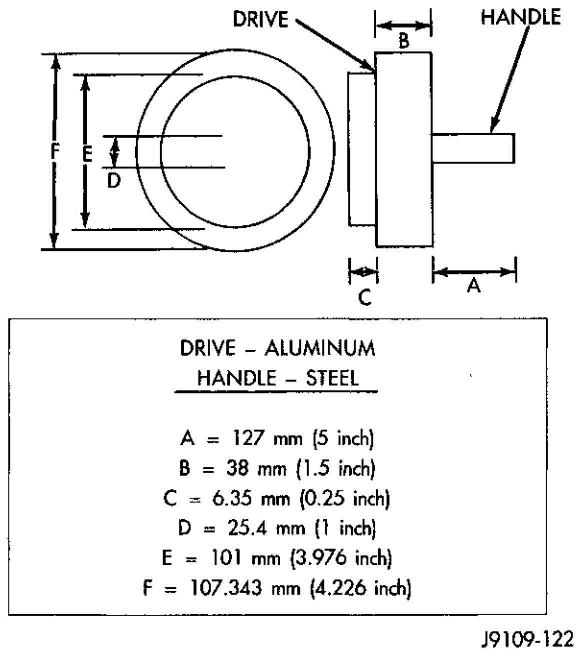


Fig. 23 Sleeve Driver Construction

After finish honing is complete, immediately clean the cylinder bores with a strong solution of laundry detergent and hot water.

After rinsing, blow the block dry with compressed air.

Wipe the bore with a white, lint-free, lightly oiled cloth. Make sure there is no grit residue present.

Apply a rust-preventing compound if the block will not be used immediately.

A standard diameter piston and a piston ring set must be used with a sleeved cylinder bore.

CAM BORE REPAIR

The front cam bushing bore can be bored to 59.235 Mm ±0.013 mm (2.332 inch ±0.0006 inch) oversize. DO NOT bore the intermediate or rear cam bore to

SERVICE PROCEDURES (Continued)

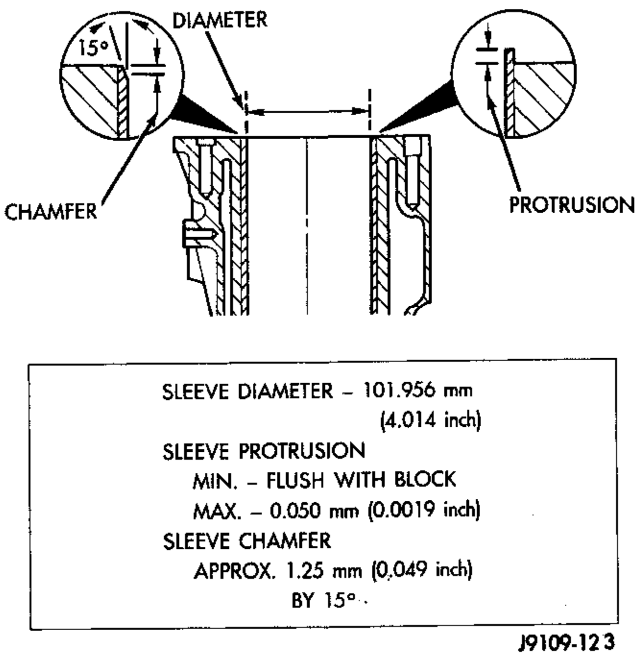


Fig. 24 Sleeve Machining Dimensions

the front cam bore oversize dimensions. Intermediate and rear cam bores may be bored to 57.235 mm ±0.013 mm (2.253 inch ±0.0006– inch) oversize.

A surface finish of 2.3 micrometers (92 microinch) must be maintained. Not more than 20% of an area of any one bore may be 3.2 micrometers (126 microinch).

Camshaft bores can be repaired individually. It is not necessary to repair undamaged cam bores in order to repair individually damaged cam bores. The standard front bushing cannot be used to repair intermediate or rear bores.

Install all cam bushings flush or below the front cam bore surface. The oil hole must align to allow a 3.2 mm (0.125 inch) rod to pass through freely (Fig. 25).

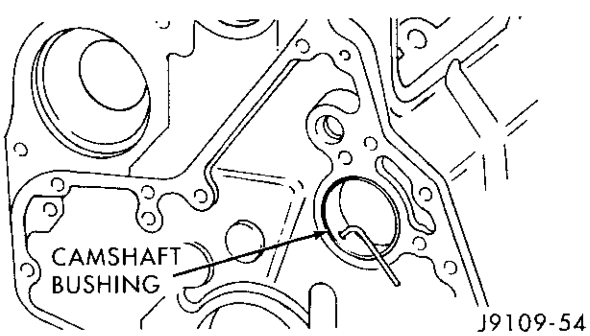


Fig. 25 Oil Hole Alignment

CYLINDER BLOCK CUP PLUG REPLACEMENT

(1) Remove the cup plugs from the oil passages (Fig. 26).

(2) Apply a bead of Loctite 277 around the outside diameter of the oil passage cup plugs.

(3) Drive the cup plugs in until they bottom in the bore (Fig. 26).

(4) Fill the engine with oil. Run the engine and check for leaks.

(5) Stop the engine and check the oil level with the dipstick.

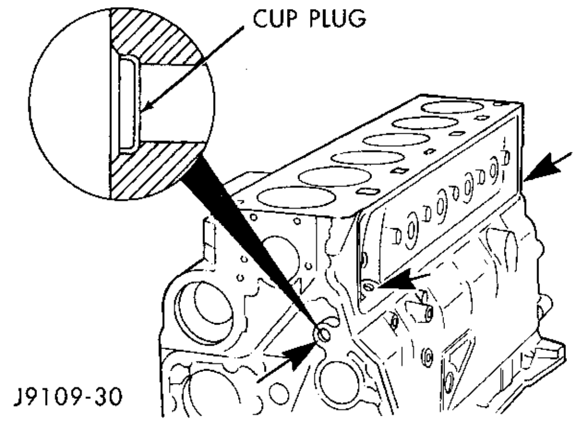


Fig. 26 Cup Plug Locations in Cylinder Block

PISTON GRADING PROCEDURE

• When rebuilding an engine with the original cylinder block, crankshaft and pistons, make sure the pistons are installed in their original cylinder.

• If replacing the piston(s), make sure the replacement piston(s) are the same grade as the one being replaced.

• If a new cylinder block and/or crankshaft is used, the piston grading procedure **MUST** be performed to determine the proper piston grade for each cylinder.

(1) Install any of the original connecting rod and piston assemblies into the No.1 cylinder. DO NOT install the piston rings.

(2) Install the upper bearing shell in the connecting rod with the tang of the bearing in the slot of the connecting rod. The connecting rod bearing shell must be installed in the original connecting rod and cap. Use clean lubricating oil to coat the inside diameter of the connecting rod bearing shell.

(3) Install the bearing shell in the connecting rod cap with the tang of the bearing in the slot to the cap. Use clean lubricating oil to coat the inside diameter of the bearing shell.

(4) The four digit number stamped on the connecting rod and cap at the parting line must match and be installed on the oil cooler side of the engine. Install the connecting rod cap and capscrews. Tighten the capscrews to 35 N·m (26 ft. lbs.) torque.

(5) Use a fine grit stone to remove any burrs from the cylinder block head deck. Zero the dial indicator to the cylinder block head deck.

SERVICE PROCEDURES (Continued)

(6) Move the dial indicator directly over the piston pin to eliminate any side-to-side movement.

(7) Rotate the crankshaft to top dead center (TDC). Rotate the crankshaft clockwise and counterclockwise to find the highest dial indicator reading. Record the reading.

(8) Remove the piston and connecting rod assembly from the No.1 cylinder and install the assembly into the No.2 cylinder. Repeat the procedure for every cylinder using the same piston and connecting rod assembly.

(9) Determine the grade of the piston being used by referring to the Piston Protrusion Chart below. Four digits on top of the piston can be cross referenced to a Chrysler part number for replacement (Fig. 27). If the number on the piston cannot be seen, measure from the top of the piston to the top of the piston pin to see what grade piston is used (Fig. 28).

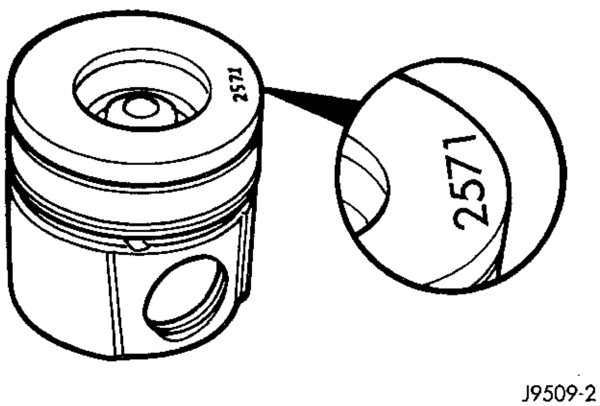


Fig. 27 Piston Grading Number Location

NOTE: Use the table below when piston grading numbers are missing or not legible.

CONNECTING ROD BEARING AND CRANKSHAFT JOURNAL CLEARANCE

Measure the connecting rod bore with the bearings installed and the bolts tightened to 100 N·m (73 ft. lbs.) torque.

Record the smaller diameter.

Measure the diameter of the rod journal at the location shown (Fig. 29). Calculate the average diameter for each side of the journal.

The clearance is the difference between the connecting rod bore (smallest diameter) and the average diameter for each side of the crankshaft journal.

If the crankshaft is within limits, replace the bearing. If the crankshaft is out of limits, grind the crankshaft to the next smaller size and use oversize rod bearings.

PISTON PROTRUSION CHART

IF MEASURING PISTON IS GRADING #:	AND PROTRUSION IS:	USE GRADE:
3708	0.609-0.711 mm (0.024-0.028 in.)	A
3708	0.508-0.609mm (0.020-0.024 in.)	B
3708	0.406-0.508 mm (0.016-0.020 in.)	C
3709	0.711-0.813 mm (0.028-0.032 in.)	A
3709	0.609-0.711 mm (0.024-0.028 in.)	B
3709	0.508-0.609 mm (0.020-0.024 in.)	C
3710	0.813-0.914 mm (0.032-0.036 in.)	A
3710	0.711-0.813 mm (0.028-0.032 in.)	B
3710	0.609-0.711 mm (0.024-0.028 in.)	C

ALTERNATIVE GRADE IDENTIFICATION METHOD

DIMENSION "A"	REF. NUMBER	GRADE
51.554-51.607 mm (2.029-2.031 in.)	3708	A
51.654-51.707 mm (2.033-2.035 in.)	3709	B
51.754-51.807 mm (2.037-2.039 in.)	3710	C

MAIN BEARING CLEARANCE

Inspect the main bearing bores for damage or abnormal wear.

Install the crankshaft main bearings and measure main bearing bore diameter with the main bolts tightened to 176 N·m (130 ft. lbs.) torque (Fig. 30).

Measure the diameter of the main journal at the locations shown (Fig. 31). Calculate the average diameter for each side of the journal.

Calculate the main bearing journal to bearing clearance. the clearance specifications are 0.119 mm (0.00475 inch). If the crankshaft journal is within limits, replace the main bearings. If not within spec-

SERVICE PROCEDURES (Continued)

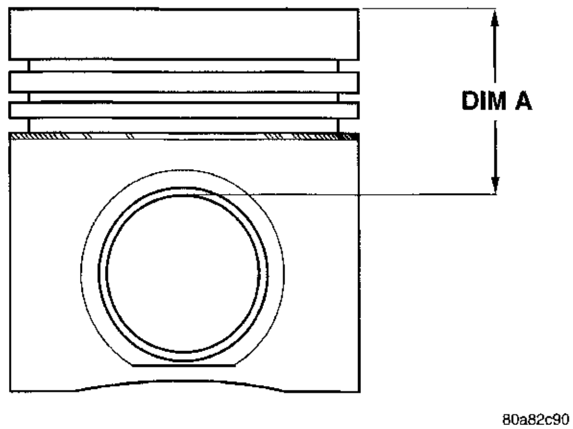


Fig. 28 Piston Grading Measurement

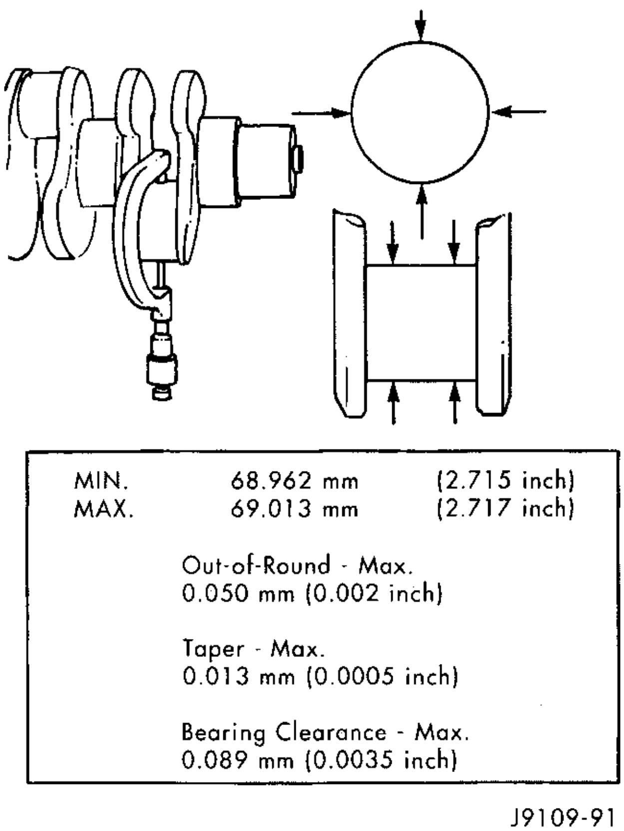


Fig. 29 Connecting Rod Journal Diameter Limits

ifications, grind the crankshaft to next size and use oversize bearings.

CRANKSHAFT SERVICE

Crankshaft main and rod journals may be ground in increments of 0.25 mm (0.0098 inch) up to a total of 1.00 mm (0.0394 inch).

The only exception is the main journal thrust width surface. This journal must be ground in increments of 0.50 mm (0.0197 inch) up to a total of 1.00

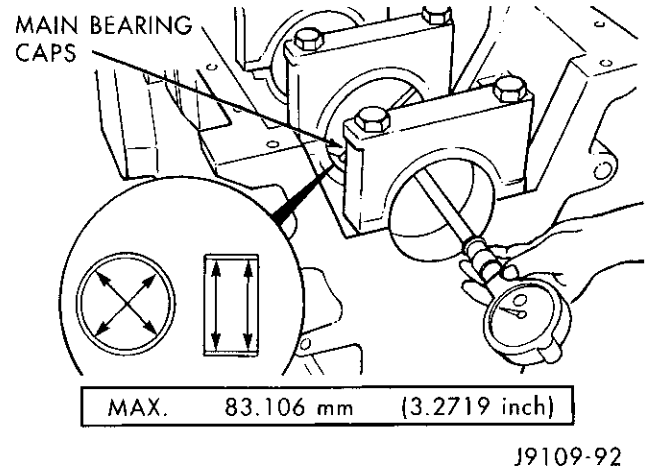


Fig. 30 Crankshaft Main Bearing Bore Diameter

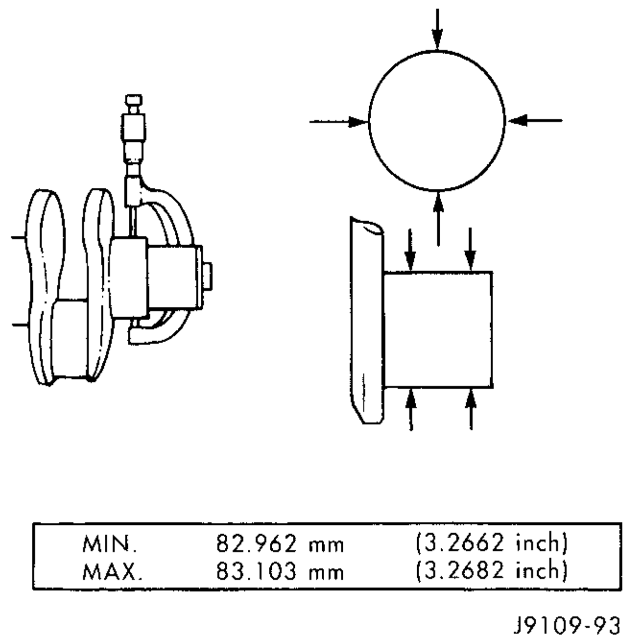


Fig. 31 Crankshaft Main Journal Diameter

mm (0.0394 inch). The thrust surface is located on the No.6 main bearing. When the thrust surface requires grinding, the main journal must be ground to the same undersize dimension.

CAUTION: Welding of the crankshaft is not allowed. Failure of the crankshaft will result.

MAIN JOURNAL

All main journals are to be ground in the opposite direction of engine rotation (clockwise as viewed from the front of crankshaft). Polish the journals in the same direction as engine rotation.

The main bearing grinding specifications are shown in (Fig. 32).

SERVICE PROCEDURES (Continued)

STANDARD MAIN JOURNAL DIAMETER	
83.000 ±0.013 mm (3.2677 ±0.0005 inch)	
WORN MAIN JOURNAL DIAMETER LIMIT	
82.962 (3.2662 inch)	
UNDERSIZES	REGRIND TO
0.25 mm (0.0098 inch)	82.750 ±0.013 mm (3.2579 ±0.0005 inch)
0.50 mm (0.0197 inch)	82.500 ±0.013 mm (3.2480 ±0.0005 inch)
0.75 mm (0.0295 inch)	82.250 ±0.013 mm (3.2381 ±0.0005 inch)
1.00 mm (0.0394 inch)	82.000 ±0.013 mm (3.2283 ±0.0005 inch)
OUT-OF ROUND & TAPER (MAX.)	
0.005 mm (0.0002 inch)	
ALL MAIN JOURNALS ARE TO BE PARALLEL TO THE FRONT AND REAR MAINS WITHIN: 0.030 mm (0.001 inch)	

J9109-125

Fig. 32 Crankshaft Main Journal Dimensions

Thrust journals can be ground in the same increments and using the same specifications as all other main journals. The main journal radius may be ground using either the preferred or the alternative procedure providing the thrust surface width is not being ground. The preferred procedure must be used when the main bearing thrust width surface is ground. When the thrust surface width requires grinding, the main journal must be ground to the same undersize dimension (Fig. 33).

THRUST JOURNAL WIDTH	
37.500 ±0.025 mm (1.4764 ±0.001 inch)	
UNDERSIZES	REGRIND WIDTH TO
0.50 mm (0.0197 inch)	38.000 ±0.025 mm (1.4961 ±0.001 inch
1.00 mm (0.0394 inch)	38.500 ±0.025 mm (1.5158 ±0.001 inch)

J9109-127

Fig. 33 Crankshaft Thrust Journal Width Dimensions

The thrust surface is to be ground on center within 0.10 mm (0.004 inch). It also must be perpendicular to the front and rear mains within 0.0015 mm (0.00006 inch) per radial inch on the thrust area (Fig. 34). The surface finish requirement is 0.04 micrometer (16.0 microinch).

PREFERRED PROCEDURE:

Smoothly blend a 4.20 ±0.020 mm (0.1654 ±0.0008 inch) radius to the ground diameters (Fig. 35).

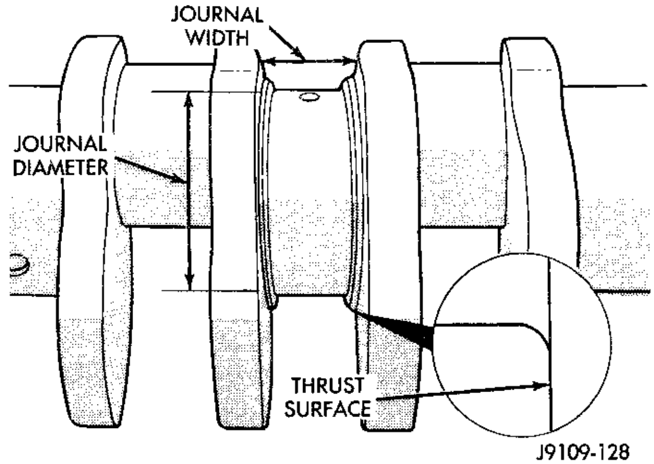


Fig. 34 Crankshaft Thrust Surface

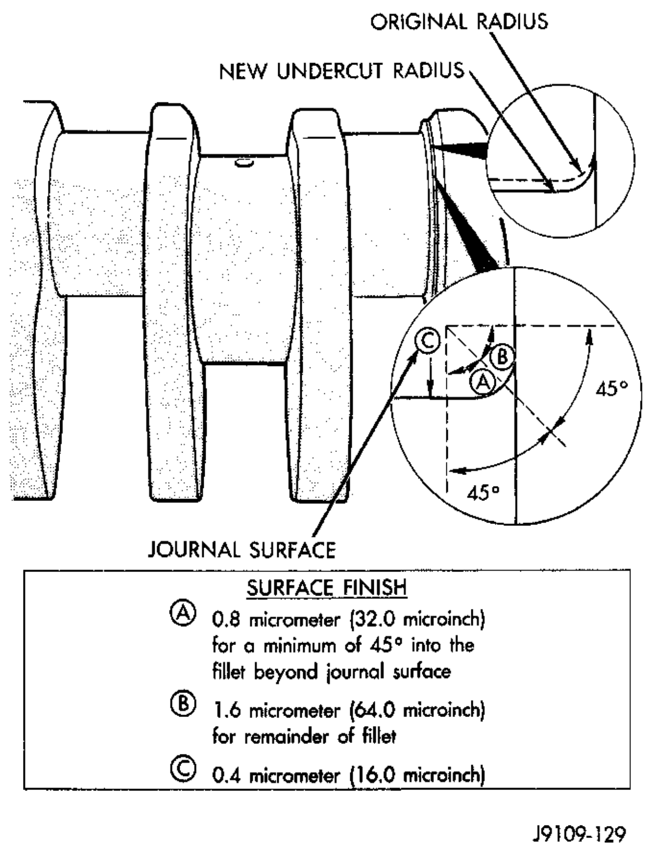


Fig. 35 Grind Crankshaft Main Journal—Preferred Method

CAUTION: DO NOT use the Alternative Procedure when the thrust surface width is ground.

ALTERNATIVE PROCEDURE:

Smoothly blend a 1.25 ±0.020 mm (0.0492 ±0.0008 inch) radius to the ground diameters (Fig. 36).

AUTHENTIC RESTORATION

SERVICE PROCEDURES (Continued)

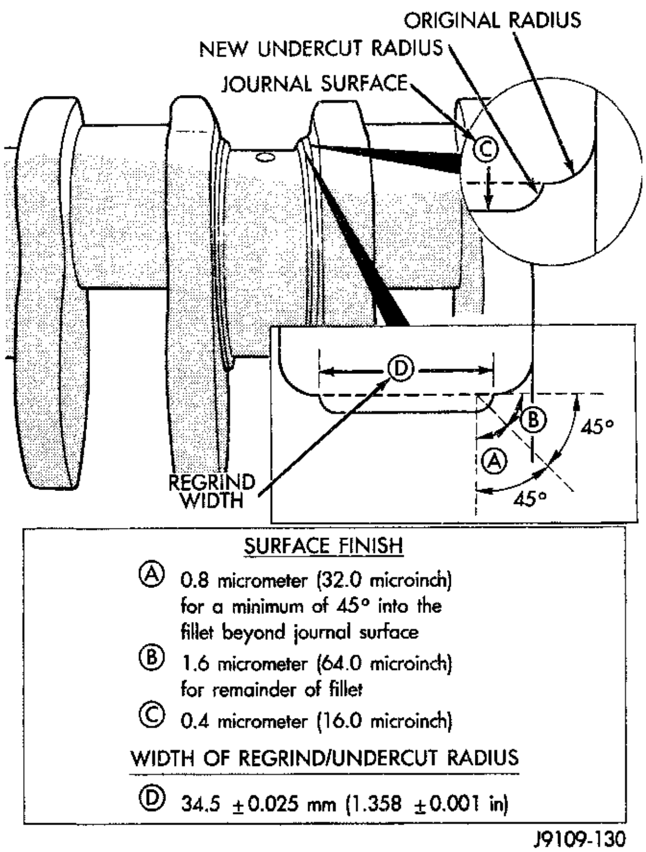


Fig. 36 Grind Crankshaft Main Journal—Alternative Method

ROD JOURNAL

All rod journals are to be ground in the opposite direction of engine rotation (clockwise as viewed from the front of crankshaft). Polish the journals in the same direction as engine rotation.

The rod bearing grinding specifications are shown in (Fig. 37).

STANDARD ROD JOURNAL DIAMETER	
69.000 ±0.013 mm (2.7165 ±0.0005 inch)	
WORN ROD JOURNAL DIAMETER LIMIT	
68.962 (2.7150 inch)	
UNDERSIZES	**REGRIND TO**
0.25 mm (0.0098 inch)	68.750 ±0.013 mm (2.7067 ±0.0005 inch)
0.50 mm (0.0197 inch)	68.500 ±0.013 mm (2.6969 ±0.0005 inch)
0.75 mm (0.0295 inch)	68.250 ±0.013 mm (2.6870 ±0.0005 inch)
1.00 mm (0.0394 inch)	68.000 ±0.013 mm (2.6772 ±0.0005 inch)
OUT-OF ROUND & TAPER (MAX.)	
0.005 mm (0.0002 inch)	
ALL MAIN JOURNALS ARE TO BE PARALLEL TO THE FRONT AND REAR MAINS WITHIN: 0.030 mm (0.001 inch)	

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Fig. 37 Crankshaft Rod Journal Dimensions

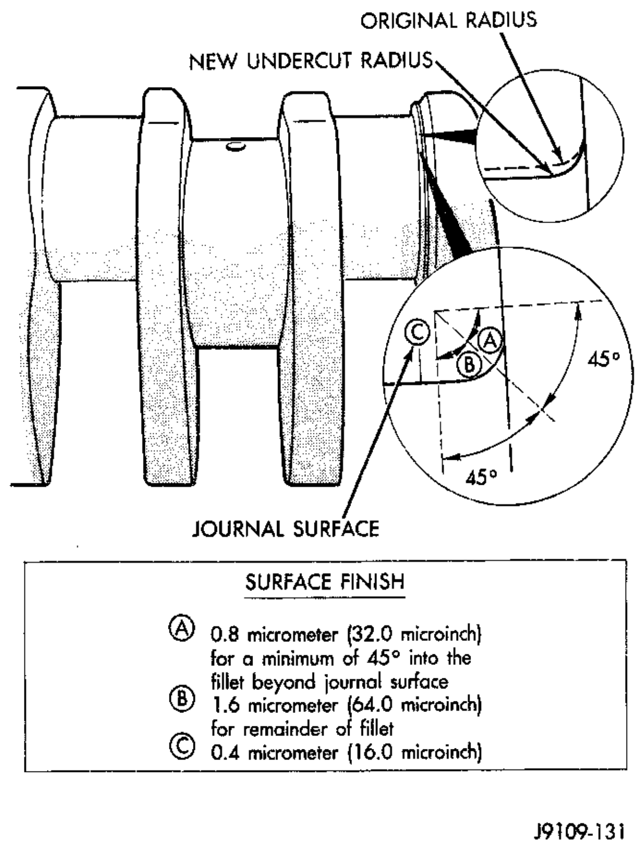

Fig. 38 Crankshaft Rod Journal Grind—Preferred Method

PREFERRED PROCEDURE:

Smoothly blend a 4.00 ±0.020 (0.1575 ±0.0008 inch) radius to the ground diameters and side faces (Fig. 38).

ALTERNATIVE PROCEDURE:

Smoothly blend a 1.25 ±0.020 mm (0.0492 ±0.0008 inch) radius to the ground journals (Fig. 39).

REMOVAL AND INSTALLATION

ENGINE MOUNTS—FRONT

REMOVAL

(1) Disconnect the battery negative cables.
(2) Remove the viscous fan/drive assy.
(3) Raise vehicle on hoist.
(4) Support engine with a screw jack and wood block.
(5) Loosen the thru-bolt and nut (Fig. 40).

REMOVAL AND INSTALLATION (Continued)

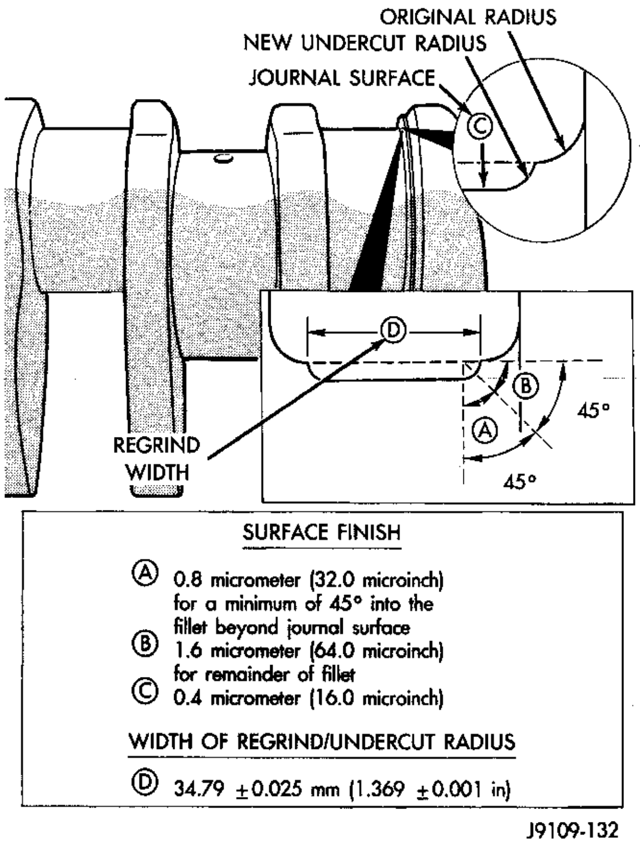

Fig. 39 Grind Crankshaft Rod Journal—Alternative Method

(6) Passenger side mount: Remove the two (2) transmission oil cooler bracket to engine mount bolts.

(7) Lift the engine SLIGHTLY and remove the four (4) mount to block bolts.

(8) Remove the mount from the vehicle.

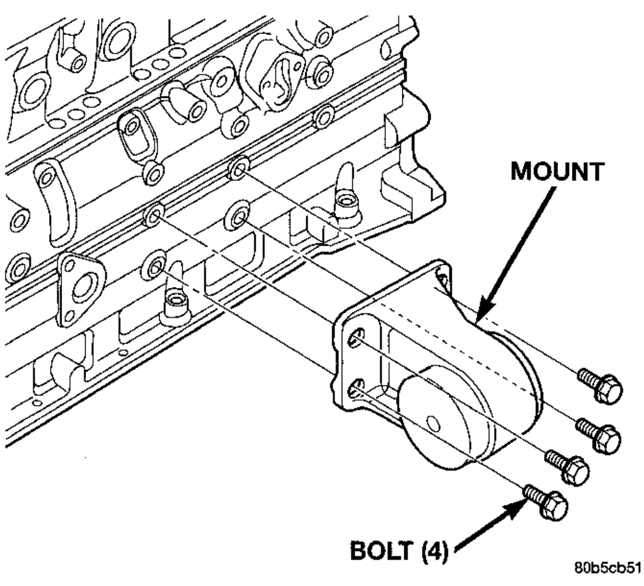

Fig. 40 Front Engine Mount—Typical

INSTALLATION

(1) With engine raised SLIGHTLY, position the engine mount to the block. Install the bolts and tighten to 149 N·m (110 ft. lbs.) torque.

(2) Install the thru-bolt into the engine mount.

(3) Lower the engine while guiding the mount and thru-bolt into the frame mounted support cushion brackets (Fig. 41).

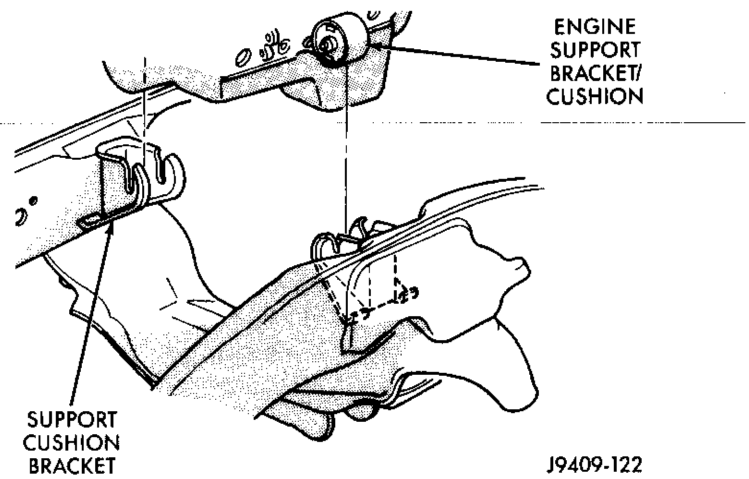

Fig. 41 Positioning Engine Front Mounts

(4) Install the thru-bolt nut and tighten the nut to 88 N·m (65 ft. lbs.) torque.

(5) Passenger side: Install the two (2) transmission oil cooler bracket to mount bolts. Tighten the bolts to 47 N·m (35 ft. lbs.) torque.

(6) Remove lifting fixture.

(7) Lower the vehicle.

(8) Install the viscous fan/drive assy. and torque to 57 N·m (42 ft. lbs.) torque.

(9) Connect the battery negative cables.

ENGINE MOUNT—REAR

REMOVAL

(1) Raise the vehicle on a hoist.

(2) Position a transmission jack in place.

(3) Remove support cushion stud nuts (Fig. 42).

(4) Raise rear of transmission and engine SLIGHTLY.

(5) Remove the bolts holding the support cushion to the transmission support bracket. Remove the support cushion.

(6) If necessary, remove the bolts holding the transmission support bracket to the transmission.

INSTALLATION

(1) If removed, position the transmission support bracket to the transmission. Install new attaching bolts and tighten to 102 N·m (75 ft. lbs.) torque.

AUTHENTIC RESTORATION PRODUCT

REMOVAL AND INSTALLATION (Continued)

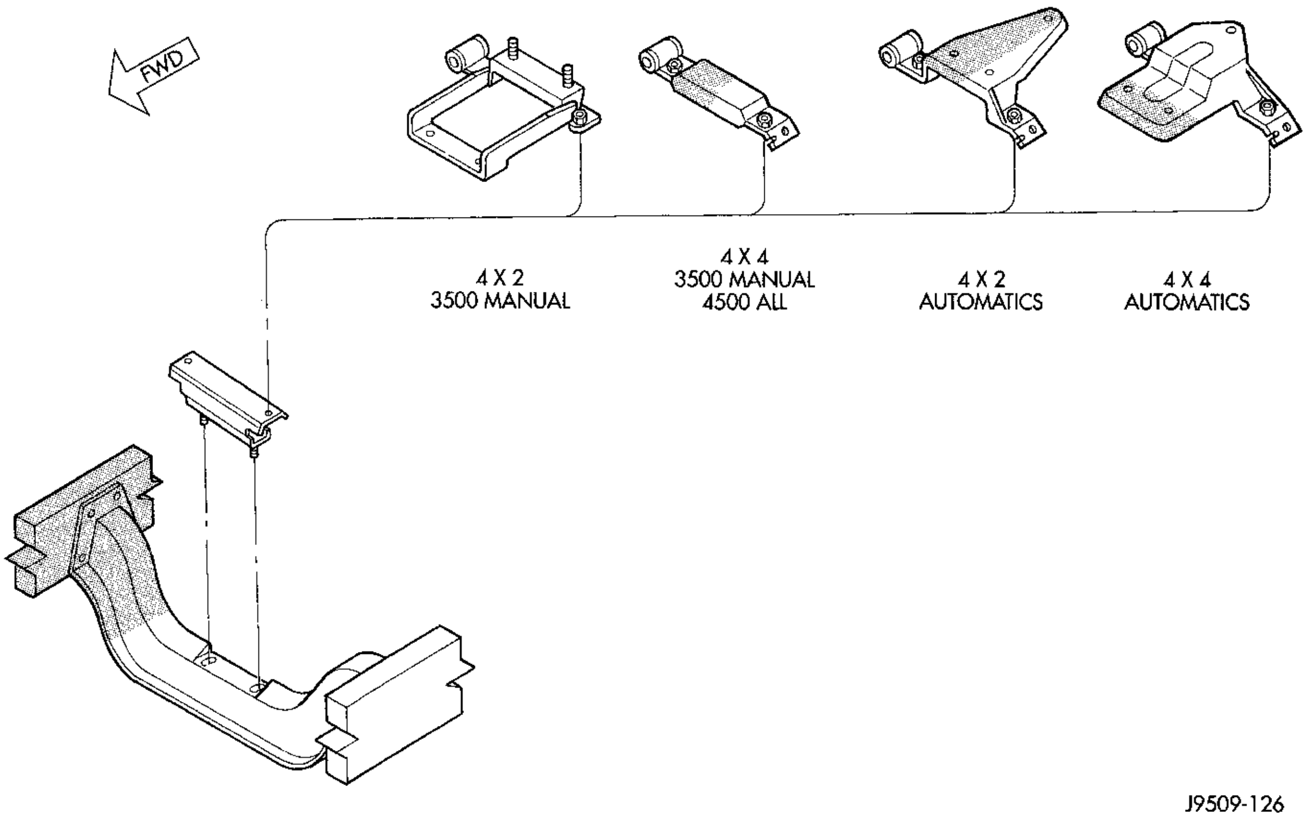

Fig. 42 Engine Rear Support Cushion Assemblies

(2) Position support cushion to transmission support bracket. Install stud nuts and tighten to 47 N·m (35 ft. lbs.) torque.

(3) Using the transmission jack, lower the transmission and support cushion onto the crossmember (Fig. 42).

(4) Install the support cushion bolts and tighten to 47 N·m (35 ft. lbs.) torque.

(5) Remove the transmission jack.

(6) Lower the vehicle.

ENGINE ASSEMBLY

REMOVAL

(1) Disconnect both battery negative cables.

(2) Recover A/C refrigerant (if A/C equipped). Refer to Group 24, Heating and Air Conditioning for the correct procedure.

(3) Raise vehicle on hoist.

(4) Drain engine coolant into container suitable for re-use.

(5) Remove engine oil drain plug and drain engine oil.

(6) Lower vehicle.

(7) Remove radiator upper hose.

(8) Remove the cooling fan shroud-to-radiator mounting bolts.

(9) Using a 36 mm wrench, remove viscous fan/drive assembly. **The fan hub and nut have left hand threads.**Remove the cooling fan and shroud together.

(10) Disconnect the coolant recovery bottle hose from the radiator filler neck and remove bottle from fan shroud (Fig. 43).

(11) Disconnect heater core supply and return hoses from the cylinder head fitting and coolant pipe.

(12) Raise vehicle on hoist.

(13) Remove transmission and transfer case (if equipped.) Refer to Group 21, Transmission and Transfer Case for the correct procedures.

(14) Disconnect exhaust pipe from turbocharger extension pipe (Fig. 44).

(15) Remove starter motor.

(16) Disconnect A/C suction/discharge hose from the rear of the A/C compressor.

(17) Lower vehicle.

(18) Disconnect lower radiator hose from radiator outlet.

(19) **Automatic Transmission models:** Disconnect transmission oil cooler lines from radiator using special tool #6931.

(20) Remove radiator mounting screws and lift radiator out of engine compartment.

(21) Remove upper radiator support panel.

REMOVAL AND INSTALLATION (Continued)

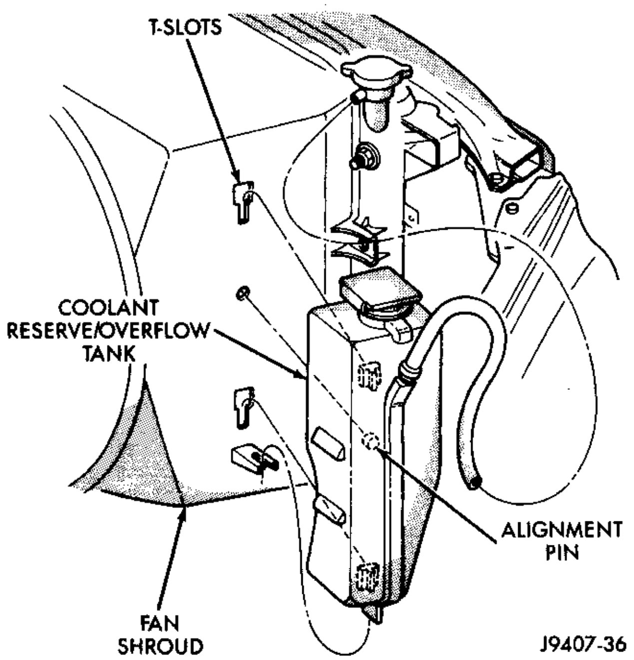

Fig. 43 Coolant Recovery Bottle

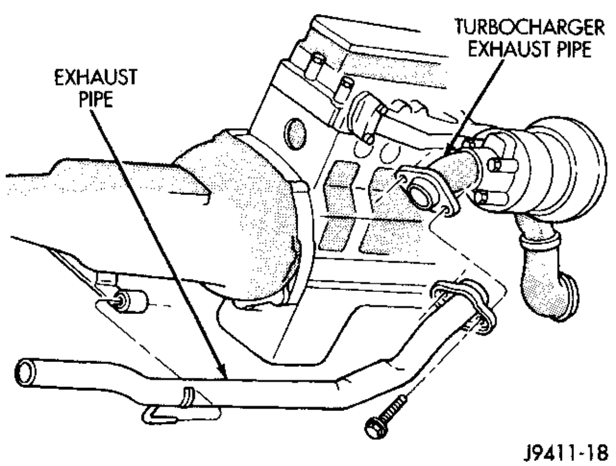

Fig. 44 Exhaust Pipe Connection at Turbocharger

(22) Remove front bumper assy. Refer to Group 13, Frame and Bumpers for the correct procedure.

(23) If A/C equipped, disconnect A/C condenser refrigerant lines. Refer to Group 24, Heating and Air Conditioning for the correct procedures.

(24) Disconnect charge air cooler piping.

(25) Remove the two charge air cooler mounting bolts.

(26) Remove charge air cooler (and A/C condenser if equipped) from vehicle.

(27) Disconnect engine block heater connector.

(28) Disconnect A/C compressor electrical connectors.

(29) Remove the passenger battery ground cable from the engine block.

(30) Disconnect power steering pump pressure and return lines.

(31) Remove accelerator linkage cover.

(32) Leaving all cables attached, remove accelerator pedal position sensor assy. (APPS) (Fig. 45) from cylinder head bracket and secure out of the way.

(33) Disconnect APPS connector (Fig. 46).

(34) Disconnect vacuum pump supply hose (Fig. 47).

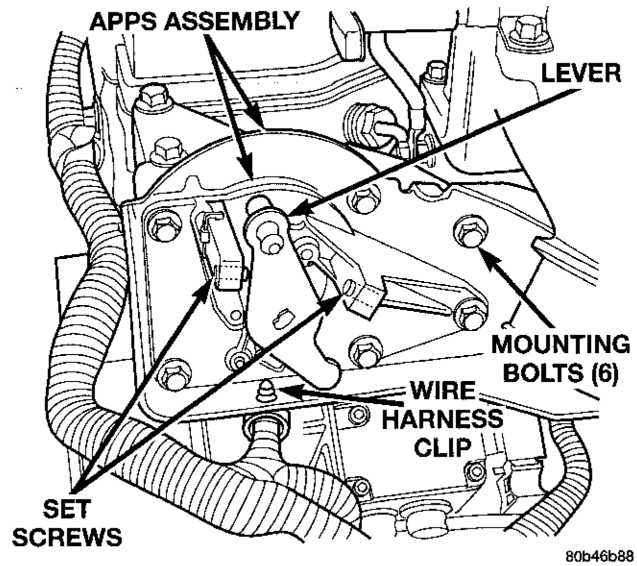

Fig. 45 APPS Assembly

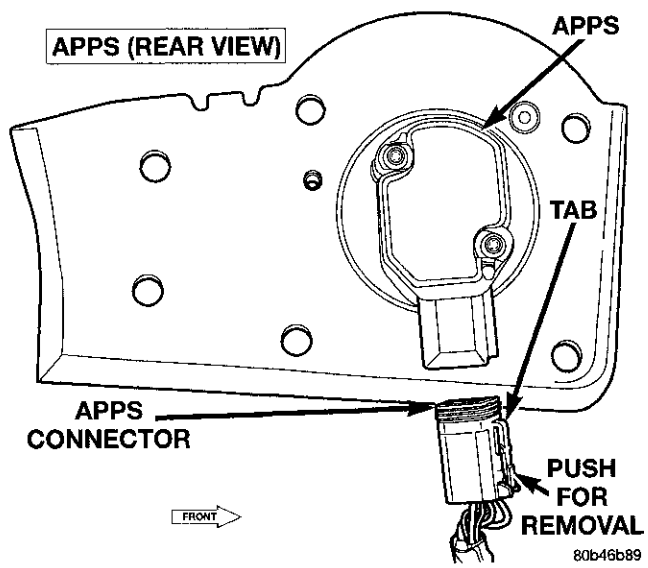

Fig. 46 APPS Connector

(35) Disconnect the engine harness and ground cable from the PDC.

(36) Disconnect the fuel supply and return hoses (Fig. 48).

(37) Remove the cylinder head cover.

REMOVAL AND INSTALLATION (Continued)

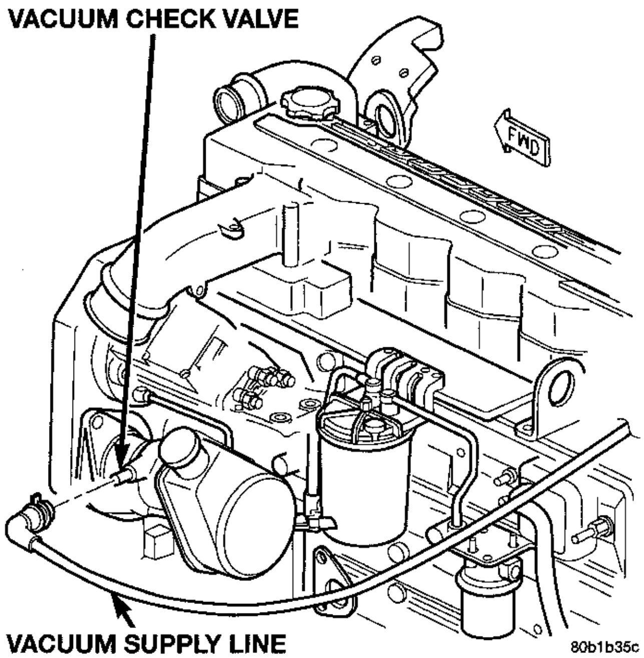

Fig. 47 Vacuum Pump Supply Hose

(38) Remove the #5 and #6 cylinder intake and exhaust rocker arms and pedestals (Fig. 49). Note the original location for re-assembly.

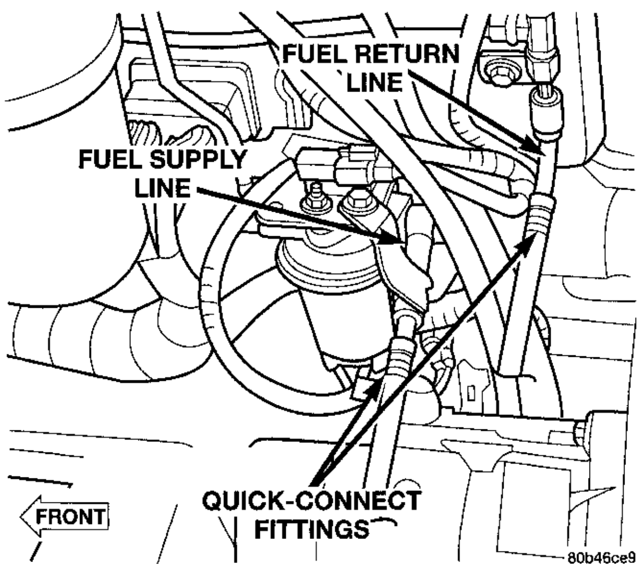

Fig. 48 Fuel Return and Supply Line Quick-Connect Locations

(39) Loosen but do not remove engine mount through bolts and nuts.

(40) Attach chain accross engine lift brackets.

(41) Lift engine up and out of engine compartment.

(42) Install engine to suitable engine stand.

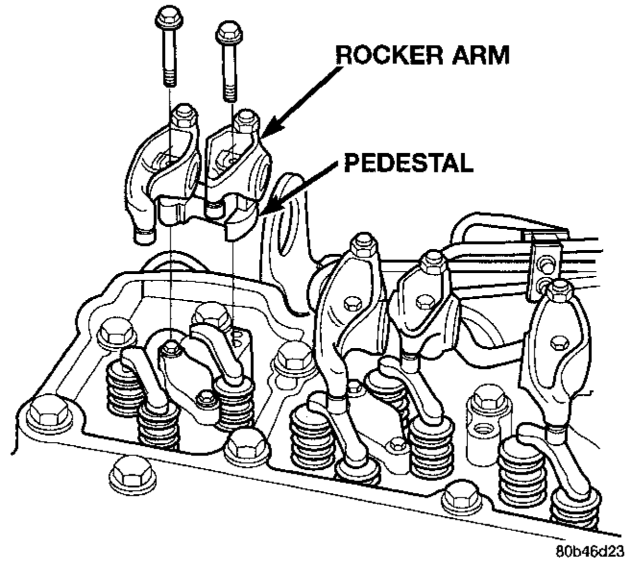

Fig. 49 Rocker Arm and Pedestal—Removal/Installation

INSTALLATION

(1) Install the engine with the cylinder head cover and the #5 and 6 rocker arm assemblies removed.

(2) Lower the engine into the compartment and install the engine mount through bolts and nuts.

(3) Tighten the mount through bolts and nuts to 88 N·m (65 ft. lbs.) torque.

(4) Remove the engine lifting device.

(5) Install the #5 and #6 rocker arms and pedestals in their original locations (Fig. 49). Torque the mounting bolts to 36 N·m (27 ft. lbs.) torque.

(6) Install the cylinder head cover and gasket. Tighten the bolts to 24 N·m (18 ft. lbs.) torque.

(7) Connect the fuel supply and return hoses (Fig. 48). Refer to Group 14, Fuel System for the correct procedure.

(8) Connect the engine harness connector and ground cable to the PDC.

(9) Connect the vacuum pump supply hose.

(10) Connect the APPS connector (Fig. 46).

(11) Install the APPS assembly bracket to the cylinder head bracket.

(12) Install the throttle linkage cover.

(13) Connect the power steering pressure and return lines.

(14) Connect the passenger battery ground cable to the engine block. Tighten the bolt to 77 N·m (57 ft. lbs.) torque.

(15) Connect the engine block heater connector.

(16) Connect the a/c compressor electrical connectors.

(17) Install the charge air cooler and a/c condenser (if a/c equipped). Install and tighten the charge air cooler mounting bolts to 2 N·m (17 in. lbs.) torque.

REMOVAL AND INSTALLATION (Continued)

(18) Connect the charge air cooler piping. Torque all clamps to 8 N·m (72 in. lbs.) torque.

(19) Connect the a/c refrigerant lines to the a/c condenser (if equipped). Refer to Group 24, Heating and Air Conditioning for the correct procedures.

(20) Install the front bumper assy. Refer to Group 13, Frame and Bumpers for the correct procedure.

(21) Install the radiator upper support panel.

(22) Install the radiator and tighten the mounting bolts to 11 N·m (95 in. lbs.) torque.

(23) Connect the transmission quick-connect oil cooler lines to the radiator. Push together until an audible "click" is heard. Verify connection by pulling apart.

(24) Raise vehicle.

(25) Connect a/c compressor suction/discharge hose (if a/c equipped). Refer to Group 24, Heating and Air Conditioning for the correct procedure.

(26) Install the radiator lower hose and clamps.

(27) Install the starter motor and connect the wires. Refer to Group 8B, Starting Systems for the correct procedures.

(28) Install the transmission and transfer case (if equipped). Refer to Group 21, Transmission and Transfer Case for the correct procedures.

(29) Connect the exhaust pipe to the turbocharger elbow (Fig. 44). Torque the bolts to 34 N·m (25 ft. lbs.) torque.

(30) Connect the transmission auxiliary oil cooler lines (if equipped).

(31) Lower the vehicle

(32) Connect the heater core supply and return hoses.

(33) Install the cooling fan and shroud at the same time. Tighten the fan nut to 57 N·m (42 ft. lbs.) torque. Tighten the fan shroud to radiator bolts to 11 N·m (95 in. lbs.) torque.

(34) Install the coolant recovery bottle to the fan shroud (Fig. 43) and connect the hose to the radiator filler neck.

(35) Install the windshield washer bottle to the fan shroud and connect the pump supply hose and electrical connections.

(36) Install the radiator upper hose and clamps.

(37) Change oil filter and install new engine oil.

(38) Fill cooling system with coolant.

(39) Connect battery negative cables.

(40) Perform the fuel line air bleed procedure. Refer to Group 14, Fuel System for the correct procedure.

(41) Start engine and inspect for engine oil, coolant, and fuel leaks.

CYLINDER HEAD COVER

REMOVAL

(1) Disconnect both battery negative cables.

(2) Loosen the five (5) cylinder head cover bolts (Fig. 50). Remove the front three bolts and leave the rear two bolts in the cover.

(3) Lift cover off of cylinder head.

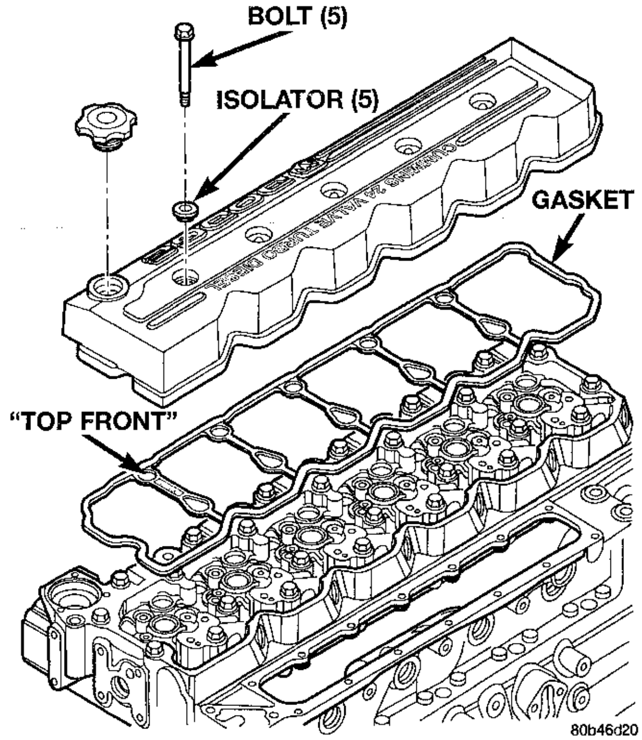

Fig. 50 Cylinder Head Cover and Gasket

CLEANING

Using a suitable solvent, Clean and dry gasket mating surfaces on cylinder head and cover. Wipe gasket dry and inspect for re-use.

INSPECTION

The cylinder head cover gasket and isolators are reusable. However, should cracks be present in the rubber/silicone construction, the defective components should be replaced.

INSTALLATION

(1) Install the gasket as shown in (Fig. 50). Make sure the gasket is properly located around the cylinder head bolts, with the words "top front" facing up and towards front of engine.

(2) Place two bolts and isolators into the rear two mounting holes and install the cover.

(3) Install the remaining bolts and isolators. Starting with the center bolt, torque in a circular pattern to 24 N·m (18 ft. lbs.).

(4) Connect both battery negative cables.

REMOVAL AND INSTALLATION (Continued)

ROCKER ARMS, CROSSHEADS, AND PUSH RODS

REMOVAL

(1) Disconnect the battery negative cables.

(2) Remove cylinder head cover (Fig. 51). Refer to procedure in this group.

(3) Remove the rocker arm/pedestal fasteners (Fig. 52) and remove rocker arm and pedestal from cylinder head. Mark the arms and pedestals so they can be installed in their original position.

CAUTION: When removing the rocker arms, the sockets (Fig. 53) may come loose and fall into the engine. Make sure they stay with the arm upon removal/installation.

(4) Lift the push rod(s) up and out of the engine (Fig. 54). Mark them so they can be installed in their original position.

NOTE: The #5 cyl. exhaust and #6 cyl. intake and exhaust push rods must be raised through the provided cowl panel access holes.

(5) Lift the crosshead(s) off of the valve stems. Mark them so they can be installed in their original position.

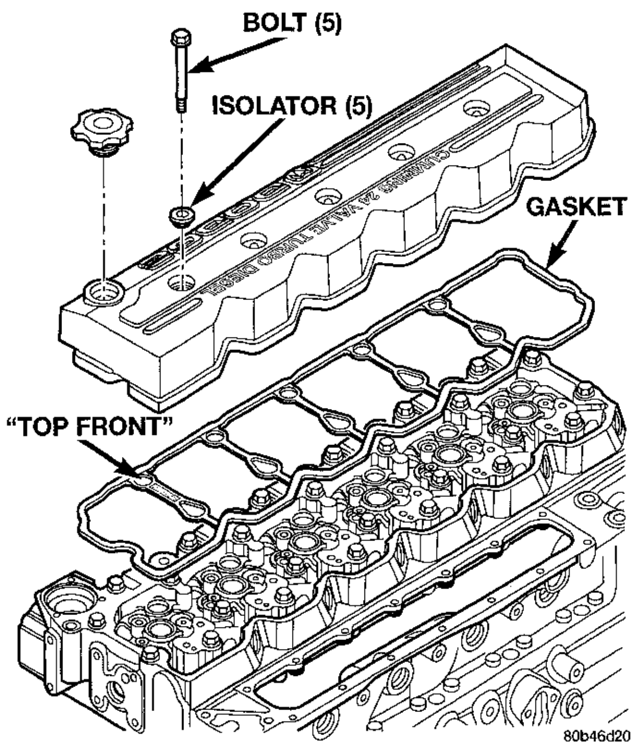

Fig. 51 Cylinder Head Cover—Removal/Installation

CLEANING

Clean all components in a suitable solvent. If necessary, use a wire brush or wheel to remove stubborn

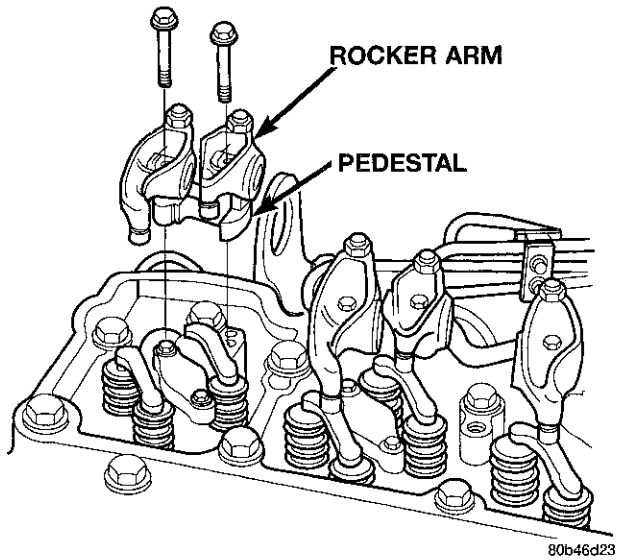

Fig. 52 Rocker Arms and Pedestals—Removal/Installation

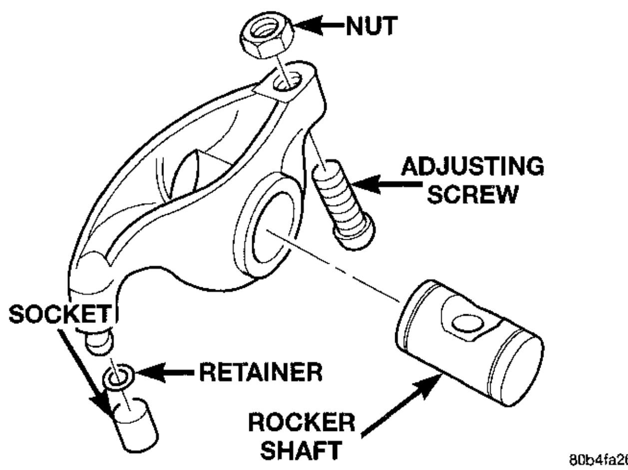

Fig. 53 Rocker Arm Assembly Identification

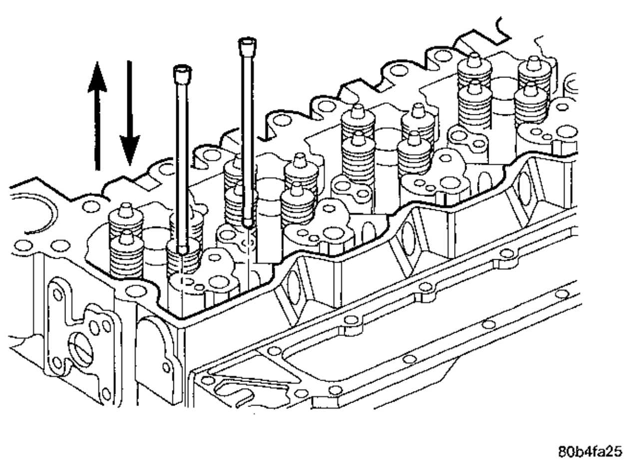

Fig. 54 Push Rod Removal/Installation

REMOVAL AND INSTALLATION (Continued)

deposits. Rinse in hot water and blow dry with compressed air. Inspect oil passages in rocker arms and pedestals. Apply compressed air to lubrication orifices to purge contaminants.

INSPECTION

Rocker Arms

(1) Remove rocker shaft and inspect for cracks and excessive wear in the bore or shaft. Remove socket and inspect ball insert and socket for signs of wear. Replace retainer if necessary.

Measure the rocker arm bore and shaft (Fig. 55)(Fig. 56).

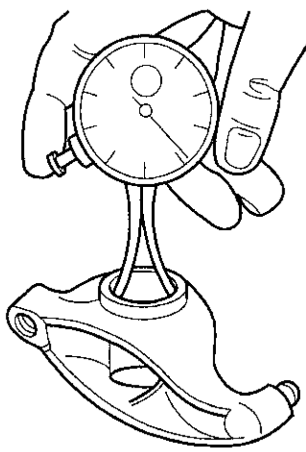

Fig. 55 Measuring Rocker Arm Bore

ROCKER ARM BORE (MAX.)
22.027 mm (.867 in.)

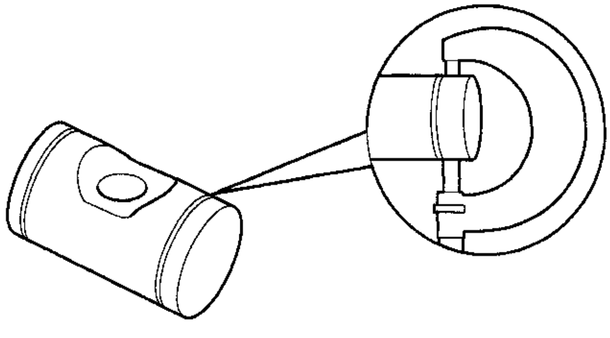

Fig. 56 Measuring Rocker Arm Shaft

ROCKER ARM SHAFT (MIN.)
21.965 mm (.865 in.)

Push Rods

Inspect the push rod ball and socket for signs of scoring. Check for cracks where the ball and the socket are pressed into the tube (Fig. 57).

Roll the push rod on a flat work surface with the socket end hanging off the edge (Fig. 58). Replace any push rod that appears to be bent.

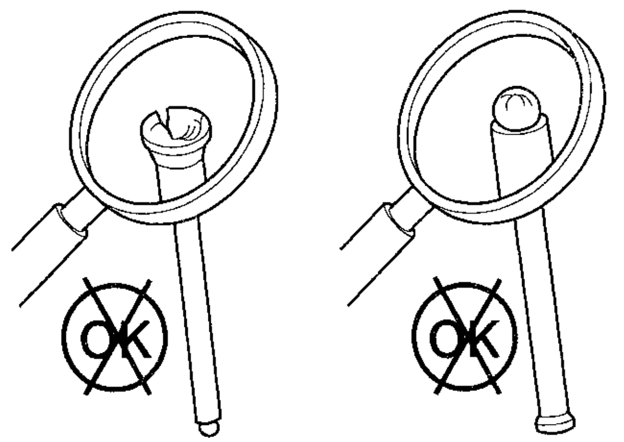

Fig. 57 Inspecting Push Rod for Cracks

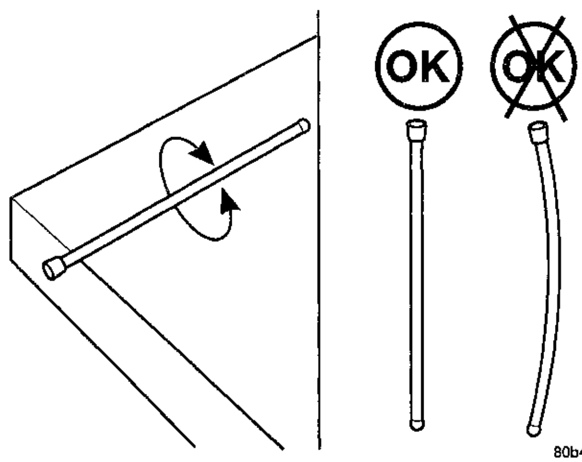

Fig. 58 Inspecting Push Rod for Flatness

Crossheads

Inspect the crossheads for cracks and/or excessive wear on rocker lever and valve tip mating surfaces (Fig. 59).

INSTALLATION

(1) If previously removed, install the push rods in their original location (Fig. 54). **Verify that they are seated in the tappets.**

(2) Lubricate the valve tips and install the crossheads in their original locations.

(3) Lubricate the crossheads and push rod sockets and install the rocker arms and pedestals (Fig. 52) in their original locations. Tighten bolts to 36 N·m (27 ft. lbs.) torque.

REMOVAL AND INSTALLATION (Continued)

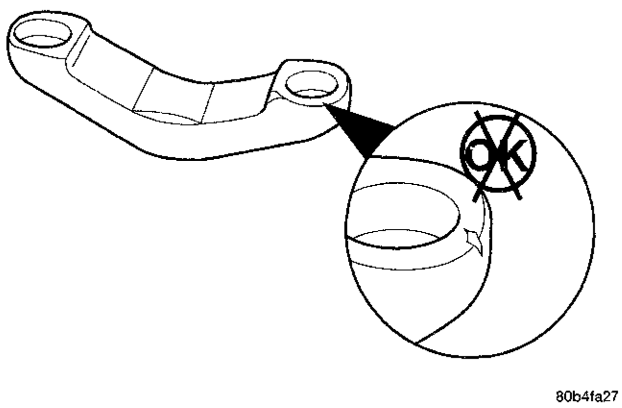

Fig. 59 Inspecting Crosshead for Cracks

(4) **Verify valve lash adjustment. Refer to Valve Lash Verification/Adjustment in Service Procedures.**

(5) Install cylinder head cover and reusable gasket (Fig. 51). Torque bolts to 24 N·m (18 ft. lbs.).

(6) Connect battery negative cables.

VALVE SPRINGS AND SEALS (IN VEHICLE)

REMOVAL

(1) Disconnect the battery negative cables.

(2) Remove the cylinder head cover (Fig. 61).

(3) Remove the rocker arms and crossheads (Fig. 62) from the cylinder(s) to be serviced. Mark each component so they can be installed in their original position.

(4) Remove the fuel pump gear access cover (Fig. 64).

(5) Using the crankshaft barring tool #7471B (Fig. 60), rotate the engine to line up the mark on the pump gear with the TDC mark on the cover. **At this engine position, cylinders #1 and #6 can be serviced.**

(6) Remove the accessory drive belt. Refer to Group 7, Cooling for the correct procedure.

(7) With the fuel injection pump gear mark aligned at TDC, add a paint mark anywhere on the gear housing cover next to the crankshaft damper. Place another mark on the vibration damper in alignment with the mark you just made on the cover.

(8) Divide the crankshaft damper into three equally sized segments as follows:

(a) Using a tape measure, measure the circumference of the crankshaft damper and divide the measurement by three (3).

(b) Measure that distance in a counter-clockwise direction from the first balancer mark and place another mark on the balancer.

(c) From the second damper mark, again measure in a counter-clockwise direction and place a mark on the damper at the same distance you measured when placing the second damper mark.

The damper should now be marked in three equally spaced locations and the fuel pump gear mark should still be aligned with the TDC mark on the cover.

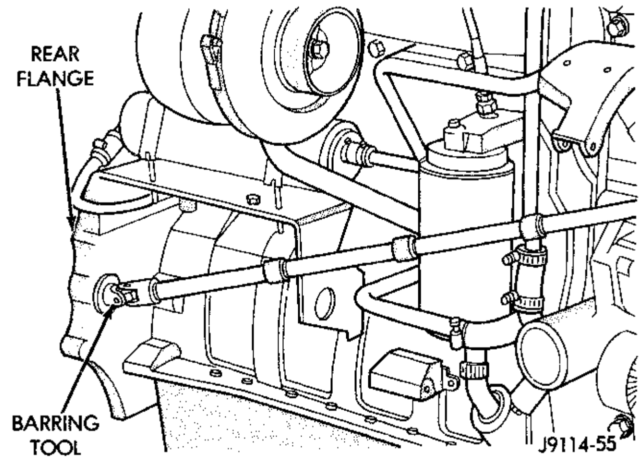

Fig. 60 Rotating Engine with Barring Tool

(9) Compress the valve springs at cyls. #1 and #6 as follows:

(a) Remove the injector clamp (Fig. 63) from the cylinder(s) to be serviced. **Do not remove the bolt shown in (Fig. 63).**

(b) Install the valve spring compressor mounting base as shown in (Fig. 65). Reinstall the injector clamp bolt finger tight.

(c) Install the top plate, washer, and nut. Using a suitable wrench tighten the nut (clock-wise) (Fig. 66) to compress the valve springs and remove the collets.

(d) Rotate the compressor nut counter-clockwise to relieve tension on springs. Remove spring compressor.

(e) Remove and replace retainers, springs, and seals as necessary.

(f) **Do not rotate the engine until the springs and retainers are re-installed.**

(g) Install seals, springs and retainers. Install spring compressor, compress valve springs and install the collets.

(h) Release the spring tension and remove the compressor. Verify that the collets are seated by tapping on the valve stem with a plastic hammer.

(10) Using the crankshaft barring tool, rotate the engine clockwise until the next crankshaft damper paint mark aligns with the mark you placed on the cover. **In this position, cylinders #2 and #5 can be serviced.**

(11) Repeat the valve spring compressing procedure previously performed and service the retainers, springs, and seals as necessary.

REMOVAL AND INSTALLATION (Continued)

(12) Using the crankshaft barring tool, rotate the engine clockwise until the next crankshaft damper paint mark aligns with the mark you placed on the cover. **In this position, cylinders #3 and #4 can be serviced.**

(13) Repeat the spring compressing procedure previously performed and service the retainers, springs, and seals as necessary.

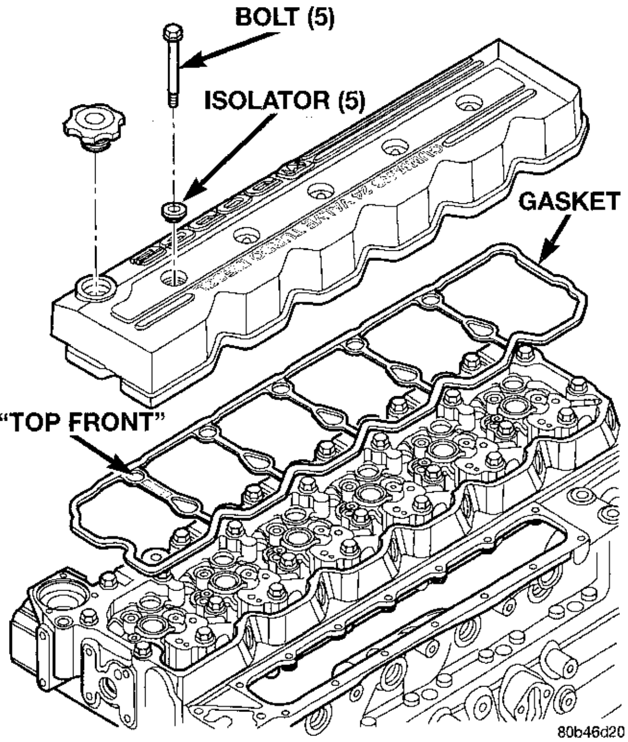

Fig. 61 Cylinder Head Cover Removal/Installation

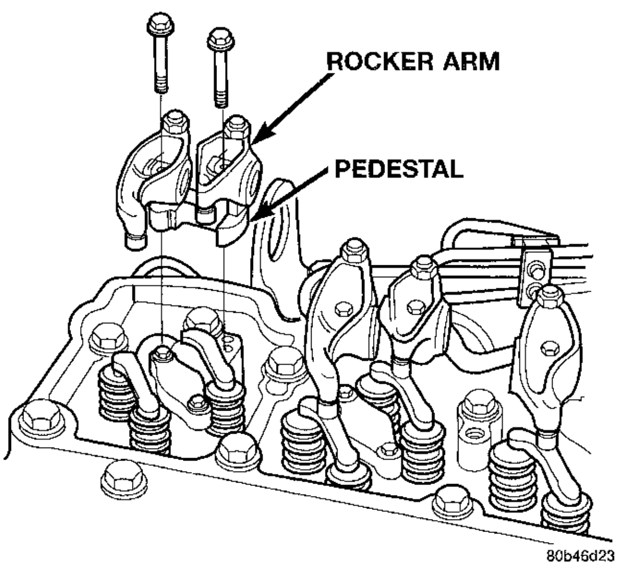

Fig. 62 Rocker Arm and Crosshead Removal/ Installation

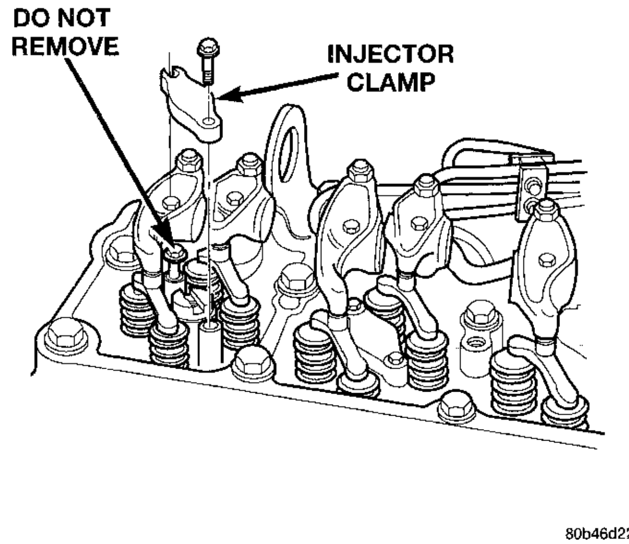

Fig. 63 Injector Clamp Removal/Installation

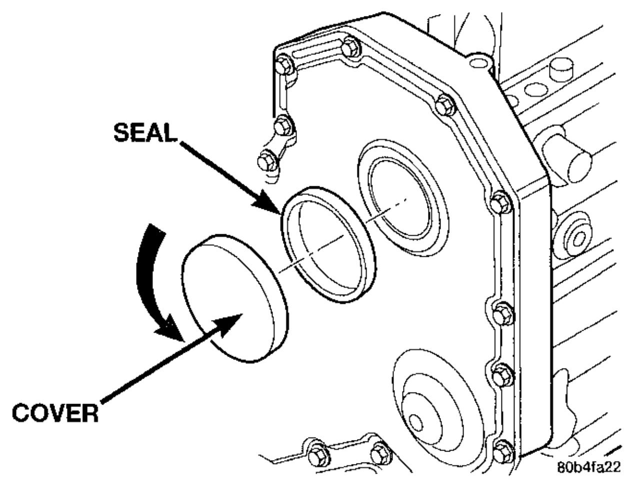

Fig. 64 Fuel Pump Gear Access Cover

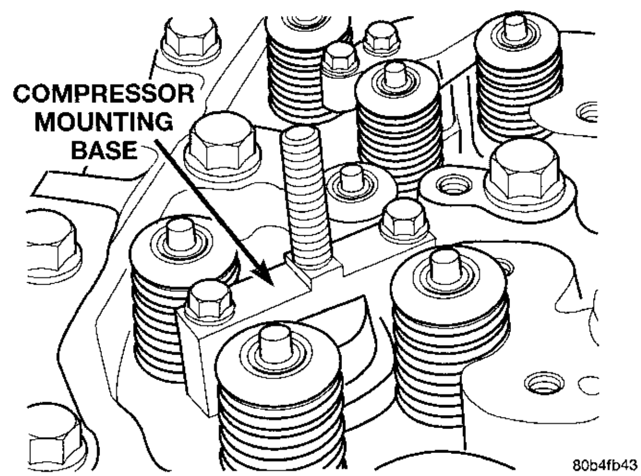

Fig. 65 Spring Compressor Mounting Base—Part of Tool 8319

REMOVAL AND INSTALLATION (Continued)

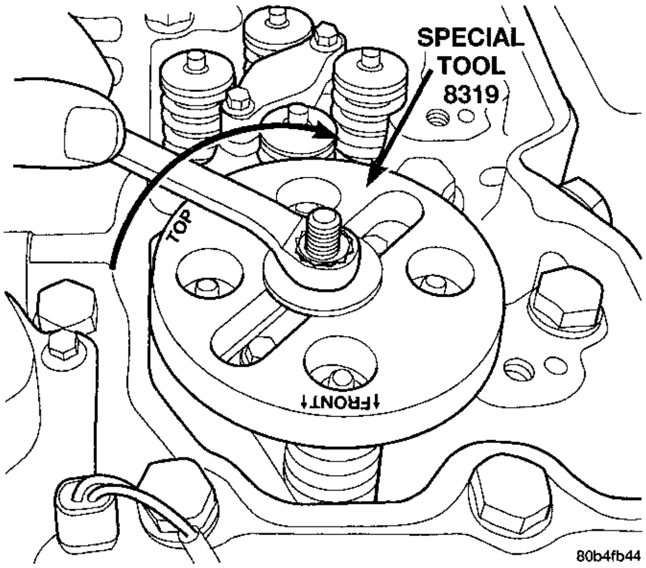

Fig. 66 Compressing Valve Springs with Tool 8319

INSTALLATION

(1) Install all injector clamps into their original location (Fig. 63). Tighten the hold down bolt to 10 N·m (89 in. lbs.) torque.

(2) Lubricate the valve tips and install the crossheads in their original locations .

(3) Lubricate the crossheads and push rod sockets and install the rocker arms and pedestals in their original locations (Fig. 62). Tighten bolts to 36 N·m (27 ft. lbs.) torque.

(4) **Verify valve lash adjustment. Refer to Valve Lash Verification/Adjustment in Service Procedures.**

(5) Install cylinder head cover and reusable gasket (Fig. 61). Torque bolts to 24 N·m (18 ft. lbs.).

(6) Install the accessory drive belt. Refer to Group 7, Cooling for the correct procedure.

(7) Connect battery negative cables.

CYLINDER HEAD ASSEMBLY

REMOVAL

(1) Disconnect battery negative cables.

(2) Raise vehicle on hoist.

(3) Drain engine coolant.

(4) Disconnect exhaust pipe from turbocharger elbow (Fig. 67).

(5) Lower vehicle.

(6) Remove air cleaner housing and snorkel from the vehicle. Cap off turbocharger air inlet to prevent intrusion of dirt or foreign material.

(7) Disconnect cab heater core supply and return hoses from the cylinder head and heater pipe.

(8) Disconnect turbocharger oil drain tube at rubber hose connection. Cap off open ports to prevent intrusion of dirt or foreign material.

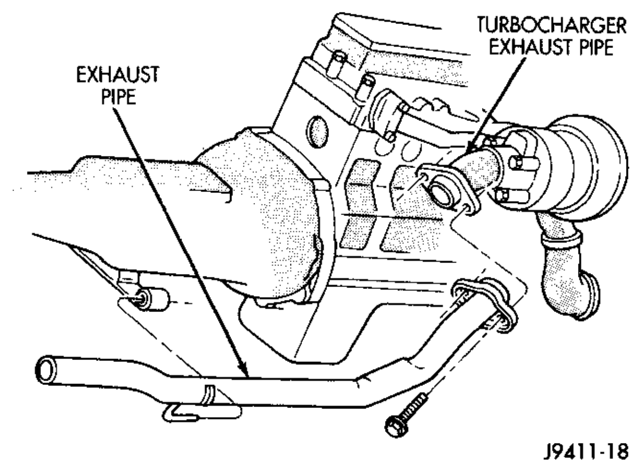

Fig. 67 Exhaust Pipe-to-Turbocharger Elbow

(9) Disconnect turbocharger oil supply line at the turbocharger end. Cap off open ports to prevent intrusion of dirt or foreign material.

(10) Remove exhaust manifold-to-cylinder head bolts and spacers. Remove exhaust manifold and turbocharger from the vehicle as an assembly.

(11) Remove accessory drive belt. Refer to Group 7, Cooling Systems for the correct procedures.

(12) Remove generator upper bracket.

(13) Disconnect radiator upper hose from the thermostat housing.

(14) Disconnect the coolant temperature sensor connector.

(15) Remove the engine harness to cylinder head attaching bolt at front of head.

(16) Remove the engine harness ground fastener at front of head below the thermostat housing.

(17) Remove the throttle linkage cover (Fig. 68).

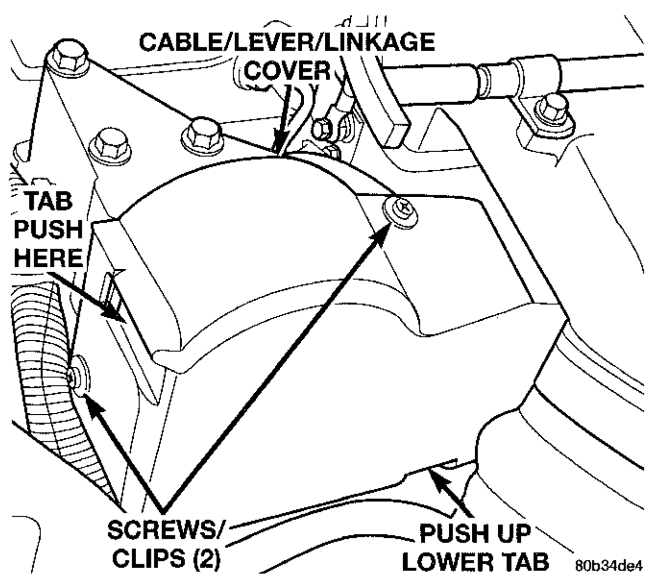

Fig. 68 Throttle Linkage Cover

REMOVAL AND INSTALLATION (Continued)

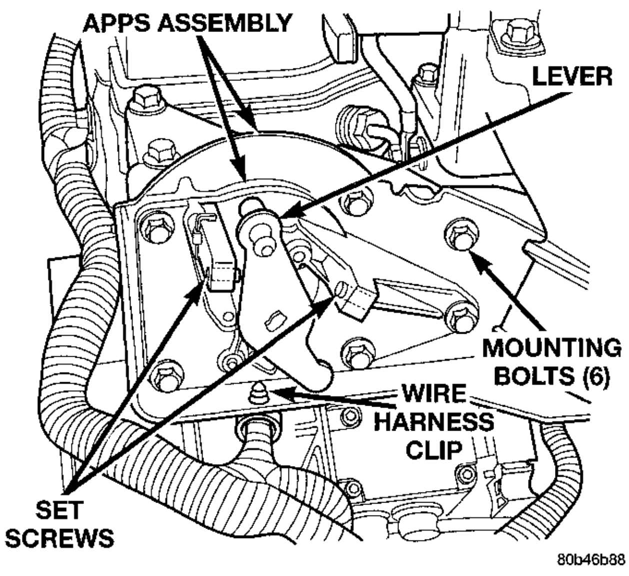

Fig. 69 APPS Assembly

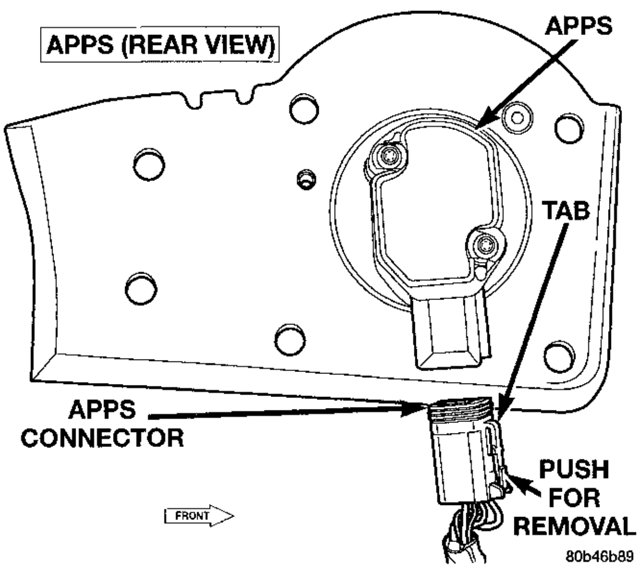

Fig. 70 APPS Connector

(18) Remove the six (6) accelerator pedal position sensor assy.-to-cylinder head bracket bolts (Fig. 69) and secure the entire assembly out of the way. Disconnect the APPS connector (Fig. 70). **It is not necessary to disconnect the cables from the throttle control assy.** Refer to Group 14, Fuel Systems for applicable cautions and warnings.

(19) Remove the intake air grid heater wires from the grid heater.

(20) Remove engine oil level indicator tube attaching bolt from the air inlet housing.

(21) Remove the charge air cooler-to-air inlet housing pipe.

(22) Remove the air inlet housing and intake grid heater from the intake manifold cover.

(23) Remove the engine lift bracket from the rear of the cylinder head.

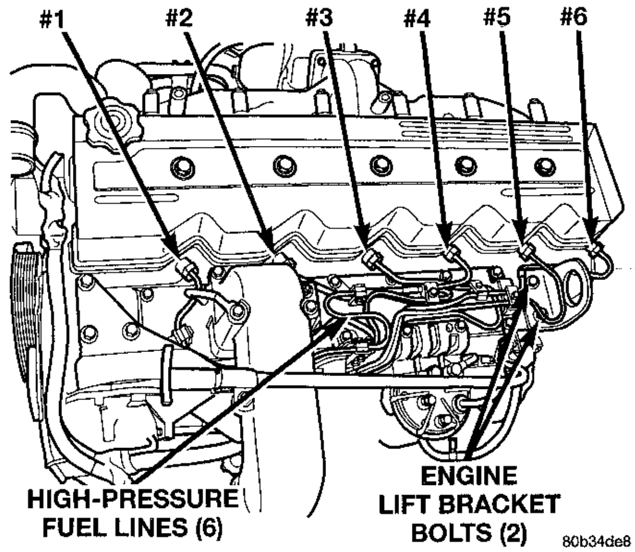

Fig. 71 High-Pressure Lines at Cylinder Head

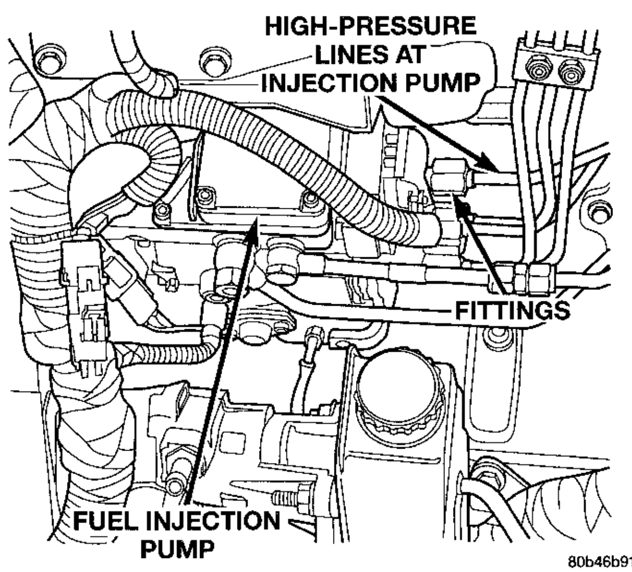

Fig. 72 High-Pressure Lines at Fuel Injection Pump

(24) **Remove the high pressure fuel lines (Fig. 71)(Fig. 72) from the engine as follows:**

(a) Remove all injection line-to-intake manifold cover support bracket bolts.

(b) Loosen the #1, 2, and 4 cylinder high pressure lines at the injection pump.

(c) Loosen the #1, 2, and 4 cylinder high pressure lines at the cylinder head.

(d) Remove the #1, 2, and 4 cylinder high pressure line bundle from the engine.

(e) Loosen the #3, 5, and 6 cylinder high pressure lines at the injection pump.

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REMOVAL AND INSTALLATION (Continued)

(f) Loosen the #3, 5, and 6 cylinder high pressure lines at the cylinder head.

(g) Remove the #3, 5, and 6 cylinder high pressure line bundle from the engine.

(25) Remove the lift pump-to-fuel filter low pressure line.

(26) Remove the fuel filter-to-injection pump low pressure line.

(27) Disconnect the water-in-fuel and fuel heater connectors.

(28) Remove the fuel filter assy.-to-manifold cover bolts and remove filter assy. from vehicle.

(29) Disconnect the Intake Air Temperature and Manifold Air Pressure sensor connectors (Fig. 73).

(30) Remove the cylinder head cover (Fig. 74). Refer to procedure in this group.

(31) Remove the rocker levers (Fig. 75), cross heads and push rods (Fig. 76). Mark each component so they can be installed in their original positions.

NOTE: The #5 cylinder exhaust and the #6 cylinder intake and exhaust pushrods are removed by lifting them up and through the provided cowl panel access holes. Remove the rubber plugs to expose these relief holes.

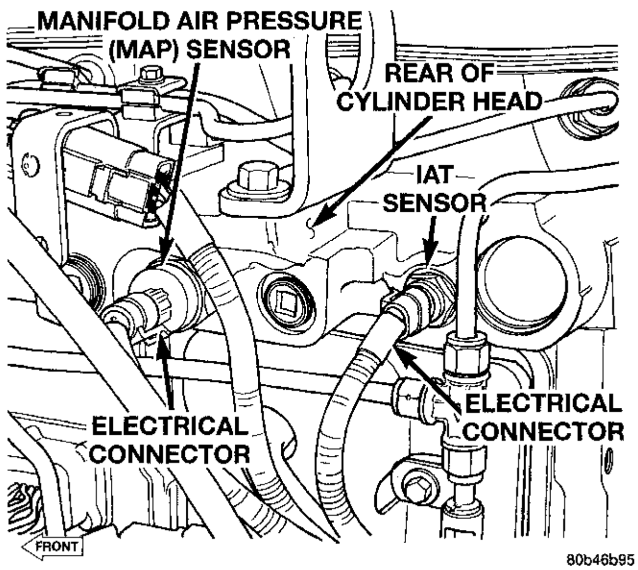

Fig. 73 IAT and MAP Sensor Location

(32) Remove the fuel return line banjo bolt at the rear of the cylinder head (Fig. 77). Be careful not to drop the two (2) sealing washers.

(33) Reinstall the engine lift bracket at the rear of cylinder head.

(34) Remove twenty six (26) cylinder head-to-block bolts.

(35) Attach an engine lift crane to engine lift brackets and lift cylinder head off engine and out of vehicle.

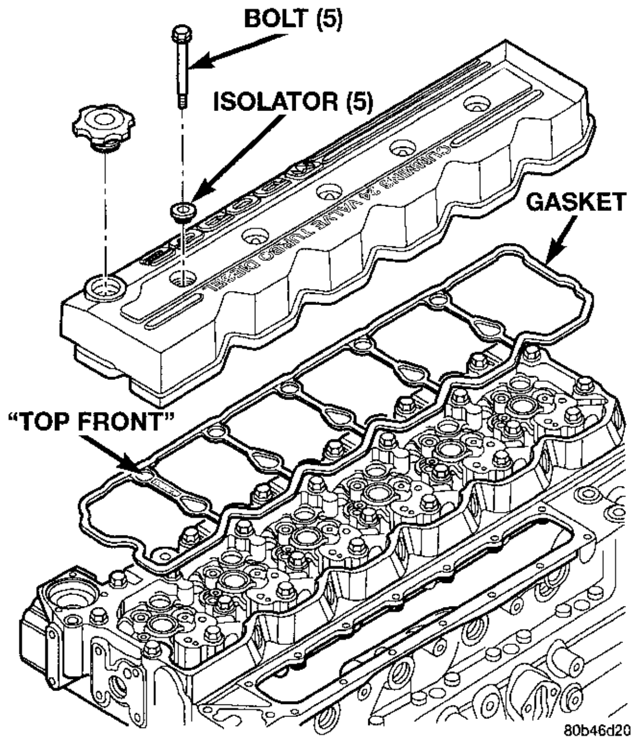

Fig. 74 Cylinder Head Cover Removal

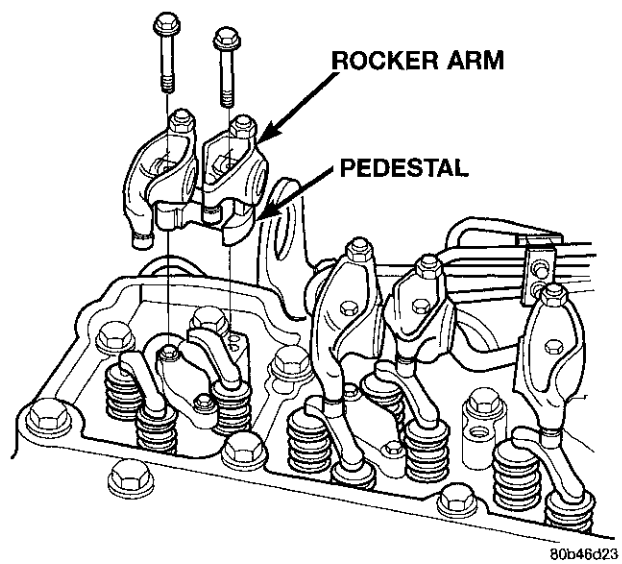

Fig. 75 Rocker Arms and Pedestal Removal

(36) Remove the head gasket and inspect for failure.

CLEANING

Clean the cylinder head and cylinder block mating surfaces with an ordinary scraper. Remove all excess gasket material and carbon. Use a quality wire brush on stubborn areas. Inspect head bolt holes for damage and remove any foreign material.

REMOVAL AND INSTALLATION (Continued)

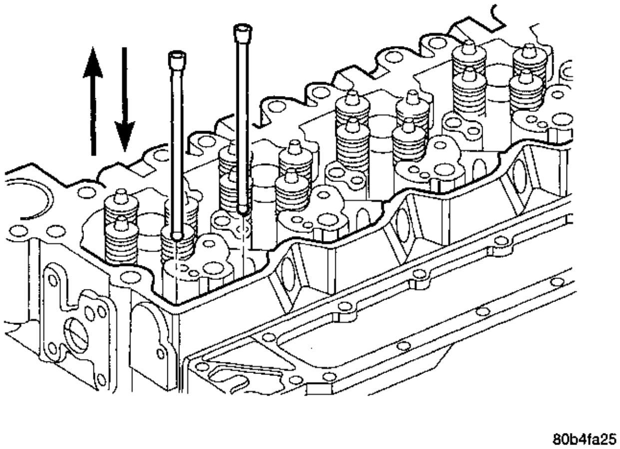

Fig. 76 Push Rod Removal

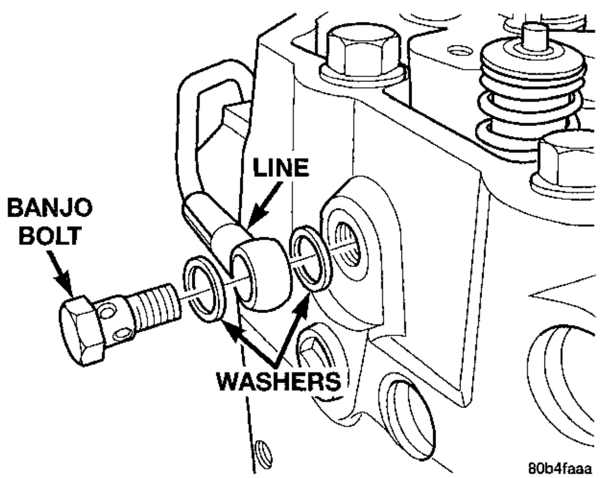

Fig. 77 Fuel Drain Fitting at Rear of Head

Clean the cylinder head bolts with a wire brush or a soft wire wheel. Remove deposits from the shank and threads.

Remove any excess coolant, oil, or foreign material from the top of the pistons and inside the piston bowls.

INSPECTION

CHECKING FOR CRACKS

Inspect the cylinder head for cracks in the combustion surface. Pressure test any cylinder head that is visibly cracked. A cylinder head that is cracked between the injector bore and valve seat can be pressure tested and re-used if o.k.; however, if the crack extends **into** the valve seat, the valve seat **must** be replaced.

SURFACE CONDITION

Visually inspect the cylinder block and head combustion surfaces for localized dips or imperfections. Check the cylinder head and block combustion surfaces for overall out-of-flatness. If either the visual or manual inspection exceeds the limits, then the head or block must be surfaced.

CYLINDER HEAD FLATNESS (MAX)

End to End	0.305 mm (0.012 in.)
Side to Side	0.076 mm (0.003 in.)

CYLINDER BLOCK FLATNESS (MAX)

End to End	0.075 mm (0.003 in.)
Side to Side	0.075 mm (0.003 in.)

HEAD BOLT INSPECTION

Visually inspect the cylinder head bolts for damaged threads, corroded/pitted surfaces, or a reduced diameter due to bolt stretching.

If the bolts are not damaged, their "free length" should be measured using the capscrew stretch gauge provided with the replacement head gasket. Place the head of the bolt against the base of the slot and align the bolt with the straight edge of gauge (Fig. 78). If the end of the bolt touches the foot of the gauge, the bolt **must** be discarded. **The maximum bolt free length is 132.1 mm (5.200 in.).**

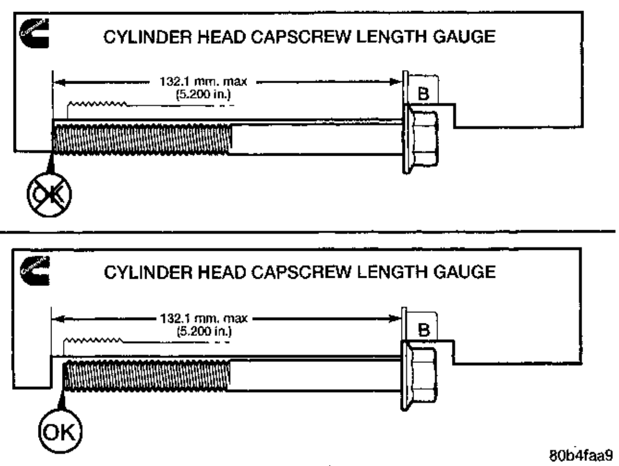

Fig. 78 Head Bolt Stretch Gauge

INSTALLATION

WARNING: THE OUTSIDE EDGE OF THE HEAD GASKET IS VERY SHARP. WHEN HANDLING THE NEW HEAD GASKET, USE CARE NOT TO INJURE YOURSELF.

(1) Install a new gasket with the part number side up, and locate the gasket over the dowel sleeves.

(2) Using an engine lifting crane, lower the cylinder head onto the engine.

(3) Lightly lubricate head bolts with engine oil and install. Using the sequence shown in (Fig. 79), torque bolts in the following three (3) steps:

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REMOVAL AND INSTALLATION (Continued)

(a) Torque bolts to 90 N·m (66 ft. lbs.)
(b) Re-check all bolts to 90 N·m (66 ft. lbs.)
(c) Torque all bolts an additional ¼ turn (90°)

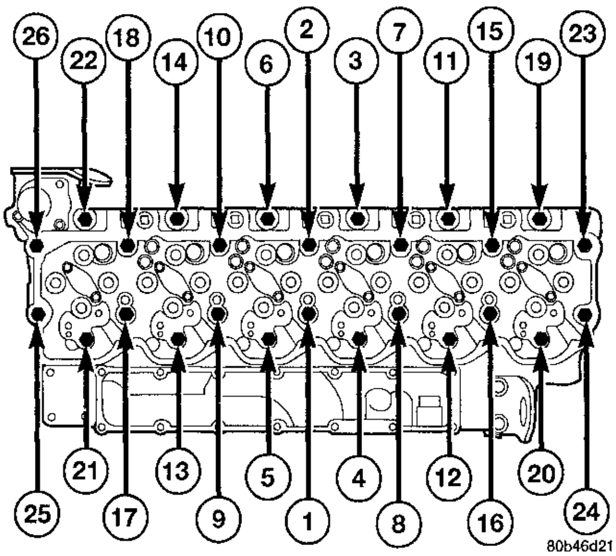


Fig. 79 Cylinder Head Bolt Torque Sequence

(4) Connect fuel return line at rear of head (Fig. 77). Install both sealing washers and torque banjo bolt to 24 N·m (18 ft. lbs.).

(5) Install push rods into their original locations (Fig. 80). **Verify that they are seated in the tappets.**

(6) Lubricate valve stem tips and install the cross-heads in their original locations.

(7) Lubricate the rocker arms and pedestals and install them in their original locations (Fig. 81). Install the bolts and torque them to 36 N·m (27 ft. lbs.).

(8) Verify that the valve lash settings are maintained. Refer to Valve Lash Verification/Adjustment in the Service Procedures section of this group.

(9) Install cylinder head cover (Fig. 82). Refer to procedure in this group.

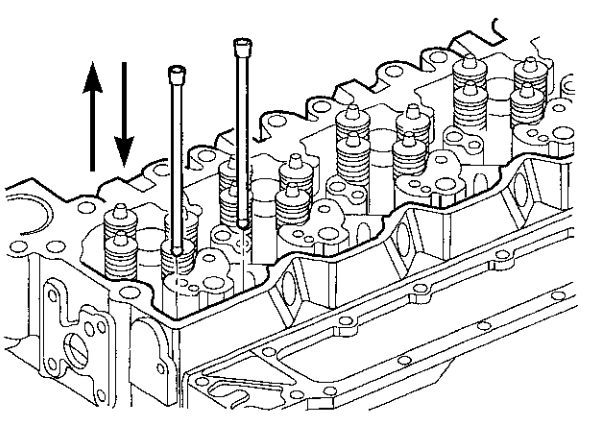


Fig. 80 Push Rod Installation

(10) Connect the IAT and MAP sensor connectors.

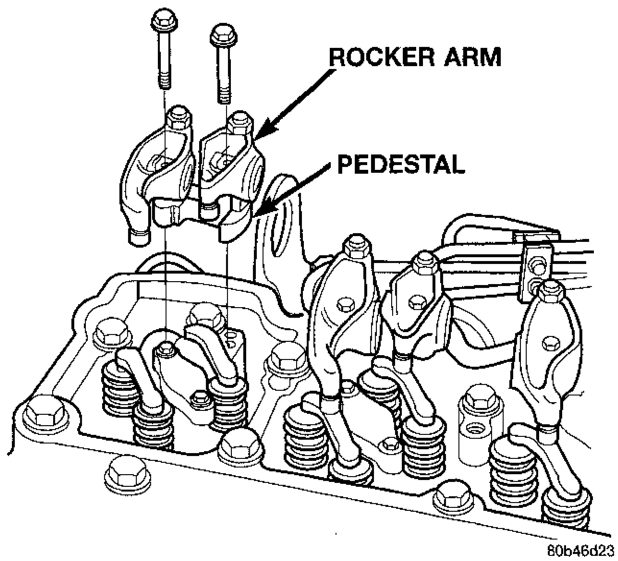


Fig. 81 Rocker Arms and Pedestal Installation

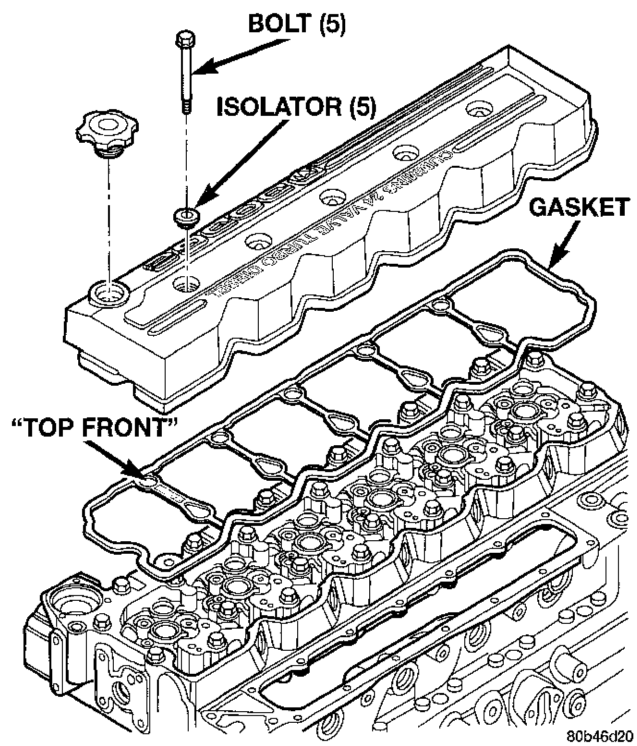


Fig. 82 Cylinder Head Cover Installation

(11) Install the fuel filter cannister assy. and torque mounting bolts to 24 N·m (18 ft. lbs.).

(12) Connect the lift pump to fuel filter low pressure line. Torque fittings to 24 N·m (18 ft. lbs.).

(13) Connect the Water-in-Fuel and Fuel Heater Element connectors at the filter assy.

(14) Remove the engine lift bracket at rear of cylinder head.

(15) **Install the high pressure fuel lines (Fig. 71)(Fig. 72) as follows:**

REMOVAL AND INSTALLATION (Continued)

(a) Lubricate the threads (both ends) of the high pressure line nuts with diesel fuel or engine oil.

(b) Install the rear line bundle (cyls. #3,5, and 6), and tighten the threads at the head and pump by hand.

(c) Torque the connections at the cylinder head first. Torque connections to 40 N·m (30 ft. lbs.).

(d) Torque the line connections at the injection pump to 24 N·m (18 ft. lbs.).

(e) Install the front line bundle (cyls. #1,2, and 4) following the same procedure used for the rear line bundle.

(f) Torque the connections at the cylinder head first. Torque connections to 40 N·m (30 ft. lbs.).

(g) Torque the line connections at the injection pump to 24 N·m (18 ft. lbs.).

(h) Install the injection line support bracket to intake cover/cylinder head bolts and torque to 24 N·m (18 ft. lbs.).

(16) Install the engine lift bracket at the rear of cylinder head.

(17) Install the fuel filter to injection pump low pressure line. Inspect and replace sealing washers if necessary. Torque banjo bolts to 24 N·m (18 ft. lbs.).

(18) Using new gaskets, install the intake grid heater and air inlet housing. Torque bolts to 24 N·m (18 ft. lbs.).

(19) Connect the APPS connector (Fig. 70).

(20) Install the APPS assy. to the cylinder head bracket and torque bolts to 12 N·m (105 in. lbs.).

(21) Install the throttle linkage cover (Fig. 68).

(22) Install the charge air cooler-to-air inlet housing duct assy. Torque all clamps to 8 N·m (71 in. lbs.).

(23) Connect intake grid heater wires.

(24) Fasten engine harness to front of cylinder head with bolt.

(25) Install engine harness ground wire and torque bolt to 24 N·m (18 ft. lbs.).

(26) Connect engine coolant temperature sensor connector.

(27) Connect radiator upper hose to thermostat housing.

(28) Install generator upper bracket and torque bolts to 41 N·m (31 ft. lbs.).

(29) Install accessory drive belt. Refer to Group 7, Cooling System for the correct procedure.

(30) Install exhaust manifold/turbocharger assy. and start all bolts/spacers by hand. Torque bolts to 43 N·m (32 ft. lbs.).

(31) Connect turbocharger oil drain tube.

(32) Perform the turbocharger pre-lube procedure. Refer to Group 11, Exhaust System and Turbocharger for the correct procedure.

(33) Connect the turbocharger oil supply line.

(34) Install air cleaner housing and duct.

(35) Raise vehicle on hoist.

(36) Install exhaust pipe to turbocharger elbow (Fig. 67). Torque bolts to 34 N·m (25 ft. lbs.).

(37) Lower vehicle.

(38) Add coolant.

(39) Start engine and check for leaks.

VALVES, SPRINGS, AND SEALS (OFF VEHICLE)

REMOVAL

(1) Remove cylinder head. Refer to Cylinder Head Removal and Installation in this group.

(2) Support cylinder head on stands, or install head bolts upside down (through combustion surface side) to protect injector tips from damage from work bench.

(3) Remove the injector clamp (Fig. 83) from the cylinder(s) to be serviced. **Do not remove the bolt shown in (Fig. 83).**

(4) Install the valve spring compressor mounting base (special tool 8319) as shown in (Fig. 84). Reinstall the injector clamp bolt finger tight.

(5) Install the compressor top plate, washer, and nut. Using a suitable wrench, tighten the nut (clockwise) to compress the valve springs (Fig. 85) and remove the locks.

(6) Rotate the compressor nut counter-clockwise to relieve tension on the springs. Remove the spring compressor.

(7) Remove the retainers, springs, valve seals (if necessary), and valves (Fig. 86). Arrange or number all components so they can be installed in their original locations.

(8) Repeat the procedure on all cylinders to be serviced.

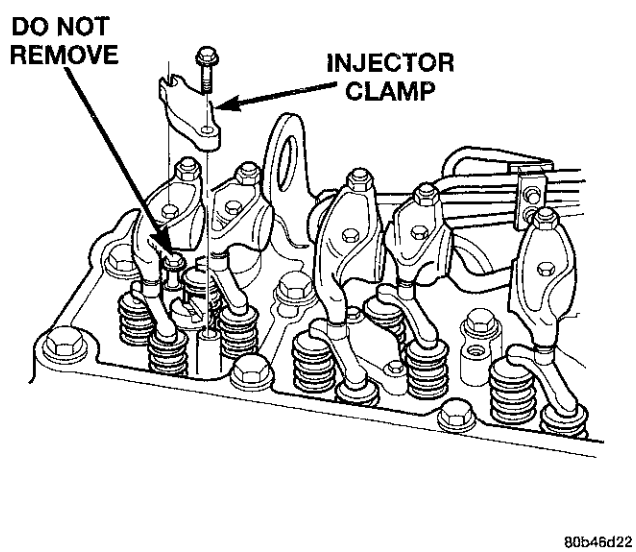


Fig. 83 Injector Clamp Removal/Installation

REMOVAL AND INSTALLATION (Continued)

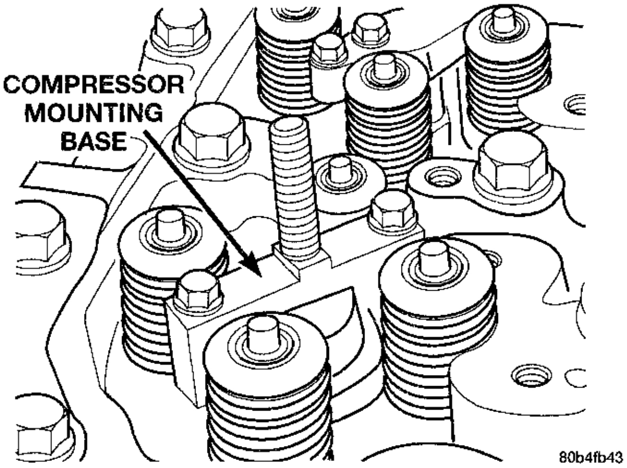


Fig. 84 Spring Compressor Mounting Base—Part of Tool 8319

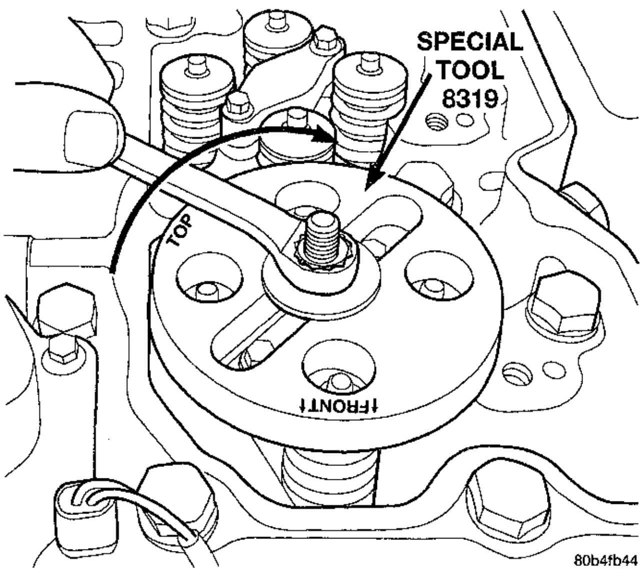


Fig. 85 Compressing Valve Springs with Tool 8319

CLEANING

Clean the valve stems with crocus cloth or a Scotch-Brite™ pad. Remove carbon with a soft wire brush. Clean valves, springs, retainers, and valve retaining locks in a suitable solvent. Rinse in hot water and blow dry with compressed air.

INSPECTION

Visually inspect the valves for abnormal wear on the heads, stems, and tips. Replace any valve that is worn out or bent (Fig. 87).

Measure the valve stem diameter in three places as shown in (Fig. 88).

Measure the cylinder head valve guide bore (Fig. 89). Subtract the corresponding valve stem diameter to obtain valve stem-to-guide clearance.

Measure valve margin (rim thickness) (Fig. 90).

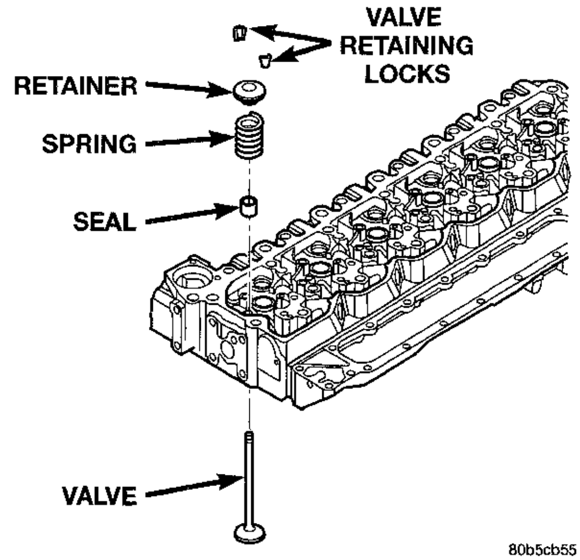


Fig. 86 Valve Spring, Seal, and Retainers

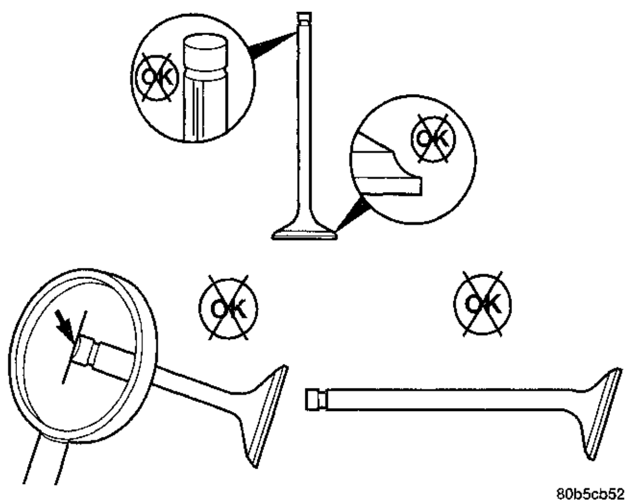


Fig. 87 Visually Inspect Valves for Abnormal Wear

Measure the valve spring free length and maximum inclination (Fig. 91).

Test valve spring force with tool C-647 (Fig. 92).

INSTALLATION

(1) Install new valve seals. The yellow seals are for the intake valves and the green seals are for the exhaust valves.

(2) Install the valves in their original postion. The exhaust valves are identified by a dimple on the valve head (Fig. 93).

(3) Install the valve springs and retainer.

(4) Install the valve spring compressor tool 8319 as shown in (Fig. 84) and (Fig. 85).

(5) Compress the valve springs and install the valve retaining locks (Fig. 86).

REMOVAL AND INSTALLATION (Continued)

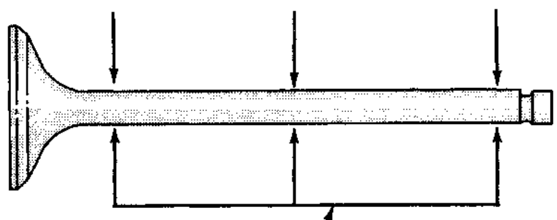


Fig. 88 Measure Valve Stem Diameter

VALVE STEM DIAMETER
6.990 mm (0.2752 in.) MIN
7.010 mm (0.2760 in.) MAX

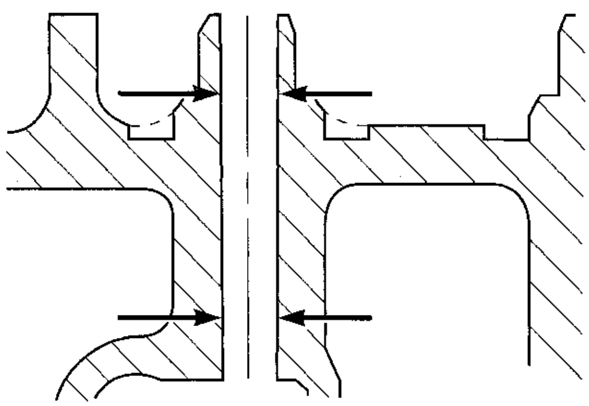


Fig. 89 Measure Valve Guide Bore

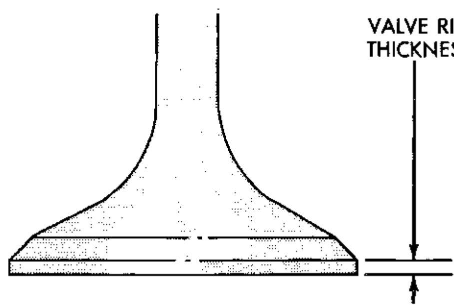


Fig. 90 Measure Valve Margin (Rim Thickness)

VALVE MARGIN (RIM THICKNESS)
0.72 mm (0.031 in.) MIN.

(6) Remove the compressor and repeat the procedure on the remaining cylinders.

(7) Install the injector clamp and hold down bolts and tighten to 10 N·m (89 in. lbs.) torque.

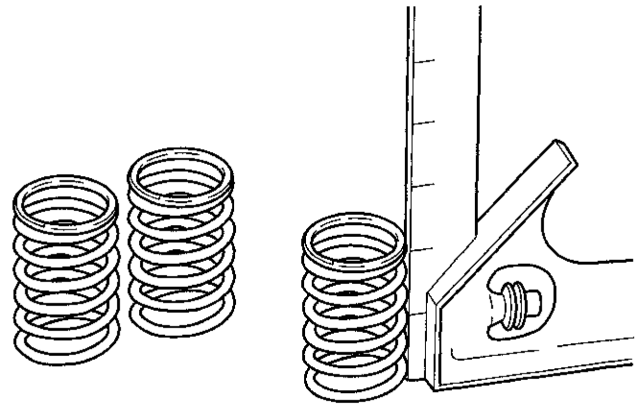


Fig. 91 Measure Valve Spring Free Length and Max. Inclination

VALVE SPRING FREE LENGTH
47.75 mm (1.88 in.)

MAX INCLINATION
1.5 mm (.059 in.)

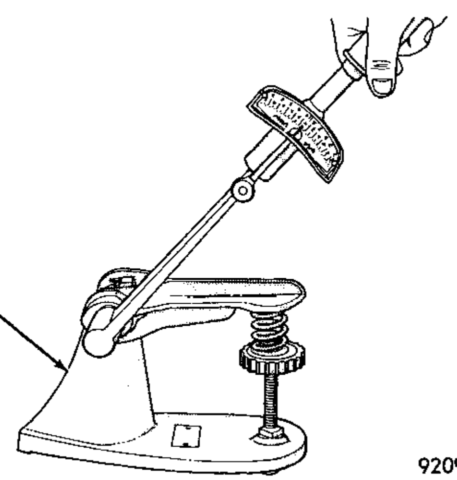


Fig. 92 Testing Valve Spring with Tool C-647

VALVE SPRING MINIMUM LOAD
@ 35.33 mm — 339.8 N
@ 1.39 in. — 76.4 lbs.

(8) Install the cylinder head. Refer to Cylinder Head Removal and Installation in this group.

REMOVAL AND INSTALLATION (Continued)

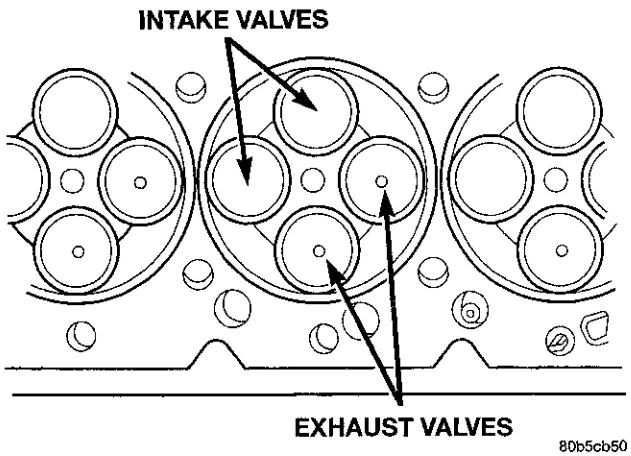


Fig. 93 Valve Identification

CRANKSHAFT DAMPER

REMOVAL

(1) Remove the accessory drive belt. Refer to Group 7, Cooling System for the correct procedure.

(2) Remove the four (4) damper to crankshaft bolts and remove damper (Fig. 94).

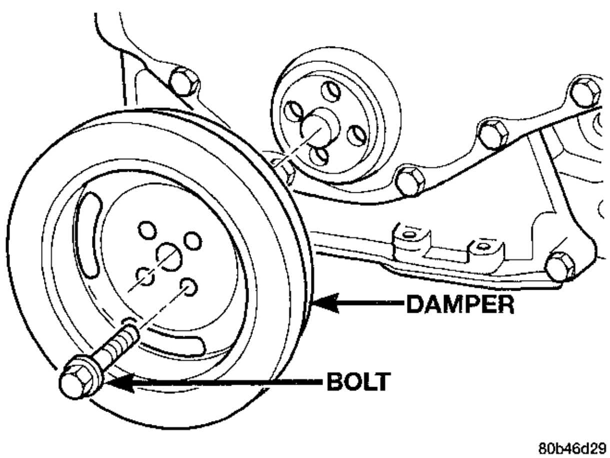


Fig. 94 Crankshaft Damper Removal/Installation

INSPECTION

(1) Inspect the damper hub for cracks and replace if any are found.

(2) Inspect the index lines on the damper hub and the inertia member (Fig. 95). If the lines are more than 1.59 mm (1/16 in.) out of alignment, replace the damper.

(3) Inspect the rubber member for deterioration or missing segments (Fig. 96).

INSTALLATION

(1) Install the crankshaft damper and bolts (Fig. 94). Tighten bolts to 125 N·m (92 ft. lbs.) torque.

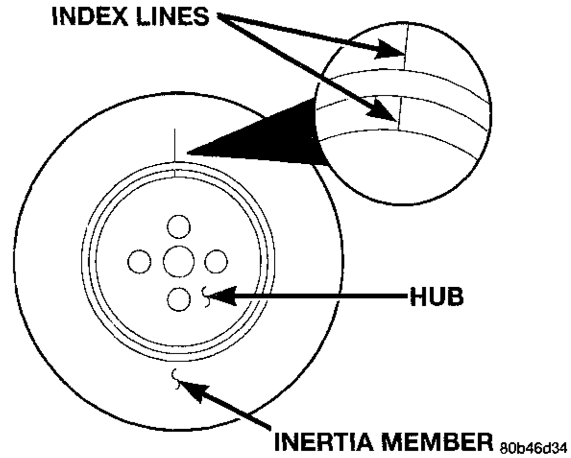


Fig. 95 Inspect Index Lines for Alignment

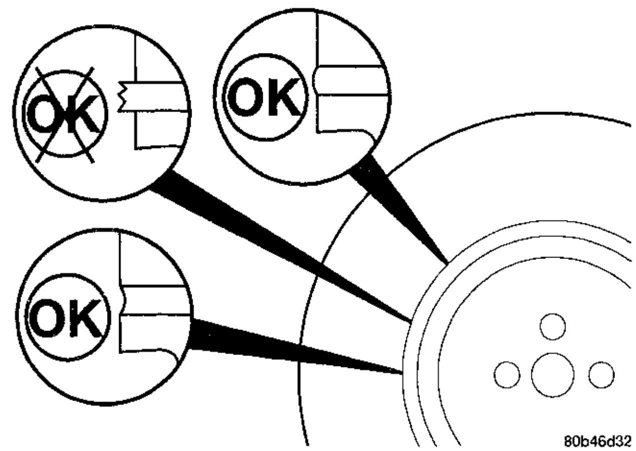


Fig. 96 Inspect Damper Rubber Member

(2) Install the accessory drive belt. Refer to Group 7, Cooling System for the correct belt schematic and procedure.

CRANKSHAFT OIL SEAL—FRONT

REMOVAL

(1) Disconnect both battery negative cables.

(2) Raise vehicle on hoist.

(3) Partially drain engine coolant into container suitable for re-use.

(4) Lower vehicle.

(5) Remove radiator upper hose.

(6) Disconnect coolant recovery bottle from radiator filler neck and lift bottle off of fan shroud.

(7) Disconnect windshield washer pump supply hose and electrical connections and lift washer bottle off of fan shroud.

(8) Remove the fan shroud-to-radiator mounting bolts.

REMOVAL AND INSTALLATION (Continued)

(9) Remove viscous fan/drive assembly. **The fan drive nut has left handed threads.** Refer to Group 7, Cooling System for the correct procedure.

(10) Remove cooling fan shroud and fan assy. from the vehicle.

(11) Remove the accessory drive belt. Refer to Group 7, Cooling for the correct procedure.

(12) Remove the cooling fan support/hub from the front of the engine (Fig. 97).

(13) Raise the vehicle on hoist.

(14) Remove the vibration damper (Fig. 98).

(15) Remove the gear cover-to-housing bolts and gently pry the cover away from the housing, taking care not to mar the gasket surfaces.

(16) Support the cover on a flat work surface with wooden blocks (Fig. 99), and using a suitable punch and hammer, drive the old seal out of the cover from the the outside of the cover (Fig. 99).

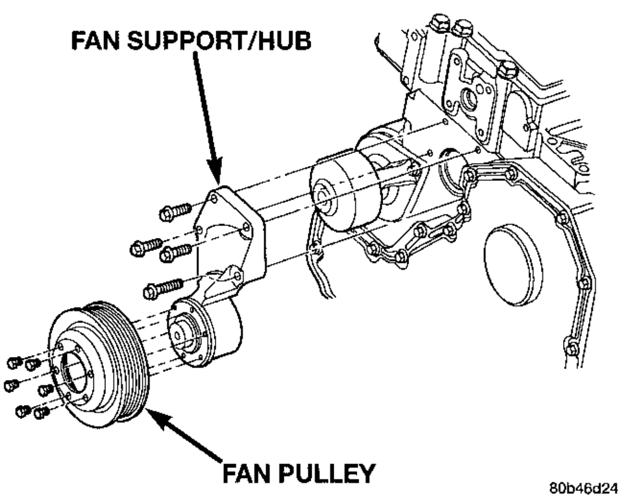


Fig. 97 Fan Support Hub Assembly—Removal/Installation

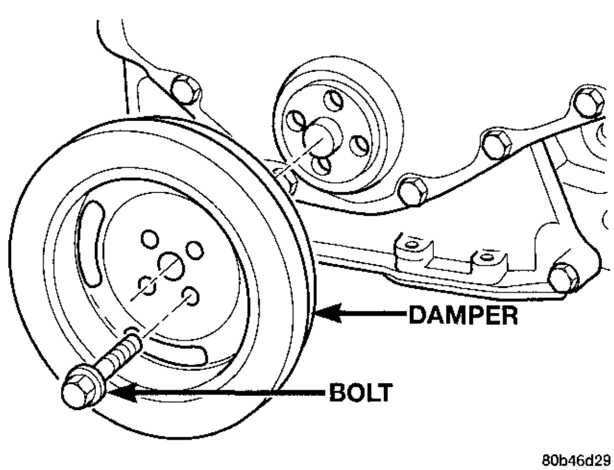


Fig. 98 Vibration Damper—Removal/Installation

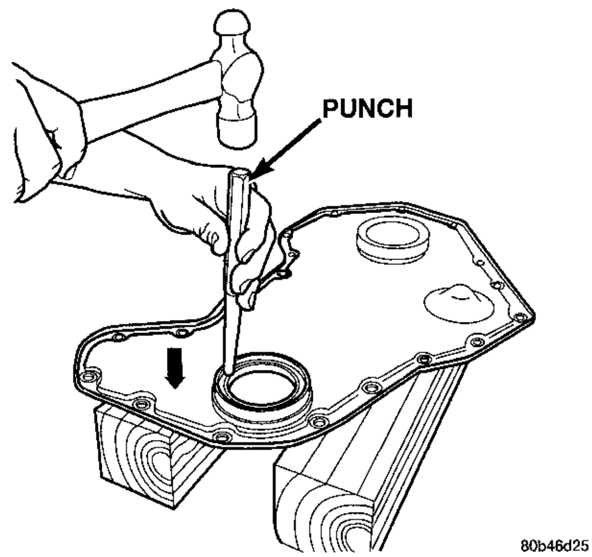


Fig. 99 Removing Seal from Cover

CLEANING

Clean cover and housing gasket mating surfaces. Use a suitable scraper and be careful not to damage the gear housing surface, since it is aluminum. Remove any old sealer from the oil seal bore. Thoroughly clean the front seal area of the crankshaft. The seal lip and the sealing surface on the crankshaft must be free from all oil residue to prevent seal leaks.

INSPECTION

Inspect the gear housing and cover for cracks and replace if necessary. Carefully straighten any bends or imperfections in the gear cover with a ball-peen hammer on a flat surface. Inspect the crankshaft front journal for any grooves or nicks that would affect the integrity of the new seal.

INSTALLATION

(1) Apply a bead of Loctite 277® or equivalent to the outside diameter of the seal. Do not lubricate the inside diameter of the new seal.

(2) With the cover supported by wood blocks, install the seal into the rear of the cover using crankshaft seal installer tool #8281 and universal driver handle C4171 (Fig. 100). Strike the driver handle until the installation tool bottoms out on the inside of the cover.

(3) Install the plastic seal pilot (provided with seal kit) into the crankshaft seal.

(4) Apply a bead of Mopar® Silicone Rubber Adhesive Sealant or equivalent to the cover sealing surface.

(5) Install the cover to the gear housing, aligning the seal pilot with the nose of the crankshaft (Fig. 101).

REMOVAL AND INSTALLATION (Continued)

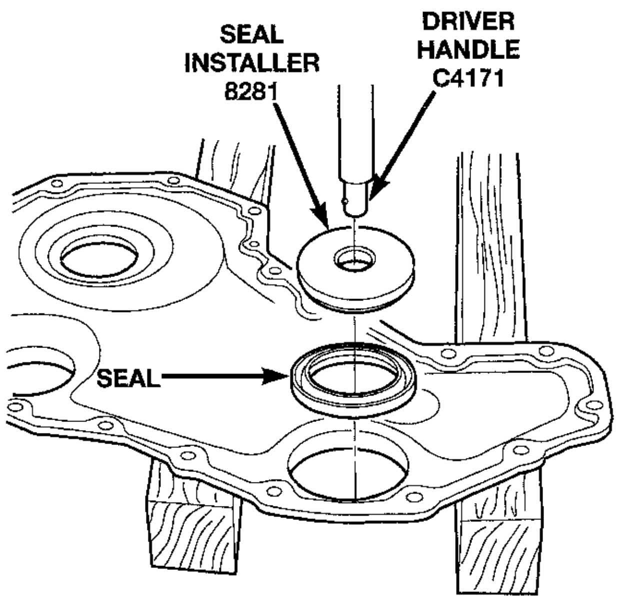


Fig. 100 Installing Seal Into Cover With Tool 8281

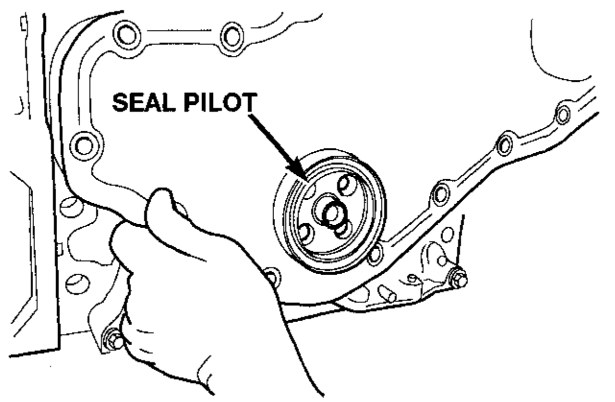


Fig. 101 Installing Front Cover with Seal Pilot

(6) Install the cover bolts and tighten to 24 N·m (18 ft. lbs.) torque. Remove pilot tool.

(7) Install the vibration damper (Fig. 98) and torque the bolts to 125 N·m (92 ft. lbs.). Use the engine barring tool to keep the engine from rotating during tightening operation.

(8) Install the fan support/hub assembly (Fig. 97)and torque bolts to 24 N·m (18 ft. lbs.).

(9) Install the accessory drive belt. Refer to Group 7, Cooling for the correct procedure.

(10) Connect battery negative cables.

(11) Start engine and check for oil leaks.

GEAR HOUSING COVER

REMOVAL

(1) Disconnect both battery negative cables.

(2) Raise vehicle on hoist.

(3) Partially drain engine coolant into container suitable for re-use.

(4) Lower vehicle.

(5) Remove radiator upper hose.

(6) Disconnect coolant recovery bottle hose from radiator filler neck and lift bottle off of fan shroud.

(7) Disconnect windshield washer pump supply hose and electrical connections and lift washer bottle off of fan shroud.

(8) Remove the fan shroud-to-radiator mounting bolts.

(9) Remove viscous fan/drive assembly. **The fan drive nut has left handed threads.** Refer to Group 7, Cooling System for the correct procedure.

(10) Remove cooling fan shroud and fan assy. from the vehicle.

(11) Remove the accessory drive belt. Refer to Group 7, Cooling for the correct procedure.

(12) Remove the cooling fan support/hub from the front of the engine (Fig. 102).

(13) Raise the vehicle on hoist.

(14) Remove the crankshaft damper (Fig. 103).

(15) Lower the vehicle.

(16) Remove the gear cover-to-housing bolts and gently pry the cover away from the housing, taking care not to mar the gasket surfaces.

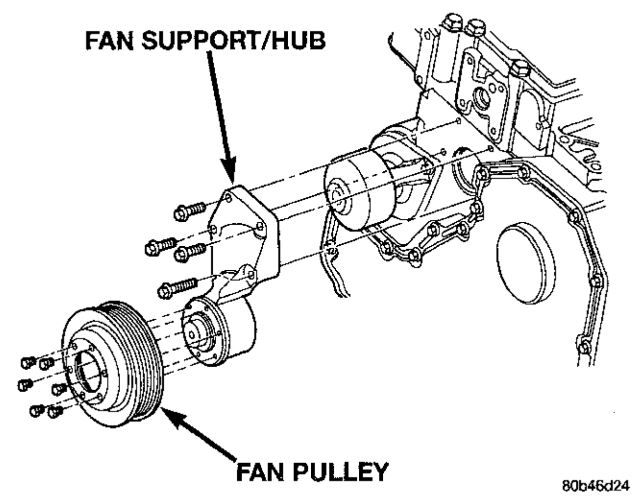


Fig. 102 Fan Support/Hub Assembly—Removal/ Installation

CLEANING

Clean cover and housing gasket mating surfaces. Use a suitable scraper and be careful not to damage the gear housing surface, since it is aluminum. Thor-

REMOVAL AND INSTALLATION (Continued)

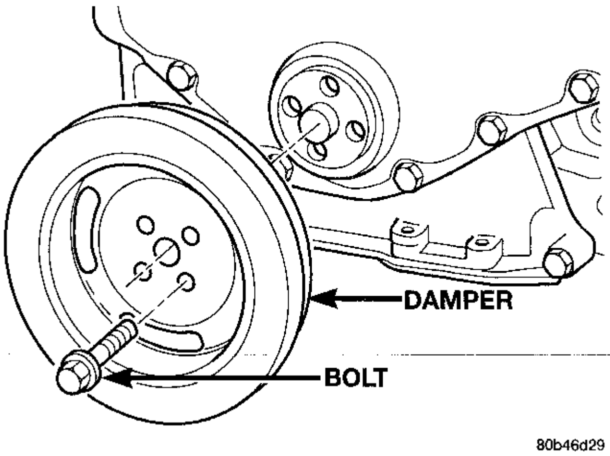


Fig. 103 Crankshaft Damper—Removal/Installation

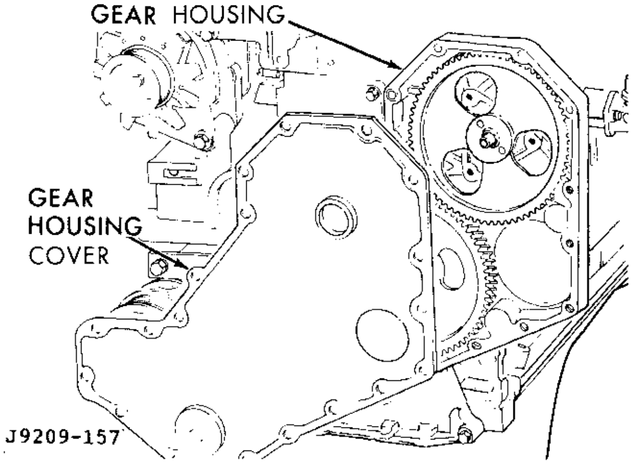


Fig. 104 Gear Housing and Cover

oughly clean the front seal area of the crankshaft. The seal lip and the sealing surface on the crankshaft must be free from all oil residue to prevent seal leaks.

INSPECTION

Inspect the gear housing and cover for cracks and replace if necessary. Carefully straighten any bends or imperfections in the gear cover with a ball-peen hammer on a flat surface. Inspect the crankshaft front seal and journal for imperfections and replace seal if necessary. Refer to procedure in this group.

INSTALLATION

(1) Obtain a seal pilot/installation tool from a crankshaft front seal service kit and install the pilot into the seal.

(2) Apply a bead of Mopar® Silicone Rubber Adhesive Sealant or equivalent to the gear housing cover. Be sure to surround all through holes.

(3) Using the seal pilot to align the cover (Fig. 105), install the cover to the housing and install the bolts. Tighten the bolts to 24 N·m (18 ft. lbs.) torque.

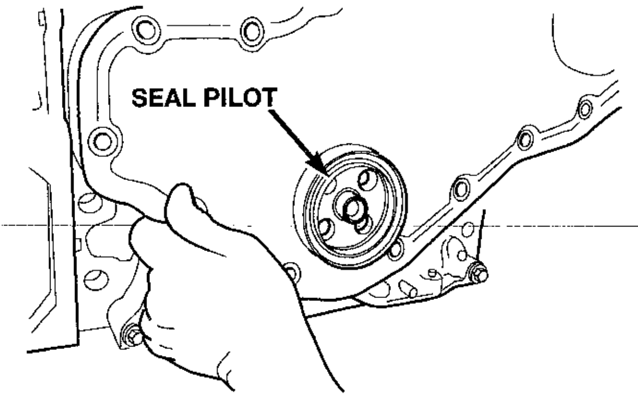


Fig. 105 Installing Cover with Seal Pilot

(4) Remove the seal pilot.

(5) Raise the vehicle.

(6) Install the crankshaft damper (Fig. 103) and tighten bolts to 125 N·m (92 ft. lbs.) torque.

(7) Lower vehicle.

(8) Install the fan support/hub assy. (Fig. 102)and tighten bolts to 24 N·m (18 ft. lbs.) torque.

(9) Install the accessory drive belt. Refer to Group 7, Cooling System for the correct procedure.

(10) Install the cooling fan and shroud together. Start fan nut and fan shroud-to-radiator bolts by hand.

(11) Torque fan drive nut to 57 N·m (42 ft. lbs.) torque.

(12) Torque fan shroud-to-radiator bolts to 11 N·m (95 in. lbs.) torque.

(13) Install the windshield washer reservoir to the fan shroud and connect the washer pump supply hose and electrical connection.

(14) Install the coolant recovery bottle to the fan shroud and connect the hose to the radiator filler neck.

(15) Install the radiator upper hose and clamps.

(16) Add coolant.

(17) Connect the battery cables.

(18) Start engine and inspect for leaks.

GEAR HOUSING

REMOVAL

(1) Disconnect the battery negative cables.

(2) Raise vehicle on hoist.

(3) Remove the oil pan and suction tube. Refer to procedure in this group.

(4) Partially drain engine coolant into container suitable for re-use.

REMOVAL AND INSTALLATION (Continued)

(5) Lower vehicle.

(6) Remove radiator upper hose.

(7) Disconnect coolant recovery bottle hose from radiator filler neck and lift bottle off of fan shroud.

(8) Disconnect windshield washer pump supply hose and electrical connections and lift washer bottle off of fan shroud.

(9) Remove the fan shroud-to-radiator mounting bolts.

(10) Remove viscous fan/drive assembly. **The fan drive nut has left handed threads.** Refer to Group 7, Cooling System for the correct procedure.

(11) Remove cooling fan shroud and fan assy. from the vehicle.

(12) Remove the accessory drive belt. Refer to Group 7, Cooling for the correct procedure.

(13) Remove the cooling fan support/hub from the front of the engine (Fig. 106).

(14) Raise the vehicle on hoist.

(15) Remove the crankshaft damper (Fig. 107).

(16) Lower the vehicle.

(17) Remove the gear cover-to-housing bolts and gently pry the cover away from the housing (Fig. 108), taking care not to mar the gasket surfaces.

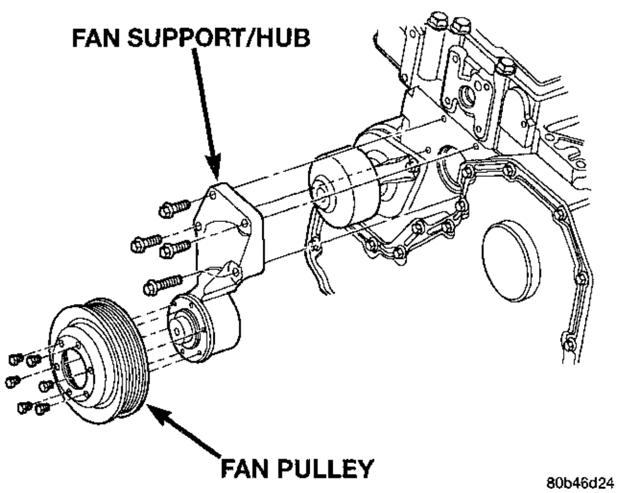


Fig. 106 Fan Support/Hub Assembly—Removal/ Installation

(18) Remove the fuel injection pump. Refer to Group 14, Fuels Systems for the correct procedure.

(19) Disconnect the camshaft position sensor connector.

(20) Raise the tappets and remove the camshaft. Refer to procedure in this group.

(21) Remove the gear housing and gasket (Fig. 109).

(22) Clean the gasket material from the cylinder block.

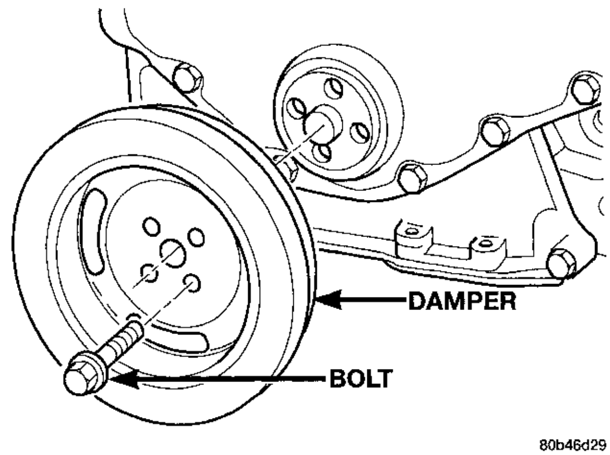


Fig. 107 Crankshaft Damper—Removal/Installation

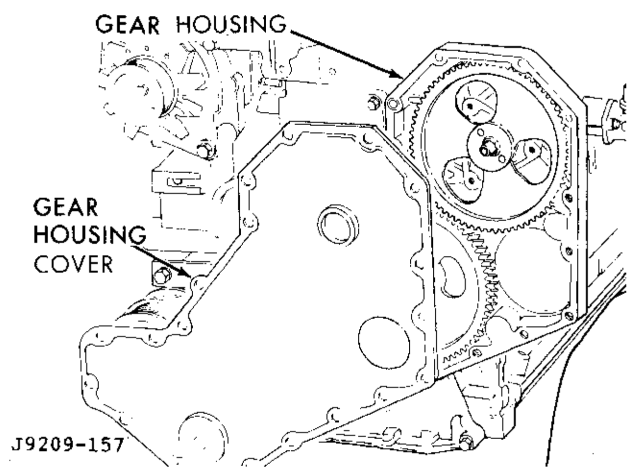


Fig. 108 Gear Housing and Cover

INSTALLATION

(1) Install a new gasket and the gear housing (Fig. 109). Tighten the bolts to 24 N·m (18 ft. lbs.) torque.

(2) Connect the camshaft position sensor connector.

(3) Install the injection pump. Refer to Group 14, Fuel System for the correct procedure.

(4) Install the camshaft. Align the crankshaft, camshaft, and injection pump gear marks as shown in (Fig. 110).

(5) If a new housing is installed, the camshaft position sensor must be transferred to the new housing.

(6) Obtain a seal pilot/installation tool from a crankshaft front seal service kit and install the pilot into the crankshaft front oil seal.

(7) Apply a bead of Mopar® Silicone Rubber Adhesive Sealant or equivalent to the gear housing cover. Be sure to surround all through holes.

(8) Using the seal pilot to align the cover (Fig. 111), install the cover to the housing and install the bolts. Tighten the bolts to 24 N·m (18 ft. lbs.) torque.

REMOVAL AND INSTALLATION (Continued)

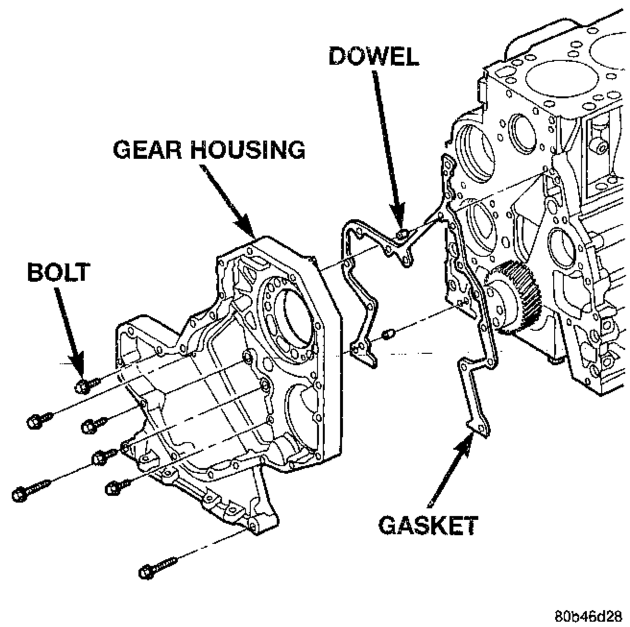


Fig. 109 Gear Housing and Gasket

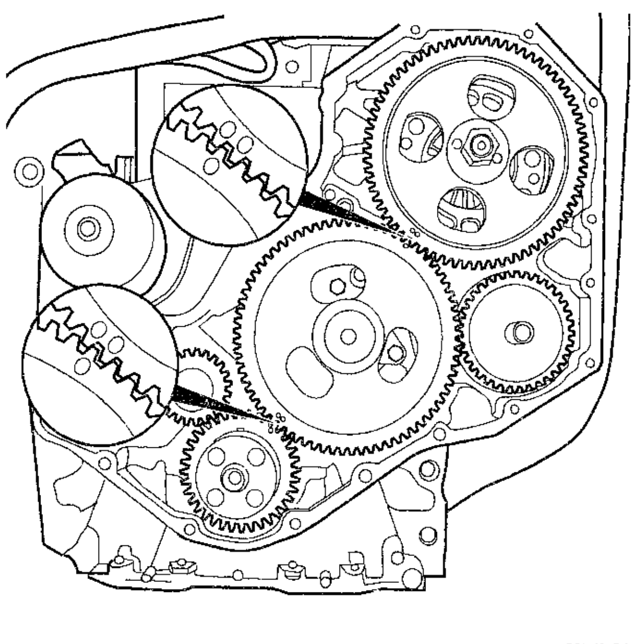


Fig. 110 Camshaft/Crankshaft Gear Alignment

(9) Remove the seal pilot.

(10) Raise the vehicle.

(11) Trim any excess gear housing gasket to make it flush with the oil pan rail.

(12) Using a new gasket, install the oil pan and suction tube. Refer to procedure in this group.

(13) Install the crankshaft damper (Fig. 107) and tighten bolts to 125 N·m (92 ft. lbs.) torque.

(14) Lower vehicle.

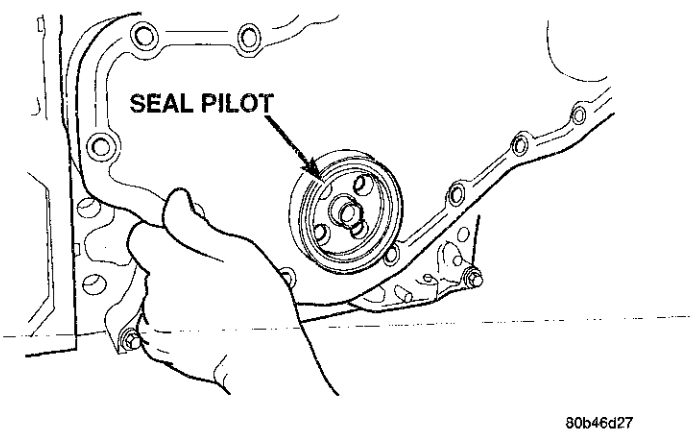


Fig. 111 Installing Cover with Seal Pilot

(15) Install the fan support/hub assy. (Fig. 106)and tighten bolts to 24 N·m (18 ft. lbs.) torque.

(16) Install the accessory drive belt. Refer to Group 7, Cooling System for the correct procedure.

(17) Install the cooling fan and shroud together. Start fan nut and fan shroud-to-radiator bolts by hand.

(18) Torque fan drive nut to 57 N·m (42 ft. lbs.) torque.

(19) Torque fan shroud-to-radiator bolts to 11 N·m (95 in. lbs.) torque.

(20) Install the windshield washer reservoir to the fan shroud and connect the washer pump supply hose and electrical connection.

(21) Install the coolant recovery bottle to the fan shroud and connect the hose to the radiator filler neck.

(22) Install the radiator upper hose and clamps.

(23) Add engine oil.

(24) Add coolant.

(25) Connect the battery cables.

(26) Start engine and inspect for leaks.

CAMSHAFT

NOTE: This procedure requires use of the Cummins Tappet Replacement Tool Kit #3822513.

REMOVAL

(1) Disconnect both battery negative cables.

(2) Recover A/C refrigerant (if A/C equipped). Refer to Group 24, Heating and Air Conditioning for the correct procedure.

(3)

(3) Raise vehicle on hoist.

(4) Drain engine coolant into container suitable for re-use.

(5) Lower vehicle.

AUTHENTIC RESTORATION PRODUCT

REMOVAL AND INSTALLATION (Continued)

(6) Remove radiator upper hose.
(7) Remove viscous fan/drive assembly.
(8) Disconnect the coolant recovery bottle hose from the radiator filler neck.
(9) Remove cooling fan shroud.
(10) Disconnect lower radiator hose from radiator outlet.
(11) **Automatic Transmission models:** Disconnect transmission oil cooler lines from radiator using special tool #6931 (unless equipped with finger-release disconnect).
(12) Remove radiator mounting screws and lift radiator out of engine compartment.
(13) Remove upper radiator support panel.
(14) Remove front bumper assy. Refer to Group 13, Frame and Bumpers for the correct procedure.
(15) If A/C equipped, disconnect A/C condenser refrigerant lines. Refer to Group 24, Heating and Air Conditioning for the correct procedures.
(16) Disconnect charge air cooler piping from the cooler inlet and outlet.
(17) Remove the two charge air cooler mounting bolts.
(18) Remove charge air cooler (and A/C condenser if equipped) from vehicle.
(19) Remove accessory drive belt. Refer to Group 7, Cooling System for the correct procedure.
(20) Remove the fan support/hub assembly (Fig. 112).
(21) Remove crankshaft damper (Fig. 113).
(22) Remove the pump gear access cover by rotating counter-clockwise (Fig. 114).

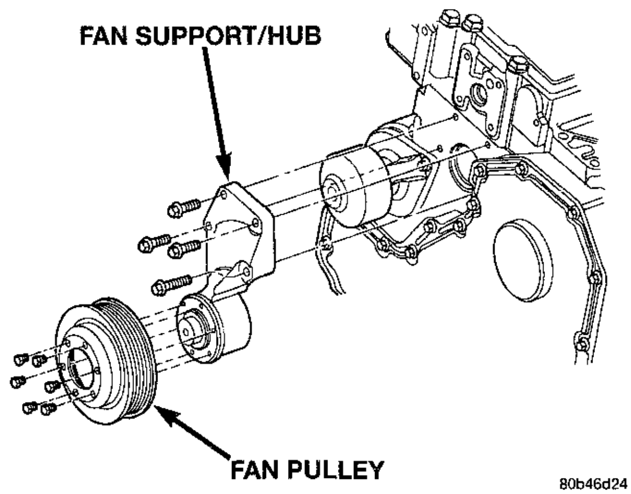


Fig. 112 Fan Support/Hub Removal/Installation

(23) Using an engine barring tool, rotate the crankshaft to bring the engine to TDC #1.

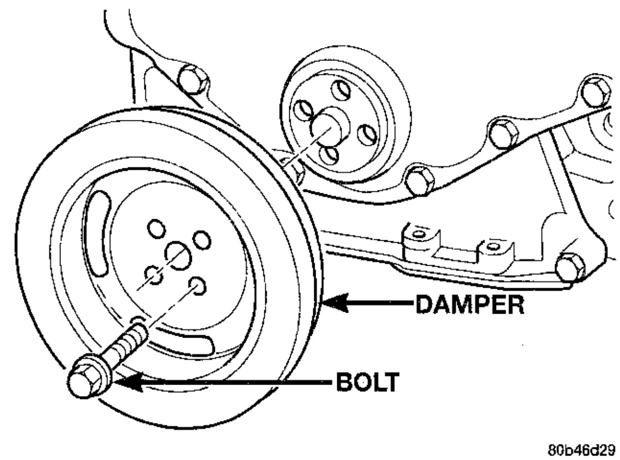


Fig. 113 Crankshaft Damper Removal/Installation

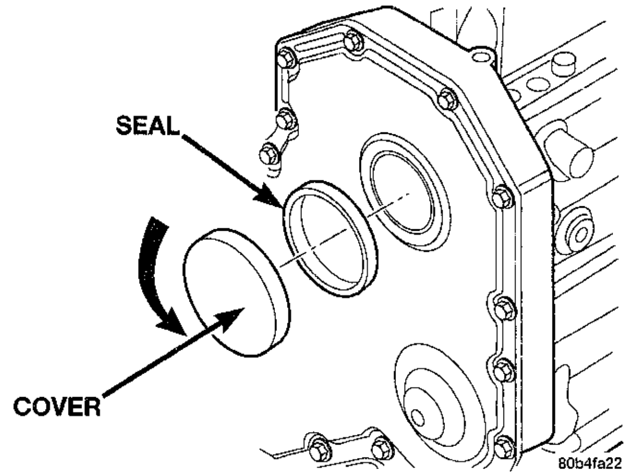


Fig. 114 Removing Injection Pump Gear Access Cover

(24) Remove the gear cover-to-housing bolts and gently pry the cover away from the housing, taking care not to mar the sealing surfaces.
(25) Remove the cylinder head cover (Fig. 115).
(26) Remove the rocker arms (Fig. 116), cross heads, and push rods (Fig. 117). Mark each component so they can be installed in their original positions.

NOTE: The #5 cylinder exhaust and the #6 cylinder intake and exhaust pushrods are removed by lifting them up and through the provided cowl panel access holes. Remove the rubber plugs to expose these relief holes.

(27) Raise the tappets as follows, using the wooden dowel rods (Fig. 118)provided with the Cummins tappet replacement tool kit #3822513:
(a) Insert the slotted end of the dowel rod into the tappet. **The dowel rods for the rear two cylinders will have to be cut for cowl panel**

REMOVAL AND INSTALLATION (Continued)

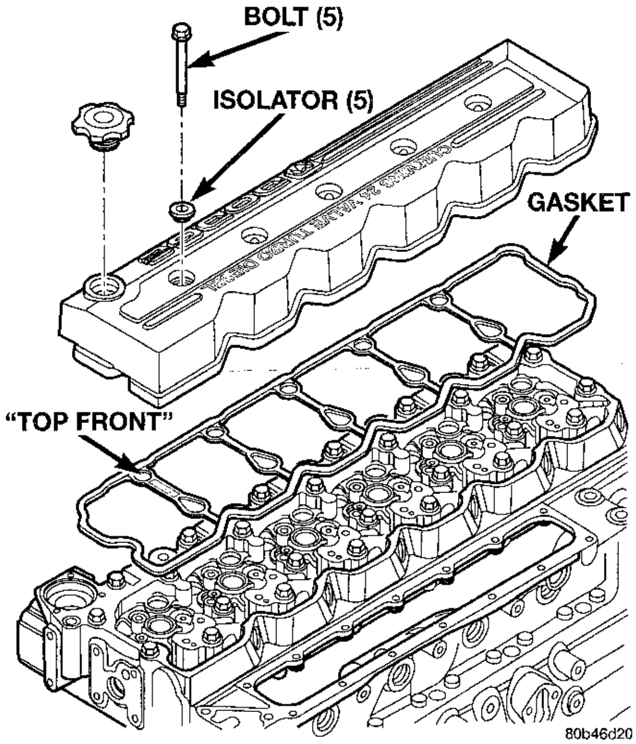


Fig. 115 Cylinder Head Cover Removal/Installation

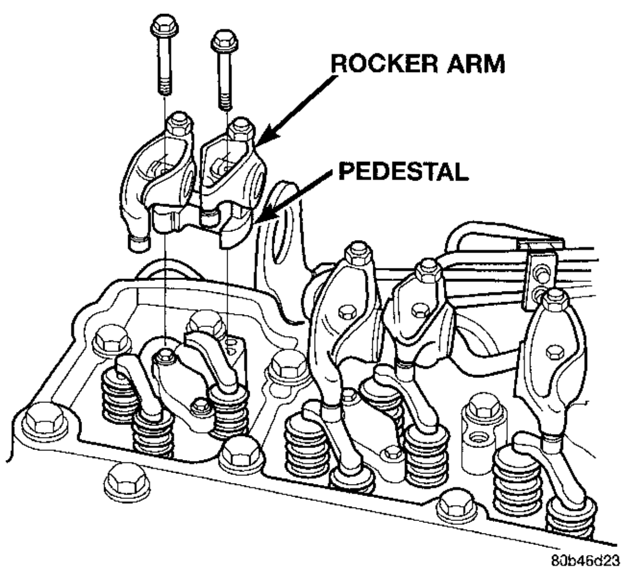


Fig. 116 Rocker Arm and Pedestal Removal/ Installation

clearance. Press firmly to ensure that it is seated in the tappet.

(b) Raise the dowel rod to bring the tappet to the top of its travel, and wrap a rubber band around the dowel rods (Fig. 118) to prevent the tappets from dropping into the crankcase.

(c) Repeat this procedure for the remaining cylinders.

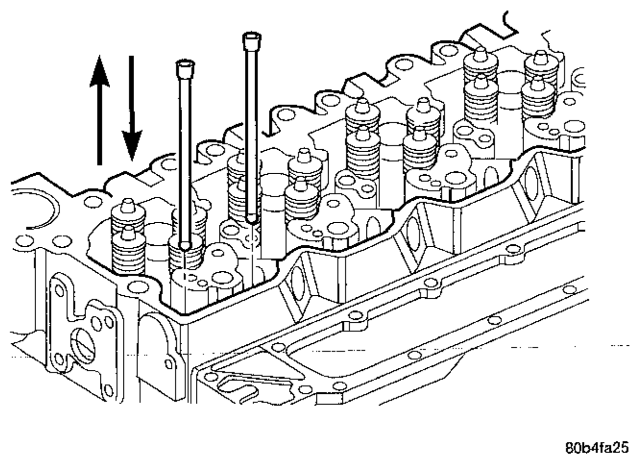


Fig. 117 Push Rod Removal/Installation

(28) Verify that the camshaft timing marks are aligned with the crankshaft and injection pump marks (Fig. 119).

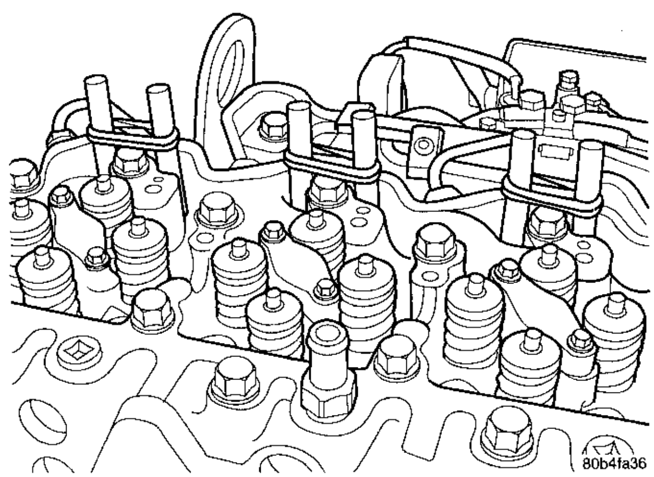


Fig. 118 Use Wooden Dowel Rods to Secure Tappets in Place

(29) Remove the bolts from the thrust plate (Fig. 120).

CAUTION: When removing the camshaft and thrust plate, grab the thrust plate to prevent it from falling into the crankcase.

(30) Remove the camshaft (Fig. 121) and thrust plate.

CLEANING

Clean the camshaft with a suitable solvent. Rinse in hot water and blow dry with compressed air.

REMOVAL AND INSTALLATION (Continued)

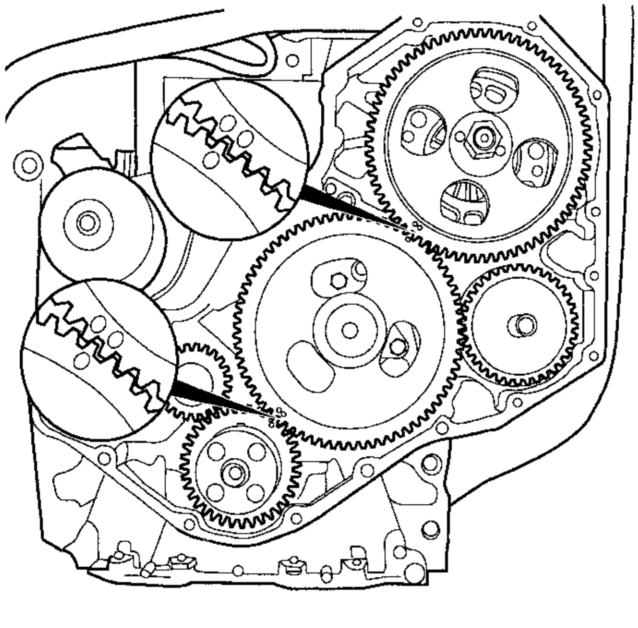


Fig. 119 Timing Mark Alignment

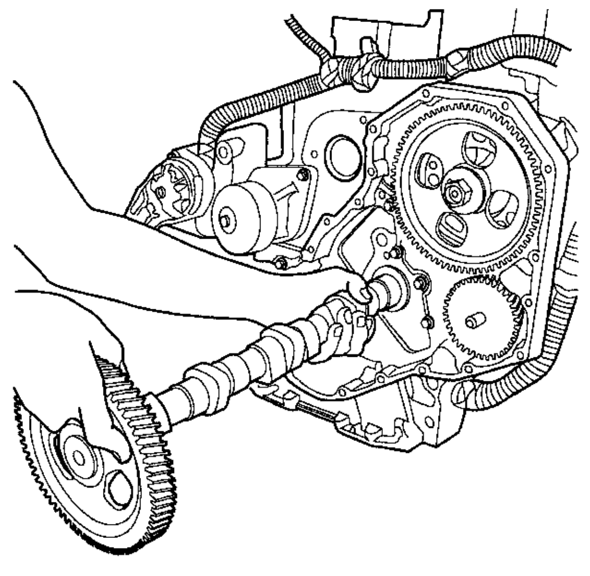


Fig. 121 Camshaft Removal/Installation

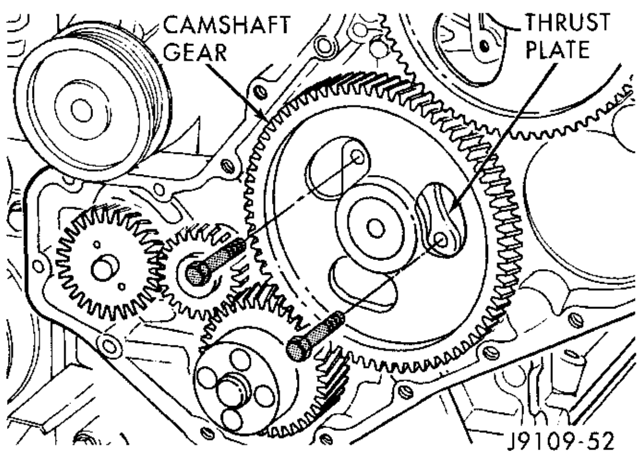


Fig. 120 Thrust Plate Bolt Location

INSPECTION

Camshaft

(1) Inspect the valve lobes and bearing journals for cracks, pitting, scoring, or generally excessive wear. Replace any camshaft that exceeds the allowable limits.

(2) Measure the bearing journals and lobes (Fig. 122).

CAUTION: If Camshaft lobes are worn, requiring camshaft replacement, it is necessary to replace the tappets also. Refer to Tappet Removal and Installation in this group.

Camshaft Bushing/Bores

Camshaft bores No. 2–7 **do not** use a bushing.

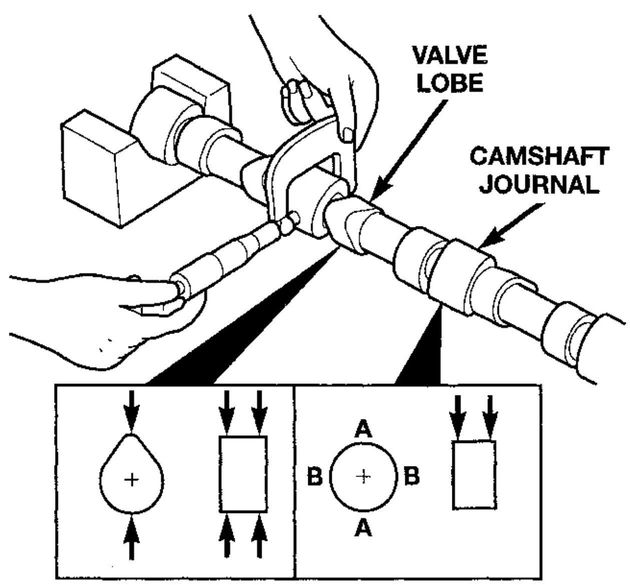


Fig. 122 Measuring Camshaft Main Journals and Lobes

Camshaft Journal Diameter
Journal #1 54.028 mm (2.1270 in.) MIN.
Journal #2-7 53.987 mm (2.1245 in.) MIN.

Camshaft Lobe Height
Intake Lobe 47.173 mm (1.857 in.) MIN.
Exhaust Lobe 45.636 mm (1.796 in.) MIN.

REMOVAL AND INSTALLATION (Continued)

(1) Inspect the camshaft bushing and bores for signs of excessive wear.

(2) Measure the camshaft bushing and bores (Fig. 123)with a telescoping bore gauge and micrometer. If out of specification, refer to Camshaft Bushing Removal and Installation for replacement procedures.

(3) Inspect the camshaft bushing oil hole for alignment with cylinder block (Fig. 124).

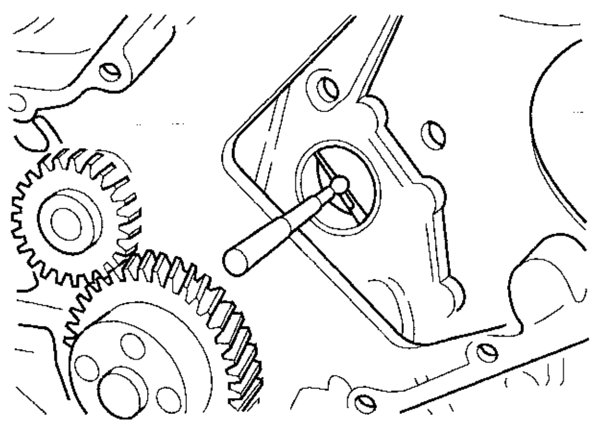


Fig. 123 Measuring Camshaft Bushing and Bores

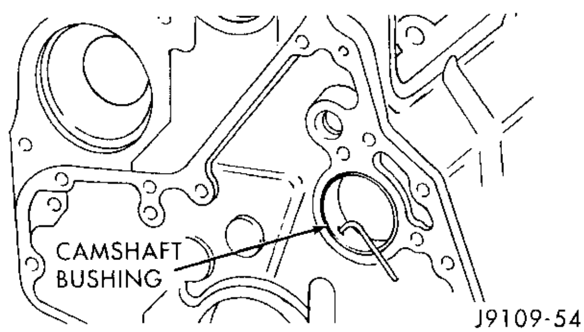


Fig. 124 Inspecting Oil Hole Alignment

Camshaft Gear

Inspect the camshaft gear for cracks (gear and hub) (Fig. 125), and chipped/broken/fretted teeth (Fig. 126). If replacement is necessary, refer to Camshaft Gear Removal and Installation in this group.

Thrust Plate

Inspect the camshaft thrust plate for excessive wear in the camshaft contact area. Measure thrust plate thickness using the following chart. Replace any thrust plate that falls outside of these specifications:

CAMSHAFT THRUST PLATE THICKNESS
9.34 mm (0.368 in.) MIN.
9.58 mm (0.377 in.) MAX.

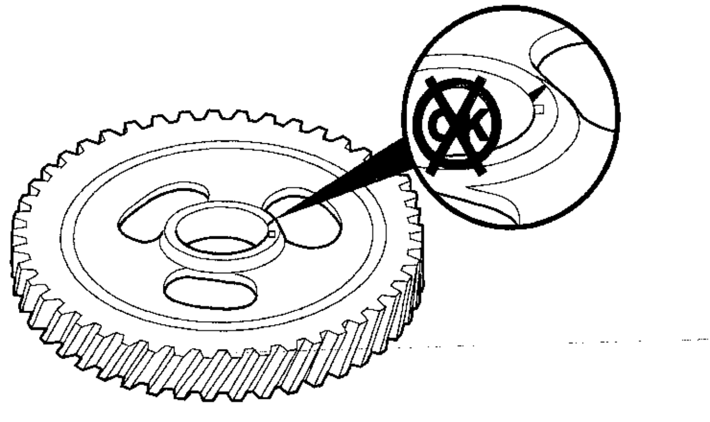


Fig. 125 Inspect Camshaft Gear Hub for Cracks

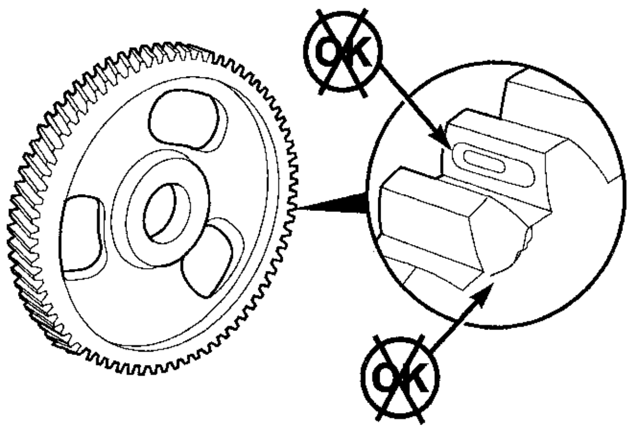


Fig. 126 Inspect Camshaft Gear for Cracks and Fretting

BUSHING REPLACEMENT

(1) Measure the diameter of each bore. (The limit for the bushing in the No.1 bore is the same as for the other bores without bushings). The limit of the inside diameter is 54.133 mm (2.1312 inch). If the camshaft bore for the first cam bushing is worn beyond the limit, install a new service bushing. Inspect the rest of the camshaft bores for damage or excessive wear.

(2) If the bores without a bushing are worn beyond the limit, the engine must be removed for machining and installation of service bushings. If badly worn, replace the cylinder block.

(3) Remove the bushing from the No.1 bore, using a universal cam bushing tool.

(4) Mark the cylinder block so you can align the oil hole in the cylinder block with the oil hole in the bushing.

Apply a coating of Loctite® 609 to the backside of the new bushing. Avoid getting Loctite® in the oil hole.

REMOVAL AND INSTALLATION (Continued)

(5) Use a universal cam bushing installation tool and install the bushing so that it is even with the front face of the cylinder block. The oil hole must be aligned. A 3.2 mm (0.128 inch) diameter rod must be able to pass through the hole (Fig. 127).

(6) Measure the installed bushing. The limit of the inside diameter is 54.133 mm (2.1312 inch).

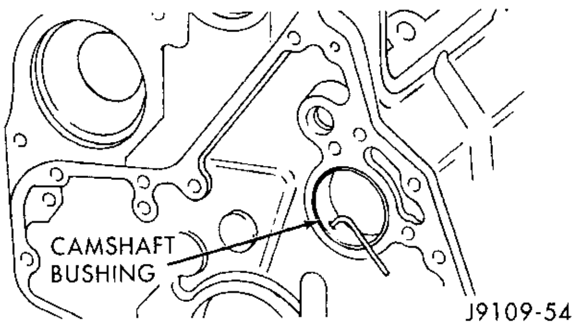


Fig. 127 Oil Hole Alignment

INSTALLATION

(1) Lubricate the camshaft bushing and bores with fresh engine oil or suitable equivalent.

(2) Liberally coat the camshaft lobes, journals, and thrust washer with fresh engine oil or suitable equivalent.

CAUTION: When installing the camshaft (Fig. 121), DO NOT push it in farther than it will go with the thrust washer in place. Pushing it too far can dislodge the plug in the rear of the camshaft bore and cause an oil leak.

(3) Install the camshaft (Fig. 121) and thrust plate. Align the timing marks as shown in (Fig. 119).

(4) Install the thrust plate bolts and tighten to 24 N·m (18 ft. lbs.) torque.

(5) Measure camshaft back lash and end clearance(Fig. 128).

(6) Remove the wooden dowel rods and rubber bands from the tappets.

(7) Lubricate the push rods with engine oil and install in their original location (Fig. 117). **Verify that they are seated in the tappets.**

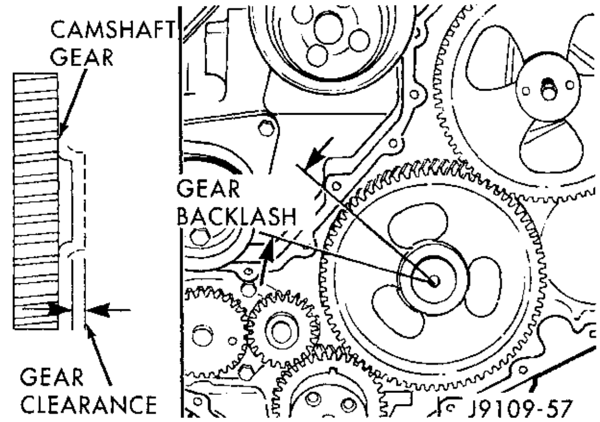
(8) Lubricate the valve tips with engine oil and install the crossheads in their original locations.

(9) Lubricate the crossheads and push rod sockets with engine oil and install the rocker arms and pedestals in their original locations (Fig. 116).

(10) **Verify valve lash adjustment. Refer to Valve Lash Verification and Adjustment in Service Procedures.**

(11) Install the cylinder head cover and reusable gasket (Fig. 115). Torque bolts to 24 N·m (18 ft. lbs.).

(12) Apply a bead of Mopar® Silicone Rubber Adhesive Sealant or equivalent to the gear housing cover. Install and tighten bolts to 24 N·m (18 ft. lbs.) torque.



BACKLASH - 0.080-0.330 mm (0.003-0.013 inch)
CLEARANCE - 0.152-0.254 mm (0.006-0.010 inch)

Fig. 128 Camshaft Backlash and End Clearance

(13) Install the crankshaft damper (Fig. 113) and tighten bolts to 125 N·m (92 ft. lbs.) torque.

(14) Install the fan support/hub assy. (Fig. 112)and tighten bolts to 24 N·m (18 ft. lbs.) torque.

(15) Install the fuel pump gear access cover. Tighten clock-wise by hand.

(16) Install the charge air cooler (with a/c condenser and auxiliary transmission oil cooler, if equipped) and tighten the mounting bolts to 2 N·m (17 in. lbs.) torque.

(17) Connect charge air cooler inlet and outlet pipes. Tighten clamps to 8 N·m (72 in. lbs.) torque.

(18) Install the radiator upper support panel.

(19) Close radiator petcock and lower the radiator into the engine compartment. Tighten the mounting bolts to 11 N·m (95 in. lbs.) torque.

(20) Raise vehicle on hoist.

(21) Connect radiator lower hose and install clamp.

(22) Connect transmission auxiliary oil cooler lines (if equipped).

(23) Lower vehicle.

(24) Install the fan shroud and tighten the mounting screws to 6 N·m (50 in. lbs.) torque.

(25) Install the viscous fan/drive assy. and tighten to 57 N·m (42 ft. lbs.) torque.

(26) Install the coolant recovery and windshield washer fluid reservoirs to the fan shroud.

(27) Connect the coolant recovery hose to the radiator filler neck.

(28) Install the accessory drive belt. Refer to Group 7, Cooling for the correct procedure.

(29) Install the front bumper assy. Refer to Group 13, Frame and Bumper for the correct procedure.

REMOVAL AND INSTALLATION (Continued)

(30) Add engine coolant.

(31) Connect the battery negative cables.

(32) Start engine and check for engine oil and coolant leaks.

(33) Charge A/C system with refrigerant (if A/C equipped). Refer to Group 24, Heating and Air Conditioning for the correct procedure.

CAMSHAFT GEAR (CAMSHAFT REMOVED)

CAUTION: DO NOT use an oxygen/acetylene torch to heat the gear upon removal from the camshaft. This will weaken the gear-to-hub joint and result in gear failure.

REMOVAL

(1) Remove camshaft. Refer to Camshaft Removal and Installation in this group.

(2) Support gear hub and press the camshaft out of the gear.

(3) Remove all burrs and smooth any rough surfaces caused by removing the gear.

INSPECTION

Visually inspect the camshaft gear for cracks (hub and gear), chipped or broken teeth, or excessive fretting (Fig. 129)(Fig. 130). Inspect and replace the keyway, if damaged.

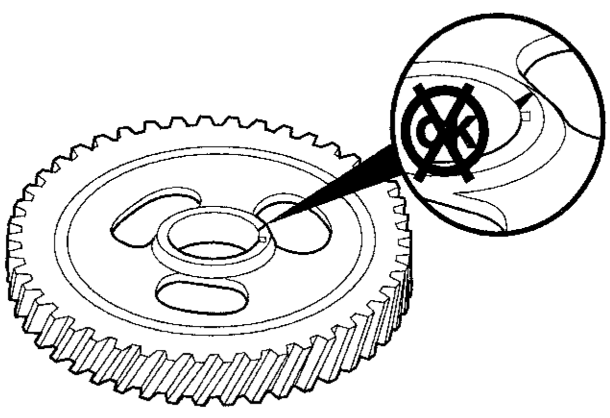


Fig. 129 Inspecting Camshaft Gear Hub for Cracks

INSTALLATION

(1) If replacing the camshaft, make sure the keyway is transferred to the new camshaft.

(2) Lubricate the camshaft surface with Lubriplate 105, or equivalent.

CAUTION: The camshaft gear will be permanently distorted if overheated. The oven temperature should never exceed 177°C (350°F).

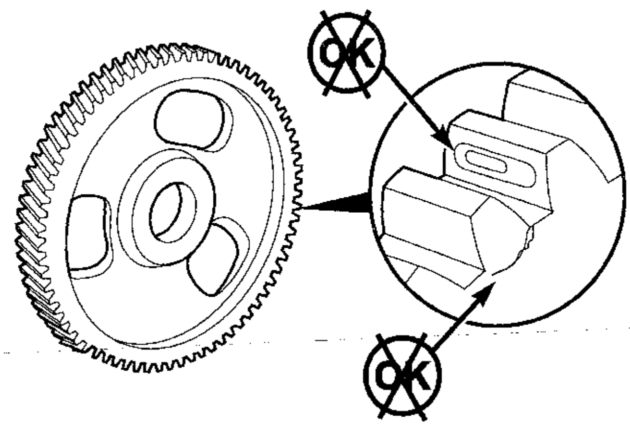


Fig. 130 Inspecting Camshaft Gear for Cracks and Fretting

(3) Heat the gear in an oven at 177°C (350°F) for 45 minutes.

WARNING: WEAR PROTECTIVE GLOVES (Fig. 131) TO HANDLE THE HOT GEAR.

(4) Install the gear with the timing marks visible (Fig. 131). Be sure the gear is seated against the camshaft shoulder (Fig. 132).

(5) If the camshaft is not to be used immediately, lubricate the lobes and journals to prevent rust.

(6) Install the camshaft, referring to the Camshaft Removal and Installation procedure in this group.

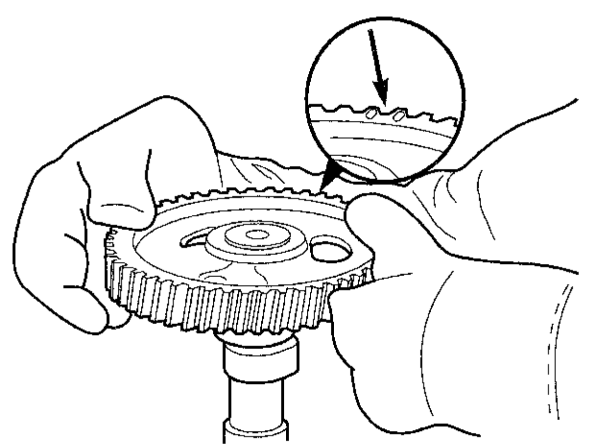


Fig. 131 Installing Camshaft Gear

TAPPETS

NOTE: This procedure requires use of the Cummins Tappet Replacement Tool Kit #3822513.

(1) Raise tappets and remove camshaft. Refer to Camshaft Removal and Installation procedure in this group.

REMOVAL AND INSTALLATION (Continued)

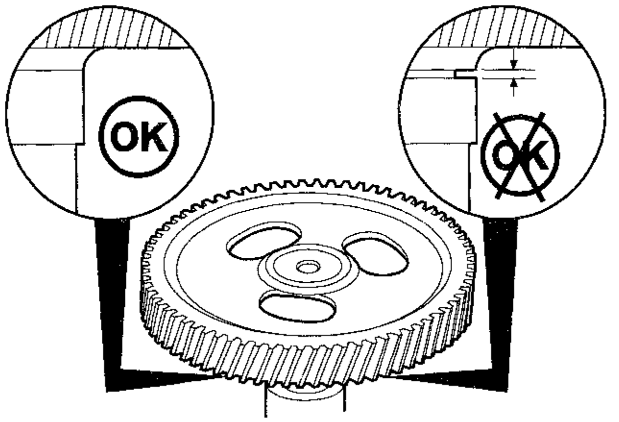


Fig. 132 Verify Correct Gear Installation

(2) Insert the trough (provided with tool kit) the full length of the camshaft bore (Fig. 133). Make sure the cap end goes in first and the open side faces up (towards lifters).

(3) **Remove only one tappet at a time.** Remove rubber band from one cylinder pair and attach tappet dowel not being removed to the next cylinder pair (Fig. 134).

(4) Raise dowel rod (disengage from tappet) and allow tappet to fall into trough (Fig. 135).

(5) Carefully remove trough **(do not rotate)** and tappet. If the tappet is not being replaced, mark it so it can be installed in its original location.

(6) Re-install trough and repeat procedure on remaining tappets.

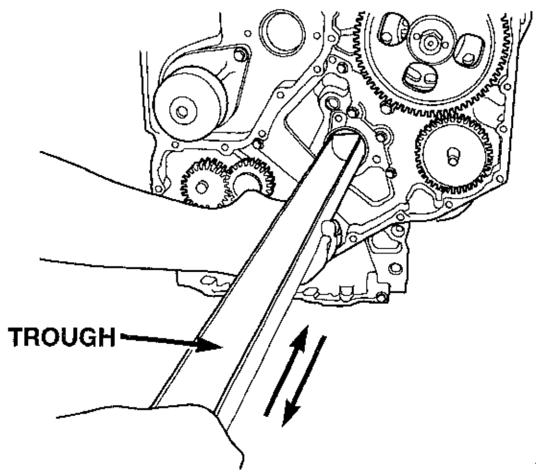


Fig. 133 Inserting the Trough

CLEANING

Clean tappet with a suitable solvent. Rinse in hot water and blow dry with a clean shop rag or compressed air.

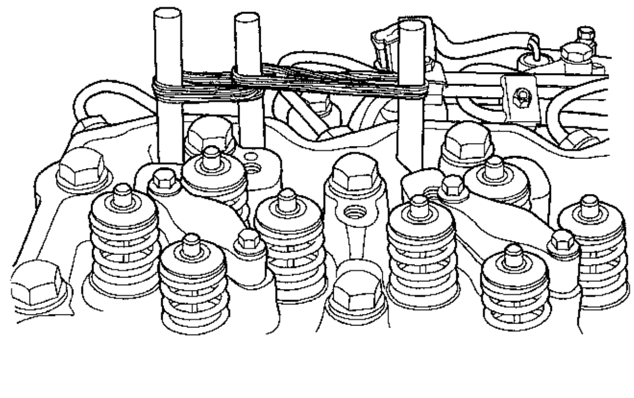


Fig. 134 Secure Dowel/Tappet to Adjacent Cylinder

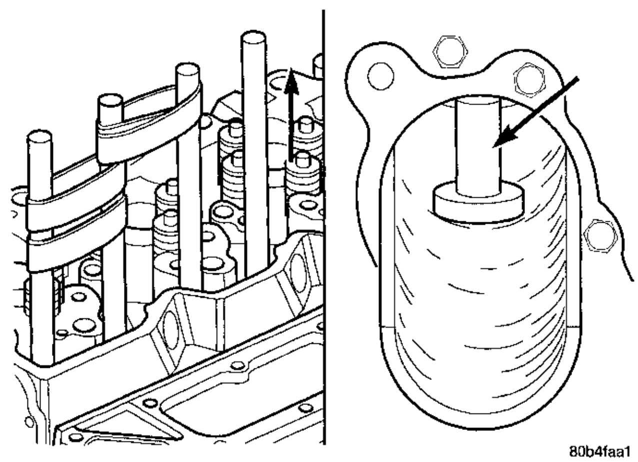


Fig. 135 Lift Dowel Rod to Disengage from Tappet

INSPECTION

(1) Visually inspect the tappet the tappet socket, stem, and face for excessive wear, cracks, or obvious damage (Fig. 136).

(2) Measure the tappet stem diameter. Replace the tappet if it falls below the minimum size (Fig. 136).

INSTALLATION

(1) Insert the trough the full length of the camshaft bore (Fig. 133). Again, make sure the cap end goes in first and the open side faces up (towards lifters).

(2) Lower the tappet installation tool through the push rod hole (Fig. 137) and into the trough.

(3) Retrieve the tappet installation tool using the hooked rod provided with the tool kit (Fig. 138).

(4) Lubricate the tappet with clean engine oil or suitable equivalent and install the tappet to the installation tool (Fig. 139).

(5) Pull the tappet up and into position (Fig. 139). If difficulty is experienced getting the tappet to make

REMOVAL AND INSTALLATION (Continued)

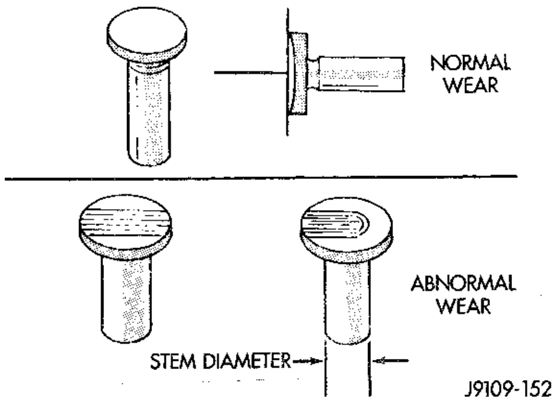


Fig. 136 Tappet Inspection

TAPPET STEM DIAMETER
15.925 mm (0.627 in.) MIN.
15.977 mm (0.629 in.) MAX.

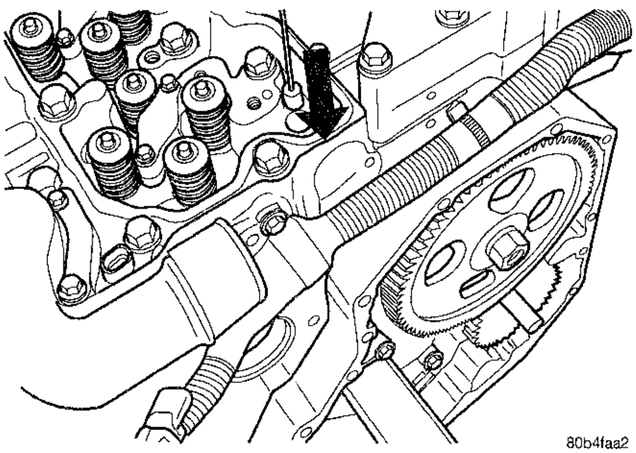


Fig. 137 Insert Installation Tool through Push Rod Hole

the turn into the tappet bore, wiggle the trough while **gently** pulling up on the tappet.

(6) With the tappet in place, rotate the trough one half turn so the open side is down (toward crankshaft) (Fig. 140).

(7) Remove the tappet installation tool from the tappet.

(8) Re-install a dowel rod and secure the rod with a rubber band.

(9) Rotate the trough one half turn and repeat the procedure for the remaining tappets.

(10) Install the camshaft and previously removed components. Refer to Camshaft Removal and Installation in this group.

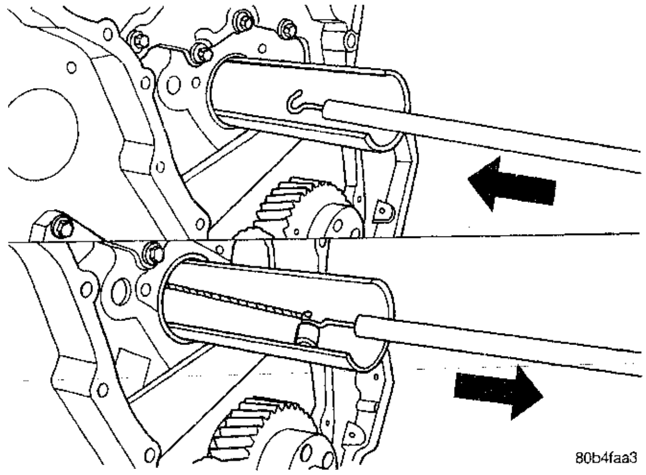


Fig. 138 Retrieve Tappet Installation Tool through Cam Bore

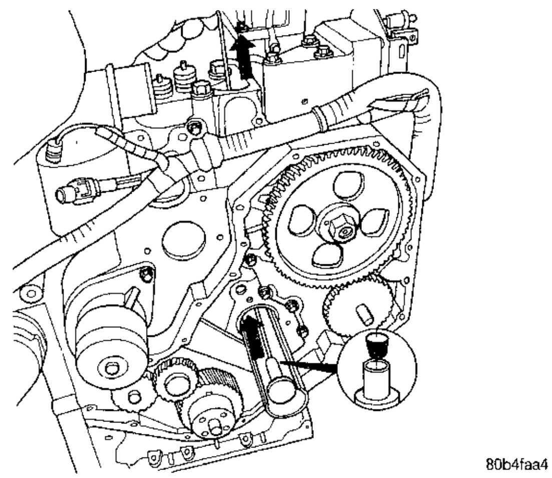


Fig. 139 Insert Tool and Pull Tappet Into Place

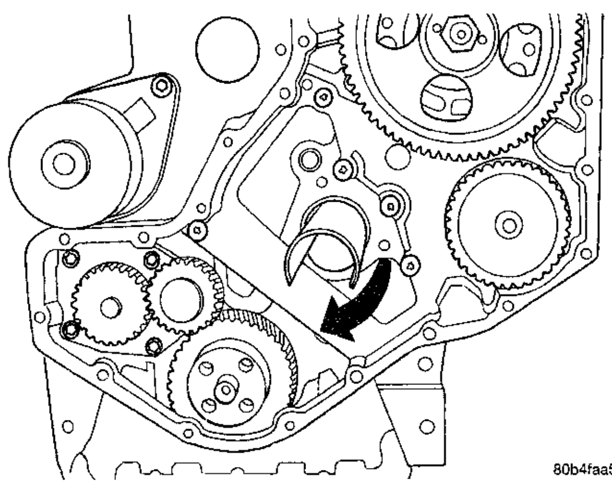


Fig. 140 Rotate Trough One Half Turn (180°)

REMOVAL AND INSTALLATION (Continued)

OIL PAN AND SUCTION TUBE

REMOVAL

(1) Disconnect the battery negative cables.

(2) Raise vehicle on hoist.

(3) Remove transmission and transfer case (if equipped) from vehicle, refer to Group 21 Transmission and Transfer Case.

(4) Remove flywheel.

(5) Disconnect starter cables from starter motor.

(6) Remove starter motor and transmission adapter plate assembly.

WARNING: HOT OIL CAN CAUSE PERSONAL INJURY.

(7) Drain the used engine oil. Dispose of the used oil properly.

(8) Install the oil pan drain plug with a new sealing washer and tighten to 60 N·m (44 ft. lbs.) torque.

(9) Remove oil pan bolts, break the pan to block seal, and lower pan slightly and remove oil suction tube fasteners.

(10) Remove oil pan and suction tube (Fig. 141).

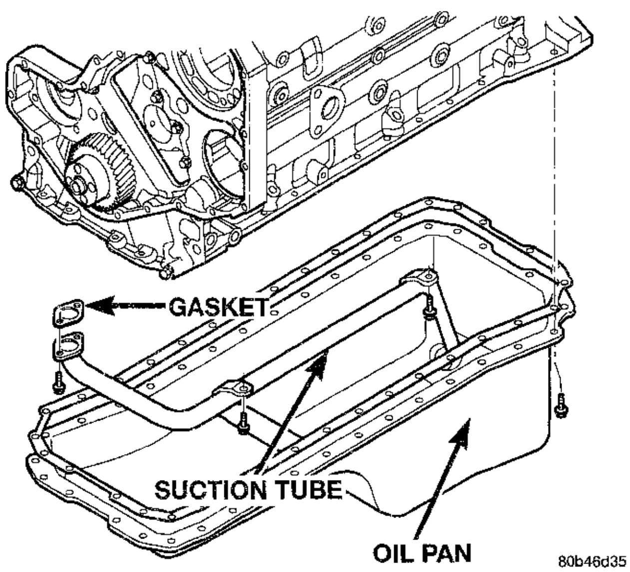


Fig. 141 Oil Pan, Suction Tube and Gasket

CLEANING

Remove all gasket material from the oil pan and cylinder block sealing surfaces. Extra effort may be required around T-joint areas. Clean oil pan and flush suction tube with a suitable solvent.

INSPECTION

Inspect the oil pan, suction tube, and tube braces for cracks and damage. Replace any defective component. Inspect the oil drain plug and drain hole threads. Inspect the oil pan sealing surface for straightness. Repair any minor imperfections with a ball-peen hammer. Do not attempt to repair an oil pan by welding.

INSTALLATION

(1) Fill the T-joint between the pan rail/gear housing and pan rail/rear seal retainer with sealant. Use Mopar® Silicone Rubber Adhesive Sealant or equivalent.

(2) Place suction tube in oil pan and guide them into place (Fig. 141). Using a new tube to oil pump gasket, install and tighten the suction tube bolts by hand. Starting with the oil pump inlet bolts, tighten the bolts to 24 N·m (18 ft. lbs.) torque. Tighten the remaining tube brace bolts to 24 N·m (18 ft. lbs.) torque.

(3) Starting in the center and working outward, tighten the oil pan bolts to 24 N·m (18 ft. lbs.) torque.

(4) Install the flywheel housing assembly with the starter motor attached and tighten bolts to 60 N·m (44 ft. lbs.) torque.

(5) Connect starter motor cables.

(6) Install transmission and transfer case (if equipped). Refer to Group 21, Transmission and Transfer Case.

(7) Lower vehicle.

(8) Install battery negative cables.

(9) Fill the crankcase with new engine oil.

(10) Start engine and check for leaks. Stop engine, check oil level, and adjust if necessary.

PISTON AND CONNECTING ROD ASSEMBLY

REMOVAL

(1) Disconnect the battery cables.

(2) Remove the cylinder head. Refer to procedure in this group.

(3) Remove the oil pan and suction tube. Refer to procedure in this group.

(4) Using the crankshaft barring tool #7471B, rotate the crankshaft so all of the pistons are below TDC.

(5) Before removing the piston(s) from the bore(s):

(a) Remove any carbon ridge formations or deposits at the top of the bore with a dull scraper or soft wire brush.

(b) If cylinder bore wear ridges are found, use a ridge reamer to cut the ridge from the bore. DO NOT remove more metal than necessary to remove the ridge.

NOTE: If cylinders have ridges, the cylinders are oversize and will more than likely need boring.

(6) Using a hammer and steel stamp, identify the front of the piston by stamping the cylinder number in each piston to be removed at the top of the piston toward the front of the engine. DO NOT stamp in the outside 5 mm (.197 in.) of the piston diameter.

REMOVAL AND INSTALLATION (Continued)

(7) Mark the connecting rod and cap with the corresponding cylinder numbers.

(8) Remove the connecting rod bolts and rod caps. Use care so the cylinder bores and connecting rods are not damaged.

(9) Use a hammer handle or similar object to push the piston and connecting rod through the cylinder bore.

(10) Store the piston/rod assemblies in a rack.

(11) If a piston must be replaced, replace with the same part number (grading) that was removed.

PISTON GRADING PROCEDURE

- If a new cylinder block and/or crankshaft is used, the piston grading procedure **MUST** be performed to determine the proper piston grade for each cylinder.
- When rebuilding an engine with the original cylinder block, crankshaft and pistons, make sure the pistons are installed in their original cylinder.
- If replacing the piston(s), make sure the replacement piston(s) are the same grade as the one being replaced.

(1) Install any of the original connecting rod and piston assemblies into the No.1 cylinder. DO NOT install the piston rings.

(2) Install the upper bearing shell in the connecting rod with the tang of the bearing in the slot of the connecting rod. The connecting rod bearing shell must be installed in the original connecting rod and cap. Use clean lubricating oil to coat the inside diameter of the connecting rod bearing shell.

(3) Install the bearing shell in the connecting rod cap with the tang of the bearing in the slot to the cap. Use clean lubricating oil to coat the inside diameter of the bearing shell.

(4) The number stamped on the connecting rod and cap at the parting line must match and be installed on the oil cooler side of the engine. Install the connecting rod cap and capscrews. Tighten the capscrews to 35 N·m (26 ft. lbs.) torque.

(5) Use a fine grit stone to remove any burrs from the cylinder block head deck. Zero the dial indicator to the cylinder block head deck.

(6) Move the dial indicator directly over the piston pin to eliminate any side-to-side movement.

(7) Rotate the crankshaft to top dead center (TDC). Rotate the crankshaft clockwise and counterclockwise to find the highest dial indicator reading. Record the reading.

(8) Remove the piston and connecting rod assembly from the No.1 cylinder and install the assembly into the No.2 cylinder. Repeat the procedure for every cylinder using the same piston and connecting rod assembly.

(9) Determine the grade of the piston being used by referring to the Piston Protrusion Chart below. Four digits on top of the piston can be cross referenced by a letter to a Chrysler part number for replacement (Fig. 142). If the number on the piston cannot be seen, use the alternate method for determining grade by measuring from the top of the piston to the top of the piston pin bore to see what grade piston is used. Refer to the illustration and chart (Fig. 143).

Ideal piston protrusion is 0.610 to 0.711 mm (0.024 to 0.028 in.)

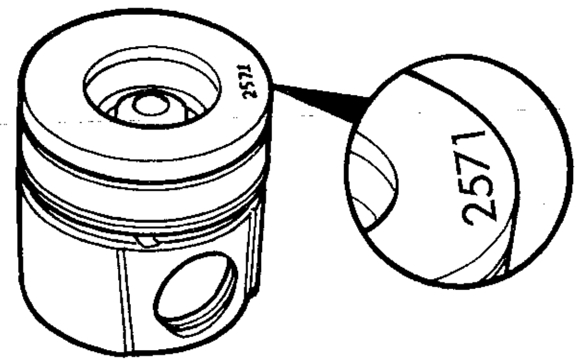


Fig. 142 Piston Grading Number Location

PISTON PROTRUSION CHART

IF MEASURING PISTON IS GRADING #:	AND PROTRUSION IS:	USE GRADE:
3708	0.609-0.711 mm (0.024-0.028 in.)	A
3708	0.508-0.609mm (0.020-0.024 in.)	B
3708	0.406-0.508 mm (0.016-0.020 in.)	C
3709	0.711-0.813 mm (0.028-0.032 in.)	A
3709	0.609-0.711 mm (0.024-0.028 in.)	B
3709	0.508-0.609 mm (0.020-0.024 in.)	C
3710	0.813-0.914 mm (0.032-0.036 in.)	A
3710	0.711-0.813 mm (0.028-0.032 in.)	B
3710	0.609-0.711 mm (0.024-0.028 in.)	C

REMOVAL AND INSTALLATION (Continued)

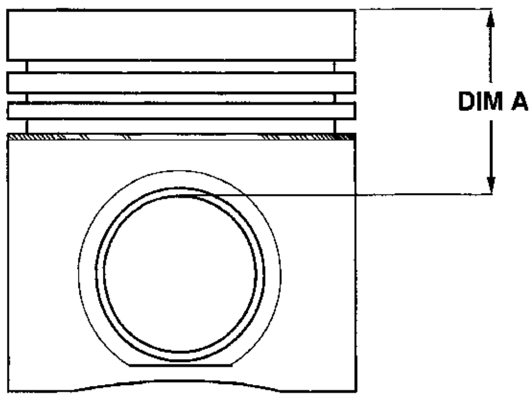


Fig. 143 Piston Grading Measurement

NOTE: Use the table below when piston grading numbers are missing or not legible.

ALTERNATIVE GRADE IDENTIFICATION METHOD

DIMENSION "A"	REF. NUMBER	GRADE
51.554-51.607 mm (2.029-2.031 in.)	3708	A
51.654-51.707 mm (2.033-2.035 in.)	3709	B
51.754-51.807 mm (2.037-2.039 in.)	3710	C

DISASSEMBLY

(1) Remove the retaining rings from the piston (Fig. 144).

(2) Slide the piston pin out of the bore. Heating the connecting rod is not required.

(3) Remove the piston rings (Fig. 151).

CLEANING

Pistons

Clean the pistons and pins in a suitable solvent, rinse in hot water and blow dry with compressed air. Soaking the pistons over night will loosen most of the carbon build up. De-carbon the ring grooves with a broken piston ring and again clean the pistons in solvent. Rinse in hot water and blow dry with compressed air.

Connecting Rods

Clean the connecting rods in a suitable solvent, rinse in hot water and blow dry with compressed air.

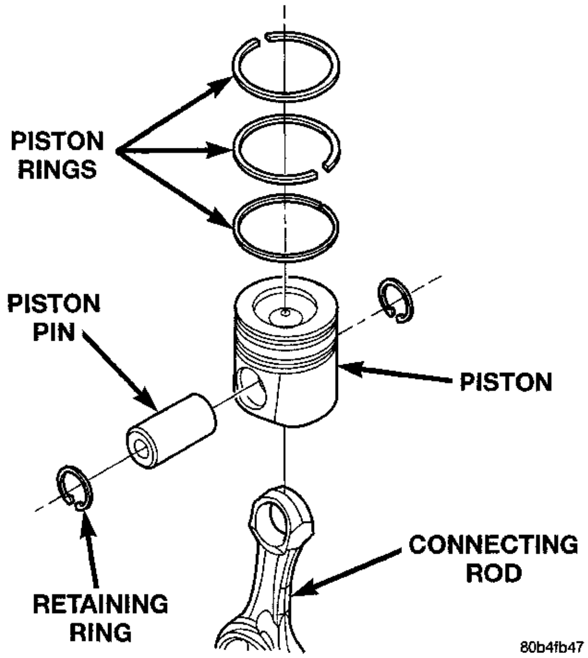


Fig. 144 Piston and Connecting Rod Assembly

INSPECTION

Pistons

Inspect the pistons for damage and excessive wear. Check top of the piston, ring grooves, skirt and pin bore. Measure the piston skirt diameter (Fig. 145). If the piston is out of limits, replace the piston.

Uses new piston rings to measure the ring side clearance (Fig. 146). Refer to the illustration and chart for specifications.

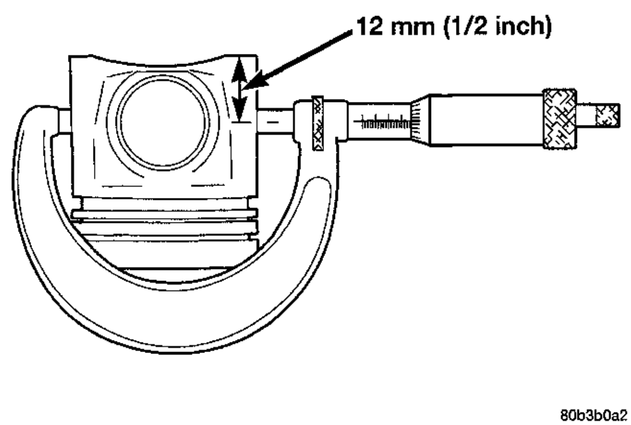


Fig. 145 Piston Skirt Diameter

PISTON SKIRT DIAMETER (MIN.)
101.864 mm (4.0104 in.)

REMOVAL AND INSTALLATION (Continued)

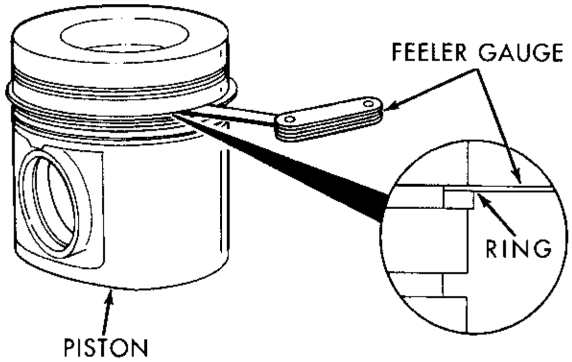


Fig. 146 Intermediate and Oil Ring Clearances

RING SIDE CLEARANCE	
TOP KEYSTONE	0.075 mm (0.003 in.) MIN 0.150 mm (0.006 in.) MAX
INTERMEDIATE	0.045 mm (0.0018 in.) MIN 0.095 mm (0.0037 in.) MAX
OIL CONTROL	0.040 mm (0.0016 in.) MIN 0.085 mm (0.0033 in.) MAX

Measure the pin bore (Fig. 147). The maximum diameter is 40.025 mm (1.5758 inch). If the bore is over limits, replace the piston.

Inspect the piston pin for nicks, gouges and excessive wear. Measure the pin diameter (Fig. 148). The minimum diameter is 39.990 mm (1.5744 inch). If the diameter is out of limits, replace the pin.

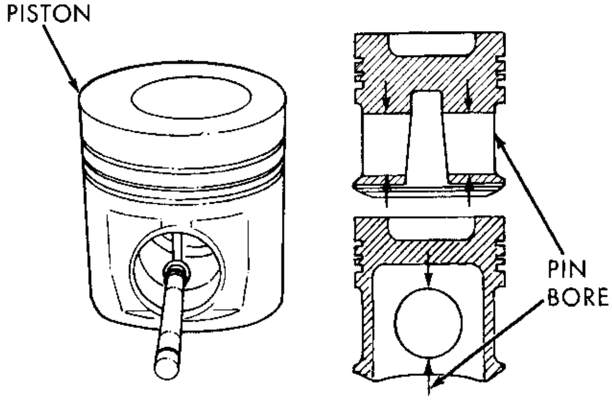


Fig. 147 Piston Pin Bore

Connecting Rods

Inspect the connecting rod for damage and wear. The I-Beam section of the connecting rod cannot have dents or other damage. Damage to this part can cause stress risers which will progress to breakage.

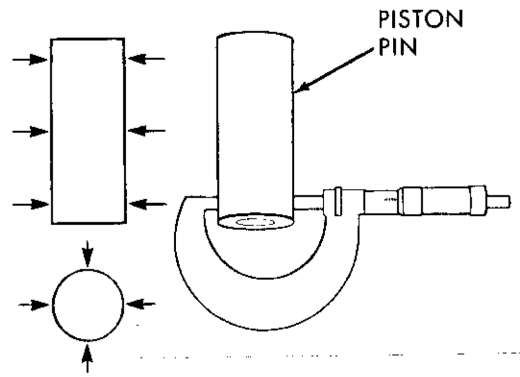


Fig. 148 Piston Pin Diameter

Measure the connecting rod pin bore (Fig. 149). The maximum diameter is 40.042 mm (1.5764 inch). If out of limits, replace the connecting rod.

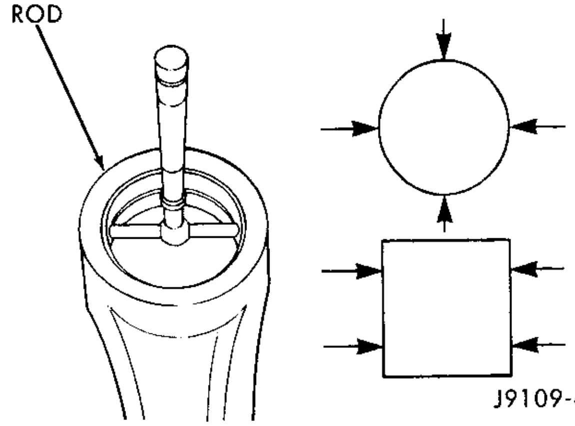


Fig. 149 Connecting Rod Pin Bore

ASSEMBLY

NOTE: The piston is symmetrical and can be installed to the connecting rod in either direction. It is good practice to re-install the piston in the same orientation as it was removed.

(1) Position the rod into the piston, orienting the mark you made on removal and the numbers on the rod and cap the same way(Fig. 150). Install the retaining ring into the pin groove on the one side of the piston.

(2) Lubricate the pin and bore with engine oil.

(3) Install the piston pin in the opposite side of the installed retaining pin. Pistons and rods do not

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REMOVAL AND INSTALLATION (Continued)

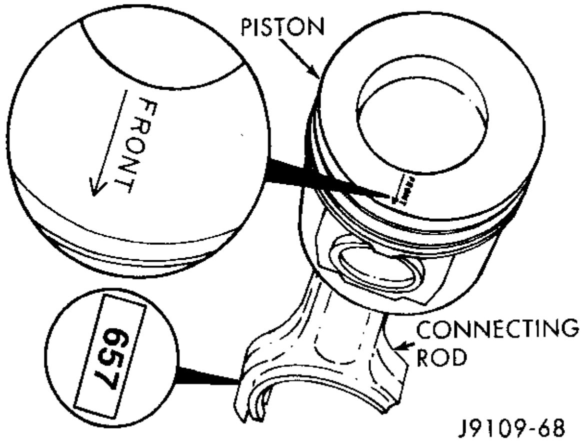


Fig. 150 Proper Markings on the Piston and Connecting Rod

require heating to install the pin, however, the piston does need to be at room temperature or above.

(4) Determine the piston diameter and obtain the appropriate ring set. The piston rings can be identified as shown in (Fig. 151).

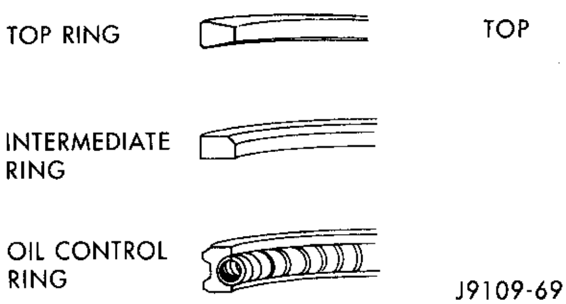


Fig. 151 Piston Ring Identification

(5) Position each ring in the cylinder and use a piston to square it with the bore at a depth of 89.0 mm (3.5 inch) - (Fig. 152).

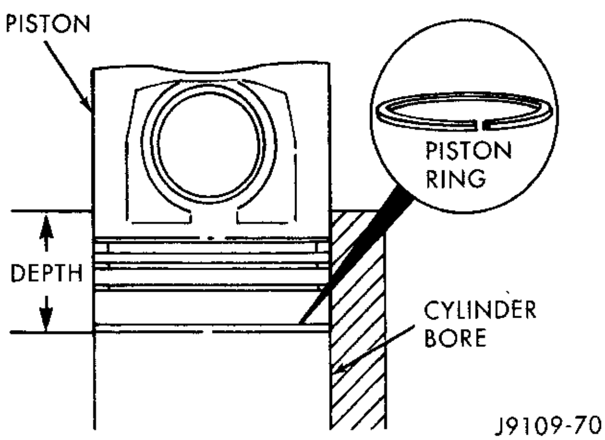
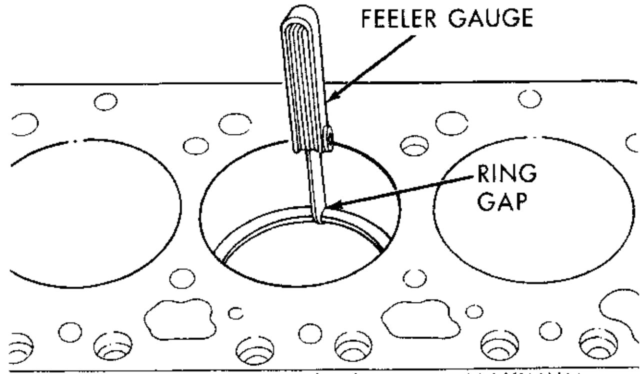


Fig. 152 Position of Ring in Cylinder Bore

(6) Use a feeler gauge to measure the piston ring gap (Fig. 153).



	MINIMUM	MAXIMUM
TOP	0.400 mm (0.0160 inch)	0.700 mm (0.0275 inch)
INTERMEDIATE	0.250 mm (0.0100 inch)	0.550 mm (0.0215 inch)
OIL CONTROL	0.250 mm (0.0100 inch)	0.550 mm (0.0215 inch)

J9109-71

Fig. 153 Piston Ring Gap

(7) The top surface of all of the rings are identified with the word TOP or the supplier's MARK. Assemble the rings with the word TOP or the supplier's MARK up.

(8) Position the oil ring expander in the oil control ring groove (bottom groove).

(9) Install the oil control ring with the end gap OPPOSITE the ends on the expander (Fig. 154).

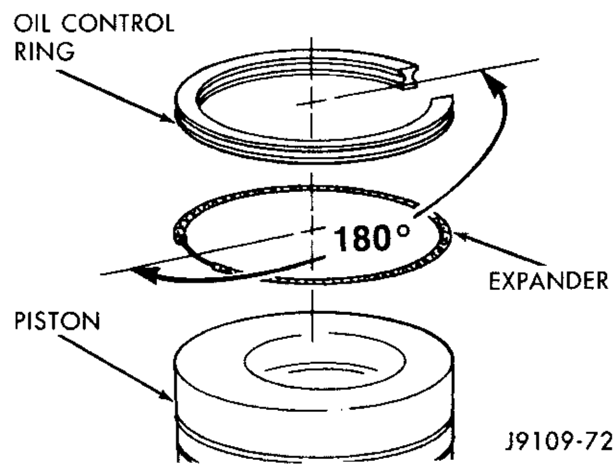


Fig. 154 Oil Control Ring/Expander Location in Groove

(10) Install the intermediate piston ring in the second groove (Fig. 152).

(11) Install the top piston ring in the top groove (Fig. 155).

(12) Position the rings as shown in (Fig. 156).

(13) Install the original bearings as removed or install new bearings. If new bearings are used, be

REMOVAL AND INSTALLATION (Continued)

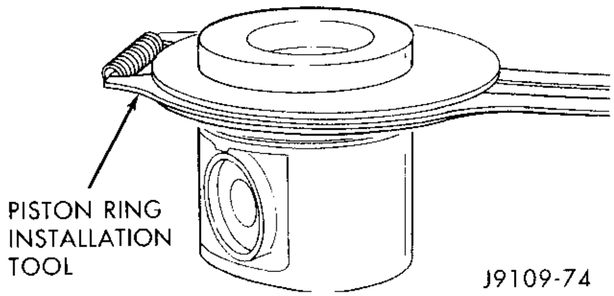


Fig. 155 Piston Ring Installation Tool

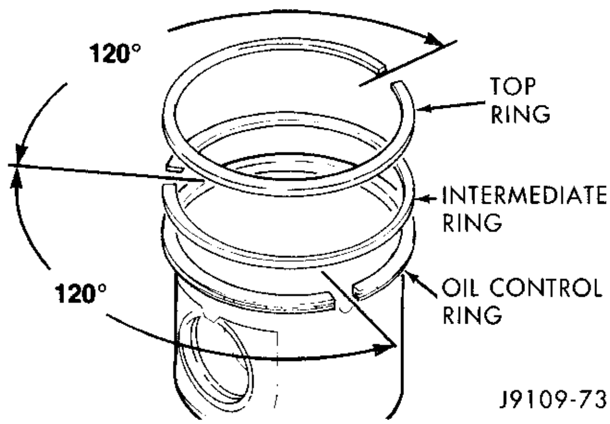


Fig. 156 Piston Ring Orientation

sure to obtain the proper bearing clearance (Fig. 157).

(14) DO NOT lubricate the side of the bearing that is against the connecting rod or cap. Apply a coat of Lubriplate 105, or equivalent to the new upper and lower connecting rod bearings.

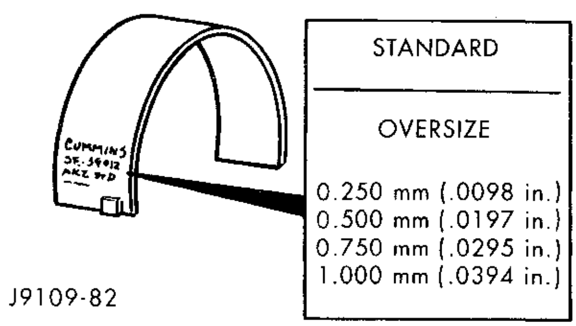


Fig. 157 Connecting Rod Bearing Size Location

INSTALLATION

(1) Lubricate the cylinder bores with clean engine oil.

(2) Generously lubricate the rings and piston skirts with clean engine oil.

(3) Compress the rings using a piston ring compressor tool (Fig. 158). If using a strap-type ring compressor, make sure the inside end of the strap does not hook on a ring gap and break the ring.

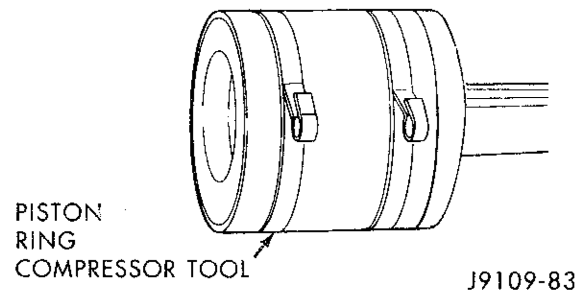


Fig. 158 Piston Ring Compressor Tool

(4) Bar the crankshaft so the rod journal for the piston to be installed is at BDC (Bottom Dead Center) - (Fig. 159).

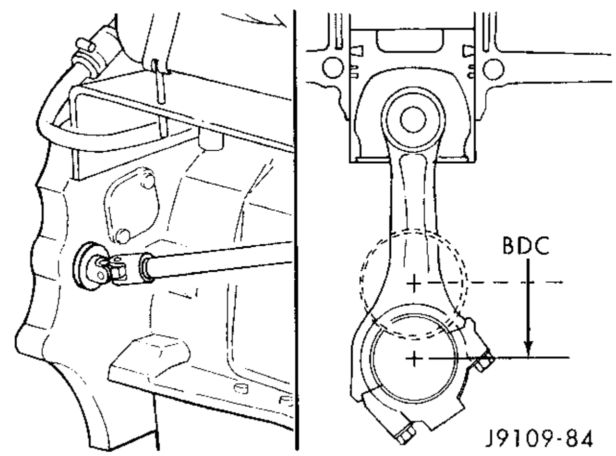


Fig. 159 Piston/Rod Assembly at BDC

(5) Be sure the mark you made on the piston and the numbers on the rod and cap are oriented as illustrated.

(6) Position the piston and rod assembly into the cylinder bore with the mark you made on the piston towards the front of the cylinder block. In this position the numbers on the connecting rod should be facing the oil cooler side of the engine, and the rod bolt holes toward the camshaft. Use care when you install the piston and connecting rod so the cylinder bore is not damaged.

(7) Push the piston into the bore until the top of the piston is approximately 50 mm (2 inch) below the top of the block. Carefully pull the connecting rod onto the crankshaft journal.

(8) Use clean engine oil to lubricate the threads and under the heads of the connecting rod bolts.

(9) The number stamped on the rod cap at the parting line must match and be installed towards the oil cooler side of the engine (Fig. 160).

(10) Install the rod cap and bolts to the connecting rod. Tighten the connecting rod and bolt evenly in 3 steps.

- Tighten the bolts to 35 N·m (26 ft. lbs.) torque.

REMOVAL AND INSTALLATION (Continued)

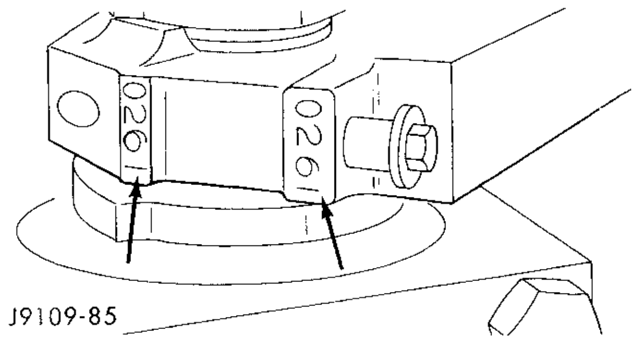
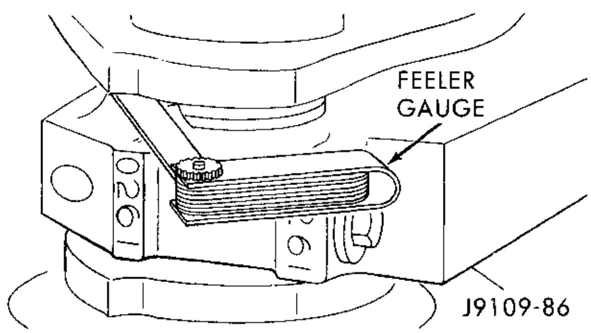


Fig. 160 Correct Rod Cap Installation

- Tighten the bolts to 70 N·m (51 ft. lbs.) torque.
- Tighten the bolts to 100 N·m (73 ft. lbs.) torque.

(11) The crankshaft must rotate freely. Check for freedom of rotation as the caps are installed. If the crankshaft does not rotate freely, check the installation of the rod bearing and the bearing size.

(12) Measure the side clearance between the connecting rod and the crankshaft (Fig. 161). DO NOT measure the clearance between the cap and crankshaft.



SIDE CLEARANCE LIMITS		
MIN.	0.100 mm	(0.004 inch)
MAX.	0.300 mm	(0.012 inch)

Fig. 161 Side Clearance between Connecting Rod/Crankshaft

(13) Install the suction tube and oil pan. Refer to Procedure in this Group.

(14) Install the cylinder head onto the engine. Refer to Procedure in this group.

(15) Install a new filter and fill the crankcase with new engine oil.

(16) Connect the battery negative cables and start engine.

CRANKSHAFT OIL SEAL—REAR

REMOVAL

(1) Disconnect the battery negative cables.

(2) Remove the transmission and transfer case (if equipped). Refer to Group 21, Transmission and transfer case for the correct procedures.

(3) Remove the clutch cover and disc (if manual trans equipped).

(4) Remove the flywheel or converter drive plate.

(5) Drill holes 180° apart into the seal. Be careful not to get the drill against the crankshaft.

(6) Install #10 sheet metal screws in the drilled holes and remove the rear seal with a slide hammer (Fig. 162).

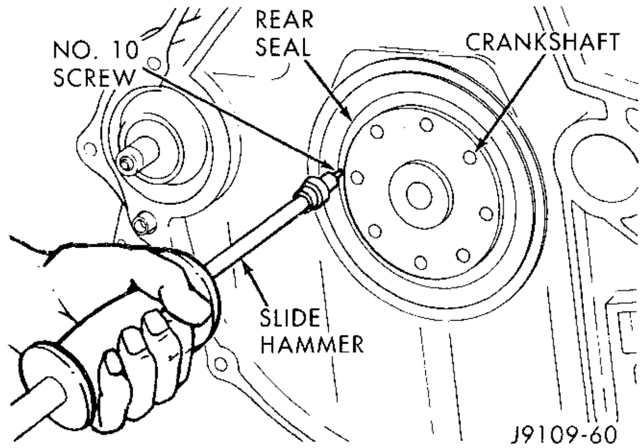


Fig. 162 Crankshaft Rear Seal Removal

CLEANING

Clean the cranshaft journal with a suitable solvent and dry with a clean shop towel or compressed air. Wipe the inside bore of the crankshaft seal retainer with a clean shop towel.

INSPECTION

Inspect the crankshaft journal for gouges, nicks, or other imperfections. If the seal groove in the crankshaft is excessively deep, install the new seal 1/8" deeper into the retainer bore, or obtain a crankshaft wear sleeve that is available in the aftermarket.

INSTALLATION

CAUTION: The seal lip and the sealing surface on the crankshaft must be free from all oil residue to prevent seal leaks. The crankshaft and seal must be completely dry when the seal is installed.

(1) Install the seal pilot, provided in the replacement kit, onto the crankshaft.

(2) Using the provided alignment/installation tool, start the seal over the pilot and into the retainer by hand.

(3) Using a ball peen hammer, strike the tool at the 12, 3, 6, and 9 o'clock positions until the alignment tool bottoms out on the retainer (Fig. 163).

(4) Remove the seal pilot.

REMOVAL AND INSTALLATION (Continued)

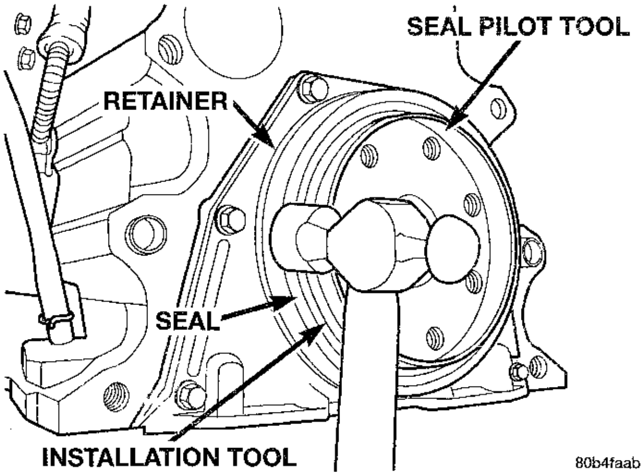


Fig. 163 Seal Installation using Alignment Tool and Hammer

(5) Install the flywheel or converter drive plate. Tighten the bolts to 137 N·m (101 ft. lbs.) torque.

(6) Install the clutch cover and disc (if equipped). Refer to Group 6, Clutch for the correct procedures.

(7) Intsall the transmission and transfer case (if equipped). Refer to Group 21, Transmission and Transfer Case for the correct procedures.

(8) Lower vehicle.

(9) Connect battery negative cables.

(10) Check engine oil level and adjust, if necessary.

(11) Start engine and check for oil leaks.

CRANKSHAFT REAR SEAL RETAINER

REMOVAL

(1) Disconnect the battery negative cables.

(2) Raise vehicle on hoist.

(3) Remove the oil pan drain plug and drain the engine oil. Re-install plug and torque to 60 N·m (44 ft. lbs.) torque.

(4) Remove transmission and transfer case (if equipped) from vehicle, refer to Group 21, Transmission and Transfer Case.

(5) Remove flywheel or torque converter drive plate.

(6) Disconnect starter cables from starter motor.

(7) Remove starter motor and transmission adapter plate assembly.

(8) Disconnect cables from starter motor.

(9) Remove the eight flywheel housing to block bolts and remove housing and starter motor as an assembly.

(10) Remove oil pan bolts, break the pan to block seal, and lower pan slightly and remove oil suction tube fasteners.

(11) Remove oil pan and suction tube (Fig. 164).

(12) Remove the six (6) retainer-to-block bolts (Fig. 165).

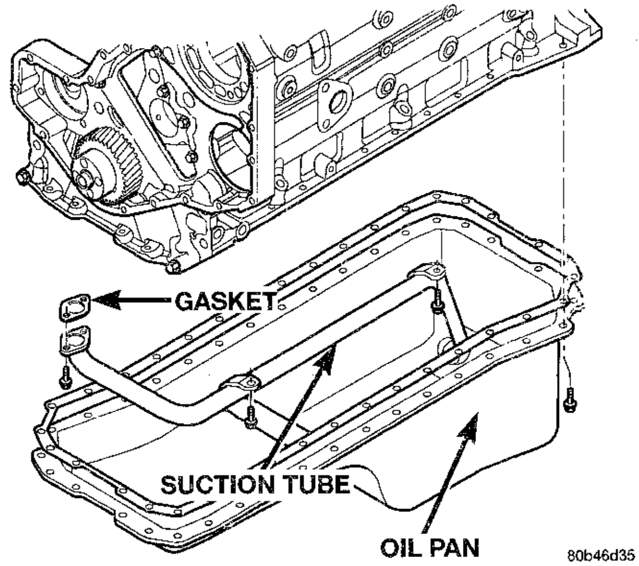


Fig. 164 Oil Pan, Suction Tube and Gasket

(13) Remove the rear seal retainer and gasket (Fig. 165).

(14) Support the seal retainer and drive out the crankshaft seal with a hammer and suitable punch.

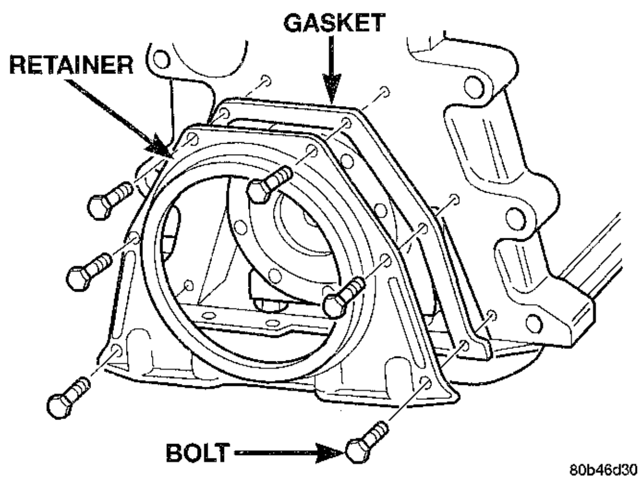


Fig. 165 Crankshaft Rear Seal Housing and Gasket

CLEANING

Clean the cylinder block and seal retainer gasket surfaces with a suitable scraper. Use care not to allow any gasket material to fall into the crankcase. Clean and dry the crankshaft sealing surface. **The seal lip and the sealing surface on the crankshaft must be free from all oil residue to prevent seal leaks.**

INSPECTION

Inspect the crankshaft flange for nicks or an excessively deep seal groove. Inspect the seal retainer for cracks and replace if necessary.

REMOVAL AND INSTALLATION (Continued)

INSTALLATION

(1) If using the old seal retainer, it is recommended that the crankshaft seal is replaced. Support the seal retainer and drive out the old seal.

(2) Using the retainer alignment/seal installation tool provided in the seal service kit, install the alignment tool into the retainer and install to the cylinder block (Fig. 166), using a new gasket. Tighten the six (6) mounting bolts by hand.

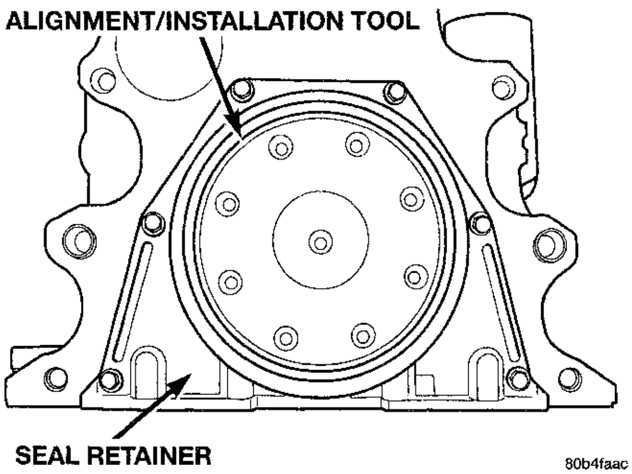


Fig. 166 Aligning Seal Retainer with Alignment/ Installation

(3) Starting with the center two bolts, tighten the retainer in a circular pattern to 9 N·m (80 in. lbs.). Remove the alignment tool.

NOTE: Install the crankshaft seal dry, with no lubrication on either the inside or outside diameters.

(4) Make sure the provided seal pilot is installed into the new crankshaft seal. Use the alignment/installation tool and press the seal onto the crankshaft (Fig. 167). Alternately drive the seal at the 12, 3, 6 and 9 o'clock positions.

(5) Remove the alignment tool and trim the retainer gasket even with the oil pan mounting surface (Fig. 168).

(6) Remove the seal pilot.

(7) Apply a small amount of Mopar® Silicone Rubber Adhesive Sealant to the oil pan rail T-joints.

(8) Install the oil pan, suction tube and gaskets. Tighten the suction tube fasteners to 24 N·m (18 ft. lbs.). Tighten the oil pan mounting bolts, starting from the center and working outward, to 24 N·m (18 ft. lbs.) torque.

(9) Install the flywheel housing and bolts. Tighten the bolts to 60 N·m (44 ft. lbs.) torque.

(10) Connect the starter motor wires.

(11) Install the flywheel or converter drive plate. Tighten bolts to 137 N·m (101 ft. lbs.)

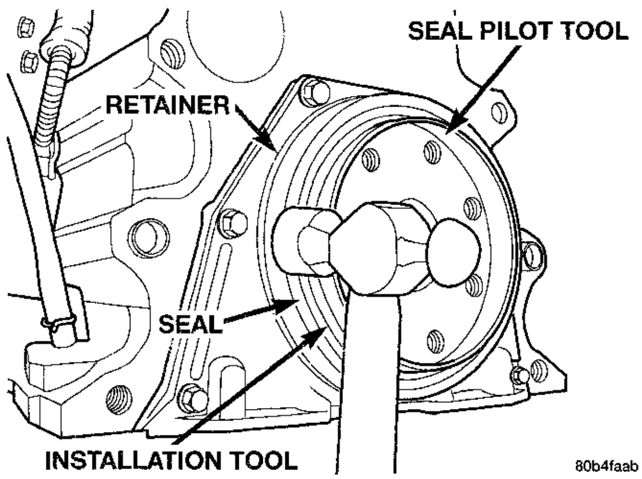


Fig. 167 Installing Seal Using Alignment/Installation Tool

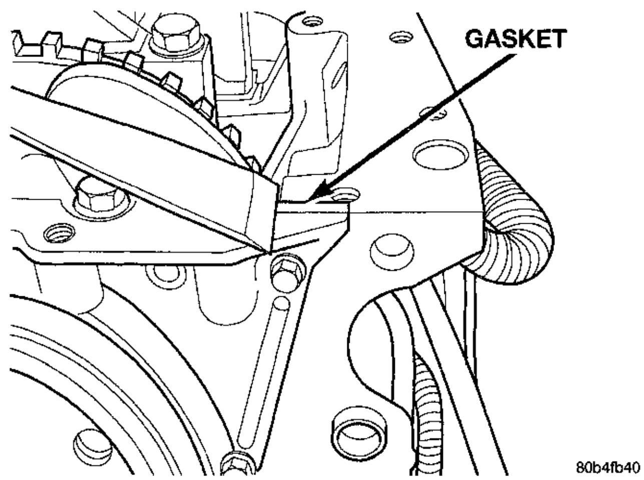


Fig. 168 Trimming Excess Gasket Material

(12) Install the transmission and transfer case (if equipped). Refer to Group 21, Transmission and Transfer Case for the correct procedures.

(13) Lower vehicle.

(14) Fill the crankcase with new engine oil.

(15) Connect the battery negative cables.

(16) Start engine and check for oil leaks.

CRANKSHAFT

REMOVAL

(1) Remove engine from vehicle and place on a stand. Refer to procedure in this group.

(2) Remove oil pan and suction tube. Refer to procedure in this group.

(3) Remove the crankshaft rear seal retainer. Refer to procedure in this group.

(4) Remove the front gear housing. Refer to procedure in this group.

(5) The main bearing caps should be numbered. If they are not, be sure to mark them, beginning with

REMOVAL AND INSTALLATION (Continued)

number one at the front and ending with number seven at the rear (Fig. 169).

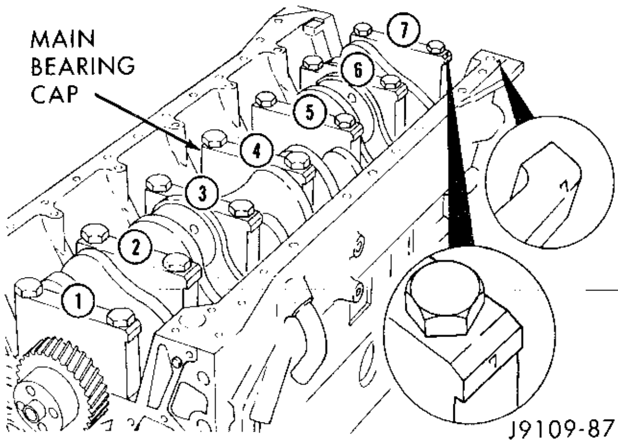


Fig. 169 Numbering Main Bearing Caps

CAUTION: DO NOT pry on the main caps to free them from the cylinder block.

(6) Use two of the main bearing cap bolts to wiggle the main cap loose (Fig. 170), being careful not to damage the bolt threads. Remove all caps in the same manner.

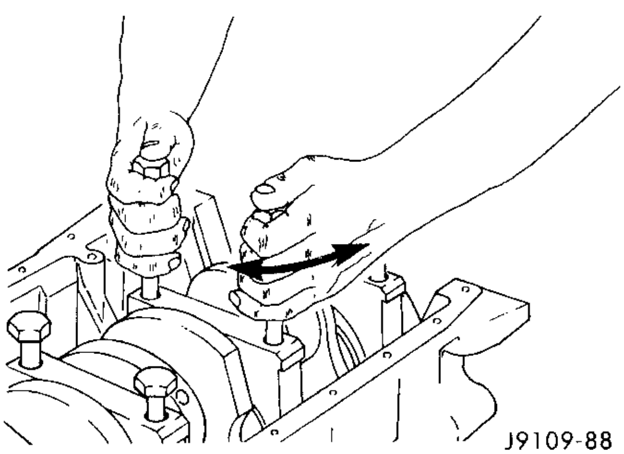


Fig. 170 Main Bearing Cap Removal

WARNING: USE A HOIST TO AVOID INJURY.

(7) Lift the crankshaft and gear from the cylinder block (Fig. 171).

(8) Remove the main bearings from the block and the main caps.

(9) Remove the piston cooling nozzles by using a 3/16 inch pin punch to push them out (Fig. 172).

CLEANING

Clean the crankshaft oil galley holes with a nylon brush.

Rinse in clean solvent and dry with compressed air.

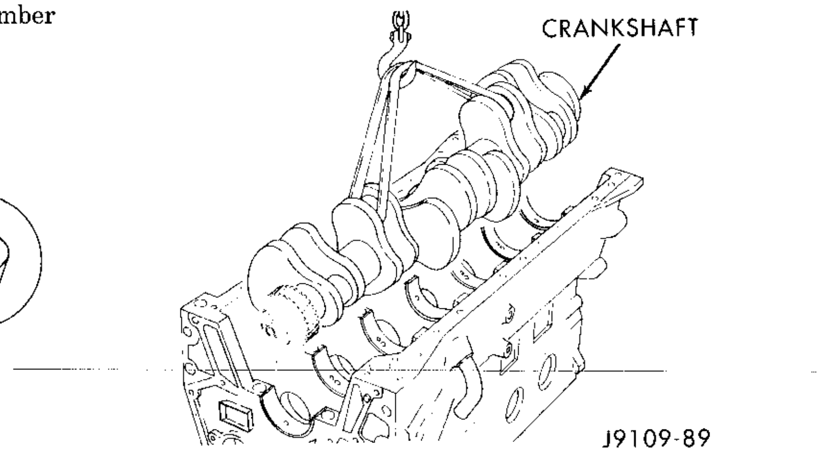


Fig. 171 Lifting Crankshaft Out of Cylinder Block

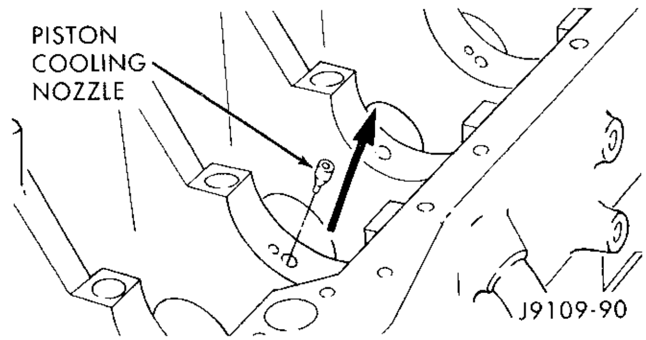


Fig. 172 Piston Cooling Nozzles

INSPECTION

Inspect the rod and main journal for deep scores, signs of overheating and other abnormal marks. Inspect the front and rear seal contact areas of the crankshaft for scratches or grooving.

The service seal kit will position the seal slightly deeper into the seal bore so it will contact the crankshaft at a different location. If this has already been done and the crankshaft has two worn areas, install a wear sleeve to provide a new contact surface for the seal.

(1) Visually inspect the tone wheel for missing teeth, cracks, and out-of-round.

NOTE: For additional crankshaft procedures, refer to "Crankshaft Service" in the Service Procedures section of this group.

INSTALLATION

CAUTION: Use only hand force to push the nozzle in place. If driven with a hammer, the nozzle will be damaged.

AUTHENTIC RESTORATION PRODUCT

REMOVAL AND INSTALLATION (Continued)

(1) Use a center punch to push the piston cooling nozzle into place. Install nozzles so they are flush with or slightly below the saddle surface.

(2) Make sure the saddle surface is clean and dry. Install the upper main bearings.

(3) Install the combination thrust/main bearing in the number six main bearing location.

(4) Lubricate the bearings with Lubriplate 105, or equivalent.

WARNING: TO AVOID INJURY, USE A HOIST TO INSTALL THE CRANKSHAFT.

(5) If replacing the crankshaft, transfer the tone wheel to the new crankshaft.

(a) Install the large section of the tone wheel.

(b) Coat the bolts with Mopar® Lock 'N Seal or Loctite® 242, install and torque to 8 N·m (71 in. lbs.) torque.

(c) Rotate the crankshaft and install the small section of the tone wheel.

(d) Coat the bolts with Mopar® Lock 'N Seal or Loctite® 242, install and torque to 8 N·m (71 in. lbs.) torque.

(6) Install the crankshaft.

CAUTION: Crankshaft must be lowered onto the bearings straight to prevent damage to thrust bearings.

(7) Install the ring dowels in the main bearing caps (Fig. 173).

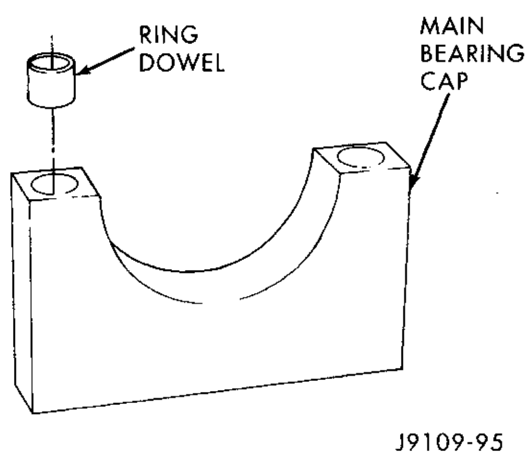


Fig. 173 Install Ring Dowels

(8) Install the lower main bearings in the caps.

(9) Lubricate the bearings with Lubriplate, or equivalent.

(10) Numbers on the main bearings caps face the oil cooler side of the engine with number one at the front of the engine.

(11) Place the caps in their respective positions.

(12) Lubricate the main bearing bolt threads and underside of the bolt head with clean engine oil.

(13) Tighten the bolts in the sequence shown in (Fig. 174)using the following steps:

- STEP 1—Torque all bolts in sequence to 60 N·m (44 ft. lbs.) torque.
- STEP 2—Torque all bolts in sequence to 119 N·m (88 ft. lbs.) torque.
- STEP 3—Torque all bolts in sequence to 176 N·m (129 ft. lbs.) torque.

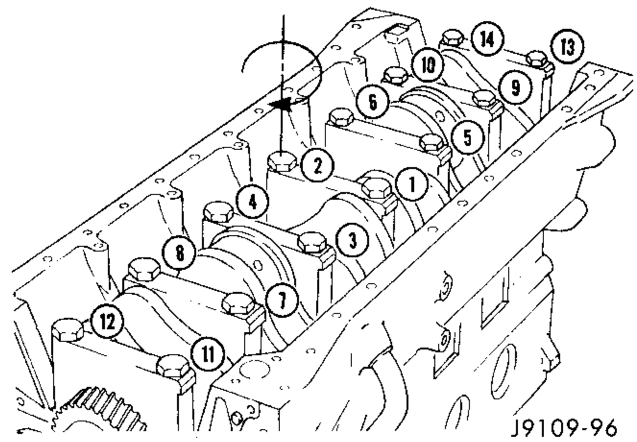


Fig. 174 Crankshaft Main Bearing Bolt Torque Sequence

(14) Turn the crankshaft to determine that it will rotate freely all 360°. Check the main bearing cap installations and/or the bearing sizes if the shaft does not turn easily.

(15) **Verify crankshaft end play:** Push the crankshaft towards one end of its thrust and place a dial indicator as shown in (Fig. 175). Zero the indicator needle and push the crankshaft towards the other end of its thrust and record the crankshaft end clearance (Fig. 176).

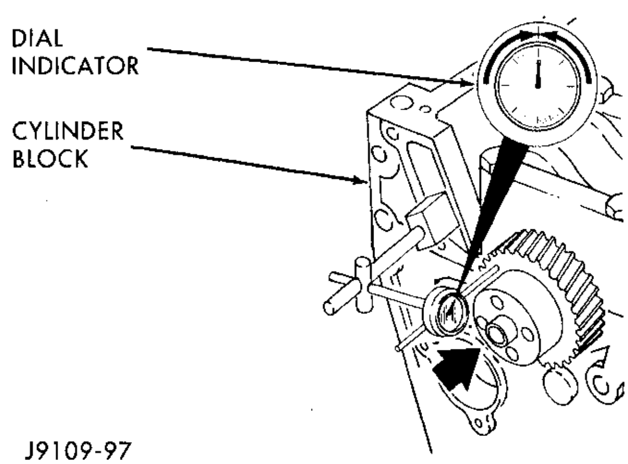


Fig. 175 Measuring Crankshaft End Play

REMOVAL AND INSTALLATION (Continued)

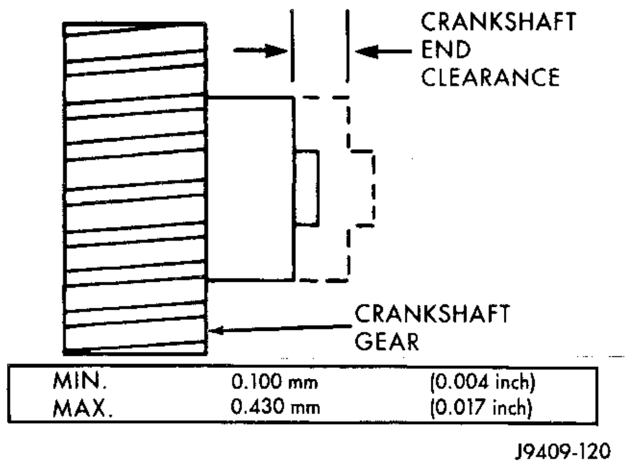


Fig. 176 Crankshaft End Clearance

CRANKSHAFT END PLAY SPECIFICATIONS

MIN	0.100 mm (0.004 in.)
MAX	0.430 mm (0.017 in.)

(16) Install the front gear housing. Refer to procedure in this group.

(17) Install the crankshaft rear oil seal retainer. Refer to procedure in this group.

(18) Install the oil pan and suction tube. Refer to procedure in this group.

(19) Install engine into vehicle. Refer to procedure in this group.

CRANKSHAFT TONE WHEEL

REMOVAL

(1) Disconnect the battery negative cables.

(2) Remove the oil pan and suction tube. Refer to procedure in this group.

(3) Using the crankshaft barring tool #7471B, rotate the crankshaft so the small section of the ring is facing away from the engine.

(4) Remove the #6 main bearing cap.

(5) Remove the two bolts fastening the small section of the wheel to the crankshaft. Remove the small section (Fig. 177).

(6) Using the barring tool, rotate the crankshaft and remove the three bolts from the large section of the tone wheel.

(7) Rotate the large section of the ring off of the crankshaft (Fig. 178). The crankshaft might have to be rotated to allow clearance for removal.

CLEANING

Clean the tone wheel with a suitable solvent. Rinse with hot water and blow dry with compressed air. Make sure the mounting surface of the wheel and crankshaft are free of all debris.

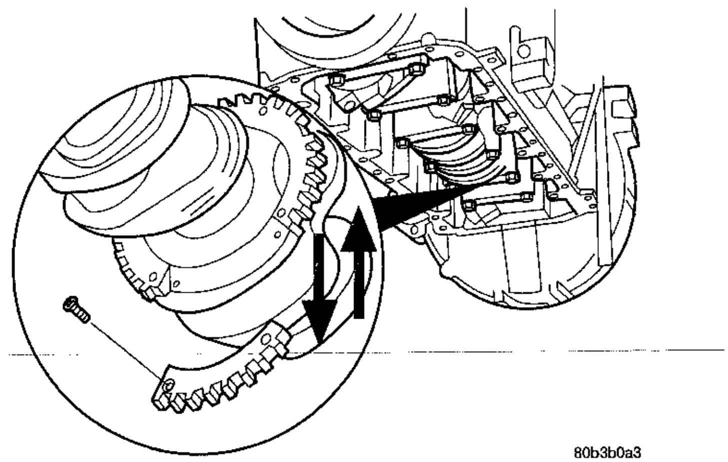


Fig. 177 Removing/Installing Small Section of Tone Wheel

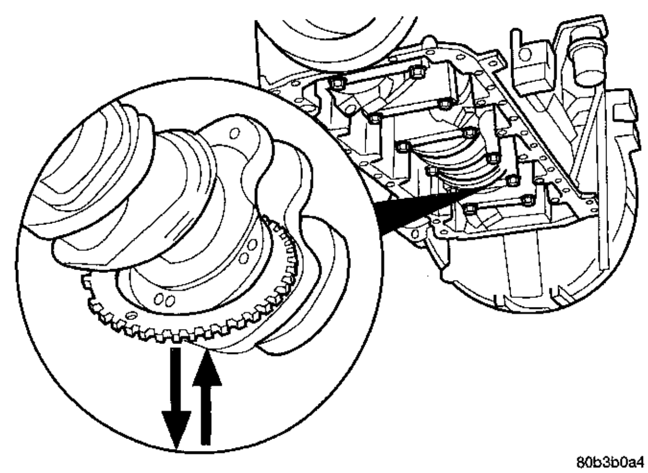


Fig. 178 Removing Installing Large Section of Tone Wheel

INSPECTION

Inspect the tone wheel for missing teeth, cracks, or a damaged mounting surface (Fig. 179). Place the wheel on a known flat surface and verify that it is not out of flat. Replace the tone wheel if any of these conditions are found.

INSTALLATION

(1) Install the large section of the tone wheel.

(2) Coat the bolts with Mopar® Lock 'N Seal or Loctite® 242, install and torque to 8 N·m (71 in. lbs.) torque.

(3) Rotate the crankshaft and install the small section of the tone wheel.

(4) Coat the bolts with Mopar® Lock 'N Seal or Loctite® 242, install and torque to 8 N·m (71 in. lbs.) torque.

(5) Install the #6 main bearing cap. Install the bolts and torque in three steps:

REMOVAL AND INSTALLATION (Continued)

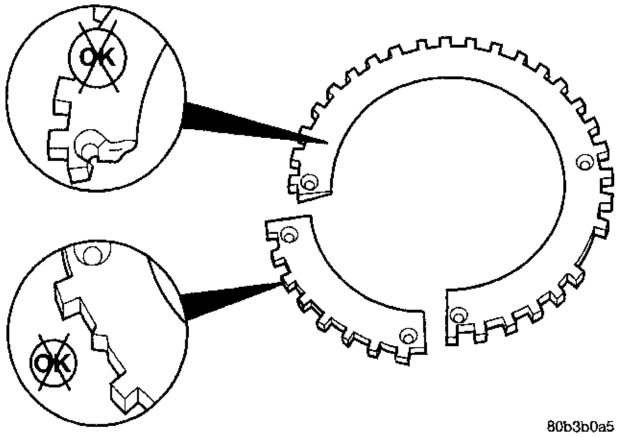


Fig. 179 Inspecting Tone Wheel for Damage

Step 1—Preliminary . . . . 60 N·m (44. ft. lbs.)
Step 2—Secondary . . . . 119 N·m (88 ft. lbs.)
Step 3—Final . . . . 176 N·m (129 ft. lbs.)

(6) Using a new gasket, install the oil pan and suction tube. Refer to procedure in this group.
(7) Add engine oil.
(8) Connect the battery negative cables and start engine.

OIL PRESSURE SENSOR

REMOVAL

(1) Disconnect the battery negative cables.
(2) Disconnect the oil pressure sensor connector (Fig. 180).
(3) Using a suitable socket, remove the oil pressure sensor from the block (counter-clockwise).

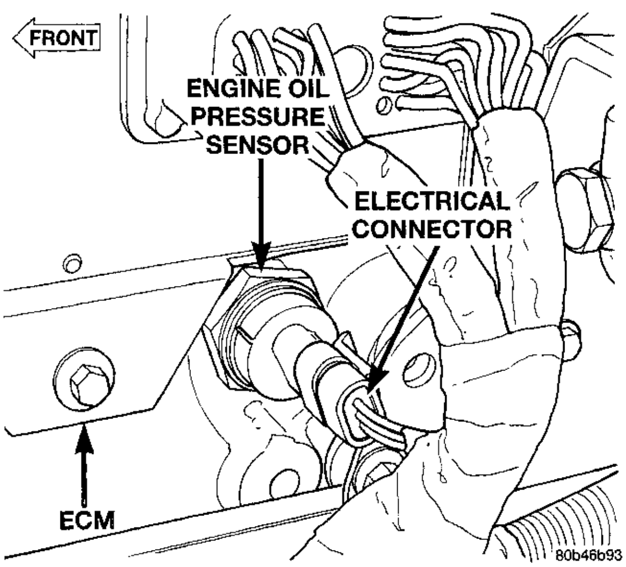


Fig. 180 Oil Pressure Sensor Location

INSTALLATION

(1) If the sensor is not being replaced, inspect the o-ring (Fig. 181) and replace if necessary.
(2) Install the oil pressure sensor and tighten to 16 N·m (144 in. lbs.) torque.
(3) Connect the battery negative cables.
(4) Start engine and check for oil leaks at the sensor.

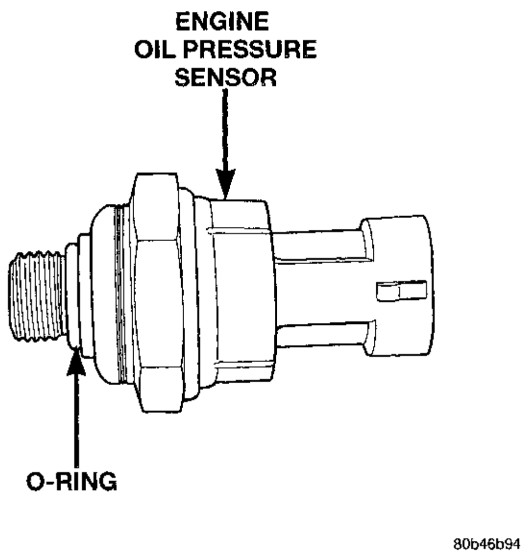


Fig. 181 Oil Pressure Sensor and O-Ring

OIL PRESSURE REGULATOR VALVE AND SPRING

REMOVAL

(1) Disconnect the battery negative cables.
(2) Remove the threaded plug, spring and plunger (Fig. 182). Insert a finger or a seal pick to lift the plunger from the bore.

NOTE: If the plunger is stuck in the bore, it will be necessary to remove the filter head.

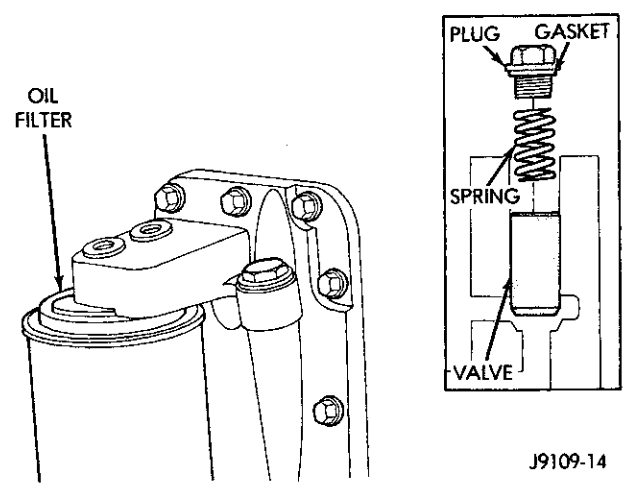


Fig. 182 Oil Pressure Regulator

REMOVAL AND INSTALLATION (Continued)

CLEANING

(1) Clean the regulator spring and plunger with a suitable solvent and blow dry with compressed air. If the plunger bore requires cleaning, it is necessary to remove the oil filter head to avoid getting debris into the engine.

INSPECTION

Inspect the plunger and plunger bore for cracks and excessive wear. Polished surfaces are acceptable. Verify that the plunger moves freely in the bore.

Check the spring for height and load limitations (Fig. 183). Replace the spring if out of limits shown in the figure.

Inspect the plug o-ring for cracks or brittleness, and replace as necessary.

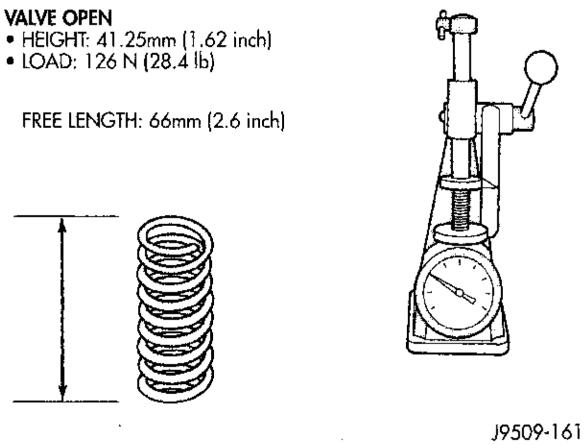


Fig. 183 Oil Pressure Regulator Spring Check

INSTALLATION

(1) Install the plunger, spring, and plug as shown in (Fig. 183). Tighten the plug to 80 N·m (60 ft. lbs.) torque.

(2) Connect the battery negative cables.

(3) Start the engine and verify that it has oil pressure.

OIL PUMP

REMOVAL

(1) Disconnect the battery negative cables.

(2) Remove fan/drive assembly.

(3) Remove the accessory drive belt.

(4) Remove the fan support/hub assembly.

(5) Remove crankshaft damper (Fig. 184).

(6) Remove the gear cover-to-housing bolts and gently pry the cover away from the housing, taking care not to mar the gasket surfaces (Fig. 185).

(7) Remove the four mounting bolts and pull the pump from the bore in the cylinder block (Fig. 186).

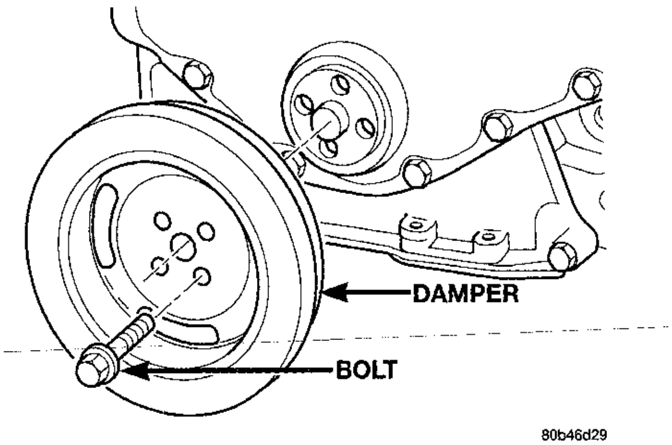


Fig. 184 Crankshaft Damper Removal/Installation

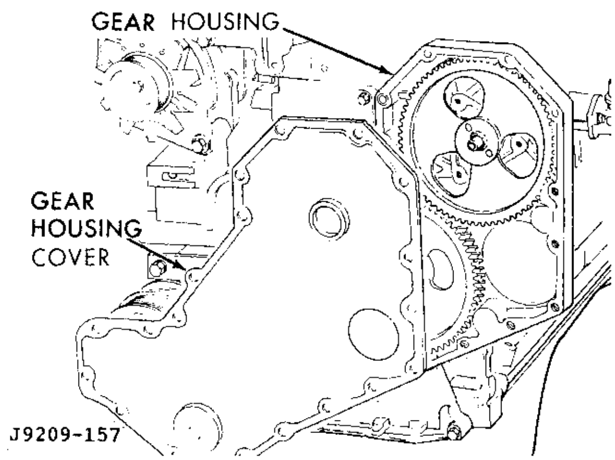


Fig. 185 Gear Housing and Cover

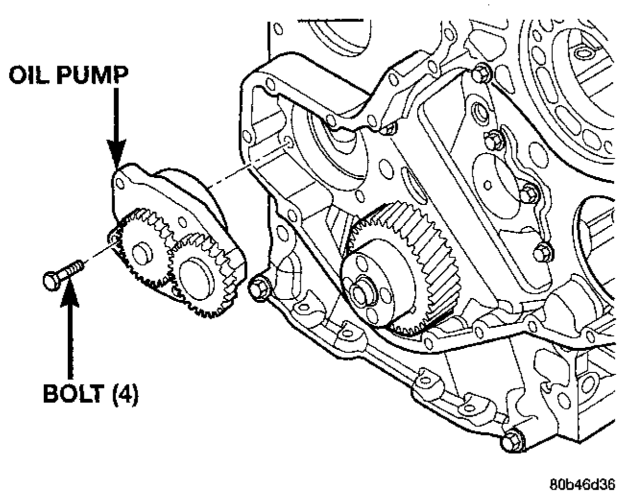


Fig. 186 Oil Pump Removal

REMOVAL AND INSTALLATION (Continued)

CLEANING

Clean all parts in solvent and dry with compressed air. Clean the old sealer residue from the back of the gear housing cover and front of the gear housing.

INSPECTION

Disassemble and inspect the oil pump as follows:

(1) Visually inspect the lube pump gears for chips, cracks or excessive wear.

(2) Remove the back plate (Fig. 187).

(3) Mark TOP on the gerotor planetary using a felt tip pen (Fig. 187).

(4) Remove the gerotor planetary (Fig. 187). Inspect for excessive wear or damage. Inspect the pump housing and gerotor drive for damaged and excessive wear.

(5) Install the gerotor planetary in the original position. The chamfer must be on the O.D. and down.

(6) Measure the tip clearance (Fig. 188). Maximum clearance is 0.1778 mm (0.007 inch). If the oil pump is out of limits, replace the pump.

(7) Measure the clearance of the gerotor drive/gerotor planetary to port plate (Fig. 189). Maximum clearance is 0.127 mm (0.005 inch). If the oil pump is out of limits, replace the pump.

(8) Measure the clearance of the gerotor planetary to the body bore (Fig. 190). Maximum clearance is 0.381 mm (0.015 inch). If the oil pump is out of limits, replace the pump.

(9) Measure the gears backlash (Fig. 191). The limits of a used pump is 0.080- 0.380 mm (0.003-0.015 inch). If the backlash is out of limits, replace the oil pump.

(10) Install the back plate.

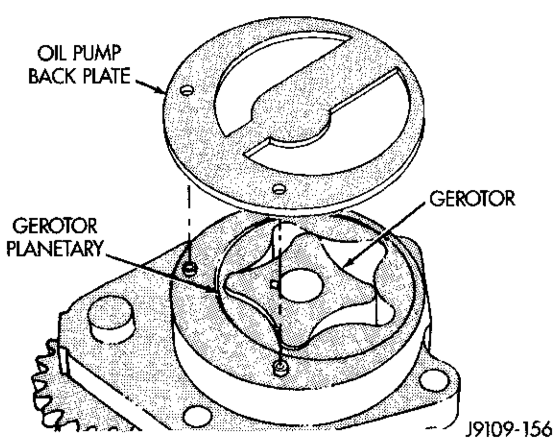


Fig. 187 Gerotor Planetary and Gerotor

INSTALLATION

(1) Lubricate the pump with clean engine oil. Filling the pump with clean engine oil during installation will help to prime the pump at engine start up.

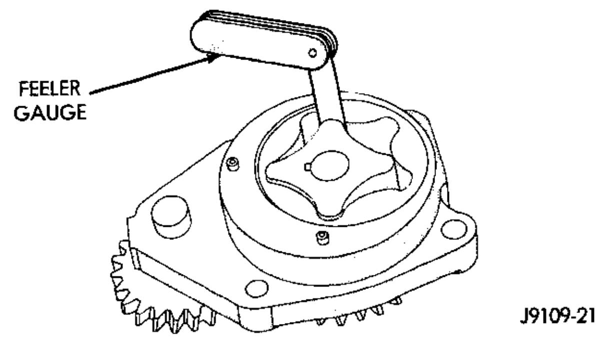


Fig. 188 Measuring Tip Clearance

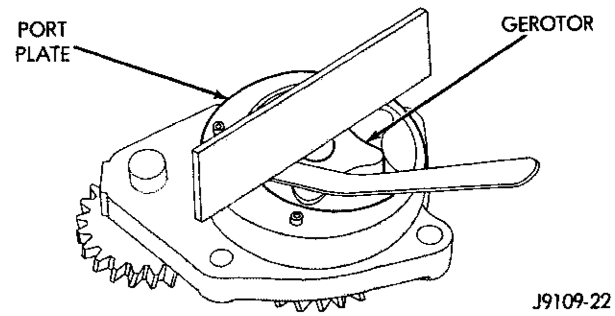


Fig. 189 Measuring Gerotor to Port Plate Clearance

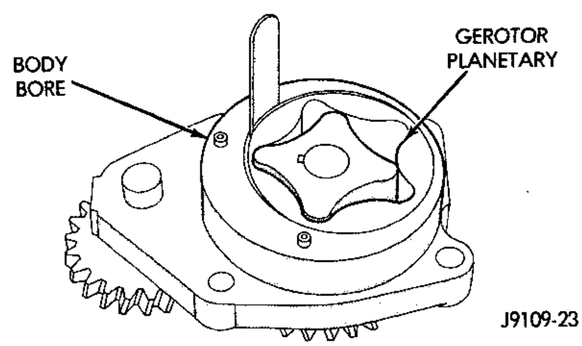


Fig. 190 Measuring Gerotor Planetary to Body Bore Clearance

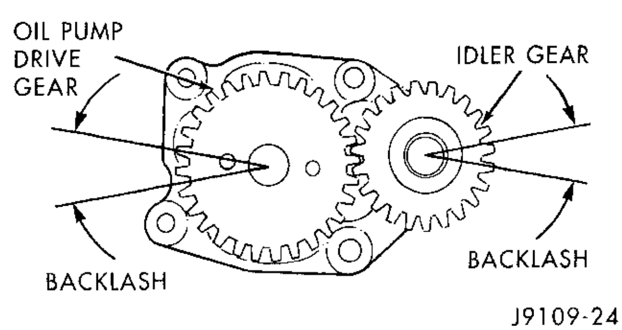


Fig. 191 Measure Gear Backlash

(2) Verify the idler gear pin is installed in the locating bore in the cylinder block.

REMOVAL AND INSTALLATION (Continued)

(3) Install the pump (Fig. 186). Tighten the oil pump mounting bolts in two steps, in the sequence shown in (Fig. 192).
- Step 1—Tighten to 5 N·m (44 in. lbs.) torque.
- Step 2—Tighten to 24 N·m (18 ft. lbs.) torque.

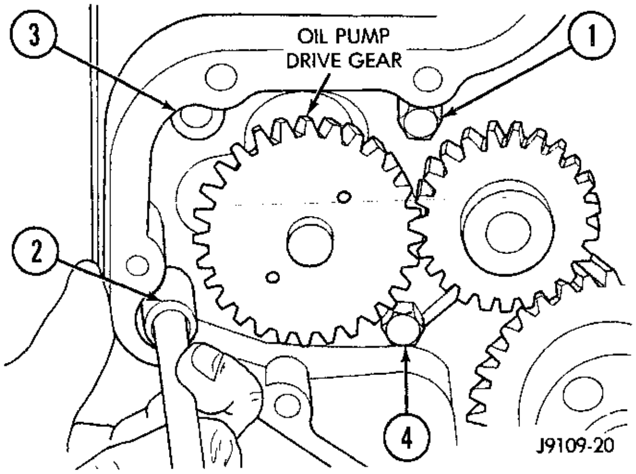


Fig. 192 Oil Pump Mounting Bolt Torque Sequence

(4) The back plate on the pump seats against the bottom of the bore in the cylinder block. When the pump is correctly installed, the flange on the pump will not touch the cylinder block.

(5) Measure the idler gear to pump drive gear backlash and the idler gear to crankshaft gear backlash (Fig. 193). The backlash should be 0.080- 0.330 mm (0.003-0.013 inch). If the backlash is out of limits, replace the oil pump drive gear and the idler gear.

(6) If the adjoining gear moves when you measure the backlash, the reading will be incorrect.

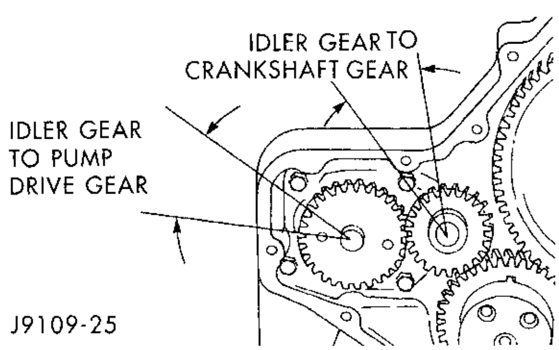


Fig. 193 Idler Gear to Pump Drive Gear and Crankshaft Gear Backlash

(7) Apply a bead of Mopar® Silicone Rubber Adhesive Sealant or equivalent to the gear housing cover sealing surface.

(8) Install the gear housing cover and tighten to 24 N·m (18 ft. lbs.) torque.

(9) Install the vibration damper and torque the bolts to 125 N·m (92 ft. lbs.). Use the engine barring tool to keep the engine from rotating during tightening operation.

(10) Install the fan support/hub assembly and torque bolts to 24 N·m (18 ft. lbs.).

(11) Install the accessory drive belt. Refer to Group 7, Cooling for the correct procedure.

(12) Connect battery negative cables.

(13) Start engine and check for oil leaks.

VACUUM PUMP

REMOVAL

(1) Disconnect battery negative cables.

(2) Position drain pan under power steering pump.

(3) Disconnect vacuum and steering pump hoses.

(4) Disconnect lubricating oil feed line from fitting at underside of vacuum pump (Fig. 194).

(5) Remove lower bolt that attaches pump assembly to engine block (Fig. 195).

(6) Remove bottom, inboard nut that attaches adapter to steering pump. This nut secures a small bracket to engine block. Nut and bracket must be removed before pump assembly can be removed from block.

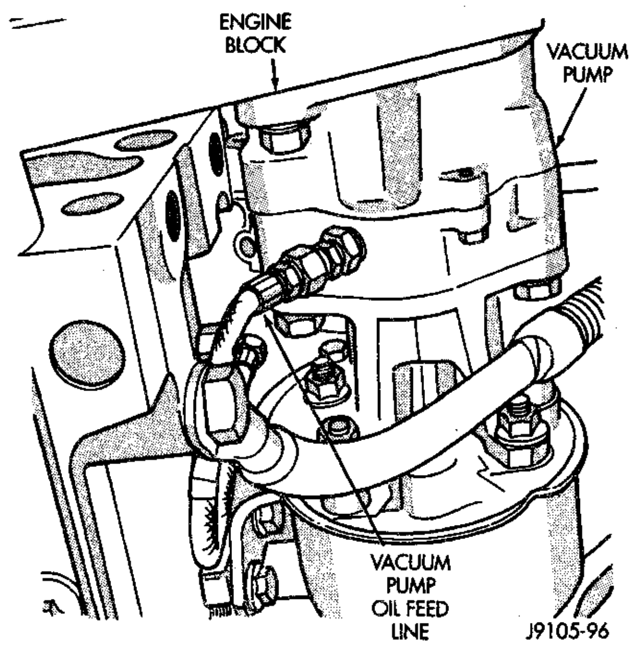


Fig. 194 Vacuum Pump Oil Feed Line

(7) Remove upper bolt that attaches pump assembly to engine block (Fig. 196).

(8) Remove pump assembly from vehicle.

(9) Remove nuts attaching vacuum pump to adapter (Fig. 197).

REMOVAL AND INSTALLATION (Continued)

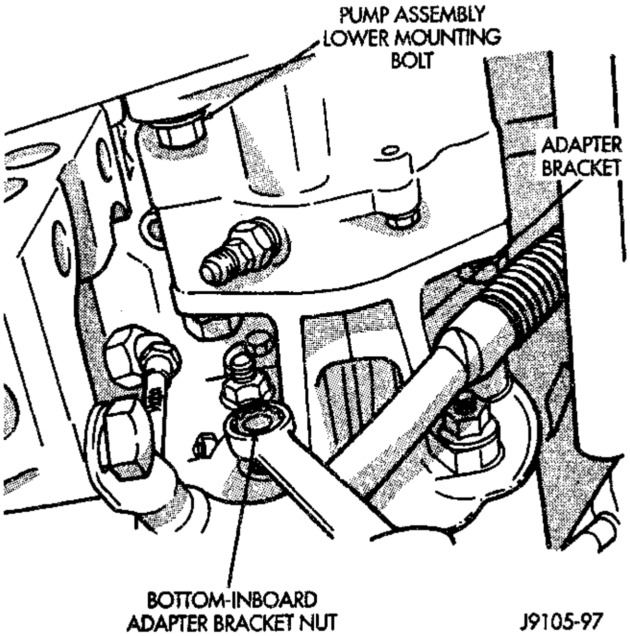


Fig. 195 Vacuum Pump Mounting

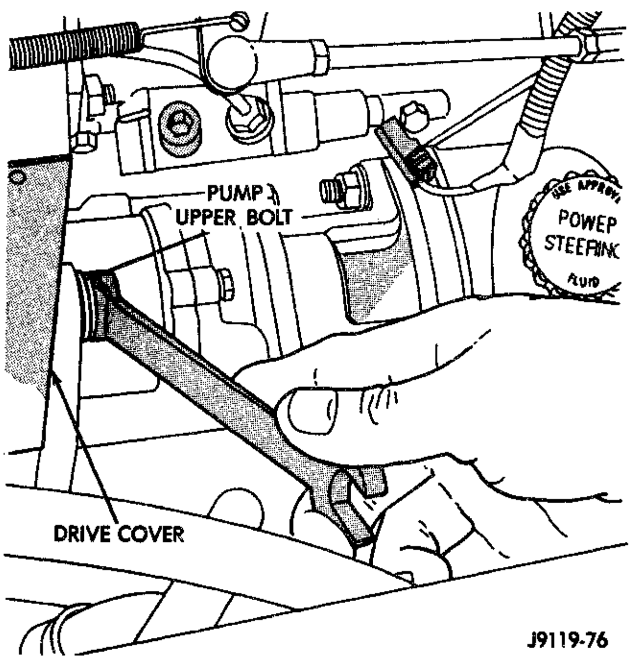


Fig. 196 Pump Assembly Upper Mounting Bolt

(10) Remove vacuum pump from adapter (Fig. 198). Turn pump gear back and forth to disengage pump shaft from coupling.

(11) Remove coupling from adapter (Fig. 199).

(12) Remove remaining adapter attaching nuts and remove adapter from steering pump (Fig. 200). If steering pump will be serviced, remove spacer from each inboard mounting stud on pump.

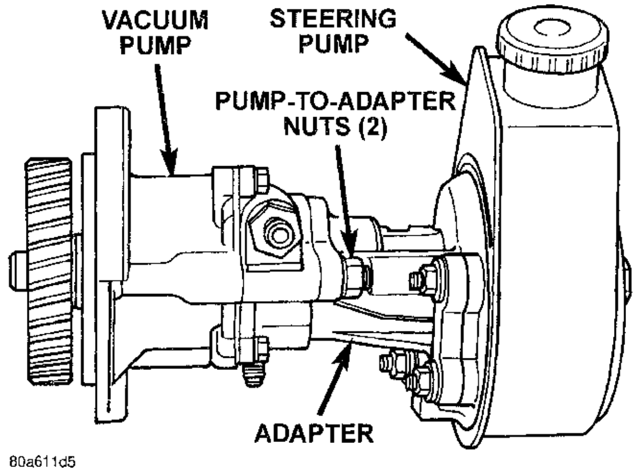


Fig. 197 Pump Assembly

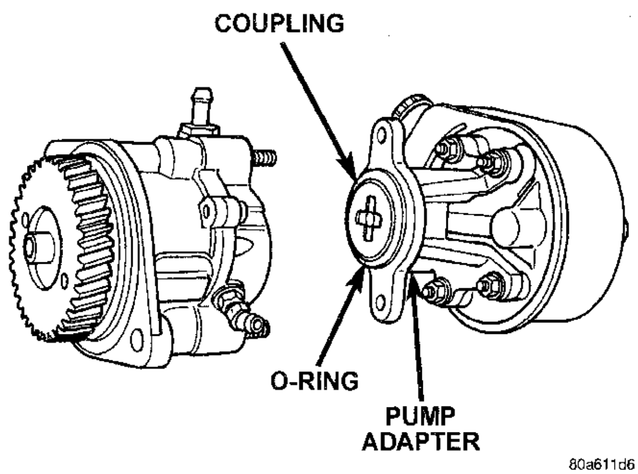


Fig. 198 Vacuum Pump Adapter

INSTALLATION

(1) Clean and lubricate pump shaft with engine oil.

(2) Install spacers on steering pump studs.

(3) Install O-ring on adapter.

(4) Position adapter on pump studs.

(5) Install attaching nuts on outboard stud and on the two upper pump studs. Do **not** install nut on lower, inboard stud at this time. Tighten nuts to 24 N·m (18 ft. lbs.).

(6) Install coupling on pump shaft. Be sure coupling is securely engaged in shaft drive tangs.

(7) Install vacuum pump on adapter. Rotate drive gear until tangs on pump shaft engage in coupling. Verify that pump is seated before installing attaching nuts.

(8) Install and tighten vacuum pump attaching nuts.

(9) Inspect adapter O-ring and replace O-ring if cut or torn.

(10) Lubricate adapter O-ring with engine oil.

REMOVAL AND INSTALLATION (Continued)

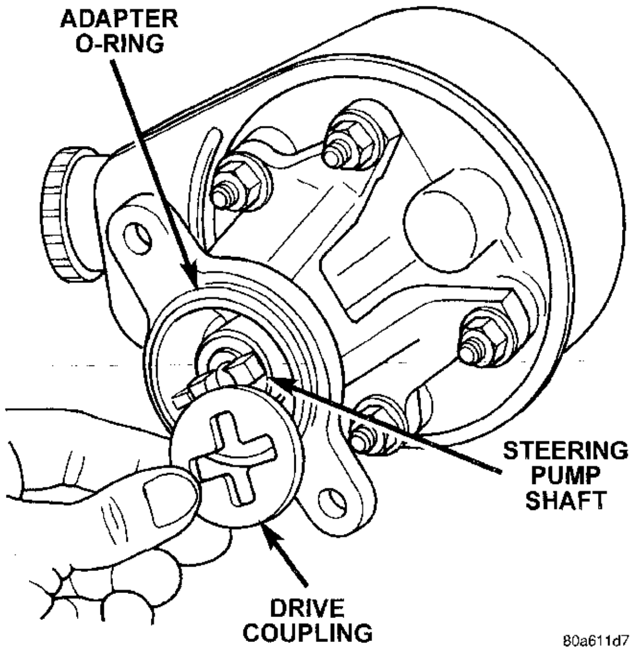


Fig. 199 Pump Drive Coupling

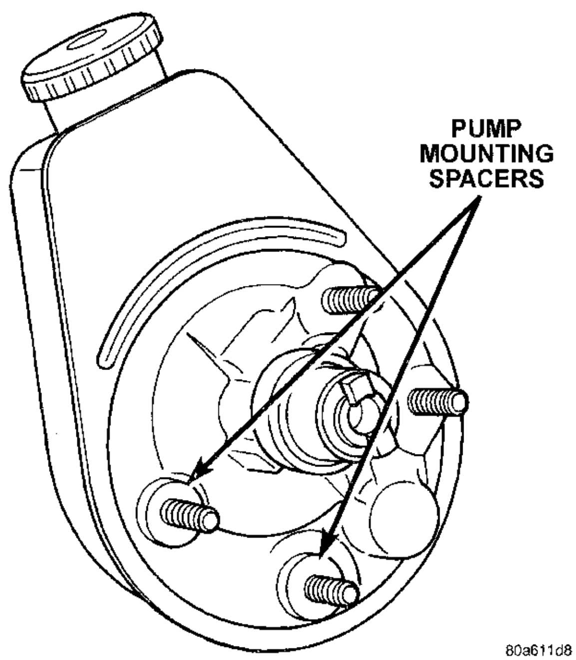


Fig. 200 Steering Pump Mounting Stud Spacers

(11) Note position of drive slots in coupling (Fig. 201). Then rotate drive gear to align tangs on vacuum pump shaft with coupling.

(12) Verify that pump is seated in adapter and coupling.

(13) Install and tighten pump attaching nuts and washers.

(14) Position new gasket on vacuum pump mounting flange (Fig. 202). Use Mopar Perfect Seal, or silicone adhesive/sealer to hold gasket in place.

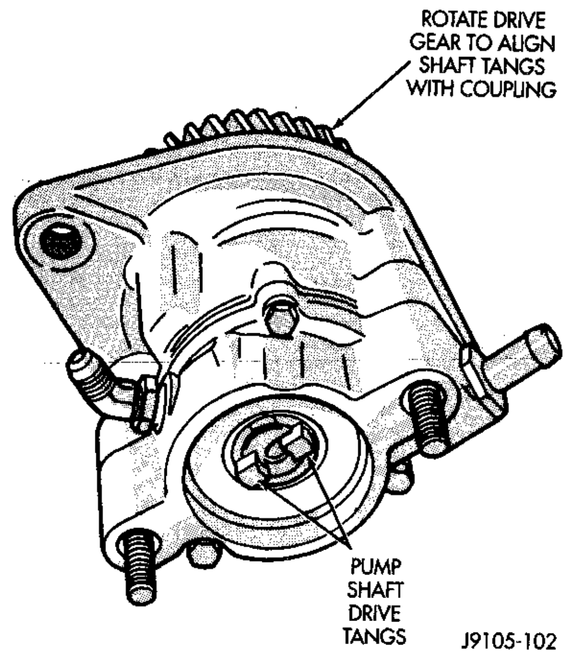


Fig. 201 Pump Shaft Drive Tangs

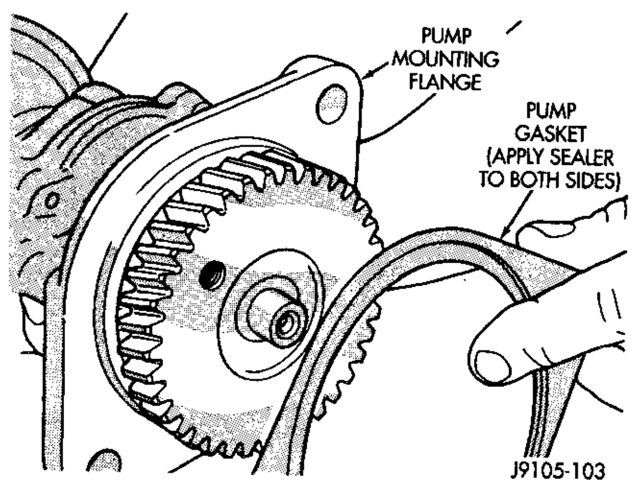


Fig. 202 Pump Mounting Flange Gasket

(15) Insert pump assembly upper attaching bolt in mounting flange and gasket. Use sealer or grease to hold bolt in place if necessary.

(16) Position pump assembly on engine and install upper bolt (Fig. 203). Tighten upper bolt only enough to hold assembly in place at this time.

(17) Working from under vehicle, install pump assembly lower attaching bolt. Then tighten upper and lower bolt to 77 N·m (57 ft. lbs.).

(18) Position bracket on steering pump inboard stud. Then install remaining adapter attaching nut on stud. Tighten nut to 24 N·m (18 ft. lbs.).

(19) Connect oil feed line to vacuum pump connector and tighten line fitting.

REMOVAL AND INSTALLATION (Continued)

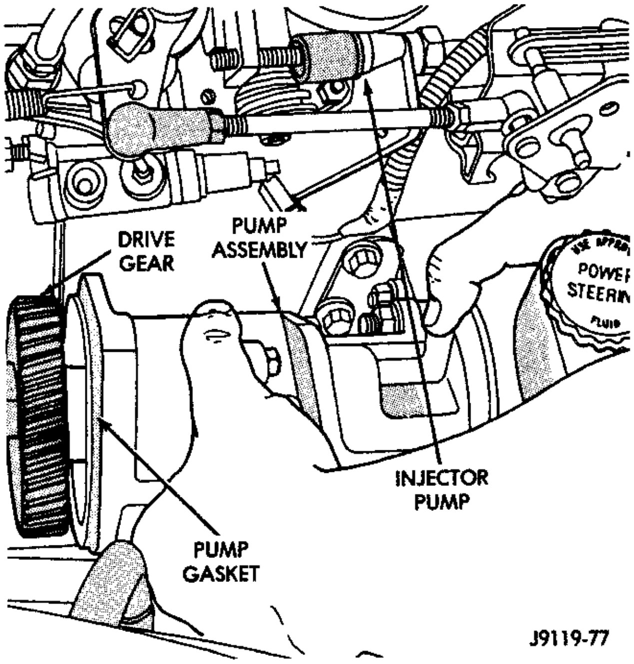


Fig. 203 Installing Pump Assembly On Engine

(20) Connect steering pump pressure and return lines to pump. Tighten pressure line fitting to 30 N·m (22 ft. lbs.).
(21) Connect vacuum hose to vacuum pump.
(22) Connect battery cables, if removed.
(23) Fill power steering pump reservoir.
(24) Purge air from steering pump lines. Start engine and slowly turn steering wheel left and right to circulate fluid and purge air from system.
(25) Stop engine and top off power steering reservoir fluid level.
(26) Start engine and verify that steering action is correct. Do this before moving vehicle.

CLEANING AND INSPECTION

CYLINDER BLOCK

INSPECTION

Measure the combustion deck face using a straight edge and a feeler gauge(Fig. 204). The distortion of the combustion deck face is not to exceed 0.010 mm (0.0004 inch) in any 50.00 mm (2.0 inch) diameter. Overall variation end to end or side to side is 0.075 mm (0.003 inch).

If the surface exceeds the limit, refer to Cylinder Block Refacing.

Inspect the cylinder bores for damage or excessive wear.

Measure the cylinder bores (Fig. 205). If the cylinder bores exceeds the limit, refer to Cylinder Bore Repair.

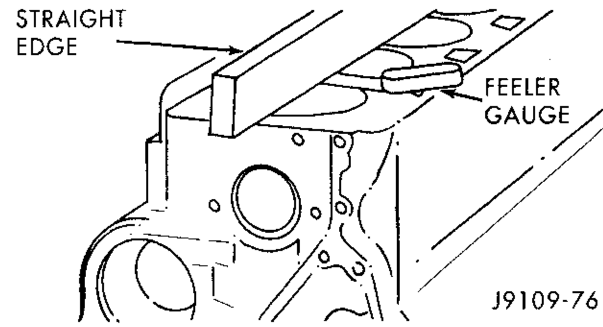
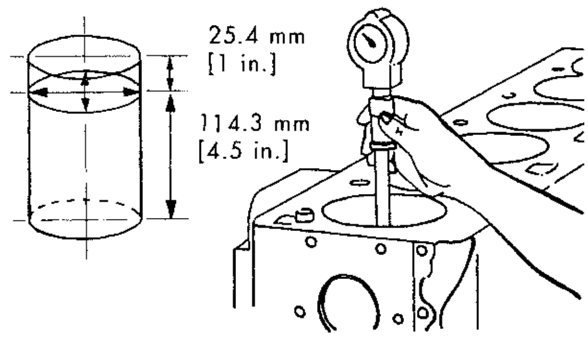


Fig. 204 Combustion Deck Face Measurement



MIN.	102.0 mm	(4.0157 inch)
MAX.	102.116 mm	(4.0203 inch)
Out-of-Round	0.038 mm	(0.0015 inch)
Taper	0.076 mm	(0.003 inch)
Oversize pistons and rings are available for bored cylinder blocks.		

J9209-167

Fig. 205 Cylinder Bore Diameter

Inspect the camshaft bores for scoring or excessive wear.

Measure the camshaft bores. Refer to engine specifications at the rear of this section. Limit for the No.1 bore applies to the ID of the bushing.

If a bore exceeds the limit, refer to Camshaft Bore Repair.

Inspect the tappet bores for scoring or excessive wear (Fig. 206). If out of limits, replace the cylinder block.

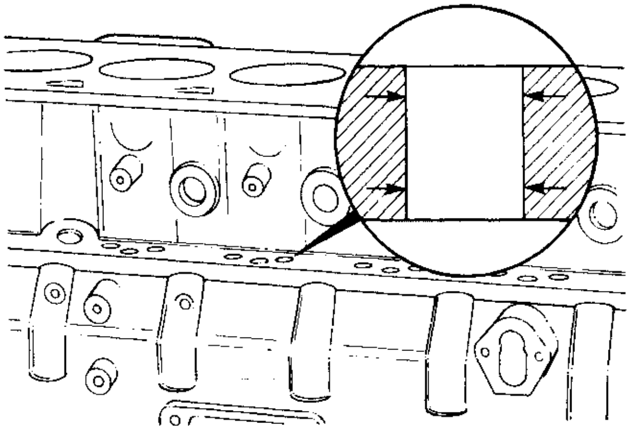
CYLINDER HEAD

INSPECTION

Remove the cup plugs and inspect the coolant passages. A large build up of rust and lime will require removal of the cylinder block for cleaning in a hot tank.

Inspect the cylinder bores for damage or excessive wear. Rotate the crankshaft so the piston is at Bottom Dead Center (BDC) to inspect the bores.

CLEANING AND INSPECTION (Continued)

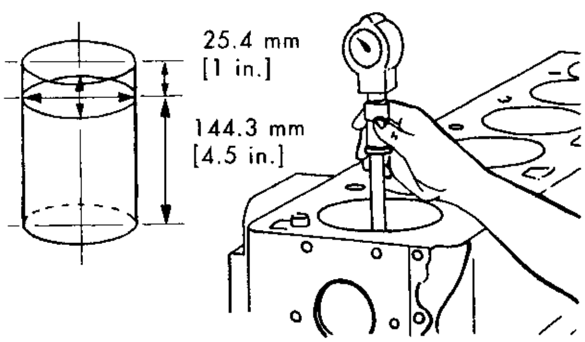


TAPPET BORE DIAMETER		
MAX.	16.055 mm	(0.632 inch)

J9109-79

Fig. 206 Tappet Bore Diameter

Measure the cylinder bores (Fig. 207). DO NOT proceed with in-chassis repair if the bores are damaged or worn beyond the limits (refer to Cylinder Bore Repair - Cylinder Block).



MIN.	102.0 mm	(4.0157 inch)
MAX.	102.116 mm	(4.0203 inch)
Out-of-Round	0.038 mm	(0.0015 inch)
Taper	0.76 mm	(0.003 inch)
Oversize pistons and rings are available for bored cylinder blocks.		

J9109-75

Fig. 207 Cylinder Bore Diameter

Check the top surface for damage caused by the cylinder head gasket leaking between cylinders.

Inspect the block and head surface for nicks, erosion, etc.

Check the head distortion (Fig. 208). The distortion of the combustion deck face is not to exceed 0.010 mm (0.0004 inch) in any 50.8 mm (2.00 inch) diameter. Overall variation end to end or side to side 0.30 mm (0.012 inch).

DO NOT proceed with the in-chassis overhaul if the cylinder head or block surface is damaged or not flat (within specifications).

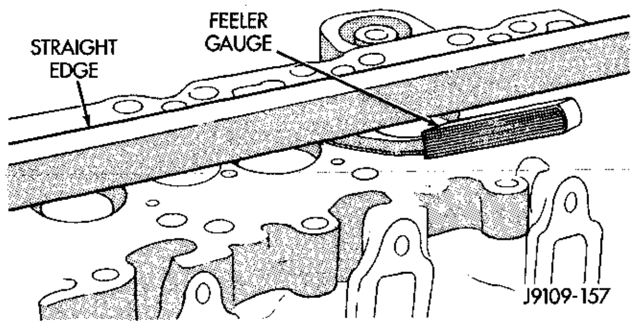


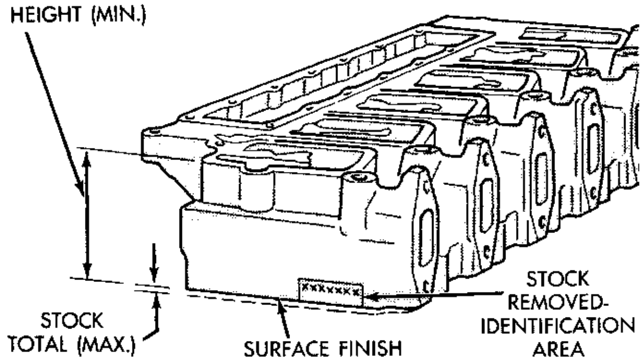
Fig. 208 Cylinder Head Combustion Deck Face Measurement

REFACING HEAD SURFACE

The cylinder head combustion deck may be refaced in whatever increments necessary to clean up the surface and maintain the surface finish and flatness tolerances. The combined total of stock removed must not exceed 1.00 mm (0.03937 inch). The amount of stock removed each time must be steel stamped above combustion deck edge, on the lower right hand corner of the rear face (Fig. 209). Check valve protrusion after head surface refacing.

Surface finish requirements are 1.5-3.2 micrometers (60-126 microinch).

REFERENCE HEIGHT (MIN.)



STOCK TOTAL (MAX.)
1.00 mm (0.03937 inch)
REFERENCE HEIGHT (MIN.)
94.00 ±0.25 mm
(3.7008 ±0.0010 inch)
SURFACE FINISH
1.5 to 3.2 micrometers
(60 to 128 microinches)

J9109-134

Fig. 209 Cylinder Head Stock Removal

AUTHENTIC RESTORATION PRODUCT

CLEANING AND INSPECTION (Continued)

CLEANING

Clean the carbon from the injector nozzle seat with a nylon or brass brush.

Scrape the gasket residue from all gasket surfaces.

Wash the cylinder head in hot soapy water solution (88°C or 140°F).

After rinsing, use compressed air to dry the cylinder head.

Polish the gasket surface with 400 grid paper. Use an orbital sander or sanding block to maintain a flat surface.

VALVES AND VALVE SPRINGS

CLEANING

Clean the valve stems with crocus cloth or a Scotch-Brite® pad. Remove carbon with a soft wire brush. Clean valves, springs, retainers, and collets in a suitable solvent. Rinse in hot water and blow dry with compressed air.

INSPECTION

Visually inspect the valves for abnormal wear on the heads, stems, and tips. Replace any valve that is worn out or bent (Fig. 210).

Measure the valve stem diameter in three places

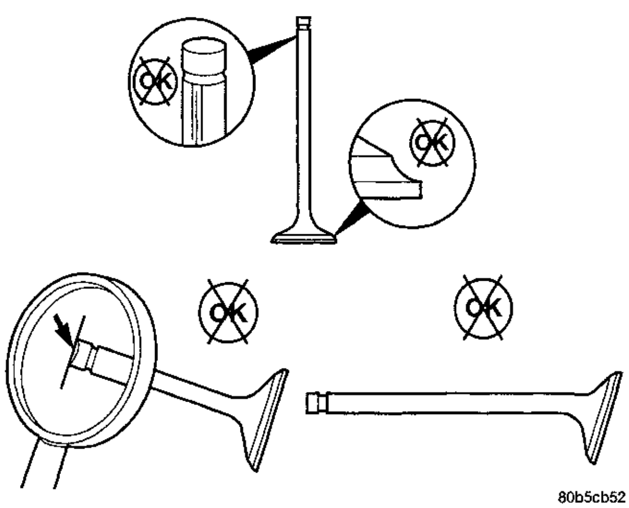


Fig. 210 Visually Inspect Valves for Abnormal Wear

as shown in (Fig. 211).

Measure the cylinder head valve guide bore (Fig. 212). Subtract the corresponding valve stem diameter to obtain valve stem-to-guide clearance.

Measure valve margin (rim thickness) (Fig. 213).

Measure the valve spring free length and maximum inclination (Fig. 214).

Test valve spring force with tool C-647 (Fig. 215).

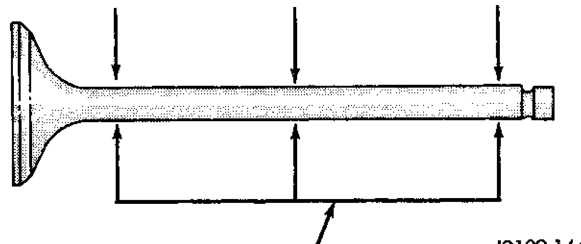


Fig. 211 Measure Valve Stem Diameter

VALVE STEM DIAMETER
6.990 mm (0.2752 in.) MIN
7.010 mm (0.2760 in.) MAX

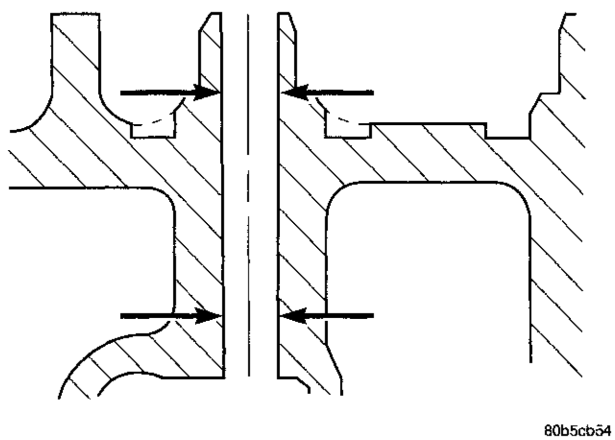


Fig. 212 Measure Valve Guide Bore

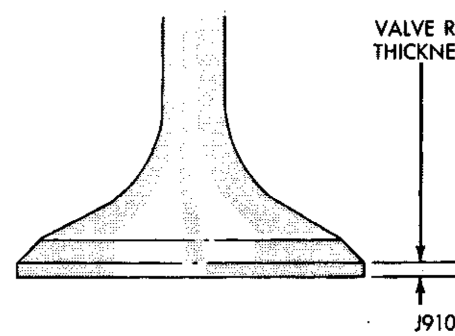


Fig. 213 Measure Valve Margin (Rim Thickness)

VALVE MARGIN (RIM THICKNESS)
0.72 mm (0.031 in.) MIN.

CRANKSHAFT

CLEANING AND INSPECTION

Clean the crankshaft oil galley holes with a nylon brush.

CLEANING AND INSPECTION (Continued)

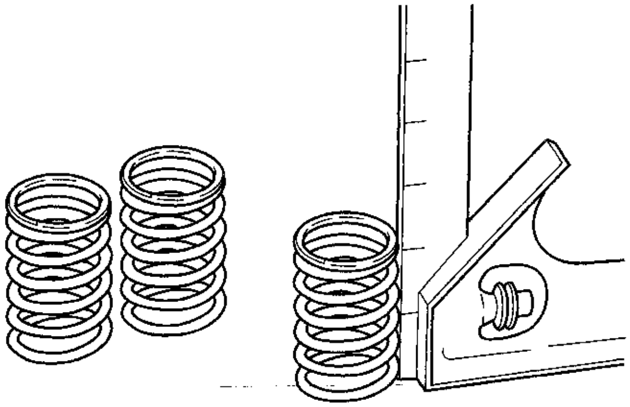


Fig. 214 Measure Valve Spring Free Length and Max. Inclination

VALVE SPRING FREE LENGTH
47.75 mm (1.88 in.)

MAX INCLINATION
1.5 mm (.059 in.)

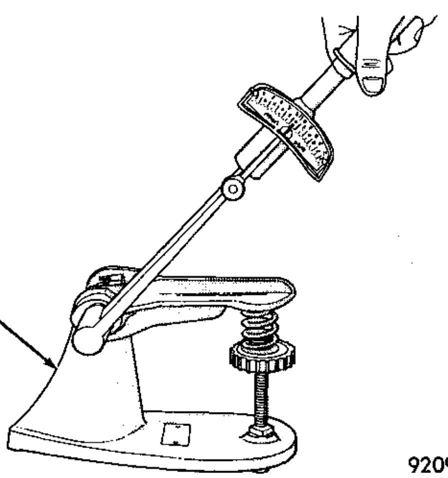


Fig. 215 Testing Valve Spring with Tool C-647

VALVE SPRING MINIMUM LOAD
@ 35.33 mm — 339.8 N
@ 1.39 in. — 76.4 lbs.

Rinse in clean solvent and dry with compressed air.

Inspect the front and rear seal contact areas of the crankshaft for scratches or grooving.

The service seal kit will position the seal slightly deeper into the seal bore so it will contact the crankshaft at a different location. If this has already been done and the crankshaft has two worn areas, install a wear sleeve to provide a new contact surface for the seal.

Inspect the rod and main journal for deep scores, signs of overheating and other abnormal marks.

PISTON AND CONNECTING ROD ASSEMBLY

CLEANING

Pistons

CAUTION: DO NOT use bead blast to clean the pistons. DO NOT clean the pistons and rods in an acid tank.

Clean the pistons and pins in a suitable solvent, rinse in hot water and blow dry with compressed air. Soaking the pistons over night will loosen most of the carbon build up. De-carbon the ring grooves with a broken piston ring and again clean the pistons in solvent. Rinse in hot water and blow dry with compressed air.

Connecting Rods

Clean the connecting rods in a suitable solvent, rinse in hot water and blow dry with compressed air.

INSPECTION

Pistons

Inspect the pistons for damage and excessive wear. Check top of the piston, ring grooves, skirt and pin bore. Measure the piston skirt diameter (Fig. 216). If the piston is out of limits, replace the piston.

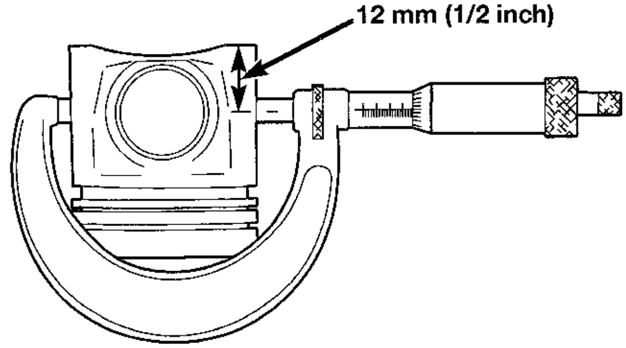


Fig. 216 Piston Skirt Diameter

PISTON SKIRT DIAMETER (MIN.)
101.864 mm (4.0104 in.)

CLEANING AND INSPECTION (Continued)

The upper groove only needs to be inspected for damage. Use a new piston ring to measure the clearance in the intermediate ring groove (Fig. 217). If the clearance of the intermediate ring exceeds 0.152 mm (0.006 inch), replace the piston.

Use a new oil ring to measure the clearance in the oil groove (Fig. 217). If the clearance exceeds 0.127 mm (0.005 inch), replace the piston.

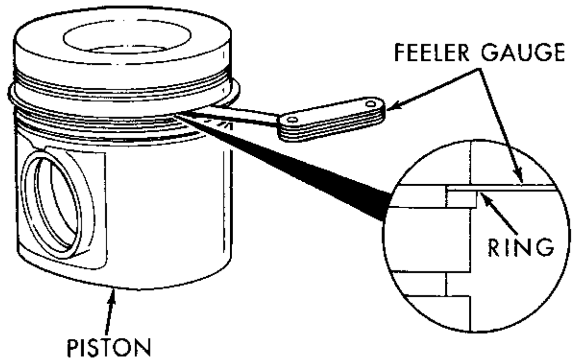


Fig. 217 Intermediate and Oil Ring Clearances

Measure the pin bore (Fig. 218). The maximum diameter is 40.025 mm (1.5758 inch). If the bore is over limits, replace the piston.

Inspect the piston pin for nicks, gouges and excessive wear. Measure the pin diameter (Fig. 219). The minimum diameter is 39.990 mm (1.5744 inch). If the diameter is out of limits, replace the pin.

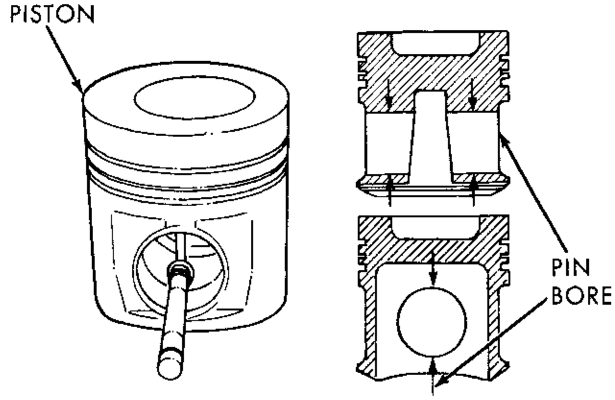


Fig. 218 Piston Pin Bore

Connecting Rods

Inspect the connecting rod for damage and wear. The I-Beam section of the connecting rod cannot have dents or other damage. Damage to this part can cause stress risers which will progress to breakage.

Measure the connecting rod pin bore (Fig. 220). The maximum diameter is 40.042 mm (1.5764 inch). If out of limits, replace the connecting rod.

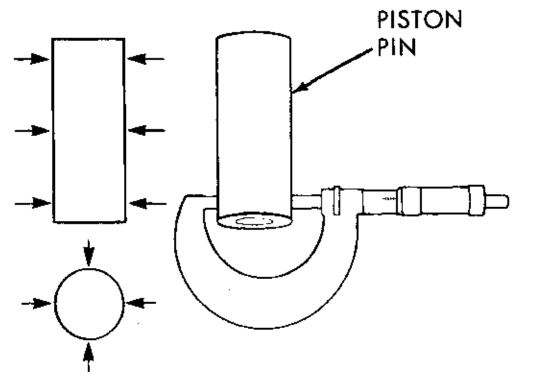


Fig. 219 Piston Pin Diameter

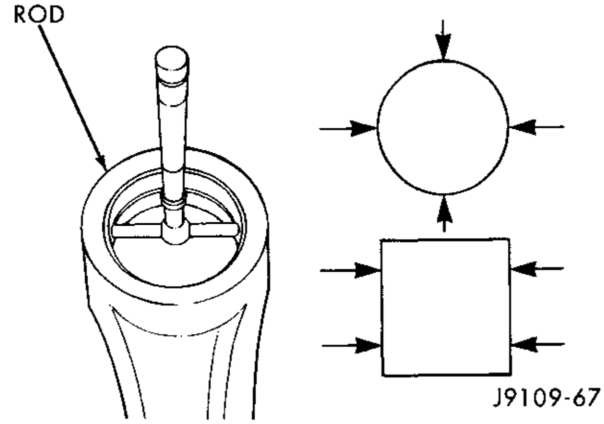


Fig. 220 Connecting Rod Pin Bore

CAMSHAFT

CLEANING

Clean the camshaft in a suitable solvent. Rinse in hot water and blow dry with compressed air.

INSPECTION

NOTE: For camshaft gear inspection, refer to procedure in this group.

(1) Inspect the valve lobes and bearing journals for cracks, pitting, scoring, or generally excessive wear. Replace any camshaft that exceeds the allowable limits.

(2) Measure the bearing journals and lobes (Fig. 221).

CAUTION: If Camshaft lobes are worn, requiring camshaft replacement, it is necessary to replace the tappets also. Refer to Tappet Removal and Installation in this group.

CLEANING AND INSPECTION (Continued)

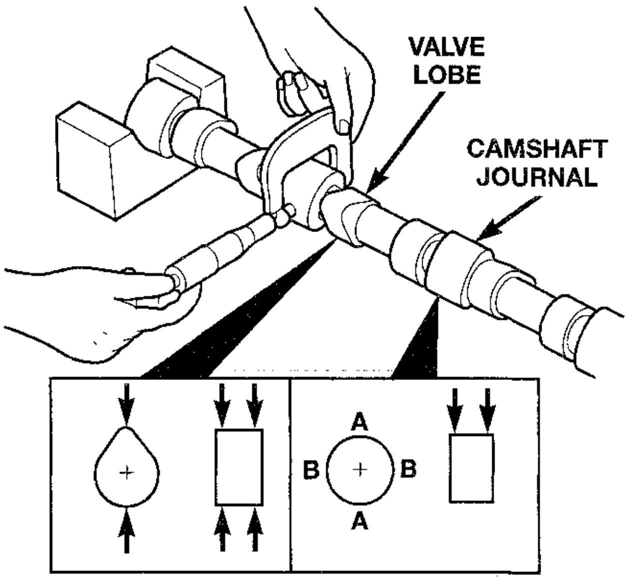


Fig. 221 Measuring Camshaft Main Journals and Lobes

Camshaft Journal Diameter
Journal #1 54.028 mm (2.1270 in.) MIN.
Journal #2-7 53.987 mm (2.1245 in.) MIN.

Camshaft Lobe Height
Intake Lobe 47.173 mm (1.857 in.) MIN.
Exhaust Lobe 45.636 mm (1.796 in.) MIN.

CAMSHAFT GEAR

INSPECTION

Visually inspect the camshaft gear for cracks (hub and gear), chipped or broken teeth, or excessive fretting (Fig. 222)(Fig. 223). Inspect and replace the keyway, if damaged.

TAPPETS

CLEANING

Clean tappet with a suitable solvent. Rinse in hot water and blow dry with a clean shop rag or compressed air.

INSPECTION

(1) Visually inspect the tappet the tappet socket, stem, and face for excessive wear, cracks, or obvious damage (Fig. 224).

(2) Measure the tappet stem diameter. Replace the tappet if it falls below the minimum size (Fig. 224).

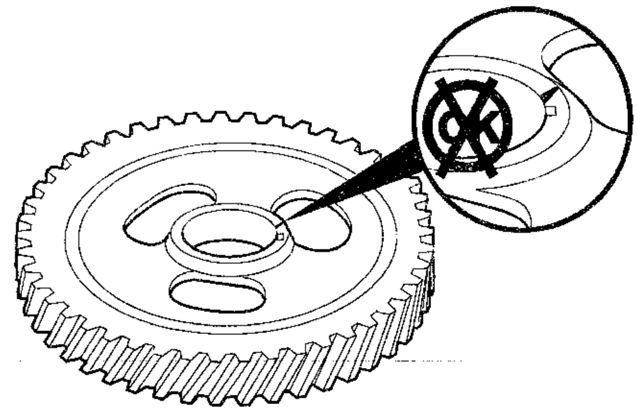


Fig. 222 Inspecting Camshaft Gear Hub for Cracks

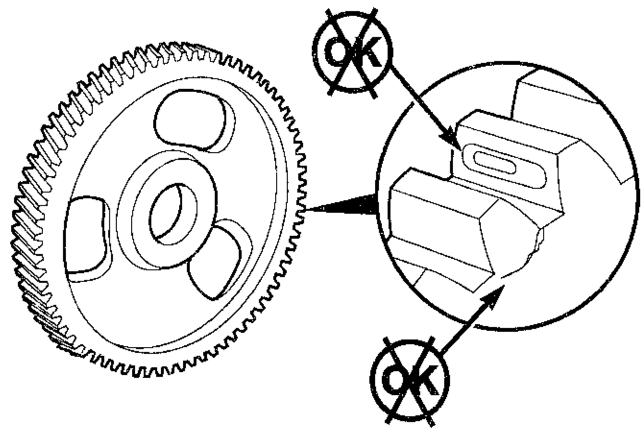


Fig. 223 Inspecting Camshaft Gear for Cracks and Fretting

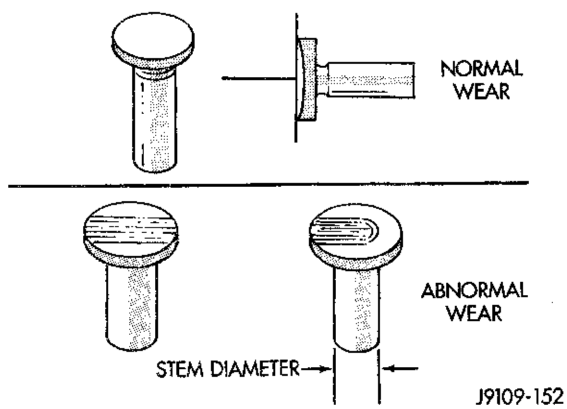


Fig. 224 Tappet Inspection

TAPPET STEM DIAMETER
15.925 mm (0.627 in.) MIN.

CLEANING AND INSPECTION (Continued)

CRANKSHAFT DAMPER

INSPECTION

(1) Inspect the damper hub for cracks and replace if any are found.

(2) Inspect the index lines on the damper hub and the inertia member (Fig. 225). If the lines are more than 1.59 mm (1/16 in.) out of alignment, replace the damper.

(3) Inspect the rubber member for deterioration or missing segments (Fig. 226).

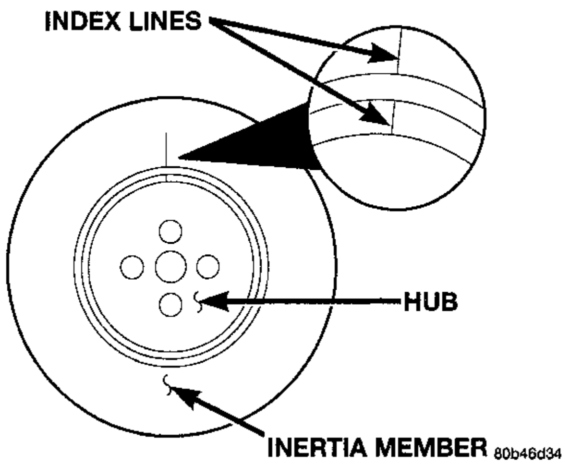


Fig. 225 Inspect Index Lines for Alignment

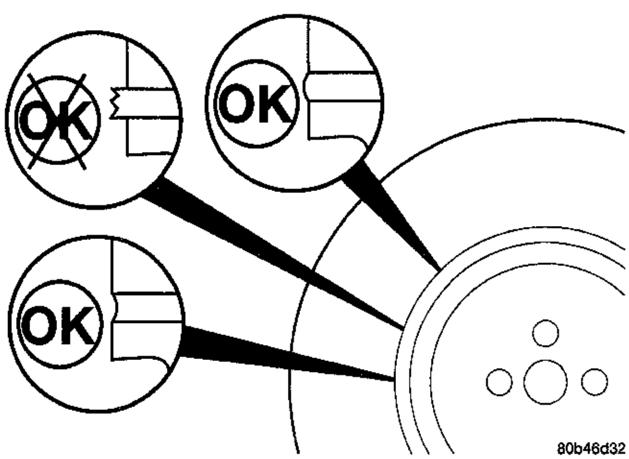


Fig. 226 Inspect Damper Rubber Member

ROCKER ARM AND SHAFT

CLEANING

Disassemble and clean the rocker arm(s) (Fig. 227)in a suitable solvent. Rinse in hot water and blow dry with compressed air. If necessary, use a wire brush or wheel to remove stubborn deposits. Inspect oil passages in rocker arms and pedestals. Apply compressed air to oil orifices to purge contaminants.

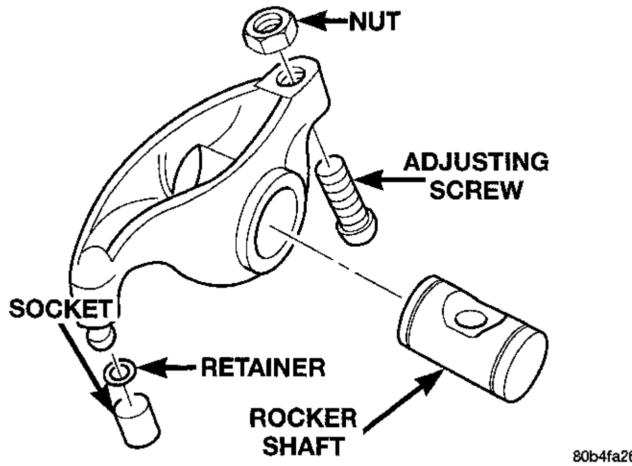


Fig. 227 Rocker Arm Assembly

INSPECTION

(1) Remove rocker shaft and inspect for cracks and excessive wear in the bore or shaft. Remove socket and inspect ball insert and socket for signs of wear. Replace retainer if necessary.

(2) Measure the rocker arm bore and shaft (Fig. 228)(Fig. 229).

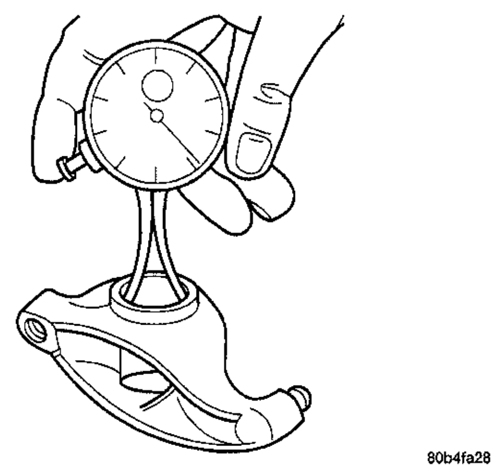


Fig. 228 Measuring Rocker Arm Bore

ROCKER ARM BORE (MAX.)
22.027 mm (.867 in.)

PUSHRODS

CLEANING

Clean the push rods in a suitable solvent. Rinse in hot water and blow dry with compressed air. If necessary, use a wire brush or wheel to remove stubborn deposits.

CLEANING AND INSPECTION (Continued)

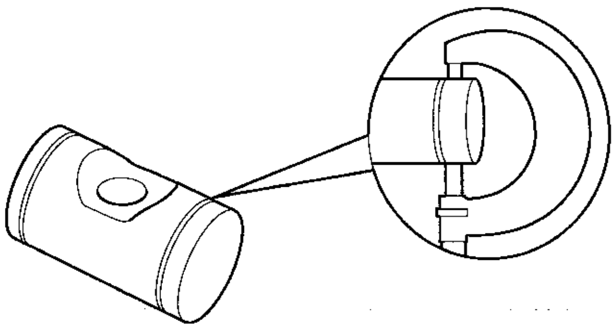


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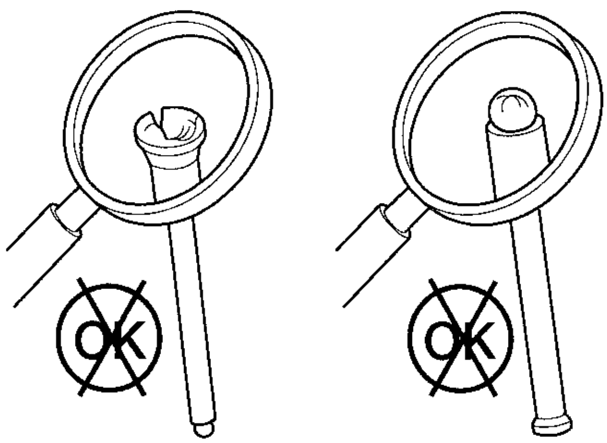
Fig. 229 Measuring Rocker Arm Shaft

ROCKER ARM SHAFT (MIN.)
21.965 mm (.865 in.)

INSPECTION

Inspect the push rod ball and socket for signs of scoring. Check for cracks where the ball and the socket are pressed into the tube (Fig. 230).

Roll the push rod on a flat work surface with the socket end hanging off the edge (Fig. 231). Replace any push rod that appears to be bent.



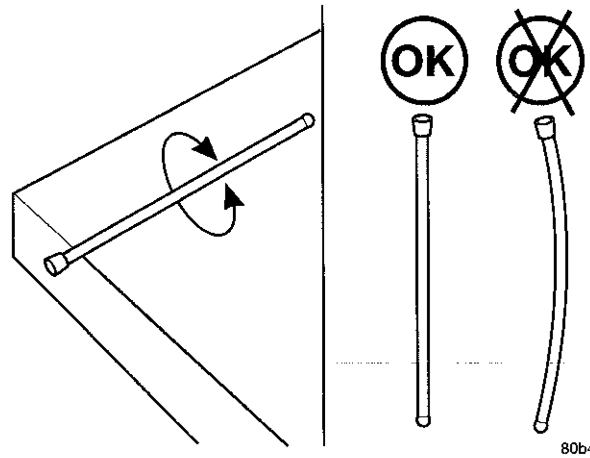
80b4fa24

Fig. 230 Inspecting Push Rod for Cracks

CROSSHEADS

CLEANING

Clean all crossheads in a suitable solvent. If necessary, use a wire brush or wheel to remove stubborn deposits. Rinse in hot water and blow dry with compressed air.



80b4fa23

Fig. 231 Inspecting Push Rod for Flatness

INSPECTION

Inspect the crossheads for cracks and/or excessive wear on rocker lever and valve tip mating surfaces (Fig. 232). Replace any crossheads that exhibit abnormal wear or cracks.

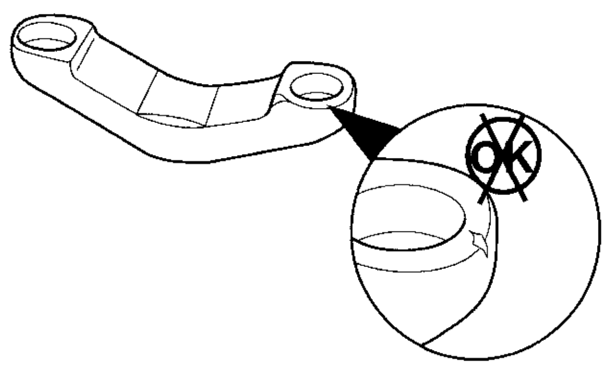


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Fig. 232 Inspecting Crosshead for Cracks

OIL COOLER ELEMENT AND GASKET

CLEANING AND INSPECTION

Clean the sealing surfaces.

Apply 483 kPa (70 psi) air pressure to the element to check for leaks. If the element leaks, replace the element.

OIL PRESSURE REGULATOR VALVE AND SPRING

CLEANING

(1) Clean the regulator spring and plunger (Fig. 233)with a suitable solvent and blow dry with compressed air. If the plunger bore requires cleaning, it is necessary to remove the oil filter head to avoid getting debris into the engine.

CLEANING AND INSPECTION (Continued)

INSPECTION

Inspect the plunger and plunger bore for cracks and excessive wear. Polished surfaces are acceptable. Verify that the plunger moves freely in the bore.

Check the spring for height and load limitations (Fig. 233). Replace the spring if out of limits shown in the figure.

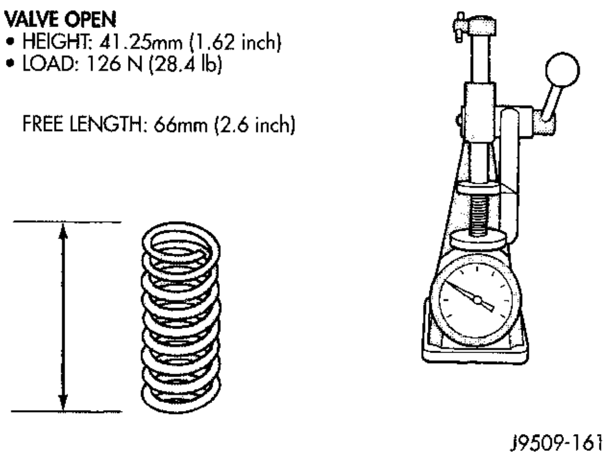

Fig. 233 Oil Pressure Regulator Spring Check

OIL PUMP

CLEANING

Clean all parts in a suitable solvent . Rinse with hot water and blow dry with compressed air. Clean the old sealer residue from the back of the gear housing cover and front of the gear housing.

INSPECTION

Disassemble and inspect the oil pump as follows:

(1) Visually inspect the lube pump gears for chips, cracks or excessive wear.

(2) Remove the back plate (Fig. 234).

(3) Mark TOP on the gerotor planetary using a felt tip pen (Fig. 234).

(4) Remove the gerotor planetary (Fig. 234). Inspect for excessive wear or damage. Inspect the pump housing and gerotor drive for damaged and excessive wear.

(5) Install the gerotor planetary in the original position. The chamfer must be on the O.D. and down.

(6) Measure the tip clearance (Fig. 235). Maximum clearance is 0.1778 mm (0.007 inch). If the oil pump is out of limits, replace the pump.

(7) Measure the clearance of the gerotor drive/gerotor planetary to port plate (Fig. 236). Maximum clearance is 0.127 mm (0.005 inch). If the oil pump is out of limits, replace the pump.

(8) Measure the clearance of the gerotor planetary to the body bore (Fig. 237). Maximum clearance is 0.381 mm (0.015 inch). If the oil pump is out of limits, replace the pump.

(9) Measure the gears backlash (Fig. 238). The limits of a used pump is 0.080- 0.380 mm (0.003-0.015 inch). If the backlash is out of limits, replace the oil pump.

(10) Install the back plate.

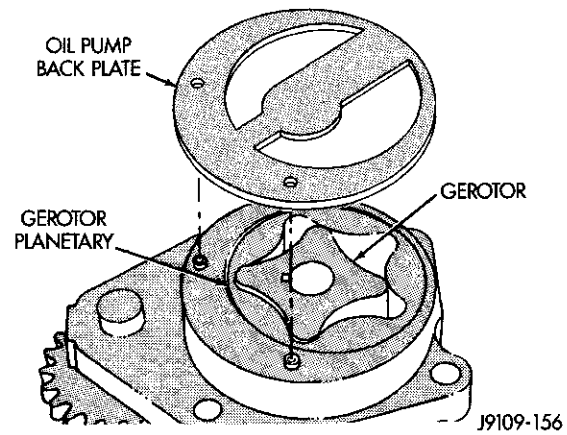

Fig. 234 Gerotor Planetary and Gerotor

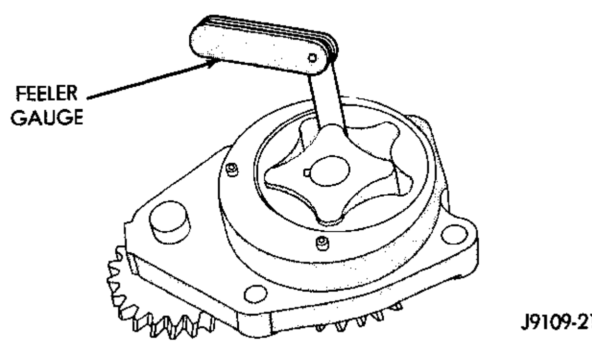

Fig. 235 Measuring Tip Clearance

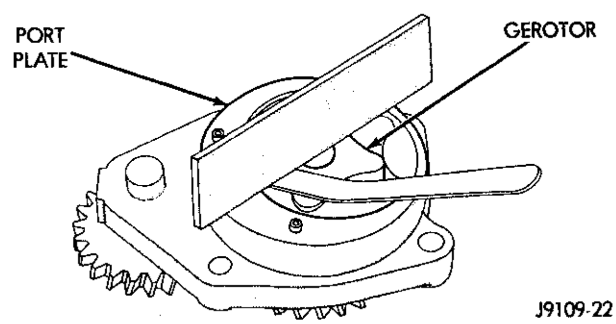

Fig. 236 Measuring Gerotor to Port Plate Clearance

SPECIFICATIONS (Continued)

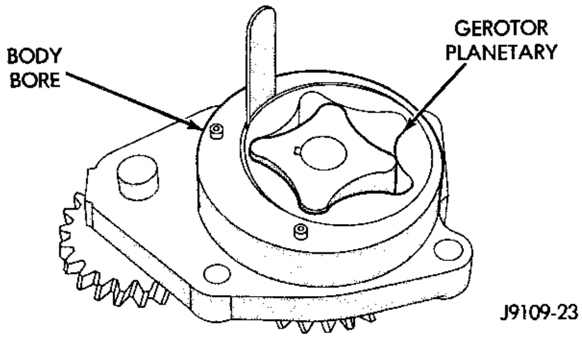

Fig. 237 Measuring Gerotor Planetary to Body Bore Clearance

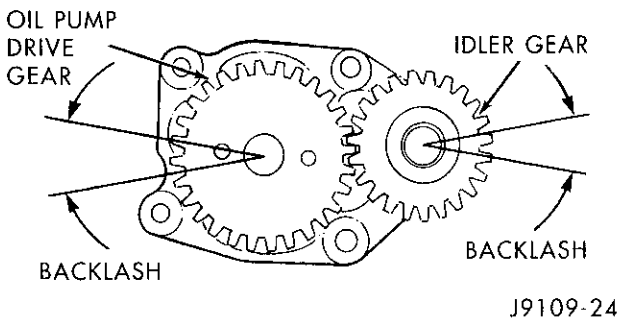

Fig. 238 Measure Gear Backlash

SPECIFICATIONS

5.9L DIESEL ENGINE SPECIFICATIONS

CAMSHAFT AND TAPPETS

Camshaft

Journal Diameter (#1) . . . . 54.028 – 54.048 mm (2.127 – 2.128 in.)
Journal Diameter (#2–7) . . . . . 53.987 – 54.013 mm (2.1245 – 2.1265 in.)
Intake Lobe (Min. dia. @ peak) . . . . 47.173 mm (1.857 in.)
Exhaust Lobe (Min. dia. @ peak) . . . . . . 45.636 mm (1.796 in.)
End Play . . . . . . 0.100 – 0.46 mm (0.005 – 0.018 in.)
Gear Backlash . . . . 0.076 – 0.330 mm (0.003 – 0.013 in.)
Cam Bore Dia. (Max.) #1 w/o bushing . . 59.248 mm (2.3326 in.)
Cam Bore Dia. (Max.) #1 w/ bushing . . . 54.133 mm (2.1312 in.)
Cam Bore Dia. (Max.) #2–7 (no bushing) . . . . 54.133 mm (2.1314 in.)

Tappets
Stem Diameter (Min.) . . . . . . 15.925 mm (0.627 in.)

CYLINDER BLOCK

Cylinder Bore Diameter (Max. Std.) . . . 102.116 mm (4.0203 in.)
Cylinder Bore Out of Round (Max.) . . . . . 0.038 mm (0.0015 in.)
Cylinder Bore Taper (Max.) . . . 0.076 mm (0.003 in.)
Tappet Bore Diameter (Max.) . . . . 16.055 mm (0.632 in.)
Deck Surface Flatness (Max. Overall) . . . 0.075 mm (0.003 in.)
First Reface . . . . 0.250 mm (0.0098 in.)
Second Reface . . . . 0.250 mm (0.0098 in.)
Total Reface . . . . 0.500 mm (0.197 in.)
Surface Finish . . . . 1.50 – 3.20 micrometers (60–126 microinches)
Main bearing Bore Dia. (Max. w/Bearing Installed) . . . . 83.106 mm (3.2719 in.)
Cam Bore Dia. (Max.) #1 w/o bushing . . 59.248 mm (2.3326 in.)
Cam Bore Dia. (Max.) #2–7 (no bushing) . . . . 54.139 mm (2.1314 in.)
Cam Bore Dia. (Max.) #1 w/ bushing . . . 54.133 mm (2.1312 in.)

PISTONS AND CONNECTING RODS

Pistons

Skirt Diameter . . . . 101.864 – 101.896 mm (4.0104 – 4.0117 in.)
Ring Groove Clearance-Intermediate (Max.) . . . . 0.095 mm 0.0037 in.)
Ring Groove Clearance-Oil Control (Max.) . . . . 0.085 mm (0.0033 in.)

Piston Pins
Diameter (Min.) . . . . 39.990 mm (1.5744 in.)
Bore Diameter (Max.) . . . . . 40.025 mm (1.5758 in.)

Piston Rings
End Gap (Top) . . . . 0.400 – 0.700 mm (0.016 – 0.0275 in.)
End Gap (Intermediate) . . . . 0.250 – 0.550 mm (0.010 – 0.0215 in.)
End Gap (Oil Control) . . . . 0.250 – 0.550 mm (0.010 – 0.0215 in.)

Connecting Rods
Pin Bore Diameter (Max.) . . 40.042 mm (1.5764 in.)
Side Clearance . . . . 0.100 – 0.330 mm (0.004 – 0.013 in.)

AUTHENTIC RESTORATION PRODUCT

SPECIFICATIONS (Continued)

CRANKSHAFT

Main Bearing Journal Diameter
(Std.) Min. . . . . 82.962 mm (3.2662 in.)
Main Journal Out of Round (Max.) . . . . . 0.050 mm (0.002 in.)
Main Journal Taper (Max.) . . 0.013 mm (0.0005 in.)
Main Journal Oil Clearance (Max.) . . . . . 0.119 mm (0.0047 in.)
Rod Bearing Journal Diameter
(Std.) Min. . . . . 68.9745 mm (2.7155 in.)
Rod Journal Out of Round (Max.) . . . . . . 0.050 mm (0.002 in.)
Rod Journal Taper (Max.) . . . 0.013 mm (0.0005 in.)
Rod Journal Oil Clearance (Max.) . . . . . . 0.089 mm (0.0035 in.)
End Play . . . . . 0.100 – 0.430 mm (0.004 – 0.017 in.)
Gear Backlash . . . . 0.076 – 0.330 mm (0.003 – 0.013 in.)

CYLINDER HEAD AND VALVES

Cylinder Head

Overall Flatness End to End (Max.) . . . . . . 0.30 mm (0.012 in.)
Overall Flatness Side to Side (Max.) . . . . 0.076 mm (0.003 in.)
Intake Valve Seat Angle . . . . 30°
Exhaust Valve Seat Angle . . . . 45°
Valve Seat Width (Min.) . . . . . . 1.49 mm (0.059 in.)
Valve Seat Width (Max.) . . . . . . 1.80 mm (0.071 in.)
Valve Margin (Min.) . . . . 0.72 mm (0.031 in.)

Valves

Clearance (Intake) . . . . 0.152 – 0.381 mm (.006 – .015 in.)
Clearance (Exhaust) . . . . 0.381 – 0.762 mm (0.015 – 0.030)
Guide Bore Diameter . . . . 7.042 – 7.062 mm (0.2772 – 0.2780 in.)
Stem Diameter . . . . 6.990 – 7.010 mm (0.2752 – 0.2760 in.)
Depth (Installed) Intake . . . . 0.59 – 1.11 mm (0.023 – 0.044 in.)
Depth (Installed) Exhaust . . . . 0.96 – 1.48 mm (0.038 – 0.058 in.)

Valve Springs

Free Length . . . . 60 mm (2.36 in.)
Installed Height . . . . 35.33 mm (1.39 in.)
Inclination (Max.) . . . . 1.5 mm (0.059 in.)
Minimum Load . . . . @ 35.33 mm — 339.8 N (@ 1.39 in. — 76.4 lbs.)

OIL PUMP/LUBRICATION

Oil Pump

Tip Clearance (Max.) . . . . 0.1778 mm (0.007 in.)
Gerotor Drive/Planetary to
Port Plate Clearance (Max.) . . . . 0.127 mm (0.005 in.)
Gerotor Planetary to
Body Clearance (Max.) . . . . 0.381 mm (0.015 in.)
Gear Backlash (Used Pump) . . . . 0.076 – 0.330 mm (0.003 – 0.015 in.)

Oil Pressure (Min.)

At Idle Speed* . . . . 69 kPa (10 psi)
At 2,500 rpm* . . . . 207 kPa (30 psi)
Regulating Valve Opening Pressure . . . . . . 448 kPa (65 psi)

Oil Filter

Diff. Pressure to Open Filter Bypass . . . . 172.3 kPa (25 psi)

CAUTION: If oil pressure is ZERO at curb idle, DO NOT run engine.

TORQUE SPECIFICATIONS

5.9L DIESEL ENGINE

DESCRIPTION	TORQUE
Battery Cable (Negative)-to-Block	
Bolt	77 N·m (57 ft. lbs.)
Belt Tensioner	
Bolt	43 N·m (32 ft. lbs.)
Block Heater	
Element	43 N·m (32 ft. lbs.)
Camshaft Thrust Plate	
Bolts	24 N·m (18 ft. lbs.)
Charge Air Cooler	
Bolts	2 N·m (17 in. lbs.)
Clutch Cover-to-Flywheel	
Bolts	23 N·m (17 ft. lbs.)
Connecting Rod Bolts	
Step 1– Preliminary	35 N·m (26 ft. lbs.)
Step 2 – Secondary	70 N·m (51 ft. lbs.)
Step 3 – Final	100 N·m (73 ft. lbs.)
Cooling Fan-to-Fan Clutch	
Bolts	20 N·m (15 ft. lbs.)
Crankshaft Main Bearing Bolts	
Step 1 – Preliminary	60 N·m (44 ft. lbs.)
Step 2 – Secondary	119 N·m (88 ft. lbs.)
Step 3 – Final	176 N·m (129 ft. lbs.)
Crankshaft Pulley/Damper	
Bolts	125 N·m (92 ft. lbs.)
Crankshaft Rear Seal Retainer	
Bolts	9 N·m (80 in. lbs.)

Mopar AUTHENTIC RESTORATION

SPECIFICATIONS (Continued)

DESCRIPTION	TORQUE
Crankshaft Tone Wheel	
Bolts	8 N·m (71 in. lbs.)
Cylinder Head	
Step 1 – (All Bolts)	90 N·m (66 ft. lbs.)
Step 2 – (Re-check All Bolts)	90 N·m (66 ft. lbs.)
Step 3 – (Rotate All Bolts)	Additional ¼ Turn-(90°)
Cylinder Head Cover	
Bolts	24 N·m (18 in. lbs.)
Exhaust Manifold	
Bolts	43 N·m (32 ft. lbs.)
Fan Clutch Mounting-to-Fan Hub	
Left Hand Thread	57 N·m (42 ft. lbs.)
Fan Hub Bracket	
Bolts	24 N·m (18 ft. lbs.)
Fan Hub Bearing	
Bolt	77 N·m (57 ft. lbs.)
Fan Pulley-to-Fan Hub	
Bolts	9 N·m (84 in. lbs.)
Fan Shroud Mounting	
Bolts	11 N·m (95 in. lbs.)
Flywheel	
Bolts	137 N·m (101 ft. lbs.)
Flywheel Housing (Aluminum)	
Bolts	60 N·m (44 ft. lbs.)
Flywheel Housing Access Plate	
Bolts	24 N·m (18 ft. lbs.)
Fuel Delivery Lines (High Pressure)	
At Pump	24 N·m (18 ft. lbs.)
Fuel Delivery Lines (High Pressure)	
At Cyl. Head	40 N·m (30 ft. lbs.)
Fuel Drain Line (rear of head)	
Banjo	24 N·m (18 ft. lbs.)
Fuel Filter Cannister	
Nut	14 N·m (10 ft. lbs.)
Fuel Injection Pump Gear Retaining Nut	
Nut	170 N·m (125 ft. lbs.)
Fuel Injection Pump Support Bracket	
Bolts	24 N·m (18 ft. lbs.)
Fuel System Low Pressure Lines	
Banjo Fittings	24 N·m (18 ft. lbs.)
Generator Mounting	
Bolts	41 N·m (30 ft. lbs.)
Generator Pulley	
Nut	80 N·m (59 ft. lbs.)
Generator Support	
Bolt	24 N·m (18 ft. lbs.)
Gear Housing-to-Block	
Bolts	24 N·m (18 ft. lbs.)
Gear Housing Cover	
Bolts	24 N·m (18 ft. lbs.)
Injector Clamp	
Bolts	10 N·m (89 in. lbs.)

DESCRIPTION	TORQUE
Injection Pump-to-Gear Housing	
Nuts	43 N·m (32 ft. lbs.)
Intake Manifold Cover	
Bolts	24 N·m (18 ft. lbs.)
Charge Air Cooler Pipe Clamp	
Nuts	8 N·m (72 in. lbs.)
Lift Bracket (Rear)	
Bolts	77 N·m (57 ft. lbs.)
Lift Bracket (Front)	
Bolts	43 N·m (32 ft. lbs.)
Lift Pump Mounting	
Nuts	12 N·m (9 ft. lbs.)
Lift Pump Mounting Bracket	
Bolts	24 N·m (18 ft. lbs.)
Oil Cooler Assembly	
Bolts	24 N·m (18 ft. lbs.)
Oil Filter	
Gasket	¾ Turn After Gasket Contact
Oil Pan	
Bolts	24 N·m (18 ft. lbs.)
Oil Pan	
Drain Plug	60 N·m (44 ft. lbs.)
Oil Pressure Regulator	
Plug	80 N·m (60 ft. lbs.)
Oil Pressure Sender/Switch	
Sender/Switch	16 N·m (12 ft. lbs.)
Oil Pump	
Bolts	24 N·m (18 ft. lbs.)
Oil Suction Tube (Flange)	
Bolts	24 N·m (18 ft. lbs.)
Oil Suction Tube (Brace)	
Bolt	24 N·m (18 ft. lbs.)
Oil Supply-to-Vacuum Pump	
Nut	10 N·m (89 in. lbs.)
Rear Mount – Support Cushion-to-Crossmember	
Nut	47 N·m (35 ft. lbs.)
Rear Mount – Support Cushion-to-Support Bracket	
Nuts	47 N·m (35 ft. lbs.)
Rear Mount – Support Bracket-to-Transmission	
Bolts	102 N·m (75 ft. lbs.)
Rear Support Plate-to-Transfer Case	
Bolts	41 N·m (30 ft. lbs.)
Rocker Arm/Pedestal	
Bolts	36 N·m (27 ft. lbs.)
Starter Mounting	
Bolts	43 N·m (32 ft. lbs.)
Thermostat Housing	
Bolts	24 N·m (18 ft. lbs.)
Throttle Control Bracket-to-Cylinder Head	
Bolts	56 N·m (40 ft. lbs.)

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SPECIFICATIONS (Continued)

DESCRIPTION	TORQUE
Torque Converter Drive Plate	
Bolts	47 N·m (35 ft. lbs.)
Transfer Case-to-Insulator Mounting Plate	
Nuts	204 N·m (150 ft. lbs.)
Transmission Support Bracket – (2wd)	
Bolts	68 N·m (50 ft. lbs.)
Transmission Support Spacer – (4wd)	
Bolts	68 N·m (50 ft. lbs.)
Transmission Support Spacer-to-Insulator Mounting Plate – (4wd)	
Bolts	204 N·m (150 ft. lbs.)
Turbocharger/CAC System Clamp(s) (All)	
Nut	8 N·m (71 in. lbs.)
Turbocharger Oil Supply Line	
Nut	20 N·m (15 ft. lbs.)
Turbocharger Oil Drain Pipe	
Bolts	27 N·m (20 ft. lbs.)
Turbocharger-to-Exhaust Manifold	
Nuts	45 N·m (33 ft. lbs.)
Vacuum Pump-to-adapter	
Nuts	24 N·m (18 ft. lbs.)
Vacuum Pump adapter-to-P/S Pump	
Nuts	24 N·m (18 ft. lbs.)
Vacuum Pump-to-Gear Housing	
Bolts	77 N·m (57 ft. lbs.)
Vacuum Pump Oil Supply Line	
Fitting	10 N·m (89 in. lbs.)
Water Pump	
Bolts	24 N·m (18 ft. lbs.)
Water In Fuel Sensor	
Sensor	3 N·m (20 in. lbs.)

SPECIAL TOOLS

5.9L DIESEL ENGINE

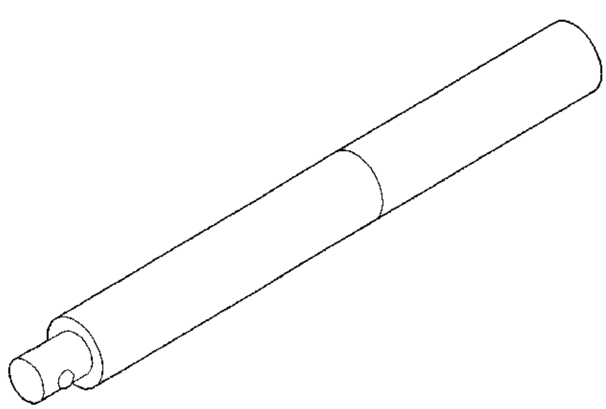
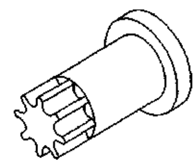
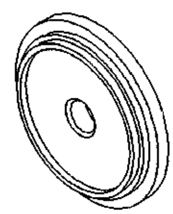


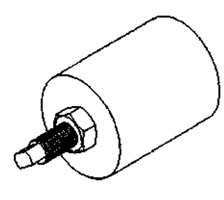
Fig. 239 Universal Driver Handle—C 4171



Crankshaft Barring Tool—7471B

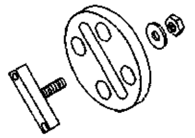


Crankshaft Front Oil Seal Installer—8281

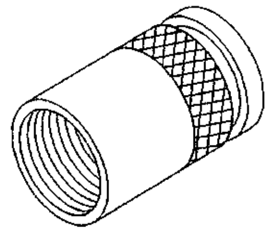


Injector Removal Tool—8318

SPECIAL TOOLS (Continued)



Valve Spring Compressor—8319



Injector Connector Removal Tool—8324

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EXHAUST SYSTEM AND TURBOCHARGER

CONTENTS

GENERAL INFORMATION

TURBOCHARGER SHUT-DOWN PROCEDURE

The most common turbocharger failure is bearing failure related to repeated hot shutdowns with inadequate "cool-down" periods. A sudden engine shut down after prolonged operation will result in the transfer of heat from the turbine section of the turbocharger to the bearing housing. This causes the oil to overheat and break down, which causes bearing and shaft damage the next time the vehicle is started.

Letting the engine idle after extended operation allows the turbine housing to cool to normal operating temperature. The following chart should be used as a guide in determining the amount of engine idle time required to sufficiently cool down the turbocharger before shut down, depending upon the type of driving and the amount of cargo.

EXHAUST SYSTEM

The diesel engine exhaust system consists of an engine exhaust manifold, turbocharger, exhaust pipe, resonator, extension pipe (if needed), muffler and exhaust tailpipe.

The exhaust manifold is a one piece design and is constructed of cast iron. Spacers are used between the fasteners and the manifold to reduce the impact of thermal stress on the manifold and fasteners.

The exhaust system must be properly aligned to prevent stress, leakage and body contact. If the system contacts any body panel, it may amplify objectionable noises from the engine or body.

When inspecting an exhaust system, critically inspect for cracked or loose joints, stripped screw or

TURBOCHARGER "COOL DOWN" CHART			
Driving Condition	**Load**	**Turbocharger Temperature**	**Idle Time (in minutes) Before Engine Shut Down**
Stop & Go	Empty	Cool	Less than 1
Stop & Go	Medium	Warm	1
Highway Speeds	Medium	Warm	2
City Traffic	Max. GCWR	Warm	3
Highway Speeds	Max. GCWR	Warm	4
Uphill Grade	Max. GCWR	HOT!!	5

GENERAL INFORMATION (Continued)

bolt threads, corrosion damage and worn, cracked or broken hangers. Replace all components that are badly corroded or damaged. DO NOT attempt to repair.

When replacement is required, use original equipment parts (or their equivalent). This will assure proper alignment and provide acceptable exhaust noise levels.

CAUTION: Avoid application of rust prevention compounds or undercoating materials to exhaust system floor pan exhaust heat shields. Light overspray near the edges is permitted. Application of coating will result in excessive floor pan temperatures and objectionable fumes.

DESCRIPTION AND OPERATION

AIR INTAKE / BOOST SYSTEM

The air intake system consists of the air cleaner/ housing assembly, turbocharger, charge air cooler piping, charge air cooler, intake air grid heater, and the intake manifold.

Intake air is drawn through the air cleaner and into the turbocharger compressor housing. Pressurized air from the turbocharger then flows forward through the charge air cooler (Fig. 1) located in front of the radiator. From the charge air cooler the air flows back into the intake manifold.

The charge air cooler is a heat exchanger that uses air flow from vehicle motion to dissipate heat from the intake air. As the turbocharger increases air pressure, the air temperature increases. Lowering the intake air temperature increases engine efficiency and power.

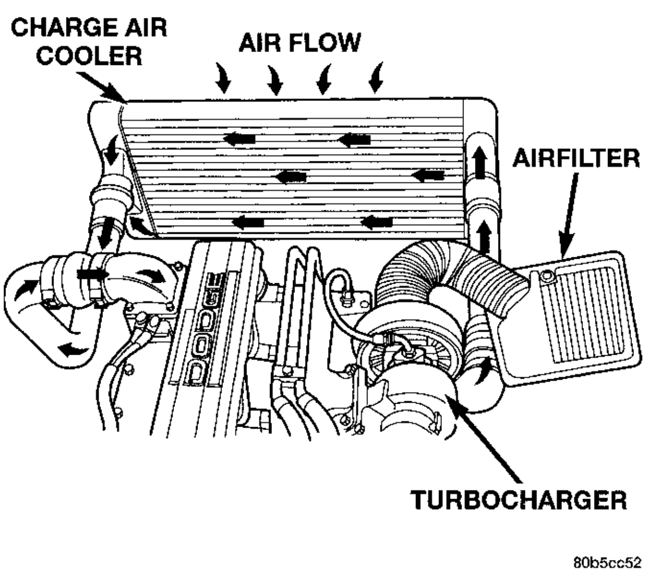

Fig. 1 Intake Air Circulation

CAUTION: The charge air cooler must be cleaned following turbocharger failure involving an oil leak. Oil leaking from the turbocharger can cause engine runaway, possibly leading to engine failure. Refer to Charge Air Cooler Removal and Installation in this group.

TURBOCHARGER

CAUTION: The turbocharger is a performance part and must not be tampered with. The wastegate bracket is an integral part of the turbocharger. Tampering with the wastegate components can reduce durability by increasing cylinder pressure and thermal loading due to incorrect inlet and exhaust manifold pressure. Poor fuel economy and failure to meet regulatory emissions laws may result. Increasing the turbocharger boost WILL NOT increase engine power.

DESCRIPTION

The turbocharger is an exhaust-driven supercharger which increases the pressure and density of the air entering the engine. With the increase of air entering the engine, more fuel can be injected into the cylinders, which creates more power during combustion.

The turbocharger assembly consists of four (4) major component systems (Fig. 2) (Fig. 3):

- Turbine section
- Compressor section
- Bearing housing
- Wastegate

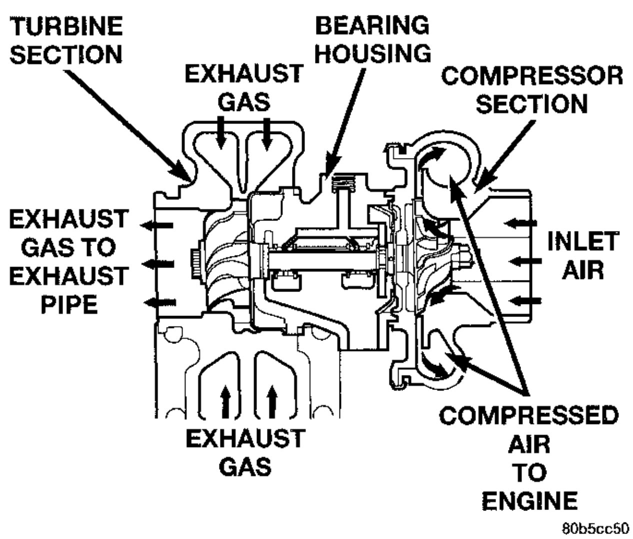

Fig. 2 Turbocharger Operation

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DESCRIPTION AND OPERATION (Continued)

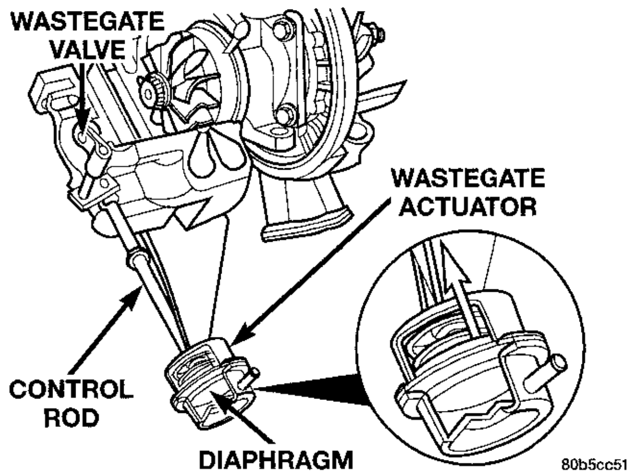

Fig. 3 Turbocharger Wastegate

OPERATION

Exhaust gas pressure and energy drive the turbine, which in turn drives a centrifugal compressor that compresses the inlet air, and forces the air into the engine through the charge air cooler and plumbing. Since heat is a by-product of this compression, the air must pass through a charge air cooler to cool the incoming air and maintain power and efficiency.

Increasing air flow to the engine provides:
- Improved engine performance
- Lower exhaust smoke density
- Improved operating economy
- Altitude compensation
- Noise reduction.

The turbocharger also uses a wastegate (Fig. 4), which regulates intake manifold air pressure and prevents over boosting at high engine speeds. When the wastegate valve is closed, all of the exhaust gases flow through the turbine wheel. As the intake manifold pressure increases, the wastegate actuator opens the valve, diverting some of the exhaust gases away from the turbine wheel. This limits turbine shaft speed and air output from the impeller.

LUBRICATION

The turbocharger is lubricated by engine oil that is pressurized, cooled, and filtered. The oil is delivered to the turbocharger by a supply line that is tapped into the oil filter head. The oil travels into the bearing housing, where it lubricates the shaft and bearings (Fig. 5). A return pipe at the bottom of the bearing housing, routes the engine oil back to the crankcase.

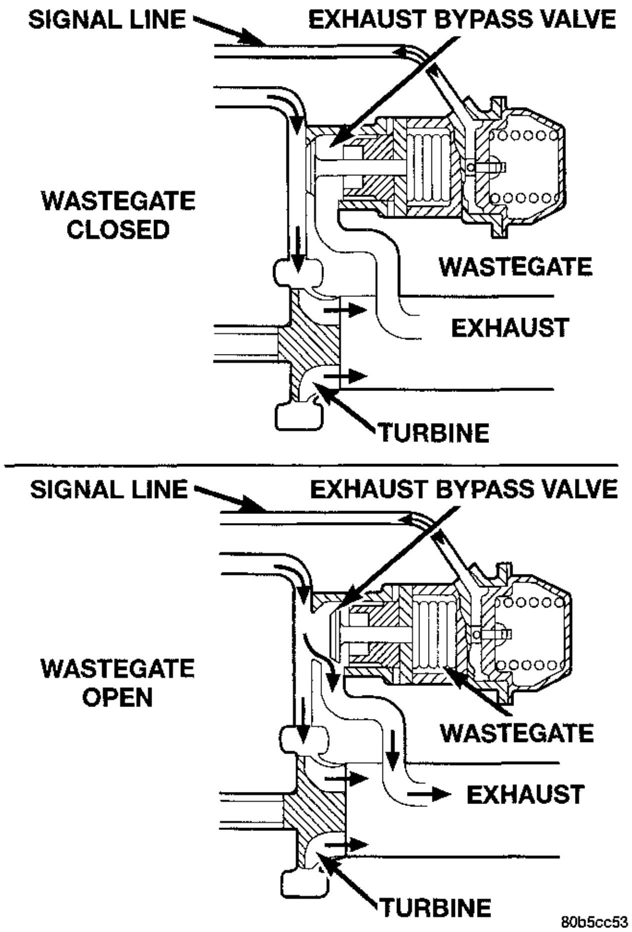

Fig. 4 Wastegate Operation

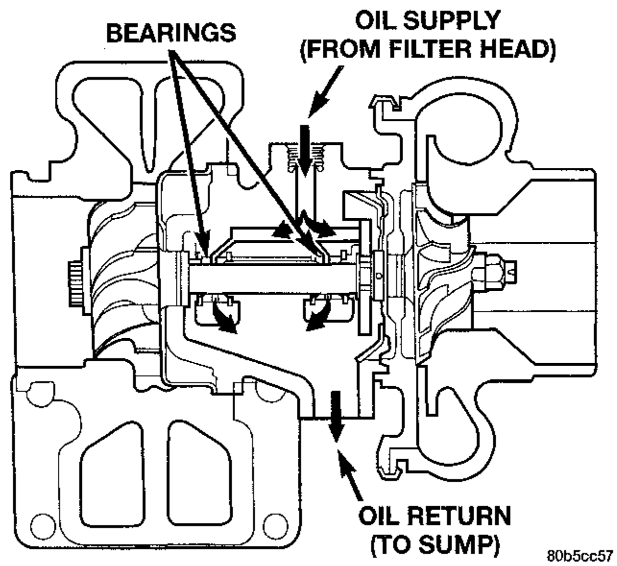

Fig. 5 Turbocharger Oil Supply and Drain

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DIAGNOSIS AND TESTING

EXHAUST SYSTEM DIAGNOSIS CHART

EXCESSIVE EXHAUST NOISE OR LEAKING EXHAUST GASES	
POSSIBLE CAUSE	**CORRECTION**
Leaks at pipe joints.	Tighten clamps/bolts at leaking joints.
Rusted or blown out muffler.	Replace muffler. Inspect exhaust system.
Broken or rusted out exhaust pipe.	Replace exhaust pipe.
Exhaust pipe leaking at manifold flange.	Tighten/replace flange attaching nuts/bolts.
Exhaust manifold cracked or broken.	Replace exhaust manifold.
Leak between exhaust manifold and cylinder head.	Tighten exhaust manifold to cylinder head bolts.
Turbocharger mounting flange cracked.	Remove turbocharger and inspect. Refer to Turbocharger Removal and Installation in this group.
Restriction in exhaust system.	Remove restriction, if possible. Replace restricted part if necessary.

TURBOCHARGER / AIR INTAKE SYSTEM DIAGNOSIS

CAUTION: Never operate the engine with the turbocharger air inlet hose and air cleaner housing removed. The turbocharger is a precision component and it is imperative that it always recieves filtered air. Otherwise, premature turbocharger and/or engine failure can result.

Proper turbocharger/air intake system diagnosis is critical when it involves low power or noise complaints. Low power, noise, and oil leak complaints can be easily misdiagnosed as a faulty turbocharger, resulting in the unnecessary replacement of an expensive component. Therefore, it is essential that the following diagnosis be performed prior to any turbocharger/air intake system service.

LOW POWER/NOISE DIAGNOSIS

NOTE: Before proceeding with turbocharger and boost system diagnosis, verify that there are no performance related DTC's or fuel and emission system faults present.

It is normal for the turbocharger to emit a "whine" sound that varies in intensity depending on engine speed and load. The sound is caused by the very high rotational speed of the rotor assembly (up to 130,000 rpm) and the method used to balance the rotor assembly during manufacturing. Consequently, the sound will be more audible at full speed.

Leaks in the air system intake and/or exhaust components can produce excessive noise. These noises are typically a high pitched "whine" or sucking sound, depending on which side of the compressor they are located. Lower pitched noises or rattles at low engine speeds may indicate debris in the system or an impeller-to-housing rubbing condition.

(1) Make sure engine is off (not running).

(2) Install a DRB III to the vehicle and check for any performance related DTC's. Repair DTC setting failures before further diagnosis. Refer to Group 25, Emission Control Systems for the correct procedures.

(3) Remove the air cleaner housing from the vehicle and inspect for obstructions. Replace the air filter as necessary. Refer to Group 14, Fuel System for air filter housing and Filter Minder® procedures.

(4) Inspect the turbocharger:

(a) Visually inspect the impeller and compressor wheel fins for nicks, cracks, or chips. Note: Some impellers may have a factory placed paint mark which, after normal operation, appears to be a crack. Remove this mark with a suitable solvent to verify that it is not a crack.

(b) Visually inspect the compressor and turbine housing for an impeller rubbing condition. Apply light side to side pressure to the nose of the impeller to see if contact with the housing will restrict impeller rotation. Replace the turbocharger if an impeller to housing rubbing condition exists.

(c) Measure rotor shaft axial end play and radial bearing clearances. Refer to procedure in this group. Replace turbocharger if measurements are outside of specifications.

(5) Inspect and test boost system for leaks:

(a) Visually inspect boost system for cracked tubes and rubber connectors, poor connections and

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DIAGNOSIS AND TESTING (Continued)

loose clamps. Verify torque at all boost system clamps at 8 N·m (71 in. lbs.) torque.

(b) Leak test boost system. Obtain the Charge Air Cooler Tester Kit #3824556 from Cummins® Service Products.

(I) Disconnect boost tube from the air inlet/intake manifold. Cap off the tube end.

(II) Install the appropriate test plug from the kit to the turbocharger air inlet.

(III) Apply 172 kPa (25 psi) to the boost system. Listen for leaks and repair as necessary. Use a solution of soap and water at connections and on suspect areas to help determine possible leak areas.

(IV) If the charge air cooler is suspected of leaking, remove the boost tubes and install the necessary cap and test plug from the CAC tester kit. Apply 172 kPa (25 psi) to the charge air cooler and replace if found to be leaking.

(6) Inspect the wastegate signal line for cracks and verify wastegate operation and adjustment. Refer to Wastegate Verification/Adjustment in this group.

(7) Perform the Boost Pressure Test to determine if there are any intake system restrictions, plugging, or damage. Refer to Group 14, Fuel System for the correct procedure.

TURBOCHARGER OIL LEAKS

Turbocharger oil leaks can be classified as one of two types: external or internal. External leaks are usually limited to the turbocharger oil supply line fitting and the oil drain tube flange and gasket. Internal leaks, however, are more complicated to detect. Many turbocharger internal oil leaks are caused by problems in systems outside of the turbocharger.

NOTE: A light trace of oil present in the turbine or compressor housing is acceptable and repair is not necessary. Repair is only necessary when oil is dripping or wet to the touch.

NOTE: When a component fails causing engine oil migration into the intake air/boost system, the charge air cooler and related tubing must be flushed. Refer to Charge Air Cooler Removal/Installation for the related procedures.

TURBOCHARGER OIL LEAK DIAGNOSIS CHARTS

EXTERNAL OIL LEAKS	
POSSIBLE CAUSE	**CORRECTION**
Oil supply line or o-ring leaking	Disconnect the oil supply line and inspect o-ring. Replace if necessary. Install and tighten line fitting to 20 N·m (133 in. lbs.) torque.
Oil drain tube leaking.	Inspect drain tube flange and gasket. Replace gasket if necessary.
Turbocharger bearing housing leaking.	Replace turbocharger assy.

INTERNAL LEAKS (OIL FOUND IN COMPRESSOR HOUSING)	
POSSIBLE CAUSE	**CORRECTION**
Dirty air cleaner or restricted air inlet system.	Inspect air cleaner, housing, and inlet duct for restriction. Repair/replace as necessary.
Foreign object in exhaust manifold.	Remove exhaust manifold and inspect for obstruction. Refer to Exhaust Manifold Removal and Installation in this group.
Restricted exhaust system.	Repair/replace restricted component as necessary.
Restricted turbocharger oil drain tube, causing engine oil to migrate past the seal.	Remove tube and inspect for obstructions.
Restricted crankcase breather.	Remove crankcase breather and inspect for obstructions.
Defective turbocharger compressor seal.	Replace turbocharger assy.
Engine mechanical problem.	Excessive crankcase pressure (blow-by). This condition does not allow the oil to drain, and oil is drawn past the compressor seal and into the engine. Refer to Group 9, Engine.

DIAGNOSIS AND TESTING (Continued)

INTERNAL LEAKS (OIL FOUND IN TURBINE HOUSING)	
POSSIBLE CAUSE	**CORRECTION**
Restricted turbocharger oil drain tube, causing engine oil to migrate past the seal.	Remove tube and inspect for obstructions.
Restricted crankcase breather.	Remove crankcase breather and inspect for obstructions.
Engine mechanical problem.	Remove turbocharger assy. Inspect turbine inlet for the presence of engine oil. If oil is present, then engine oil consumption problem exists. Refer to Group 9, Engine. If no oil is present at turbine inlet, replace turbocharger.
Defective turbocharger turbine seal.	Replace turbocharger assy.

REMOVAL AND INSTALLATION

EXHAUST PIPE

WARNING: IF TORCHES ARE USED WHEN WORKING ON THE EXHAUST SYSTEM, DO NOT ALLOW THE FALME NEAR THE FUEL LINES.

REMOVAL

(1) Disconnect the battery negative cables.
(2) Raise and support the vehicle on a hoist.
(3) Saturate the bolts and nuts with heat valve lubricant. Allow 5 minutes for penetration.
(4) Remove the exhaust pipe-to-extension pipe clamp. Separate the exhaust pipe and extension pipe.
(5) Remove the exhaust pipe-to-turbocharger elbow bolts (Fig. 6).
(6) Remove the exhaust pipe from the transmission support (Fig. 6).

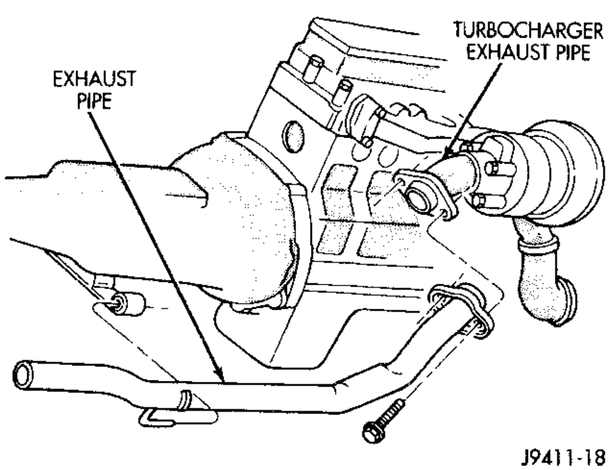

Fig. 6 Exhaust Pipe Removal/Installation

INSTALLATION

(1) Install the exhaust pipe into the transmission support and onto the turbocharger flange (Fig. 6).
(2) Install the exhaust pipe-to-turbocharger elbow bolts and tighten to 34 N·m (25 ft. lbs.) torque.
(3) Install the extension pipe and clamp to the exhaust pipe using a new clamp and tighten the clamp nuts to 43 N·m (32 ft. lbs.) torque.
(4) Lower the vehicle.
(5) Connect the battery negative cables.
(6) Start the engine and inspect for exhaust leaks and exhaust system contact with the body panels. Adjust the alignment, if needed.

RESONATOR

WARNING: IF TORCHES ARE USED WHEN WORKING ON THE EXHAUST SYSTEM, DO NOT ALLOW THE FLAME NEAR THE FUEL LINES.

REMOVAL

(1) Disconnect the battery negative cables.
(2) Raise vehicle on hoist.
(3) Remove the exhaust clamps from the resonator to extension pipes (Fig. 7).
(4) Separate the resonator from the front and rear extension pipes (Fig. 7) and remove the resonator from the vehicle.

INSTALLATION

(1) Assemble the resonator to the front and rear extension pipes (Fig. 7).
(2) Install new exhaust clamps, align the exhaust system, and tighten the exhaust clamps to 43 N·m (32 ft. lbs.) torque.
(3) Lower the vehicle.
(4) Connect the battery negative cables.
(5) Start the engine and inspect for exhaust leaks.

MUFFLER

WARNING: IF TORCHES ARE USED WHEN WORKING ON THE EXHAUST SYSTEM, DO NOT ALLOW THE FLAME NEAR THE FUEL LINES.

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REMOVAL AND INSTALLATION (Continued)

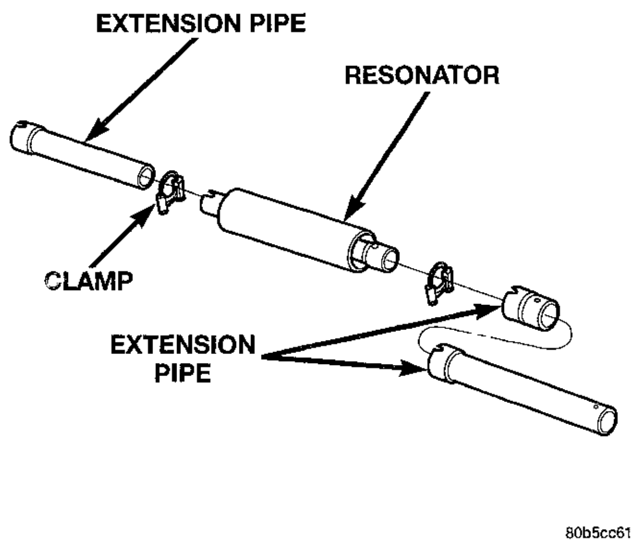

Fig. 7 Resonator Removal/Installation

REMOVAL

(1) Disconnect the battery negative cables.
(2) Raise and support the vehicle.
(3) Remove the muffler to tail pipe and extension pipe clamps (Fig. 8).
(4) Disconnect the muffler from the hanger isolators (Fig. 8).
(5) Disconnect the muffler from the tailpipe.
(6) Disconnect the muffler from the extension pipe and remove from the vehicle..

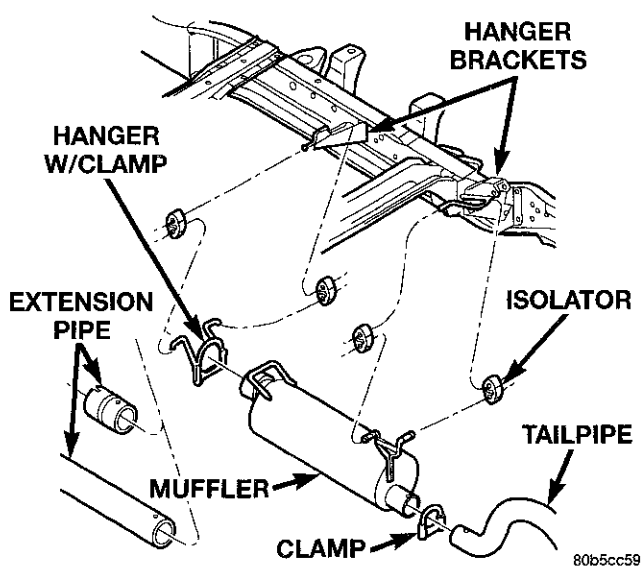

Fig. 8 Muffler Removal/Installation

INSTALLATION

(1) Install the muffler hanger rods into the isolators (Fig. 8).
(2) Install the muffler into the extension pipe.
(3) Install the muffler into the tail pipe.
(4) Install the exhaust clamps, align the exhaust system, and tighten the exhaust clamps to 43 N·m (32 ft. lbs.) torque.
(5) Lower the vehicle.
(6) Connect the battery negative cables.
(7) Start the engine and inspect for exhaust leaks and exhaust system contact with the body panels. Adjust the alignment, if needed.

TAILPIPE

WARNING: IF TORCHES ARE USED WHEN WORKING ON THE EXHAUST SYSTEM, DO NOT ALLOW THE FLAME NEAR THE FUEL LINES.

REMOVAL

(1) Disconnect the battery negative cables.
(2) Raise and support the vehicle.
(3) Saturate the clamp nuts with heat valve lubricant. Allow 5 minutes for penetration.
(4) Disconnect the exhaust tailpipe support hanger isolators (Fig. 9).
(5) Remove the muffler-to-tailpipe clamps (Fig. 9).
(6) Remove the tailpipe from the vehicle.

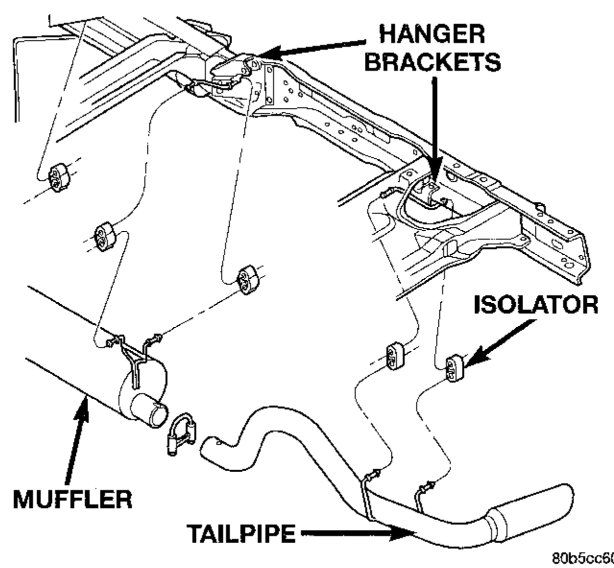

Fig. 9 Tailpipe Removal/Installation

REMOVAL AND INSTALLATION (Continued)

INSTALLATION

(1) Install the tailpipe into the muffler.

(2) Install the tailpipe hanger rods into the isolators (Fig. 9)

(3) Install the exhaust clamp, align the exhaust system, and tighten the clamp 43 N·m (32 ft. lbs.) torque.

(4) Lower the vehicle.

(5) Connect the battery negative cables.

(6) Start the engine and inspect for exhaust leaks and exhaust system contact with the body panels. Adjust the alignment, if needed.

HEAT SHIELDS

REMOVAL

(1) Raise and support the vehicle.

(2) Remove the nuts or bolts holding the exhaust heat shield to the floor pan, crossmember or bracket.

(3) Slide the shield out around the exhaust system.

INSTALLATION

(1) Position the exhaust heat shield to the floor pan, crossmember or bracket and install the nuts or bolts.

(2) Tighten the nuts and bolts.

(3) Lower the vehicle.

EXHAUST MANIFOLD

REMOVAL

(1) Disconnect the battery negative cables.

(2) Raise vehicle on hoist.

(3) Disconnect the exhaust pipe from the turbocharger elbow (Fig. 10).

(4) Lower vehicle.

(5) Disconnect the turbocharger air inlet hose (Fig. 11).

(6) Disconnect the turbocharger oil supply line and the oil drain tube from the turbocharger (Fig. 12).

(7) Disconnect the charge air cooler inlet pipe from the turbocharger (Fig. 12).

(8) Remove the turbocharger and gasket from the exhaust manifold.

(9) Remove the cab heater return pipe nut from the exhaust manifold stud. Position the tube out of the way.

(10) Remove the exhaust manifold-to-cylinder head bolts and spacers (Fig. 13).

(11) Remove the exhaust manifold and gaskets (Fig. 13).

CLEANING

Clean the cylinder head and exhaust manifold sealing surfaces with a suitable scraper. Use a Scotch-Brite™ pad or equivalent.

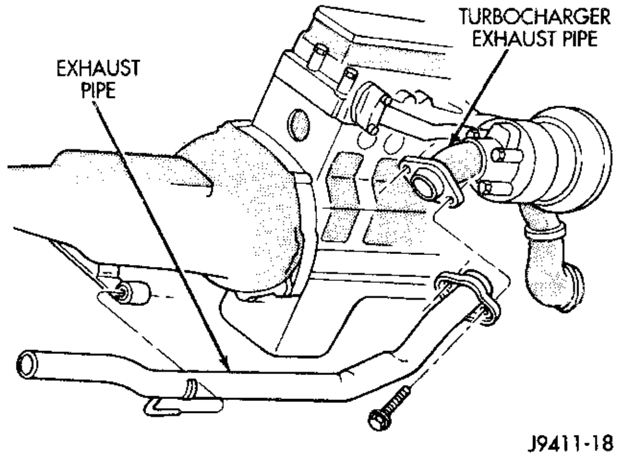

Fig. 10 Exhaust Pipe

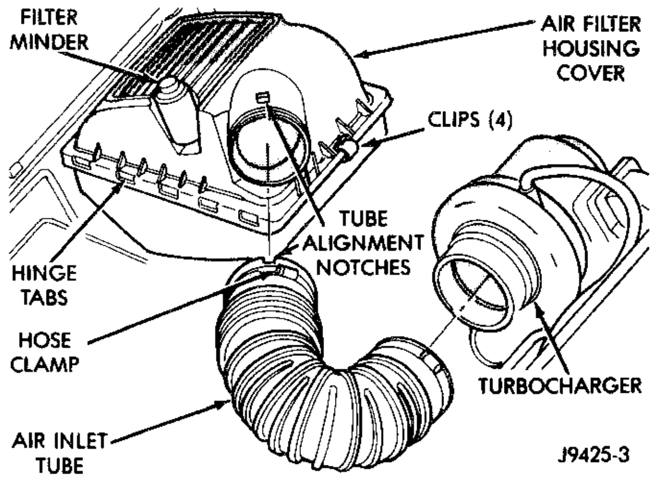

Fig. 11 Turbocharger Air Inlet Hose

INSPECTION

Inspect the exhaust manifold for cracks. Measure the exhaust manifold for flatness. Place a ruler over all of the exhaust ports and insert a feeler gauge between the port flange and the ruler.

INSTALLATION

(1) Using new gaskets, install the exhaust manifold and gaskets. Install the bolts and spacers and tighten the bolts in the sequence shown in (Fig. 13) to 43 N·m (32 ft. lbs.) torque.

(2) Install the cab heater return hose to the manifold bolt stud. Tighten the nut to 24 N·m (18 ft. lbs.) torque.

(3) Install the turbocharger. Apply anti-seize to the studs and then tighten the turbocharger mounting nuts to 32 N·m (24 ft. lbs.) torque.

(4) Install the oil drain tube and oil supply line to the turbocharger. Tighten the drain tube bolts to 24 N·m (18 ft. lbs.) torque.

REMOVAL AND INSTALLATION (Continued)

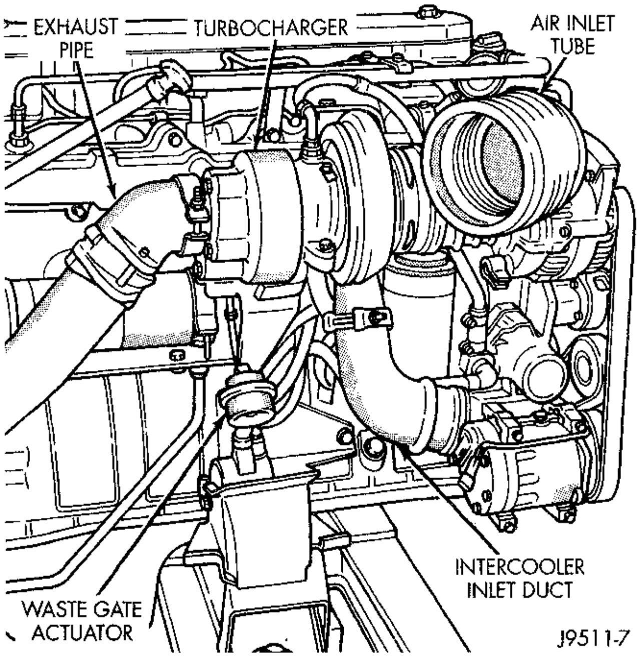

Fig. 12 Oil Supply Line and Charge Air Cooler Inlet Duct

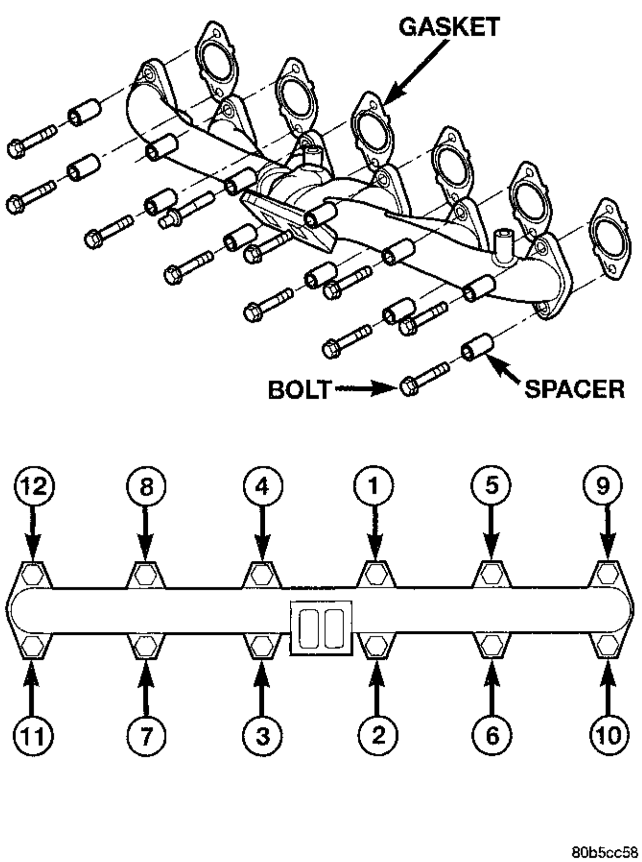

Fig. 13 Exhaust Manifold and Gaskets

EXHAUST MANIFOLD FLATNESS
0.20 mm (0.008 in.) MAX.

(5) **Pre-lube the turbocharger.** Pour 50 to 60 cc (2 to 3 oz.) clean engine oil in the oil supply line fitting. Rotate the turbocharger impeller by hand to distrubute the oil thoroughly.

(6) Install and tighten the oil supply line fitting nut to 20 N·m (133 in. lbs.) torque.

(7) Position the charge air cooler inlet pipe to the turbocharger. With the clamp in position, tighten the clamp nut to 8 N·m (72 in. lbs.) torque.

(8) Position the air inlet hose to the turbocharger (Fig. 11). Tighten the clamp to 8 N·m (72 in. lbs.) torque.

(9) Raise vehicle on hoist.

(10) Connect the exhaust pipe to the turbocharger (Fig. 10) and tighten the bolts to 34 N·m (25 ft. lbs.) torque.

(11) Lower the vehicle.

(12) Connect the battery negative cables.

(13) Start the engine to check for leaks.

INTAKE MANIFOLD COVER

REMOVAL

(1) Disconnect the battery negative cables.

(2) Remove the charge air cooler outlet tube from the air inlet housing (Fig. 14).

(3) Remove the engine oil dipstick tube mounting bolt (Fig. 14). Position dipstick tube to the side.

(4) Disconnect the air grid heater power cables at the cable mounting studs (Fig. 15).

(5) Remove the four (4) air inlet housing mounting bolts (Fig. 15) and remove the housing from top of the heater elements.

(6) Remove the intake air grid heater from the manifold (Fig. 16).

(7) Remove the high pressure fuel lines. Refer to Group 14, Fuel System for the correct procedure.

(8) Remove the remaining intake manifold cover-to-cylinder head bolts.

(9) Remove the intake manifold cover and gasket. Keep the gasket material and any other material out of the air intake.

(10) Clean the intake manifold cover and cylinder head sealing surface.

INSTALLATION

(1) Using a new gasket, install the intake manifold cover.

(2) Install the cover-to-cylinder head bolts that do not hold down the high pressure fuel line support brackets. Tighten the bolts to 24 N·m (18 ft. lbs.) torque.

REMOVAL AND INSTALLATION (Continued)

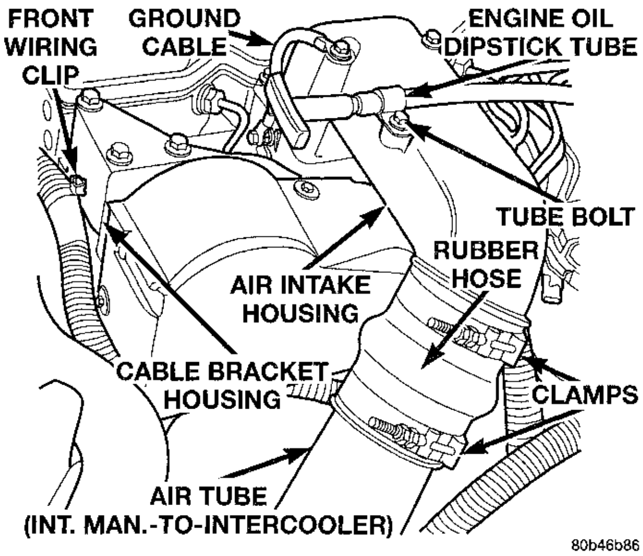

Fig. 14 Charge Air Cooler Air Tube

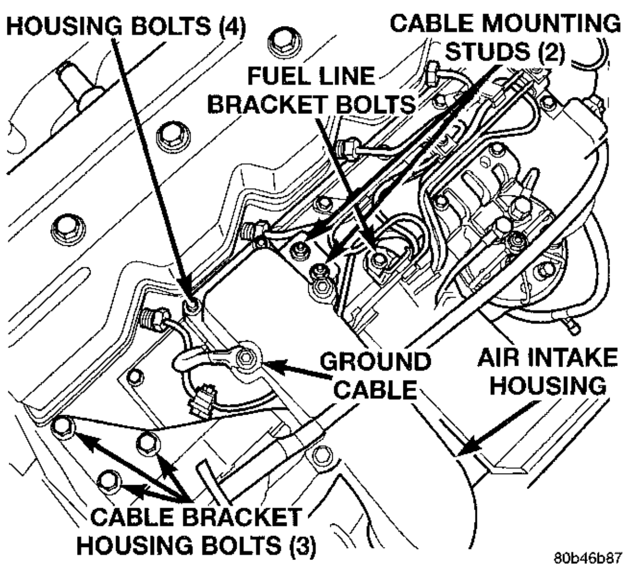

Fig. 15 Air Inlet Housing

(3) Install the high pressure fuel lines. Refer to Group 14, Fuel System for the correct procedure.

(4) Install the high pressure fuel line support bracket-to-intake manifold cover bolts and tighten to 24 N·m (18 ft. lbs.) torque.

(5) Using two (2) new gaskets, install the intake air grid heater and air inlet housing (Fig. 15). Position the ground cable and install and tighten the bolts to 24 N·m (18 ft. lbs.) torque.

(6) Install and tighten the air intake heater power supply nuts to 14 N·m (120 in. lbs.) torque.

(7) Install the engine oil dipstick tube and mounting bolt (Fig. 14).

(8) Position the charge air cooler outlet tube onto the air inlet housing (Fig. 14). Tighten the clamps to 8 N·m (72 in. lbs.) torque.

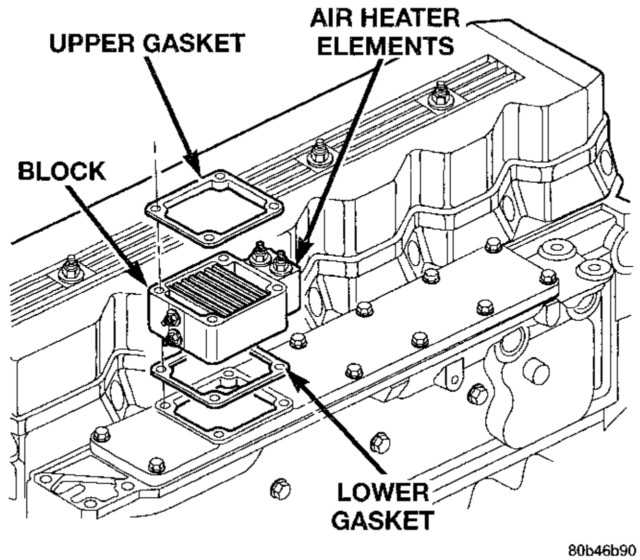

Fig. 16 Intake Air Grid Heater

(9) Perform the fuel system air bleed procedure. Refer to Air Bleed Procedure in Group 14, Fuel System.

(10) Connect the battery negative cables.

TURBOCHARGER

CAUTION: Failed turbochargers introduce engine oil and metal into the charge air cooler and air intake system. The charge air cooler and air intake system MUST be flushed of oil and metallic debris to prevent engine runaway and/or damage.

REMOVAL

(1) Disconnect the battery negative cables.

(2) Raise vehicle on hoist.

(3) Disconnect the exhaust pipe from the turbocharger elbow (Fig. 17).

(4) Lower vehicle.

(5) Disconnect the turbocharger air inlet hose (Fig. 18).

(6) Disconnect the turbocharger oil supply line and the oil drain tube from the turbocharger (Fig. 19).

(7) Disconnect the charge air cooler inlet pipe from the turbocharger (Fig. 19).

(8) Remove the turbocharger and gasket from the exhaust manifold.

(9) If the turbocharger is not to be installed immediately, cover the opening to prevent material from entering into the manifold.

(10) If replacing the turbocharger, transfer the discharge elbow and clamp to the new assembly.

(11) Clean and inspect the sealing surface.

REMOVAL AND INSTALLATION (Continued)

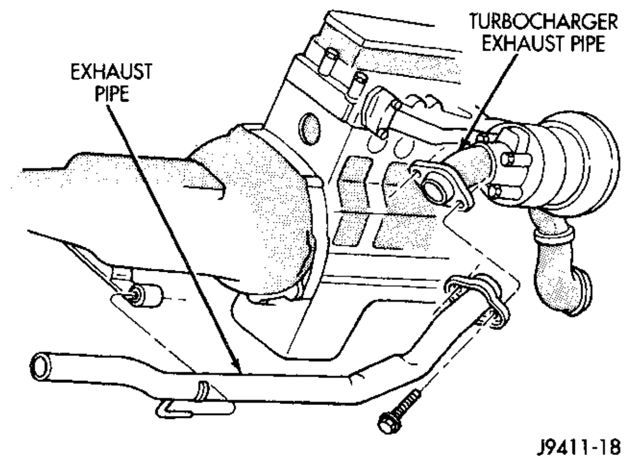

Fig. 17 Exhaust Pipe

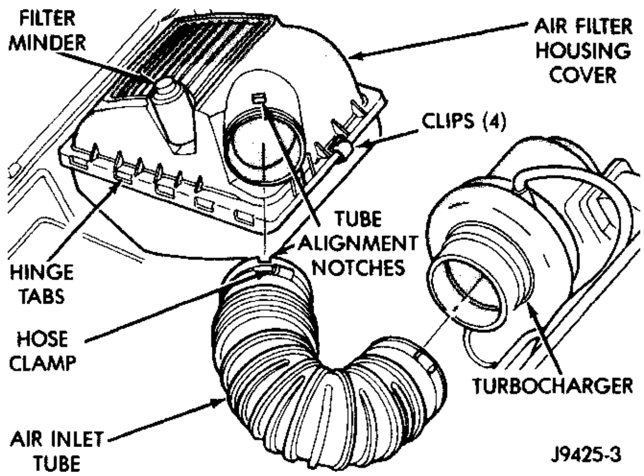

Fig. 18 Turbocharger Air Inlet Hose

CAUTION: The turbocharger is only serviced as an assembly. Do not attempt to repair the turbocharger as turbocharger and/or engine damage can result.

CLEANING

Clean the turbocharger and exhaust manifold mounting surfaces with a suitable scraper.

INSPECTION

Visually inspect the turbocharger and exhaust manifold gasket surfaces. Replace stripped or eroded mounting studs.

(1) Visually inspect the turbocharger for cracks. The following cracks are NOT acceptable:

- Cracks in the turbine and compressor housing that go completely through.
- Cracks in the mounting flange that are longer than 15 mm (0.6 in.).
- Cracks in the mounting flange that intersect bolt through-holes.

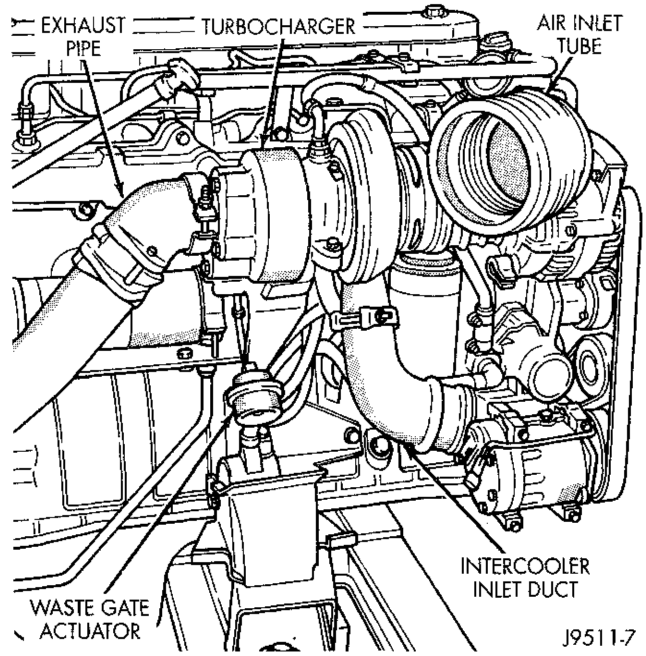

Fig. 19 Oil Supply Line and Charge Air Cooler Inlet Duct

- Two (2) Cracks in the mounting flange that are closer than 6.4 mm (0.25 in.) together.

(2) Inspect the turbocharger compressor housing for an impeller rubbing condition (Fig. 20). Replace the turbocharger if the condition exists.

(3) Measure the turbocharger axial end play:

(a) Install a dial indicator as shown in (Fig. 21). Zero the indicator at one end of travel.

(b) Move the impeller shaft fore and aft and record the measurement. Allowable end play is 0.038 mm (0.0015 in.) MIN. and 0.089 mm (0.0035 in.) MAX. If the recorded measurement falls outside these parameters, replace the turbocharger assembly.

(4) Measure the turbocharger bearing radial clearance:

(a) Insert a narrow blade or wire style feeler gauge between the compressor wheel and the housing (Fig. 22).

(b) Gently push the compressor wheel toward the housing and record the clearance.

(c) With the feeler gauge in the same location, gently push the compressor wheel away from the housing and again record the clearance.

(d) Subtract the smaller clearance from the larger clearance. This is the radial bearing clearance.

(e) Allowable radial bearing clearance is 0.326 mm (0.0128 in.) MIN. and 0.496 mm (0.0195 in.) MAX. If the recorded measurement falls outside these specifications, replace the turbocharger assy.

REMOVAL AND INSTALLATION (Continued)

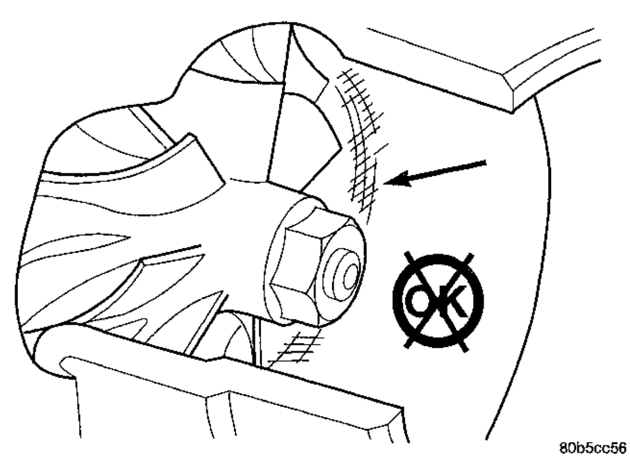

Fig. 20 Inspect Compressor Housing for Impeller Rubbing Condition

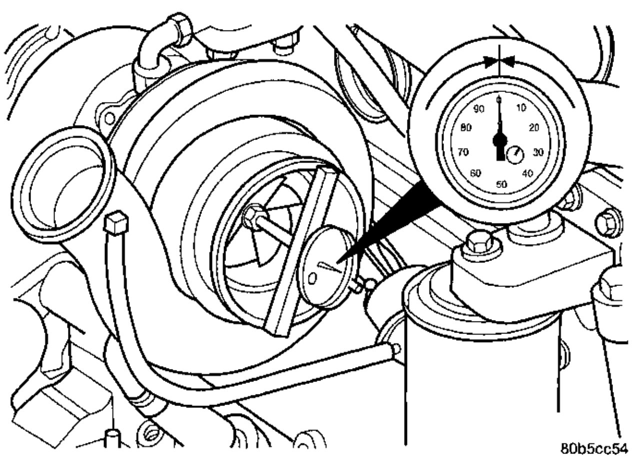

Fig. 21 Measure Turbocharger Axial End Play

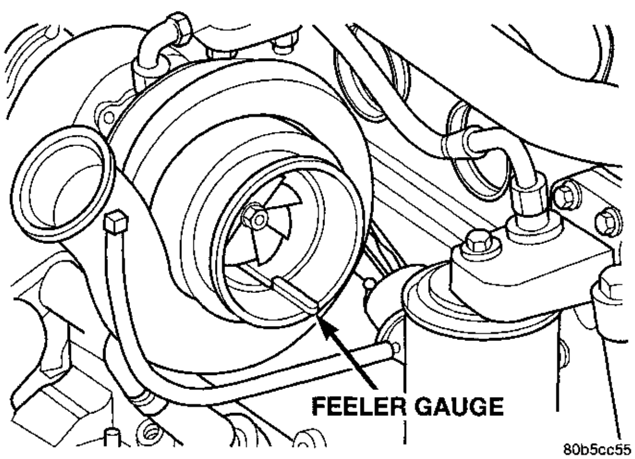

Fig. 22 Measure Turbocharger Bearing Radial Clearance

INSTALLATION

(1) Install the turbocharger. Apply anti-seize to the studs and then tighten the turbocharger mounting nuts to 32 N·m (24 ft. lbs.) torque.

(2) Install the oil drain tube and oil supply line to the turbocharger (Fig. 19). Tighten the drain tube bolts to 24 N·m (18 ft. lbs.) torque.

(3) **Pre-lube the turbocharger.** Pour 50 to 60 cc (2 to 3 oz.) clean engine oil in the oil supply line fitting. Carefully rotate the turbocharger impeller by hand to distribute the oil thoroughly.

(4) Install and tighten the oil supply line fitting nut to 20 N·m (133 in. lbs.) torque.

(5) Position the charge air cooler inlet pipe to the turbocharger. With the clamp in position, tighten the clamp nut to 8 N·m (72 in. lbs.) torque.

(6) Position the air inlet hose to the turbocharger (Fig. 18). Tighten the clamp to 8 N·m (72 in. lbs.) torque.

(7) Raise vehicle on hoist.

(8) Connect the exhaust pipe to the turbocharger (Fig. 17) and tighten the bolts to 34 N·m (25 ft. lbs.) torque.

(9) Lower the vehicle.

(10) Connect the battery negative cables.

(11) Start the engine to check for leaks.

CHARGE AIR COOLER

REMOVAL

WARNING: IF THE ENGINE WAS JUST TURNED OFF, THE AIR INTAKE SYSTEM TUBES MAY BE HOT.

(1) Disconnect the battery negative cables.

(2) Remove the front bumper. Refer to Group 13, Frame and Bumper for the correct procedure.

(3) Remove the front support bracket.

(4) Discharge the A/C system and remove the A/C condenser (Fig. 23) (if A/C equipped). Refer to Group 24, Heating and Air Conditioning for the correct procedures.

(5) Remove the transmission auxiliary cooler (Fig. 23) (if equipped). Refer to Group 7, Cooling System for the correct procedure.

(6) Remove the boost tubes from the charge air cooler (Fig. 24).

(7) Remove the charge air cooler bolts. Pivot the charge air cooler forward and up to remove.

CLEANING

(1) If the engine experiences a turbocharger failure or any other situation where oil or debris get into the charge air cooler, the charge air cooler must be cleaned internally.

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REMOVAL AND INSTALLATION (Continued)

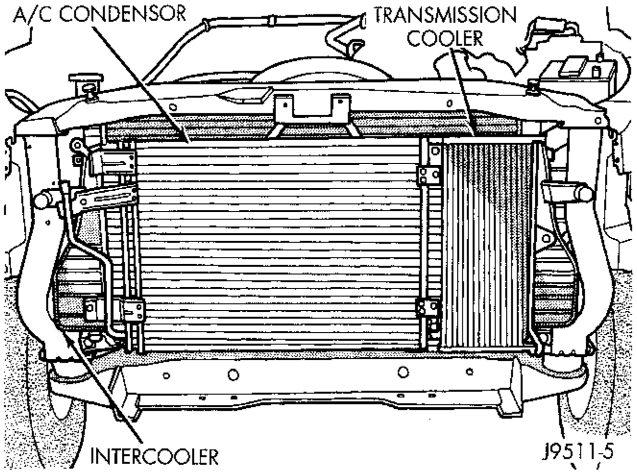

Fig. 23 Condenser and Transmission Auxiliary Cooler

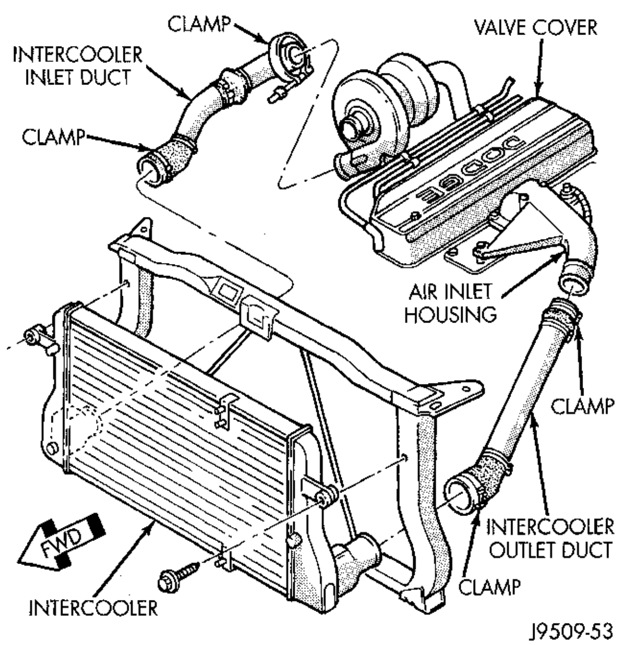

Fig. 24 Air Intake System Tubes

CAUTION: Do not use caustic cleaners to clean the charge air cooler. Damage to the charge air cooler will result.

(2) Position the charge air cooler so the inlet and outlet tubes are vertical.

(3) Flush the cooler internally with solvent in the direction opposite of normal air flow.

(4) Shake the cooler and lightly tap on the end tanks with a rubber mallet to dislodge trapped debris.

(5) Continue flushing until all debris or oil are removed.

(6) Rinse the cooler with hot soapy water to remove any remaining solvent.

(7) Rinse thoroughly with clean water and blow dry with compressed air.

INSPECTION

Visually inspect the charge air cooler for cracks, holes, or damage. Inspect the tubes, fins, and welds for tears, breaks, or other damage.

Pressure test the charge air cooler, using Charge Air Cooler Tester Kit #3824556. This kit is available through Cummins® Service Products. Instructions are provided with the kit.

INSTALLATION

(1) Position the charge air cooler. Install the bolts and tighten to 2 N·m (17 in. lbs.) torque.

(2) Install the air intake system tubes to the charge air cooler. With the clamps in position, tighten the clamps to 8 N·m (72 in. lbs.) torque.

(3) Install the transmission auxiliary cooler (if equipped). Refer to Group 7, Cooling for the correct procedures.

(4) Install the A/C condenser (if A/C equipped). Refer to Group 24, Heating and Air Conditioning for the correct procedures.

(5) Install the front support bracket. Install and tighten the bolts.

(6) Install the front bumper. Refer to Group 13, Frame and Bumpers for the correct procedures.

(7) Connect the battery negative cables.

(8) Start engine and check for boost system leaks.

CLEANING AND INSPECTION

CHARGE AIR COOLER

CLEANING

(1) If the engine experiences a turbocharger failure or any other situation where oil or debris get into the charge air cooler, the charge air cooler must be cleaned internally.

CAUTION: Do not use caustic cleaners to clean the charge air cooler. Damage to the charge air cooler will result.

NOTE: If internal debris cannot be removed from the cooler, the charge air cooler MUST be replaced.

(2) Position the charge air cooler so the inlet and outlet tubes are vertical.

(3) Flush the cooler internally with solvent in the direction opposite of normal air flow.

(4) Shake the cooler and lightly tap on the end tanks with a rubber mallet to dislodge trapped debris.

(5) Continue flushing until all debris or oil are removed.

CLEANING AND INSPECTION (Continued)

(6) Rinse the cooler with hot soapy water to remove any remaining solvent.

(7) Rinse thoroughly with clean water and blow dry with compressed air.

INSPECTION

Visually inspect the charge air cooler for cracks, holes, or damage. Inspect the tubes, fins, and welds for tears, breaks, or other damage. Replace the charge air cooler if damage is found.

Pressure test the charge air cooler, using Charge Air Cooler Tester Kit #3824556. This kit is available through Cummins® Service Products. Instructions are provided with the kit.

TURBOCHARGER

CLEANING

Clean the turbocharger and exhaust manifold mounting surfaces with a suitable scraper.

INSPECTION

Visually inspect the turbocharger and exhaust manifold gasket surfaces. Replace stripped or eroded mounting studs.

(1) Visually inspect the turbocharger for cracks. The following cracks are NOT acceptable:

- Cracks in the turbine and compressor housing that go completely through.
- Cracks in the mounting flange that are longer than 15 mm (0.6 in.).
- Cracks in the mounting flange that intersect bolt through-holes.
- Two (2) Cracks in the mounting flange that are closer than 6.4 mm (0.25 in.) together.

(2) Visually inspect the impeller and compressor wheel fins for nicks, cracks, or chips. Note: Some impellers may have a factory placed paint mark which, after normal operation, appears to be a crack. Remove this mark with a suitable solvent to verify that it is not a crack.

(3) Visually inspect the turbocharger compressor housing for an impeller rubbing condition (Fig. 25). Replace the turbocharger if the condition exists.

(4) Measure the turbocharger axial end play:

(a) Install a dial indicator as shown in (Fig. 26). Zero the indicator at one end of travel.

(b) Move the impeller shaft fore and aft and record the measurement. Allowable end play is 0.038 mm (0.0015 in.) MIN. and 0.089 mm (0.0035 in.) MAX. If the recorded measurement falls outside these parameters, replace the turbocharger assembly.

(5) Measure the turbocharger bearing radial clearance:

(a) Insert a narrow blade or wire style feeler gauge between the compressor wheel and the housing (Fig. 27).

(b) Gently push the compresser wheel toward the housing and record the clearance.

(c) With the feeler gauge in the same location, gently push the compressor wheel away from the housing and again record the clearance.

(d) Subtract the smaller clearance from the larger clearance. This is the radial bearing clearance.

(e) Allowable radial bearing clearance is 0.326 mm (0.0128 in.) MIN. and 0.496 mm (0.0195 in.) MAX. If the recorded measurement falls outside these specifications, replace the turbocharger assy.

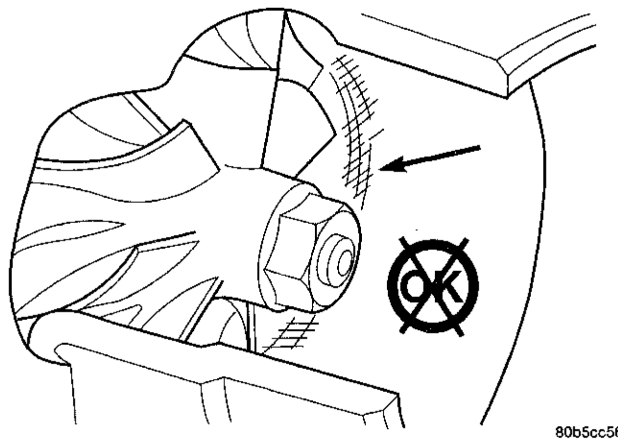

Fig. 25 Inspect Compressor Housing for Impeller Rubbing Condition

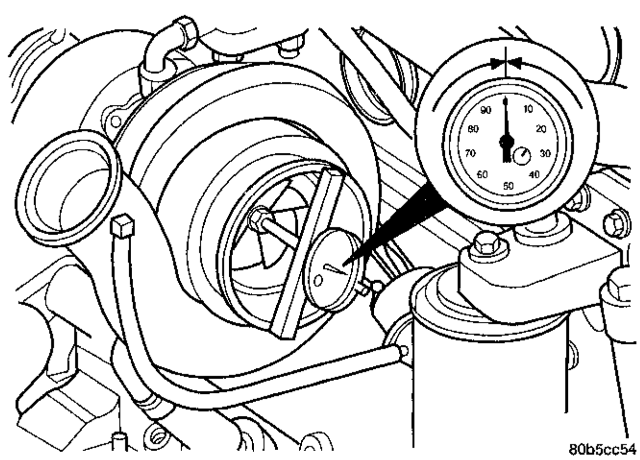

Fig. 26 Measure Turbocharger Axial End Play

EXHAUST MANIFOLD

CLEANING

Clean the cylinder head and exhaust manifold sealing surfaces with a suitable scraper. Use a Scotch-Brite® pad or equivalent.

CLEANING AND INSPECTION (Continued)

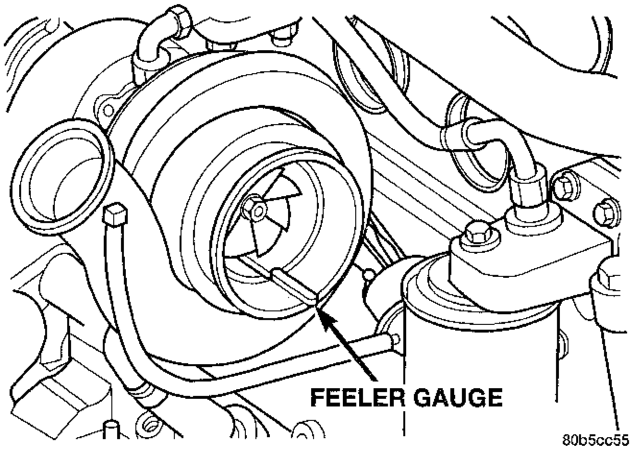

Fig. 27 Measure Turbocharger Bearing Radial Clearance

INSPECTION

Inspect the exhaust manifold for cracks. Measure the exhaust manifold for flatness. Place a ruler over all of the exhaust ports and insert a feeler gauge between the port flange and the ruler. Replace any manifold that is cracked or warped.

EXHAUST MANIFOLD FLATNESS
0.20 mm (0.008 in.) MAX.

ADJUSTMENTS

WASTEGATE ADJUSTMENT

The wastegate turbocharger provides additional low speed boost without over-boost at high speeds. This increases low speed torque and better driveability.

Proper adjustment of the wastegate assembly is critical to the operation of the wastegate turbocharger (Fig. 28). The control rod is set at the factory and no adjustment should be necessary, unless wastegate assembly is damaged.

CAUTION: DO NOT adjust the wastegate so that higher pressures are required to open the wastegate valve. The turbocharger speed will be increased and can cause damage to the turbocharger and cause a loss of engine performance.

(1) Remove signal line from wastegate actuator. **The signal line may be installed with tamper-proof clamps. These can be discarded and replaced with standard worm-gear clamps.**

(2) Connect regulated air pressure to the wastegate actuator (Fig. 29). Install a dial indicator to measure the control rod movement. Apply 103 - 138 kPa (15 - 20 psi) to seat the components and take

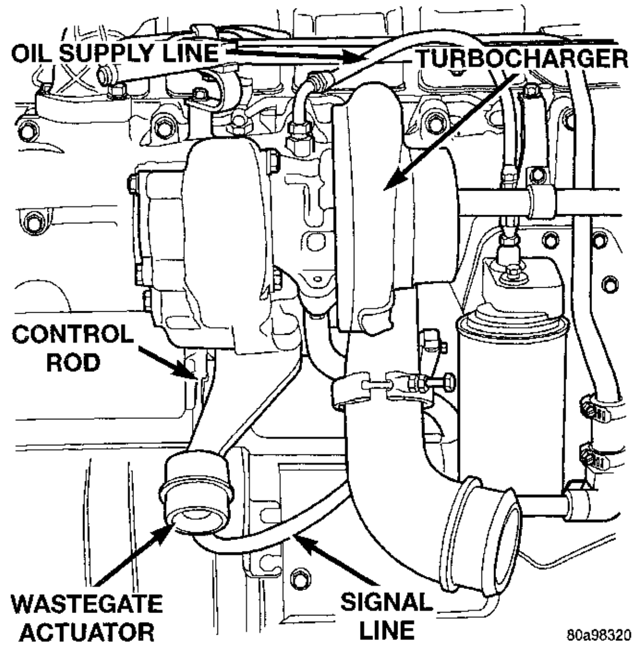

Fig. 28 Wastegate Turbocharger

any slack out of the control rod. Release the air pressure and zero the dial indicator gauge.

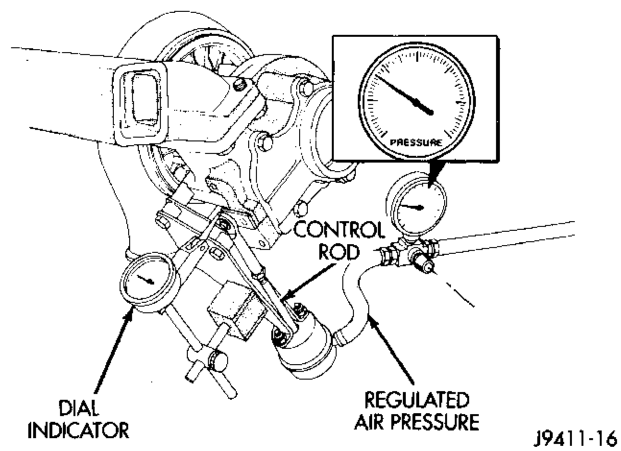

Fig. 29 Wastegate and Dial Indicator

(3) Apply 144.8 kPa (21 psi) air pressure to the actuator. The control rod should move 0.33 - 1.27 mm (0.013 - 0.050 in) total travel. If the rod travel is out of limits, the wastegate linkage must be adjusted.

(4) To adjust the wastegate linkage, apply air pressure to the actuator to release the spring tension on the lever. Remove the control rod from the wastegate lever (Fig. 30). Pull the wastegate lever toward the actuator (closed position).

(5) Adjust the length of the clevis end of the control rod to align the clevis pin hole to the wastegate lever. Install the adjusting link and retaining clip (Fig. 30).

ADJUSTMENTS (Continued)

CAUTION: DO NOT pull, push or force the alignment of the clevis pin.

(6) After the adjustment is complete, tighten the actuator rod jam nut.

(7) Recheck the travel on the wastegate control rod. Adjust, if necessary.

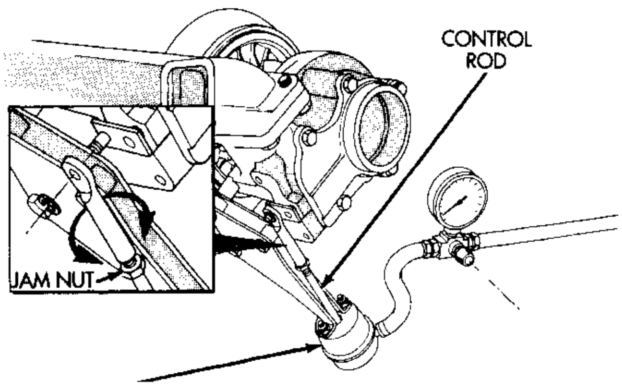

Fig. 30 Adjustment of Wastegate Actuator

SPECIFICATIONS

TORQUE SPECIFICATIONS

DESCRIPTION	TORQUE
Air Grid Heater Power Supply	
Nuts	14 N·m (124 in. lbs.)
Air Inlet Housing	
Bolts	24 N·m (18 ft. lbs.)
Charge Air Cooler/Boost System Pipes	
Clamps	8 N·m (72 in. lbs.)
Charge Air Cooler Mounting	
Bolts	2 N·m (17 in. lbs.)
Exhaust Clamps (All)	
Nuts	43 N·m (32 ft. lbs.)
Exhaust Manifold to Cylinder Head	
Bolts	43 N·m (32 ft. lbs.)
Exhaust Pipe to Manifold	
Bolts	34 N·m (25 ft. lbs.)
Intake Manifold Cover	
Bolts	24 N·m (18 ft. lbs.)
Turbocharger-to-Exhaust Manifold	
Nuts	32 N·m (24 ft. lbs.)
Turbocharger Oil Drain Tube	
Bolts	24 N·m (18 ft. lbs.)
Turbocharger Oil Supply Line	
Fitting	15 N·m (133 in. lbs.)
Turbocharger V-Band Clamp	
Nut	9 N·m (75 in. lbs.)

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FUEL SYSTEM

CONTENTS

GENERAL INFORMATION

INDEX

GENERAL INFORMATION

FUEL REQUIREMENTS—DIESEL ENGINE

WARNING: Do not use alcohol or gasoline as a fuel blending agent. They can be unstable under certain conditions and hazardous or explosive when mixed with diesel fuel.

Use good quality diesel fuel from a reputable supplier in your Dodge truck. For most year-round service, number 2 diesel fuel meeting ASTM specification D-975 will provide good performance. If the vehicle is exposed to extreme cold (below 0°F/-18°C), or is required to operate at colder-than-normal conditions for prolonged periods, use climatized No. 2 diesel fuel or dilute the No. 2 diesel fuel with 50% No. 1 diesel fuel. This will provide better protection from fuel gelling or wax-plugging of the fuel filters.

Diesel fuel is seldom completely free of water. To prevent fuel system trouble, including fuel line freezing in winter, drain the accumulated water from the fuel/water separator using the fuel/water separator drain provided. If you buy good-quality fuel and follow the cold-weather advice above, fuel conditioners should not be required in your vehicle. If available in your area, a high cetane "premium" diesel fuel may offer improved cold starting and warm-up performance.

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FUEL DELIVERY SYSTEM-DIESEL ENGINE

INDEX

DESCRIPTION AND OPERATION

FUEL DELIVERY SYSTEM—DIESEL ENGINE

Two different fuel systems (early and late) are used for the diesel engine in this model year. The **early** fuel system, using the two-valve-per-cylinder engine, will retain the mechanical fuel injection pump as used in previous model years. The **late** fuel system, using the four-valve-per-cylinder engine, will use an **electronic** fuel injection pump with three control modules. This book will include information for the **late** fuel system only.

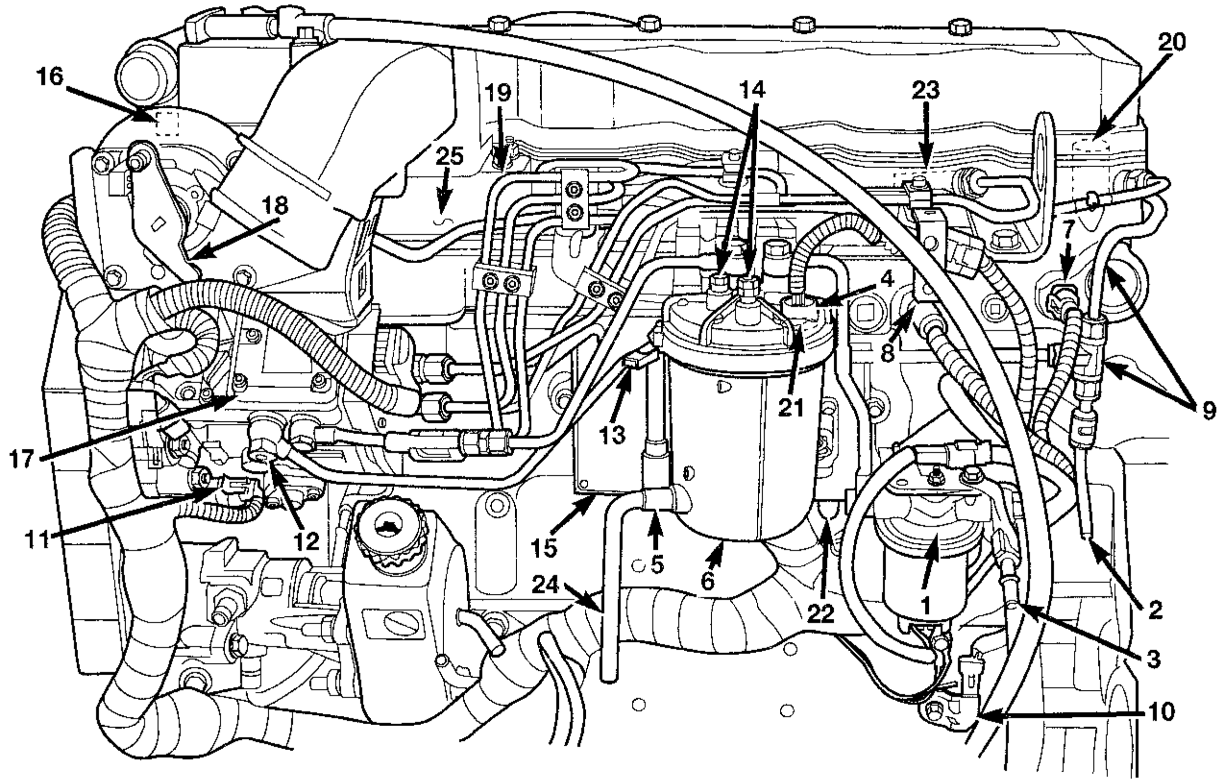
Also refer to the Powertrain Control Module (PCM) or Engine Control Module sections.

Some fuel system components are shown in (Fig. 1).

The fuel delivery system consists of the:

- Accelerator pedal
- Air cleaner housing/element
- Fuel drain manifold (passage)
- Fuel filter/water separator
- Fuel heater
- Fuel heater relay
- Fuel transfer (lift) pump
- Fuel injection pump
- Fuel injectors
- Fuel heater temperature sensor
- Fuel tank
- Fuel tank filler/vent tube assembly
- Fuel tank filler tube cap
- Fuel tank module containing the rollover valve, fuel gauge sending unit (fuel level sensor) and a separate fuel filter located at bottom of tank module
- Fuel tubes/lines/hoses
- High-pressure fuel injector lines
- In-tank fuel filter (at bottom of fuel tank module)
- Low-pressure fuel supply lines
- Low-pressure fuel return line
- Overflow valve
- Quick-connect fittings
- Throttle cable
- Water draining

DESCRIPTION AND OPERATION (Continued)



1. FUEL TRANSFER (LIFT) PUMP
2. FUEL RETURN LINE (TO FUEL TANK)
3. FUEL SUPPLY LINE (LOW-PRESSURE, TO ENGINE)
4. FUEL HEATER
5. WATER-IN-FUEL (WIF) SENSOR
6. FUEL FILTER/WATER SEPARATOR
7. IAT SENSOR
8. MAP (BOOST) SENSOR
9. FUEL DRAIN MANIFOLD
10. CKP SENSOR
11. CMP SENSOR
12. OVERFLOW VALVE
13. DRAIN VALVE
14. FUEL PRESSURE TEST PORTS
15. ECM
16. ECT SENSOR
17. FUEL INJECTION PUMP
18. THROTTLE LEVER BELLCRANK AND APPS
19. HIGH-PRESSURE FUEL LINES
20. FUEL INJECTORS
21. FUEL HEATER TEMPERATURE SENSOR (THERMOSTAT)
22. OIL PRESSURE SENSOR
23. FUEL INJECTOR CONNECTOR
24. DRAIN TUBE
25. INTAKE MANIFOLD AIR HEATER/ELEMENTS

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Fig. 1 Fuel System Components—Diesel Engine

DESCRIPTION AND OPERATION (Continued)

FUEL TANK MODULE

An electric fuel pump is **not used** in the fuel tank module for diesel powered engines. Fuel is supplied by the engine mounted fuel transfer pump and the fuel injection pump.

The fuel tank module is installed in the top of the fuel tank (Fig. 2). The fuel tank module (Fig. 2) contains the following components:

- Fuel reservoir
- A separate in-tank fuel filter
- Rollover valve
- Fuel gauge sending unit (fuel level sensor)
- Fuel supply line connection
- Fuel return line connection
- Auxiliary non-pressurized fuel supply fitting

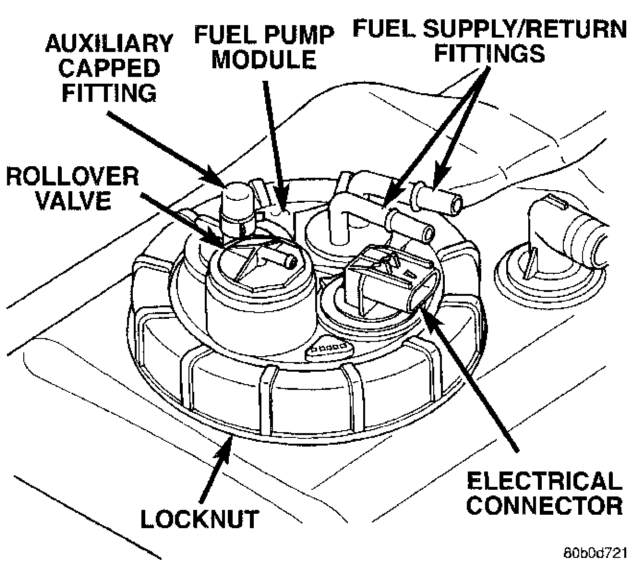

Fig. 2 Top View of Fuel Tank Module—Diesel

FUEL GAUGE SENDING UNIT

The fuel gauge sending unit (fuel level sensor) is attached to the side of the fuel tank module. The sending unit consists of a float, an arm, and a variable resistor (track). The resistor track is used to send electrical signals to the Powertrain Control Module (PCM) for fuel gauge operation. After this signal is sent to the PCM, the PCM will transmit the data across the CCD bus circuits to the instrument panel. Here it is translated into the appropriate fuel gauge level reading.

As fuel level increases, the float and arm move up. This decreases the sending unit resistance, causing the fuel gauge to read full. As fuel level decreases, the float and arm move down. This increases the sending unit resistance causing the fuel gauge to read empty.

FUEL HEATER

The fuel heater is used to prevent diesel fuel from waxing during cold weather operation. The fuel heater assembly is located in the top of the fuel filter housing (Fig. 3).

The heater/element assembly is equipped with a temperature sensor (thermostat) that senses fuel temperature. This sensor is attached to the fuel heater/element assembly (Fig. 4) (bottom view). When the temperature is below 45 ±8 degrees F, the sensor allows current to flow to the heater element warming the fuel. When the temperature is above 75 ±8 degrees F, the sensor stops current flow to the heater element.

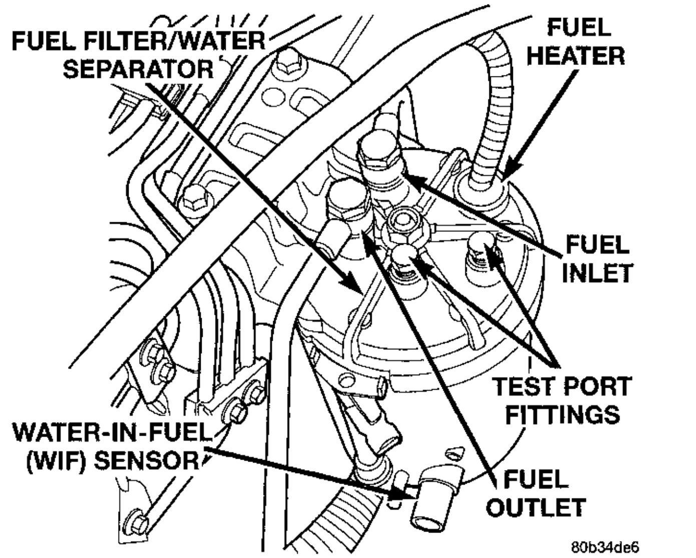

Fig. 3 Fuel Heater Location

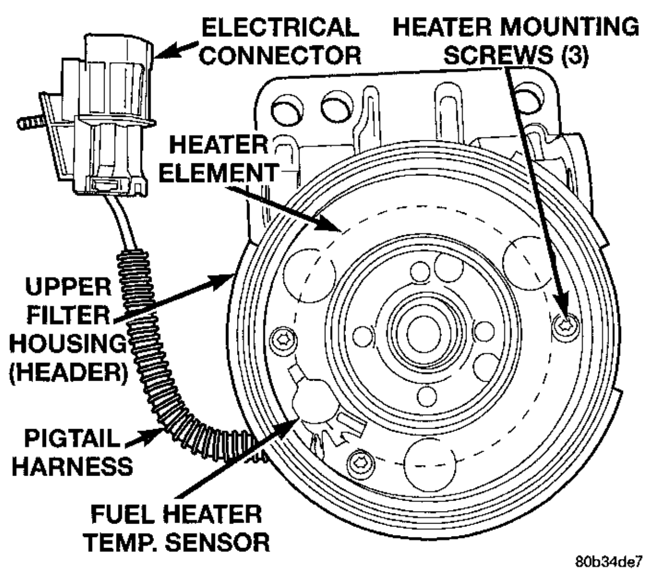

Fig. 4 Fuel Heater Temperature Sensor Location

DESCRIPTION AND OPERATION (Continued)

Battery voltage to operate the fuel heater element is supplied from the ignition switch and through the fuel heater relay. Also refer to Fuel Heater Relay. **The fuel heater element and fuel heater relay are not computer controlled.**

The heater element operates on 12 volts, 300 watts at 0 degrees F.

FUEL HEATER RELAY

Battery voltage to operate the fuel heater element is supplied from the ignition switch through the fuel heater relay. **The fuel heater element and fuel heater relay are not computer controlled.**

The fuel heater relay is located in Power Distribution Center (PDC) (Fig. 5). Refer to label on inside of PDC cover for relay location.

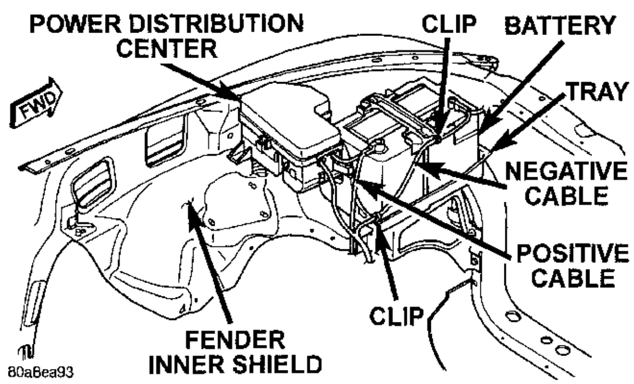

Fig. 5 Power Distribution Center Location

FUEL TRANSFER (LIFT) PUMP

The fuel transfer pump (fuel lift pump) is located on the left-rear side of the engine cylinder block above the starter motor (Fig. 6). The 12–volt electric vane-type pump is operated and controlled by the Engine Control Module (ECM). The ECM is bolted to the left side of the engine block behind the fuel filter (Fig. 7).

The purpose of the fuel transfer pump is to supply (transfer) a low-pressure fuel source: **from** the fuel tank, **through** the fuel filter/water separator and **to** the fuel injection pump. Here, the low-pressure is raised to a high-pressure by the fuel injection pump for operation of the high-pressure fuel injectors. Check valves within the pump, control direction of fuel flow and prevent fuel bleed-back during engine shut down.

Normal current flow to the pump is 12 amperes.

With the engine running, the pump has **2** modes of operation: Mode 1: 100 percent duty-cycle with a minimum pressure of 10 psi **except when the**

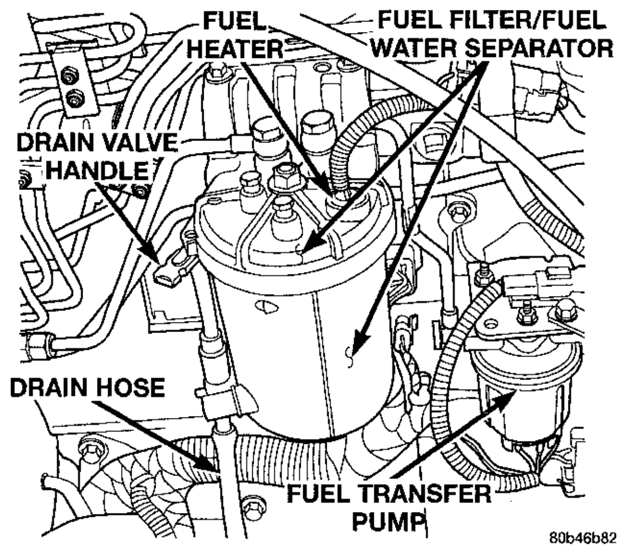

Fig. 6 Fuel Transfer Pump Location

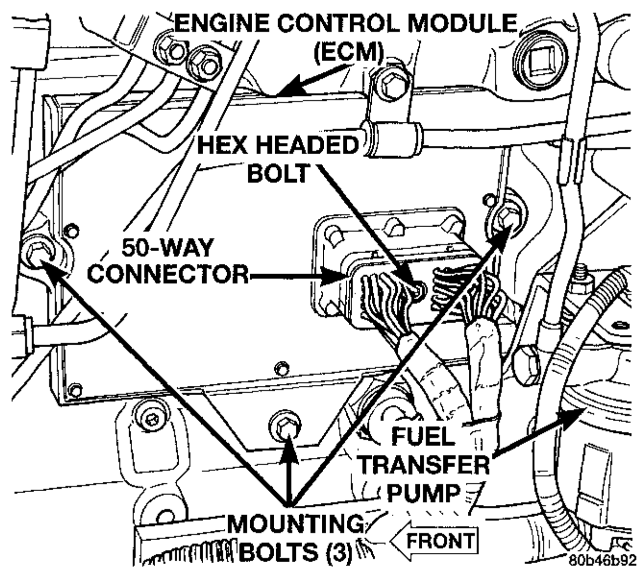

Fig. 7 Engine Control Module (ECM) Location

engine is cranking. Mode 2: 25 percent duty-cycle with minimum pressure of 7 psi **with the engine cranking**

The 25 percent duty-cycle is used to limit injection pump inlet pressure until the engine is running.

The transfer pump is self-priming: When the key is first turned on (without cranking engine), the pump will operate for approximately 2 seconds and then shut off. The pump will also operate for up to 25 seconds after the starter is engaged, and then disengaged and the engine is not running. The pump shuts off immediately if the key is on and the engine stops running.

DESCRIPTION AND OPERATION (Continued)

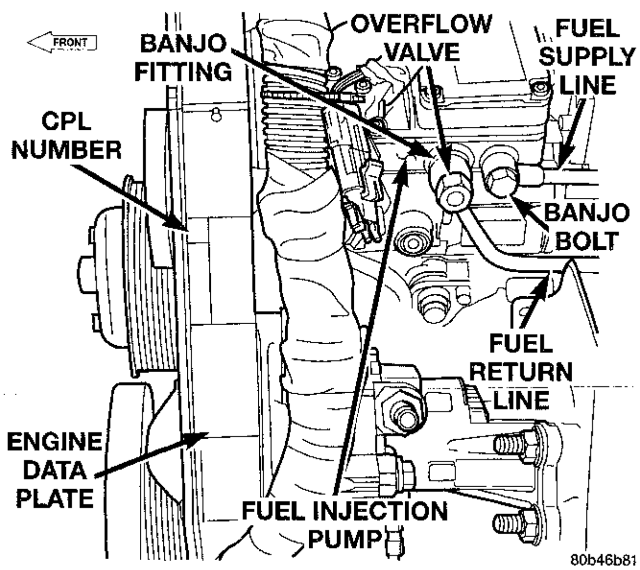

Fig. 8 Injection Pump Overflow Valve Location

The fuel volume of the transfer pump will always provide more fuel than the fuel injection pump requires. Excess fuel is returned from the injection pump through an overflow valve. The valve is located on the side of the injection pump (Fig. 8). It is also used to connect the fuel return line to the side of the injection pump. This valve opens at approximately 97 kPa (14 psi) and returns fuel to the fuel tank through the fuel return line.

FUEL TANK

The fuel tank is similar to the tank used with gasoline powered models. The tank is equipped with a separate fuel return line and a different fuel tank module for diesel powered models. A fuel tank mounted, electric fuel pump is not used with diesel powered models. Refer to Fuel Tank Module for additional information.

ROLLOVER VALVE(S)

Refer to Group 25, Emission Control System for information.

FUEL FILTER/WATER SEPARATOR

The fuel filter/water separator protects the fuel injection pump by removing water and contaminants from the fuel. The construction of the filter/separator allows fuel to pass through it, but helps prevent moisture (water) from doing so. Moisture collects at the bottom of the canister.

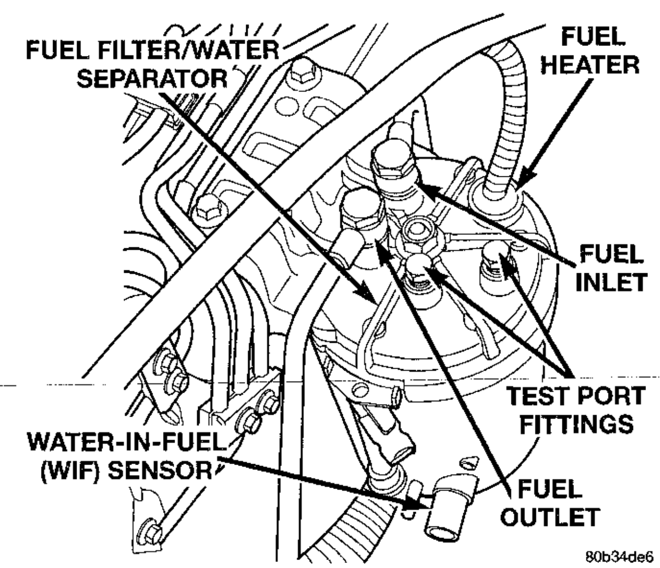

Fig. 9 Fuel Filter/Water Separator Location

The fuel filter/water separator assembly is located on left side of engine above starter motor (Fig. 9). The assembly also includes the fuel heater and Water-In-Fuel (WIF) sensor.

Refer to the maintenance schedules in Group 0 in this manual for the recommended fuel filter replacement intervals.

For draining of water from canister, refer to Fuel Filter/Water Separator Removal/Installation section.

A Water-In-Fuel (WIF) sensor is attached to side of canister. Refer to Water-In-Fuel Sensor Description/ Operation.

The fuel heater is installed into the top of the filter/separator housing. Refer to Fuel Heater Description/Operation.

FUEL SYSTEM PRESSURE WARNING

WARNING: HIGH-PRESSURE FUEL LINES DELIVER DIESEL FUEL UNDER EXTREME PRESSURE FROM THE INJECTION PUMP TO THE FUEL INJECTORS. THIS MAY BE AS HIGH AS 120,000 KPA (17,405 PSI) . USE EXTREME CAUTION WHEN INSPECTING FOR HIGH-PRESSURE FUEL LEAKS. INSPECT FOR HIGH-PRESSURE FUEL LEAKS WITH A SHEET OF CARDBOARD. HIGH FUEL INJECTION PRESSURE CAN CAUSE PERSONAL INJURY IF CONTACT IS MADE WITH THE SKIN.

DESCRIPTION AND OPERATION (Continued)

FUEL INJECTION PUMP

The Bosch VP44 fuel injection pump (Fig. 10) is a solenoid-valve controlled-radial-piston-distributor type pump. The pump is mounted to the rear of the timing gear housing on the left side of engine (Fig. 11).

The injection pump is driven by the engine camshaft. A gear on the end of the pump shaft meshes with the camshaft gear. The pump is timed to the engine. The VP44 is controlled by an integral (and non-serviceable) Fuel Pump Control Module (FPCM) (Fig. 11). The FPCM can operate the engine as an engine controller if a Crankshaft Position Sensor (CKP) signal is not present.

Fuel from the transfer (lift) pump enters the VP44 where it is pressurized and then distributed through high-pressure lines to the fuel injectors. The VP44 is cooled by the fuel that flows through it. A greater quantity of fuel is required for cooling the VP44 than what is necessary for engine operation. Because of this, approximately 70 percent of fuel entering the pump is returned to the fuel tank through the overflow valve and fuel return line. Refer to Overflow Valve Description/Operation for additional information.

The VP44 is not self-priming. At least two fuel injectors must be bled to remove air from the system. When servicing the fuel system, disconnecting components up to the pump will usually not require air bleeding from the fuel system. However, removal of the high-pressure lines, removal of the VP44 pump, or allowing the vehicle to completely run out of fuel, will require bleeding air from the high-pressure lines at the fuel injectors.

VP44 timing is matched to engine timing by an offset keyway that fits into the pump shaft. This keyway has a stamped number on it that is matched to a number on the VP44 pump (each keyway is calibrated to each pump).

When removing/installing the VP44, the same numbered keyway must always be installed. Also, the arrow on the top of the keyway should be installed pointed to the rear of pump.

Because of electrical control, the injection pump high and low idle speeds are not adjustable. Also, adjustment of fuel pump timing is not required and is not necessary.

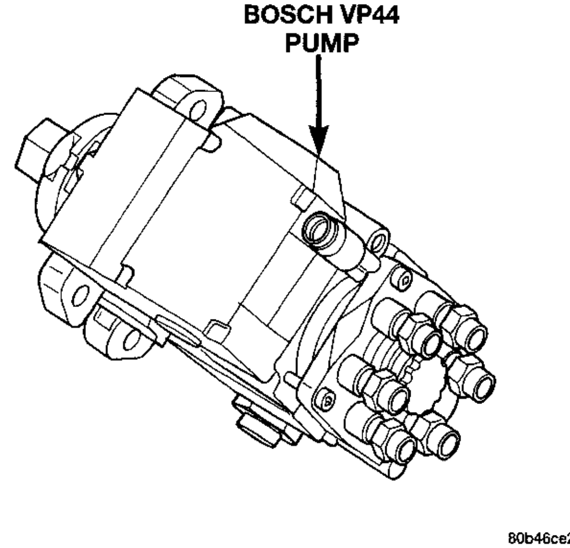

Fig. 10 Bosch VP44 Fuel Injection Pump

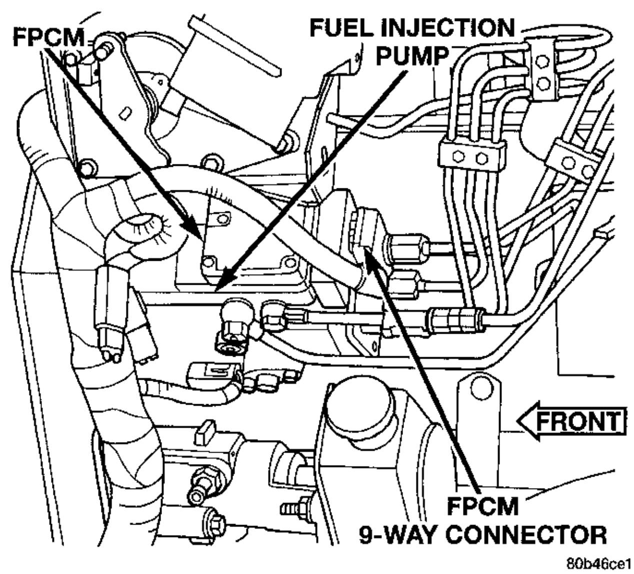

Fig. 11 Fuel Injection Pump Location

DESCRIPTION AND OPERATION (Continued)

FUEL INJECTORS

Six individual, high-pressure fuel injectors are used. The injectors are vertically mounted (Fig. 12) into a bored hole in the top of the cylinder head. This bored hole is located between the intake/exhaust valves.

High-pressure fuel is supplied from the injection pump, through a high-pressure fuel line, through a steel connector and into the fuel injector. When fuel pressure rises to approximately 31,026 kPa (4,500 psi), the needle valve spring tension is overcome. The needle valve rises and fuel flows through the spray holes in the nozzle tip into the combustion chamber. The pressure required to lift the needle valve is the nozzle opening pressure. This is sometimes referred to as the "pop" pressure setting.

Each fuel injector is connected to each high-pressure fuel line with a steel connector (Fig. 13). This steel connector is positioned into the cylinder head and sealed with an o-ring. The connectors are sealed to the high-pressure fuel lines with fittings (Fig. 13). The ferrule (Fig. 13) on the end of the high-pressure fuel line pushes against the steel connector when the fuel line fitting is torqued into the cylinder head. This torquing force provides a sealing pressure between both the fuel line-to-connector and the fuel connector-to-fuel injector. **The fitting torque is very critical.** If the fitting is under torqued, the mating surfaces will not seal and a high-pressure fuel leak will result. If the fitting is over torqued, the connector and injector will deform and also cause a high-pressure fuel leak. This leak will be inside the cylinder head and will not be visible. The result will be a possible fuel injector miss-fire and low power.

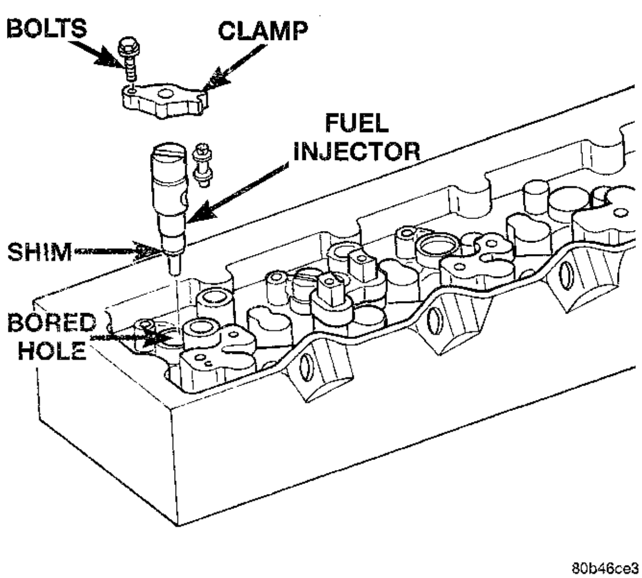

Fig. 12 Fuel Injector Location

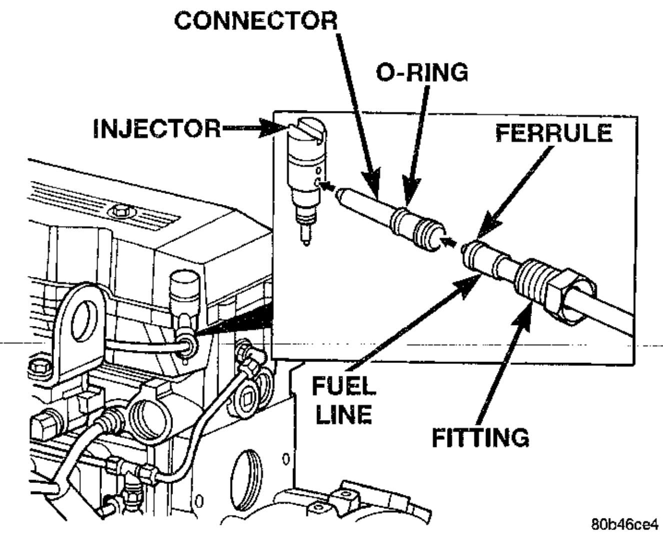

Fig. 13 Fuel Injector Connections

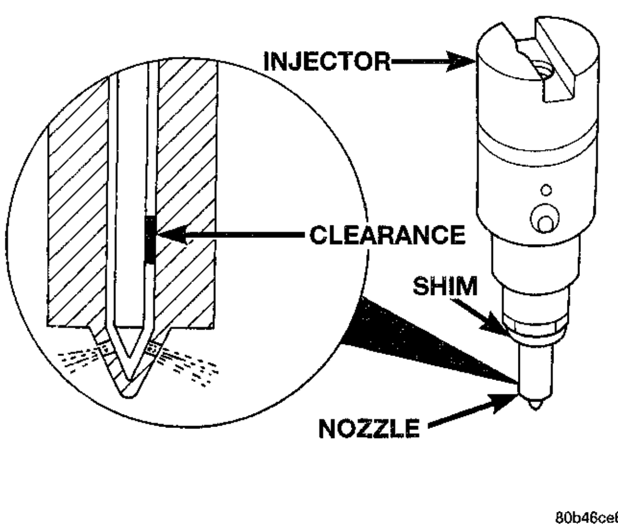

Fig. 14 Fuel Injector Spray Pattern

The fuel injectors use hole type nozzles (Fig. 14). High-pressure flows into the side of the injector and causes the injector needle to lift and fuel to be injected. The clearances in the nozzle bore (Fig. 14) are extremely small and any sort of dirt or contaminants will cause the injector to stick. Because of this, it is very important to do a thorough cleaning of any lines before opening up any fuel system component. Always cover or cap any open fuel connections before a fuel system repair is performed.

DESCRIPTION AND OPERATION (Continued)

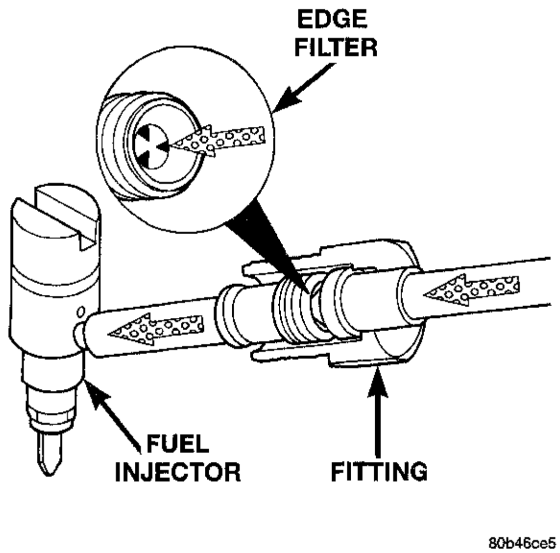

Fig. 15 Fuel Injector Edge Filter

Each fuel injector connector tube contains an edge filter (Fig. 15) that breaks up small contaminants that enter the injector. The edge filter uses the injectors pulsating high-pressure to break up most particles so they are small enough to pass through the injector. **The edge filters are not a substitute for proper cleaning and covering of all fuel system components during repair.**

The bottom of each fuel injector is sealed to the cylinder head with a **1.5mm** thick copper shim (gasket) (Fig. 14). The correct thickness shim must always be re-installed after removing an injector.

Fuel pressure in the injector circuit decreases after injection. The injector needle valve is immediately closed by the needle valve spring and fuel flow into the combustion chamber is stopped. Exhaust gases are prevented from entering the injector nozzle by the needle valve.

QUICK-CONNECT FITTINGS

Different types/sizes of quick-connect fittings are used to attach various fuel system components. These may be: a single-tab type, a two-tab type or a plastic retainer ring-type. Most fittings on diesel applications are the two-tab type. Refer to Quick-Connect Fittings Removal/Installation for more information.

CAUTION: The interior components (o-rings, spacers) of quick-connect fittings are not serviced separately, but new clips are available for some types. Do not attempt to repair damaged fittings or fuel lines/tubes. If repair is necessary, replace the complete fuel tube assembly.

LOW-PRESSURE FUEL LINES

All fuel lines up to the fuel injection pump are considered low-pressure. This includes the fuel lines from: the fuel tank to the fuel transfer pump, and the fuel transfer pump to the fuel injection pump. The fuel return lines, the fuel drain manifold and the fuel drain manifold lines are also considered low-pressure lines. High-pressure lines are used between the fuel injection pump and the fuel injectors. Also refer to High-Pressure Fuel Lines Description/Operation.

HIGH-PRESSURE FUEL LINES

The high-pressure fuel lines are the 6 lines located between the fuel injection pump and the fuel injector connector tubes (Fig. 16). All other fuel lines are considered low-pressure lines.

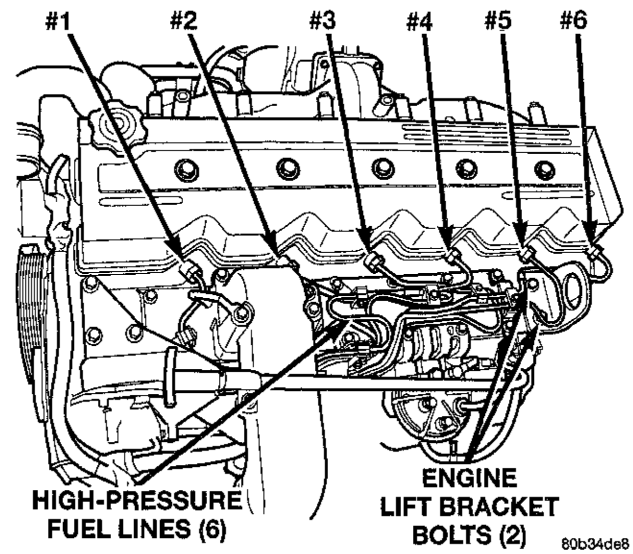

Fig. 16 High-Pressure Fuel Lines

CAUTION: The high-pressure fuel lines must be held securely in place in their holders. The lines cannot contact each other or other components. Do not attempt to weld high-pressure fuel lines or to repair lines that are damaged. If lines are ever kinked or bent, they must be replaced. Use only the recommended lines when replacement of high-pressure fuel line is necessary.

High-pressure fuel lines deliver fuel under pressure of up to approximately 120,000 kPa (17,405 PSI) from the injection pump to the fuel injectors. The lines expand and contract from the high-pressure fuel pulses generated during the injection process. All high-pressure fuel lines are of the same length and inside diameter. Correct high-pressure fuel line usage and installation is critical to smooth engine operation.

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DESCRIPTION AND OPERATION (Continued)

WARNING: USE EXTREME CAUTION WHEN INSPECTING FOR HIGH-PRESSURE FUEL LEAKS. INSPECT FOR HIGH-PRESSURE FUEL LEAKS WITH A SHEET OF CARDBOARD. HIGH FUEL INJECTION PRESSURE CAN CAUSE PERSONAL INJURY IF CONTACT IS MADE WITH THE SKIN.

FUEL DRAIN MANIFOLD PASSAGE

When the engine is running, and during injection, a small amount of fuel flows past the injector nozzle and is not injected into the combustion chamber. This fuel is used to lubricate the fuel injectors. Excess fuel drains into the fuel drain manifold (or passage). The fuel drain manifold is actually a rifled passage within the cylinder head (Fig. 17). Fuel is drained from this passage into a line at the rear of the cylinder head (Fig. 17). After exiting the cylinder head, fuel is routed (returned) back to the fuel tank. A "T" is installed into the fuel return line (Fig. 17). This "T" is used to allow excess fuel from the injection pump to be returned into the fuel tank. A one-way check valve within the overflow valve prevents fuel (from the fuel drain manifold) from entering the fuel injection pump.

A **small** amount of fuel is returned from the fuel injectors, while a **large** amount (about 70% of supplied fuel) is returned from the fuel injection pump.

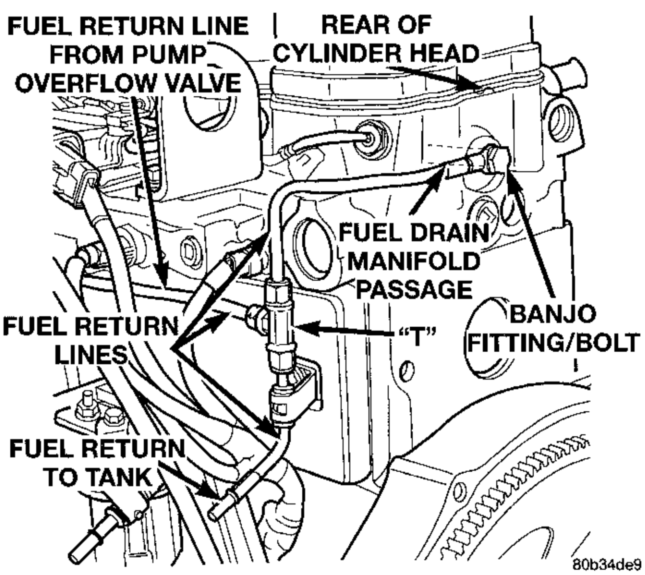

Fig. 17 Fuel Drain Manifold Passage

OVERFLOW VALVE

Fuel volume from the fuel transfer (lift) pump will always provide more fuel than the fuel injection pump requires. The overflow valve (a pressure relief valve) is used to route excess fuel through the fuel return line and back to the fuel tank. Approximately 70% of supplied fuel is returned to the fuel tank. The valve is located on the side of the injection pump (Fig. 18). It is also used to connect the fuel return line (banjo fitting) to the fuel injection pump. The valve opens at approximately 97 kPa (14 psi). If the check valve within the assembly is sticking, low engine power, hard starting or white smoke may result.

If a Diagnostic Trouble Code (DTC) has been stored for "decreased engine performance due to high injection pump fuel temperature", the overflow valve may be stuck in closed position.

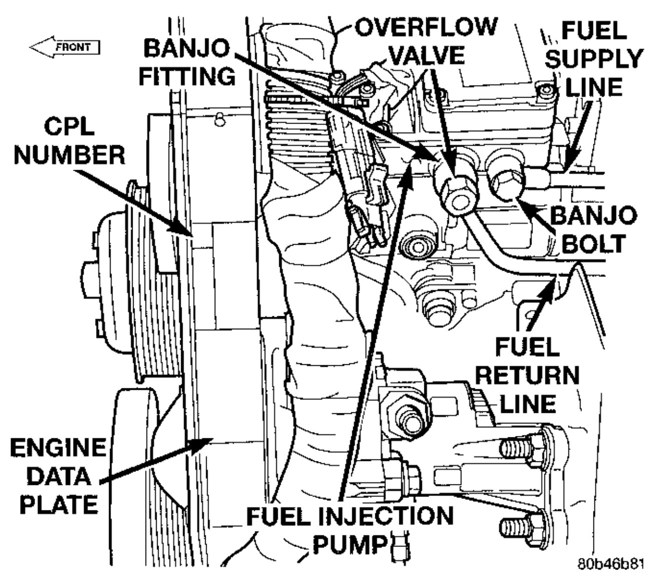

Fig. 18 Overflow Valve Location

DIAGNOSIS AND TESTING

AIR IN FUEL SYSTEM

Air will enter the fuel system whenever fuel supply lines, separator filters, injection pump, high-pressure lines or injectors are removed or disconnected. Air trapped in the fuel system can result in hard starting, a rough running engine, engine misfire, low power, excessive smoke and fuel knock. After service is performed, air must be bled from the system before starting the engine.

Inspect the fuel system from the fuel transfer pump to the injectors for loose connections. Leaking fuel is an indicator of loose connections or defective seals. Air can also enter the fuel system between the fuel tank and the transfer pump. Inspect the fuel tank and fuel lines for damage that might allow air into the system.

For air bleeding, refer to the Air Bleed Procedure.

FUEL SUPPLY RESTRICTIONS

LOW-PRESSURE LINES

Fuel supply line restrictions or a defective fuel transfer pump can cause starting problems and prevent engine from revving up. The starting problems include; low power and/or white fog like exhaust.

Test all fuel supply lines for restrictions or blockage. Flush or replace as necessary. Bleed fuel system of air once a fuel supply line has been replaced. Refer to Air Bleed Procedure for procedures.

To test for fuel line restrictions, a vacuum restriction test may be performed. Refer to Fuel Transfer Pump Pressure Test.

HIGH-PRESSURE LINES

Restricted (kinked or bent) high-pressure lines can cause starting problems, poor engine performance, engine mis-fire and white smoke from exhaust.

Examine all high-pressure lines for any damage. Each radius on each high-pressure line must be smooth and free of any bends or kinks.

Replace damaged, restricted or leaking high-pressure fuel lines with correct replacement line.

CAUTION: All high-pressure fuel lines must be clamped securely in place in holders. Lines cannot contact each other or other components. Do not attempt to weld high-pressure fuel lines or to repair lines that are damaged. If line is kinked or bent, it must be replaced. Use only recommended lines when replacement of high-pressure fuel line is necessary.

FUEL TRANSFER PUMP PRESSURE TEST

The following tests will include: pressures tests of fuel transfer pump (engine running and engine cranking), a pressure drop test of fuel filter, a test for supply side restrictions, and a test for air in fuel supply side.

Refer to Fuel Transfer Pump Description/Operation for an operational description of transfer pump.

The fuel transfer (lift) pump is located on left side of engine and above starter motor (Fig. 19).

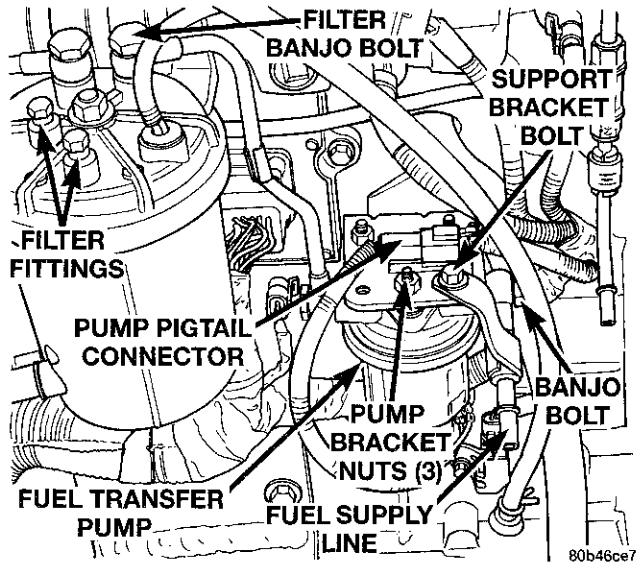

Fig. 19 Fuel Transfer Pump Location

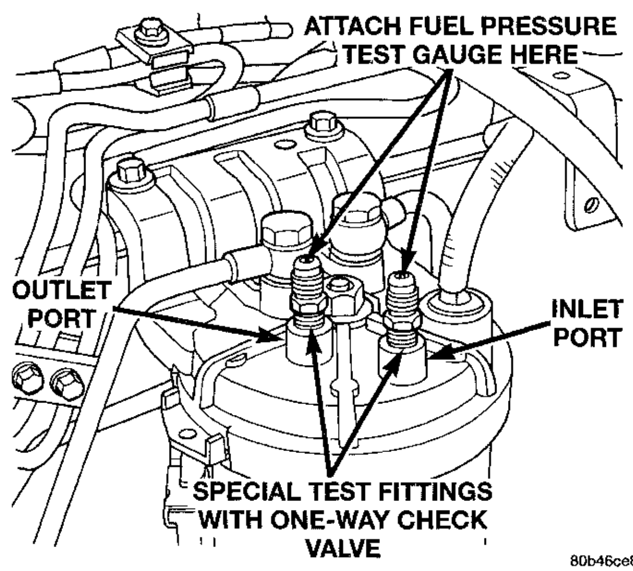

Fig. 20 Fuel Pressure Test Port Fitting Location

DIAGNOSIS AND TESTING (Continued)

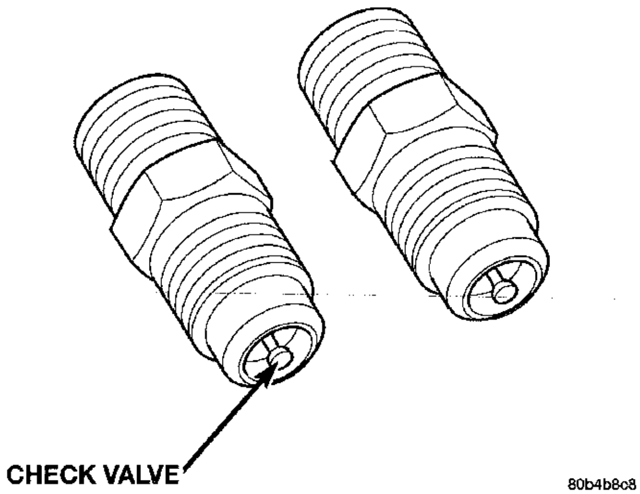

Fig. 21 Fuel Pressure Test Port Fittings

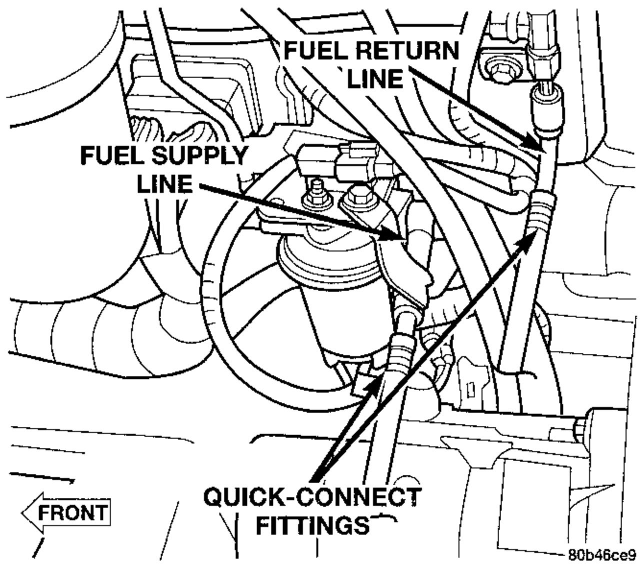

Fig. 22 Fuel Return and Supply Line Quick-Connect Locations

An improperly operating fuel transfer pump, a plugged or dirty fuel filter, or a defective overflow valve can cause low engine power, excessive white smoke and/or hard engine starting.

Before performing following tests, inspect fuel supply and return lines for restrictions, kinks or leaks.

Fuel leaking from pump casing indicates a leaking pump which must be replaced.

Pressure Test: Because the transfer pump is operating at two different pressure cycles (engine running and engine cranking), two different pressure tests will be performed.

(1) Remove 2 existing filter fittings (plugs) at top of fuel filter housing (Fig. 19) (clean area around fittings before fitting removal). In place of 2 fittings

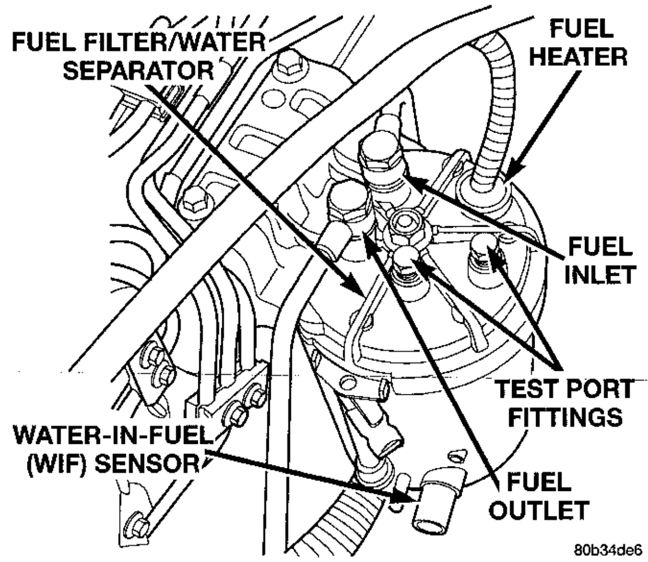

Fig. 23 Test Port at Fuel Inlet

(plugs), install 2 special fittings (Fig. 20). These special fittings are equipped with a spring-loaded shut-off valve (one-way check valve) and are commercially available from a Tube Fitting Supplier. Use Parker® Access Valve, Male Connector part number AVU1-2 or equivalent (Fig. 21).

(2) Install Special Fuel Pressure Test Gauge 6828 (or equivalent) to special fitting at INLET PORT (Fig. 20).

(3) To prevent engine from starting, remove fuel system relay (fuel injection pump relay). Relay is located in Power Distribution Center (PDC). Refer to label under PDC cover for relay location.

(4) Using key, crank engine over while observing gauge. Pressure should be 5–7 psi.

(5) Re-install fuel system relay to PDC.

(6) Start engine and record fuel pressure. Pressure should be a **minimum** of 69 kPa (10 psi) at idle speed.

(7) Because fuel pump relay was removed, a Diagnostic Trouble Code (DTC) may have been set. After testing, use DRB scan tool to remove DTC.

Pressure Drop Test:

(8) Shut engine off and remove test gauge from INLET PORT. Re-attach 6828 test gauge to OUTLET PORT (Fig. 20). Start engine and record fuel pressure. Pressure should not be more than 34 kPa (5 psi) lower than INLET PORT pressure test. If so, replace fuel filter.

Fuel Supply Restriction Test:

Due to very small vacuum specifications, the DRB scan tool along with the Periphal Expansion Port (PEP) Module and 0–15 psi transducer must be used.

(9) Verify transfer pump pressure is OK before performing restriction test.

AUTHENTIC RESTORATION PRODUCT

DIAGNOSIS AND TESTING (Continued)

(10) Locate and disconnect fuel supply line quick-connect fitting at left-rear of engine (Fig. 22). After disconnecting line, plastic clip will remain attached to metal fuel line at engine. Carefully remove clip from metal line. Snap same clip into fuel supply hose.

(11) Install Special Rubber Adapter Hose Tool 6631 (3/8") into ends of disconnected fuel supply line.

(12) Install transducer from PEP module to brass "T" fitting on tool 6631.

(13) Hook up DRB scan tool to transducer.

(14) Start engine and record vacuum reading with engine speed at high-idle (high-idle means engine speed is at 100 percent throttle and no load). The fuel restriction test **MUST** be done wth engine speed at high-idle.

(15) If vacuum reading is **less** than 6 in/hg. (0–152 mm hg.), test is OK. If vacuum reading is **higher** than 6 in/hg. (152 mm hg.), restriction exists in fuel supply line or in fuel tank module. Check fuel supply line for damage, dents or kinking. If OK, remove module and check module and lines for blockage. Also check fuel pump inlet filter at bottom of module for obstructions.

Testing For Air Leaks in Fuel Supply Side:

(16) A 3–foot section of 1/4" I.D. clear tubing and a 1/8" NPT fitting are required for this test.

(17) Two test port fittings (plugs) are located at top of fuel filter housing (Fig. 23). Remove fitting at fuel **inlet** side of housing (towards rear of filter housing). Clean area around fitting before removal. In place of test port fitting (plug), install a 1/8" NPT fitting having a 1/4" O.D. nipple.

(18) Attach and clamp clear hose to fitting nipple.

(19) Place other end of hose into a clear container.

(20) The fuel transfer pump can be put into a 25 second run mode if key is turned to crank position and released back to run position without starting engine.

(21) Allow air to purge from empty hose before examining for air bubbles. Air bubbles should not be present.

(22) If bubbles are present, check for leaks in supply line to fuel tank.

(23) If supply line is not leaking, remove fuel tank module and remove filter at bottom of module (filter snaps to module). Check for leaks between supply nipple at top of module, and filter opening at bottom of module. Replace module if necessary.

OVERFLOW VALVE TEST

Fuel volume from the fuel transfer (lift) pump will always provide more fuel than the fuel injection pump requires. The overflow valve (a pressure relief valve) is used to route excess fuel through the fuel return line and back to the fuel tank. Approximately 70% of supplied fuel is returned to the fuel tank. The valve is located on the side of the injection pump (Fig. 24). It is also used to connect the fuel return line (banjo fitting) to the fuel injection pump. The valve opens at approximately 97 kPa (14 psi). If the check valve within the assembly is sticking, low engine power or hard starting may result.

If a Diagnostic Trouble Code (DTC) has been stored for "decreased engine performance due to high injection pump fuel temperature", the overflow valve may be stuck in closed position.

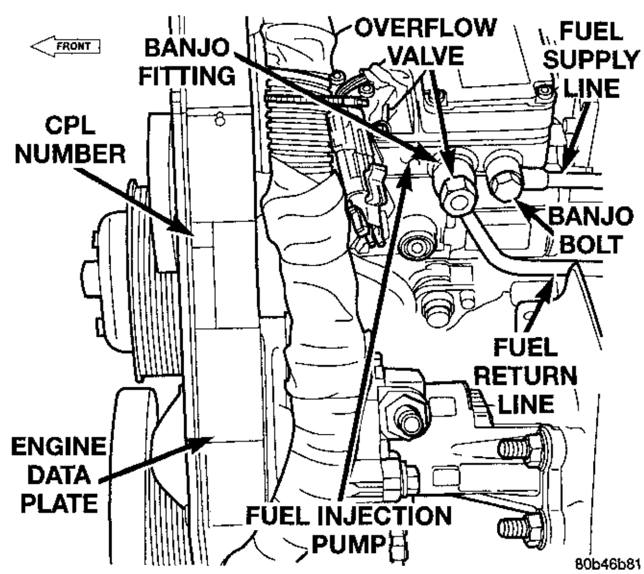

Fig. 24 Overflow Valve Location

A rubber tipped blow gun with regulated air line pressure is needed for this test.

(1) Clean area around overflow valve and fuel return line at injection pump before removal.

(2) Remove valve from pump and banjo fitting.

(3) Discard old sealing gaskets.

(4) Set regulated air pressure to approximately 97 kPa (14–16 psi).

(5) Using blow gun, apply pressure to overflow valve inlet end (end that goes into injection pump).

DIAGNOSIS AND TESTING (Continued)

(6) Internal check valve should release, and air should pass through valve at 97 kPa (14–16 psi). If not, replace valve.

(7) Reduce regulated air pressure to 10 psi and observe valve. Valve should stay shut. If not, replace valve.

(8) Install new sealing gaskets to valve.

(9) Install valve through banjo fitting and into pump.

(10) Tighten to 30 N·m (24 ft. lbs.) torque.

FUEL HEATER TEST

The fuel heater is used to prevent diesel fuel from waxing during cold weather operation.

NOTE: The fuel heater element, fuel heater relay and fuel heater temperature sensor are not controlled by the powertrain control module (PCM).

A malfunctioning fuel heater can cause a wax build-up in the fuel filter/water separator. Wax build-up in the filter/separator can cause engine starting problems and prevent the engine from revving up. It can also cause blue or white fog-like exhaust. If the heater is not operating in cold temperatures, the engine may not operate due to fuel waxing.

The fuel heater assembly is located in the top of the fuel filter housing (Fig. 25).

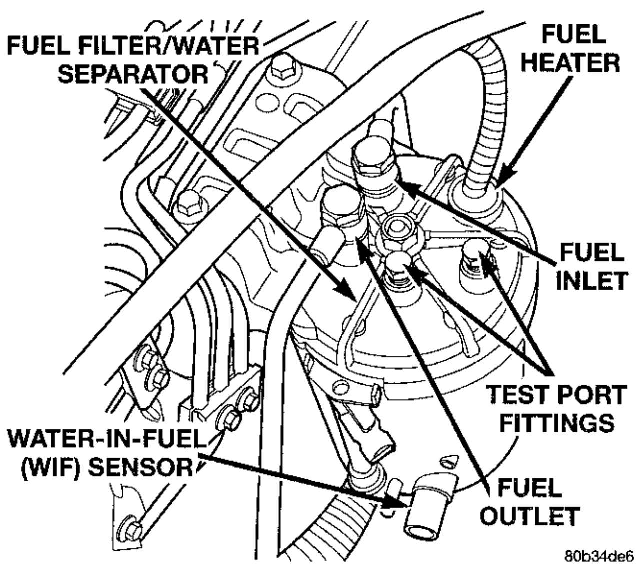

Fig. 25 Fuel Heater Location

The heater assembly is equipped with a built-in fuel temperature sensor (thermostat) (Fig. 26) that senses fuel temperature. When fuel temperature drops below 45 degrees ± 8 degrees F, the sensor allows current to flow to the built-in heater element to warm the fuel. When fuel temperature rises above

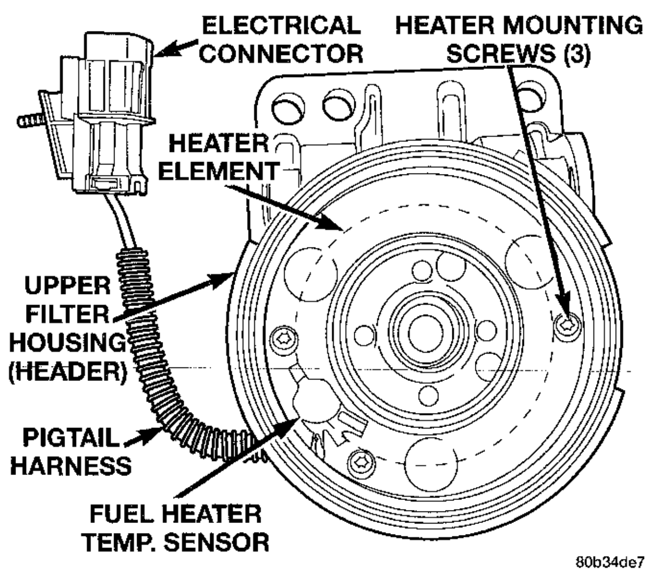

Fig. 26 Fuel Heater Assembly (Bottom View)

75 degrees ± 8 degrees F, the sensor stops current flow to the heater element (circuit is open).

Voltage to operate the fuel heater element is supplied from the ignition switch, through the fuel heater relay (also refer to Fuel Heater Relay), to the fuel temperature sensor and on to the fuel heater element.

The heater element operates on 12 volts, 300 watts at 0 degrees F. As temperature increases, power requirements decrease.

A minimum of 7 volts is required to operate the fuel heater. The resistance value of the heater element is less than 1 ohm (cold) and up to 1000 ohms warm.

TESTING

(1) Disconnect heater pigtail harness (Fig. 26) from main engine harness. Connection is made above and slightly rearward of fuel filter. All heater testing will be done at these 2 connectors.

Turn key to ON position. 12 volts should be present at red wire (at engine harness side of connector). If not, check fuel heater relay and related wiring. Refer to Relay Test—Fuel Heater. If OK, proceed.

Turn key OFF. Check black wire (at engine harness side of connector) for ground continuity with an ohmmeter. If continuity is not present, correct ground circuit. If OK, proceed.

(2) With pigtail harness connector still unplugged and key OFF, check electrical/mechanical operation of fuel temperature sensor (Fig. 26). Proceed to next step:

(3) Using an ohmmeter, check resistance across two terminals in connector (at heater side of connector). Sensor circuit should be open if fuel tempera-

AUTHENTIC RESTORATION PRODUCT

DIAGNOSIS AND TESTING (Continued)

ture has risen above 75 degrees ± 8 degrees F. Sensor circuit should be closed if fuel temperature has dropped below 45 degrees ± 8 degrees F. If not, replace fuel heater assembly. This same test can also be performed using a voltmeter, with key ON, and by back-probing connector.

RELAY TEST—FUEL HEATER

The fuel heater relay is located in the Power Distribution Center (PDC). Refer to label under PDC cover for relay location.

To test the fuel heater, refer to Fuel Heater Test.

To test the relay only, refer to following:

The relay terminal numbers from (Fig. 27) can be found on the bottom of the relay.

- Terminal number 30 is connected to battery voltage and can be switched or B+ (hot) at all times.
- The center terminal number 87A is connected (a circuit is formed) to terminal 30 in the de-energized (normally OFF) position.
- Terminal number 87 is connected (a circuit is formed) to terminal 30 in the energized (ON) position. Terminal number 87 then supplies battery voltage to the component being operated.
- Terminal number 86 is connected to a switched (+) power source.
- Terminal number 85 is grounded by the powertrain control module (PCM).

TESTING

(1) Remove relay before testing.

(2) Using an ohmmeter, perform a resistance test between terminals 85 and 86. Resistance value (ohms) should be 75 ±5 ohms for resistor equipped relays.

(3) Connect the ohmmeter between terminals number 87A and 30. Continuity should be present at this time.

(4) Connect the ohmmeter between terminals number 87 and 30. Continuity should not be present at this time.

(5) Use a set of jumper wires (16 gauge or smaller). Connect one jumper wire between terminal number 85 (on the relay) to the ground side (-) of a 12 Volt power source.

(6) Attach the other jumper wire to the positive side (+) of a 12V power source. Do not connect this jumper wire to relay at this time.

CAUTION: Do not allow the ohmmeter to contact terminals 85 or 86 during these tests. Damage to ohmmeter may result.

(7) Attach the other jumper wire (12V +) to terminal number 86. This will activate the relay. Continuity should now be present between terminals number 87 and 30. Continuity should not be present between terminals number 87A and 30.

(8) Disconnect jumper wires from relay and 12 Volt power source.

(9) If continuity or resistance tests did not pass, replace relay. If tests passed, refer to Group 8W, Wiring Diagrams for (fuel system) relay wiring schematics and for additional circuit information.

FUEL INJECTOR TEST

The fuel injectors are located in the top of the cylinder head between the intake/exhaust valves (Fig. 28).

A leaking fuel injector can cause fuel knock, poor performance, black smoke, poor fuel economy and rough engine idle. If fuel injector needle valve does not operate properly, engine may misfire and produce low power.

A leak in injection pump-to-injector high-pressure fuel line can cause many of same symptoms as malfunctioning injector. Inspect for leaks in high-pressure lines before checking for malfunctioning fuel injector.

WARNING: THE INJECTION PUMP SUPPLIES HIGH-PRESSURE FUEL OF UP TO APPROXIMATELY 120,000 kPa (17,400 psi) TO EACH INDIVIDUAL INJECTOR THROUGH HIGH-PRESSURE LINES. FUEL UNDER THIS AMOUNT OF PRESSURE CAN PENETRATE SKIN AND CAUSE PERSONAL INJURY. WEAR SAFETY GOGGLES AND ADEQUATE PROTECTIVE CLOTHING. AVOID CONTACT WITH FUEL SPRAY WHEN BLEEDING HIGH-PRESSURE FUEL LINES.

WARNING: DO NOT BLEED AIR FROM FUEL SYSTEM OF A HOT ENGINE. DO NOT ALLOW FUEL TO SPRAY ONTO EXHAUST MANIFOLD WHEN BLEEDING AIR FROM FUEL SYSTEM.

(1) To determine which fuel injector is malfunctioning, run engine and isolate each cylinder using DRB scan tool. Note RPM drop for each cylinder. As an alternative, loosen high-pressure fuel line fitting at fuel injector connector tube (Fig. 29). Listen for a change in engine speed. After testing, tighten line fitting to 40 N·m (30 ft. lbs.) torque. If engine speed drops, injector was operating normally. If engine speed remains same, injector may be malfunctioning. Test all injectors in same manner one at a time.

(2) Once injector has been found to be malfunctioning, remove it from engine and test it. Refer to Fuel Injector Removal/Installation.

DIAGNOSIS AND TESTING (Continued)

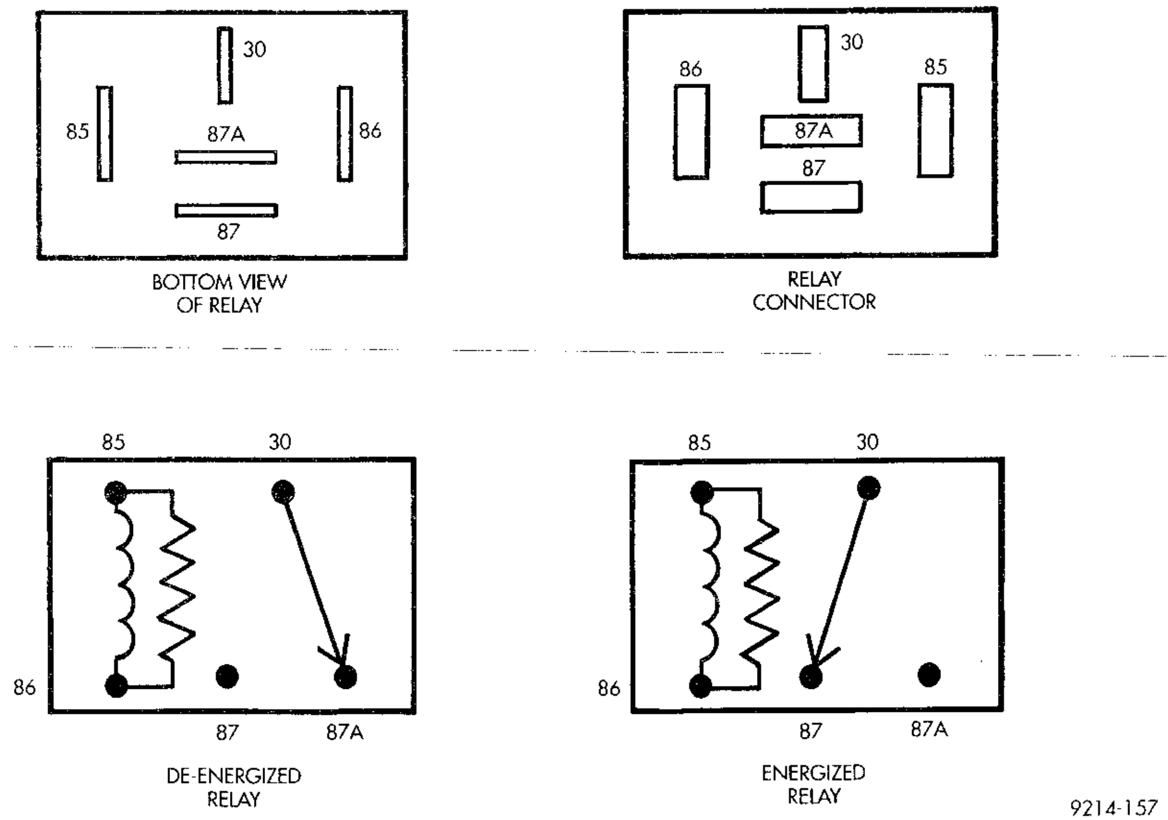

Fig. 27 Relay Terminals

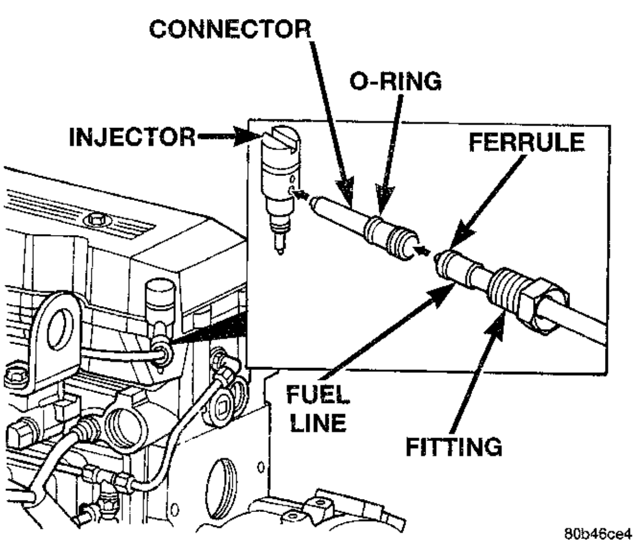

Fig. 28 Fuel Injector Connections

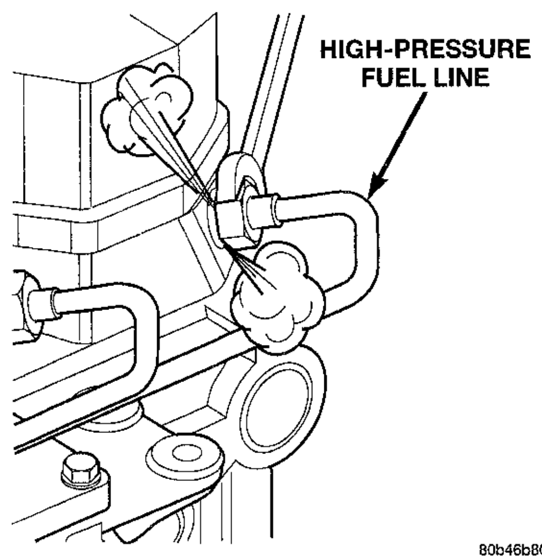

Fig. 29 Inspecting Injector Operation

DIAGNOSIS AND TESTING (Continued)

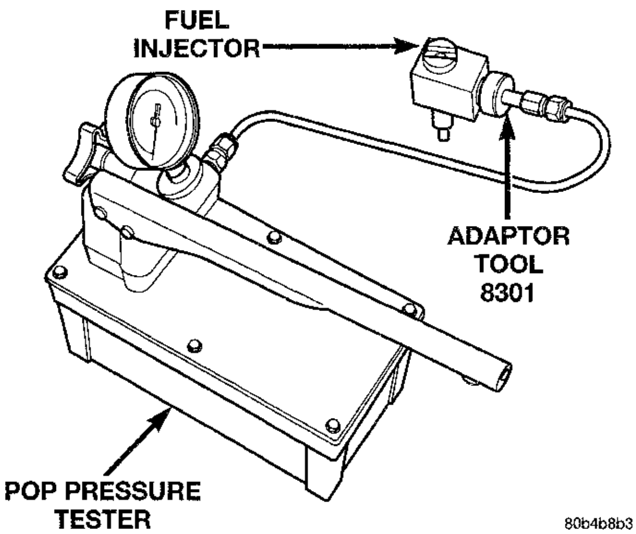

Fig. 30 Fuel Injector Tester and Adapter Tool

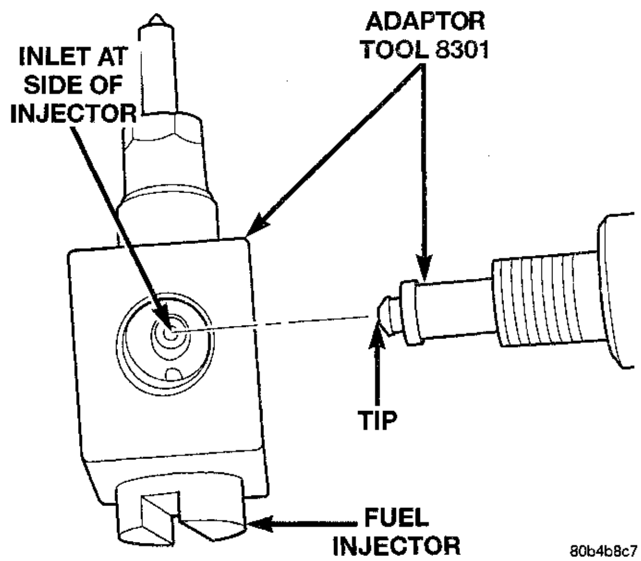

Fig. 31 Installing Injector to Adaptor Tool 8301

WARNING: FUEL INJECTOR TESTERS CAN DEVELOP EXTREMELY HIGH PRESSURES. FUEL UNDER THIS AMOUNT OF PRESSURE CAN PENETRATE SKIN AND CAUSE PERSONAL INJURY. WEAR SAFETY GOGGLES AND ADEQUATE PROTECTIVE CLOTHING. AVOID CONTACT WITH FUEL SPRAY WHEN OPERATING INJECTOR TESTOR.

(3) After injector has been removed, obtain bench-mount fuel injector tester OTC® (SPX®) part number 4210 (Fig. 30) (or equivalent). Install Special Tool number 8301 (Fuel Injector Adapter) to 4210 tester. Install fuel injector into 8301 adapter. Be sure tip of adapter tool 8301 is aligned to inlet hole at side of injector (Fig. 31) before tightening tool. Tighten tool 8301 to injector. Position container below injector before testing.

(4) Refer to operating instructions supplied with pressure tester for procedures.

(a) Check opening pressure or "pop" pressure. Pressure should be approximately 31,026 kPa (310 bars) or (4500 psi ± 250 psi). If fuel injector needle valve is opening (popping) too early or too late, replace injector.

(b) Perform a leak-down test on injector. Apply pressure with injector tester. The injector should not leak (drip) fuel with pressure at approximately 20 bars (291 psi) lower than pop pressure.

(c) Operate tester lever quickly several times to check injector spray pattern. Verify fuel is spraying from each injector nozzle hole. Injector should also spray evenly from each nozzle hole.

(d) Pay attention to size and shape of spray plumes. They should all be equal. If possible, compare spray pattern to that of a new fuel injector with same part number. Checking each plume for consistency is an excellent indicator of injector performance. Even if only one nozzle hole is plugged, significant performance problems could result.

(e) Look for burrs on injector inlet.

(f) Check nozzle holes for hole erosion or plugging.

(g) Inspect end of nozzle for burrs or rough machine marks.

(h) Look for cracks at nozzle end.

(i) Check nozzle color for signs of overheating. Overheating will cause nozzle to turn a dark yellow/tan or blue (depending on overheating temperature).

(j) Look at end of injector tube where it meets injector. A small, shiny band should be seen at this point. The band should have a consistent thickness. If not, injector could be leaking into fuel return.

(k) If any of these conditions occur, replace injector.

HIGH-PRESSURE FUEL LINE LEAK TEST

High-pressure fuel line leaks can cause starting problems and poor engine performance.

WARNING: DUE TO EXTREME FUEL PRESSURES OF UP TO 120,000 kPa (17,400 PSI), USE EXTREME CAUTION WHEN INSPECTING FOR HIGH-PRESSURE FUEL LEAKS. DO NOT GET YOUR HAND NEAR A SUSPECTED LEAK. INSPECT FOR HIGH-PRESSURE FUEL LEAKS WITH A SHEET OF CARDBOARD. HIGH FUEL INJECTION PRESSURE CAN CAUSE PERSONAL INJURY IF CONTACT IS MADE WITH THE SKIN.

DIAGNOSIS AND TESTING (Continued)

Start the engine. Move the cardboard over the high-pressure fuel lines and check for fuel spray onto the cardboard (Fig. 32). If a high-pressure line connection is leaking, bleed the system and tighten the connection. Refer to the Air Bleed Procedure in this group for procedures. Replace damaged, restricted or leaking high-pressure fuel lines with the correct replacement line.

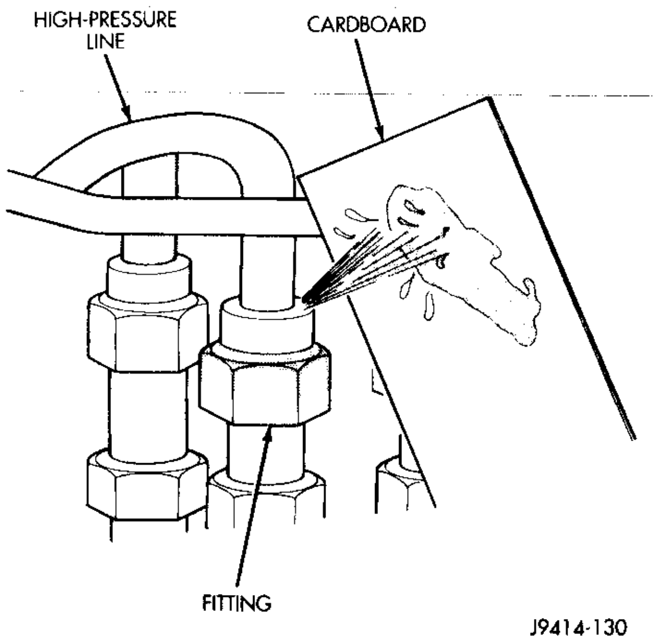

Fig. 32 Typical Test for Leaks with Cardboard

CAUTION: The high-pressure fuel lines must be clamped securely in place in the holders. The lines cannot contact each other or other components. Do not attempt to weld high-pressure fuel lines or to repair lines that are damaged. Only use the recommended lines when replacement of high-pressure fuel line is necessary.

FUEL INJECTION PUMP TIMING

With the Bosch VP44 injection pump, there are no mechanical adjustments needed for fuel injection timing. All timing and fuel adjustments are made by the Engine Control Module (ECM). However, if a Diagnostic Trouble Code (DTC) has been stored indicating an "engine sync error" or a "static timing error", perform the following.

Note: If this DTC appears after installation of a new or rebuilt injection pump, the pump keyway has probably been installed backwards. Refer to Fuel Injection Pump Removal/Installation for keyway information.

(1) Remove plastic access cover, injection pump nut and washer (Fig. 33). Locate keyway behind washer.

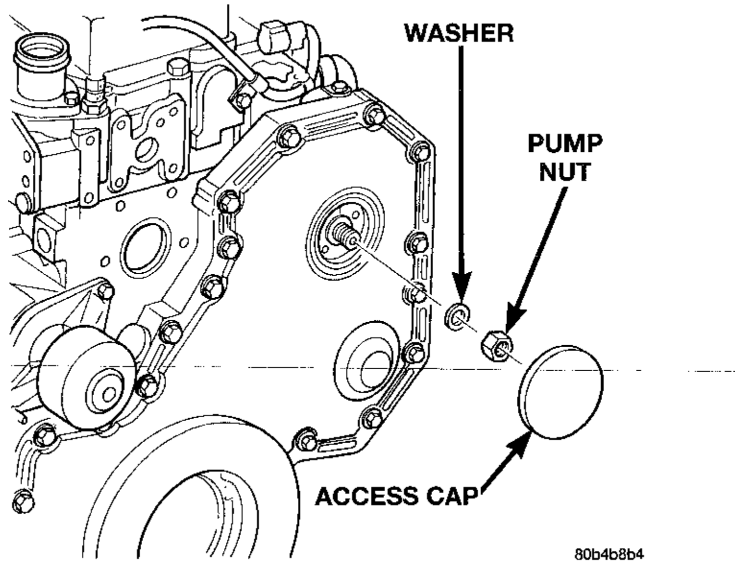

Fig. 33 Injection Pump Gear Access Cap

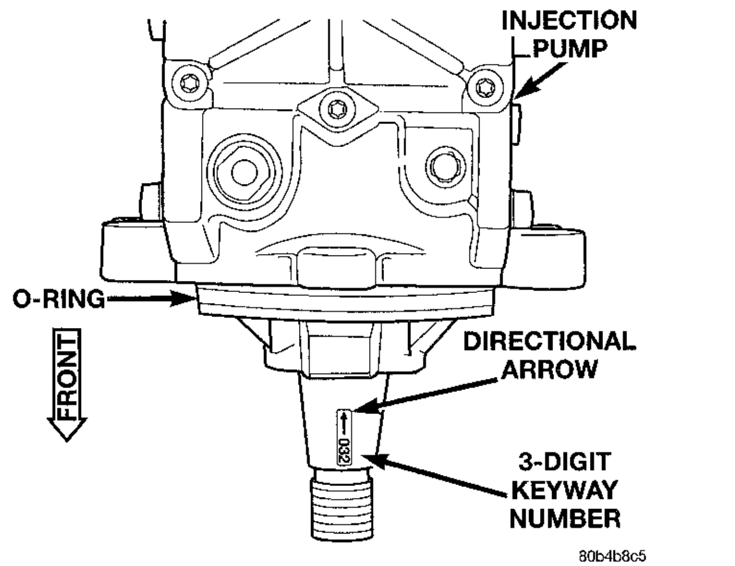

Fig. 34 Pump Keyway, Keyway Arrow and Keyway Number

(2) Be sure keyway aligning fuel injection pump shaft to injection pump gear is in proper position and pump gear has not slipped on pump shaft.

The following steps will require removing timing gear cover to gain access to timing gears. Refer to Group 9, Engines for procedures.

(3) Use a T-type puller to separate injection pump gear from pump shaft.

(4) Be sure keyway has been installed with arrow pointed to **rear** of pump (Fig. 34).

(5) **Pump timing has been calibrated to pump keyway. Be sure 3–digit number on pump keyway (Fig. 34) matches 3–digit number on fuel injection pump data plate. Plate is located on**

AUTHENTIC RESTORATION PRODUCT

DIAGNOSIS AND TESTING (Continued)

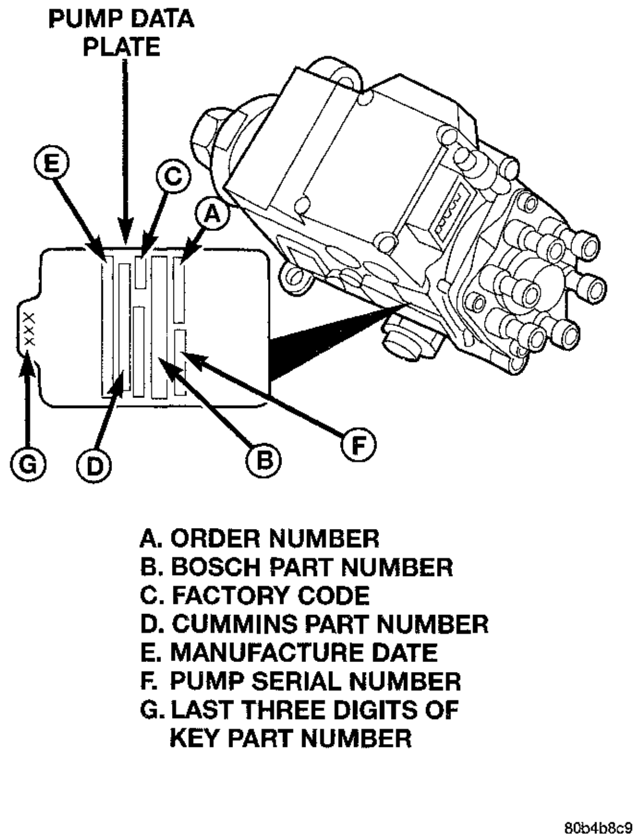

Fig. 35 Pump Data Plate Location

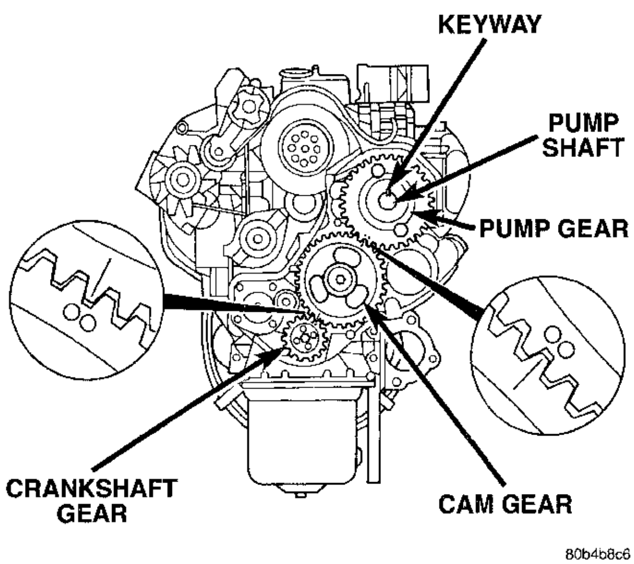

Fig. 36 Checking Fuel Injection Pump Gear Timing

side of injection pump (Fig. 35). Twenty–one different calibrated keyways/pumps are available.

(6) Verify timing marks on crank, cam and pump are aligned (Fig. 36).

(7) Perform necessary gear alignment/repairs as needed.

(8) After repairs are completed, erase DTC using DRB Scan Tool.

SERVICE PROCEDURES

CLEANING FUEL SYSTEM PARTS

CAUTION: Cleanliness cannot be overemphasized when handling or replacing diesel fuel system components. This especially includes the fuel injectors, high-pressure fuel lines and fuel injection pump. Very tight tolerances are used with these parts. Dirt contamination could cause rapid part wear and possible plugging of fuel injector nozzle tip holes. This in turn could lead to possible engine misfire. Always wash/clean any fuel system component thoroughly before disassembly and then air dry. Cap or cover any open part after disassembly. Before assembly, examine each part for dirt, grease or other contaminants and clean if necessary. When installing new parts, lubricate them with clean engine oil or clean diesel fuel only.

AIR BLEED PROCEDURE

A certain amount of air becomes trapped in the fuel system when fuel system components on the supply and/or high-pressure side are serviced or replaced. Primary air bleeding is accomplished using the electric fuel transfer (lift) pump. If the vehicle has been allowed to run completely out of fuel, the fuel injectors must also be bled as the fuel injection pump **is not** self-bleeding (priming).

Servicing or replacing components on the fuel return side will not require air bleeding.

WARNING: DO NOT BLEED AIR FROM THE FUEL SYSTEM OF A HOT ENGINE.

(1) Loosen, but do not remove, banjo bolt holding low-pressure fuel supply line to side of fuel injection pump (Fig. 37). Place a shop towel around banjo fitting to catch excess fuel.

The fuel transfer (lift) pump is self-priming: When the key is first turned on (without cranking engine), the pump operates for approximately 2 seconds and then shuts off. The pump will also operate for up to 25 seconds after the starter is engaged, and then disengaged and the engine is not running. The pump shuts off immediately if the key is on and the engine stops running.

(2) Turn key to CRANK position and quickly release key to ON position before engine starts. This will operate fuel transfer pump for approximately 25 seconds.

(3) If fuel is not present at fuel supply line after 25 seconds, turn key OFF. Repeat previous step until fuel is exiting at fuel supply line.

SERVICE PROCEDURES (Continued)

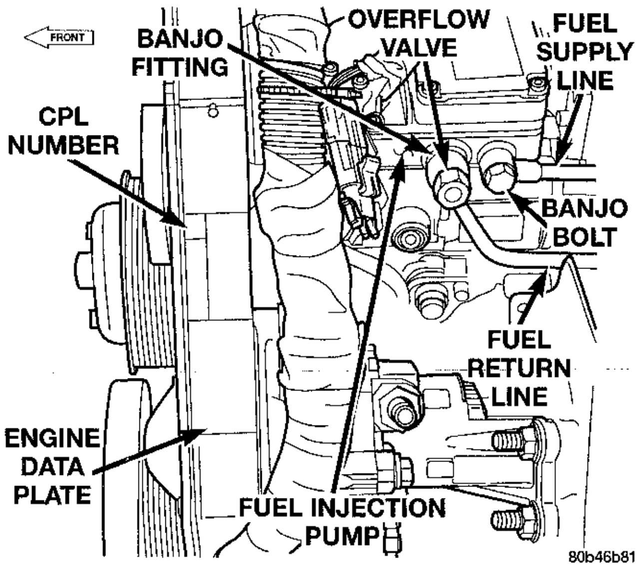

Fig. 37 Fuel Supply Line Banjo Bolt

(4) Tighten banjo bolt at fuel supply line to 24 N·m (18 ft. lbs.) torque. Primary air bleeding is now completed.

(5) Attempt to start engine. If engine will not start, proceed to following steps. **If engine does start, it may run erratically and be very noisy for a few minutes. This is a normal condition.**

(6) **Continue to next step if:**

- The vehicle fuel tank has been allowed to run empty
- The fuel injection pump has been replaced
- High-pressure fuel lines have been replaced
- Vehicle has not been operated after an extended period

CAUTION: Do not engage the starter motor for more than 30 seconds at a time. Allow two minutes between cranking intervals.

(7) Perform previous air bleeding procedure steps using fuel transfer pump. Be sure fuel is present at fuel supply line (Fig. 37) before proceeding.

(8) Crank the engine for 30 seconds at a time to allow air trapped in the injection pump to vent out the drain manifold.

WARNING: THE FUEL INJECTION PUMP SUPPLIES EXTREMELY HIGH FUEL PRESSURE TO EACH INDIVIDUAL INJECTOR THROUGH THE HIGH-PRESSURE LINES. FUEL UNDER THIS AMOUNT OF PRESSURE CAN PENETRATE THE SKIN AND CAUSE PERSONAL INJURY. WEAR SAFETY GOGGLES AND ADEQUATE PROTECTIVE CLOTHING AND AVOID CONTACT WITH FUEL SPRAY WHEN BLEEDING HIGH-PRESSURE FUEL LINES.

WARNING: ENGINE MAY START WHILE CRANKING STARTER MOTOR.

Engine may start, may run erratically and be very noisy for a few minutes. This is a normal condition.

(9) Thoroughly clean area around injector fittings where they join injector connector tubes.

(10) Bleed air by loosening high-pressure fuel line fittings (Fig. 38) at cylinders number 3, 4 and 5.

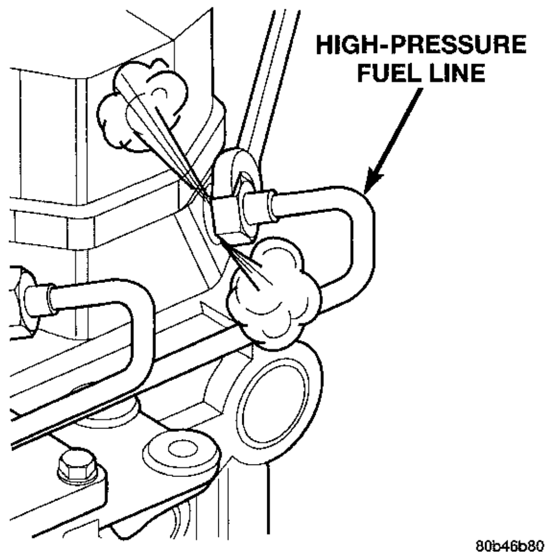

Fig. 38 Bleeding High-Pressure Fuel Lines at Injectors

(11) Continue bleeding injectors until engine runs smoothly. It may take a few minutes for engine to run smooth.

(12) Tighten fuel line(s) at injector(s) to 40 N·m (30 ft. lbs.) torque.

WATER DRAINING AT FUEL FILTER

Refer to Fuel Filter/Water Separator removal/installation for procedures.

AUTHENTIC RESTORATION PRODUCT

REMOVAL AND INSTALLATION

ACCELERATOR PEDAL

REMOVAL

CAUTION: Be careful not to damage or kink the cable core wire (within the cable sheathing) while servicing accelerator pedal or cables.

(1) From inside vehicle, hold up accelerator pedal. Remove plastic cable retainer and throttle cable core wire from upper end of pedal arm (Fig. 39). The plastic cable retainer snaps into pedal arm.

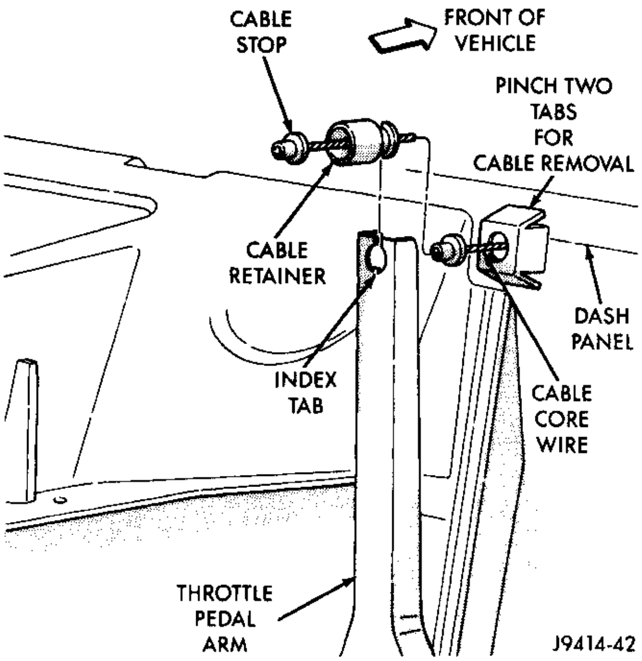

Fig. 39 Cable Removal/Installation at Pedal

(2) Insert a small screwdriver into square holes located on pivots/bushings (Fig. 40). Twist screwdriver to disengage pivot locks from pivot pin. Pivots will be damaged when removing. Discard old pivots.
(3) Remove pedal/bracket assembly from vehicle.

INSTALLATION

(1) Position pedal/bracket assembly over pivot pin (Fig. 40).
(2) Install two new pivots/bushings. Using large pliers, press both bushings together until they bottom on sides of pedal/bracket assembly. Bushing retaining ears will snap into position when properly installed.

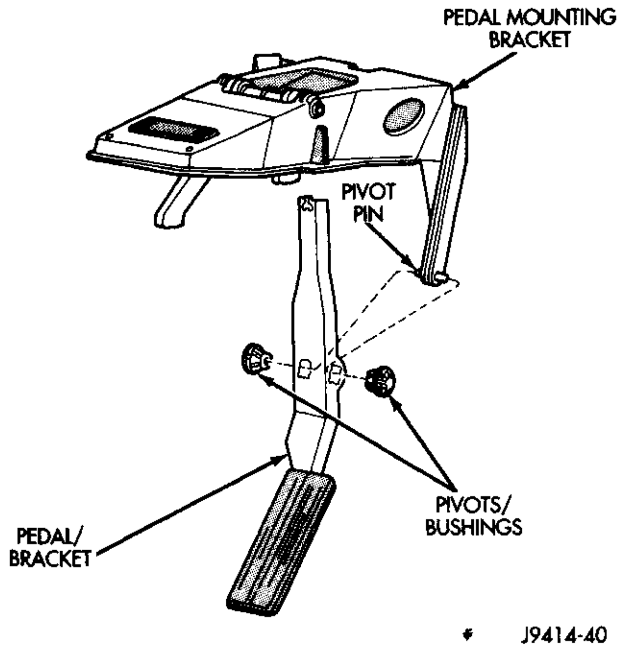

Fig. 40 Accelerator Pedal—Removal or Installation

(3) From inside vehicle, hold up accelerator pedal. Install throttle cable core wire and plastic cable retainer into and through upper end of pedal arm (the plastic retainer is snapped into pedal arm). When installing plastic retainer to accelerator pedal arm, note index tab on pedal arm (Fig. 39). Align index slot on plastic cable retainer to this index tab.

THROTTLE CABLE

CAUTION: Be careful not to damage or kink the cable core wire (within the cable sheathing) while servicing accelerator pedal or cables.

REMOVAL

(1) Disconnect both negative battery cables at both batteries.
(2) From inside vehicle, hold up accelerator pedal. Remove plastic cable retainer and throttle cable core wire from upper end of pedal arm (Fig. 39). The plastic cable retainer snaps into pedal arm.
(3) Remove cable core wire at pedal arm.
(4) From inside vehicle, pinch both sides of plastic cable housing retainer tabs at dash panel (Fig. 39).
(5) Remove cable housing from dash panel and pull cable into engine compartment.

REMOVAL AND INSTALLATION (Continued)

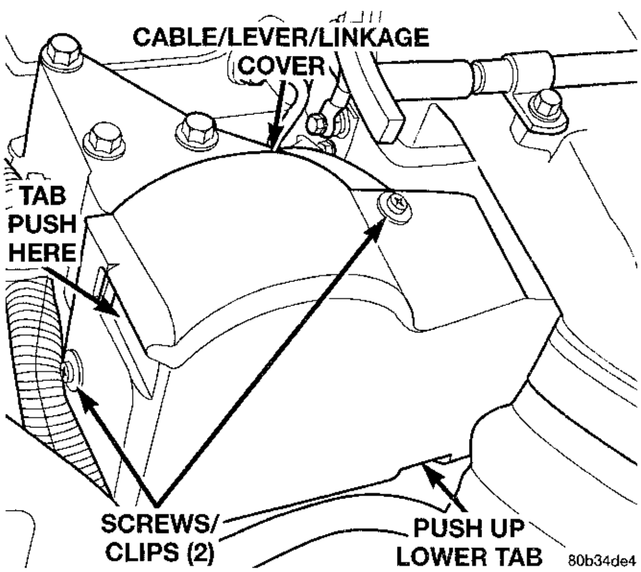

Fig. 41 Cable/Lever/Throttle Linkage Cover

(6) Remove cable cover (Fig. 41). Cable cover is attached with 2 Phillips screws, 2 plastic retention clips and 2 push tabs (Fig. 41). Remove 2 Phillips screws and carefully pry out 2 retention clips. After clip removal, push rearward on front tab, and upward on lower tab for cover removal.

(7) Using 2 screwdrivers, pry cable connector socket from throttle lever ball (Fig. 42). **Be very careful not to bend throttle lever arm.**

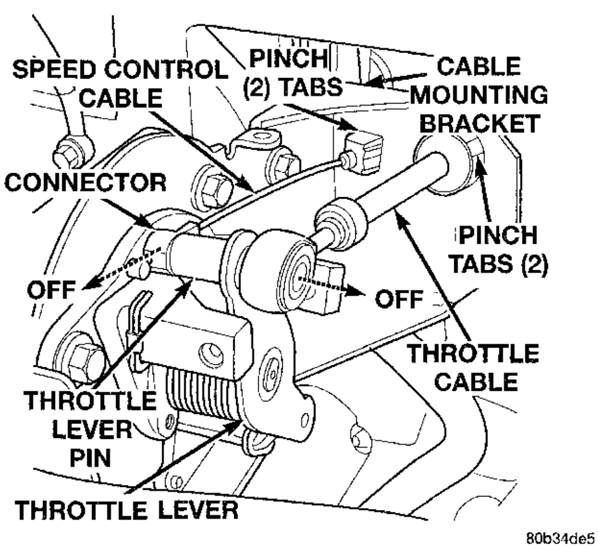

Fig. 42 Throttle Cable at Throttle Lever

(8) Squeeze 2 pinch tabs on sides of throttle cable at mounting bracket (Fig. 42) and push cable rearward out of bracket .

INSTALLATION

(1) Install cable through mounting hole on cable mounting bracket (Fig. 42). Cable snaps into bracket. Be sure 2 pinch tabs are secure.

(2) Using large pliers, connect cable end socket to throttle lever ball (snaps on).

(3) Install remaining cable housing end into and through dash panel opening (snaps into position). The two plastic pinch tabs (Fig. 39) should lock cable to dash panel.

(4) From inside vehicle, hold up accelerator pedal. Install throttle cable core wire and plastic cable retainer into and through upper end of pedal arm (the plastic retainer is snapped into pedal arm). When installing plastic retainer to accelerator pedal arm, note index tab on pedal arm (Fig. 39). Align index slot on plastic cable retainer to this index tab.

(5) Connect negative battery cables to both batteries.

(6) Before starting engine, operate accelerator pedal to check for any binding.

(7) Install cable/lever cover.

AIR CLEANER HOUSING/AIR CLEANER ELEMENT

TESTING AIR CLEANER ELEMENT

Do not attempt to unnecessarily remove the top of the air cleaner housing for air cleaner element inspection on diesel engines.

The air cleaner (filter) housing is equipped with an air Filter Minder® gauge (Fig. 43). This air flow restriction gauge will determine when the air cleaner element is restricted and should be replaced.

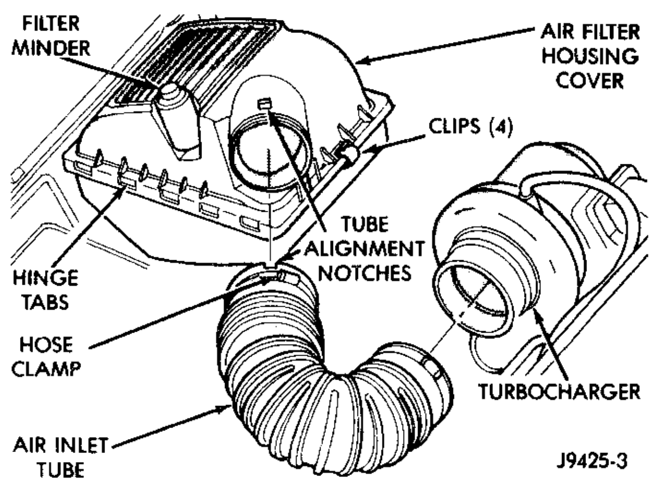

Fig. 43 Filter Minder®—Location—Diesel Engine

AUTHENTIC RESTORATION

REMOVAL AND INSTALLATION (Continued)

The Filter Minder™ consists of a diaphragm and calibrated spring sealed inside of a plastic housing (Fig. 44). A yellow colored disc attached to the diaphragm moves along a graduated scale on the side of the Filter Minder. After the engine has been shut off, a ratcheting device located within the Filter Minder will hold the yellow disc at the highest restriction that the air cleaner element has experienced. A drop in air pressure due to an air cleaner element restriction moves the diaphragm and the yellow disc will indicate the size of the air drop.

CAUTION: Certain engine degreasers or cleaners may discolor or damage the plastic housing of the Filter Minder. Cover and tape the Filter Minder if any engine degreasers or cleaners are to be used.

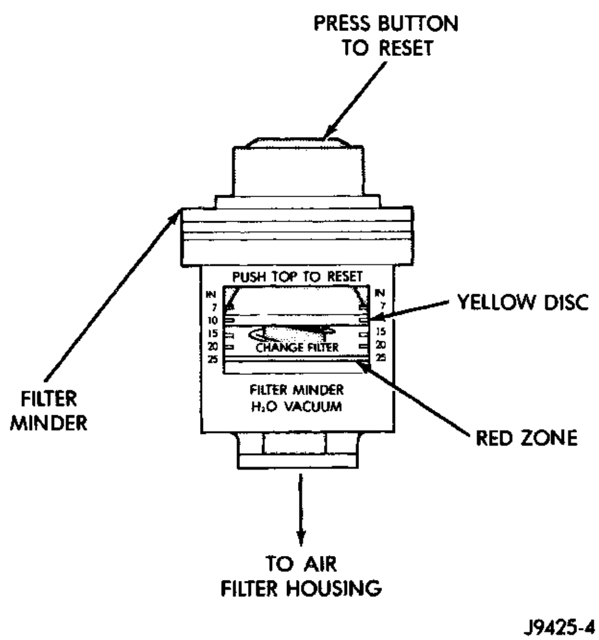

Fig. 44 Filter Minder™—Diesel Engine

To test, turn the engine off. If the yellow disc (Fig. 44) has reached the red colored zone on the graduated scale, the air cleaner element should be replaced. Refer to the proceeding removal/installation paragraphs.

Resetting the Filter Minder: After the air cleaner (filter) element has been replaced, press the rubber button on the top of the Filter Minder (Fig. 44). This will allow the yellow colored disc to reset. After the button has been pressed, the yellow disc should spring back to the UP position.

If the Filter Minder gauge has reached the red colored zone, and after an examination of the air cleaner (filter) element, the element appears to be clean, the high reading may be due to a temporary condition such as snow build-up at the air intake. Temporary high restrictions may also occur if the air cleaner (filter) element has gotten wet such as during a heavy rain or snow. If this occurs, allow the element to dry out during normal engine operation. Reset the rubber button on the top of the Filter Minder and retest after the element has dried.

REMOVAL

(1) Loosen air inlet tube clamp at air cleaner housing inlet (Fig. 43). Remove this tube at air cleaner housing cover.

(2) The housing cover is equipped with four (4) spring clips (Fig. 43) and is hinged at front with plastic tabs. Unlatch clips from top of air cleaner housing and tilt housing cover up and forward for cover removal.

(3) Remove air cleaner element from air cleaner housing.

INSTALLATION

(1) Before installing a new air cleaner element, clean inside of air cleaner housing.

(2) Position air cleaner cover to tabs on front of air cleaner housing. Latch four spring clips to seal cover to housing.

(3) Install air inlet tube at air cleaner housing inlet. Note hose alignment notches at both inlet hose and air cleaner cover (Fig. 43).

(4) Position tube clamp to inlet tube and tighten to 3 N·m (25 in. lbs.) torque.

FUEL DRAIN MANIFOLD

The fuel drain manifold (line) connects a fuel return passage within the cylinder head to a "T" fitting on the fuel return line. It is located at the rear of the cylinder head.

REMOVAL

(1) Disconnect both negative battery cables at both batteries.

(2) Remove starter motor. Refer to Group 8B for procedures.

(3) Disconnect fitting at "T" (Fig. 45).

(4) Remove banjo bolt at rear of cylinder head. Discard old sealing washers.

(5) Remove fuel line from vehicle.

(6) Clean connection at rear of cylinder head before line installation.

INSTALLATION

Servicing fuel return components will not require air bleeding.

(1) Using new sealing washers, assemble banjo bolt to fuel line.

(2) Position line to engine and loosely tighten fasteners.

(3) Tighten banjo bolt to 24 N·m (18 ft. lbs.) torque.

REMOVAL AND INSTALLATION (Continued)

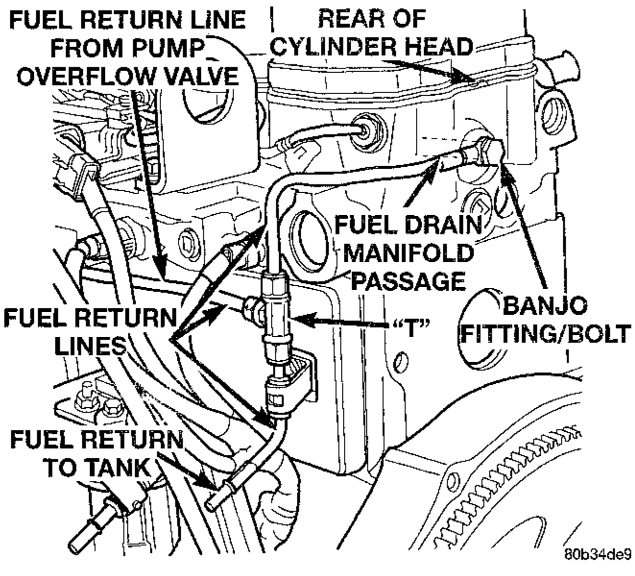

Fig. 45 Fuel Return Line at Rear of Cylinder Head

(4) Tighten fitting at "T" to 12 N·m (106 in. lbs.) torque.

(5) Install starter motor. Refer to Group 8B for procedures.

(6) Connect both negative battery cables at both batteries.

FUEL FILTER/WATER SEPARATOR

Refer to maintenance schedules in Group 0 in this manual for recommended fuel filter replacement intervals.

The fuel filter/water separator assembly is located on left/rear side of engine above starter motor (Fig. 46). The assembly contains the fuel filter cartridge, Water-In-Fuel (WIF) sensor, and fuel heater.

REMOVAL

Draining water from filter canister:

The canister drain valve (Fig. 47) serves two purposes. One is to **partially** drain filter canister of excess water. The other is to **completely** drain canister for filter, heater or water-in-fuel sensor replacement.

The filter should be drained whenever water-in-fuel warning lamp remains illuminated. (Note that lamp will be illuminated for approximately two seconds when ignition key is initially placed in ON position for a bulb check).

(1) A drain hose is located at bottom of drain valve (Fig. 48). Place drain pan under drain hose.

(2) **With engine not running,** rotate drain valve handle forward to OPEN (DRAIN) position (Fig. 47). Hold drain valve open until all water and contaminants have been removed and clean fuel exits drain hose.

(3) If fuel filter, fuel heater or Water-In-Fuel (WIF) sensor is being replaced, drain canister completely. Dispose of mixture in drain pan according to applicable regulations.

(4) After draining operation, rotate valve handle rearward to CLOSE position (Fig. 47). **If fuel filter, fuel heater or WIF sensor is being replaced, proceed to next step.**

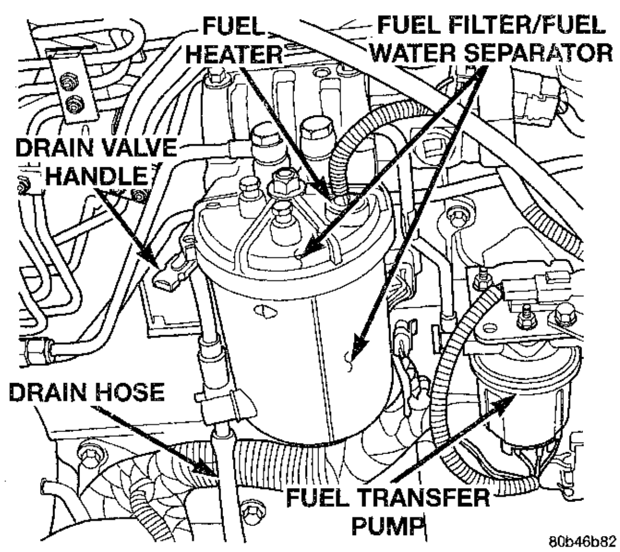

Fig. 46 Fuel Filter/Water Separator/Drain Hose Location

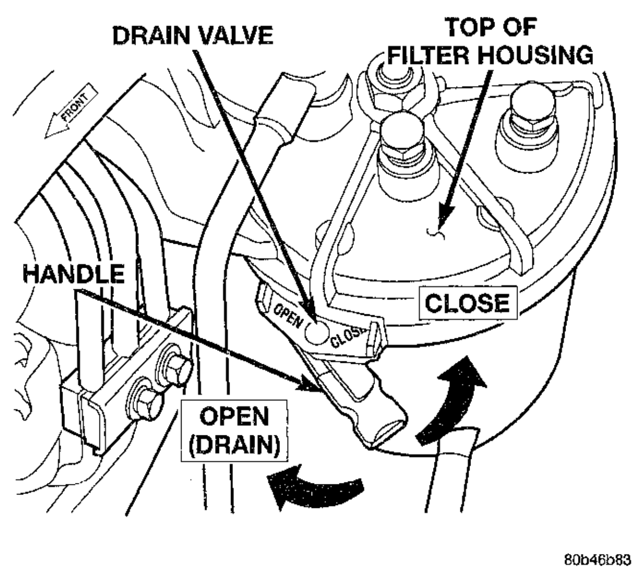

Fig. 47 Drain Valve at Fuel Filter/Water Separator

(5) Remove drain hose at drain valve (Fig. 46).

(6) Disconnect Water-In-Fuel (WIF) sensor electrical connector at sensor. The WIF sensor is located at side of filter canister (Fig. 48).

REMOVAL AND INSTALLATION (Continued)

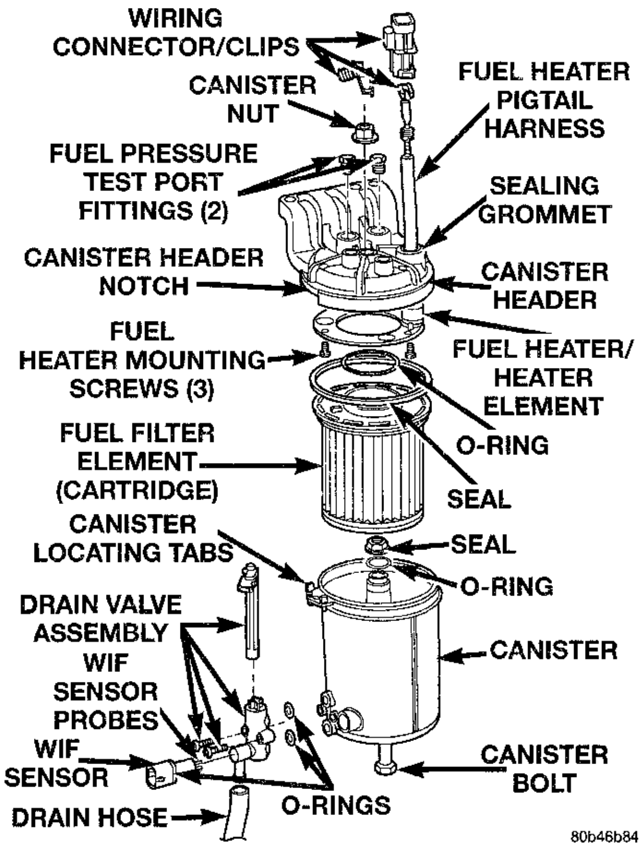

Fig. 48 Fuel Filter/Water Separator Components

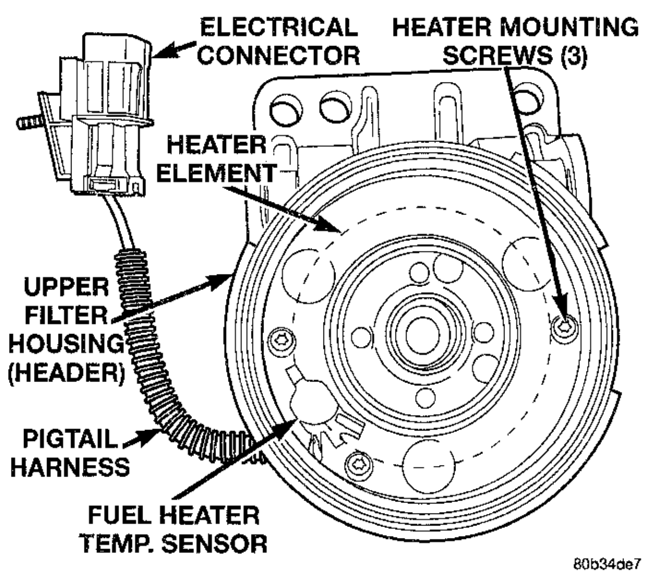

Fig. 49 Fuel Heater Mounting Screws (Bottom View)

(7) Loosen filter canister nut at top of header (Fig. 48) while lowering canister assembly from header.

(8) Remove and discard seals and center o-rings (Fig. 48).

(9) Remove filter element (cartridge) from canister.

(10) Remove WIF sensor and its o-ring seal from canister (Fig. 48).

(11) Inspect WIF sensor probes (Fig. 48). Carefully clean contaminants from sensor probes with a cloth if necessary. Replace sensor if probes are covered with contaminants and will not clean up.

(12) **Fuel Heater:** The fuel heater is located inside fuel filter housing (header) (Fig. 46), (Fig. 48) or (Fig. 49). The heater mounting plate, heating element, temperature sensor and wiring harness are serviced as one assembly.

(a) Disconnect heater pigtail harness electrical connector (Fig. 49) from main engine wiring harness near upper/rear of filter.

(b) The plastic electrical connector (Fig. 49) at end of 2–wire pigtail harness will have to be removed from wiring harness before attempting to pass harness through filter header.

(c) Note locations (colors) of wires in connector before removing connector.

(d) Remove clip (Fig. 48) retaining wires to connector.

(e) Remove wires from connector.

(f) Remove 3 fuel heater mounting screws (Fig. 48) or (Fig. 49).

(g) Press down on heater sealing grommet (Fig. 48) to remove heater from filter canister header.

(h) Pass wire harness through hole in filter header while removing heater from header.

INSTALLATION

(1) Clean inside of canister and canister header.

(2) **Fuel Heater:**

(a) Lift fuel heater assembly into filter header while passing wire harness upward through hole in header. Heater sealing grommet should protrude at top of filter header.

(b) Install 3 fuel heater mounting screws (Fig. 49) or (Fig. 48) and tighten to 2–3 N·m (15–20 in. lbs.) torque.

(c) Install 2 wires into electrical connector and install connector clip.

(d) Connect heater pigtail harness electrical connector (Fig. 49) to main engine wiring harness.

(3) Install new o-ring seal to WIF sensor.

(4) Install WIF sensor to canister. Tighten to 2–3 N·m (15–20 in. lbs.) torque.

(5) If drain valve assembly is being replaced, tighten mounting screws to 3–5 N·m (30–40 in. lbs.) torque.

(6) Install new o-rings.

(7) Install new seal between canister and canister header.

If filter canister is not filled with clean diesel fuel before installation, manual air bleeding of fuel system may be necessary (temporary rough engine running may occur). If necessary, refer to Air Bleed Procedures.

REMOVAL AND INSTALLATION (Continued)

(8) Load filter into canister.
(9) Fill filter canister with clean diesel fuel.
(10) Apply a light film of clean diesel oil to all seals.
(11) Position canister assembly to canister header. Note locating tabs on canister should align into notch on canister header (Fig. 48).
(12) Install canister nut and tighten to 14 N·m (10 ft. lbs.) torque.
(13) Connect electrical connector to WIF sensor.
(14) Connect drain hose to bottom of drain valve.
(15) Start engine and check for leaks.

FUEL TANK

Depending on body style, tank may have to be lowered for fuel draining. Refer to following procedures.

REMOVAL

(1) Remove fuel tank filler tube cap.
(2) Disconnect both negative battery cables at both batteries.
(3) Raise vehicle on hoist.
(4) Open fuel fill door and remove screws mounting fuel filler tube assembly to body (some body styles only). Do not disconnect rubber fuel fill or vent hoses from tank at this time.
(5) Place a transmission jack under center of fuel tank. Apply a slight amount of pressure to fuel tank with transmission jack.
(6) Remove fuel tank mounting strap nuts from mounting strap studs (Fig. 50). If equipped, remove fuel tank shield bolts.
(7) Lower fuel tank only enough to allow access to top of tank. The 2 tank fittings (where rubber fuel fill and vent hose connections are made) must be positioned above tank level. Rotate tank slightly to allow these fittings to be above tank level.

WARNING: WRAP SHOP TOWELS AROUND HOSES TO CATCH ANY DIESEL FUEL SPILLAGE.

(8) While working over left rear tire/wheel, disconnect rubber fuel vent hose at fuel vent fitting (Fig. 51) (vent hose is the smallest of 2 hoses). Position fuel siphoning/drain hose into this fitting at tank. Drain fuel into an approved portable holding tank or a properly labeled diesel fuel safety container.
(9) Disconnect rubber fuel fill hose at fuel tank (Fig. 50).
(10) While working over left rear tire/wheel, disconnect wiring harness connector from electrical connector at top of fuel tank module (Fig. 51).
(11) Disconnect fuel supply and fuel return lines at fuel tank module fittings (Fig. 51). Refer to Quick-Connect Fittings for procedures.
(12) Continue lowering fuel tank for removal.
(13) If fuel tank module removal is necessary, refer to Fuel Tank Module Removal/Installation in this group.

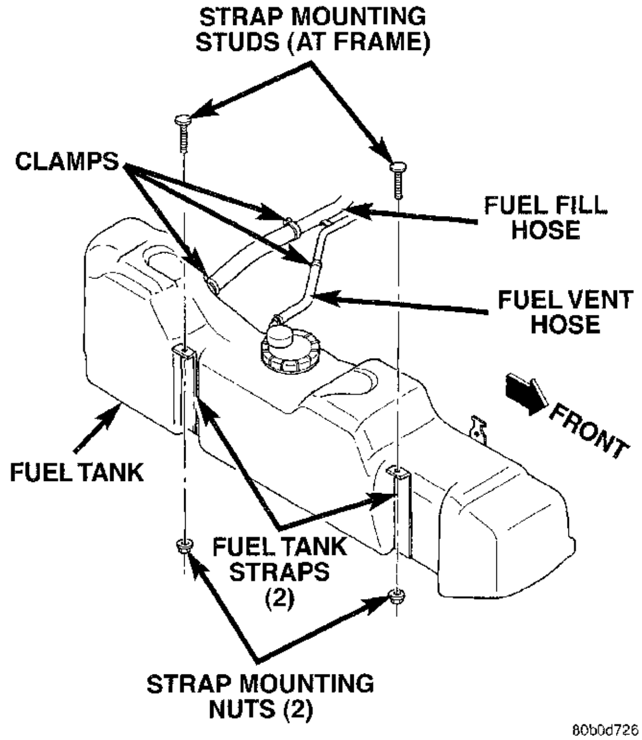

Fig. 50 Fuel Tank Mounting—Typical

INSTALLATION

(1) If fuel tank module is being installed, refer to Fuel Tank Module Removal/Installation in this group.
(2) Place fuel tank on top of transmission jack.
(3) Install rubber fill and vent lines to tank. Tighten hose clamps to 2.3 N·m (20 in. lbs.) torque.
(4) Raise tank into position while guiding fill and vent hoses to body. Raise tank only enough to allow access to top of tank.
(5) Connect electrical connector to fuel tank module.

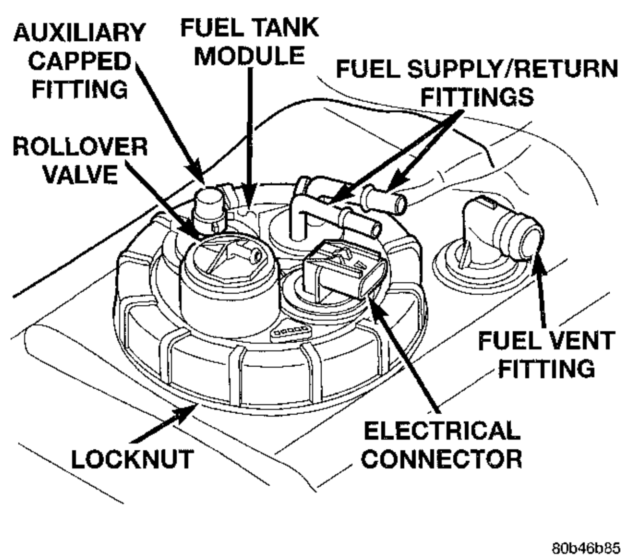

Fig. 51 Fuel Tank Module Location

REMOVAL AND INSTALLATION (Continued)

(6) Connect fuel supply and fuel return lines to fuel tank module fittings. Refer to Quick-Connect Fittings in this group.

(7) Connect two mounting straps and mounting strap nuts.

(8) Tighten strap nuts to 41 N·m (30 ft. lbs.) torque. Do not over tighten retaining strap nuts.

(9) Remove transmission jack.

(10) Connect fuel filler tube assembly to body.

(11) Refill fuel tank and inspect all hoses and lines for leaks.

(12) Connect both negative battery cables to both batteries.

FUEL TANK MODULE

REMOVAL

(1) Drain and remove fuel tank. Refer to Fuel Tank Removal/Installation.

(2) Thoroughly clean area around tank module at top of tank.

(3) The plastic fuel tank module locknut is threaded onto fuel tank (Fig. 51). Install Special Tool 6856 to locknut and remove locknut (Fig. 52). The fuel tank module will spring up when locknut is removed.

(4) Remove module from fuel tank.

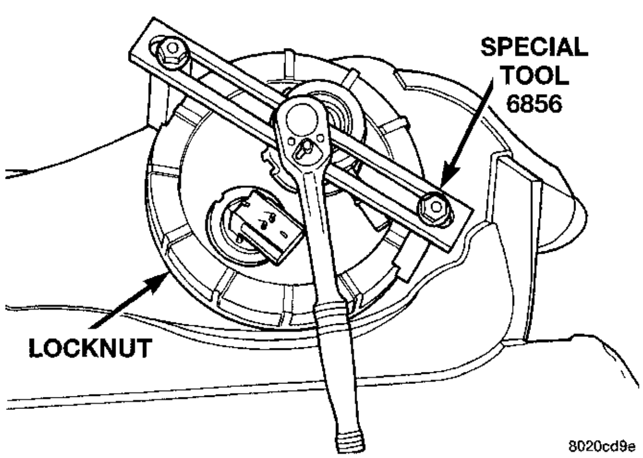

Fig. 52 Locknut Removal/Installation—TYPICAL MODULE

INSTALLATION

CAUTION: Whenever the fuel tank module is serviced, the rubber gasket must be replaced.

(1) Thoroughly clean locknut and locknut threads at top of tank.

(2) Using new gasket, carefully position fuel tank module into opening in fuel tank.

(3) Position locknut over top of fuel tank module. Install locknut finger tight.

(4) When looking down at tank from drivers side of tank, the arrow at top of module should be aligned between two marks stamped into tank (approximately 2 o'clock position). The fuel line connectors, roll over valve and fuel gauge electrical connector should all be pointed to drivers side of vehicle. Rotate and align module/tank marks if necessary before tightening locknut. **This step must be performed to prevent the module's float from contacting side of fuel tank.**

(5) Tighten locknut to 24–44 N·m (18–32 ft. lbs.) torque.

(6) Install fuel tank. Refer to Fuel Tank Removal/Installation.

FUEL HEATER

The fuel heater/element/sensor assembly is located inside of the fuel filter housing. Refer to Fuel Filter/Water Separator Removal/Installation for procedures.

FUEL HEATER RELAY

The fuel heater relay is located in the Power Distribution Center (PDC) (Fig. 53). Refer to label under PDC cover for relay location.

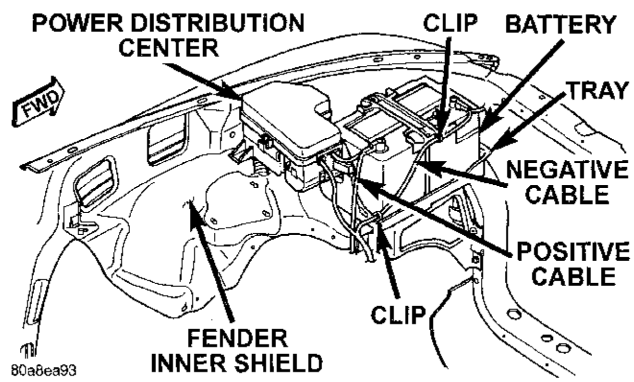

Fig. 53 Power Distribution Center (PDC) Location

REMOVAL

(1) Remove PDC cover.

(2) Remove relay from PDC.

(3) Check condition of relay terminals and PDC connector terminals for damage or corrosion. Repair if necessary before installing relay.

(4) Check for pin height (pin height should be the same for all terminals within the PDC connector). Repair if necessary before installing relay.

INSTALLATION

(1) Install relay to PDC.

(2) Install cover to PDC.

REMOVAL AND INSTALLATION (Continued)

HIGH-PRESSURE FUEL LINES

High-pressure lines are used between the fuel injection pump and the fuel injectors only. All high-pressure fuel lines are of the same length and inside diameter. Correct high-pressure fuel line usage and installation is critical to smooth engine operation.

Whenever the high-pressure lines are removed, they should be removed as a bundle (if possible). They should also be tagged for return to original position.

CAUTION: The high-pressure fuel lines must be clamped securely in place in the holders. The lines cannot contact each other or other components. Do not attempt to weld high-pressure fuel lines or to repair lines that are damaged. Only use the recommended lines when replacement of high-pressure fuel line is necessary.

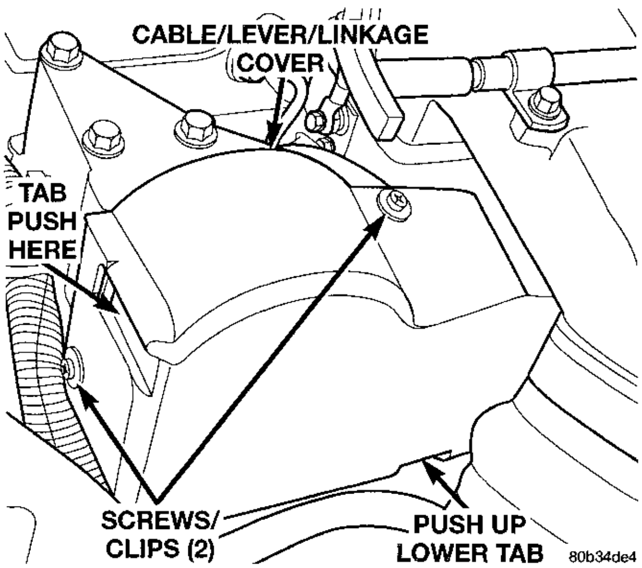

Fig. 54 Cable/Lever/Throttle Linkage Cover

REMOVAL

CAUTION: Refer to Cleaning Fuel System Parts.

(1) Disconnect both negative battery cables from both batteries. Cover and isolate ends of cables.

(2) Thoroughly clean fuel lines at cylinder head and injection pump ends.

(3) Remove cable cover (Fig. 54). Cable cover is attached with 2 Phillips screws, 2 plastic retention clips and 2 push tabs (Fig. 54). Remove 2 Phillips screws and carefully pry out 2 retention clips. After clip removal, push rearward on front tab, and upward on lower tab for cover removal. **Do not remove any cables at lever.**

(4) Disconnect wiring harness (clip) at bottom of Accelerator Pedal Position Sensor (APPS) mounting bracket (Fig. 55).

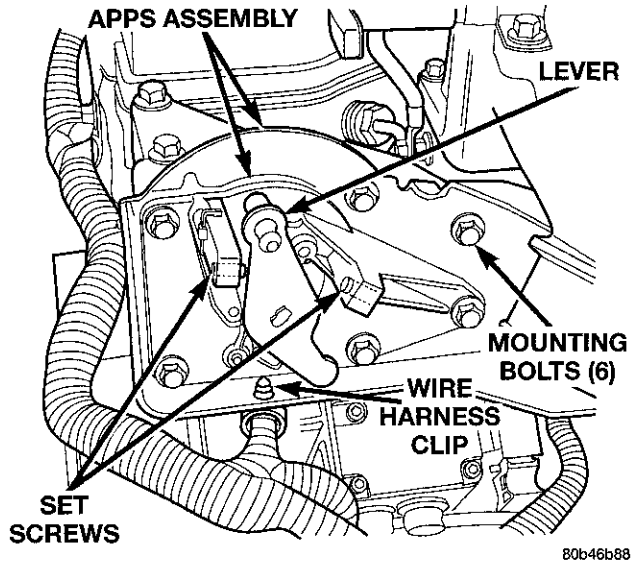

Fig. 55 Wiring Clip at APPS

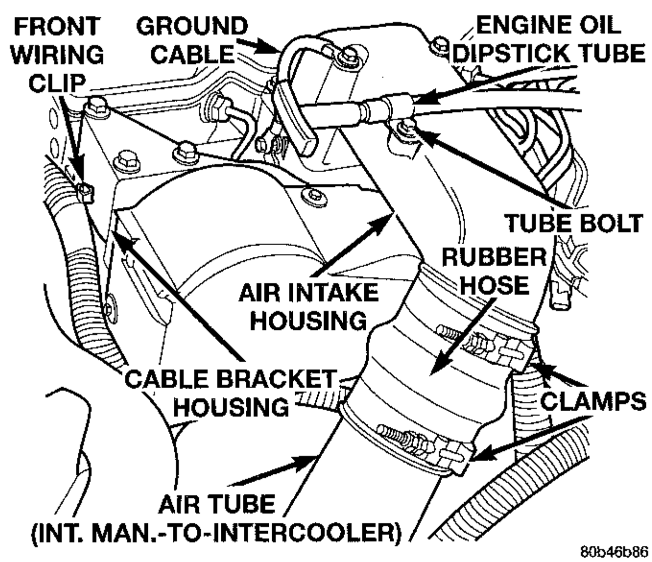

Fig. 56 Air Tube

(5) Using 2 small screwdrivers, pry front wiring clip (Fig. 56) from cable bracket housing. Position wiring harness towards front of engine.

(6) Remove electrical connector from APPS by pushing connector tab rearward while pulling down on connector (Fig. 57).

(7) Disconnect 2 electrical cables from cable mounting studs (Fig. 58) at intake air heater on top of intake manifold.

(8) Remove engine oil dipstick from engine.

(9) Remove engine oil dipstick tube support mounting bolt (Fig. 56) and position tube to side.

(10) Disconnect clamps and remove air tube (intake manifold-to-intercooler) (Fig. 56).

REMOVAL AND INSTALLATION (Continued)

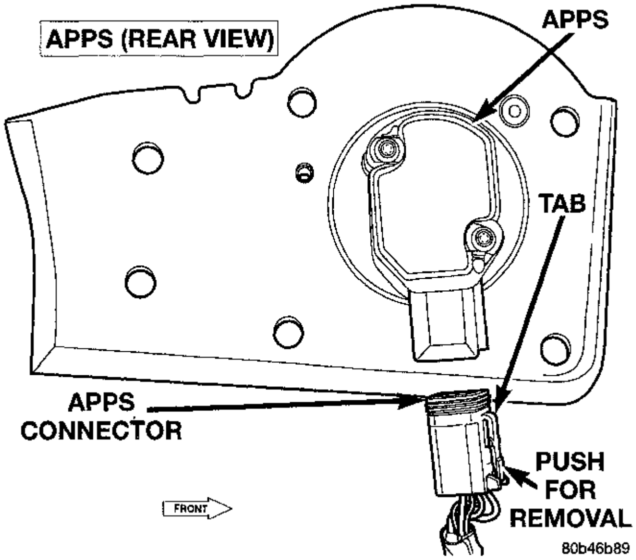

Fig. 57 Rear View of APPS

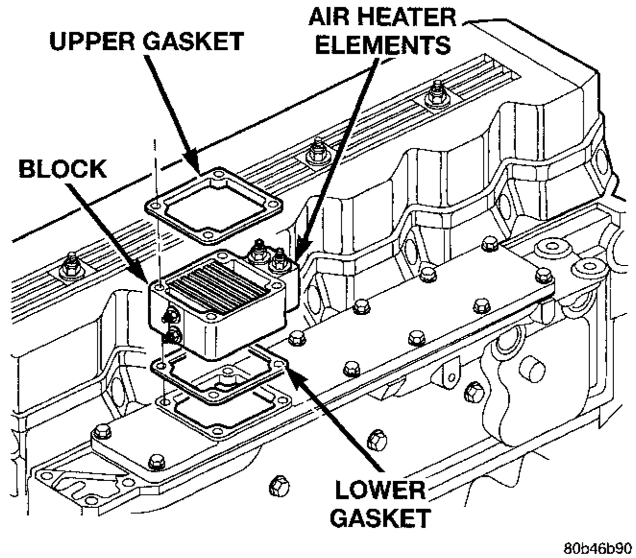

Fig. 59 Intake Manifold Air Heater (Elements)

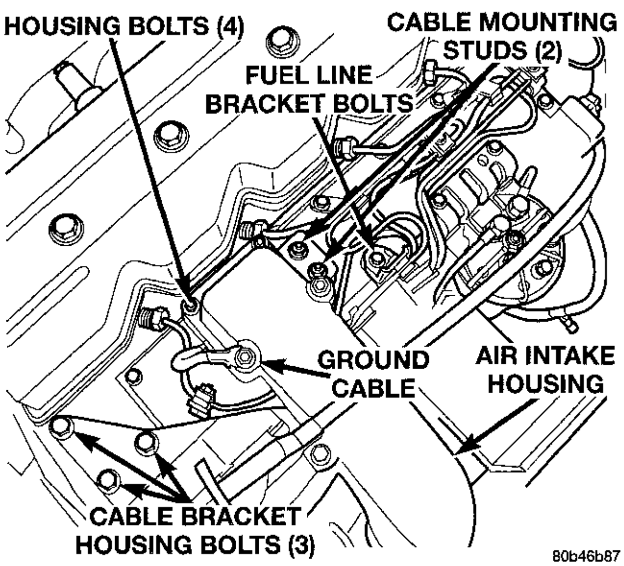

Fig. 58 Air Intake Housing

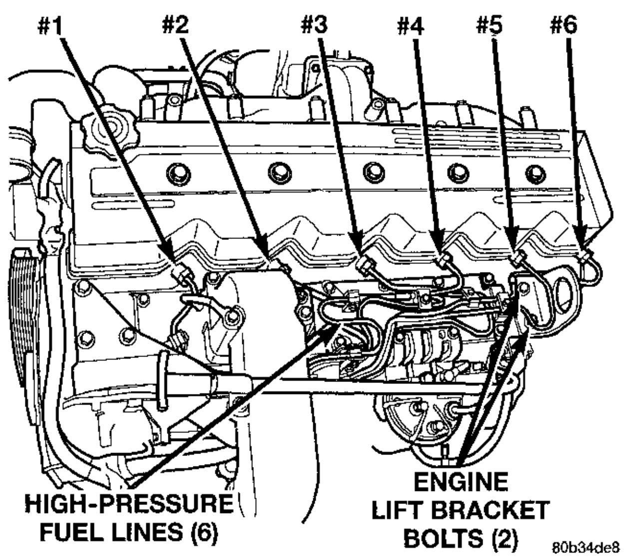

Fig. 60 High-Pressure Lines at Cylinder Head

(11) Remove 4 air intake housing mounting bolts and remove housing (Fig. 58). Position ground cable at top of air intake housing to front of engine.

(12) Remove intake manifold air heater element block from engine (Fig. 59). Discard old upper and lower gaskets

(13) Remove 3 cable bracket housing mounting bolts (Fig. 58). Carefully position cable bracket and cable assembly to side of engine. **Leave cables connected to lever.**

(14) Remove engine lifting bracket at rear of intake manifold (2 bolts) (Fig. 60).

(15) Remove bolts from all fuel injection line support brackets at intake manifold (Fig. 58).

(16) Place shop towels around fuel lines at fuel injectors. Do not allow fuel to drip down side of engine.

CAUTION: WHEN LOOSENING OR TIGHTENING HIGH-PRESSURE FITTINGS AT INJECTION PUMP, USE A BACK-UP WRENCH ON DELIVERY VALVE AT PUMP. DO NOT ALLOW DELIVERY VALVE TO ROTATE.

(17) Loosen high-pressure lines at injection pump (Fig. 61) beginning with cylinders 1, 2 and 4.

(18) Loosen high-pressure lines at cylinder head for cylinders 1, 2 and 4 (Fig. 60).

REMOVAL AND INSTALLATION (Continued)

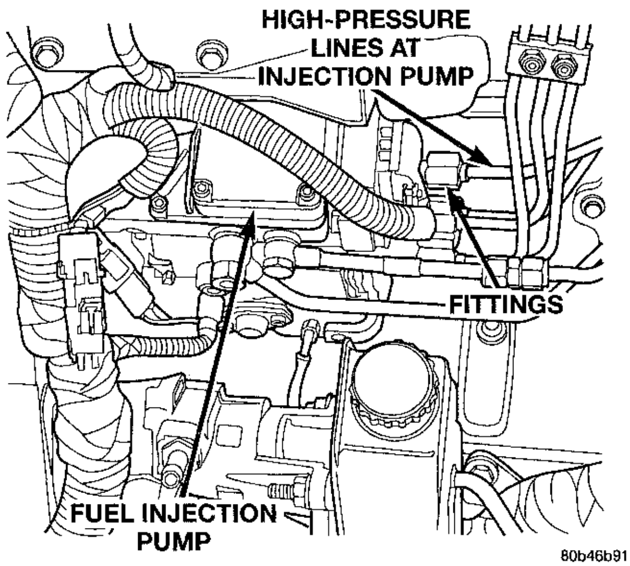

Fig. 61 High-Pressure Lines at Fuel Injection Pump

(19) Carefully remove front line bundle from engine. **Do not bend lines while removing.** While removing front line bundle, note line position.

(20) Loosen high-pressure lines at injection pump beginning with cylinders 3, 5 and 6.

(21) Loosen high-pressure lines at cylinder head for cylinders 3, 5 and 6 (Fig. 60).

(22) Carefully remove rear line bundle from engine. **Do not bend lines while removing.** While removing rear line bundle, note line position.

INSTALLATION

CAUTION: Be sure that the high-pressure fuel lines are installed in the same order that they were removed.

(1) Lubricate threads of injector line fittings with clean engine oil.

(2) Loosen, but do not remove, all fuel line support bracket bolts.

(3) Install **rear** injection line bundle beginning with cylinder head (fuel injector) connections, followed by injection pump connections. Tighten all fittings finger tight.

(4) Tighten fittings at fuel injector ends for cylinders number 6 and 5 to 40 N·m (30 ft. lbs.) torque. **Do not tighten number 3 line at this time. It will be tightened during bleeding procedure.**

(5) Tighten 3 fittings at fuel injection pump ends to 24 N·m (18 ft. lbs.) torque.

(6) Install **front** injection line bundle beginning with cylinder head (fuel injector) connections, followed by injection pump connections. Tighten all fittings finger tight.

(7) Tighten fitting at fuel injector end for cylinder number 2 to 40 N·m (30 ft. lbs.) torque. **Do not tighten lines number 1 or 4 at this time. They will be tightened during bleeding procedure.**

(8) Tighten remaining 3 fittings at fuel injection pump ends to 24 N·m (18 ft. lbs.) torque.

(9) Install fuel line support bracket bolts to intake manifold and tighten to 24 N·m (18 ft. lbs.) torque.

CAUTION: Be sure fuel lines are not contacting each other or any other component. Noise will result.

(10) Install engine lifting bracket at rear of intake manifold. Tighten 2 bolts to 77 N·m (57 ft. lbs.) torque.

(11) Install cable bracket housing/cable assembly and tighten 3 mounting bolts to 24 N·m (18 ft. lbs.) torque.

(12) Clean any old gasket material below and above intake manifold air heater element block. Also clean mating areas at intake manifold and air intake housing.

(13) Using new gaskets, position intake manifold air heater element block to engine.

(14) Install air intake housing and position ground cable. Install 4 mounting bolts (Fig. 58) and tighten to 24 N·m (18 ft. lbs.) torque.

(15) Install air tube (intake manifold-to-intercooler) (Fig. 56). Tighten clamps to 8 N·m (72 in. lbs.) torque.

(16) Install engine oil dipstick tube support mounting bolt (Fig. 56) and tighten to 24 N·m (18 ft. lbs.) torque.

(17) Install engine oil dipstick to engine.

(18) Connect 2 electrical cables to cable mounting studs (Fig. 58).

(19) Connect electrical connector to bottom of APPS by pushing connector upward until it snaps into position.

(20) Connect wiring harness (clip) at bottom of Accelerator Pedal Position Sensor (APPS) mounting bracket (Fig. 55).

(21) Connect front wiring clip (Fig. 56) to cable bracket housing.

(22) Install cable cover (Fig. 54).

(23) Connect both negative battery cables to both batteries.

(24) Bleed air from fuel system. Do this at fuel injector ends of lines. Use cylinders numbers 1, 3 and 4 for bleeding . Refer to Air Bleed Procedure section of this group. After bleeding, tighten fittings to 40 N·m (30 ft. lbs.) torque.

(25) Check lines/fittings for leaks.

AUTHENTIC RESTORATION PRODUCT

REMOVAL AND INSTALLATION (Continued)

OVERFLOW VALVE

The overflow valve (pressure relief valve) is located at the outside of fuel injection pump (Fig. 62). It connects the fuel return line (banjo fitting) to the pump. The valve has no internal serviceable parts and must be replaced as an assembly. Two sealing gaskets are used. One gasket is located between pump and banjo fitting. The other is located between the banjo fitting and end of valve.

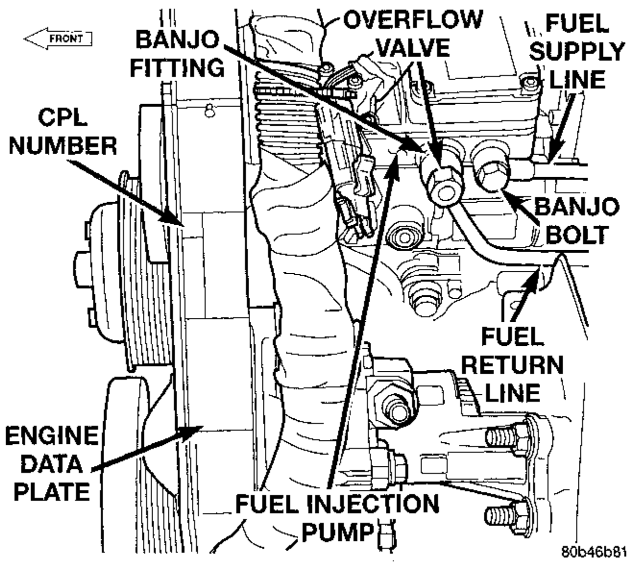

Fig. 62 Overflow Valve Location

REMOVAL

(1) Clean area around overflow valve and fuel return line at injection pump before removal.

(2) Remove valve from pump and banjo fitting.

(3) Discard old sealing gaskets.

INSTALLATION

(1) Install new sealing gaskets to valve.

(2) Install valve through banjo fitting and into pump.

(3) Tighten to 30 N·m (24 ft. lbs.) torque.

FUEL INJECTION PUMP

New or remanufactured fuel injection pumps should have a new overflow valve temporarily installed into side of pump. **Do not install a used overflow valve into a new or remanufactured injection pump.**.

CAUTION: Whenever the fuel injection pump is removed from the engine, the pump drive gear is laying loose on the camshaft drive gear. Never attempt to crank or rotate the engine with the pump removed from the engine. Serious damage will occur.

REMOVAL

CAUTION: Refer to Cleaning Fuel System Parts.

(1) Disconnect both negative battery cables at both batteries. Cover and isolate ends of cables.

(2) Thoroughly clean fuel lines at cylinder head and injection pump ends. Thoroughly clean fuel injection pump and supply/return lines at side of pump.

(3) Disconnect 9–way electrical connector at Fuel Pump Control Module (FPCM) (Fig. 63).

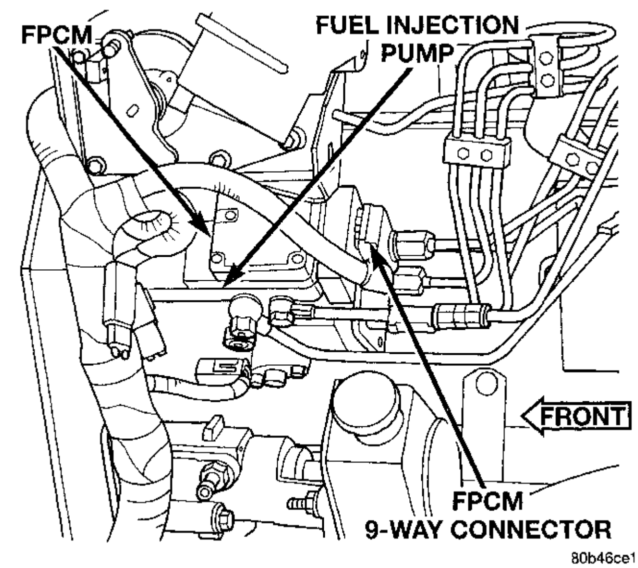

Fig. 63 FPCM 9–Way Connector

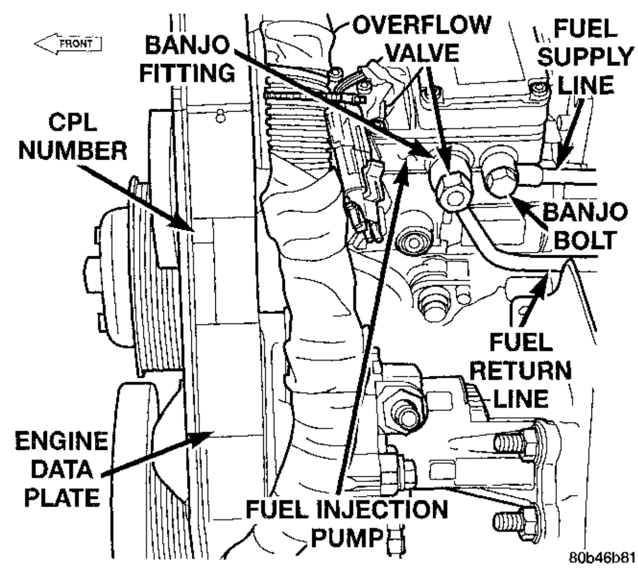

Fig. 64 Fuel Supply and Return Lines at Pump

(4) Remove fuel return line at side of injection pump by removing overflow valve (Fig. 64). Place rag beneath overflow valve to catch excess fuel.

REMOVAL AND INSTALLATION (Continued)

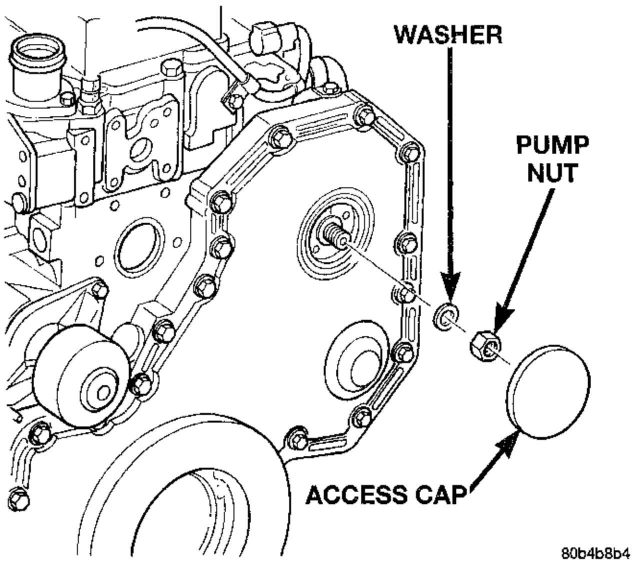

Fig. 65 Access Cap at Front Gear Cover

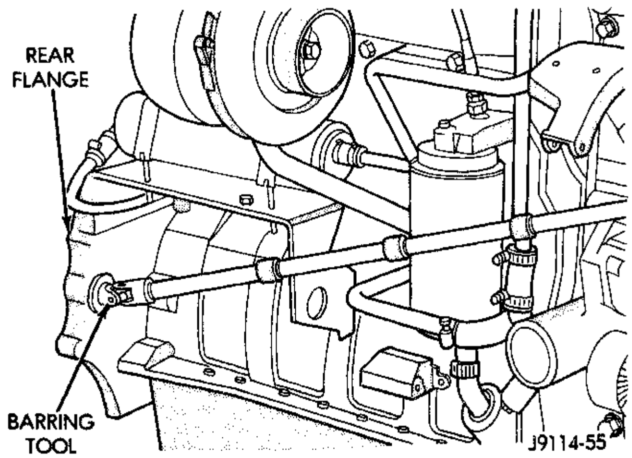

Fig. 66 Rotating Engine with Barring Tool

(5) Remove fuel supply line at side of injection pump by removing banjo bolt (Fig. 64). Also remove same line at top of fuel filter housing (banjo bolt).

(6) Remove all high-pressure fuel lines, intake air tube, accelerator pedal position sensor, air intake housing, engine oil dipstick tube, wiring clips, electrical cables at intake heaters and engine lifting bracket. Refer to High-Pressure Fuel Line Removal/Installation. All of these items are covered in this procedure.

(7) Unscrew plastic access cap (Fig. 65) at front gear cover.

CAUTION: To prevent pump/gear keyway from falling into gear housing, engine must be rotated until keyway is at 12 o'clock position (Fig. 67). If gear retainer nut, washer or key drops into gear housing, cover may have to be removed to retrieve them before engine is started.

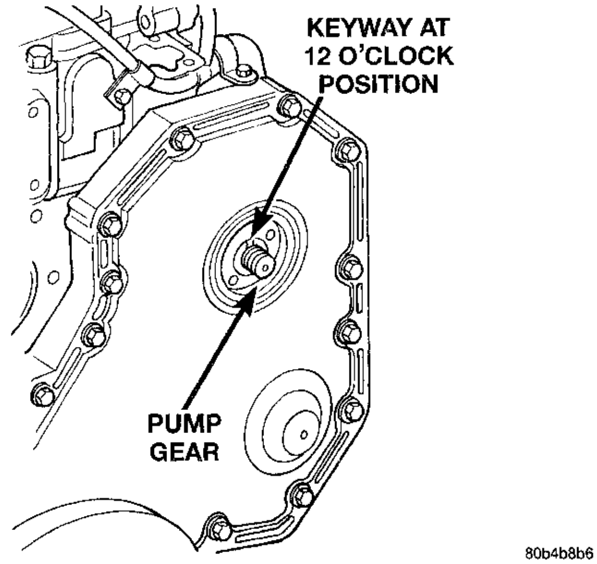

Fig. 67 Placing Keyway at 12 O'clock Position

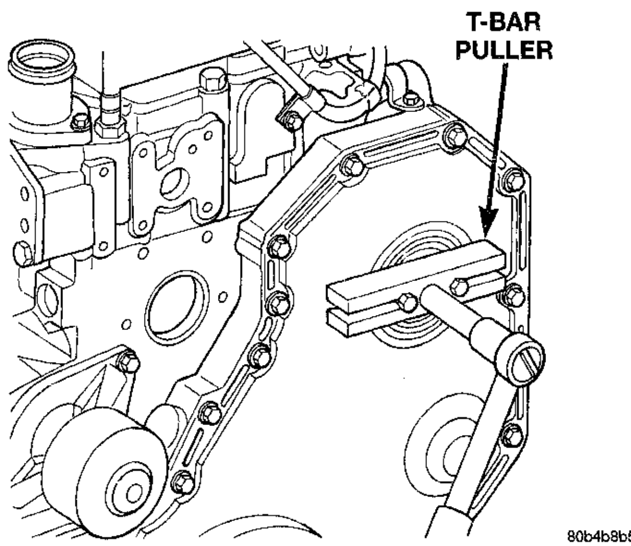

Fig. 68 Separating Injection Pump Gear from Pump Shaft

(8) Remove nut and washer retaining injection pump gear to injection pump shaft (Fig. 65).

(9) The engine can be rotated with a barring tool such as Snap-On No. SP371, MTE No. 3377371 (Cummins Tool Division), or an equivalent. The opening for barring tool is located in rear flange of engine on exhaust manifold side (Fig. 66). Remove rubber access plug covering this opening.

(10) Insert barring tool into flywheel housing opening (Fig. 66).

(11) Rotate engine until keyway is at 12 o'clock position (Fig. 67).

(12) Use T-bar type puller (Fig. 68) to separate injection pump gear from injection pump shaft. Attach two M8 X 1.24 MM (metric) screws through

REMOVAL AND INSTALLATION (Continued)

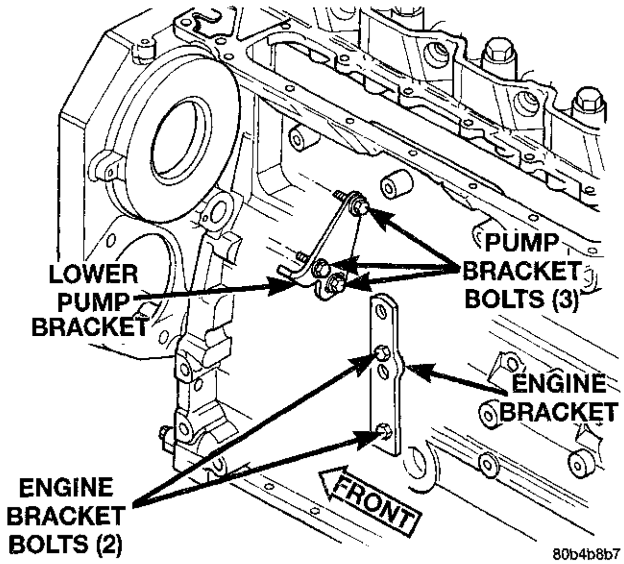

Fig. 69 Lower Pump Bracket and Mounting Bolts

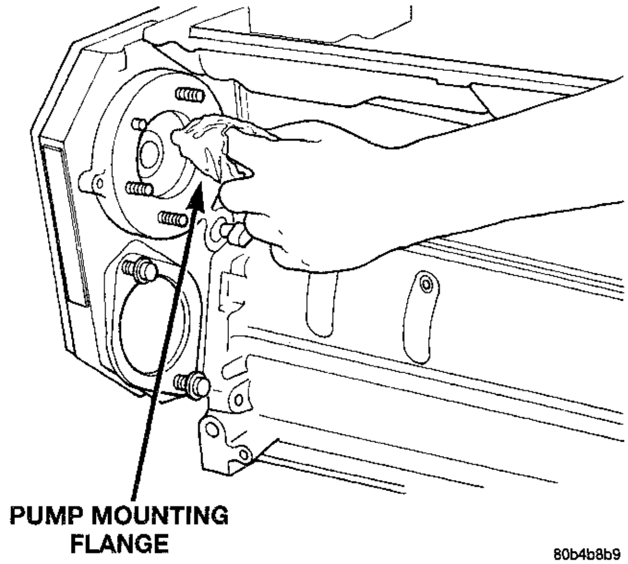

Fig. 71 Cleaning Pump Mounting Flange

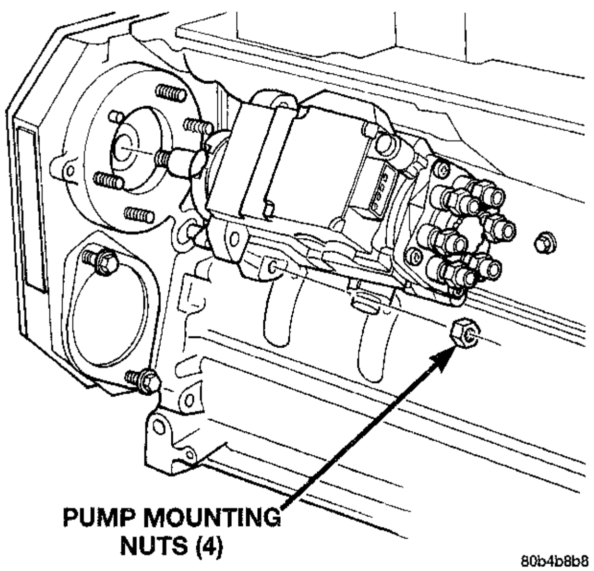

Fig. 70 Injection Pump Mounting Nuts

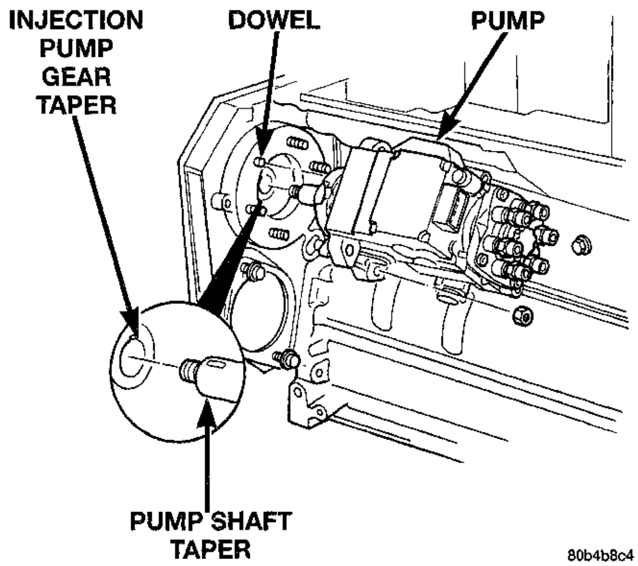

Fig. 72 Injection Pump Installation

puller and into two threaded holes supplied in pump gear. Pull injection pump gear forward until it loosens from injection pump shaft. **Pull on gear only enough to loosen it from injection pump shaft. Pulling gear too far may cause damage or breakage to gear cover.**

(13) Remove 3 lower pump bracket bolts (Fig. 69) and remove lower pump bracket. Loosen, but do not remove 2 engine bracket bolts (Fig. 69).

(14) Remove 4 injection pump-to-gear housing mounting nuts (Fig. 70).

(15) Remove injection pump from gear housing. **Take care not to nick injection pump shaft on aluminum gear housing when removing pump. Also be very careful not to drop pump keyway (Fig. 73) into gear housing.**

CAUTION: Whenever the fuel injection pump is removed from the engine, the pump drive gear is laying loose on the camshaft drive gear. Never attempt to crank or rotate the engine with the pump removed from the engine. Serious damage will occur.

INSTALLATION

(1) Inspect pump mounting surfaces at pump and mounting flange for nicks, cuts or damage. Inspect o-ring surfaces for nicks, cuts or damage.

(2) Clean injection pump mounting flange (Fig. 71) at gear housing. Also clean front of injection pump.

(3) Install new rubber o-ring (Fig. 73) at pump mounting area.

AUTHENTIC RESTORATION PRODUCT

REMOVAL AND INSTALLATION (Continued)

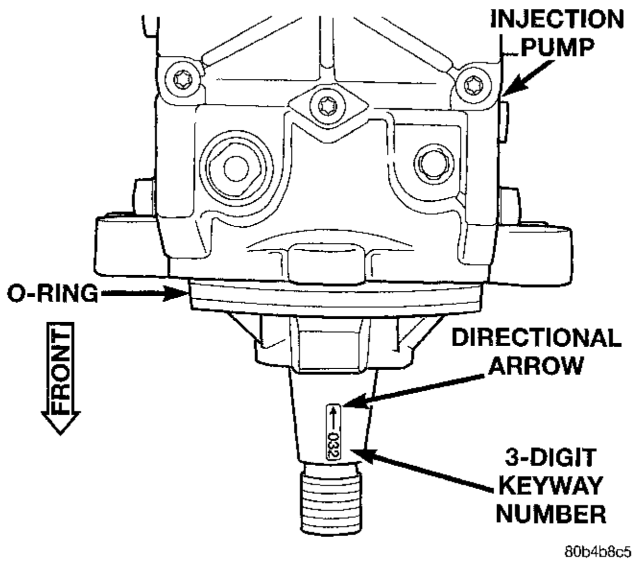

Fig. 73 Keyway, Keyway Arrow and Keyway Number

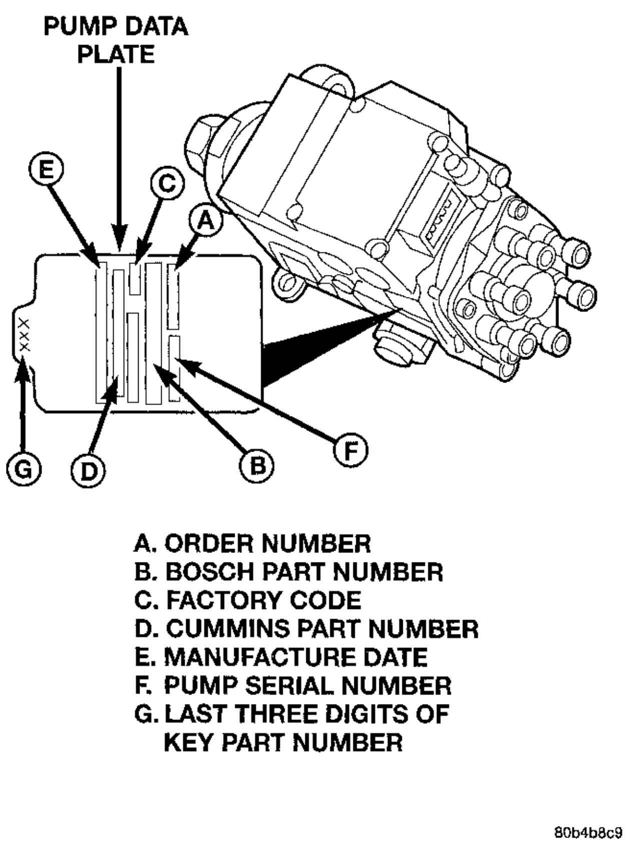

Fig. 74 Injection Pump Data Plate Location

(4) Apply clean engine oil **to injection pump o-ring only.**

The machined tapers on both injection pump shaft and injection pump gear (Fig. 72) must be absolutely dry, clean and free of any dirt or oil film. This will ensure proper gear-to-shaft tightening.

(5) Clean pump gear and pump shaft at machined tapers (Fig. 72) with an evaporative type cleaner such as brake cleaner.

Keyway Installation:

(6) The pump/gear keyway has an arrow and a 3–digit number stamped at top edge (Fig. 73). Position keyway into pump shaft with **arrow pointed to rear of pump.** Also be sure 3–digit number stamped to top of keyway is same as 3–digit number stamped to injection pump data plate (Fig. 74). If wrong keyway is installed, a diagnostic trouble code may be set.

(7) Position pump assembly to mounting flange on gear cover while aligning injection pump shaft through back of injection pump gear. When installing pump, dowel (Fig. 72) on mounting flange must align to hole in front of pump.

(8) After pump is positioned flat to mounting flange, install four pump mounting nuts and tighten finger tight only. Do not attempt a final tightening at this time. **Do not attempt to tighten (pull) pump to gear cover using mounting nuts. Damage to pump or gear cover may occur. The pump must be positioned flat to its mounting flange before attempting to tighten mounting nuts.**

(9) To prevent damage or cracking of components, tighten nuts/bolts in the following sequence:

(a) Install injection pump shaft washer and nut to pump shaft. Tighten nut **finger tight only.**

(b) Position lower pump bracket and install 3 bolts **finger tight only.**

(c) Do preliminary tightening of injection pump shaft nut to 30 N·m (15–22 ft. lbs.) torque. **This is not the final torque.**

(d) Tighten 4 pump mounting nuts to 43 N·m (32 ft. lbs.) torque.

(e) Tighten 3 lower pump bracket-to-pump bolts 24 N·m (18 ft. lbs.) torque.

(f) Tighten 2 engine bracket-to-engine bolts 24 N·m (18 ft. lbs.) torque.

(g) Do final tightening of injection pump shaft nut to 170 N·m (125 ft. lbs.) torque. Use barring tool to prevent engine from rotating when tightening gear.

(10) Install plastic access cap (Fig. 65) to front gear cover.

(11) Using new gaskets, install fuel return line and overflow valve to side of injection pump (Fig. 64). Tighten overflow valve to 24 N·m (18 ft. lbs.) torque.

(12) Using new gaskets, install fuel supply line to side of injection pump and top of fuel filter housing (Fig. 64). Tighten banjo bolts to 24 N·m (18 ft. lbs.) torque.

(13) Install all high-pressure fuel lines, intake air tube, accelerator pedal position sensor, air intake housing, engine oil dipstick tube, wiring clips, electrical cables at intake heaters and engine lifting

AUTHENTIC RESTORATION PRODUCT

REMOVAL AND INSTALLATION (Continued)

bracket. Refer to High-Pressure Fuel Line Removal/Installation. All of these items are covered in this procedure.

(14) Connect 9–way electrical connector to Fuel Pump Control Module (FPCM) (Fig. 63).

(15) Connect both negative battery cables to both batteries.

(16) Bleed air from fuel system. Refer to Air Bleed Procedure.

(17) Check system for fuel or engine oil leaks.

FUEL INJECTORS

The fuel injectors are located in the top of the cylinder head between the intake/exhaust valves (Fig. 75).

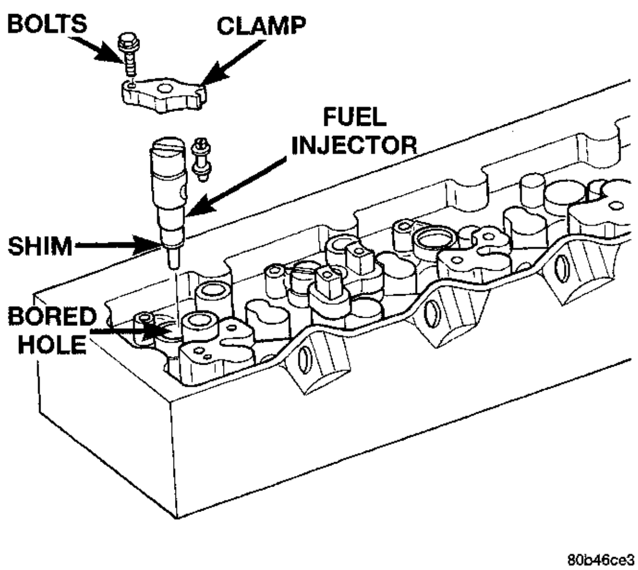

Fig. 75 Fuel Injector Location

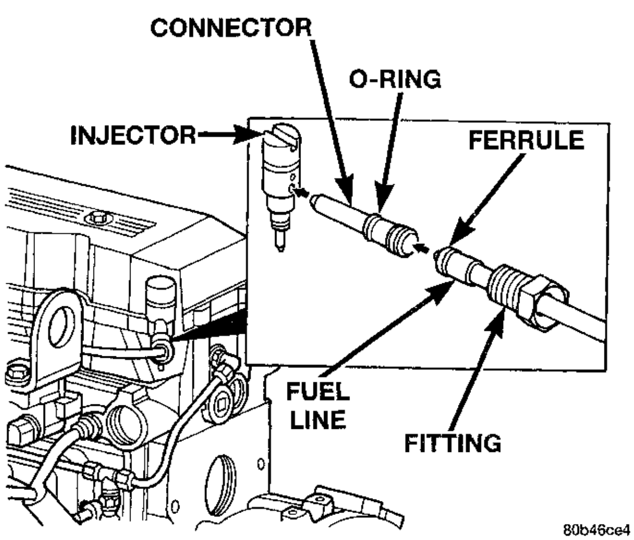

Fig. 76 Fuel Injector Connections

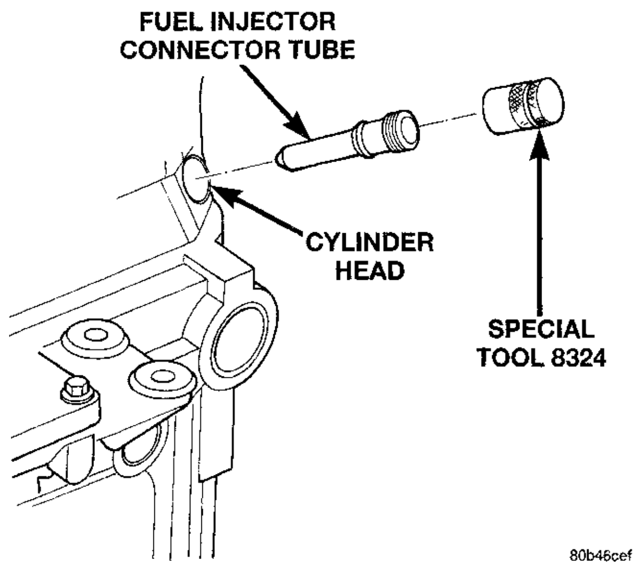

Fig. 77 Fuel Injector Connector Tube Removal

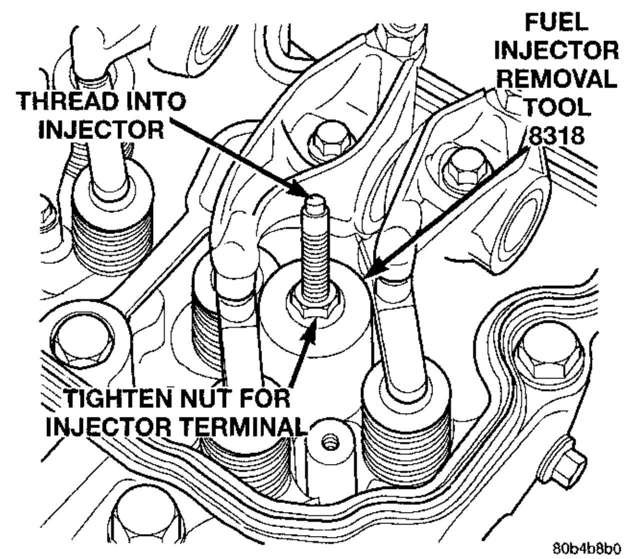

Fig. 78 Fuel Injector Removal

REMOVAL

CAUTION: Refer to Cleaning Fuel System Parts.

(1) Disconnect both negative battery cables from both batteries. Cover and isolate ends of cables.

Each fuel injector is connected to each high-pressure fuel line with a steel connector tube (Fig. 76). This steel connector is positioned into cylinder head and sealed with an o-ring. The connectors are connected to high-pressure fuel lines with fittings (Fig. 76).

(2) If injector at #1 or #2 cylinder is being removed, intake manifold air heater assembly must be removed. Refer to Intake Manifold Air Heater Removal/Installation.

REMOVAL AND INSTALLATION (Continued)

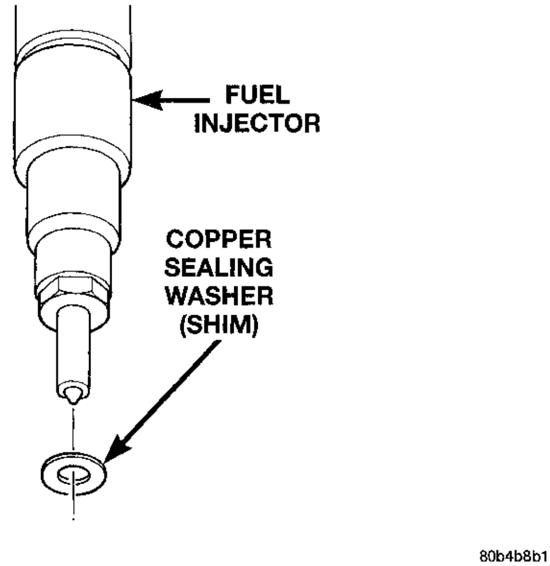

Fig. 79 Fuel Injector Sealing Washer (Shim) Location

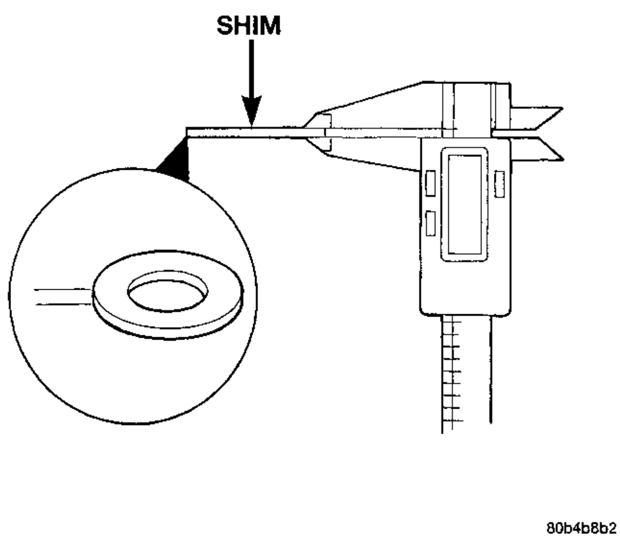

Fig. 80 Measuring Injector Sealing Washer (Shim)

(3) If injector at #5 cylinder is being removed, remove engine lifting bracket (2 bolts).

(4) Thoroughly clean area around injector and injector high-pressure lines before removal.

(5) Remove necessary high-pressure fuel lines. Refer to High-Pressure Fuel Lines Removal/Installation. **Do not bend any high-pressure fuel line to gain access to fuel injector.** Cover or cap any open fuel connections.

(6) Remove valve cover. Refer to Group 9, Engines.

(7) Thread Special Tool 8324 (Fuel Injector Connector Tube Remover) onto end of injector connector tube (Fig. 77).

(8) Pull injector connector tube from cylinder head. **The injector connector tube must be removed before attempting to remove fuel injector or serious damage to fuel injector and tube will result.**

(9) Remove and discard old o-ring (Fig. 76) from injector connector tube.

(10) Remove fuel injector hold down clamp bolt at front end of clamp (Fig. 75). **Do not loosen or remove special (2 shouldered) bolt at rear end of clamp.** Remove injector clamp by sliding it from shoulders on rear clamp bolt.

(11) Thread rod from Special Tool number 8318 (Fuel Injector Remover) into top of fuel injector (Fig. 78).

(12) Tighten nut on 8318 tool to pull (remove) fuel injector from cylinder head.

(13) Remove and discard old o-ring from fuel injector.

(14) Remove and discard copper sealing washer (shim) (Fig. 79) from bottom of injector. **If copper sealing washer has remained in cylinder head, it must be removed.**

INSTALLATION

(1) Inspect fuel injector.

(a) If necessary, perform pressure test of injector. Refer to Fuel Injector Testing.

(b) Look for burrs on injector inlet.

(c) Check nozzle holes for hole erosion or plugging.

(d) Inspect end of nozzle for burrs or rough machine marks.

(e) Look for cracks at nozzle end.

(f) Check nozzle color for signs of overheating. Overheating will cause nozzle to turn a dark yellow/tan or blue (depending on overheating temperature).

(g) If any of these conditions occur, replace injector.

(2) Thoroughly clean fuel injector cylinder head bore with special Cummins wire brush tool or equivalent (Fig. 81). Blow out bore hole with compressed air.

(3) The bottom of fuel injector is sealed to cylinder head bore with a copper sealing washer (shim) of a certain thickness. A new shim with correct thickness must always be re-installed after removing injector. Measure thickness of injector shim (Fig. 80). **Shim Thickness: 1.5 mm (.060")**

(4) Install new shim (washer) to bottom of injector (Fig. 79). Apply light coating of clean engine oil to washer. This will keep washer in place during installation.

(5) Install new o-ring to fuel injector. Apply small amount of clean engine oil to o-ring.

REMOVAL AND INSTALLATION (Continued)

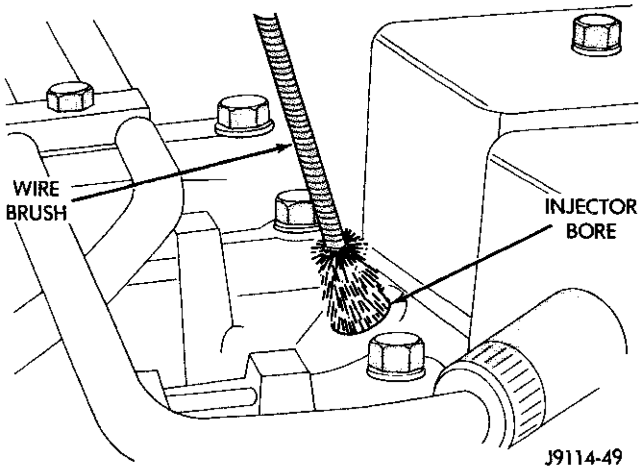

Fig. 81 Cleaning Cylinder Head Injector Bore— TYPICAL BORE

(6) Note fuel inlet hole on side of fuel injector. This hole must be positioned towards injector connector tube. Position injector into cylinder head bore being extremely careful not to allow injector tip to touch sides of bore. Press fuel injector into cylinder head with finger pressure only. **Do not use any tools to press fuel injector into position. Damage to machined surfaces may result.**

(7) Position fuel injector hold down clamp into shouldered bolt while aligning slot in top of injector into groove in bottom of clamp. Tighten opposite clamp bolt (Fig. 75) to 10 N·m (89 in. lbs.) torque.

(8) Install new o-ring to fuel injector connector tube. Apply small amount of clean engine oil to o-ring.

(9) Press injector connector tube into cylinder head with finger pressure only. **Do not use any tools to press tube into position. Damage to machined surfaces may result.**

(10) Connect high-pressure fuel lines. Refer to High-Pressure Fuel Lines Removal/Installation. **The fuel line fitting torque is very critical.** If fitting is under torqued, the mating surfaces will not seal and a high-pressure fuel leak will result. If fitting is over torqued, the connector and injector will deform and also cause a high-pressure fuel leak. This leak will be inside cylinder head and will not be visible resulting in a possible fuel injector miss and low power.

(11) Install valve cover. Refer to Group 9, Engines.

(12) (If necessary) install intake manifold air heater assembly. Refer to Intake Manifold Air Heater Removal/Installation.

(13) (If necessary) install engine lifting bracket. Tighten 2 bolts to 77 N·m (57 ft. lbs.) torque.

(14) Connect negative battery cables to both batteries.

(15) Bleed air from high-pressure lines. Refer to Air Bleed Procedure.

FUEL TRANSFER PUMP

The fuel transfer pump (fuel lift pump) is located on left side of engine, below and rearward of fuel filter (Fig. 82).

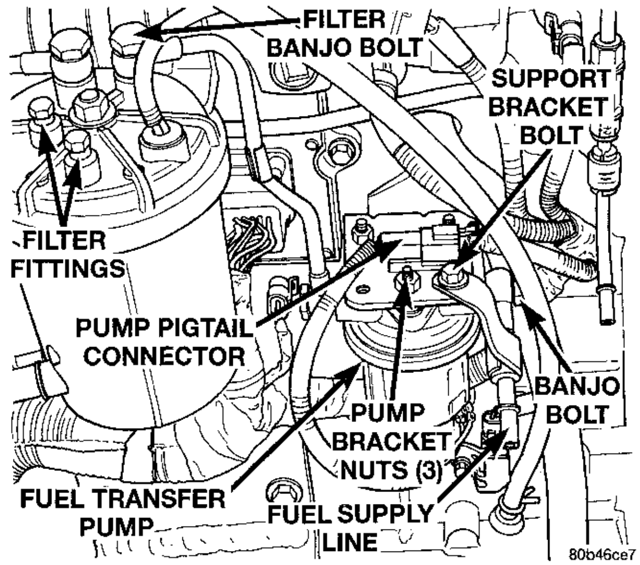

Fig. 82 Fuel Transfer Pump Location

REMOVAL

(1) Disconnect both negative battery cables at both batteries.

(2) Thoroughly clean area around transfer pump and fuel lines of any contamination.

(3) Remove starter motor. Refer to Starter in Group 8B for procedures.

(4) Place a drain pan below the pump.

(5) Disconnect fuel line quick-connect fitting at fuel supply line (Fig. 82) at rear of pump.

(6) Remove support bracket bolt at top of pump (Fig. 82).

(7) Remove banjo bolts at front and rear of pump (Fig. 82).

(8) Disconnect pigtail harness electrical connector from main engine wiring harness (Fig. 82).

(9) Remove three pump bracket nuts (Fig. 82) and remove pump from vehicle.

INSTALLATION

(1) Install new gaskets to fuel supply line/support bracket and banjo bolt at rear of pump. Install line and banjo bolt to pump. **Do not** tighten banjo bolt at this time.

(2) Install new gaskets to fuel line and banjo bolt at front of pump.

(3) Position 3 pump studs into pump mounting bracket and install 3 nuts. **Do not** tighten nuts at this time.

(4) Install support bracket bolt (Fig. 82). **Do not** tighten bolt at this time.

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REMOVAL AND INSTALLATION (Continued)

(5) Tighten 3 pump nuts to 12 N·m (9 ft. lbs.) torque.

(6) Tighten both banjo bolts to 24 N·m (18 ft. lbs.) torque.

(7) Tighten support bracket bolt 12 N·m (9 ft. lbs.) torque.

(8) Connect pigtail harness electrical connector to main engine wiring harness (Fig. 82).

(9) Connect fuel line quick-connect fitting to fuel supply line at rear of pump.

(10) Install starter motor. Refer to Starter Removal/Installation in Group 8B for procedures.

(11) Connect both negative battery cables at both batteries.

(12) Bleed air at fuel supply line at side of fuel injection pump. Refer to the Air Bleed Procedure.

(13) Start engine and check for leaks.

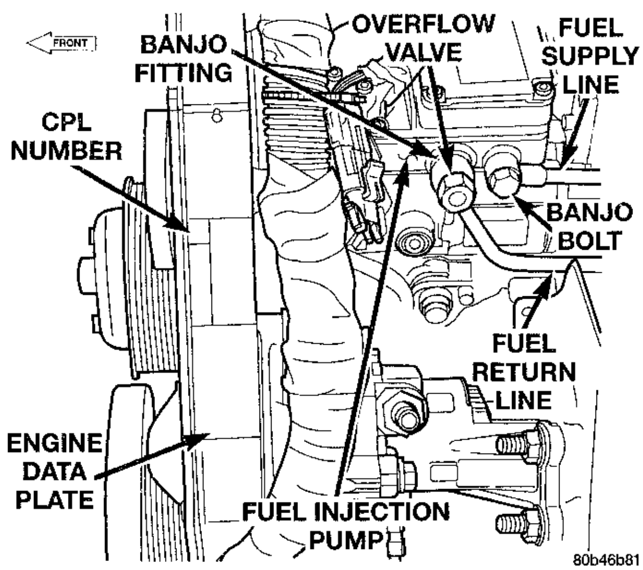


Fig. 83 Engine Data Plate Location

SPECIFICATIONS

ENGINE DATA PLATE

The engine data plate contains:

- Advertised horsepower
- Cubic inch/liter of engine
- Engine model number
- Fuel rate at advertised horsepower
- Idle speed specification
- Injection pump CPL number
- Injection pump timing (in degrees)
- Injector firing order
- Valve lash specification

If anything differs between the specifications found on the engine data plate, and the specifications used in this manual, use specifications on data plate. The engine data plate is permanently riveted to the side of the engine timing gear cover located on the drivers side of engine (Fig. 83).

FUEL INJECTION PUMP DATA PLATE

Pertinent information about the fuel injection pump is machined into a boss on the drivers side of the fuel injection pump (Fig. 84).

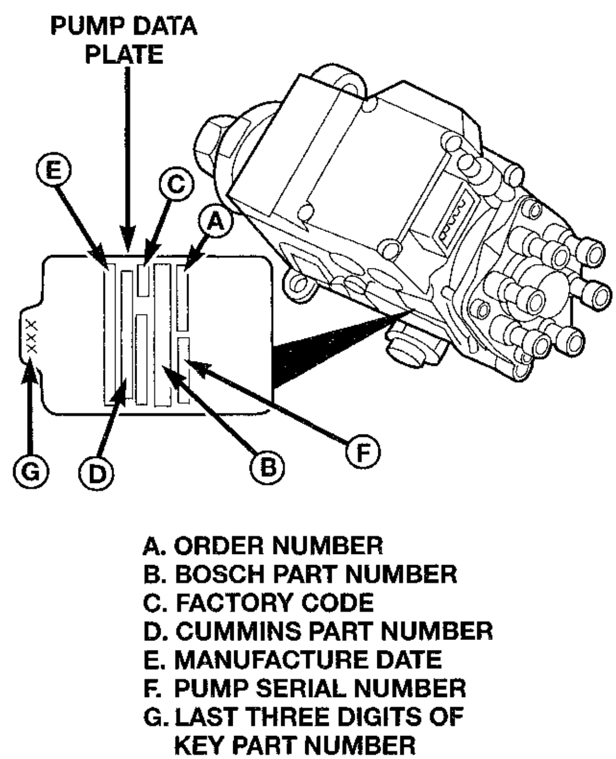


Fig. 84 Fuel Injection Pump Data Plate Location

FUEL TANK CAPACITY—DIESEL ENGINE

MODEL	LITERS	U.S. GALLONS
138″ Wheelbase With Extended Cab (Diesel Powered)	129	34
All Other Diesel Powered Models	132	35
Nominal refill capacities are shown. A variation may be observed from vehicle to vehicle due to manufacturing tolerance and refill procedure.		

AUTHENTIC RESTORATION

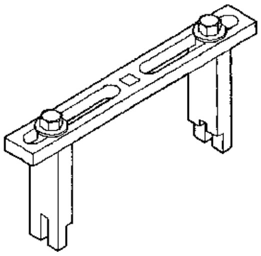
SPECIFICATIONS (Continued)

FUEL SYSTEM PRESSURES—DIESEL ENGINES

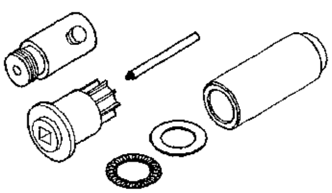
DESCRIPTION	PRESSURE
Fuel Transfer (Lift) Pump Pressure With Engine Running	minimum 69 kPa (10 psi)
Fuel Transfer (Lift) Pump Pressure With Engine Cranking	minimum 48 kPa (7 psi)
Fuel Injector "Pop Off" Pressure	31,026 kPa (310 bars) or (4500 psi ± 250 psi)
Fuel Injector Leak-Down Pressure	approximately 20 bars (291 psi) lower than pop pressure.
Fuel Pressure Drop Across Fuel Filter Test Ports	34 kPa max. (5 psi. max.) at 2500 rpm (rated rpm)
Overflow Valve Release Pressure	97 kPa max. (14 psi.) at 2500 rpm (rated rpm)

SPECIAL TOOLS

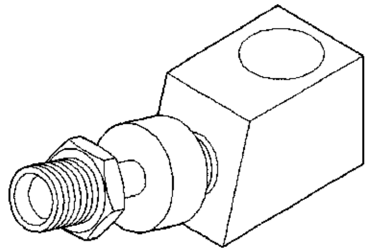
DIESEL FUEL SYSTEM



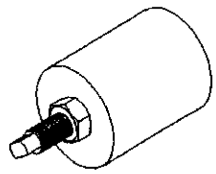
Spanner Wrench (Fuel Tank Module Removal/ Installation)—6856



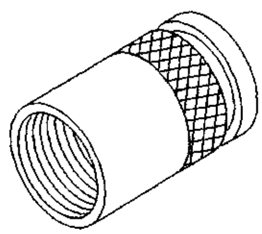
Engine Barring (Rotating) Tool—7471B or 7471C (part of Kit 6714)



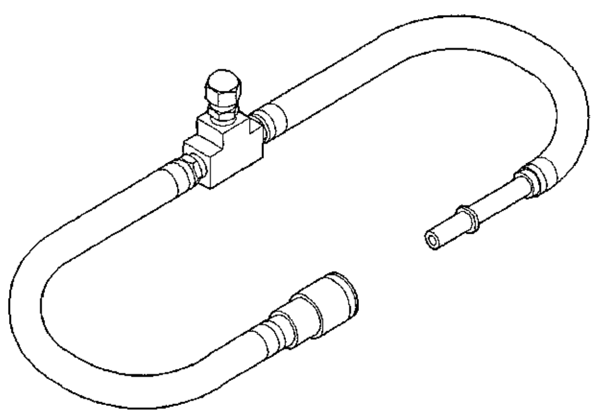
Fuel Injector Pop Pressure Adaptor—8301



Fuel Injector Remover—8318



Fuel Injector Tube (Connector) Remover—8324



Fuel Pressure Hose Adapters—6631 and/or 6539

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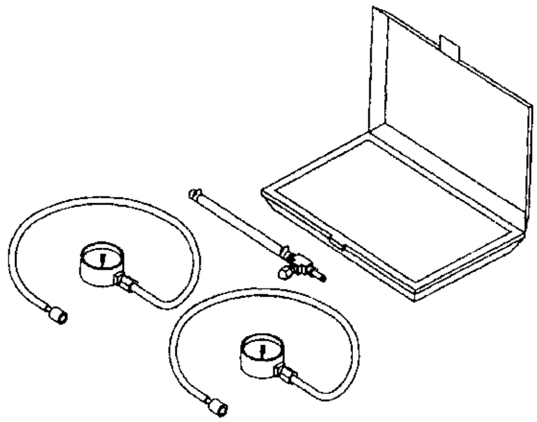
SPECIAL TOOLS (Continued)



Fuel Pressure Test Gauge Kit —5069 (or gauge 6828)

Fuel Line Removal Tool—6782

Mopar AUTHENTIC RESTORATION PRODUCT

FUEL INJECTION SYSTEM-DIESEL ENGINE

INDEX

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DESCRIPTION AND OPERATION

FUEL INJECTION SYSTEM—DIESEL ENGINE

Two different fuel systems (early and late) are used for the diesel engine in this model year. The **early** fuel system, using the two-valve-per-cylinder engine, will retain the mechanical fuel injection pump as used in previous model years. The **late** fuel system, using the four-valve-per-cylinder engine, will use an **electronic** fuel injection system with three different control modules. This book will include information for the **late** fuel system only.

The Engine Control Module (ECM) and Fuel Injection Pump Control Module (FPCM) are used primarily for fuel system control. The ECM is a separate replaceable component, while the FPCM is internal to the fuel injection pump and is a non-serviceable part. The ECM and FPCM are interconnected (wired together) for fuel injection control.

The Powertrain Control Module (PCM) is used to regulate or control the A/C, charging and speed control systems. It is also used to partially control certain electronic automatic transmission components. The PCM also has control over certain instrument panel components.

Refer to either Powertrain Control Module (PCM) or Engine Control Module (ECM) for additional information. Refer to (Fig. 1) for a partial list of fuel system components.

ENGINE CONTROL MODULE (ECM)

The Engine Control Module (ECM) and Fuel Injection Pump Control Module (FPCM) are used to electrically control the fuel system. The Powertrain Control Module (PCM) **does not control** the fuel system.

The ECM is bolted to the left side of the engine behind the fuel filter (Fig. 2). It is a separate component and can be serviced. The FPCM is internal to the fuel injection pump (Fig. 3) and cannot be serviced.

The main function of the ECM and the FPCM is to control the fuel injection system.

The ECM can adapt its programming to meet changing operating conditions. **If the ECM has been replaced, flashed or re-calibrated, the ECM must learn the Accelerator Pedal Position Sensor (APPS) idle voltage. Failure to learn this voltage may result in unnecessary diagnostic trouble codes. Refer to ECM Removal/Installation for learning procedures.**

The ECM receives input signals from various switches and sensors. Based on these inputs, the ECM regulates various engine and vehicle operations through different system components. These components are referred to as **ECM Outputs.** The sensors and switches that provide inputs to the ECM are considered **ECM Inputs.**

NOTE: ECM Inputs:

- Accelerator Pedal Position Sensor (APPS)
- Battery voltage
- Camshaft Position Sensor (CMP)
- CCD bus (+) circuits
- CCD bus (-) circuits
- Crankshaft Position Sensor (CKP)
- Data link connection for DRB scan tool
- (FPCM) Fuel Injection Pump Control Module
- Engine Coolant Temperature (ECT) sensor
- Ground circuits
- Intake manifold Air Temperature (IAT) sensor
- Manifold Air Pressure (MAP) Sensor
- Oil pressure sensor output
- PCM
- Power Take Off (PTO)
- Power ground
- Sensor return
- Signal ground
- Water-In-Fuel (WIF) sensor

NOTE: ECM Outputs:

After inputs are received by the ECM, certain sensors, switches and components are controlled or regulated by the ECM. These are considered **ECM Outputs.** These outputs are for:

- CCD bus (+) circuits
- CCD bus (-) circuits
- CKP and APPS outputs to the PCM
- Data link connection for DRB scan tool
- Five volt sensor supply
- Fuel injection pump
- Fuel injection pump relay
- (FPCM) Fuel Pump Control Module
- Fuel transfer (lift) pump
- Intake manifold air heater elements #1 and #2
- Intake manifold air heater relays #1 and #2
- Malfunction indicator lamp (Check engine lamp)
- Oil pressure gauge/warning lamp
- PCM
- Wait-to-start warning lamp
- Water-In-Fuel (WIF) warning lamp

ACCELERATOR PEDAL POSITION SENSOR (APPS)—ECM INPUT

The Accelerator Pedal Position Sensor (APPS) is a linear potentiometer. It provides the Engine Control Module (ECM) with a DC voltage signal proportional to the angle, or position of the accelerator pedal. In previous model years, this part was known as the Throttle Position Sensor (TPS).

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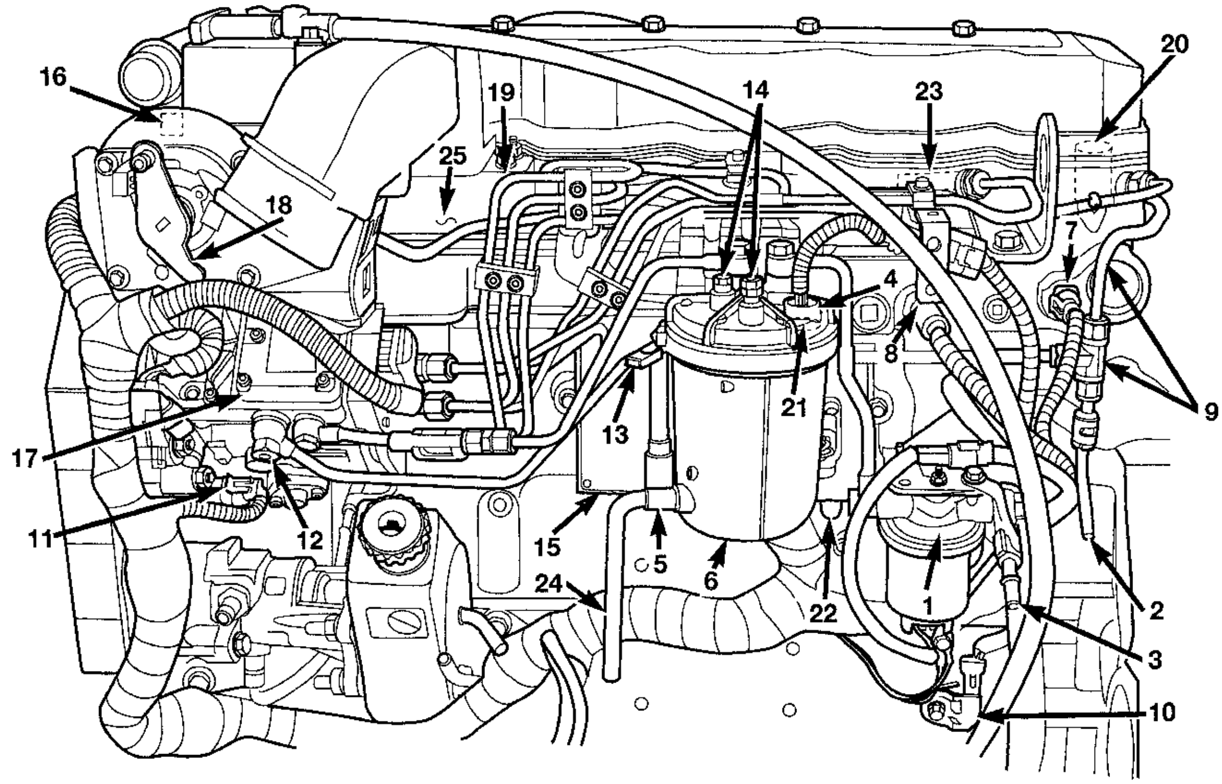
DESCRIPTION AND OPERATION (Continued)



1. FUEL TRANSFER (LIFT) PUMP
2. FUEL RETURN LINE (TO FUEL TANK)
3. FUEL SUPPLY LINE (LOW-PRESSURE, TO ENGINE)
4. FUEL HEATER
5. WATER-IN-FUEL (WIF) SENSOR
6. FUEL FILTER/WATER SEPARATOR
7. IAT SENSOR
8. MAP (BOOST) SENSOR
9. FUEL DRAIN MANIFOLD
10. CKP SENSOR
11. CMP SENSOR
12. OVERFLOW VALVE
13. DRAIN VALVE
14. FUEL PRESSURE TEST PORTS
15. ECM
16. ECT SENSOR
17. FUEL INJECTION PUMP
18. THROTTLE LEVER BELLCRANK AND APPS
19. HIGH-PRESSURE FUEL LINES
20. FUEL INJECTORS
21. FUEL HEATER TEMPERATURE SENSOR (THERMOSTAT)
22. OIL PRESSURE SENSOR
23. FUEL INJECTOR CONNECTOR
24. DRAIN TUBE
25. INTAKE MANIFOLD AIR HEATER/ELEMENTS

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Fig. 1 Fuel System Components—Diesel Engine

DESCRIPTION AND OPERATION (Continued)

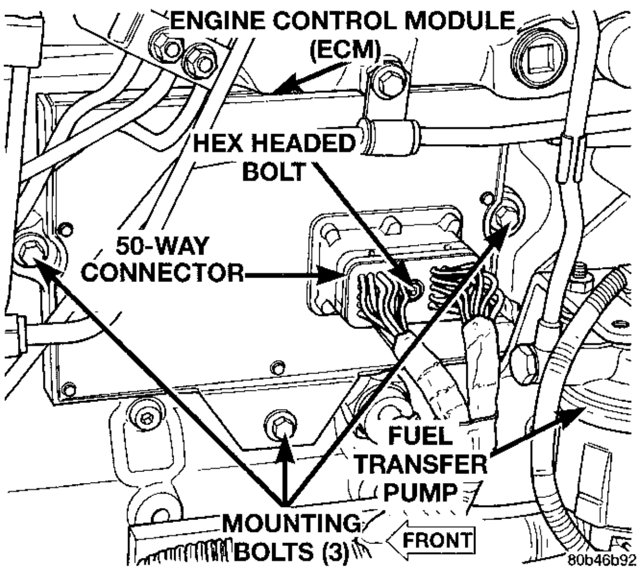

Fig. 2 Engine Control Module (ECM) Location

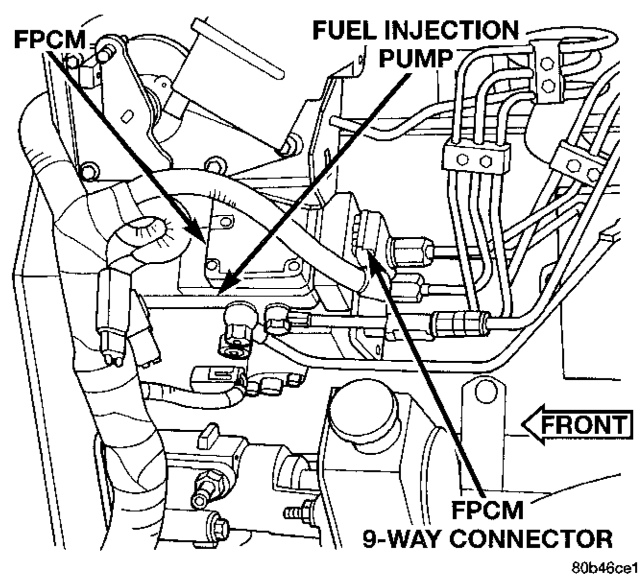

Fig. 3 Fuel Injection Pump Control Module (FPCM) Location

Diesel engines used in previous model years used a mechanical cable between the accelerator pedal and the TPS lever. Linkage and bellcranks between the TPS cable lever and the fuel injection pump were also used. Although the cable has been retained with the APPS, the linkage and bellcranks between the cable lever and the fuel injection pump are no longer used.

The APPS assembly is located at the top-left-front of the engine (Fig. 4). A plastic cover is used to cover the assembly. The actual sensor is located behind its mounting bracket (Fig. 5).

The APPS is serviced (replaced) as one assembly including the lever, brackets and sensor. The APPS is calibrated and permanently positioned to its mounting bracket.

CAUTION: Do not attempt to remove sensor from its mounting bracket as electronic calibration will be destroyed (sensor-to-bracket mounting screws are permanently attached). Two accelerator lever set screws (Fig. 4) are used to position lever. Do not attempt to alter positions of these set screws as electronic calibration will be destroyed.

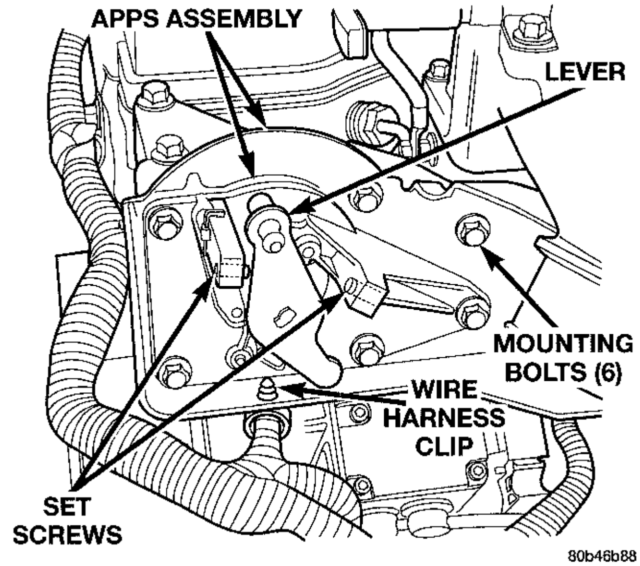

Fig. 4 APPS Assembly Location

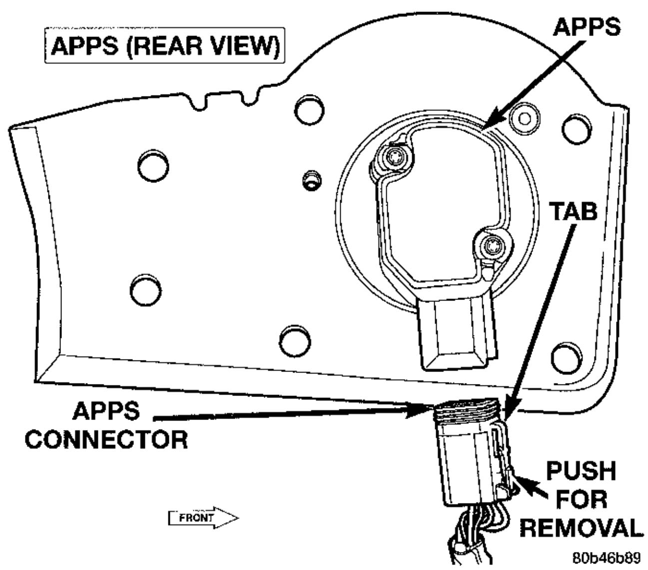

Fig. 5 APPS Sensor Location (Rear View)

BATTERY VOLTAGE—ECM INPUT

The battery voltage input provides power to the Engine Control Module (ECM). It also informs the ECM what voltage level is being supplied by the generator once the vehicle is running.

The battery input also provides the voltage that is needed to keep the ECM memory alive. The memory stores Diagnostic Trouble Code (DTC) messages.

DESCRIPTION AND OPERATION (Continued)

CAMSHAFT POSITION SENSOR (CMP)—ECM INPUT

The Camshaft Position Sensor (CMP) (Fig. 6) contains a hall effect device called a sync signal generator to generate a sync signal.

The sync signal generator detects a machined hole on the rear face of the camshaft drive gear. The signal is used to verify the position of the #1 cylinder during engine operation.

When the leading edge of the machined hole enters the tip of the CMP, the interruption of magnetic field causes the voltage to switch high resulting in a signal of approximately 5 volts.

When the trailing edge of the machined hole leaves the tip of the CMP, the change of the magnetic field causes the voltage to switch low to 0 volts.

The CMP is located below the fuel injection pump (Fig. 7). It is attached to the back of the timing gear cover housing.

The CMP is **not used** for any control of fuel system. It is used only for diagnostic purposes.

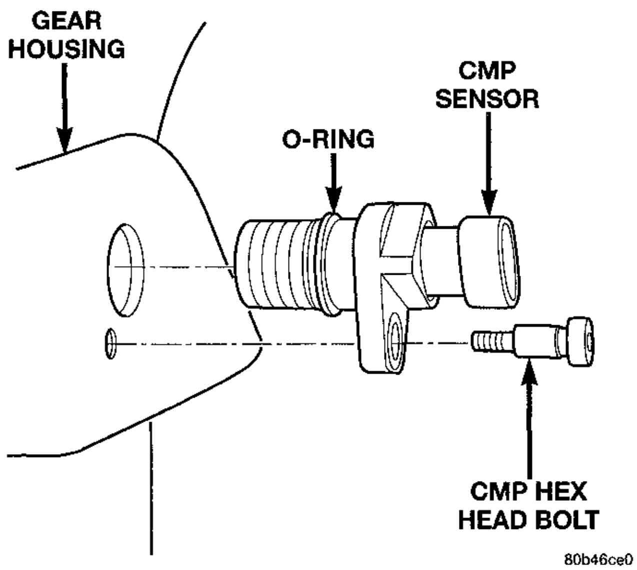

Fig. 6 Camshaft Position Sensor (CMP)

CCD BUS (+/-) CIRCUITS—ECM/PCM INPUTS/ OUTPUTS

The Engine Control Module (ECM) and the Powertrain Control Module (PCM) send certain signals through the CCD bus circuits. Some of these signals are parallel circuited between the two control modules (ECM and PCM). These signals are used to control certain instrument panel located items and to determine certain identification numbers.

Refer to Group 8E, Instrument Panel and Gauges for additional information.

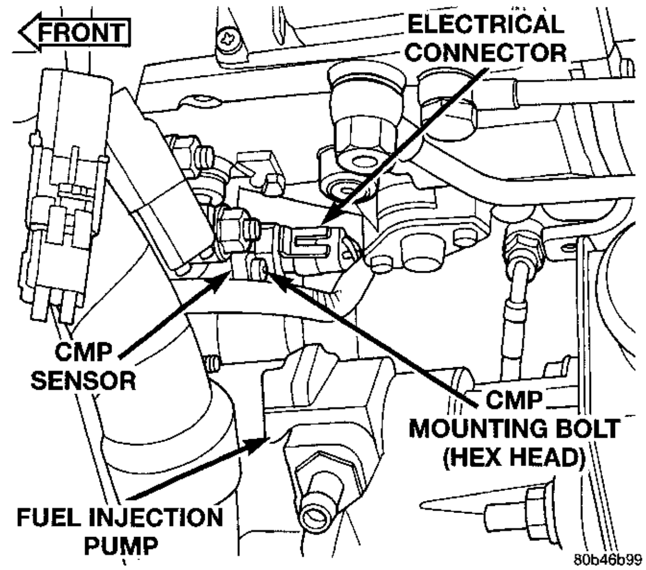

Fig. 7 Camshaft Position Sensor (CMP) Location

CRANKSHAFT POSITION SENSOR (CKP)—ECM INPUT

The Crankshaft Position Sensor (CKP) is located on the lower left-rear side of the engine behind the starter motor (Fig. 8).

Engine speed and crankshaft position are provided through the CKP. The sensor generates pulses that are the input sent to the Engine Control Module (ECM). The ECM interprets the sensor input to determine the crankshaft position. The ECM then uses this position, along with other inputs, to determine injector firing sequence and fuel timing. The sensor must be powered up by 5 volts to operate.

The sensor is a hall effect device combined with an internal magnet. It is also sensitive to steel within a certain distance from it.

The engine crankshaft is equipped with a bolt-on tone wheel (Fig. 9). The tone wheel is equipped with 35 teeth and a gap where the 36th tooth should be placed (Fig. 9). This missing tooth indicates to the ECM the relative position of cylinder #1 to the Top Dead Center (TDC) position. This does not mean that cylinder #1 is at TDC. When the CKP is aligned with the missing tooth, the missing tooth is 60 degrees away from cylinder #1 TDC position. The teeth cause pulses to be generated when they pass under the sensor. The pulses are the input to the ECM.

DESCRIPTION AND OPERATION (Continued)

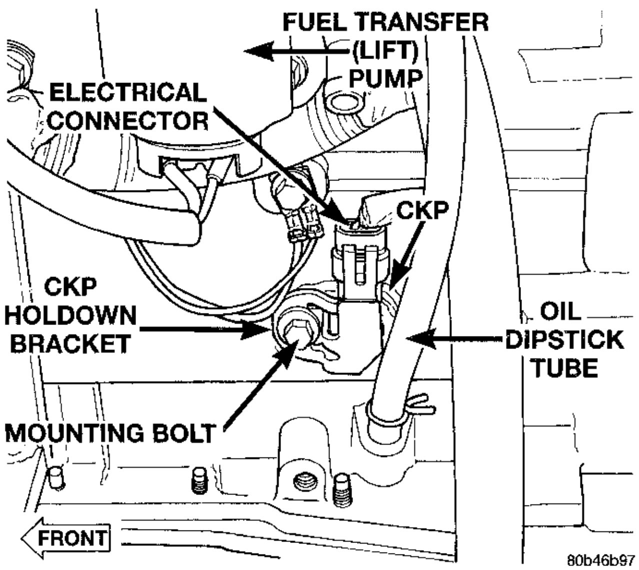

Fig. 8 Crankshaft Position Sensor (CKP) Location

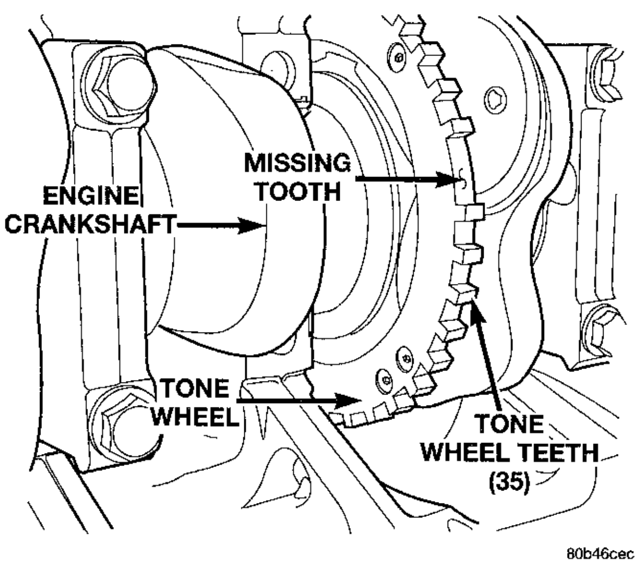

Fig. 9 Crankshaft Tone Wheel

ENGINE COOLANT TEMPERATURE (ECT) SENSOR—ECM INPUT

The engine coolant temperature sensor is installed into the front of the cylinder head near to the thermostat housing (Fig. 10) and protrudes into a water jacket. The sensor provides an input voltage to the Engine Control Module (ECM) to monitor coolant temperature. The ECM uses this input along with inputs from other sensors for engine protection, fuel timing and fuel control. As coolant temperature varies, the coolant temperature sensor resistance will change. This change in resistance results in a different input voltage to the ECM.

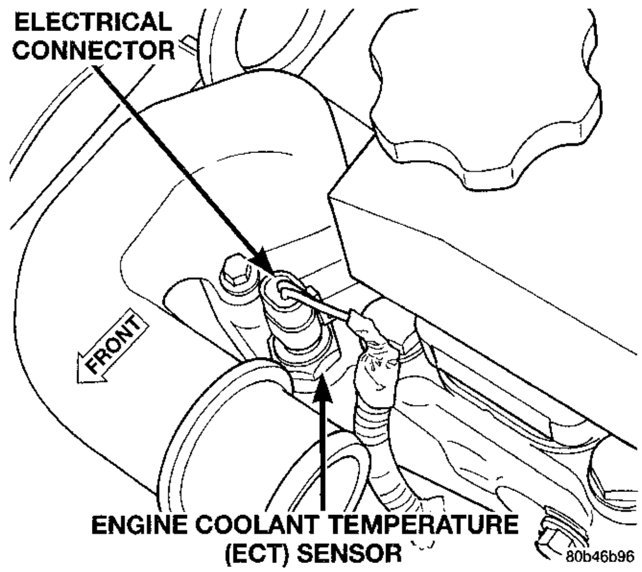

Fig. 10 Engine Coolant Temperature Sensor

FUEL TEMPERATURE SENSOR

Two different fuel temperature sensors are used. One of the sensors is located inside of the Bosch VP44 fuel injection pump and is a non-serviceable part. It is used to check fuel temperature within the injection pump and to set a Diagnostic Trouble Code (DTC) if a specific high fuel temperature has been reached. If high temperature has been reached, engine power will be de-rated by the Engine Control Module (ECM).

The other fuel temperature sensor is located in the top of the fuel filter housing and is serviceable. It is used to control the fuel heater element. Refer to Fuel Heater Description and Operation for additional information.

INTAKE MANIFOLD AIR TEMPERATURE (IAT) SENSOR—ECM INPUT

The IAT provides an input voltage to the Engine Control Module (ECM) indicating intake manifold air temperature. The input is used along with inputs from other sensors for engine protection, fuel timing and fuel control. As the temperature of the air-fuel stream in the manifold varies, the sensor resistance changes. This results in a different input voltage to the ECM.

The intake manifold air temperature sensor is installed into the rear of the intake manifold (Fig. 11) with the sensor element extending into the air stream.

AUTHENTIC RESTORATION PRODUCT

DESCRIPTION AND OPERATION (Continued)

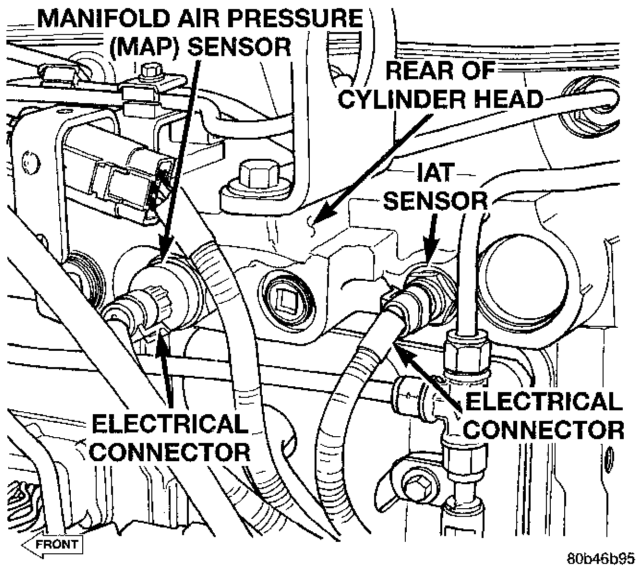

Fig. 11 Intake Manifold Air Temperature (IAT) Sensor Location

MANIFOLD AIR PRESSURE (MAP) SENSOR—ECM INPUT

The MAP sensor reacts to air pressure changes in the intake manifold. It provides an input voltage to the Engine Control Module (ECM). As pressure changes, MAP sensor voltage will change. The change in MAP sensor voltage results in a different input voltage to the ECM. The ECM uses this input, along with inputs from other sensors to provide fuel timing, fuel control and engine protection. Engine protection is used to derate (drop power off) the engine if turbocharger pressure becomes to high.

The MAP sensor is installed into the rear of the intake manifold (Fig. 11).

OIL PRESSURE SENSOR (ENGINE)—ECM INPUT

A signal is sent from the engine oil pressure sensor (sending unit) to the Engine Control Module (ECM) relating to engine oil pressure. The ECM monitors this signal and converts it to a pressure value. This value is used by the ECM for the engine protection system.

The pressure signal from the ECM is bussed to the instrument panel oil gauge/lamp via the CCD circuits.

The oil pressure sensor is installed into the oil pressure galley on the engine block. It is located below and to the rear of the ECM (Fig. 12).

PTO SWITCH SENSE—ECM INPUT

This Engine Control Module (ECM) input is used only on models equipped with aftermarket Power Take Off (PTO) units.

The input is used to tell the ECM that the PTO has been engaged. When engaged, the ECM will disable certain OBD II functions until the PTO has been turned off.

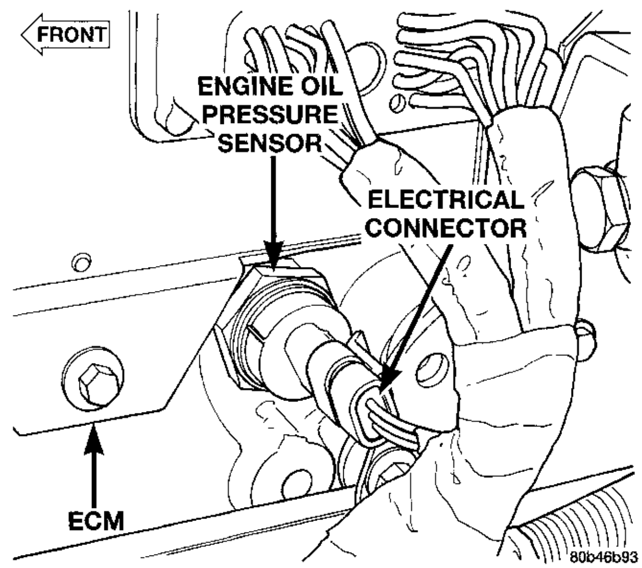

Fig. 12 Oil Pressure Sensor (Engine) Location

WATER-IN-FUEL (WIF) SENSOR—ECM INPUT

The sensor sends an input to the Engine Control Module (ECM) when it senses water in the fuel filter/water separator. As the water level in the filter/separator increases, the resistance across the WIF sensor decreases. This decrease in resistance is sent as a signal to the ECM and compared to a high water standard value. Once the value reaches 30 to 40 kilohms, the ECM will activate the water-in-fuel warning lamp through CCD bus circuits. This all takes place when the ignition key is initially put in the ON position. The ECM continues to monitor the input at the end of the intake manifold air heater post-heat cycle.

The WIF sensor is located at the bottom of the fuel filter/water separator canister (Fig. 13).

FUEL INJECTION PUMP RELAY—ECM OUTPUT

The Engine Control Module (ECM) energizes the electric fuel injection pump through the fuel injection pump relay. Battery voltage is applied to the fuel injection pump relay at all times. When the key is turned ON, the relay is energized when a 12–volt signal is provided by the ECM. When energized, 12–volts is supplied to the Fuel Pump Control Module. The Fuel Pump Control Module is located on the top of the fuel injection pump and is non-servicable.

The fuel injection pump relay is located in the Power Distribution Center (PDC). Refer to label under PDC cover for relay location.

DESCRIPTION AND OPERATION (Continued)

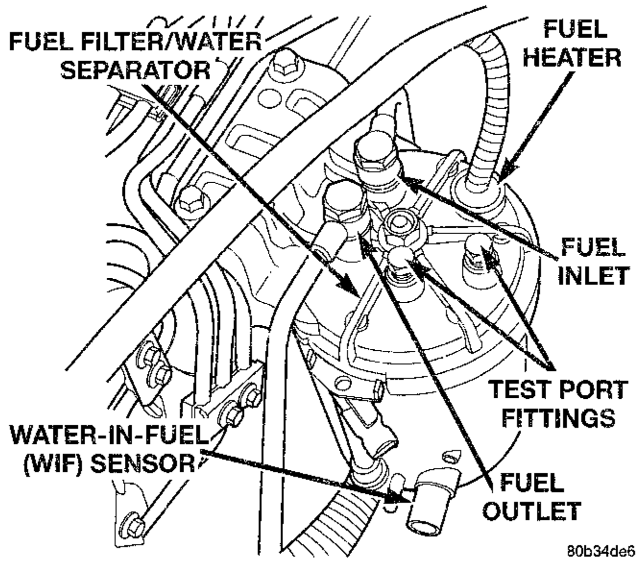

Fig. 13 Water-in-Fuel Sensor Location

INTAKE MANIFOLD AIR HEATER ELEMENTS

The air heater elements are used to heat incoming air to the intake manifold. This is done to help engine starting and improve driveability with cool or cold outside temperatures.

Electrical supply for the 2 air heater elements is controlled by the Engine Control Module (ECM) through the 2 air heater relays. Refer to Intake Manifold Air Heater Relays for more information.

Two heavy-duty cables connect the 2 air heater elements to the 2 air heater relays. Each of these cables will supply approximately 95 amps at 12 volts to an individual heating element within the heater block assembly.

The intake manifold air heater element assembly is located in the top of the intake manifold (Fig. 14).

Refer to the Powertrain Diagnostic Procedures manual for an electrical operation and complete description of the intake heaters, including pre-heat and post-heat cycles.

INTAKE MANIFOLD AIR HEATER RELAYS—ECM OUTPUT

The Engine Control Module (ECM) operates the 2 heating elements through the 2 intake manifold air heater relays.

The 2 relays are located in the engine compartment, attached to the left inner fender below the left battery (Fig. 15).

Refer to the Powertrain Diagnostic Procedures manual for an electrical operation and complete description of the intake heaters, including pre-heat and post-heat cycles.

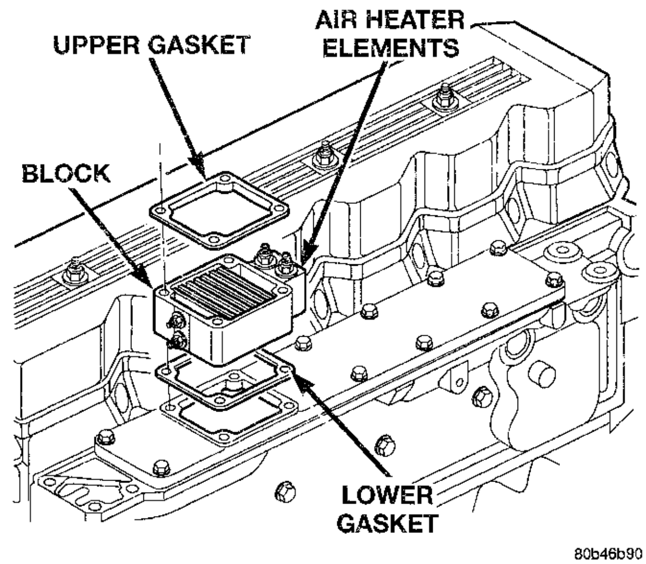

Fig. 14 Air Heater Elements Location

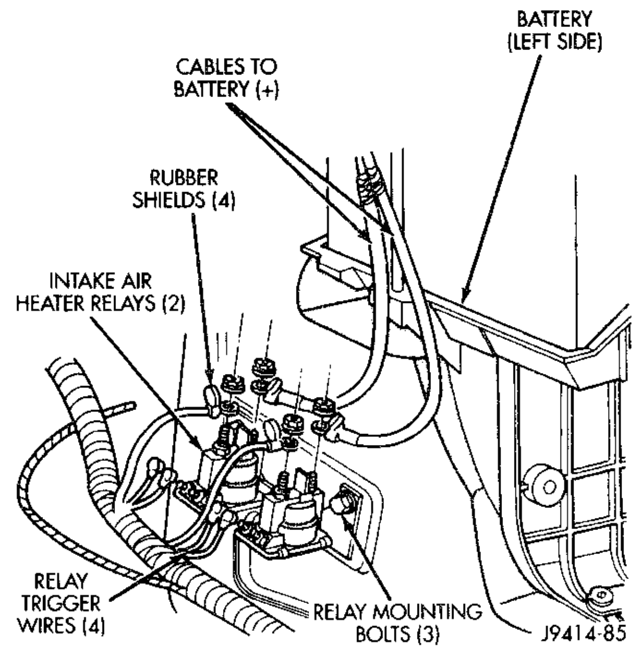

Fig. 15 Intake Manifold Air Heater Relays Location

WAIT-TO-START WARNING LAMP—ECM OUTPUT

The wait-to-start warning lamp is turned on and off by the Engine Control Module (ECM) based on the intake manifold air temperature sensor input. The lamp is located on the instrument panel.

The lamp is turned on when the key is first activated. If the ECM reads intake manifold air temperature below 19°C (66°F), it will turn the wait-to-start warning lamp on for the air heater pre-heat cycle. The lamp stays on until the pre-heat cycle is over.

DESCRIPTION AND OPERATION (Continued)

Refer to the Powertrain Diagnostic Procedures manual for electrical operation and complete description of the intake heaters, including pre-heat and post-heat cycles.

WATER-IN-FUEL WARNING LAMP—ECM INPUT

The Engine Control Module (ECM) turns on the water-in-fuel warning lamp if water is detected in the diesel fuel. The water-in-fuel warning lamp is located in the instrument panel. The lamp will illuminate for about two seconds each time the key is initially turned to the ON position as a bulb check.

If the lamp continues to be illuminated, it signals an immediate need for service. Refer to Fuel Filter/ Water Separator Removal/Installation for water draining procedures.

Also refer to Water-In-Fuel Sensor—ECM Input for additional information.

POWERTRAIN CONTROL MODULE (PCM)—DIESEL

Two different control modules are used: The Powertrain Control Module (PCM), and the Engine Control Module (ECM). The ECM **controls** the fuel system. The PCM **does not control** the fuel system.

The PCM is located in the right-rear side of the engine compartment (Fig. 16).

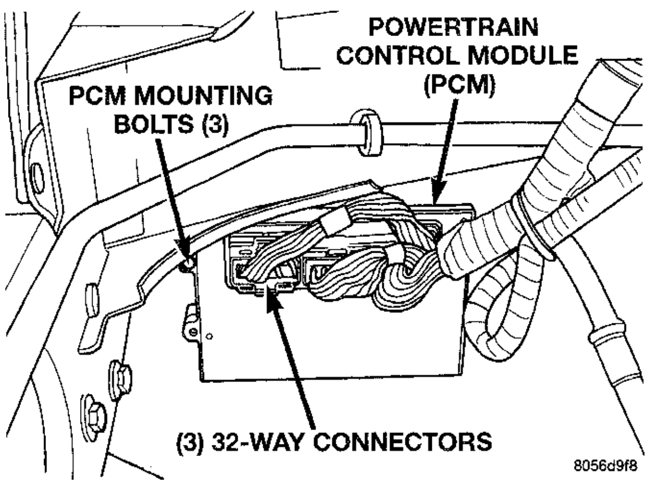

Fig. 16 PCM Location

The PCM's main function is to control: the vehicle charging system, speed control system, transmission, air conditioning system and certain bussed messages.

The PCM can adapt its programming to meet changing operating conditions.

The PCM receives input signals from various switches and sensors. Based on these inputs, the PCM regulates various engine and vehicle operations through different system components. These components are referred to as **PCM Outputs.** The sensors and switches that provide inputs to the PCM are considered **PCM Inputs.**

NOTE: PCM Inputs:

- A/C request (if equipped with factory A/C)
- A/C select (if equipped with factory A/C)
- Accelerator Pedal Position Sensor (APPS) output from ECM
- Auto shutdown (ASD) relay sense
- Battery temperature sensor
- Battery voltage
- Brake switch
- CCD bus (+) circuits
- CCD bus (-) circuits
- Crankshaft Position Sensor (CKP) output from ECM
- Data link connection for DRB scan tool
- Fuel level sensor
- Generator (battery voltage) output
- Ignition sense
- Output shaft speed sensor
- Overdrive/override switch
- Park/neutral switch (auto. trans. only)
- Power ground
- Sensor return
- Signal ground
- Speed control resume switch
- Speed control set switch
- Speed control on/off switch
- Transmission governor pressure sensor
- Transmission temperature sensor
- Vehicle speed inputs from ABS or RWAL system

NOTE: PCM Outputs:

After inputs are received by the PCM, certain sensors, switches and components are controlled or regulated by the PCM. These are considered **PCM Outputs.** These outputs are for:

- A/C clutch relay and A/C clutch
- Auto shutdown (ASD) relay
- CCD bus (+) circuits
- CCD bus (-) circuits
- Data link connection for DRB scan tool
- Five volt sensor supply
- Generator field driver (-)
- Generator field driver (+)
- Generator lamp (if equipped)
- Malfunction indicator lamp (Check engine lamp)
- Overdrive warning lamp (if equipped)
- Speed control vacuum solenoid
- Speed control vent solenoid
- Tachometer (if equipped)
- Transmission convertor clutch circuit
- Transmission 3–4 shift solenoid
- Transmission relay
- Transmission temperature lamp (if equipped)
- Transmission variable force solenoid (governor sol.)

DESCRIPTION AND OPERATION (Continued)

AIR CONDITIONING (A/C) CONTROLS—PCM INPUT

The A/C control system information applies to factory installed air conditioning units.

A/C SELECT SIGNAL: When the A/C switch is in the ON position, an input signal is sent to the powertrain control module (PCM). The signal informs the PCM that the A/C has been selected. The PCM adjusts idle speed to a pre-programmed rpm through the idle air control (IAC) motor to compensate for increased engine load.

A/C REQUEST SIGNAL: Once A/C has been selected, the powertrain control module (PCM) receives the A/C request signal from the clutch cycling pressure switch. The input indicates that the evaporator pressure is in the proper range for A/C application. The PCM uses this input to cycle the A/C compressor clutch (through the A/C relay). It will also determine the correct engine idle speed through the idle air control (IAC) motor position.

If the A/C low-pressure switch or high-pressure switch opens (indicating a low or high refrigerant pressure), the PCM will not receive an A/C request signal. The PCM will then remove the ground from the A/C relay. This will deactivate the A/C compressor clutch.

If the switch opens, (indicating that evaporator is not in proper pressure range), the PCM will not receive the A/C request signal. The PCM will then remove the ground from the A/C relay, deactivating the A/C compressor clutch.

AUTOMATIC SHUTDOWN (ASD) SENSE—PCM INPUT

A 12 volt signal at this input indicates to the PCM that the ASD has been activated. The ASD relay is located in the power distribution center (PDC). The PDC is located in the engine compartment. For the location of the relay within the PDC, refer to PDC cover.

This input is used only to sense that the ASD relay is energized. If the powertrain control module (PCM) does not see 12 volts + at this input when the ASD should be activated, it will set a diagnostic trouble code (DTC).

BATTERY VOLTAGE—PCM INPUT

The battery voltage input provides power to the Powertrain Control Module (PCM). It also informs the PCM what voltage level is being supplied by the generator once the vehicle is running.

The battery input also provides the voltage that is needed to keep the PCM memory alive. The memory stores Diagnostic Trouble Code (DTC) messages and speed control adaptive memory.

BATTERY TEMPERATURE SENSOR—PCM INPUT

Provides a signal to the PCM corresponding to the battery temperature. Refer to Group 8C, Charging System for additional information.

FUEL LEVEL SENSOR—PCM INPUT

The Powertrain Control Module (PCM) sends a 5 volt signal to the fuel level sensor (fuel gauge sending unit). The fuel level sensor will then return a signal to the PCM to indicate fuel level. A signal is then sent out from the PCM to the CCD bus circuits for fuel gauge operation.

SPEED CONTROL SWITCHES—PCM INPUT

Six different speed control functions, using three momentary contact switches, are monitored through this **multiplexed** input. The resistance monitored at this input, in combination with the length of time the PCM measures the resistance, determines which switch feature has been selected. The three switches are: On/Off, Set/Coast, Cancel and Resume/Accelerate.

Refer to Group 8H, Vehicle Speed Control System for further speed control information.

PARK/NEUTRAL POSITION SWITCH—PCM INPUT

The park/neutral switch provides an input to the powertrain control module (PCM). This will indicate that the automatic transmission is in Park, Neutral or a Drive gear selection. This input is used to determine speed control strategy and electrical operation of both the overdrive and torque convertor solenoids. Refer to Group 21, Transmissions, for testing, replacement and adjustment information.

TRANSMISSION TEMPERATURE SENSOR—PCM INPUT

The transmission temperature sensor is a variable, thermistor type. It reacts to temperature changes. At cold transmission oil temperatures, its resistance is high. As temperatures increase, its resistance will decrease.

The transmission temperature sensor is used on models equipped with an automatic transmission. Its purpose is to help control transmission fluid overheating. If transmission overheating has been determined by this sensor (temp. above approximately 280 degrees F), an input is sent to the powertrain control module (PCM). The PCM will then force a 4-3 downshift. Once transmission temperature has cooled below specifications, a 3-4 upshift will be allowed. An instrument panel mounted transmission temperature warning lamp is also used.

AUTHENTIC RESTORATION PRODUCT

DESCRIPTION AND OPERATION (Continued)

TRANSMISSION GOVERNOR PRESSURE SENSOR—PCM INPUT

Provides a signal proportional to the transmission governor pressure. It provides feedback for control of the governor pressure solenoid, which regulates transmission governor pressure. This input is used with 4–speed electronic transmissions only.

VEHICLE SPEED AND DISTANCE—PCM INPUT

The Vehicle Speed Sensor (VSS) is no longer used for any Dodge truck in the 1998 model year.

Vehicle speed and distance covered are measured by the Rear Wheel Speed Sensor. The sensor is mounted to the rear axle. A signal is sent from this sensor to the Controller Antilock Brake (CAB) computer. A signal is then sent from the CAB to the Powertrain Control Module (PCM) to determine vehicle speed and distance covered. The PCM will then determine strategies for fuel system and speed control system operation.

Refer to Odometer and Trip Odometer in Group 8E, Instrument Panel for additional information.

AIR CONDITIONING CLUTCH RELAY—PCM OUTPUT

The A/C relay is located in the Power Distribution Center (PDC). Refer to label under PDC cover for relay location.

The powertrain control module (PCM) activates the A/C compressor through the A/C clutch relay. The PCM regulates A/C compressor operation by switching the ground circuit for the A/C clutch relay on and off.

The PCM will also de-energize the relay if coolant temperature exceeds 125°C (257°F).

AUTOMATIC SHUTDOWN (ASD) RELAY—PCM OUTPUT

This circuit controls operation of the ASD relay. It provides the necessary power to operate the generator field control for charging system operation.

The ASD relay is located in the power distribution center (PDC). The PDC is located in the engine compartment. For location of relay within the PDC, refer to PDC cover.

GENERATOR FIELD SOURCE (+)—PCM OUTPUT

This output from the Powertrain Control Module (PCM) regulates charging system voltage to the generator field source (+) circuit. The voltage range is 12.9 to 15.0 volts. Models of previous years had used the ASD relay (directly) to apply the 12 volt + power supply to the generator field source (+) circuit. Refer to Groups 8A and 8C for charging system information.

GENERATOR FIELD DRIVER (-)—PCM OUTPUT

This output from the Powertrain Control Module (PCM) regulates charging system ground control to the generator field driver (-) circuit. Refer to Groups 8A and 8C for charging system information.

GENERATOR LAMP—PCM OUTPUT

If the powertrain control module (PCM) senses a low charging condition in the charging system, it will illuminate the generator lamp (if equipped) on the instrument panel. For example, during low idle with all accessories turned on, the lamp may momentarily go on. Refer to Groups 8A and 8C for charging system information.

DATA LINK CONNECTOR—PCM/ECM INPUT AND OUTPUT

The 16–way data link connector (diagnostic scan tool connector) links the Diagnostic Readout Box (DRB) scan tool or the Mopar Diagnostic System (MDS) with both the Powertrain Control Module (PCM) and the Engine Control Module (ECM). The data link connector (Fig. 17) is located at lower edge of instrument panel near steering column . For operation of the DRB scan tool, refer to the appropriate Powertrain Diagnostic Procedures service manual.

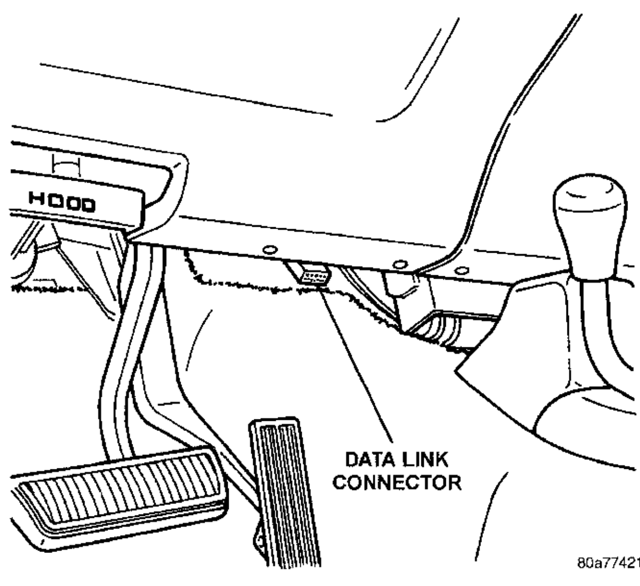

Fig. 17 16–Way Data Link Connector

MALFUNCTION INDICATOR LAMP—ECM/PCM OUTPUT

Refer to Group 25, Emission Control System for information.

DESCRIPTION AND OPERATION (Continued)

OVERDRIVE LAMP—PCM OUTPUT

Automatic Transmission Only: This circuit controls a signal for operation of the overdrive warning lamp. When the lamp is illuminated, overdrive is disengaged. When the lamp is off, overdrive is engaged.

OVERDRIVE/OVERRIDE SWITCH-PCM INPUT

On vehicles equipped with an automatic transmission and overdrive, the powertrain control module (PCM) regulates the 3-4 overdrive up-shift and downshift through the overdrive solenoid. This solenoid is located in the transmission. An overdrive/override push-button switch is located at the end of the shift lever.

The overdrive/override push-button switch is normally open (overdrive allowed) when the lamp is not illuminated. It momentarily closes (overdrive not allowed) when the operator presses the switch and the lamp is illuminated. Overdrive will revert to ON (lamp off) each time the ignition switch in turned on. The transmission downshifts if the operator presses the override switch while in overdrive.

Refer to Group 21 for more transmission information.

SPEED CONTROL SOLENOIDS—PCM OUTPUT

Speed control operation is regulated by the powertrain control module (PCM). The PCM controls the vacuum to the throttle actuator through the speed control vacuum and vent solenoids. Refer to Group 8H for Speed Control Information.

TACHOMETER—PCM OUTPUT

The Powertrain Control Module (PCM) supplies engine rpm values to the tachometer through the CCD circuits, after an engine speed (rpm) signal is sent from the Engine Control Module (ECM). Refer to Group 8E, Instrument Panel for tachometer information.

TORQUE CONVERTOR CLUTCH (TCC) SOLENOID—PCM OUTPUT

This circuit controls operation of the transmission mounted torque convertor clutch (TCC) solenoid used for torque convertor engagement.

The Powertrain Control Module (PCM) will determine when to engage and disengage the solenoid by monitoring vehicle miles per hour (mph) versus the output voltage of the Accelerator Pedal Position Sensor (APPS). The APPS signal is sent from the Engine Control Module (ECM). Also needed are various inputs from:

- Transmission temperature sensor
- Output shaft speed sensor
- Module timer
- Engine rpm signal from ECM
- Brake switch

TRANSMISSION TEMPERATURE WARNING LAMP—PCM OUTPUT

AUTOMATIC TRANSMISSION ONLY

An instrument panel mounted lamp is used to warn of a possible transmission fluid overheating condition. When transmission fluid temperature has been determined to be above approximately 280 degrees F by the transmission temperature sensor, a signal is sent to the powertrain control module (PCM). The PCM will then control warning lamp operation. The lamp will illuminate for about two seconds each time the ignition key is initially turned to the ON position as a bulb check.

This feature is used with certain heavy-duty automatic transmissions only.

Also refer to Transmission Temperature Sensor—PCM Input for additional information.

DIAGNOSIS AND TESTING

BOOST PRESSURE TEST

Two pressure gauges attached at two different points are required for this test.

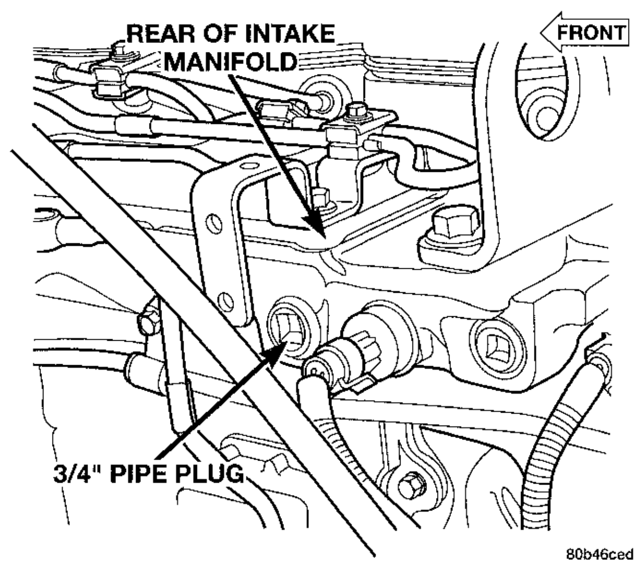

Fig. 18 Boost Pressure Test at Intake Manifold

(1) Obtain two 6828 fuel pressure test gauges (equivalent gauges are OK). **Gauge Consistency Test:** Connect the gauges together to a common pressure source and verify pressure consistency of both gauges. Do this consistency test at approximately 206 kPa (30 psi). If pressures are different, they can still be used for test. Note and record differences in pressures before testing. Make adjustments as necessary.

AUTHENTIC RESTORATION PRODUCT

DIAGNOSIS AND TESTING (Continued)

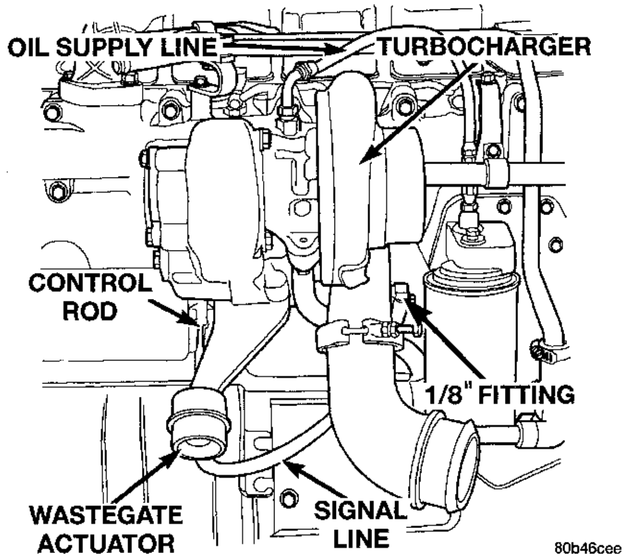

Fig. 19 Boost Pressure Test at Turbocharger

(2) Remove 3/4" pipe plug fitting at rear of intake manifold (Fig. 18). Temporarily replace this fitting with fitting reducer to adapt to pressure gauge. **Note: This pipe plug is located to front of MAP sensor. Do not remove plug to rear of MAP sensor. This is a COOLANT passage plug.**

(3) Loosen hose clamp and disconnect rubber signal line (Fig. 19) from 1/8" brass fitting at front of turbocharger.

(4) Remove 1/8" brass fitting (Fig. 19) from turbocharger. Temporarily replace this fitting with a 1/8" "T" fitting to adapt to pressure gauge.

(5) Reattach signal line to temporary "T".

(6) Attach first pressure gauge to intake manifold fitting.

(7) Attach second pressure gauge to "T" fitting at turbocharger.

Engine must be at rated RPM and full load for the test.

If gauge pressure differential is greater than 3 psi (6 in. Hg), check intercooler and associated piping for restrictions, plugging or damage.

Maximum pressure at intake manifold (rated rpm and load) is 36–37 in/hg ± 3 in/hg (17.7–18.2 psi ± 1.5 psi).

Wastegate should open at no higher than 38.7 in/hg (19 psi) at wide open throttle, full load. If wastegate is out of adjustment, a DTC may have been set. Refer to Wastegate Adjustment in Group 11, Exhaust System and Turbocharger for adjustment procedures.

REMOVAL AND INSTALLATION

ACCELERATOR PEDAL POSITION SENSOR (APPS)

The APPS is serviced (replaced) as one assembly including the lever, brackets and sensor. The APPS is calibrated to its mounting bracket. The APPS assembly is located at left-front of engine below plastic cable/lever/linkage cover (Fig. 20).

CAUTION: Do not attempt to remove sensor from its mounting bracket as electronic calibration will be destroyed (sensor-to-bracket mounting screws are permanently attached). Two accelerator lever set screws (Fig. 22) are used to position lever. Do not attempt to alter positions of these set screws as electronic calibration will be destroyed.

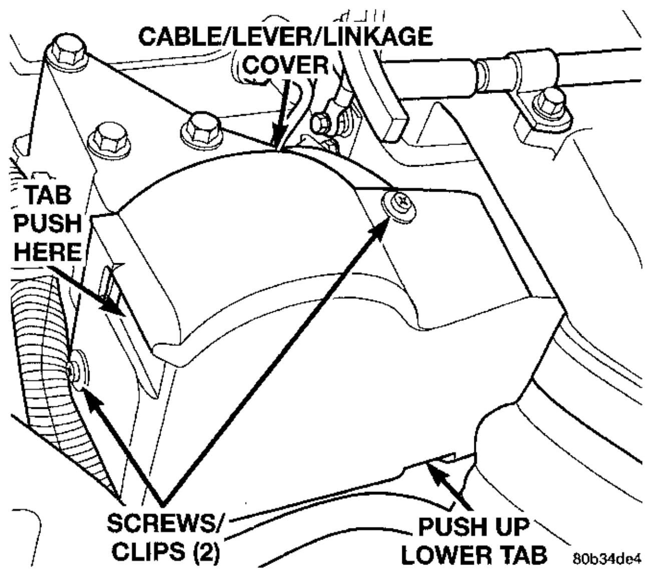

Fig. 20 Cable/Lever/Linkage/Cover

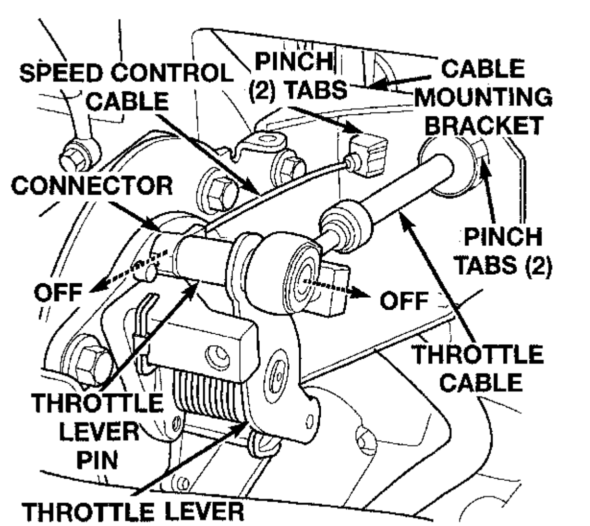

Fig. 21 Cables at Throttle Lever

REMOVAL AND INSTALLATION (Continued)

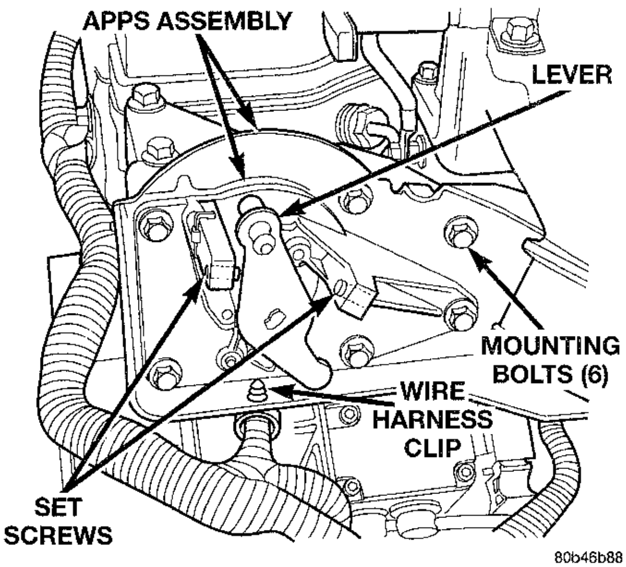

Fig. 22 APPS Assembly

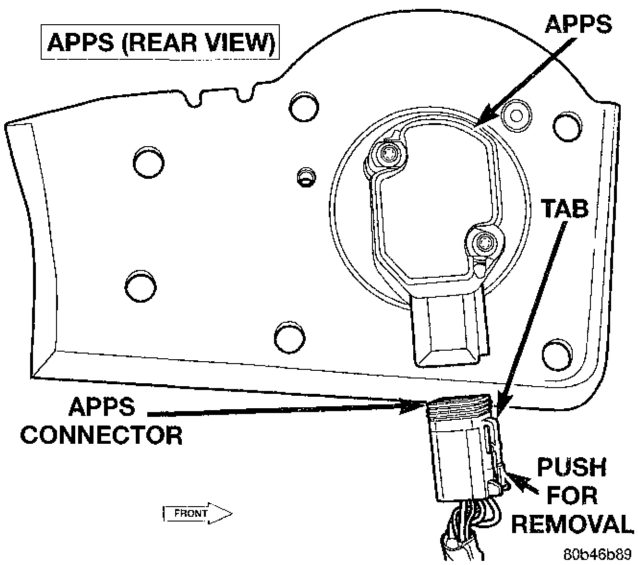

Fig. 23 Electrical Connector at Bottom of APPS

REMOVAL

(1) Disconnect both negative battery cables at both batteries.

(2) Remove cable cover (Fig. 20). Cable cover is attached with 2 Phillips screws, 2 plastic retention clips and 2 push tabs (Fig. 20). Remove 2 Phillips screws and carefully pry out 2 retention clips. After clip removal, push rearward on front tab, and upward on lower tab for cover removal.

(3) Using finger pressure only, disconnect end of speed control servo cable from throttle lever pin by pulling forward on connector while holding lever rearward (Fig. 21).**DO NOT try to pull connector off perpendicular to lever pin. Connector will be broken.**

(4) Using two small screwdrivers, pry throttle cable connector socket from throttle lever ball (Fig. 21). **Be very careful not to bend throttle lever arm.**

(5) Disconnect transmission control cable at lever arm (if equipped). Refer to Group 21, Transmission.

(6) Squeeze pinch tabs on speed control cable (Fig. 21) and pull cable rearward to remove from cable mounting bracket.

(7) Squeeze pinch tabs on throttle cable (Fig. 21) and pull cable rearward to remove from cable mounting bracket.

(8) If equipped with an automatic transmission, refer to Group 21, Transmission for transmission control cable removal procedures.

(9) Disconnect wiring harness clip (Fig. 22) at bottom of bracket.

(10) Remove 6 mounting bolts (Fig. 22) and partially remove APPS assembly from engine. After assembly is partially removed, disconnect electrical connector from bottom of sensor by pushing on connector tab (Fig. 23).

(11) Remove APPS assembly from engine.

INSTALLATION

(1) Snap electrical connector into bottom of sensor.

(2) Position APPS assembly to engine and install 6 bolts. Tighten bolts to 12 N·m (105 in. lbs.) torque.

(3) Connect wiring harness clip (Fig. 22) at bottom of bracket.

(4) If equipped with an automatic transmission, refer to Group 21, Transmission for transmission control cable installation procedures.

(5) Install speed control cable into mounting bracket. Be sure pinch tabs (Fig. 21) have secured cable.

(6) Install throttle cable into mounting bracket. Be sure pinch tabs (Fig. 21) have secured cable.

(7) Connect throttle cable at lever (snaps on).

(8) Connect speed control cable to lever by pushing cable connector rearward onto lever pin while holding lever forward.

(9) Install cable cover.

(10) Connect both negative battery cables to both batteries.

(11) **ECM Calibration:** Turn key to ON position. Without starting engine, slowly press throttle pedal to floor and then slowly release. This step must be done (one time) to ensure accelerator pedal position sensor calibration has been learned by ECM. If not done, possible DTC's may be set.

(12) Use DRB scan tool to erase any DTC's from ECM/PCM.

AUTHENTIC RESTORATION PRODUCT

REMOVAL AND INSTALLATION (Continued)

CAMSHAFT POSITION SENSOR (CMP)

The camshaft position sensor (CMP) is located below the fuel injection pump (Fig. 24). It is attached to the back of the timing gear cover housing.

REMOVAL

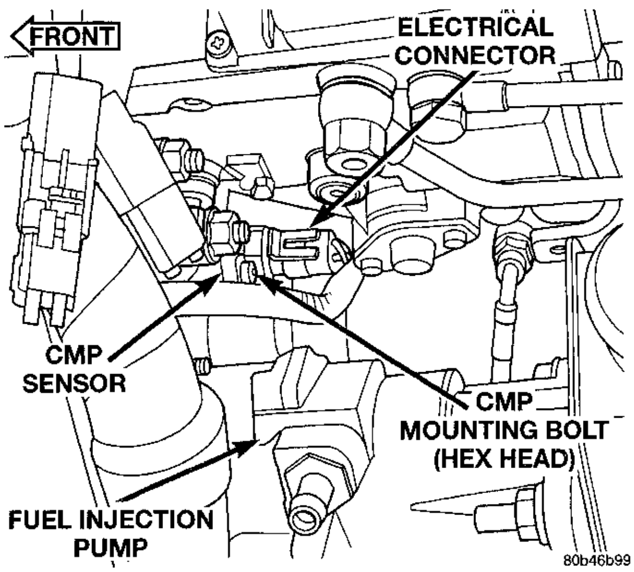

Fig. 24 Camshaft Position Sensor (CMP) Location

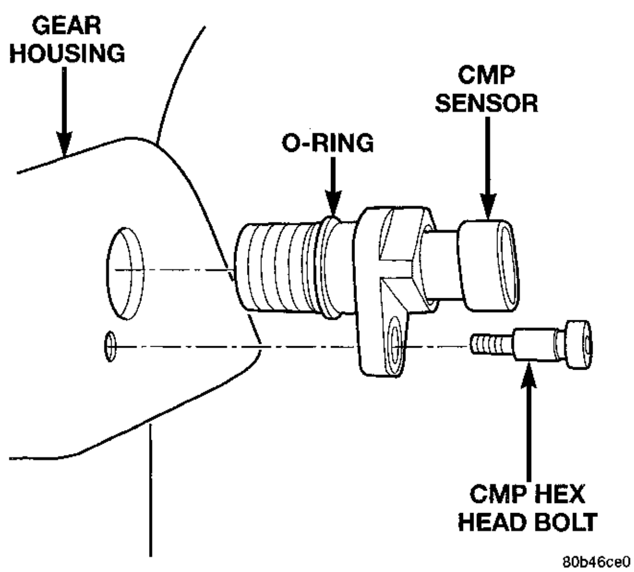

Fig. 25 Camshaft Position Sensor Removal/ Installation

(1) Disconnect both negative cables from both batteries.
(2) Clean area around CMP.
(3) Disconnect electrical at CMP (Fig. 24).
(4) Remove CMP mounting bolt. Bolt head is female-hex (Fig. 25).
(5) Remove CMP from engine by twisting and pulling straight back.
(6) Discard CMP o-ring (Fig. 25).

INSTALLATION

(1) Install new o-ring to CMP. Apply clean engine oil to o-ring.
(2) Clean area around CMP mounting hole.
(3) To prevent tearing o-ring, install CMP into gear housing using a twisting action.
(4) Install mounting bolt and tighten to 20 Nm (15 ft. lbs.) torque.
(5) Install electrical connector to CMP.
(6) Connect both negative cables to both batteries.

CRANKSHAFT POSITION SENSOR (CKP)

REMOVAL

The CKP is located on the left/rear side of engine block near the starter motor (Fig. 26).

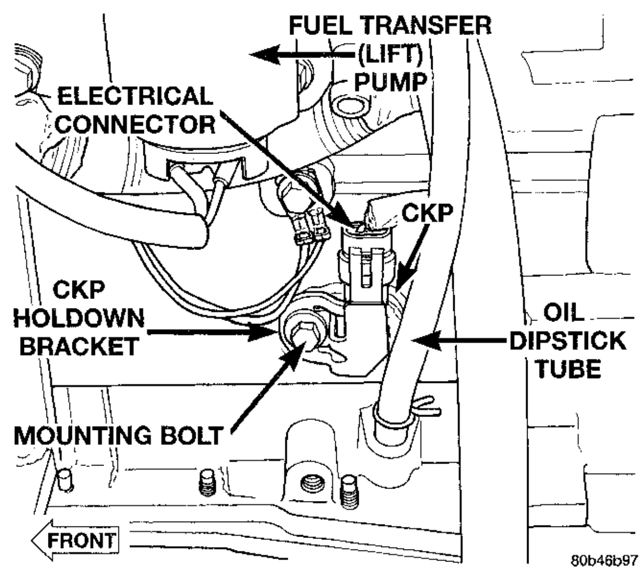

Fig. 26 Crankshaft Position Sensor (CKP) Location

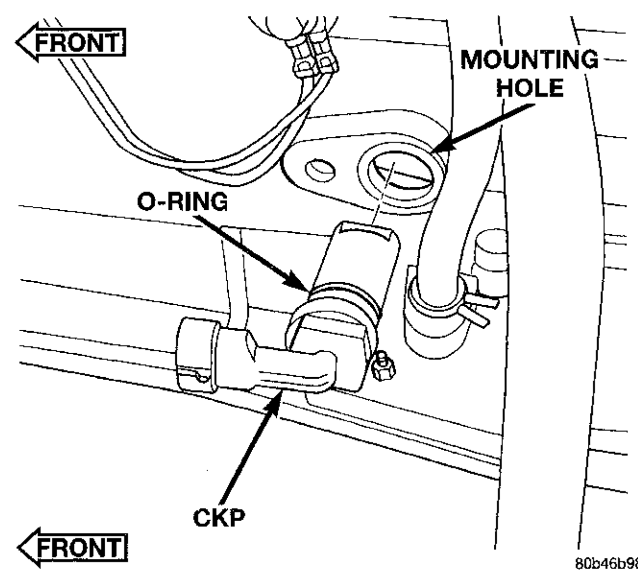

Fig. 27 CKP Removal/Installation

REMOVAL AND INSTALLATION (Continued)

(1) Disconnect both negative battery cables at both batteries.

(2) Remove starter motor. Refer to Group 8B, Starter.

(3) Disconnect electrical connector at CKP (Fig. 26).

(4) Remove CKP mounting bolt and hold down bracket (Fig. 26).

(5) Pull CKP from engine block with a slight twisting action.

(6) Discard old CKP o-ring (Fig. 27).

INSTALLATION

(1) Install new o-ring to CKP. Apply clean engine oil to o-ring.

(2) Clean area around CKP mounting hole.

(3) To prevent tearing o-ring, install CKP into engine block using a twisting action.

(4) Position hold down bracket and install mounting bolt.

(5) Tighten bolt to 24 N·m (18 ft. lbs.) torque.

(6) Install starter motor. Refer to Group 8B, Starter.

(7) Connect both negative battery cables at both batteries.

ENGINE CONTROL MODULE (ECM)

The ECM is bolted to the engine block behind the fuel filter (Fig. 28).

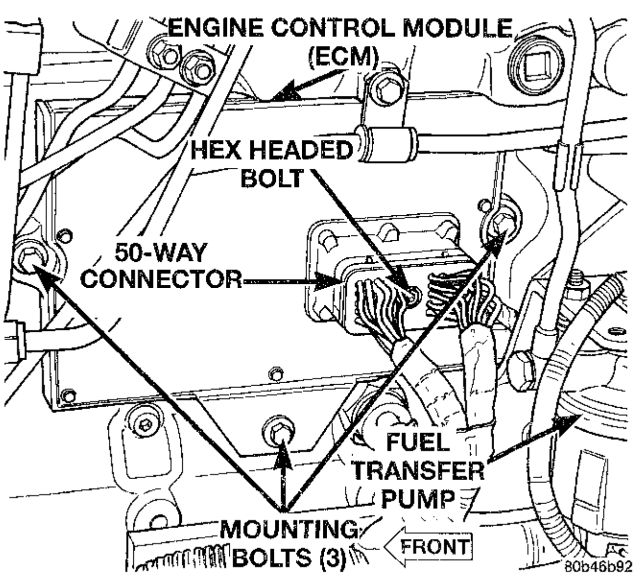

Fig. 28 Engine Control Module (ECM) Location and Mounting

REMOVAL

(1) Record any Diagnostic Trouble Codes (DTC's) found in the PCM or ECM.

To avoid possible voltage spike damage to either the Powertrain Control Module (PCM) or ECM, ignition key must be off, and negative battery cables must be disconnected before unplugging ECM connectors.

(2) Disconnect both negative battery cables at both batteries.

(3) Remove 50–way electrical connector bolt at ECM (Fig. 28). Note: Connector bolt is female 4mm hex head. To remove bolt, use a ball-hex bit or ball-hex screwdriver such as Snap-On ® 4mm SDABM4. As bolt is being removed, very carefully remove connector from ECM.

(4) Remove three ECM mounting bolts and remove ECM from vehicle.

INSTALLATION

Do not apply paint to back of ECM. Poor ground will result.

(1) Clean ECM mounting points at engine block.

(2) Position ECM to engine block and install 3 mounting bolts. Tighten bolts to 24 N·m (18 ft. lbs.).

(3) Check pin connectors in ECM and 50–way connector for corrosion or damage. Repair as necessary.

(4) Clean pins in 50–way electrical connector with a quick-dry electrical contact cleaner.

(5) Very carefully install 50–way connector to ECM. Tighten connector hex bolt.

(6) Install battery cables.

(7) **Turn key to ON position. Without starting engine, slowly press throttle pedal to floor and then slowly release. This step must be done (one time) to ensure accelerator pedal position sensor calibration has been learned by ECM. If not done, possible DTC's may be set.**

(8) Use DRB scan tool to erase any stored companion DTC's from PCM.

ENGINE COOLANT TEMPERATURE (ECT) SENSOR

The Engine Coolant Temperature (ECT) sensor is located at the front of the cylinder head near the thermostat (Fig. 29).

REMOVAL

WARNING: THE COOLING SYSTEM MAY BE UNDER PRESSURE. HOT COOLANT CAN CAUSE BURNS. OBSERVE THE WARNINGS IN GROUP 7, COOLING SYSTEM BEFORE PROCEEDING.

(1) Partially drain cooling system until coolant level is below cylinder head.

(2) Disconnect ECT sensor electrical connector from sensor (Fig. 29).

(3) Remove ECT sensor from cylinder head (Fig. 30).

(4) Discard sensor o-ring (Fig. 30).

AUTHENTIC RESTORATION PRODUCT

REMOVAL AND INSTALLATION (Continued)

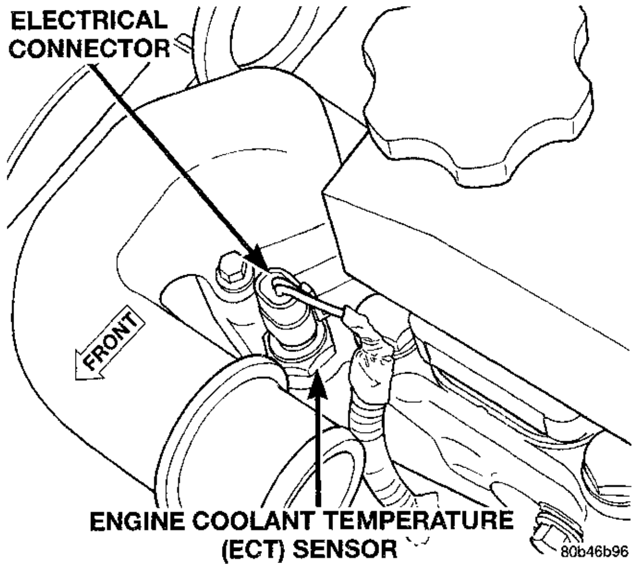

Fig. 29 ECT Sensor Location

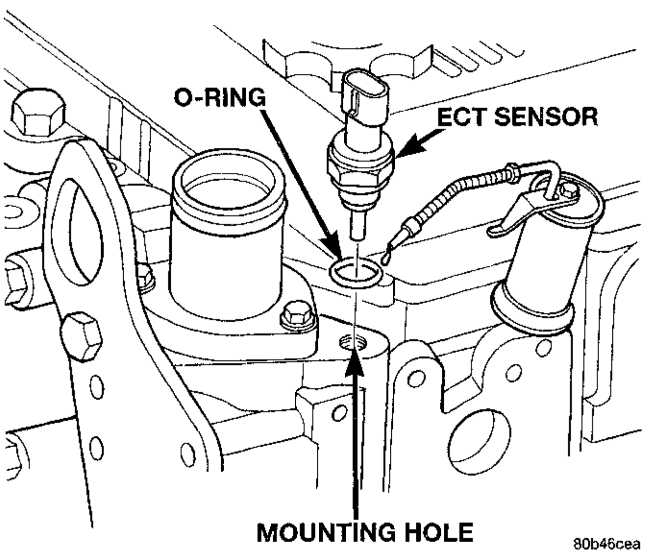

Fig. 30 ECT Sensor Removal/Installation

INSTALLATION

(1) Clean sensor mounting hole (Fig. 30) of rust or contaminants.

(2) Install new o-ring to sensor. Apply clean engine oil to sensor o-ring and sensor threads.

(3) Install ECT sensor into cylinder head. Tighten to 14 N·m (10 ft. lbs.) torque.

(4) Connect sensor electrical connector.

(5) Fill cooling system and check for coolant leaks. Refer to Group 7, Cooling System for procedures.

INTAKE MANIFOLD AIR TEMPERATURE (IAT) SENSOR

The IAT sensor is located in the left/rear side of the intake manifold (Fig. 31).

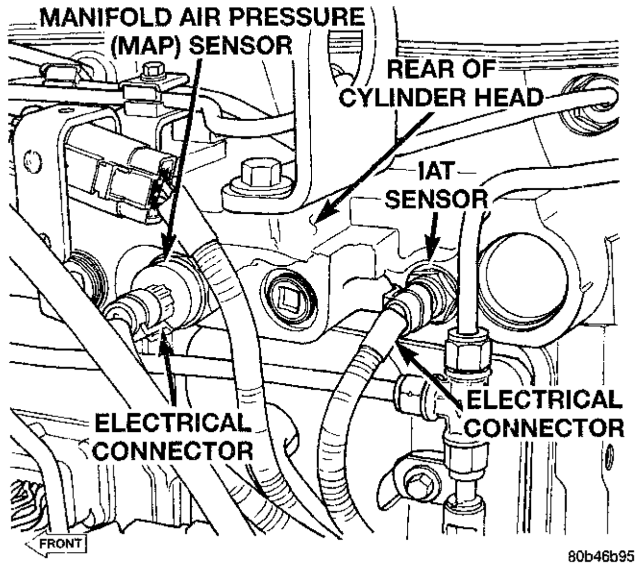

Fig. 31 IAT Sensor Location

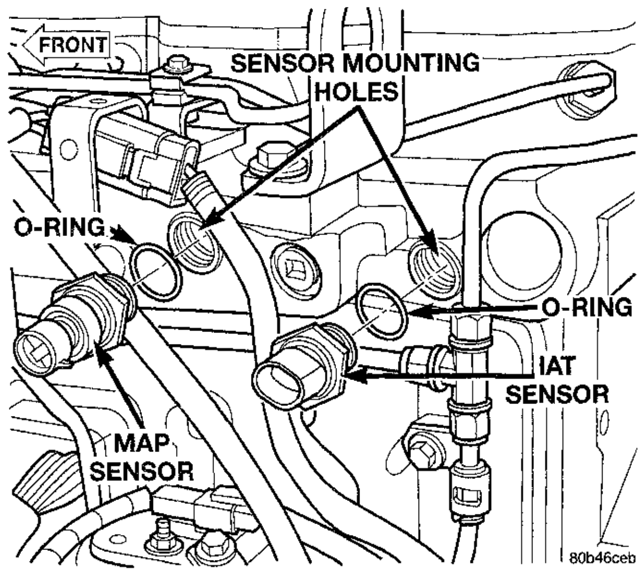

Fig. 32 IAT Sensor Removal/Installation

REMOVAL

(1) Disconnect electrical connector from IAT sensor (Fig. 31).

(2) Remove IAT sensor from intake manifold (Fig. 32).

(3) Discard sensor o-ring (Fig. 32).

INSTALLATION

(1) Clean sensor mounting hole (Fig. 32) of rust or contaminants.

(2) Install new o-ring to sensor. Apply clean engine oil to sensor o-ring and sensor threads.

(3) Install IAT sensor into intake manifold. Tighten to 14 N·m (10 ft. lbs.) torque.

(4) Connect sensor electrical connector.

REMOVAL AND INSTALLATION (Continued)

INTAKE MANIFOLD AIR HEATERS

The 2 intake manifold air heater elements are attached to a metal block located at the top of the intake manifold (Fig. 33). If servicing either of the heater elements, the entire block/element assembly must be replaced.

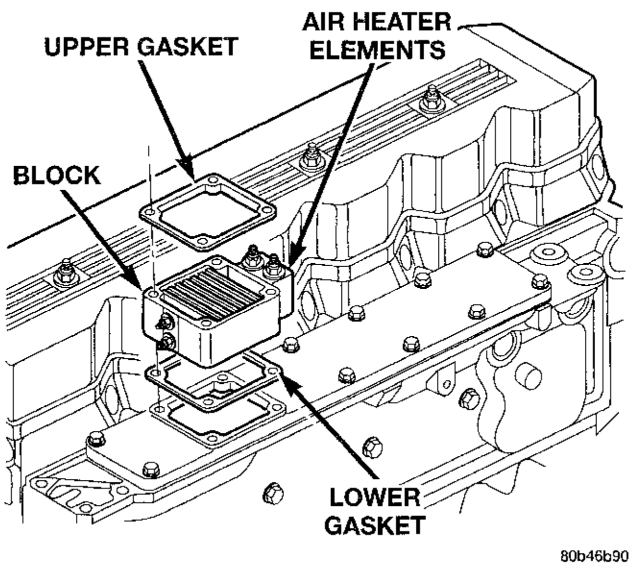

Fig. 33 Intake Manifold Air Heater Element Location

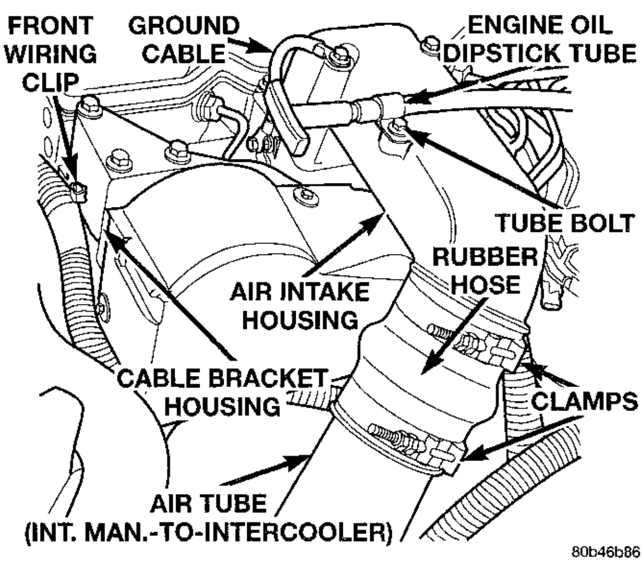

Fig. 34 Air Tube (Intercooler-to-Air Intake Housing)

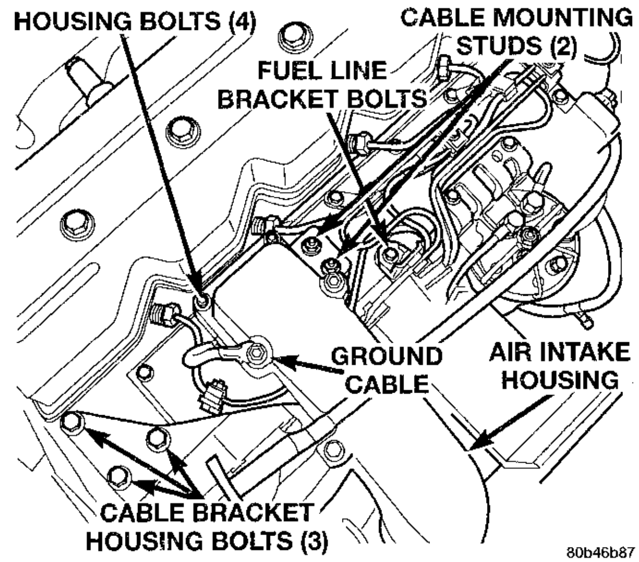

Fig. 35 Air Intake Housing

REMOVAL

(1) Disconnect both negative battery cables at both batteries.

(2) Disconnect clamp from rubber hose at air intake housing (Fig. 34).

(3) Disconnect rubber hose at air intake housing (Fig. 34).

(4) Remove engine oil dipstick tube mounting bolt (Fig. 34). Position dipstick tube to the side.

(5) Disconnect heater electrical cables at cable mounting studs (Fig. 35).

(6) Remove 4 housing bolts (Fig. 35).

(7) Remove air intake housing from top of heater elements.

(8) Remove heater element assembly from intake manifold.

(9) Clean old gasket material from air intake housing and intake manifold.

(10) Clean old gasket material from both ends of heater block (Fig. 33).

INSTALLATION

(1) Using 2 new gaskets, position element assembly and air housing to intake manifold.

(2) Position ground cable (Fig. 35) to air housing.

(3) Install 4 housing bolts and tighten to 24 N·m (18 ft. lbs.) torque.

(4) Connect heater cables at cable mounting studs (Fig. 35).

(5) Install engine oil dipstick tube and mounting bolt.

(6) Connect rubber hose to air intake housing.

(7) Connect clamp to rubber hose at air intake housing.

(8) Connect both negative battery cables at both batteries.

AUTHENTIC RESTORATION PRODUCT

REMOVAL AND INSTALLATION (Continued)

INTAKE MANIFOLD AIR HEATER RELAYS

The relays are located in engine compartment, bolted to left inner fender below left battery (Fig. 36).

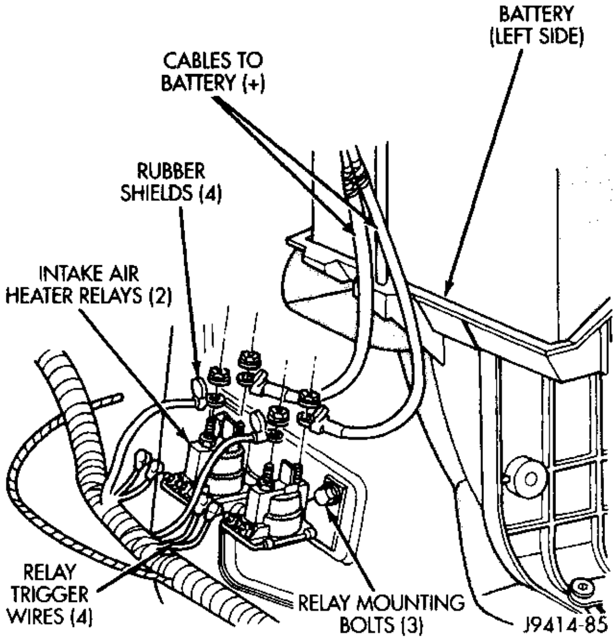

Fig. 36 Intake Manifold Air Heater Relays

REMOVAL

The mounting bracket and both relays are replaced as an assembly.

(1) Disconnect both negative battery cables at both batteries.

(2) Disconnect four relay trigger wires at both relays (Fig. 36). Note position of wiring before removing.

(3) Lift four rubber shields from all 4 cables (Fig. 36).

(4) Remove four nuts at cable connectors (Fig. 36). Note position of wiring before removing.

(5) Remove three relay mounting bracket bolts (Fig. 36) and remove relay assembly.

INSTALLATION

(1) Install relay assembly to inner fender. Tighten mounting bolts to 4.5 N·m (40 in. lbs.) torque.

(2) Connect eight electrical connectors to relays.

(3) Connect battery cables to both batteries.

MANIFOLD AIR PRESSURE (MAP) SENSOR

The MAP sensor is located in the left/rear side of the intake manifold (Fig. 37).

REMOVAL

(1) Disconnect electrical connector from MAP sensor (Fig. 37).

(2) Remove MAP sensor from intake manifold (Fig. 38).

(3) Discard sensor o-ring (Fig. 38).

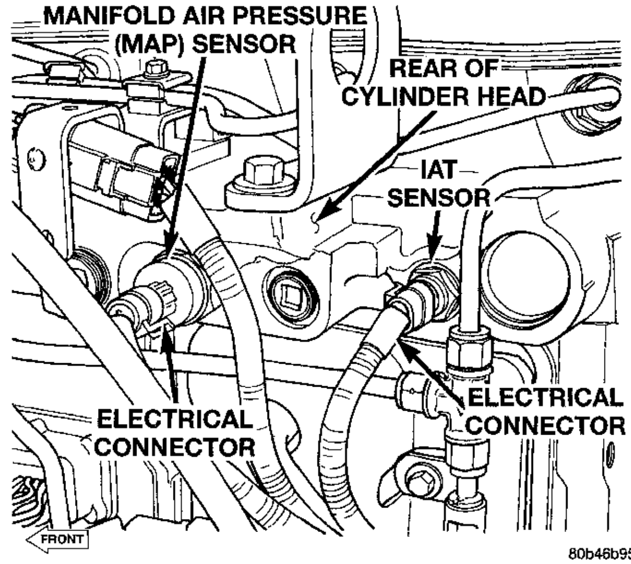

Fig. 37 MAP Sensor Location

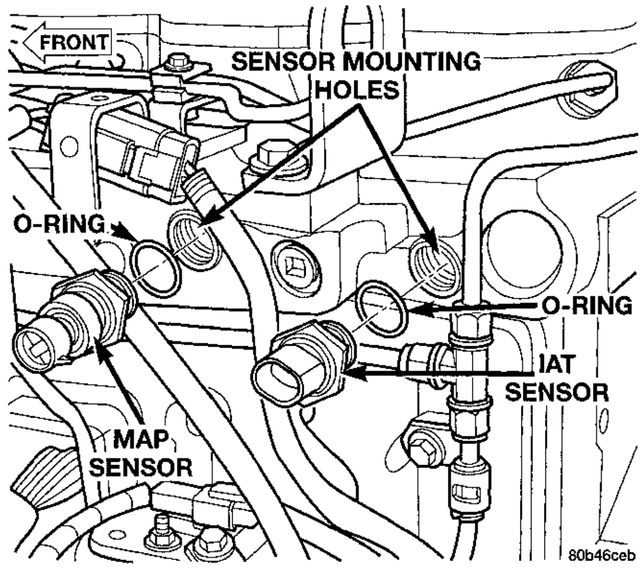

Fig. 38 MAP Sensor Removal/Installation

INSTALLATION

(1) Clean sensor mounting hole (Fig. 38) of rust or contaminants.

(2) Install new o-ring to sensor. Apply clean engine oil to sensor o-ring and sensor threads.

(3) Install MAP sensor into intake manifold. Tighten to 14 N·m (10 ft. lbs.) torque.

(4) Connect sensor electrical connector.

REMOVAL AND INSTALLATION (Continued)

POWERTRAIN CONTROL MODULE (PCM)

The PCM is located in the engine compartment (Fig. 39) to the rear of the air cleaner assembly.

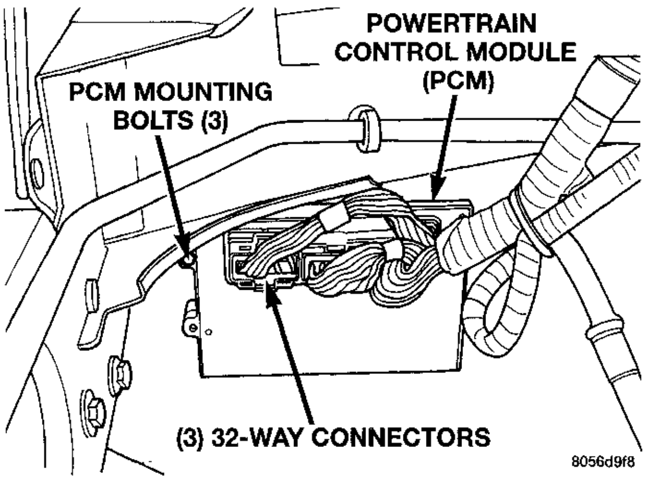

Fig. 39 PCM Location and Mounting

REMOVAL

To avoid possible voltage spike damage to either the PCM or the ECM, ignition key must be off, and both negative battery cables must be disconnected before unplugging PCM connectors.

(1) Disconnect negative battery cables at both batteries.

(2) Remove cover over electrical connectors. Cover snaps onto PCM.

(3) Carefully unplug the three 32–way connectors from PCM.

(4) Remove three PCM mounting bolts and remove PCM from vehicle.

INSTALLATION

(1) Install PCM and mounting bolts to vehicle.

(2) Tighten bolts to 4 N·m (35 in. lbs.).

(3) Check pin connectors in the PCM and the three 32–way connectors for corrosion or damage. Repair as necessary.

(4) Install three 32–way connectors.

(5) Install cover over electrical connectors. Cover snaps onto PCM.

(6) Install battery cables.

(7) Use the DRB scan tool to reprogram new PCM with vehicles original Identification Number (VIN) and original vehicle mileage. If this step is not done, a Diagnostic Trouble Code (DTC) may be set.

WATER-IN-FUEL SENSOR

The Water-In-Fuel (WIF) sensor is located at the side of fuel filter/water separator canister. Refer to Fuel Filter/Water Separator Removal/Installation for WIF sensor removal/installation procedures.

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SPECIFICATIONS

TORQUE CHART—DIESEL ENGINE

DESCRIPTION	TORQUE
Accelerator Pedal Position Sensor Bracket Bolts	12 N·m (105 in. lbs.)
Air Intake Housing Bolts	24 N·m (18 ft. lbs.)
Banjo Fittings at top of Filter/Separator	24 N·m (18 ft. lbs.)
Banjo Fittings at Fuel Return Lines	24 N·m (18 ft. lbs.)
Banjo Fitting At Fuel Supply Line (Injector Pump)	24 N·m (18 ft. lbs.)
Camshaft Position Sensor (CMP) Bolt	20 N·m (15 ft. lbs.)
Crankshaft Position Sensor (CKP) Bolt	24 N·m (18 ft. lbs.)
ECM Mounting Bolts	24 N·m (18 ft. lbs.)
Engine Coolant Temperature (ECT) Sensor	14 N·m (10 ft. lbs.)
Engine Lifting Bracket Bolts	77 N·m (57 ft. lbs.)
Fuel Drain Manifold "T" Fitting	12 N·m (106 in. lbs.)
Fuel Filter Canister Bracket Bolts	24 N·m (18 ft. lbs.)
Fuel Filter Canister Mounting Nut	14 N·m (10 ft. lbs.)
Fuel Filter Drain Valve Mounting Screws	3–5 N·m (30–40 in. lbs.)
Fuel Heater Screws	2–3 N·m (15–20 in. lbs.)
Fuel Injector Clamp Bolts	10 N·m (89 in. lbs.)
Fuel Pump Module Locknut	24–44 N·m (18–32 ft. lbs.)
Fuel Tank Mounting Nuts	41 N·m (30 ft. lbs.)
Fuel Transfer Pump Mounting Nuts	12 N·m (9 ft. lbs.)
High-Pressure Fuel Line Fittings (at Injectors)	40 N·m (30 ft. lbs.)
High-Pressure Fuel Line Fittings (at Pump)	24 N·m (18 ft. lbs.)
High-Pressure Fuel Line Clamps-to-Intake Manifold	24 N·m (18 ft. lbs.)
Hose Clamps at Intercooler Tube	8 N·m (72 in. lbs.)
Injection Pump-to-Injection Pump Gear Nut	170 N·m (125 ft. lbs.)
Injection Pump Mounting Nuts	43 N·m (32 ft. lbs.)
Intake Manifold Air Temperature (IAT) Sensor	14 N·m (10 ft. lbs.)
Intake Manifold Air Heater Relay Bolts	4.5 N·m (40 in. lbs.)
Manifold Air Pressure (MAP) Sensor	14 N·m (10 ft. lbs.)
PCM Mounting Bolts	4 N·m (35 in. lbs.)
Overflow Valve-to-Fuel Injection Pump	24 N·m (18 ft. lbs.)
Water-In-Fuel (WIF) Sensor	2–3 N·m (15–20 in. lbs.)

Mopar
AUTHENTIC RESTORATION™ PRODUCT

EMISSION CONTROL SYSTEM

ON-BOARD DIAGNOSTICS

INDEX

GENERAL INFORMATION

SYSTEM DESCRIPTION

Two different modules are used for powertrain control with the diesel engine. The Powertrain Control Module (PCM) is used primarily for charging system, transmission, and speed control functions. The Engine Control Module (ECM) is used to control the fuel system. The PCM is located in the right/rear of engine compartment (Fig. 1). The ECM is bolted to the left side of the engine cylinder block (Fig. 2). Refer to either Powertrain Control Module (PCM), or Engine Control Module (ECM) in Group 14, Fuel System for a list of inputs and outputs for each module.

The PCM and ECM monitor many different circuits in the powertrain system. If the ECM or PCM senses a problem with a monitored circuit often enough to indicate an actual problem, it stores a Diagnostic Trouble Code (DTC) in the ECM's or PCM's memory. With certain DTC's, if the problem is repaired or ceases to exist, the ECM or PCM cancels the code after 40 warm-up cycles. Certain other DTC's may be cancelled after 1 or 2 good "trips". Refer to Trip Definition. DTC's that affect vehicle emissions illuminate the Malfunction Indicator Lamp (CHECK ENGINE lamp). Refer to Malfunction Indicator Lamp.

Certain DTC's will set a "companion DTC" in the opposite control module. This means that after repair, the DTC must be erased from **both** modules.

Certain criteria must be met before the ECM or PCM will store a DTC in memory. The criteria may be a specific range of engine RPM, throttle opening, engine temperature or input voltage.

The ECM or PCM might not store a DTC for a monitored circuit even though a malfunction has occurred. This may happen because one of the DTC criteria for the circuit has not been met. **For example,** assume the DTC criteria requires the ECM to monitor the circuit only when the engine operates between 750 and 2000 RPM. Suppose the sensor's output circuit shorts to ground when engine operates above 2400 RPM (resulting in 0 volt input to the ECM). Because the condition happens at an engine speed above the maximum threshold (2000 rpm), the ECM will not store a DTC.

There are several operating conditions for which the ECM and PCM monitors and sets DTC's. Refer to Monitored Systems, Components, and Non-Monitored Circuits in this section.

Technicians must retrieve stored DTC's by connecting the DRB scan tool (or an equivalent scan tool) to the 16–way data link connector (Fig. 3). Refer to the Diagnostic Trouble Code chart (list). **Remember that DTC's are the results of a system or circuit failure, but do not directly identify the failed component or components.**

GENERAL INFORMATION (Continued)

Various diagnostic procedures may actually cause a diagnostic monitor to set a DTC. For instance, disconnecting a relay or removing an electrical connector while the engine is running. When a repair is completed and verified, connect the DRB scan tool to the 16–way data link connector to erase all ECM and PCM DTC's and extinguish the MIL (CHECK ENGINE lamp).

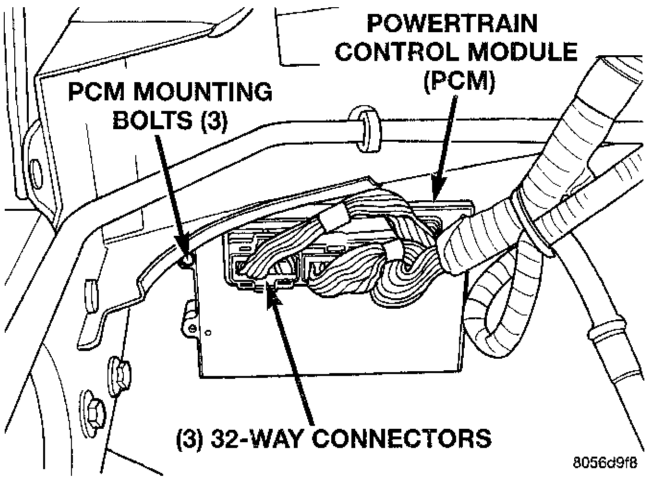

Fig. 1 Powertrain Control Module (PCM)

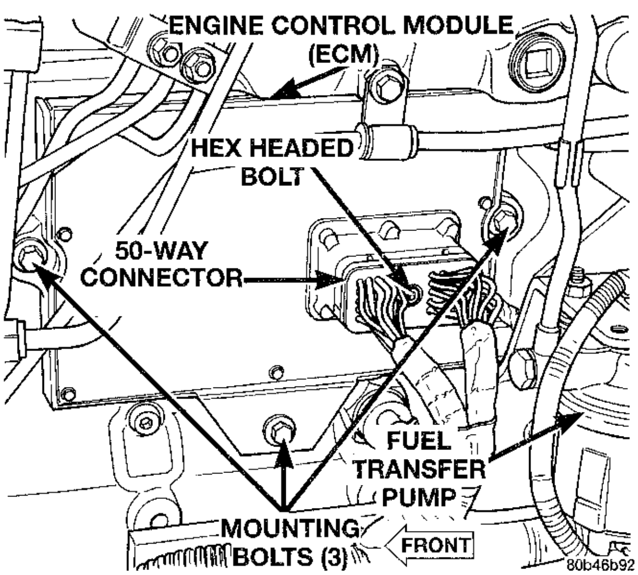

Fig. 2 Engine Control Module (ECM)

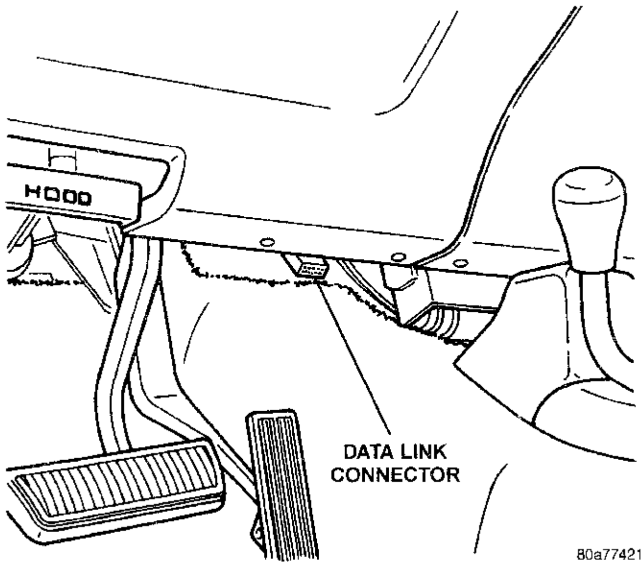

Fig. 3 16–Way Data Link (Diagnostic) Connector Location

DESCRIPTION AND OPERATION

MALFUNCTION INDICATOR LAMP (MIL)

Whenever the Engine Control Module (ECM), or the Powertrain Control Module (PCM) sets a Diagnostic Trouble Code (DTC) for an emission related item, it illuminates the Malfunction Indicator Lamp (MIL). The MIL is displayed on the instrument panel as the CHECK ENGINE lamp. The MIL will only be illuminated for DTC's that affect vehicle emissions.

There are some monitors that may take two consecutive “trips” to illuminate the MIL if a DTC has been detected. Refer to Trip Definition for additional information. The MIL will stay on continuously (if key is ON) when the ECM or PCM has entered a “Limp-In” mode or has identified a failed emission component.

The MIL either flashes or illuminates continuously when the PCM detects active engine misfire. Refer to Misfire Monitoring.

Additionally, the ECM or PCM may reset (turn off) the MIL if a previous malfunction (DTC) has not been re-detected after 2 consecutive “trips” have occurred.

The MIL will illuminate at key-on and will stay lit for approximately 2 seconds if the engine has not been cranked over. This is done as a bulb check (bulb test).

Refer to the Diagnostic Trouble Code charts for a list of emission related and non-emission related DTC's.

AUTHENTIC RESTORATION PRODUCTS

DESCRIPTION AND OPERATION (Continued)

DIAGNOSTIC TROUBLE CODES

A Diagnostic Trouble Code (DTC) indicates that either the Powertrain Control Module (PCM), or the Engine Control Module (ECM) has recognized an abnormal condition in the system. Certain DTC's will set a "Companion DTC", meaning the same code will be set in the opposite module (ECM or PCM).

DTC's are the results of a system or circuit failure, but do not directly identify the failed component or components.

Technicians must retrieve stored DTC's by connecting the DRB III scan tool (or an equivalent scan tool) to the 16–way data link connector (Fig. 3).

NOTE: For a list of DTC's, refer to the following charts.

OBTAINING DTC's

WARNING: APPLY PARKING BRAKE AND/OR BLOCK WHEELS BEFORE PERFORMING ANY TEST ON AN OPERATING ENGINE.

(1) Connect the DRB scan tool to data link (diagnostic) connector.

(2) Turn the ignition switch on, access Read Fault Screen. Record all the DTC's shown on the DRB scan tool.

(3) To erase DTC's, use the Erase Trouble Code data screen on the DRB scan tool.

(4) Certain DTC's are stored as "Companion DTC's". They must be erased from both the ECM and PCM.

(a) CHECK ENGINE lamp (Malfunction Indicator Lamp or MIL) illuminated during engine operation if this DTC was recorded (CARB and/or EPA requirements).

(b) CHECK ENGINE lamp (Malfunction Indicator Lamp or MIL) illuminated during engine operation if this DTC was recorded (CARB requirements only).

(c) ECM may derate engine power, degrade engine performance or put fuel system into "Limp-In" mode if this DTC was recorded.

(d) CHECK GAUGES lamp illuminated during engine operation if this DTC was recorded.

(e) Companion DTC recorded (DTC recorded in both ECM and PCM).

(f) Water-In-Fuel warning lamp illuminated if this DTC was recorded.

(g) CHECK ENGINE lamp (Malfunction Indicator Lamp or MIL) **not illuminated** during engine operation if this DTC was recorded.

DIAGNOSTIC TROUBLE CODE (DTC) DESCRIPTIONS

Generic Scan Tool P-Code	DRB Scan Tool Display	Description of Diagnostic Trouble Code
P0112 (b), (c)	Intake Air Temperature (IAT) Sensor Voltage Low	Intake manifold air temperature sensor voltage input below the minimum acceptable voltage.
P0113 (b), (c)	Intake Air Temperature (IAT) Sensor Voltage High	Intake manifold air temperature sensor voltage input above the maximum acceptable voltage.
P0117 (b), (c)	Engine Coolant Temperature (ECT) Sensor Voltage Too Low	Engine coolant temperature sensor voltage input below minimum acceptable voltage.
P0118 (b), (c)	Engine Coolant Temperature (ECT) Sensor Voltage Too High	Engine coolant temperature sensor voltage input above maximum acceptable voltage.
P0121 (a), (c)	Accel. Position Sensor Volts Do Not Agree w/idle Validation Sig.	Problem detected in APPS idle validation circuit
P0122 (a), (c)	Accelerator Position Sensor (APPS) Signal Voltage Too Low	APPS voltage input below the minimum acceptable voltage
P0123 (a), (c)	Accelerator Position Sensor (APPS) Signal Voltage Too High	APPS voltage input above the maximum acceptable voltage.
P0125 (b)	Engine is Cold Too Long	Engine does not reach operating temperature.
P0168 (c), (g)	Decreased Engine Performance Due To High Injection Pump Fuel Temp	Fuel temperature is above the engine protection limit. Engine power will be derated.
P0177 (f), (g)	Water In Fuel	Excess water found in fuel by water-in-fuel sensor

DESCRIPTION AND OPERATION (Continued)

Generic Scan Tool P-Code	DRB Scan Tool Display	Description of Diagnostic Trouble Code
P0178 (g)	Water In Fuel Sensor Voltage Too Low	Loss of water-in-fuel circuit or sensor.
P0181 (c), (g)	Fuel Injection Pump Failure	Low power, engine derated, or engine stops.
P0215 (g)	Fuel Injection Pump Control Circuit	Failure in fuel pump relay control circuit.
P0216 (b), (c)	Fuel Injection Pump Timing Failure	High fuel supply restriction, low fuel pressure or possible wrong or incorrectly installed pump keyway.
P0217 (c), (d)	Decreased Engine Performance Due To Engine Overheat Condition	Engine overheating. ECM will derate engine performance.
P0219 (c), (g)	Crankshaft Position Sensor Overspeed Signal	Engine has exceeded rpm limits.
P0222 (a)	Idle Validation Signals Both Low	Problem detected with idle validation circuits within APPS.
P0223 (a), (c)	Idle Validation Signals Both High (Above 5 Volts)	Problem detected with idle validation circuits within APPS.
P0230 (c), (g)	Transfer Pump (Lift Pump) Circuit Out of Range	Problem detected in fuel transfer pump circuits.
P0232 (g)	Fuel Shutoff Signal Voltage Too High	Fuel shut-off signal voltage too high from ECM to fuel injection pump.
P0234 (b), (c)	Turbo Boost Limit Exceeded	Problem detected in turbocharger wastegate.
P0236 (b)	Map Sensor Too High Too Long	Problem detected in turbocharger wastegate.
P0237 (b), (c)	Map Sensor Voltage Too Low	MAP sensor voltage input below the minimum acceptable voltage.
P0238 (b), (c)	Map Sensor Voltage Too High	MAP sensor voltage input above the maximum acceptable voltage.
P0251 (a), (c)	Fuel Inj. Pump Mech. Failure Fuel Valve Feedback Circuit	Problem sensed with fuel circuit internal to fuel injection pump.
P0253 (b), (c)	Fuel Injection Pump Fuel Valve Open Circuit	Problem sensed with fuel circuit internal to fuel injection pump.
P0254 (c), (g)	Fuel Injection Pump Fuel Valve Current Too High	Problem caused by internal fuel injection pump failure.
P0300 (b), (c)	Multiple Cylinder Mis-fire	Misfire detected in multiple cylinders.
P0301 (b), (c)	Cylinder #1 Mis-fire	Misfire detected in cylinder #1.
P0302 (b), (c)	Cylinder #2 Mis-fire	Misfire detected in cylinder #2.
P0303 (b), (c)	Cylinder #3 Mis-fire	Misfire detected in cylinder #3.
P0304 (b), (c)	Cylinder #4 Mis-fire	Misfire detected in cylinder #4.
P0305 (b), (c)	Cylinder #5 Mis-fire	Misfire detected in cylinder #5.
P0306 (b), (c)	Cylinder #6 Mis-fire	Misfire detected in cylinder #6.
P0320 (b)	No RPM Signal to PCM (Crankshaft Position Sensor Signal to JTEC)	A CKP signal has not been detected at the PCM.
P0336 (b), (c)	Crankshaft Position (CKP) Sensor Signal	Problem with voltage signal from CKP.
P0341 (b)	Camshaft Position (CMP) Sensor Signal	Problem with voltage signal from CMP.

AUTHENTIC RESTORATION PRODUCT

DESCRIPTION AND OPERATION (Continued)

Generic Scan Tool P-Code	DRB Scan Tool Display	Description of Diagnostic Trouble Code
P0370 (c), (g)	Fuel Injection Pump Speed/ Position Sensor Sig Lost	Problem caused by internal fuel injection pump failure.
P0380 (b)	Intake Air Heater Relay #1 Control Circuit	Problem detected in #1 air heater solenoid/relay circuit (not heater element)
P0381 (b)	Wait To Start Lamp Inoperative	Problem detected in wait-to-start bulb circuit.
P0382 (b)	Intake Air Heater Relay #2 Control Circuit	Problem detected in #2 air heater solenoid/relay circuit (not heater element)
P0387 (c), (g)	Crankshaft Position Sensor Supply Voltage Too Low	CKP sensor voltage input below the minimum acceptable voltage.
P0388 (c), (g)	Crankshaft Position Sensor Supply Voltage Too High	CKP sensor voltage input above the maximum acceptable voltage.
P0460 (g)	Fuel Level Unit No Change Over Miles	Fuel level sending unit voltage does not change for more than 40 miles.
P0462 (b)	Fuel Level Sending Unit Volts Too Low	Open circuit between PCM and fuel gauge sending unit.
P0463 (b)	Fuel Level Sending Unit Volts Too High	Circuit shorted to voltage between PCM and fuel gauge sending unit.
P0500 (b)	No Vehicle Speed Sensor Signal	A vehicle speed signal was not detected.
P0522 (c), (g)	Oil Pressure Voltage Too Low	Oil pressure sending unit (sensor) voltage input below the minimum acceptable voltage.
P0523 (c), (g)	Oil Pressure Voltage Too High	Oil pressure sending unit (sensor) voltage input above the maximum acceptable voltage.
P0524 (c), (d), (g)	Oil Pressure Too Low	Engine oil pressure is low. Engine power derated.
P0545 (g)	A/C Clutch Relay Circuit	Problem detected in air conditioning clutch relay control circuit.
P0562 (d), (g)	Charging System Voltage Too Low	Supply voltage sensed at ECM too low.
P0563 (d), (g)	Charging System Voltage Too High	Supply voltage sensed at ECM too high.
P0601 (b)	Internal Controller Failure	PCM Internal fault condition detected.
P0602 (b), (c)	ECM Fueling Calibration Error	ECM Internal fault condition detected.
P0606 (b)	ECM Failure	ECM Internal fault condition detected.
P0622 (d), (g)	Generator Field Not Switching Properly	An open or shorted condition detected in the generator field control circuit.
P0712 (b)	Trans Temp Sensor Voltage Too Low	Voltage less than 1.55 volts (4-speed auto. trans. only).
P0713 (b)	Trans Temp Sensor Voltage Too High	Voltage greater than 3.76 volts (4-speed auto. trans. only).
P0720 (b)	Low Output Spd Sensor RPM Above 15 mph	Output shaft speed is less than 60 rpm with vehicle speed above 15 mph (4-speed auto. trans. only).
P0743 (b)	Torque Converter Clutch Solenoid/Trans Relay Circuits	An open or shorted condition detected in the torque converter part throttle unlock solenoid control circuit (3 or 4-speed auto. trans. only).
P0748 (b)	Governor Pressure Sol Control/Trans Relay Circuits	An open or shorted condition detected in the governor pressure solenoid or relay circuits (4-speed auto. trans. only).

DESCRIPTION AND OPERATION (Continued)

Generic Scan Tool P-Code	DRB Scan Tool Display	Description of Diagnostic Trouble Code
P0751 (b)	O/D Switch Pressed (LO) More Than 5 Min	Overdrive Off switch input too low for more than 5 minutes (4-speed auto. trans. only).
P0753 (b)	Trans 3-4 Shift Sol/Trans Relay Circuits	An open or shorted condition detected in the transmission 2-4 shift solenoid circuit (4-speed auto. trans. only).
P1110 (c), (g)	Decrease Engine Performance Due To High Intake Air Temperature	Intake manifold air temperature is above the engine protection limit. Engine power will be derated.
P1180 (c), (g)	Decreased Engine Performance Due To High Injection Pump Fuel Temp	Fuel temperature is above the engine protection limit. Engine power will be derated.
P1283 (g)	Idle Select Signal Invalid	ECM or fuel injection pump module internal fault condition detected.
P1284 (b), (c)	Fuel Injection Pump Battery Voltage Out-Of-Range	Fuel injection pump module internal fault condition detected. Engine power will be derated.
P1285 (b), (c)	Fuel Injection Pump Controller Always On	Fuel injection pump module relay circuit failure detected. Engine power will be derated.
P1286 (c), (g)	Accelerator Position Sensor (APPS) Supply Voltage Too High	High voltage detected at APPS.
P1287 (c), (g)	Fuel Injection Pump Controller Supply Voltage Low	ECM or fuel injection pump module internal fault condition detected. Engine power will be derated.
P1291 (b)	No Temperature Rise Seen From Intake Air Heaters	Problem detected in intake manifold air heating system.
P1295 (c), (g)	Accelerator Position Sensor (APPS) Supply Voltage Too Low	APPS supply voltage input below the minimum acceptable voltage.
P1388 (g)	Auto Shutdown Relay Control Circuit	An open or shorted condition detected in the auto shutdown relay circuit.
P1389 (g)	No ASD Relay Output Voltage at PCM	An open condition detected In the ASD relay output circuit.
P1399 (g)	Wait To Start Lamp Circuit	Problem detected in wait-to-start lamp circuit
P01475 (g)	Aux 5 Volt Supply Voltage High	Sensor supply voltage for ECM sensors is too high.
P1488 (g)	5 Volt Supply Voltage Low	Sensor supply voltage for ECM sensors is too low.
P1492 (b), (d)	Ambient/Batt Temp Sensor Volts Too High	Battery temperature sensor input voltage above an acceptable range.
P1493 (b), (d)	Ambient/Batt Temp Sen Volts Too Low	Battery temperature sensor input voltage below an acceptable range.
P1594 (g)	Charging System Voltage Too High	Battery voltage sense input above target charging voltage during engine operation.
P1595 (g)	Speed Control Solenoid Circuits	An open or shorted condition detected in the speed control vacuum or vent solenoid circuits.
P1597 (g)	Speed Control Switch Always Low	Speed control switch input below the minimum acceptable voltage.
P1598 (g)	A/C Sensor Input Hi	Problem detected in air conditioning electrical circuit.
P1599 (g)	A/C Sensor Input Lo	Problem detected in air conditioning electrical circuit.
P1682 (d), (g)	Charging System Voltage Too Low	Charging system output voltage low.

AUTHENTIC RESTORATION

DESCRIPTION AND OPERATION (Continued)

Generic Scan Tool P-Code	DRB Scan Tool Display	Description of Diagnostic Trouble Code
P1683 (g)	Spd ctrl pwr rly, or s/c 12v driver circuit	An open or shorted condition detected in the speed control servo power control circuit.
P1688 (a), (c)	Internal Fuel Injection Pump Controller Failure	Internal problem within the fuel injection pump. Low power, engine derated, or engine stops.
P1689 (a), (c)	No Communication Between ECM and Injection Pump Module	Data link circuit failure between ECM and fuel injection pump. Low power, engine derated, or engine stops.
P1690 (b), (c)	Fuel Injection Pump CKP Sensor Does Not Agree With ECM CKP Sensor	Problem in fuel sync signal. Possible injection pump timing problem. Low power, engine derated, or engine stops.
P1691 (c), (g)	Fuel Injection Pump Controller Calibration Error	Internal fuel injection pump failure. Low power, engine derated, or engine stops.
P1692 (e), (g)	DTC Set In ECM	A "Companion DTC" was set in both the ECM and PCM.
P1693 (e), (g)	DTC Detected in PCM/ECM or DTC Detected in ECM	A "Companion DTC" was set in both the ECM and PCM.
P1694 (b), (e)	No CCD Messages received from ECM	Bus communication failure to PCM.
P1698 (e), (g)	No CCD Messages received from PCM	Bus communication failure to PCM. A "Companion DTC" was set in both the ECM and PCM.
P1740 (b)	TCC OR O/D Solenoid Performance	Problem detected in transmission convertor clutch and/or overdrive circuits (diesel engine with 4-speed auto. trans. only).
P1756 (b)	Governor Pressure Not Equal to Target @ 15-20 PSI	Governor sensor input not between 10 and 25 psi when requested (4-speed auto. trans. only).
P1757 (b)	Governor Pressure Above 3 PSI In Gear With 0 MPH	Governor pressure greater than 3 psi when requested to be 0 psi (4-speed auto. trans. only).
P1762 (b)	Governor Press Sen Offset Volts Too Low or High	Sensor input greater or less than calibration for 3 consecutive Neutral/Park occurrences (4-speed auto. trans. only).
P1763 (b)	Governor Pressure Sensor Volts Too HI	Voltage greater than 4.89 volts (4-speed auto. trans. only).
P1764 (b)	Governor Pressure Sensor Volts Too Low	Voltage less than .10 volts (4-speed auto. trans. only).
P1765 (b)	Trans 12 Volt Supply Relay Ctrl Circuit	Current state of solenoid output port is different than expected (4-speed auto. trans. only).
P1899 (b)	P/N Switch Stuck in Park or in Gear	Incorrect input state detected for the Park/Neutral switch (3 or 4-speed auto. trans. only).

COMPONENT MONITORS

There are several electrical components that will affect vehicle emissions if they malfunction. If one of these components is malfunctioning, a Diagnostic Trouble Code (DTC) will be set by either the Powertrain Control Module (PCM) or the Engine Control Module (ECM). The Malfunction Indicator Lamp (MIL) will then be illuminated when the engine is running (the MIL is displayed on the instrument panel as the CHECK ENGINE lamp).

These electrically operated components have input (rationality) and output (functionality) checks. A check is done by one or more components to check the operation of another component.

Example: The Intake Manifold Air Temperature (IAT) sensor is used to monitor intake manifold air temperature over a period of time after a cold start. If the temperature has not risen to a certain specification during a specified time, a Diagnostic Trouble Code (DTC) will be set for a problem in the manifold air heater system.

All open/short circuit checks, or any component that has an associated limp-in will set a DTC and trigger the MIL after 1 trip with the malfunction present. Components without an associated limp-in will take two trips to illuminate the MIL.

NON-MONITORED CIRCUITS

The PCM and/or the ECM will not monitor certain malfunctioning circuits or components that could cause driveability problems. Also, a Diagnostic Trouble Code (DTC) might not be stored for these malfunctions. However, problems with these circuits or components may cause the PCM/ECM to store DTC's for other circuits or components.**EXAMPLES:** A cylinder with low compression will not set a DTC directly, but may cause an engine misfire. This in turn may cause the ECM to set a DTC for an engine misfire. Or, a dirty or plugged air filter will not set a DTC directly, but may cause lack of turbocharger boost. This in turn may cause the ECM to set a DTC for a boost pressure malfunction.

FUEL PRESSURE

Primary fuel pressure from the fuel tank to the fuel injection pump is supplied by the low-pressure fuel transfer pump. High-pressure to the fuel injectors is supplied by the fuel injection pump. The ECM cannot detect actual fuel pressure, a clogged fuel filter, clogged fuel screen, or a pinched fuel supply or return line. However, a DTC may be set due to an engine misfire.

CYLINDER COMPRESSION

The ECM cannot detect uneven, low, or high engine cylinder compression. However, these could result in a possible misfire which may set a DTC.

EXHAUST SYSTEM

The ECM cannot detect a plugged, restricted or leaking exhaust system. However, DTC's may be set for engine misfire, high intake manifold temperature, high engine coolant temperature, turbocharger overboost or turbocharger underboost.

FUEL INJECTOR MECHANICAL MALFUNCTIONS

The ECM cannot determine if a fuel injector is clogged, the needle is sticking or if the wrong injector is installed. However, these could result in a possible misfire which may set a DTC.

EXCESSIVE OIL CONSUMPTION

The ECM cannot determine excessive oil consumption. However, if excess oil consumption is high enough, it could result in a possible engine misfire which may set a DTC.

AIR FLOW

The ECM cannot detect a clogged, restricted or dirty air filter element, or a restriction in the air inlet system. However, these could result in a possible misfire which may set a DTC.

AIR PRESSURE LEAKS

The ECM cannot detect leaks or restrictions in the air intake system. However, these could cause the ECM to store a Manifold Air Pressure (MAP) sensor DTC (boost pressure problem detected).

PCM/ECM SYSTEM GROUNDS

The PCM/ECM cannot directly determine poor system grounds. However, one or more DTC's may be generated as a result of poor grounds.

PCM/ECM CONNECTOR ENGAGEMENT

The PCM/ECM may not be able to determine spread, damaged or corroded connector pins. However, it might store DTC's as a result of spread connector pins (circuits that are open).

HIGH AND LOW LIMITS

Both the Powertrain Control Module (PCM) and the Engine Control Module (ECM) compare input signal voltages from each input device with established high and low limits for the device. If the input voltage is not within limits, and other criteria are met, the PCM/ECM will store a Diagnostic Trouble Code (DTC) in memory. Other DTC criteria might include engine RPM limits, or input voltages from other sensors or switches that must be present before verifying a DTC condition.

ROLLOVER VALVE

One rollover valve is used. The valve is used only to vent the fuel tank to the atmosphere. A check valve is located within the rollover valve to prevent fuel flow from fuel tank in the event of an accidental vehicle rollover. The rollover valve is located on top of the fuel tank module (Fig. 4). The valve may be serviced separately. If replacement is necessary, refer to Rollover Valve Removal/Installation.

REMOVAL AND INSTALLATION

ROLLOVER VALVE

REMOVAL

One rollover valve is used. The valve is located on top of fuel tank module (Fig. 4) and may be serviced separately.

(1) Disconnect both negative battery cables at both batteries.

(2) Remove fuel filler cap and drain fuel tank. Refer to Fuel Tank Removal/Installation in Group 14, Fuel System.

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REMOVAL AND INSTALLATION (Continued)

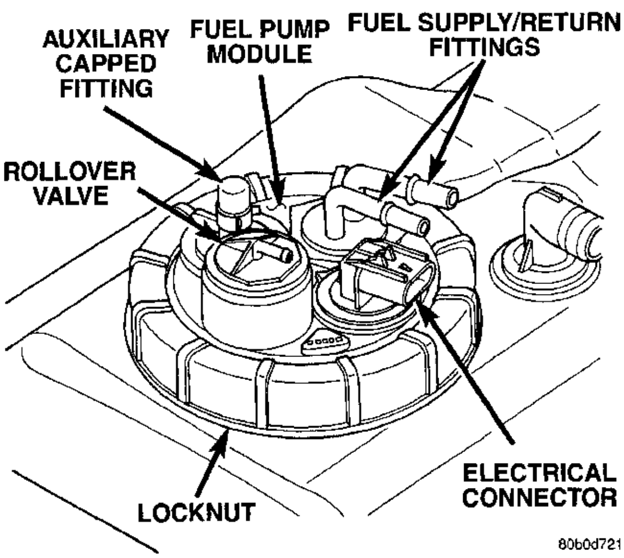

Fig. 4 Rollover Valve Location—Diesel Powered

(3) Remove fuel tank. Refer to Fuel Tank Removal/ Installation in Group 14, Fuel System.

(4) The rollover valve is seated into a rubber grommet. Remove valve by prying one side upward and then roll valve out of grommet.

(5) Discard old grommet.

INSTALLATION

(1) Install new grommet into fuel tank module.

(2) Using finger pressure only, press valve into place.

(3) Install fuel tank. Refer to Fuel Tank Removal/ Installation.

(4) Fill fuel tank. Install fuel tank filler cap.

(5) Connect both negative battery cables.

(6) Start vehicle and check for leaks.

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Description	Group-Page

AUTHENTIC RESTORATION PRODUCT

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SERVICE MANUAL COMMENTS

What features do you find most useful?____________________

What errors have you found? Please include page number. ____________________

What topics are hard to locate, confusing, or not covered completely?____________________

What comments or suggestions do you have?____________________

Your Name: ____________________ Dealership: ____________________

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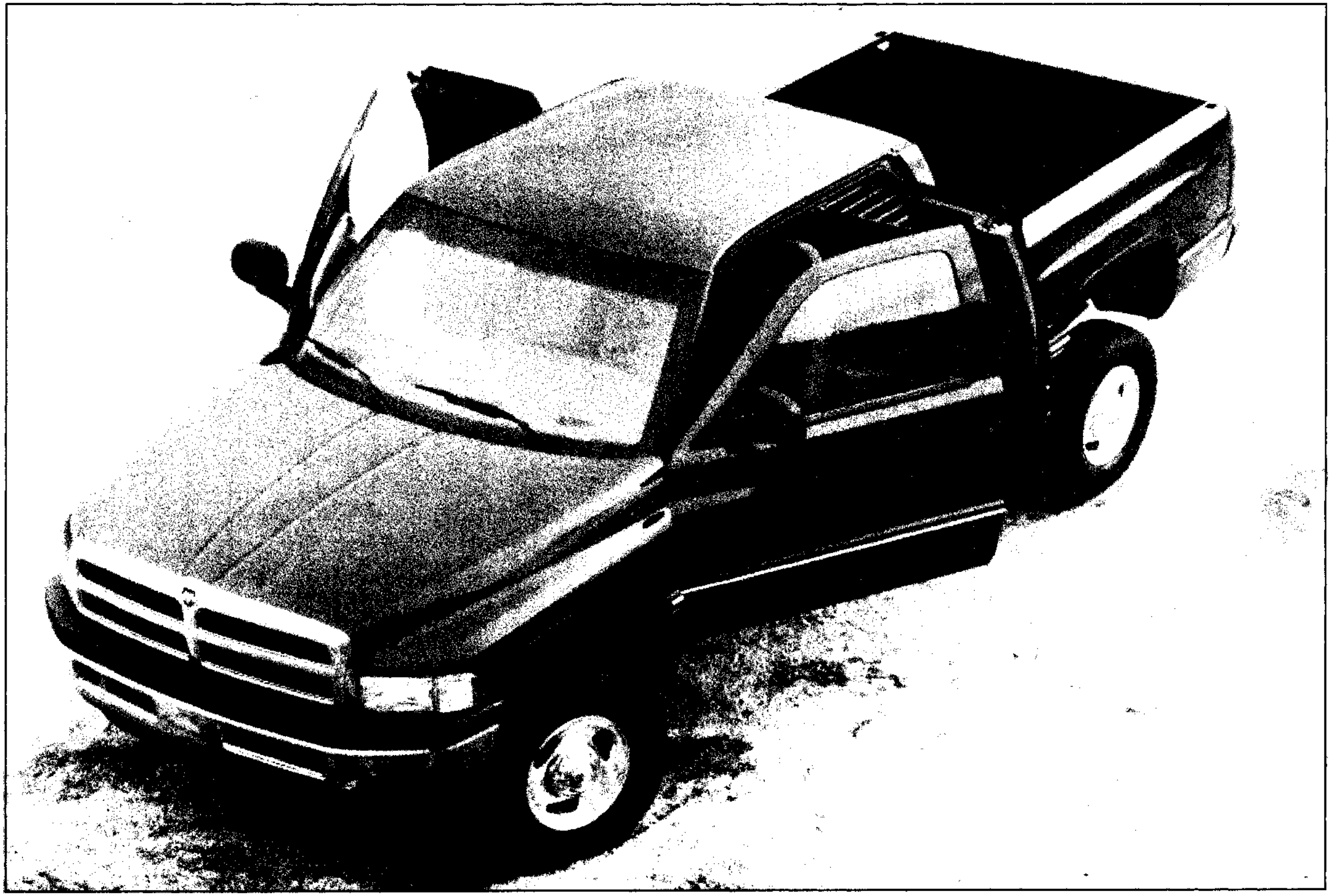
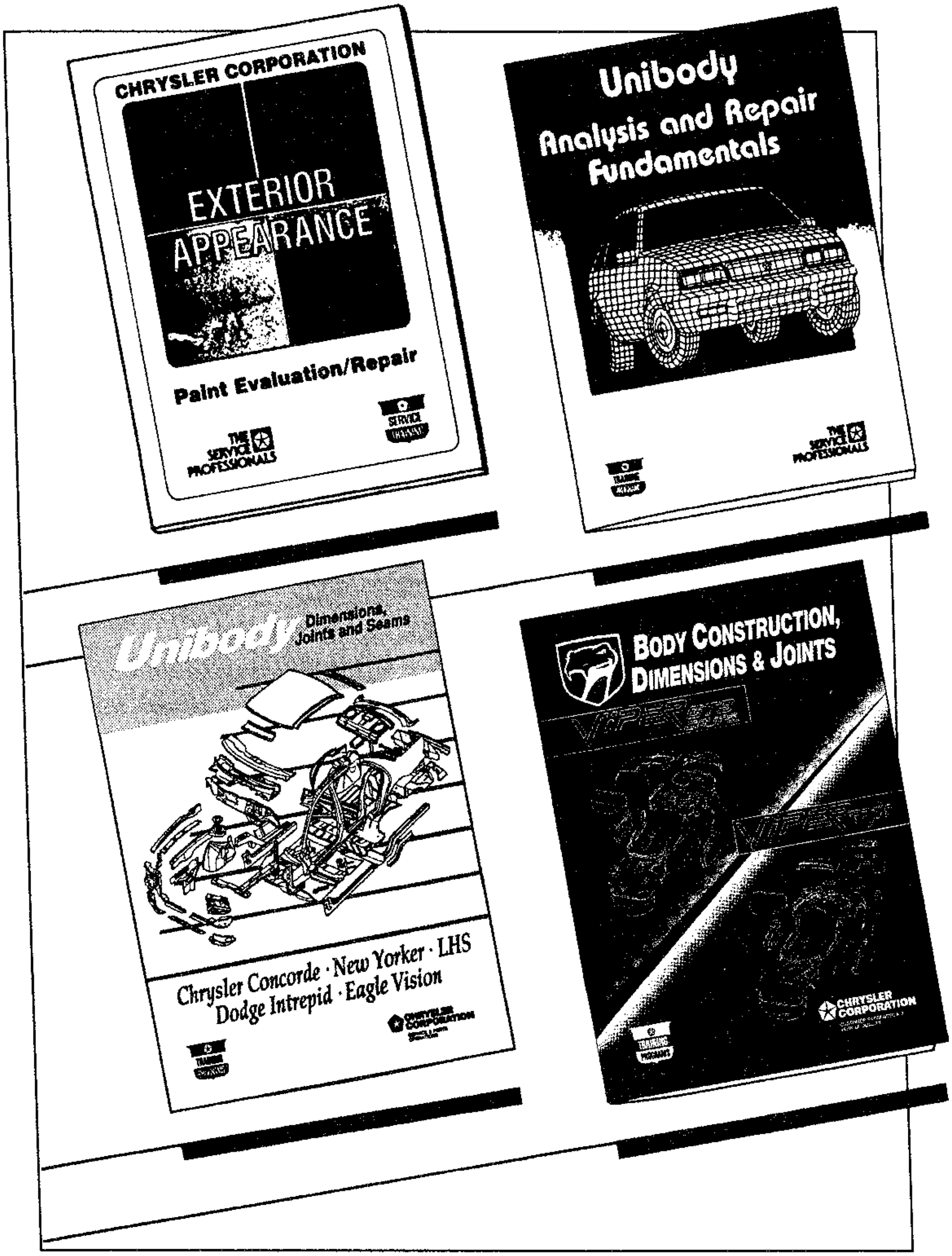


Dodge Ram Quad Cab Pickup

TECHNICAL PUBLICATIONS



For more information about Body and Paint repair,

Look for Ordering Information on Page 122

Navigation Tools: Click on the "Table of Contents" below, or use the Bookmarks to the left.

INTRODUCTION

Dodge Ram Pickup

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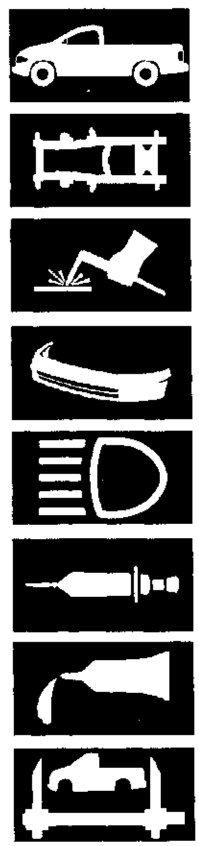
This manual has been prepared for use by all body technicians involved ı the repair of the new Dodge Dakota Pickup.

his manual shows:

- **Typical body panels contained in the new Dodge Ram Pickup**
- **The weld locations for these panels**
- **The types of welds for the panels**
- **Proper sealer types and correct locations**



Chrysler Corporation reserves the right to make improvements in design or to change specifications to these vehicles without incurring any obligation upon itself.

Notes

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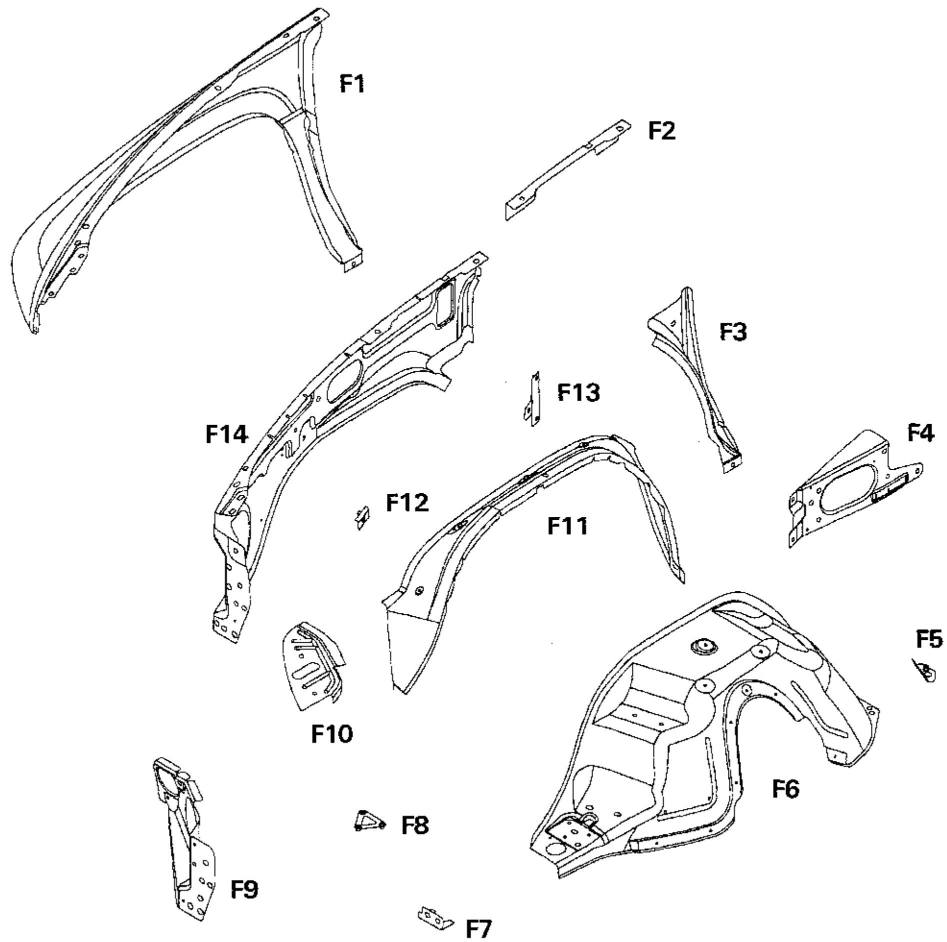
BODY CONSTRUCTION CHARACTERISTICS

Dodge Ram Pickup

FRONT FENDER COMPONENTS

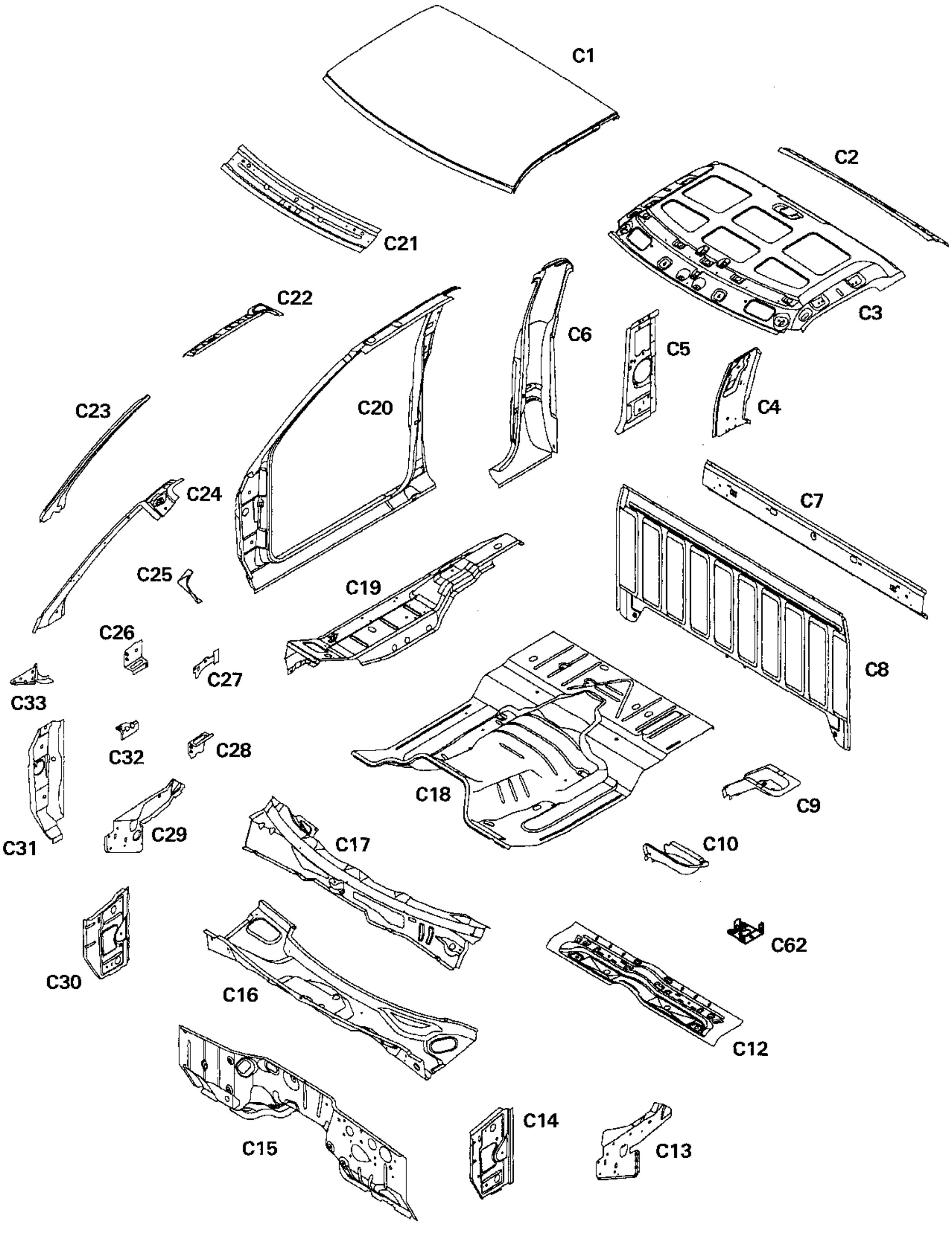


Body Panels Illustrated:

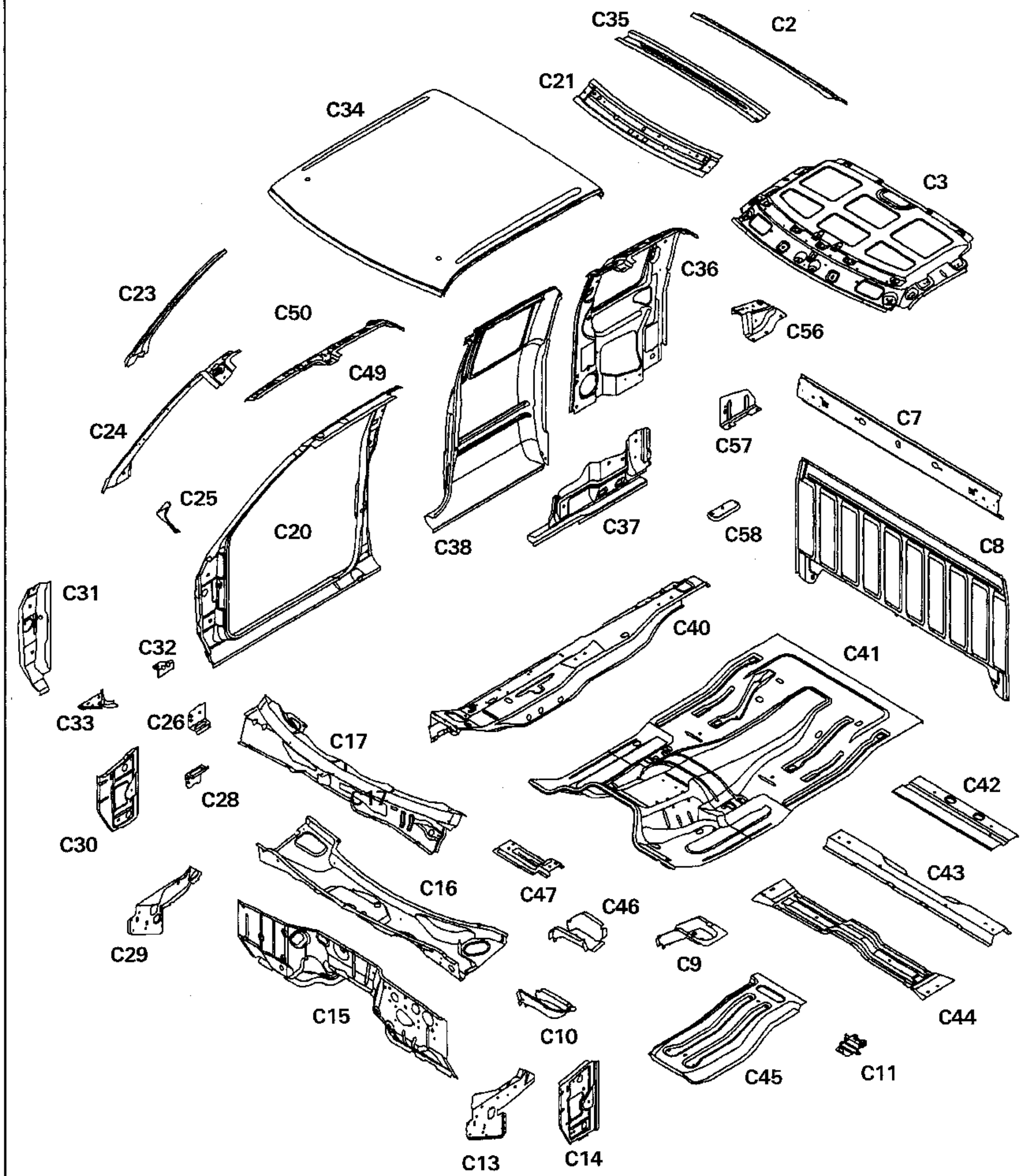
F1 Outer Fender Panel
F2 Upper Fender Reinforcement
F3 Fender Aperture Reinforcement
F4 Front Fender Reinforcement
F5 Inner Wheelhouse to Floor Reinforcement
F6 Inner Front Wheelhouse Panel
F7 Inner Fender to Wheelhouse Reinforcement
F8 Horn Tapping Plate
F9 Lower Headlamp Mounting Panel
F10 Upper Headlamp Mounting Panel
F11 Outer Front Wheelhouse Panel
F12 Inner Fender to Battery Tray Reinforcement
F13 Inner Fender Tapping Plate
F14 Inner Fender Panel

F2-F5, F7-F14: Not serviced separately

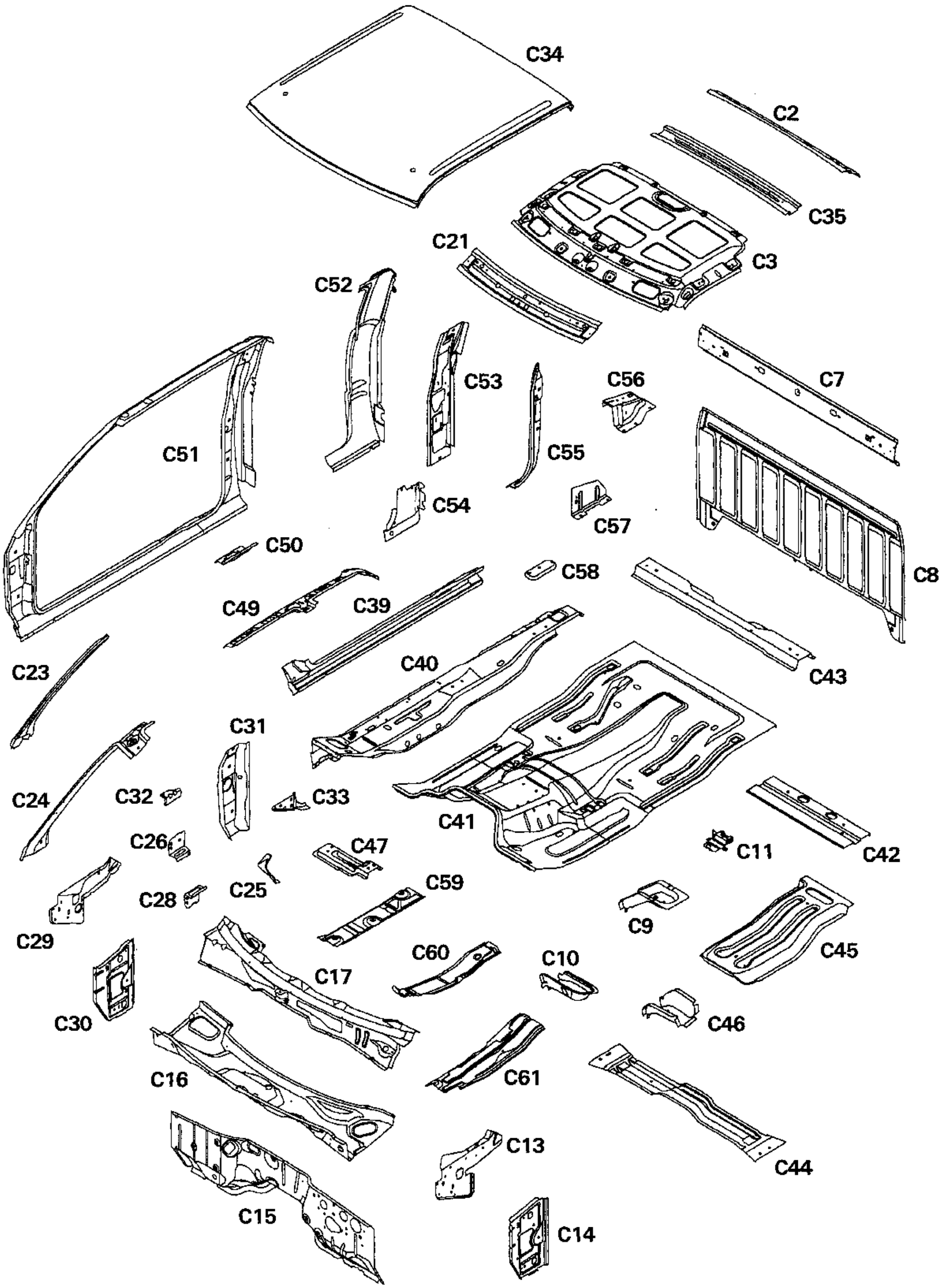
CAB COMPONENTS (REGULAR CAB)



CAB COMPONENTS (CLUB CAB)



CAB COMPONENTS (QUAD CAB)

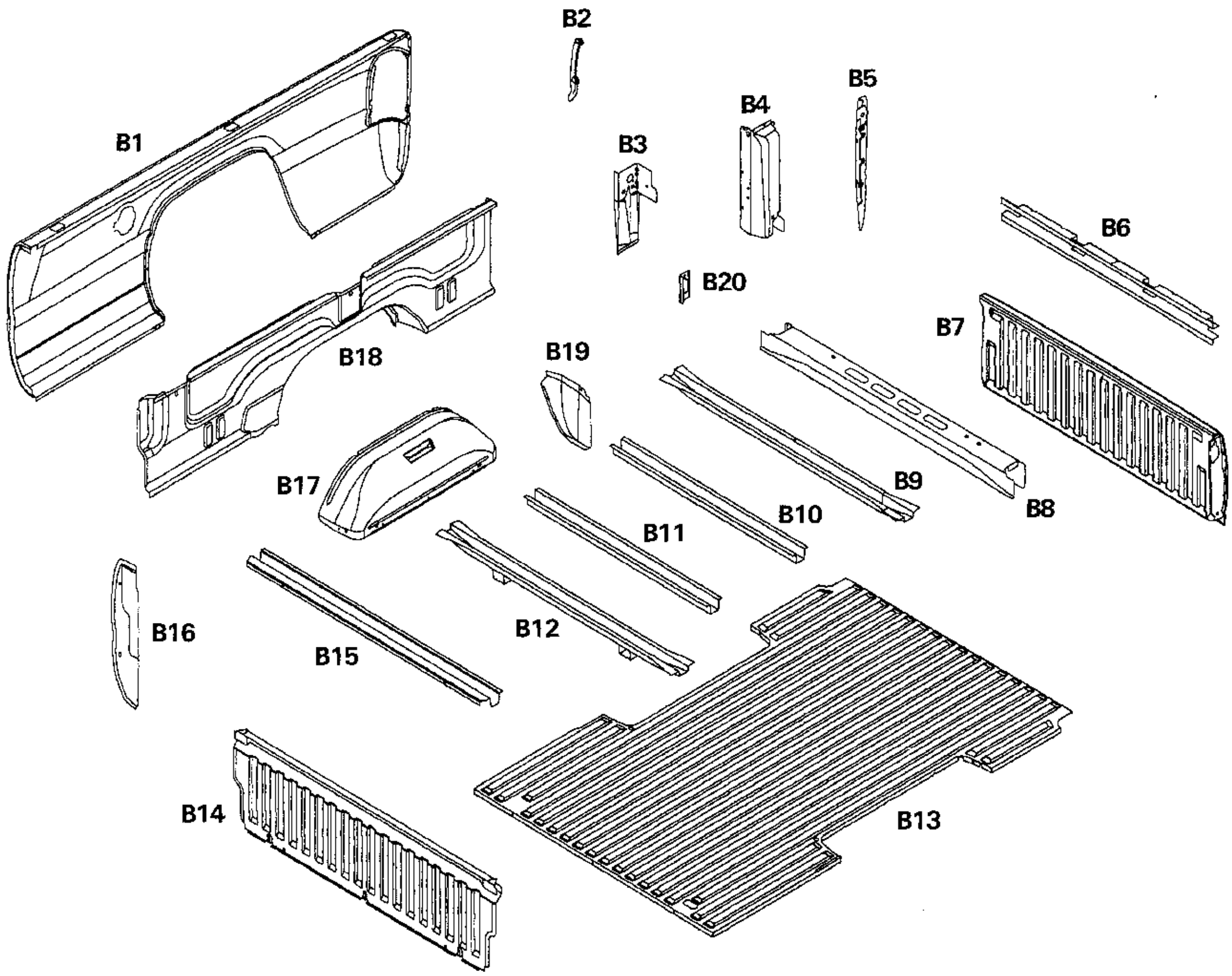


BODY PANELS ILLUSTRATED:

C

1 Roof Outer Panel (Regular Cab)
2 Rear Header Panel
3 Roof Inner Panel
4 Rear Quarter Inner Upper Panel (Regular Cab)
5 Rear Quarter Inner Lower Panel (Regular Cab)
6 Rear Quarter Outer Panel (Regular Cab)
7 Cab Back Reinforcement
8 Cab Back Panel
9 Rear Body Hold-Down Support
10 Front Body Hold-Down Support
11 Jack Stowage Bracket (Club and Quad Cab)
12 Seatbelt Anchor Reinforcement
13 Plenum End Panel, Left Side
14 Cowl Side Panel, Left Side
15 Dash Panel
16 Plenum Lower Panel
17 Cowl Bar Panel
18 Center Floor Pan (Regular Cab)
19 Outer Floor Pan (Regular Cab)
20 Body Side Aperture (Regular and Club Cab)
21 Front Header Panel
22 Roof Side Inner Rail
23 Windshield Side Opening Frame Reinforcement
24 Windshield Side Opening Frame
25 Cowl to Pillar Inner Reinforcement
26 Body Side Hinge Pillar Upper Tapping Plate
27 Retractor Mounting Reinforcement
28 Body Side Hinge Pillar Lower Tapping Plate
29 Plenum End Panel, Right Side
30 Cowl Side Panel, Right Side
31 Body Side Hinge Pillar Reinforcement
32 Aperture to Fender Bracket
33 Cowl Side to Floor Reinforcement
34 Roof Outer Panel (Club and Quad Cab)
35 Roof Bow
36 Rear Quarter Inner Upper Panel
37 Rear Quarter Inner Lower Panel
38 Rear Quarter Outer Panel
39 Sill Reinforcement
40 Outer Floor Pan (Club and Quad Cab)
41 Center Floor Pan (Club and Quad Cab)
42 Rear Seatbelt Anchor Reinforcement
43 Rear Floor Crossmember
44 Front Seat Mounting Rear Crossmember
45 Center Floor Reinforcement
46 Mid Body Hold-Down Support
47 Front Seat Mounting Front Support
48 Body Side Hinge Pillar Reinforcement
49 Half-Door Inner Rail
50 Inner Roof Rail Reinforcement
51 Half-Door Body Side Aperture
52 Quarter Outer Panel (Quad Cab)
53 Quarter Inner Upper Panel (Quad Cab)
54 Quarter Inner Lower Panel (Quad Cab)
55 Quarter Outer Filler Panel
56 Rear Seat to Floor Support
57 Seat Support Reinforcement
58 Front Seat Mounting Rear Support
59 Lower Hear Shield
60 Upper Heat Shield, Left Side
61 Upper Heat Shield, Right Side
62 Jack Stowage Bracket (Regular Cab)

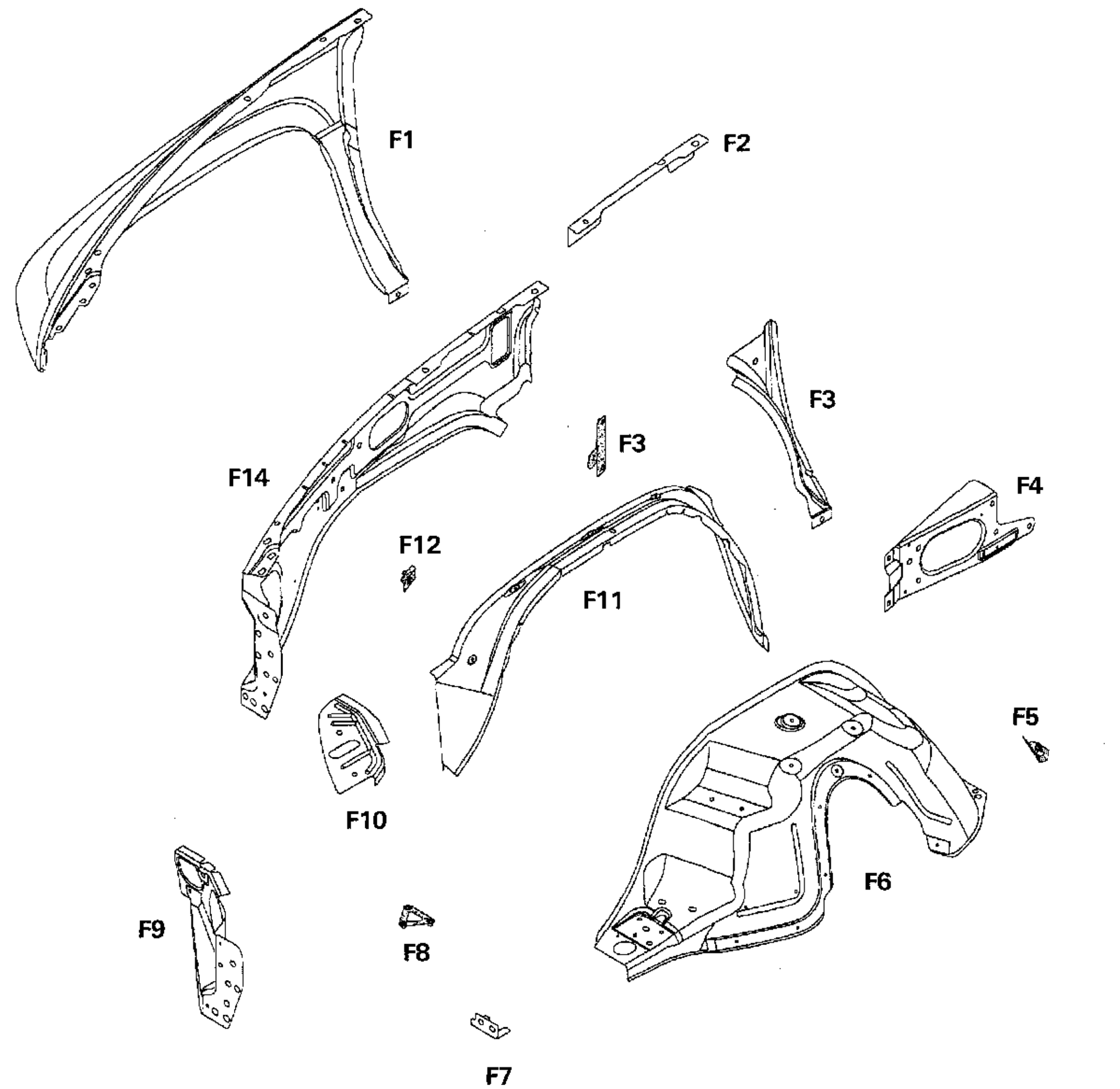
CARGO BOX COMPONENTS



Cargo Box:

B1	Box, Side Outer Panel
B2	Taillamp Mounting Bracket
B3	Rear Corner to Rear Sill Gusset
B4	Outer Rear Corner Reinforcement
B5	Box, Side Rear Reinforcement
B6	Tailgate Center Reinforcement
B7	Tailgate Panel
B8	Box, Rear Crossmember
B9	Box, Crossmember
B10	Box, Center Crossmember
B11	Box, Center Crossmember
B12	Box, Crossmember (8 foot only)
B13	Box, Floor Panel
B14	Box, Front Center Panel
B15	Box, Front Crossmember
B16	Box, Side Front Panel
B17	Rear Wheelhouse Inner Panel
B18	Box, Side Inner Panel
B19	Box, Side Wheelhouse Outer Extension
B20	Tailgate Hinge Reinforcement

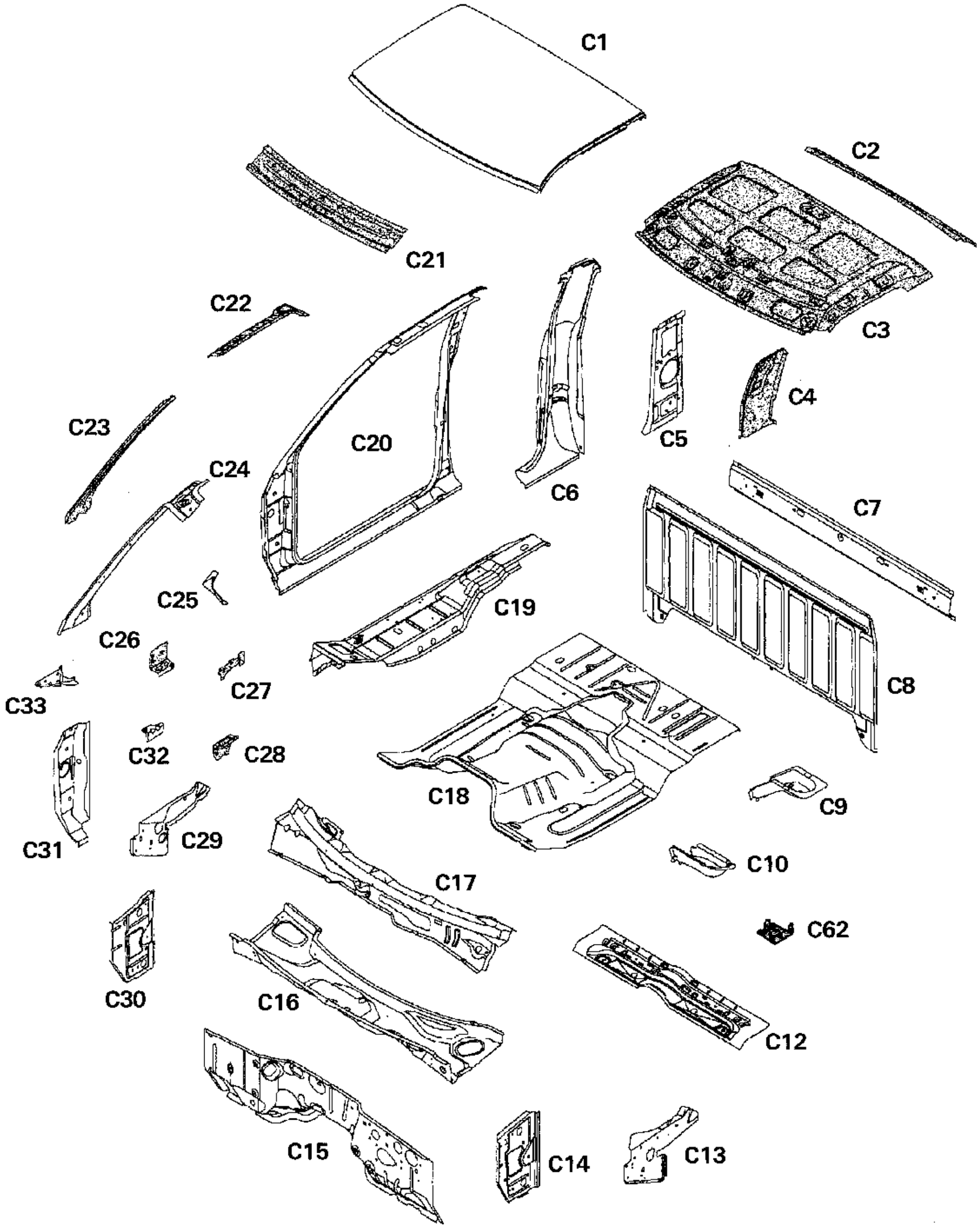
CORROSION PROTECTION (FRONT FENDER)



GALVANNEALED

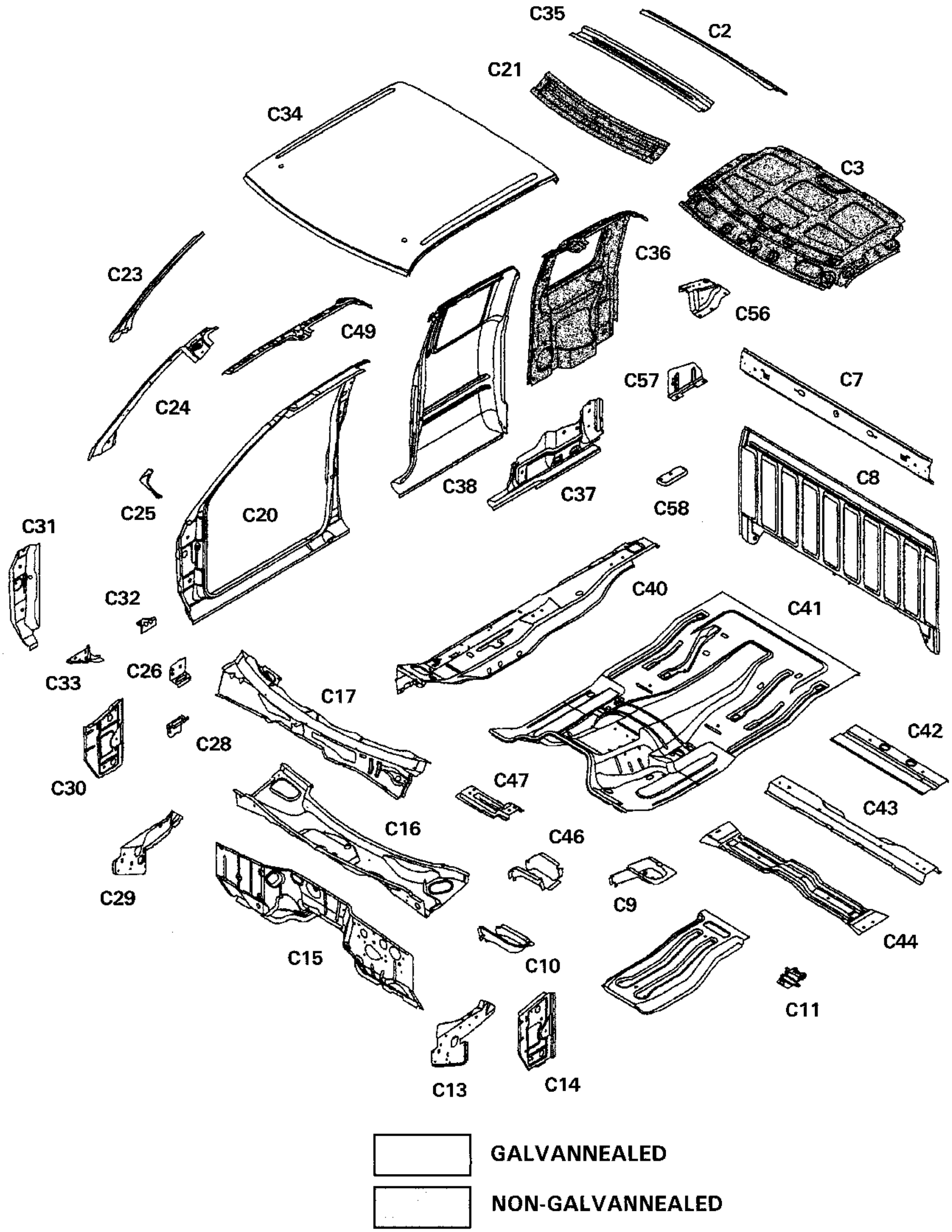
NON-GALVANNEALED

CORROSION PROTECTION (REGULAR CAB)

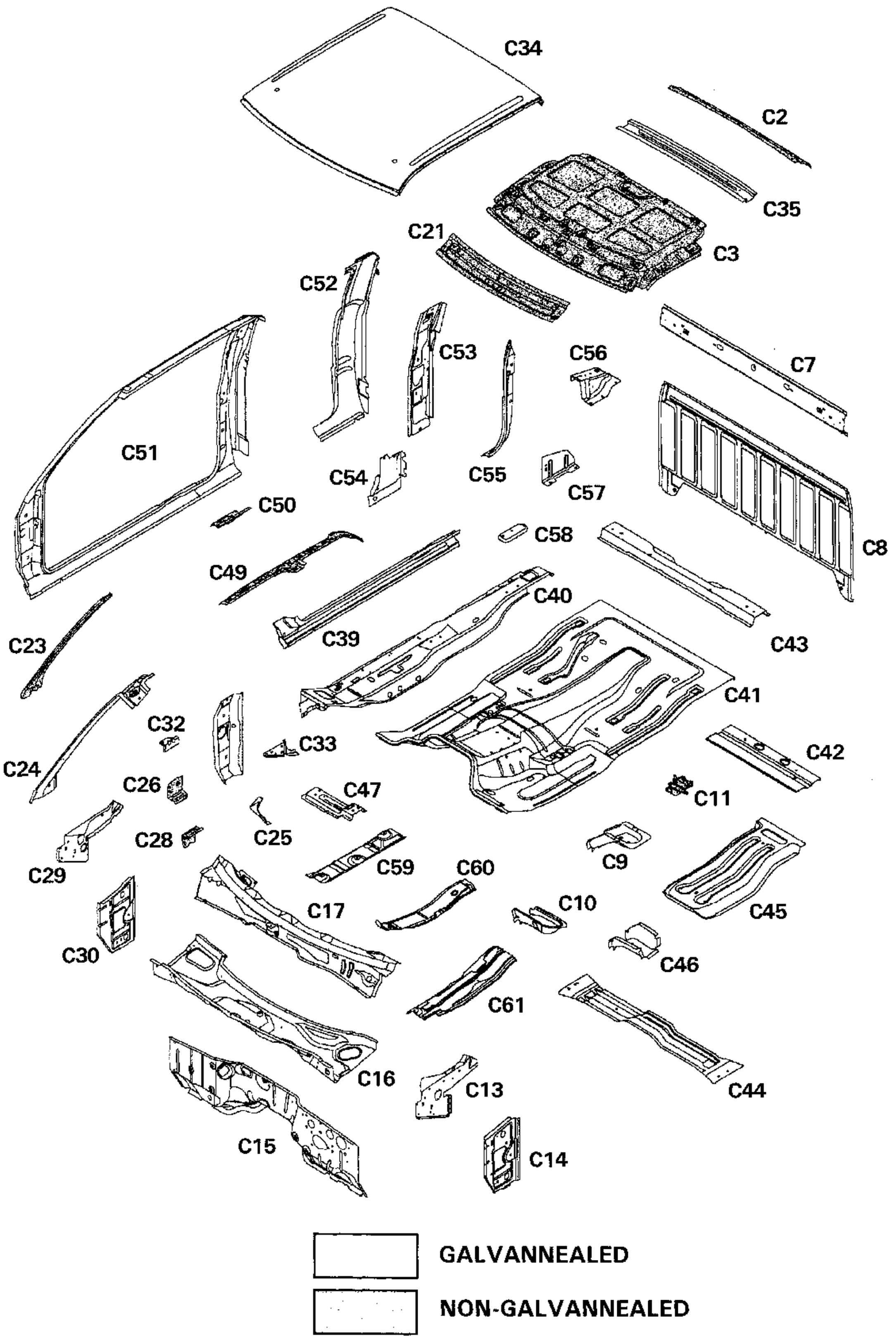


☐	GALVANNEALED
☐	NON-GALVANNEALED

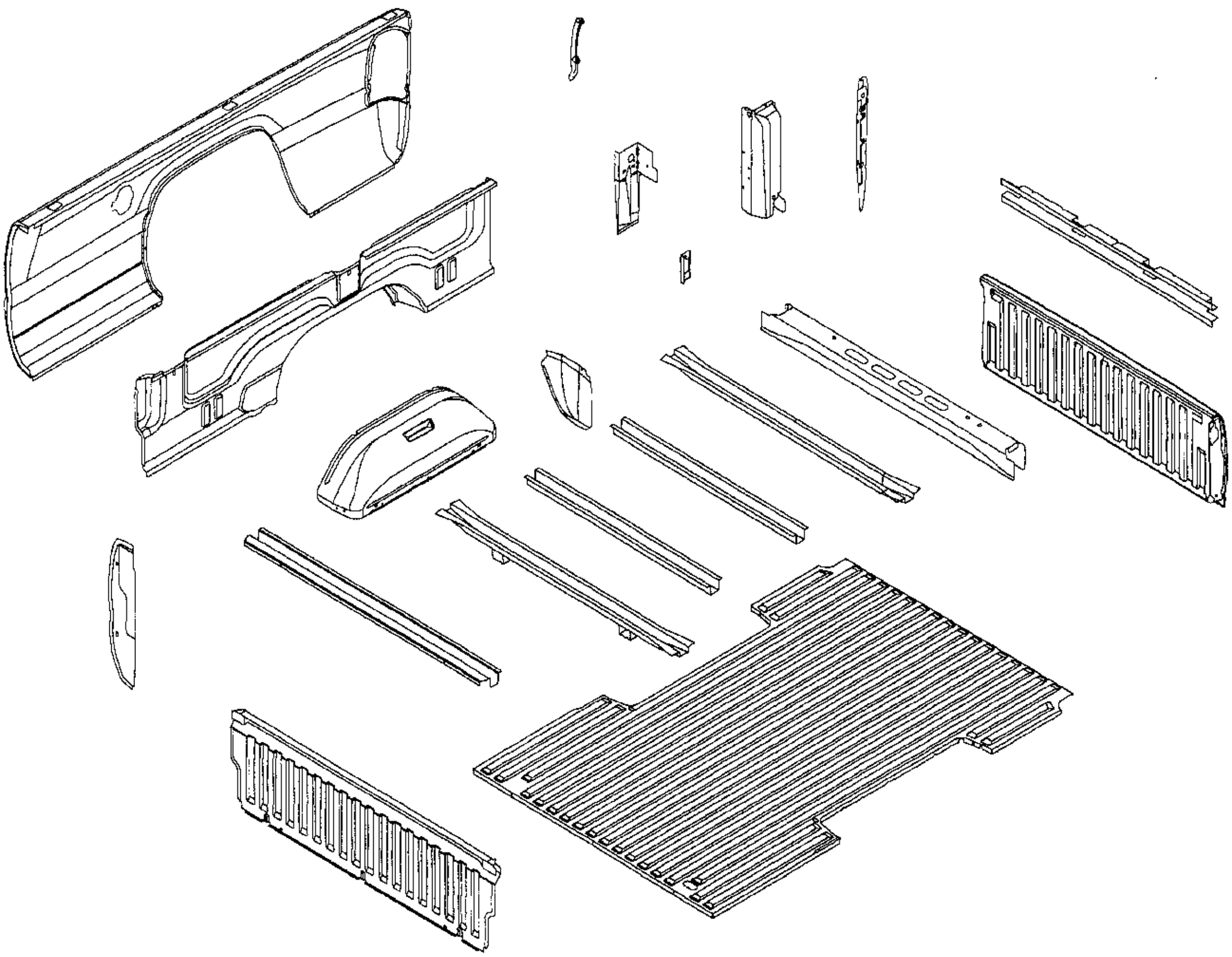
CORROSION PROTECTION (CLUB CAB)



CORROSION PROTECTION (QUAD CAB)



CORROSION PROTECTION (CARGO BOX)



	GALVANNEALED
	NON-GALVANNEALED

The following measures have been implemented in order to provide maximum corrosion prevention and protection.

1. The use of galvannealed coatings throughout the body structure.
2. Cationic electrode position undercoating is used on the complete body in all instances.
3. Body sealing.
4. Stone-chipping resistant primer application.
5. Underbody corrosion prevention.

Definitions of Steel used in the Dodge Ram Pickup:

MS 66- Represents an uncoated cold-rolled structural steel used mainly for interior braces and reinforcements.

MS 67- Represents an uncoated structural steel used in areas where structural integrity is critical. Eg., the type of steel used for the "A" pillar.

MS 264-050-XK- Represents an uncoated high strength steel used in applications where structural integity is critical.

Two-Sided Galvannealed MS 6000-44A- Represents a two-sided zinc coated steel in which the coating is fully alloyed with the sheet or strip surface.

Two-Sided Galvannealed MS 6000-44VA- Represents a two-sided zinc-iron coated high strength steel in which the coating is fully alloyed with the sheet or strip surface.

PARTIAL LIST OF GALVANNEALED PANELS

Front Wheelhouse Inner Panel

Inner Fender Panel

Cowl Bar Panel

Hinge Pillar Reinforcement

Windshield Side Opening

Front Header

Roof Panel

Outer Box Side Panel

Inner Box Side Panel

Box Front Center Panel

Box Front End Panel

Rear Wheelhouse Inner Panel

Tailgate Panel

Box Floor Crossmembers

Box Floor Panel

Center Floor Pan

Outer Floor Pan

Seat Belt Anchor and Reinforcement

Cowl Side Panel

Plenum End Panel

Plenum Lower Panel

Cowl Bar Panel

Lower Plenum Panel

Dash Panel

Body Side Aperture

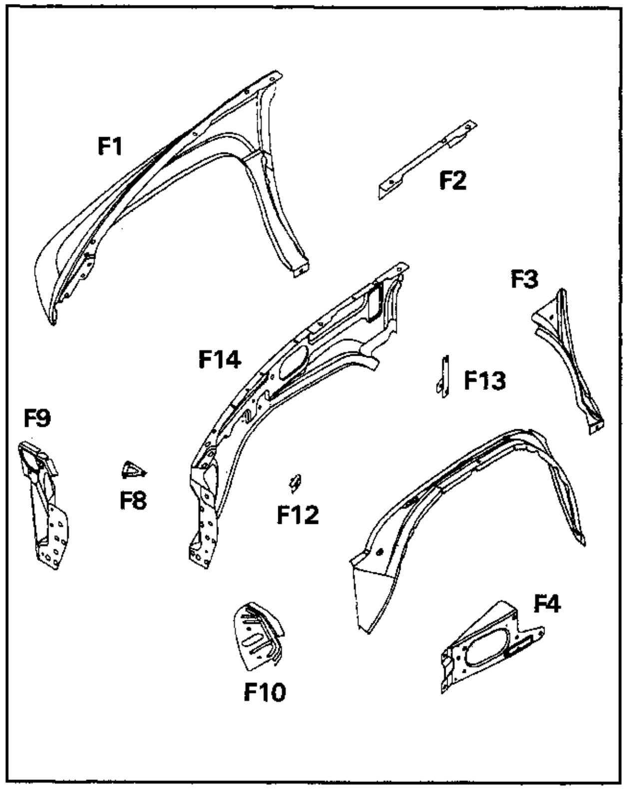
Inner Rear Quarter Panel

Outer Rear Quarter Panel

FRONT OUTER FENDER

The outer fender assembly is made up of several components, none of which are serviced separately. The outer fender is serviced as a complete assembly only.

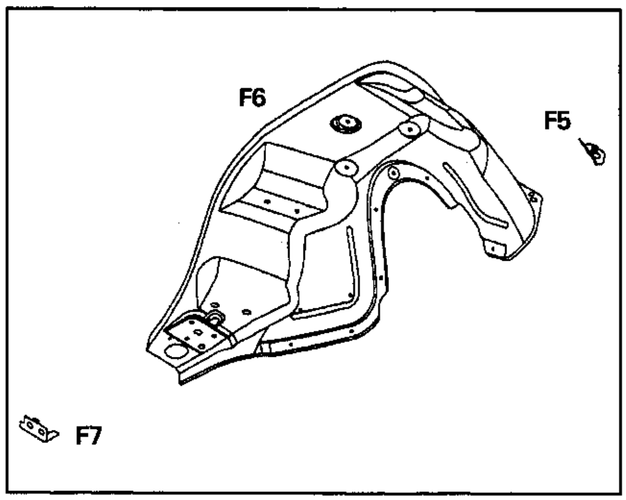
1. Outer fender panel (F1).
2. Upper fender reinforcement (F2).
3. Fender aperture reinforcement (F3).
4. Front fender reinforcement (F4).
5. Horn sensor tapping plate (F8).
6. Lower headlamp mounting panel (F9).
7. Upper headlamp mounting panel (F10).
8. Outer front wheelhouse panel (F11).
9. Inner fender to battery tray reinforcement (F12).
10. Inner fender tapping plate (F13).
11. Inner fender panel (F14).



FRONT INNER FENDER

The inner wheelhouse assembly is serviced separately from the fender assembly. The assemblies are welded together to form part of the front body.

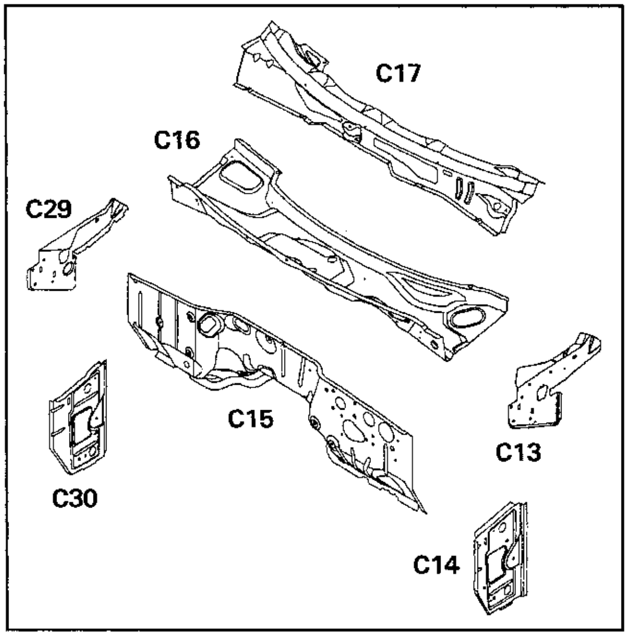
1. Inner wheelhouse to floor reinforcement (F5).
2. Inner front wheelhouse panel (F6).
3. Inner fender to wheelhouse reinforcement (F7).



COWL AND DASH

The right and left cowl side panels, plenum end panels, cowl bar, plenum lower panel and dash panel make up the cowl assembly. All panels are serviced separately.

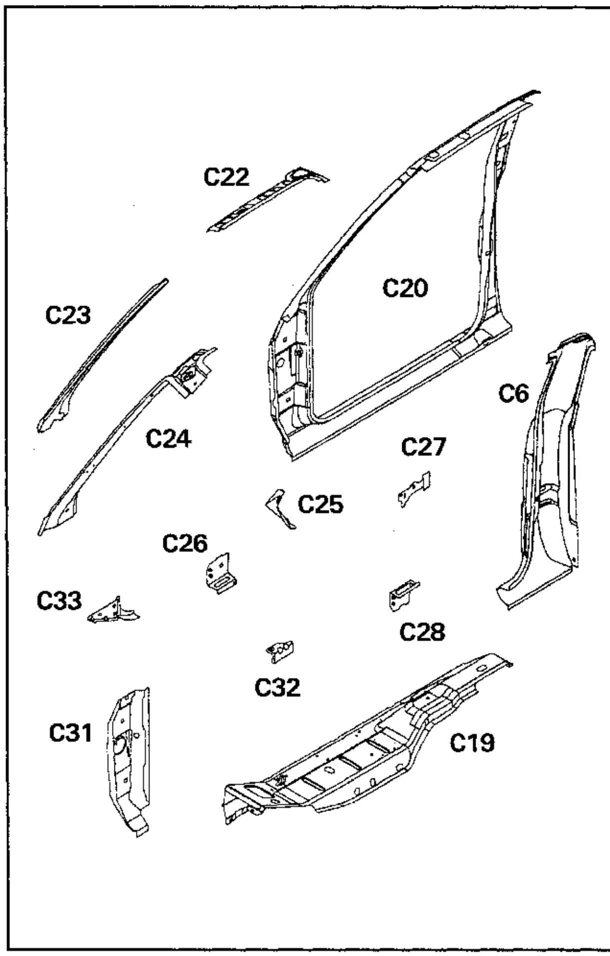
1. Plenum end panel, left side (C13).
2. Cowl side panel, left side (C14).
3. Dash panel (C15).
4. Plenum lower panel (C16).
5. Cowl bar panel (C17).
6. Plenum end panel, right side (C29).
7. Cowl side panel, right side (C30).



BODY SIDE APERTURE (REGULAR CAB)

The body side aperture is made up of several components layered and welded together. All components are serviced separately.

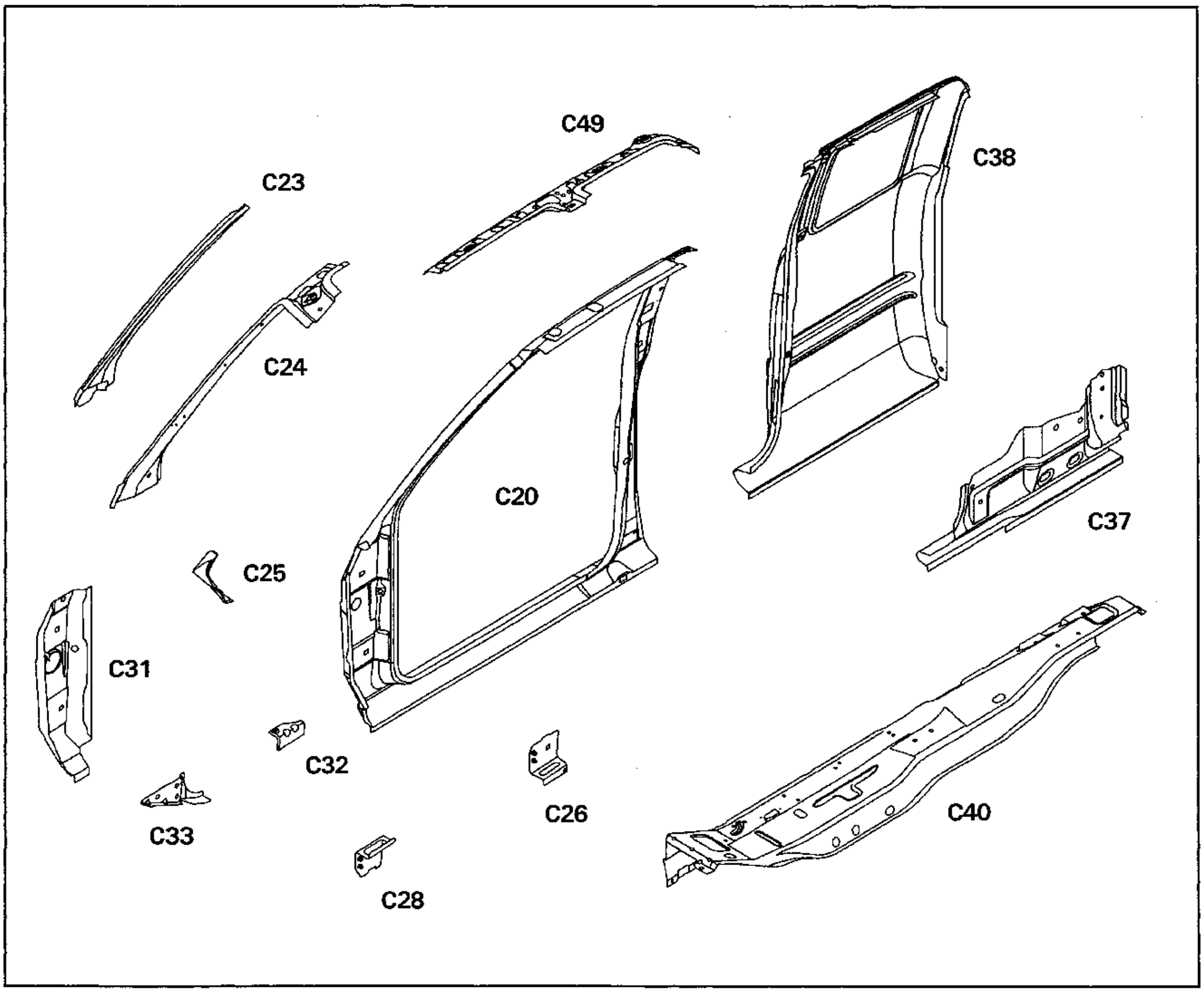
1. Rear quarter outer panel (C6).
2. Outer floor pan (C19).
3. Body side aperture (C20).
4. Roof side inner rail (C22).
5. Windshield side opening frame reinforcement (C23).
6. Windshield side opening frame (C24).
7. Cowl to pillar inner reinforcement (C25).
8. Body side hinge pillar upper tapping plate (C26).
9. Retractor mounting reinforcement (C27).
10. Body side hinge pillar lower tapping plate (C28).
11. Body side hinge pillar reinforcement(C31).
12. Aperture to fender bracket (C32).
13. Cowl side to fender reinforcement (C33).



BODY SIDE APERTURE (CLUB CAB)

All body side aperture is made up of several components layered and welded together. All panels are serviced separately.

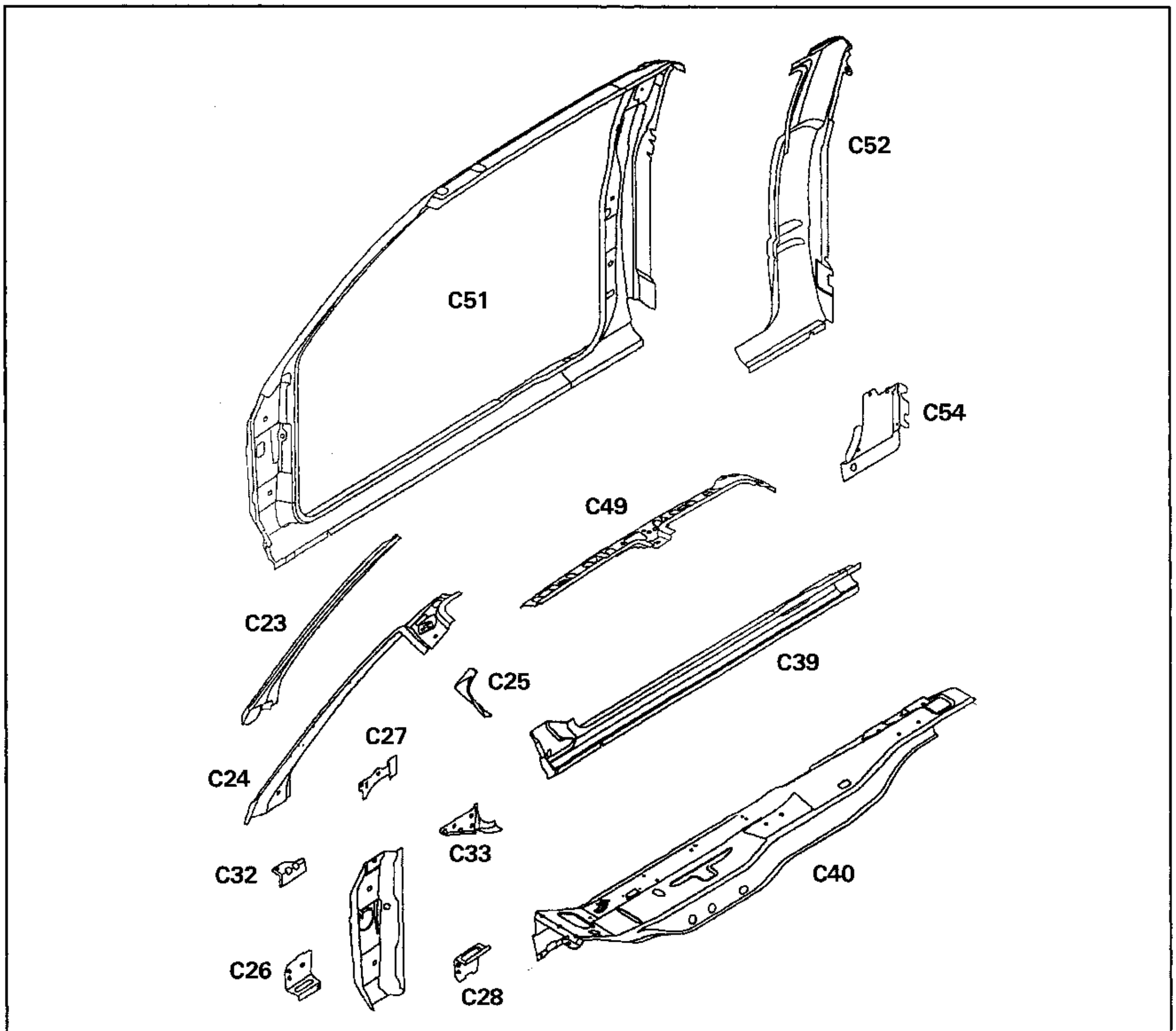
1. Body side aperture (C20).
2. Windshield side opening frame reinforcement (C23).
3. Windshield side opening frame (C24).
4. Cowl to pillar inner reinforcement (C25).
5. Body side hinge pillar lower tapping plate (C26).
6. Retractor mounting reinforcement (C27).
7. Body side hinge pillar lower tapping plate (C28)
8. Aperture to fender bracket (C32)
9. Cowl side to floor reinforcement (C33).
10. Rear quarter inner lower panel (C37).
11. Rear quarter outer panel (C38).
12. Sill reinforcement (C39).
13. Outer floor pan (C40).
14. Body side hinge pillar reinforcement (C48).
15. Half-door inner rail (C49).



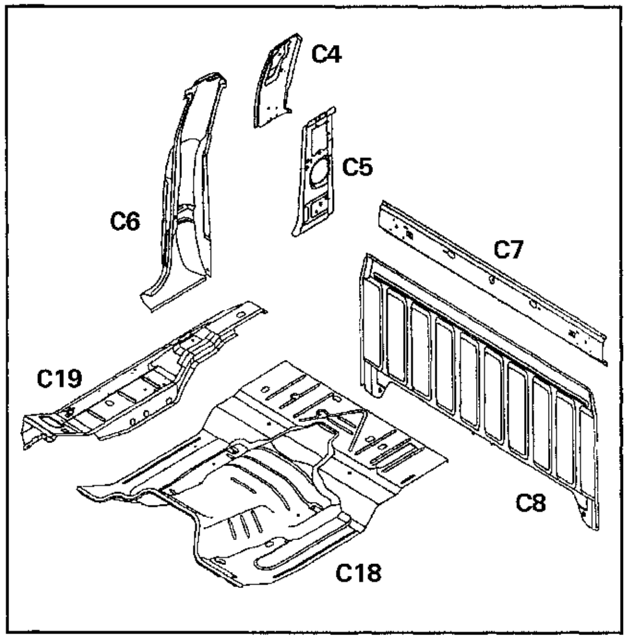
BODY SIDE APERTURE (QUAD CAB)

The body side aperture is made up of several components layered and welded together. All components are serviced separately.

1. Windshield side opening frame reinforcement (C23).
2. Windshield side opening frame (C24).
3. Cowl to pillar inner reinforcement (C25).
4. Body side hinge pillar upper tapping plate (C26).
5. Retractor mounting reinforcement (C27).
6. Body side hinge pillar lower tapping plate (C28)
7. Aperture to fender bracket (C32).
8. Cowl side to floor reinforcement (C33).
9. Sill reinforcement (C39).
10. Outer floor pan (C40).
11. Half-door inner rail (C49).
12. Half-door body side aperture (C51).
13. Quarter outer panel (C52).
14. Quarter inner panel (C54).



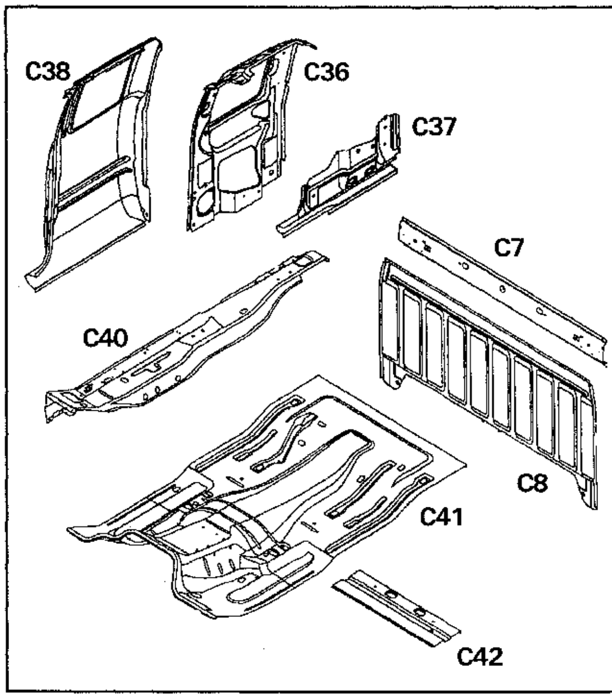
CAB BACK PANEL (REGULAR CAB)



The back panel and reinforcement panel are serviced separately. Both panels are welded in place.

1. Rear quarter inner upper panel (C4).
2. Rear quarter inner lower panel (C5).
3. Rear quarter outer panel (C6).
4. Cab back reinforcement (C7).
5. Cab back panel (C8).
6. Center floor pan (C18).
7. Outer floor pan (C19).

CAB BACK PANEL (CLUB CAB)



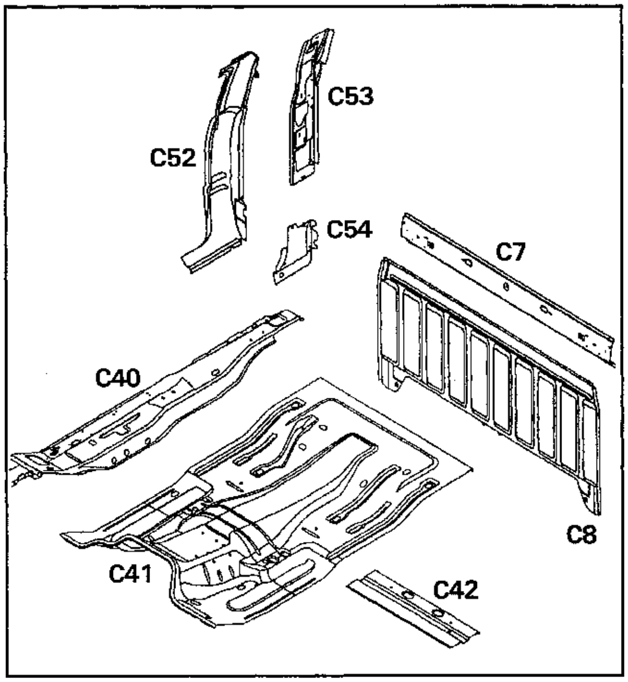
The back panel, reinforcement and extension are serviced separately. The extension panel is secured with structural adhesive and spot welds. The other panels are welded and sealed.

1. Cab back reinforcement (C7).
2. Cab back panel (C8).
3. Rear quarter inner upper panel (C36).
4. Rear quarter inner lower panel (C37).
5. Rear quarter outer panel (C38).
6. Outer floor pan (C40).
7. Center floor pan (C41).
8. Rear seatbelt anchor reinforcement (C42).

CAB BACK PANEL (QUAD CAB)

The back panel and reinforcement panel are serviced separately. Both panels are welded in place.

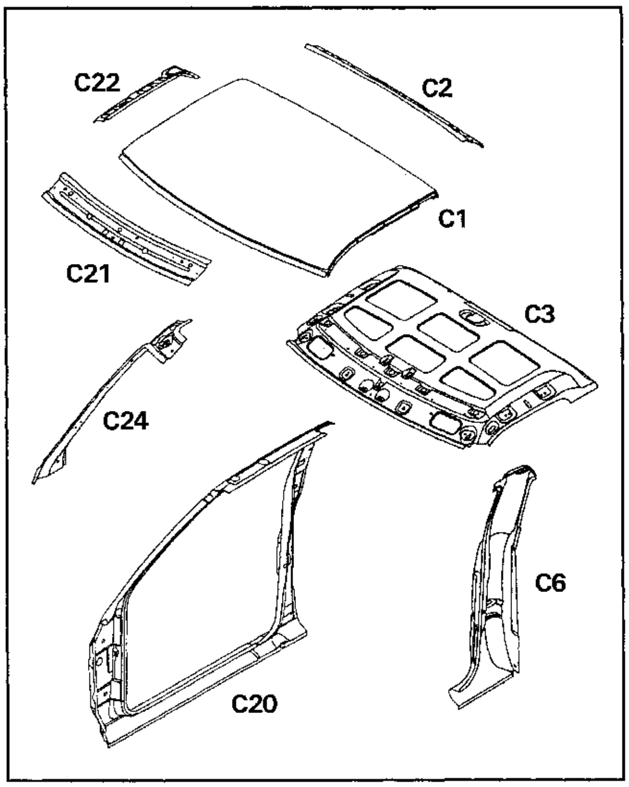
1. Cab back reinforcement (C7).
2. Cab back panel (C8).
3. Outer floor pan (C40).
4. Center floor pan (C41).
5. Rear seatbelt anchor reinforcement (C42).
6. Quarter outer panel (C52).
7. Quarter inner upper panel (C53)
8. Quarter inner lower panel (C54)



ROOF PANELS (REGULAR CAB)

The roof structure consists of inner and outer roof panels along with front and rear headers and side rails. All panels are serviced separately. Structural adhesive and spot welds are used to secure the panels.

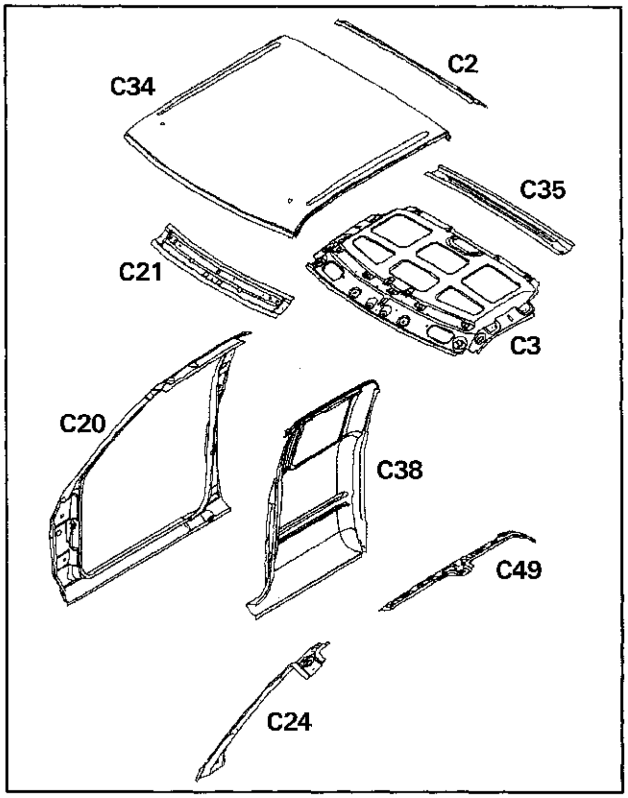
1. Roof outer panel (C1).
2. Rear header panel (C2).
3. Roof inner panel (C3).
4. Rear quarter outer panel (C6).
5. Body side aperture (C20).
6. Front header panel (C21).
7. Roof side inner rail (C22).
8. Windshield side opening frame (C24).



ROOF PANELS (CLUB CAB)

The roof structure consists of inner and outer roof panels along with front and rear headers and side rails. All panels are serviced separately. Structrual adhesive and spot welds are used to secure the panels.

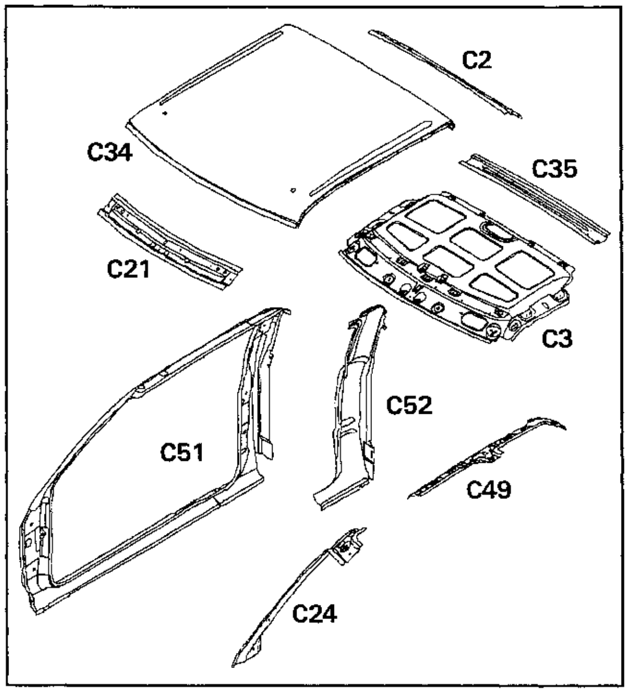
1. Roof header panel (C2).
2. Roof inner panel (C3).
3. Body side aperture (C20).
4. Front header panel (C21).
5. Windshield side opening frame (C24).
6. Roof outer panel (C34).
7. Roof bow (C35).
8. Rear quarter outer panel (C38).
9. Half-door inner rail (C49).



ROOF PANELS (QUAD CAB)

The roof structure consists of inner and outer roof panels along with front and rear headers and side rails. All panels are serviced separately. Structural adhesive and spot welds are used to secure the panels.

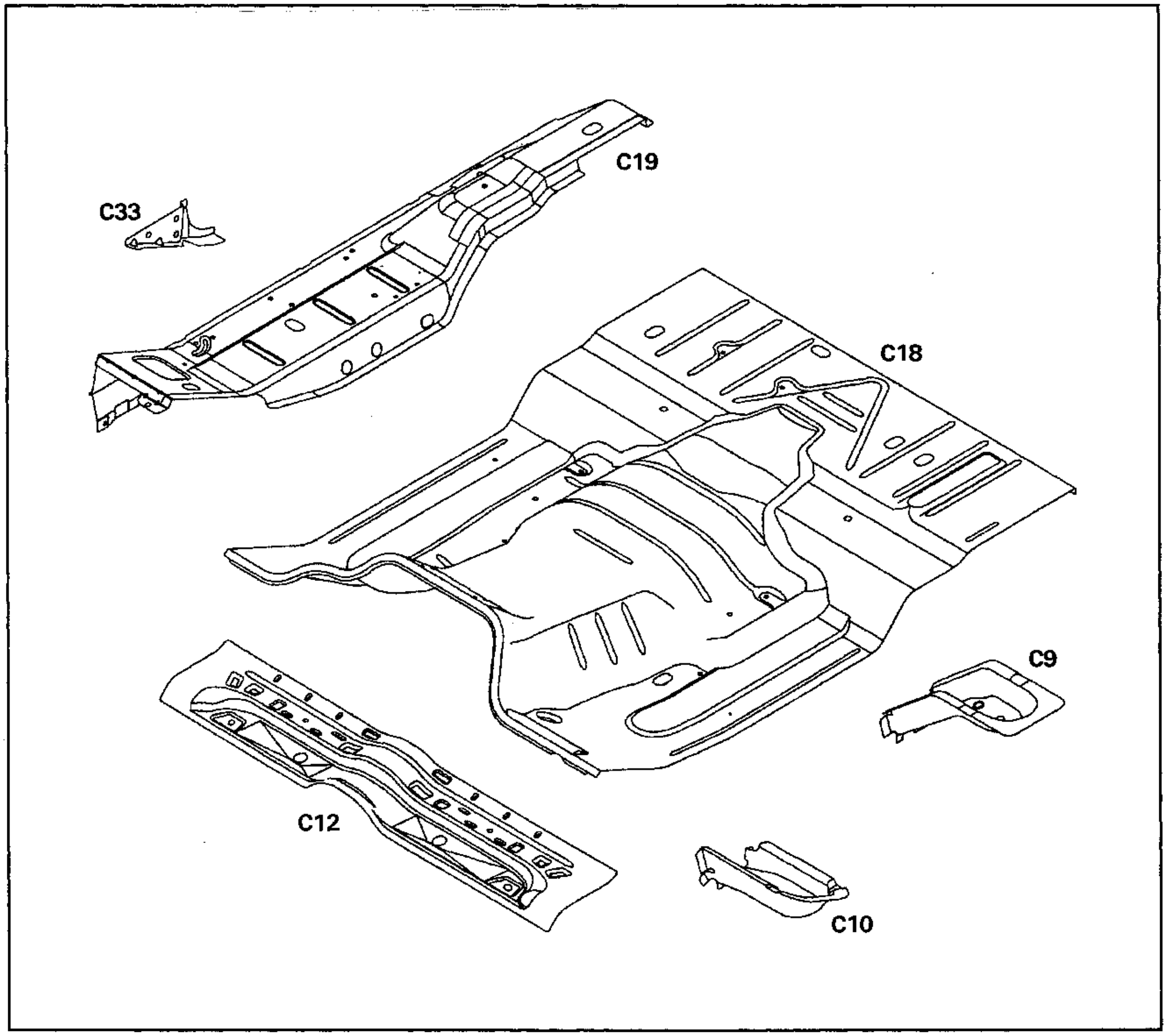
1. Roof header panel (C2).
2. Rear header panel (C3).
3. Front header panel (C21).
4. Windshield side opening frame (C24).
5. Roof outer panel (C34).
6. Roof bow (C35).
7. Half-door inner rail (C49).
8. Half-door body side aperture (C51).
9. Quarter outer panel (C52)



FLOOR PAN (REGULAR CAB)

The floor pan is made up of several components layered and welded together. All panel are serviced separately.

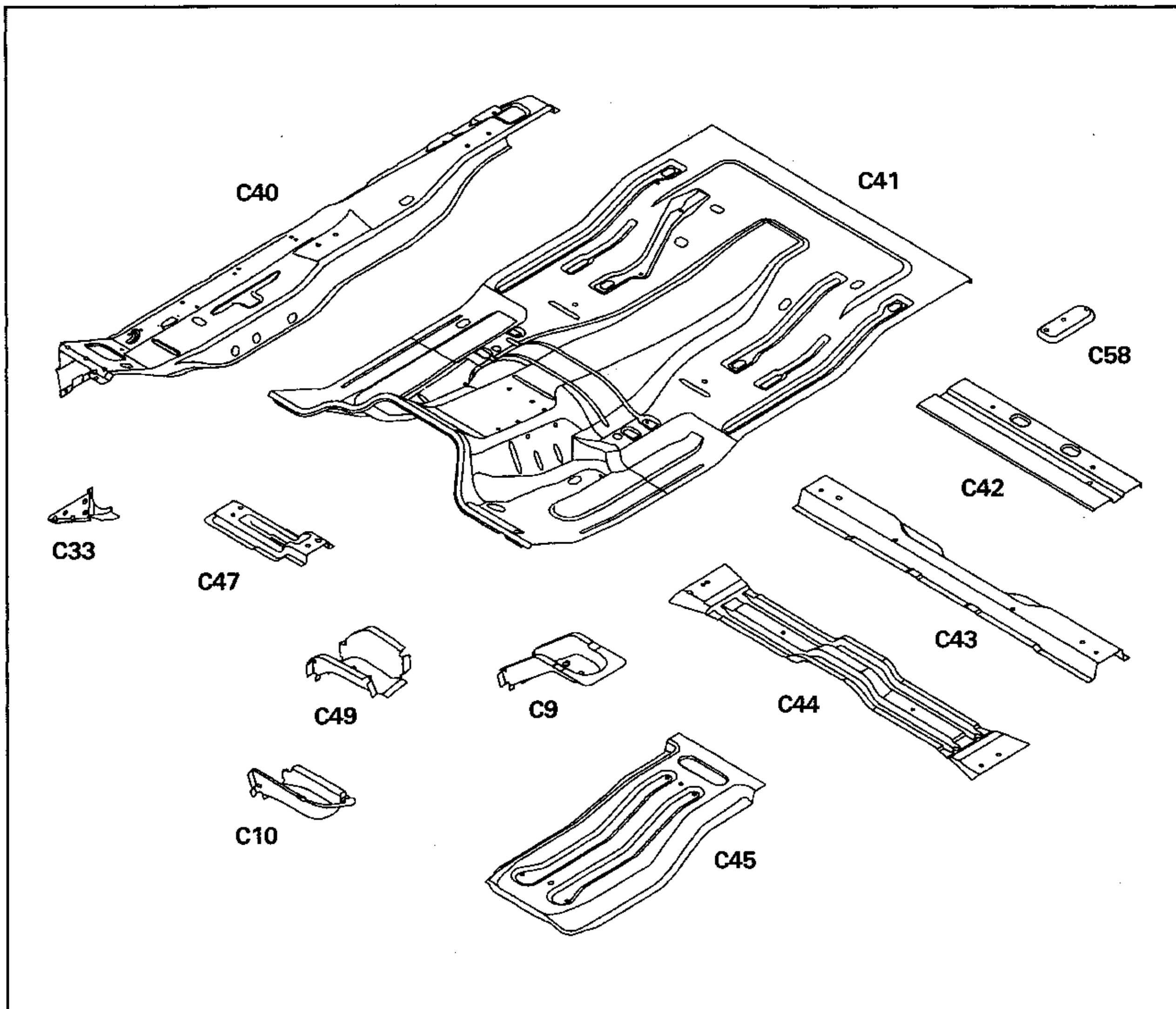
1. Rear body hold-down support (C9).
2. Front body hold-down support (C10).
3. Seatbelt anchor reinforcement (C12)
4. Center floor pan (C18).
5. Outer floor pan (C19).
6. Cowl side to floor reinforcement (C33).



FLOOR PAN (CLUB CAB)

The floor pan is made up of several components layered and welded together. All panels are serviced separately.

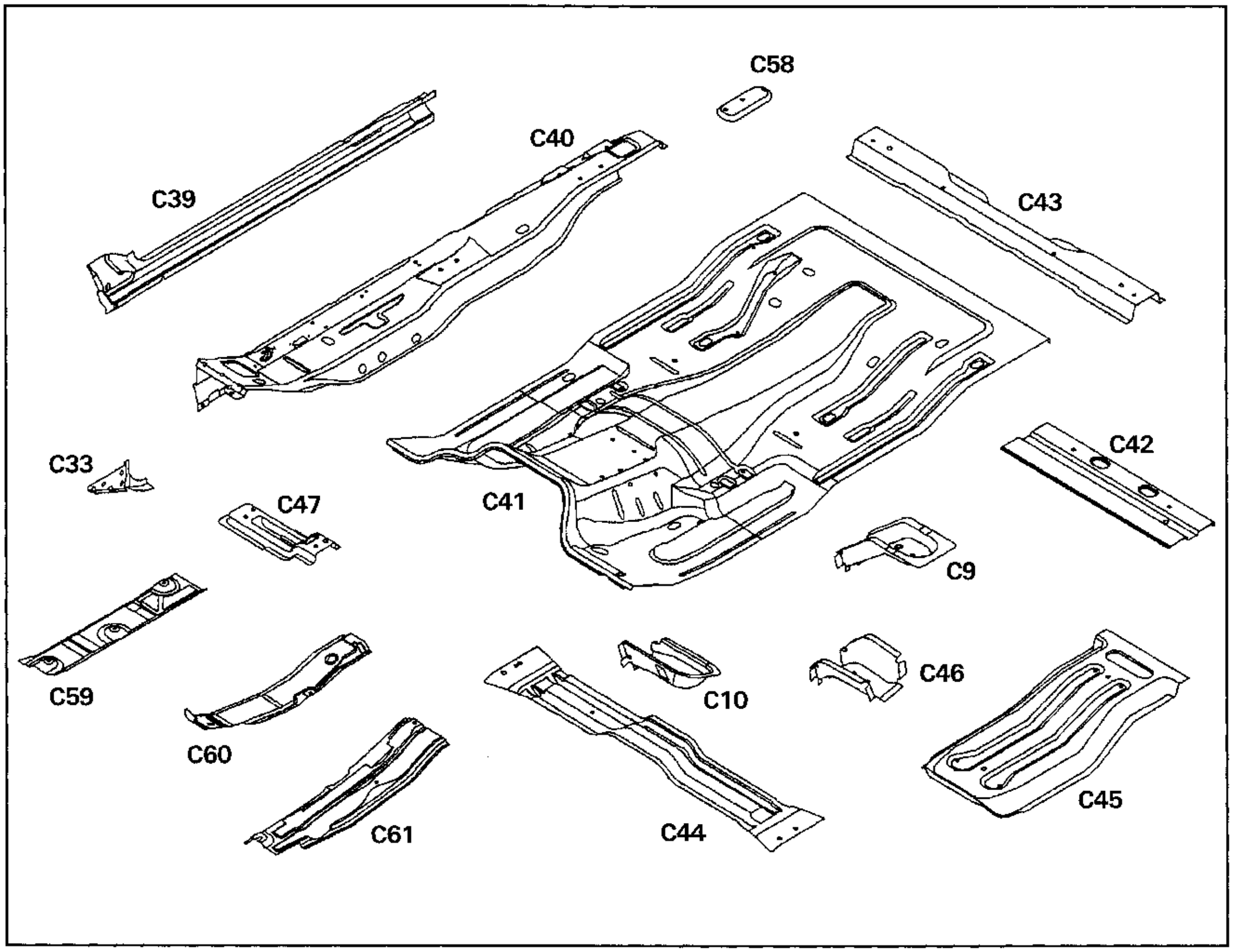
1. Rear body hold-down support (C9).
2. Front body hold-down support (C10).
3. Cowl side to floor reinforcement (C33).
4. Sill reinforcement (C39).
5. Outer floor pan (C40).
6. Center floor pan (C41)
7. Rear seatbelt anchor reinforcement (C42).
8. Rear floor crossmember (C43).
9. Front seat mounting rear crossmember (C44).
10. Center floor reinforcement (C45).
11. Front seat mounting front support (C47).
12. Half-door inner rail (C49).



FLOOR PAN (QUAD CAB)

The floor pan is made up of several components layered and welded together. All panels are serviced separately.

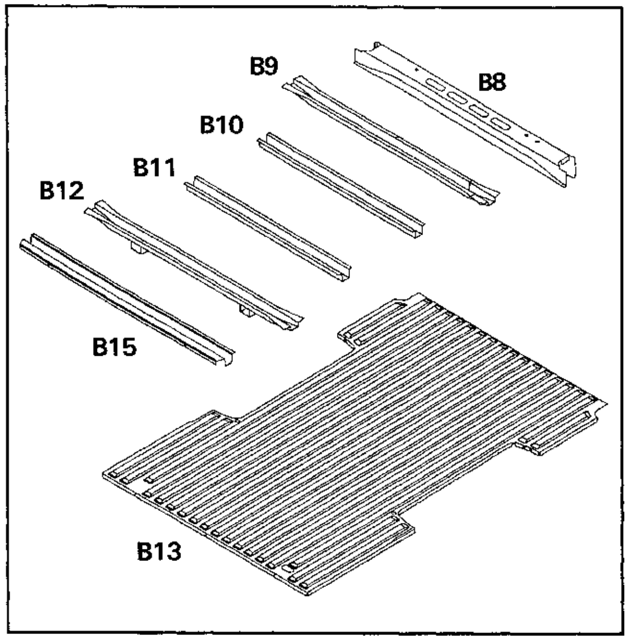
1. Rear body hold-down support (C9).
2. Front body hold-down support (C10).
3. Cowl side to floor reinforcement (C33).
4. Sill reinforcement (C39).
5. Outer floor pan (C40).
6. Center floor pan (C41).
7. Rear seatbelt anchor reinforcement (C42).
8. Rear floor crossmember (C43).
9. Front seat mounting rear crossmember (C44).
10. Center floor reinforcement (C45).
11. Mid body hold-down support (C46).
12. Front seat mounting front support (C47).
13. Front seat mounting rear support (C58).
14. Lower heat shield (C59).
15. Upper heat shield, left side (C60).
16. Upper heat shield, right side (C61).



FLOOR PANEL AND CROSSMEMBERS

All components of the cargo box floor assembly are serviced separately. All panels are welded together.

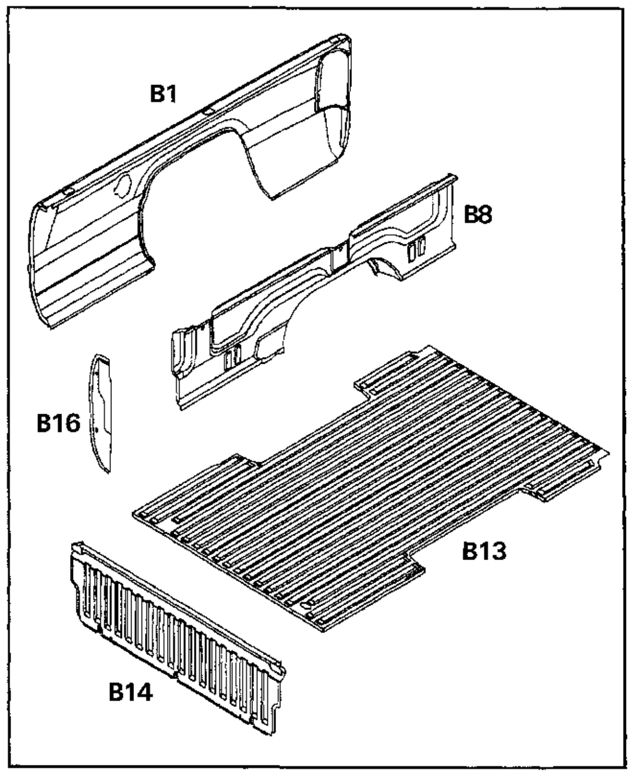
1. Box, rear crossmember (B8).
2. Box, crossmember (B9).
3. Box, center crossmember (B10).
4. Box, center crossmember (B11).
5. Box, crossmember (8 foot only) (B12).
6. Box, floor panel (B13).
7. Box, front crossmember (B15).



FRONT PANELS

The cargo box front closure is made up of several panels, each serviced separately.

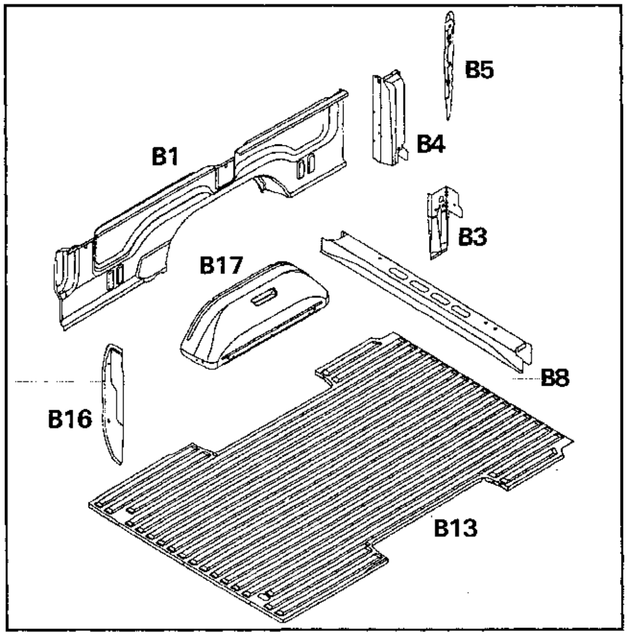
1. Box, side outer panel (B1).
2. Box, floor panel (B13).
3. Box, front center panel (B14).
4. Box, side front panel (B16).
5. Box, side inner panel (B18).



INNER SIDE PANEL

The cargo box inner side panel is basically the same for the 6 foot and 8 foot versions. The 8 foot version has one additional stake pocket in the center. All panels and components are welded together and are serviced separately.

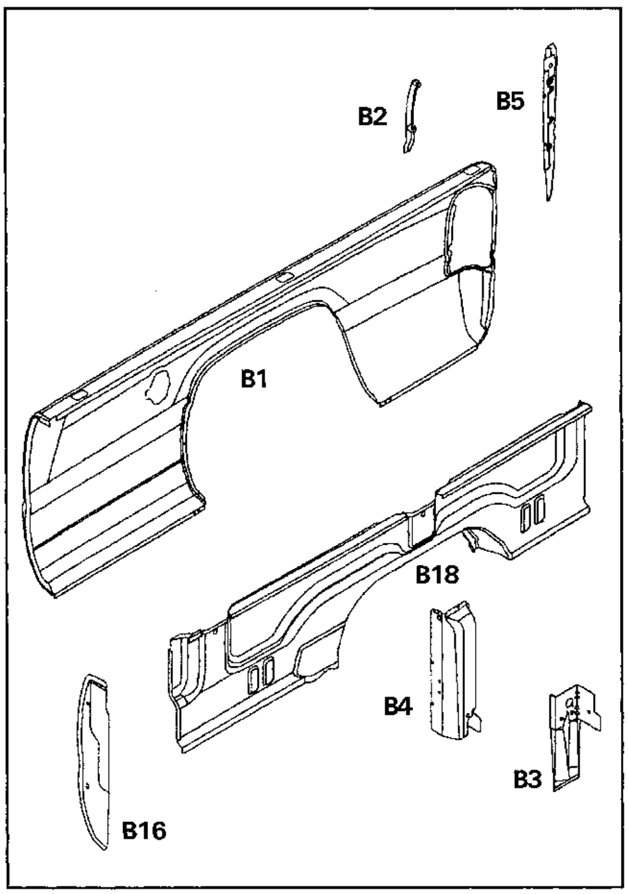
1. Box, side outer panel (B1).
2. Rear corner to rear sill gusset (B3).
3. Outer rear corner reinforcement (B4).
4. Box, side rear reinforcement (B5).
5. Box, rear crossmember (B8).
6. Box, floor panel (B13).
7. Box, side front panel (B16).
8. Rear wheelhouse inner panel (B17).



OUTER SIDE PANEL

The outer box side panel is the same for the 6 foot and 8 foot versions, except the 8 foot has the extra stake pocket in the center.

1. Box, side outer panel (B1).
2. Taillamp mounting bracket (B2).
3. Rear corner to rear sill gusset (B3).
4. Outer rear corner reinforcement (B4).
5. Box, side rear reinforcement (B5).
6. Box, side front panel (B16).
7. Box, side inner panel (B18).

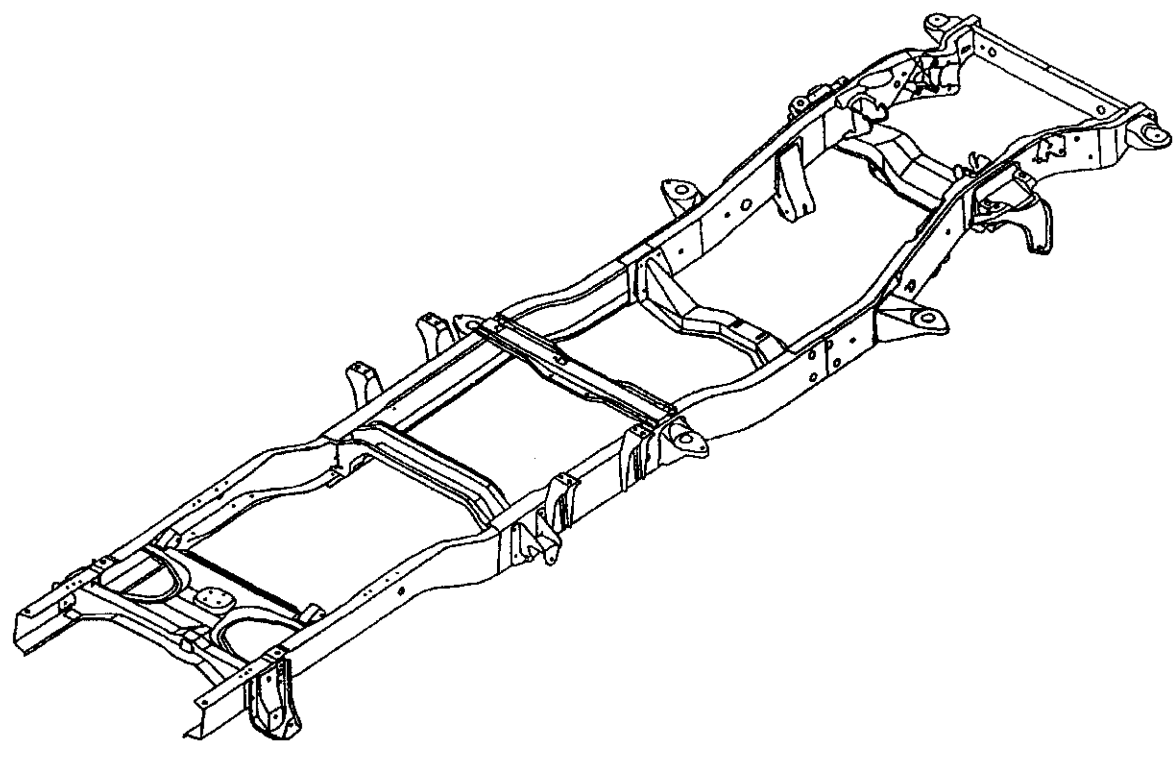


AUTHENTIC RESTORATION PRODUCT

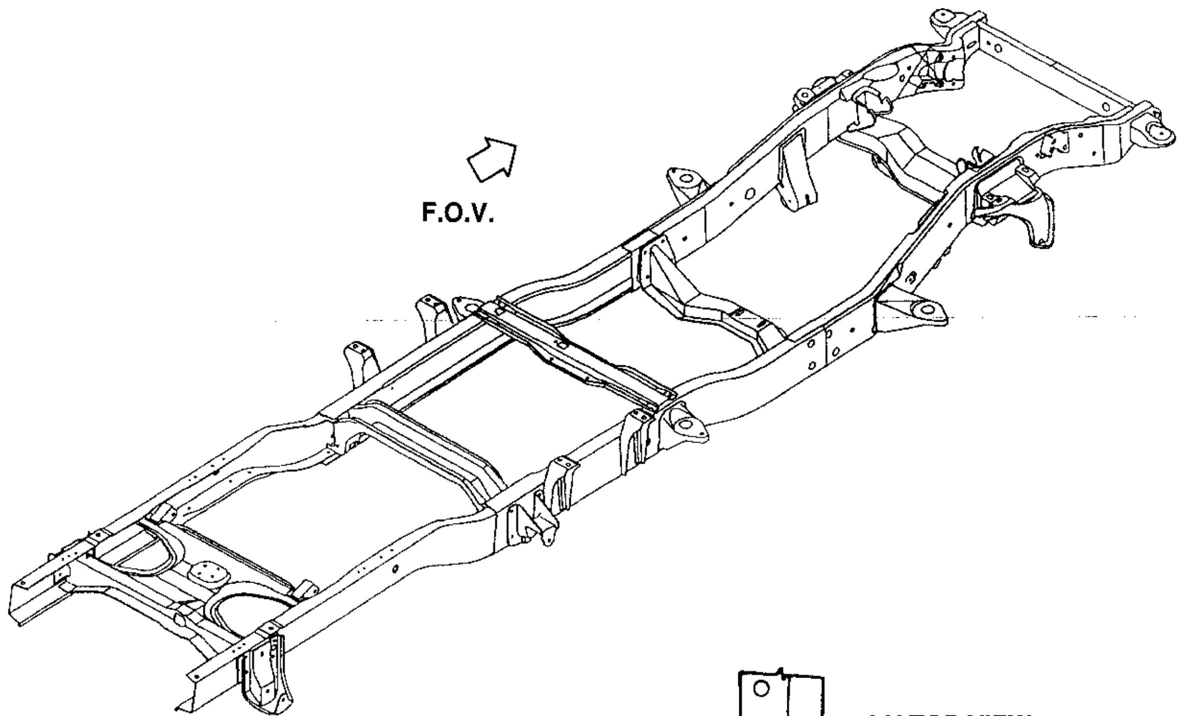
FRAME CONSTRUCTION CHARACTERISTICS

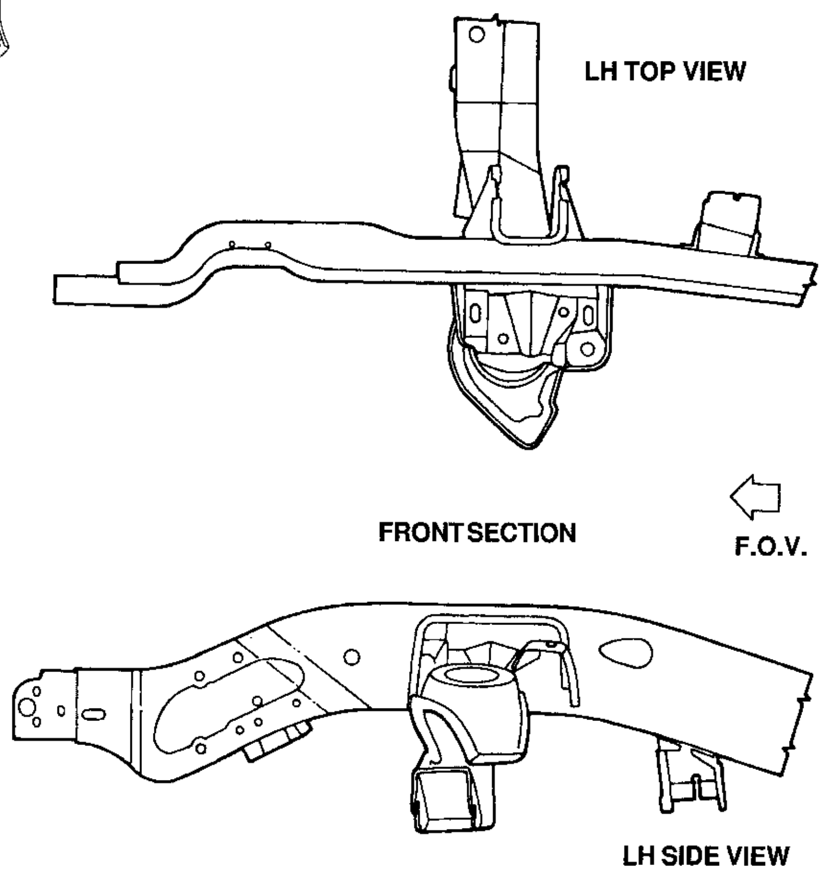
Dodge Ram Pickup

The Dodge Ram Pickup uses an exclusive patented three-section frame design that provides exceptional frame strength and stiffness. The construction of each of the three sections provides the special level of strength and stiffness needed by each part of the vehicle. The ends of the center section are swaged to fit into the front and rear sections. The front and center sections are welded together, and the center and rear sections are joined by a patented 14-rivet process. The frame is serviced as a complete unit only.

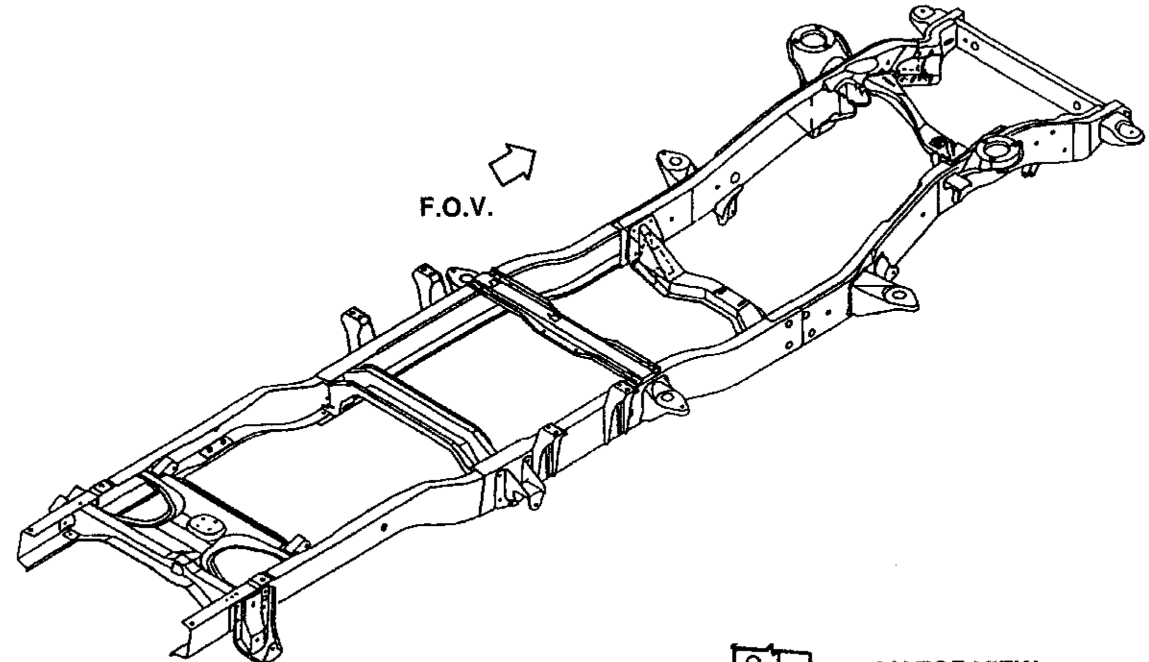


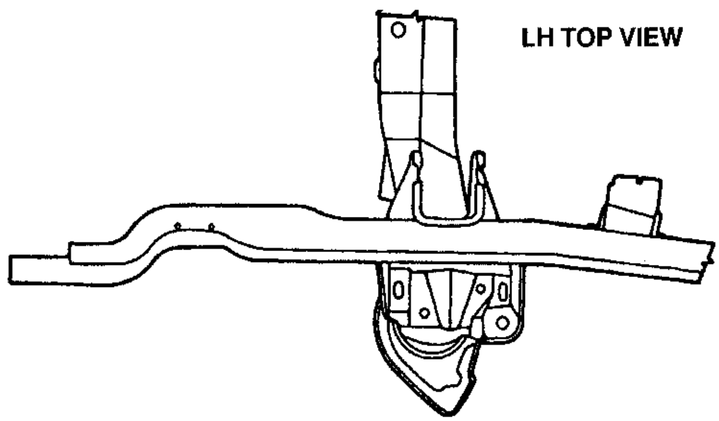
4X2 FRAME COMPONENTS





4X4 FRAME COMPONENTS

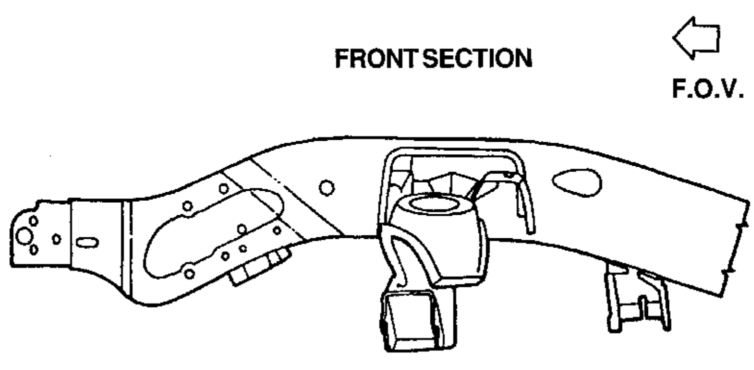




LH TOP VIEW

FRONT SECTION

F.O.V.



LH SIDE VIEW

Mopar AUTHENTIC RESTORATION™ PRODUCT

mopar AUTHENTIC RESTORATION™ PRODUCT

WELDED PANEL REPLACEMENT

Dodge Ram Pickup

The basic parts of the body structure are the welded panels. This section contains a brief description of the placement of some of these panels and their weld locations.

NOTE: To ensure the strongest, most durable and cleanest welds possible, perform testing before and during all weld procedures. Always follow American Welding Society specifications and procedures.

EXPLANATION OF MANUAL CONTENTS

This publication contains information used to repair the body structure of the Dodge Ram Pickup. The information is divided into sections covering the welded body panels (i.e., fenders, cab and box), location and use of structural adhesives and sealants, bumper configurations and frame dimensions. When servicing a damaged vehicle, please refer to the NOTES WITH REGARD TO REPAIR WORK. These notes are provided to assist in the repair process and ensure a timely and quality repair.

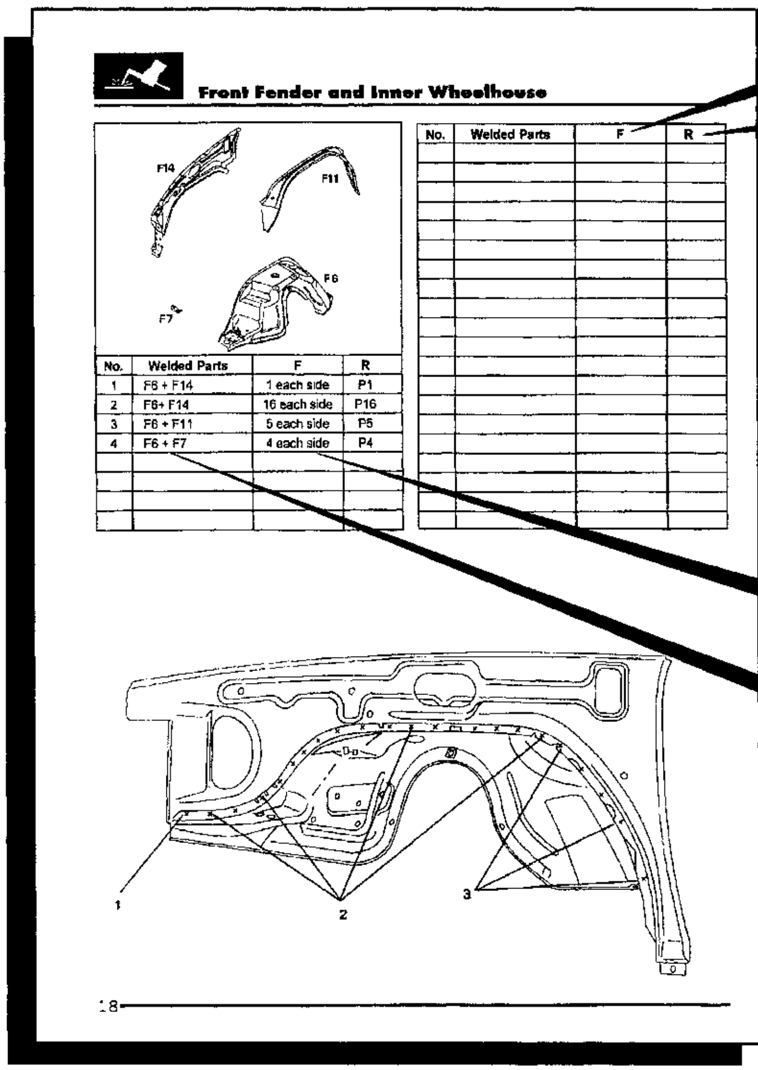
Symbols

Some of the operations for panel replacement are designated by the following symbols:

Rough cutting of panel to be replaced	++++ MIG Plug Weld	MIG Arc Welding

1 3 2 4 Continuous Stitch MIG Weld	Alternate stitch welds until you have a continuous MIG Weld.

NOTE: Although spot welds are the nuts and bolts of most body structures, they will not be used as a repair symbol because of the lack of proper spot weld equipment in most shops.



"**F**" indicates the number of factory welds to be separated. "**R**" indicates the number of welds to be made and the method to be used when making repairs.

If only a number is listed under "**F**" it indicates that the method used at the factory was a spot weld. For all other methods, both the welding method and the number of welds are indicated. For example, "**F**2, **R**P2" indicates that the 2 spot welds made at the factory should be replaced by 2 plug welds if repairs are made.

The welded components are indicated by using the designations given in the illustration below: For example, "a + b" indicates that component "a" and component "b" shown in the top illustration are welded

NOTE: Before beginning repair procedures, perform test welds to verify your equipment and to ensure your welds are the best quality. All welds should conform to the American Welding Society standards.

Certain body components must use sealers to ensure proper assembly. Be sure to check the **Body Sealing Locations** and **Structural Adhesives Sections** for location and sealer type.

For weld specifications contact:

American Welding Society
550 Northwest Le Jeune Road
P.O. Box 351040
Miami, Florida 33135
Phone: (305) 443-9353

Points which require particular attention during welded panel replacement work.

The panel removal instructions and accompanying illustrations are given in the order in which the work is to be performed.

The panel installation instructions and accompanying illustrations are given in the order in which the work is to be performed.

In order to keep the instructions brief and simple, obvious work procedures (such as removal of a panel after it has been cut) have been omitted where possible.

Front Fender and Inner Wheelhouse

NOTES WITH REGARD TO REPAIR WORK

- The front fender is made of many parts but is serviced only as a complete assembly.
- This section can be used for replacing the fender or the inner wheelhouse.

REMOVAL

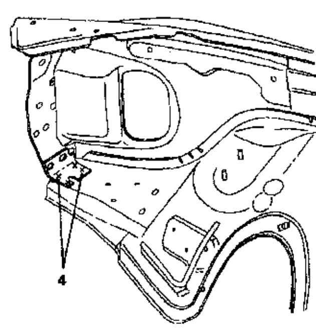
1. Using a spot weld cutter or hole saw, cut all spot welds as indicated.
2. Separate fender assembly from inner wheelhouse.

PREPARATION

1. Clean all surfaces of panels being reused by removing sealers and adhesives.
2. Using old panel, transfer weld locations to replacement panel.

INSTALLATION

1. Install new panel and clamp or tack weld in place.
2. Check alignment and fit, and reposition if necessary.
3. Complete all spot or plug welds.
4. Apply anti-corrosion and sealer materials as necessary.



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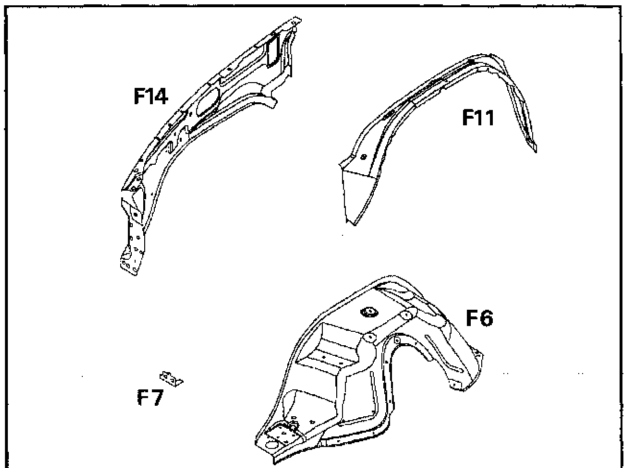
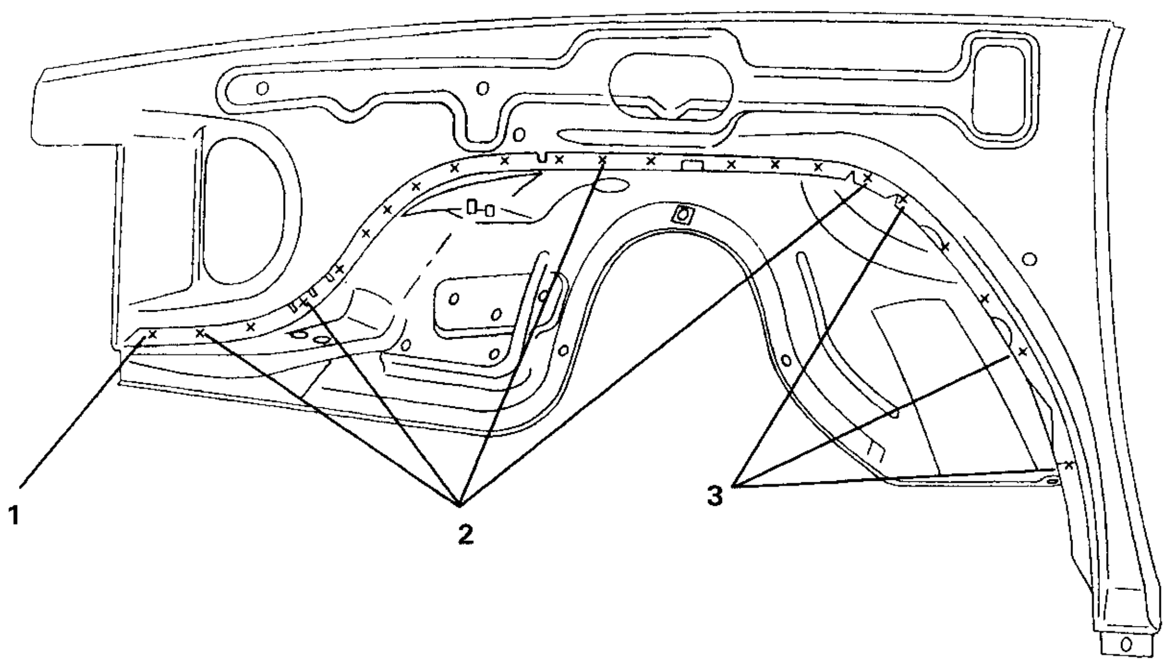
Front Fender and Inner Wheelhouse



No.	Welded Parts	F	R
1	F6 + F14	1 each side	P1
2	F6+ F14	16 each side	P16
3	F6 + F11	5 each side	P5
4	F6 + F7	4 each side	P4

No.	Welded Parts	F	R



NOTES WITH REGARD TO REPAIR WORK

- The front fender is made of many parts but is serviced only as a complete assembly.
- This section can be used for replacing the fender or the inner wheelhouse.

REMOVAL

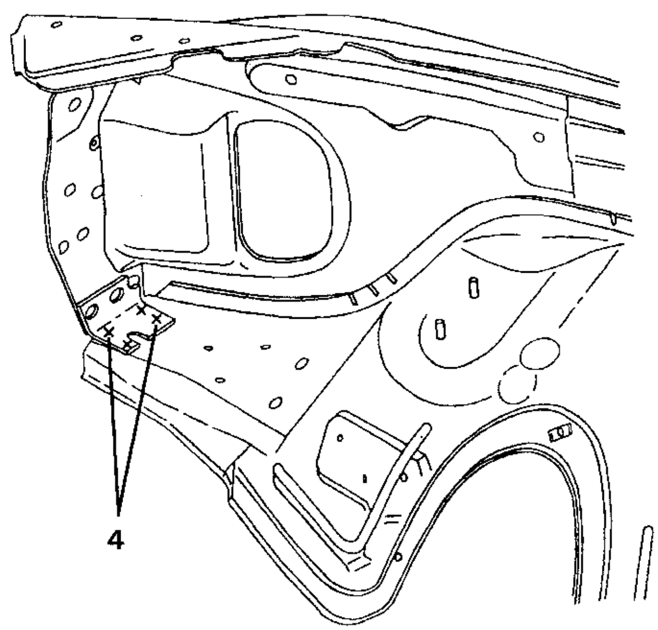
1. Using a spot weld cutter or hole saw, cut all spot welds where indicated.
2. Separate fender assembly from inner wheelhouse.

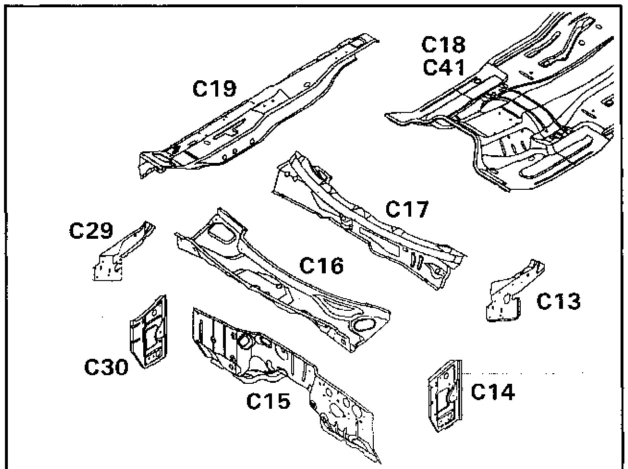
PREPARATION

1. Clean all surfaces of panels being reused by removing sealers and adhesives.
2. Using old panel, transfer weld locations to replacement panel.

INSTALLATION

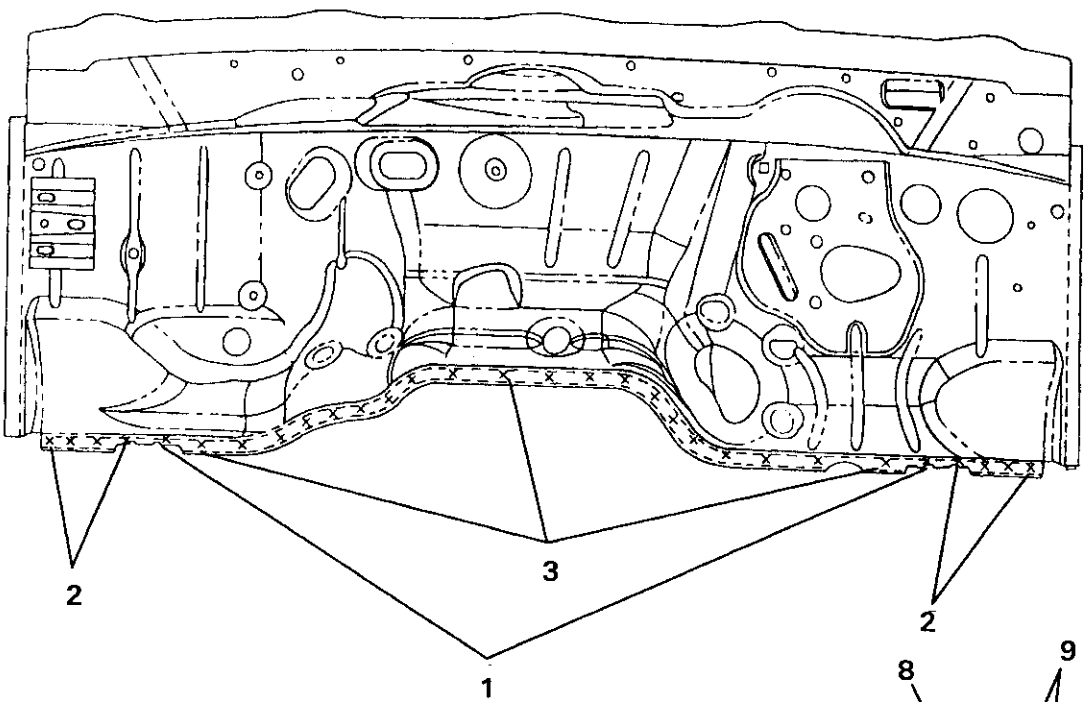
1. Install new panel and clamp or tack weld in place.
2. Check alignment and fit, and reposition if necessary.
3. Complete all plug welds.
4. Apply anti-corrosion and sealer materials as necessary.

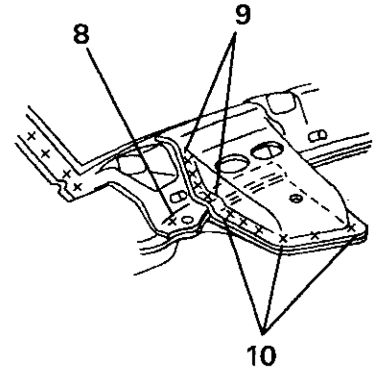




No.	Welded Parts	F	R
1	C15 + C19 + C18(Reg) /C41(Club, Quad)	1 each side	P1
2	C15 + C19	4 each side	P4
3	C15 + C18 / C41	20	P20

No.	Welded Parts	F	R
3	C15 + C18 / C41	20	P20
4	C14 + C15	7 each side	P7
5	C13 + C14 + C15	5 each side	P7
6 LH	C13 + C14 + C16	5	P5
6 RH	C13 + C14 + C16	6	P6
7	C15 + C16	33	P33
8	C16 + C17	19	P19
9	C17 + Steering Column Upper Support	12	P12
10	Steering Column Upper to Lower Supports	8	P8
11	C16 + C17	22	P22
12	C13 + C16 + C17	13	P13





NOTES WITH REGARD TO REPAIR WORK

- Use care when removing undamaged panels to gain access to cowl or dash panels.
- Remove all flammable materials before starting any repairs.

REMOVAL

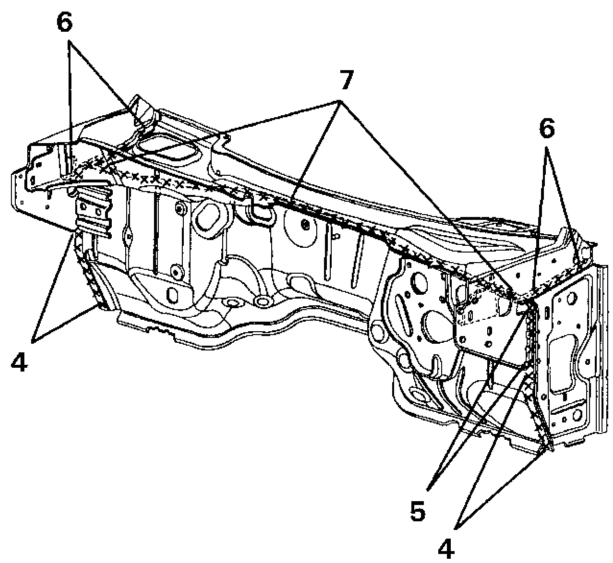
1. Carefully cut all spot welds with a spot weld cutter or hole saw.
2. Separate panels with air chisel or other suitable tools.
3. Remove damaged panel.

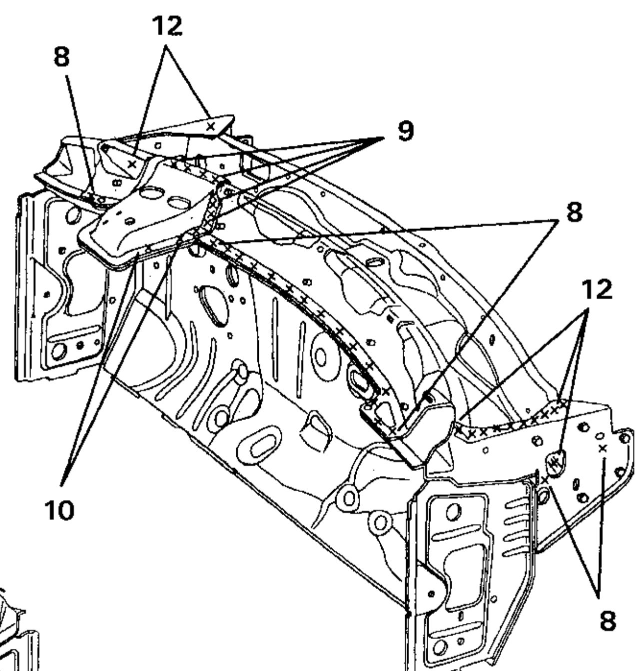
PREPARATION

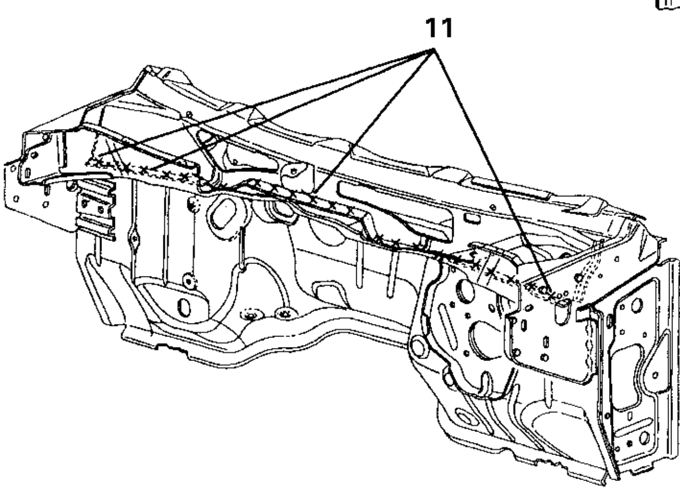
1. Transfer weld locations to new panel from old.
2. Clean all mating surfaces of adhesive.

INSTALLATION

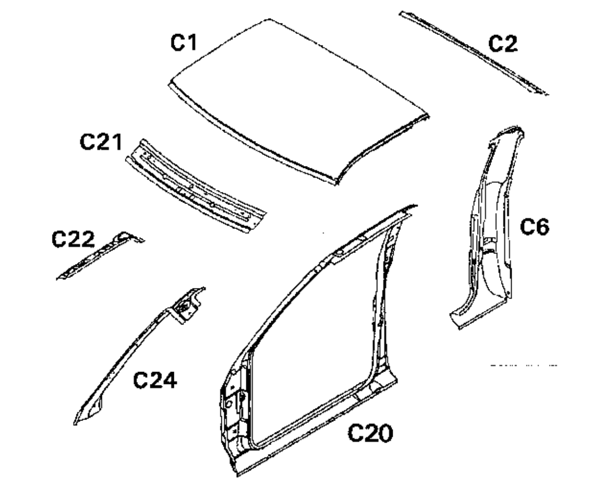
1. Test-fit new panel(s) and clamp in place. Double-check fit and alignment.
2. Plug weld new panel(s) at indicated locations.
3. Apply sealers and adhesives as required. Also apply anticorrosion materials as needed.





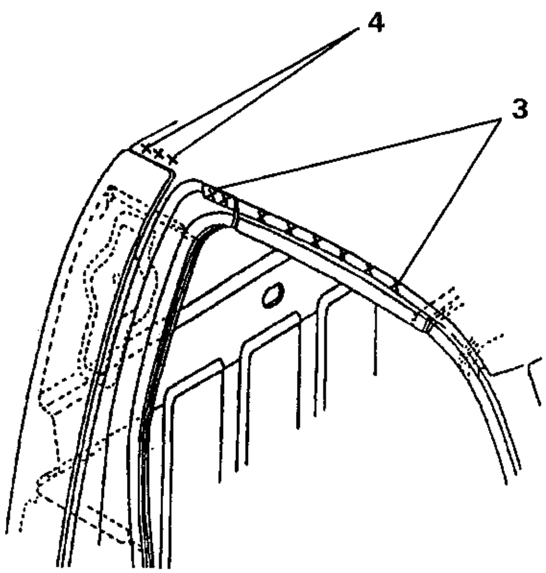


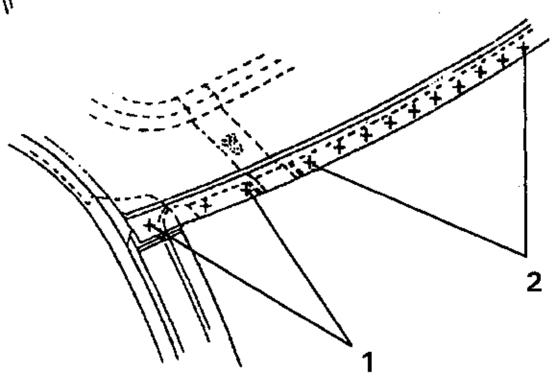
Roof Panel (Regular Cab)



No.	Welded Parts	F	R
1	C1 + C20 + C24	3 each side	P3
2	C1 + C21	10 each side	P10
3	C1 + C20 + C22	8 each side	P8
4	C1 + C6	3 each side	P3
5	C1 + C2	20	P20

No.	Welded Parts	F	R





NOTES WITH REGARD TO REPAIR WORK

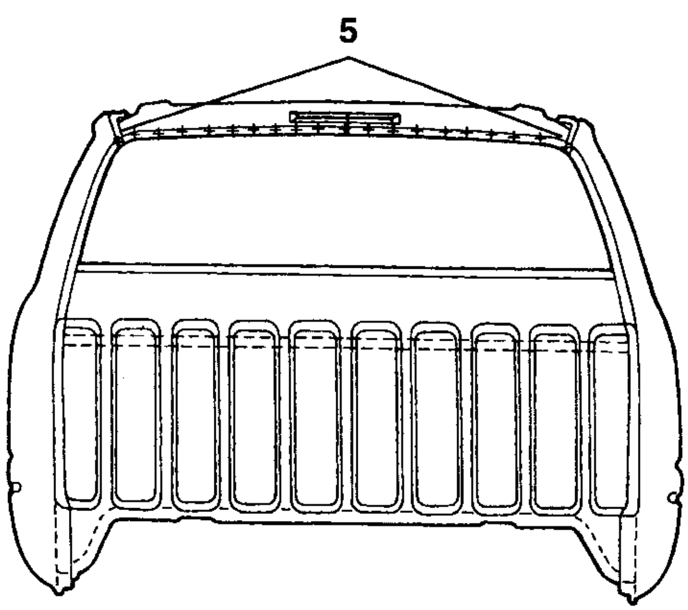
- Take care when handling a roof panel. The panels can be easily damaged by mishandling.
- Be sure to use the recommended adhesive for the roof bows.
- Before heating roof panel to soften old adhesive, make sure all flammable materials are removed from roof inner and outer areas.

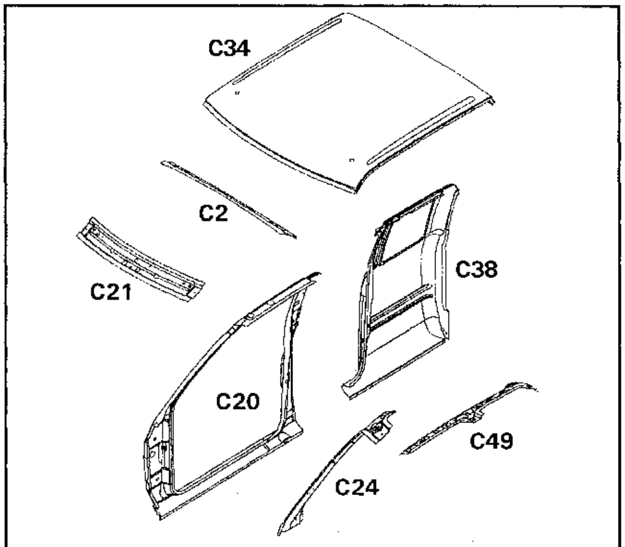
REMOVAL

1. Cut and separate the spot-weld locations, being careful not to damage any other paenls.
2. Heat the top of the roof panel at the areas where it has adhesives applied. This will make it easier to remove.
3. Remove the old roof panel.
4. Remove any old adhesive on roof braces, using a mule skinner's wire brush or something as aggressive.

INSTALLATION

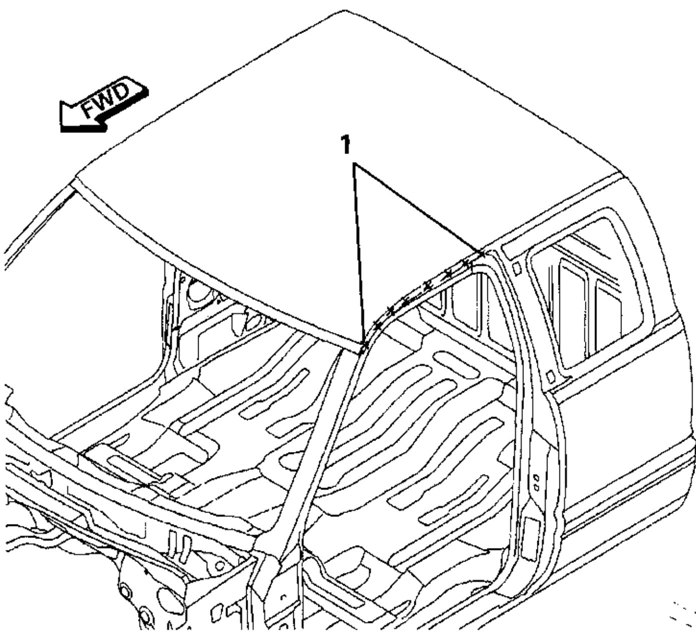
1. Temporarily align and mount the new roof panel onto the body. Make corresponding reference marks on the panel and body structure for later use.
2. Use the old roof panel as a template to mark locations for plug welds on the new roof panel.
3. Apply the adhesive to the roof bows and place roof panel into position as marked previously.
4. After a double check for alignment, clamp panel down.
5. Plug weld the roof into place.
6. Finish seams as required.

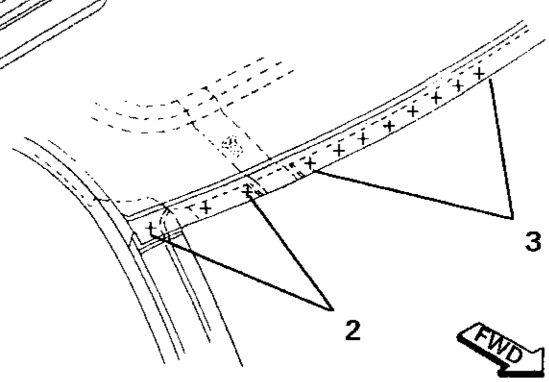




No.	Welded Parts	F	R
1	C20 + C34 + C49	8 each side	P8
2	C24 + C34	3 each side	P3
3	C21 + C34	8 each side	P8
4	C34 + C38	11 each side	P11
5	C2 + C34	20	P20

No.	Welded Parts	F	R





NOTES WITH REGARD TO REPAIR WORK

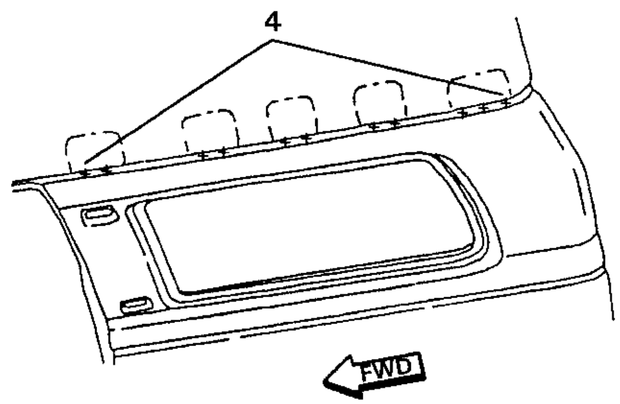
- Before heating the Roof Panel to soften old adhesive, make sure all flammable materials are removed from roof inner and outer areas.
- Take care when handling the Roof Panel. The panel can be easily damaged by mishandling.
- Be sure to use a good structural adhesive for the roof bows.

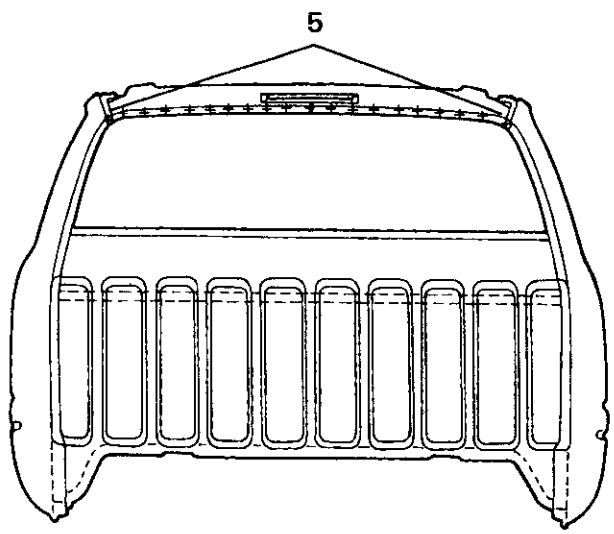
REMOVAL

1. Cut and separate the spot welded locations, being careful not to damage any panels.
2. Heat the top of the Roof Panel where adhesives are applied. It will make it easier to remove.
3. Remove the Roof Panel.
4. Remove any old adhesive on roof braces using a mule skinner's wire brush or something as aggressive.

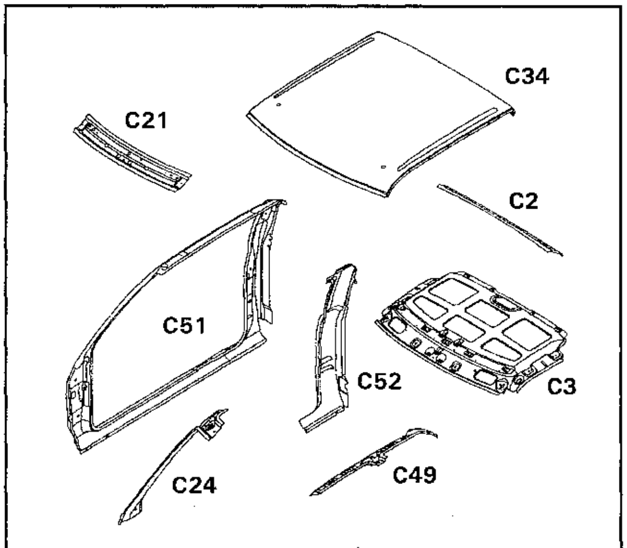
INSTALLATION

1. Temporarily align and mount the new Roof Panel onto the body. Make corresponding reference marks on the Roof Panel and body structure.
2. Use the old Roof Panel as a template to mark locations for plug welds on the Roof Panel.
3. Apply the adhesive to the Roof Bows and other mating surfaces and place the Roof Panel into position as marked previously.
4. After checking alignment and adjusting as necessary, clamp the panel down.
5. Plug weld the roof panel in place.
6. Finish seams as required.

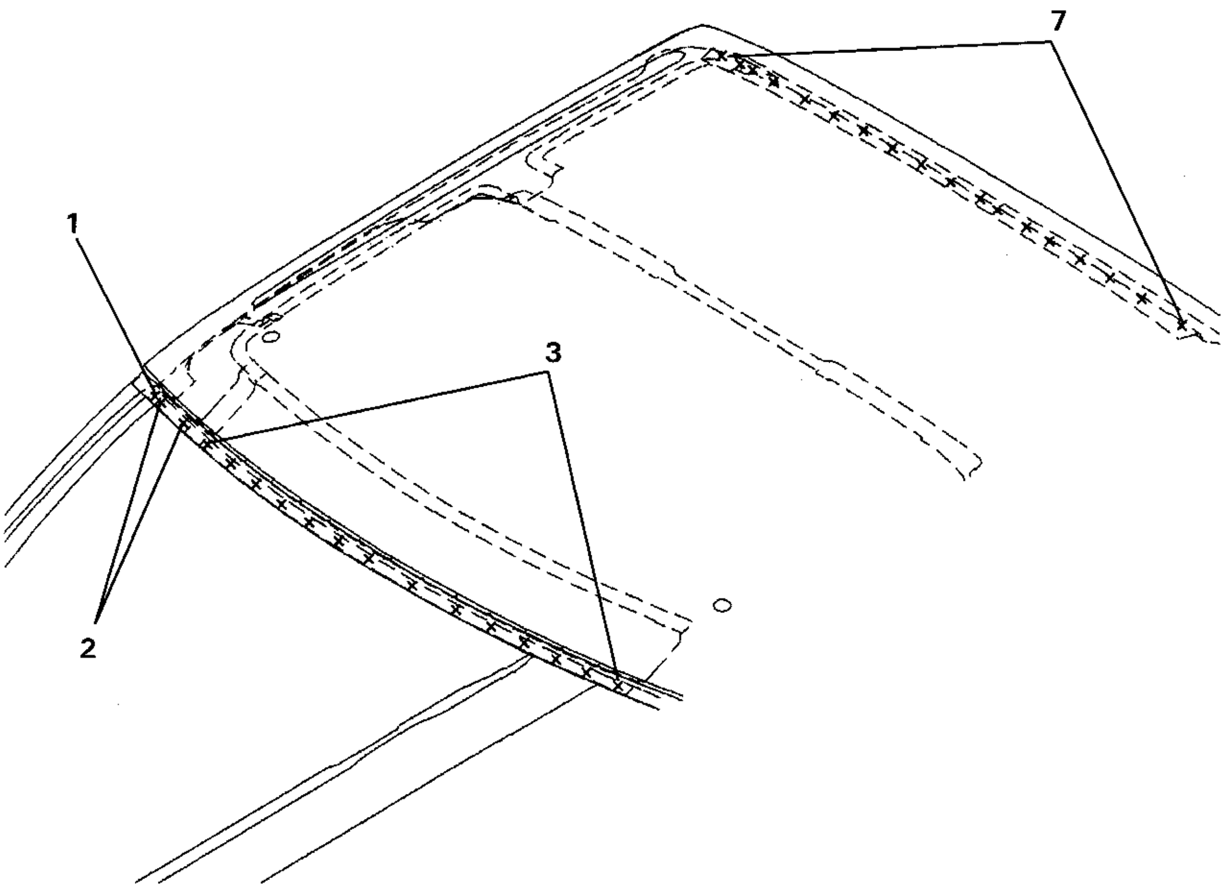




Roof Panel (Quad Cab)



No.	Welded Parts	F	R
1	C24 + C34	1 each side	P1
2	C3 + C24 + C34	2 each side	P2
3	C3 + C21 + C34	14	P14
4	C34 + C51	11 each side	P11
5	C34 +C51 + C52	2 each side	P2
6	C34 + C52	3 each side	P3
7	C2 + C34	20	P20



NOTES WITH REGARD TO REPAIR WORK

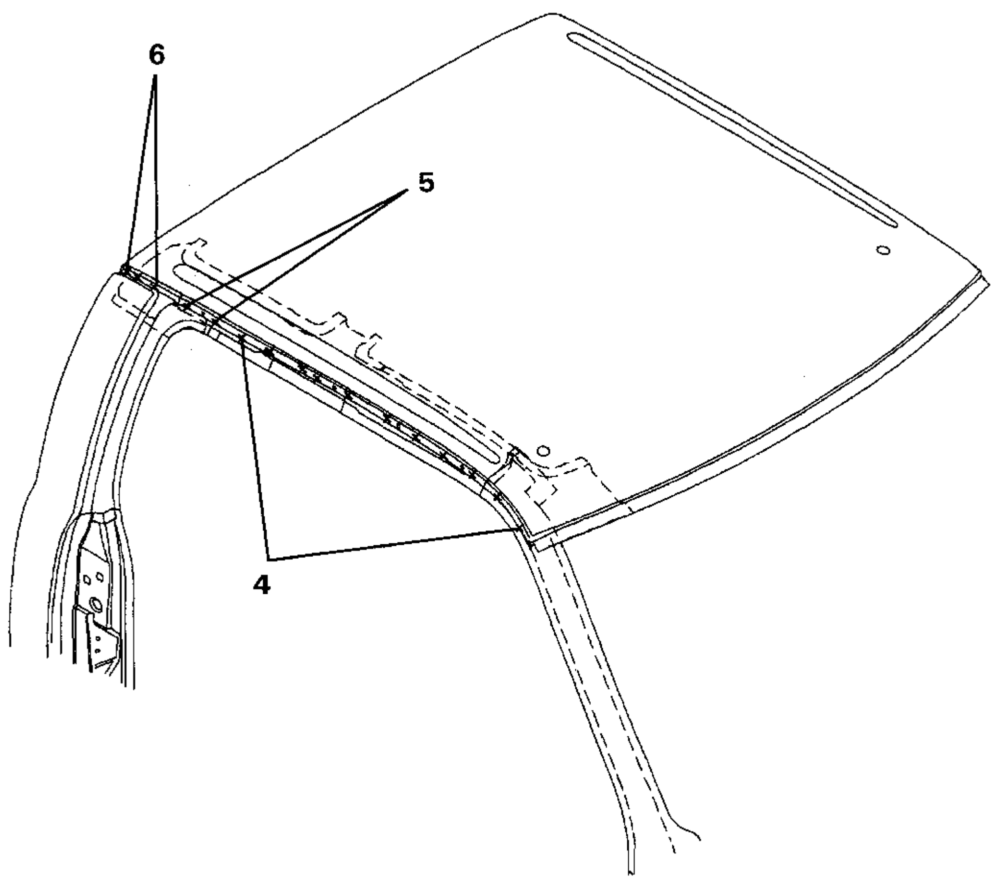
- Take care when handling the Roof Panel. The panel can be easily damaged by mishandling.
- Be sure to use the recommended adhesive for the roof bows.
- Before heating roof panel to soften old adhesive, make sure all flammable materials are removed from roof inner and outer areas.

REMOVAL

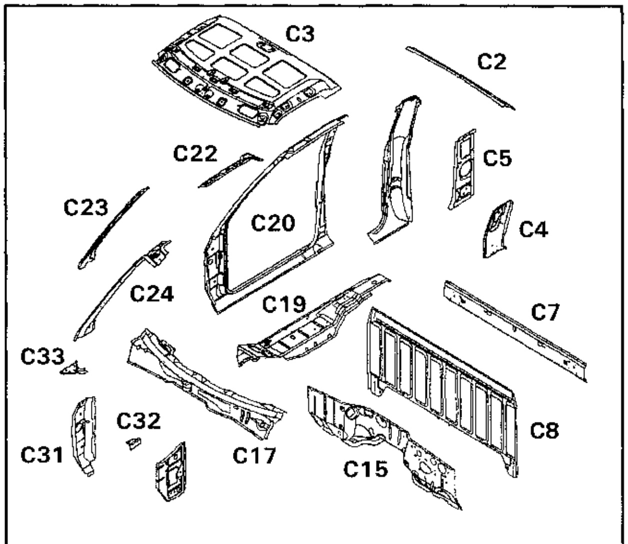
1. Cut and separate the spot welded locations, being careful not to damage any panels.
2. Heat the top of the Roof Panel where adhesives are applied. It will make it easier to remove.
3. Remove the Roof Panel.
4. Remove any old adhesive on roof braces using a mule skinner's wire brush or something as aggressive.

INSTALLATION

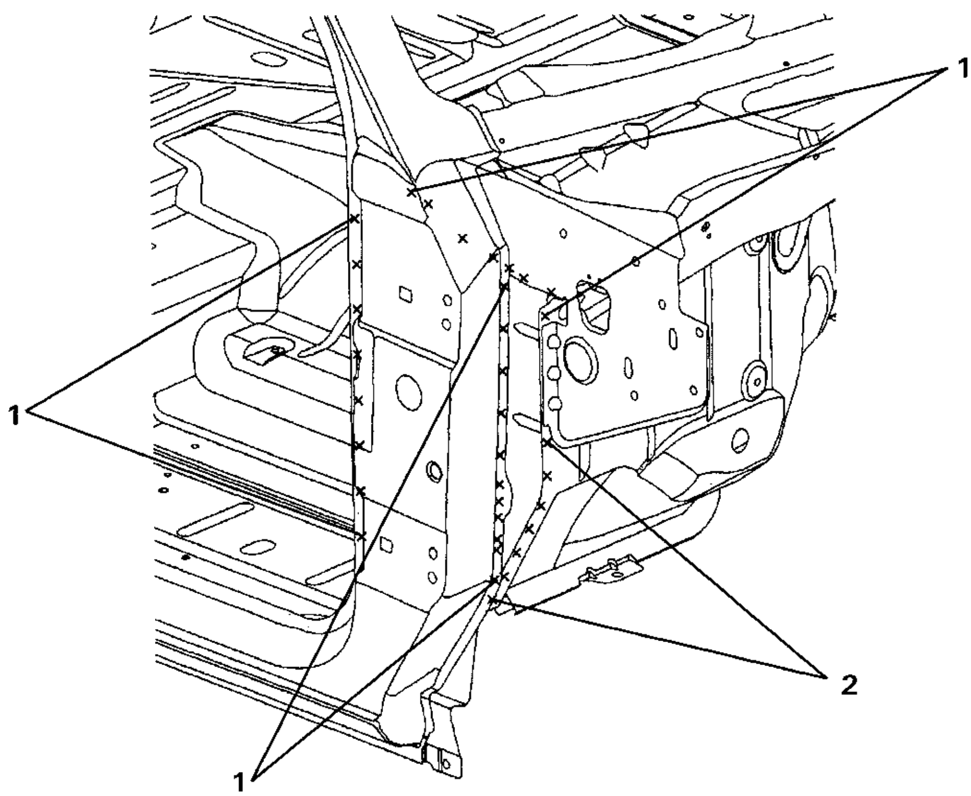
1. Temporarily align and mount the new Roof Panel onto the body. Make corresponding reference marks on the Roof Panel and body structure.
2. Use the old Roof Panel as a template to mark locations for plug welds on the Roof Panel.
3. Apply the adhesive to the Roof Bows and other mating surfaces and place the Roof Panel into position as marked previously.
4. After checking alignment and adjusting as necessary, clamp the panel down.
5. Plug weld the roof panel in place.
6. Finish seams as required.

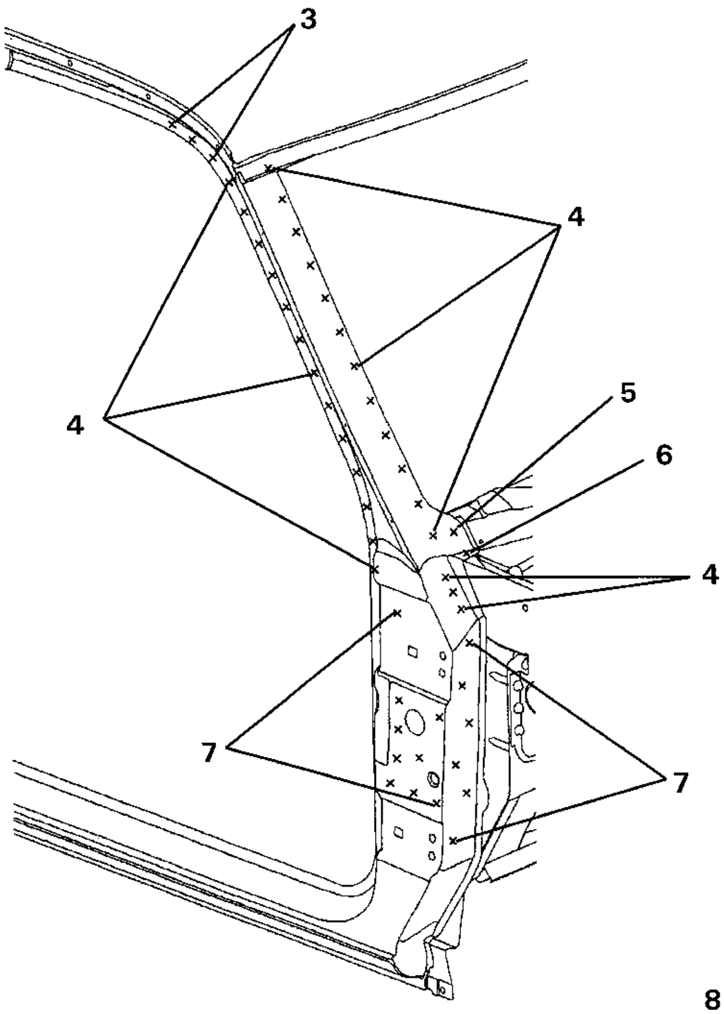


Body Side Aperture (Regular Cab)



No.	Welded Parts	F	R
1	C20 + C30	27 each side	P27
2	C15 + C30	7 each side	P7
3	C20 + C24	3 each side	P3
4	C20 + C23 + C24	28 each side	P28
5	C17 +C23 + C24	1 each side	P1
6	C17 + C24	1 each side	P1
7	C20 + C31	15 each side	P15
8	C23 + C31	4 each side	P4
9	C20 + C32	6 each side	P6
10	C3 + C20 + C30	9 each side	P9
11	C20 + C30 + C33	1 each side	P1
12	C20 + C33	3 each side	P3
13	C6 + C20	4 each side	P4
14	C19 + C20	34 each side	P34
15	C19 + C20 + C31	2 each side	P2
16	C6 + C19 + C20	7 each side	P7
17	C6 + C19	1 each side	P1
18	C6 + C8 + C19	2 each side	P2
19	C4 + C6	9 each side	P9
20	C4 + C20	7 each side	P7
21	C4 + C6 + C20	4 each side	P4
22	C4 + C7	4 each side	P4
23	C5 + C8	9 each side	P9
24	C5 + C6 + C20	10 each side	P10
25	C5 + C8 + C27	2 each side	P2
26	C2 + C22	6 each side	P6
27	C3 + C22	6 each side	P6
28	C20 + C22	4 each side	P4
29	C4 + C22	2 each side	P2

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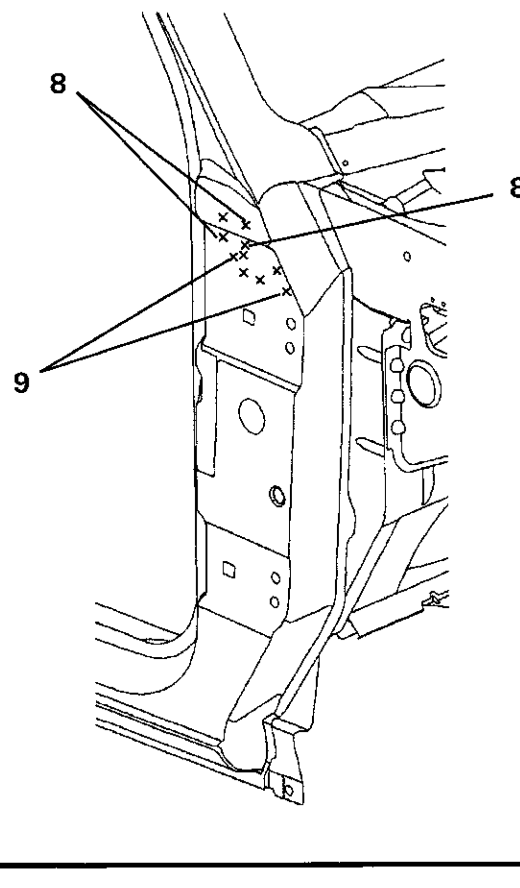
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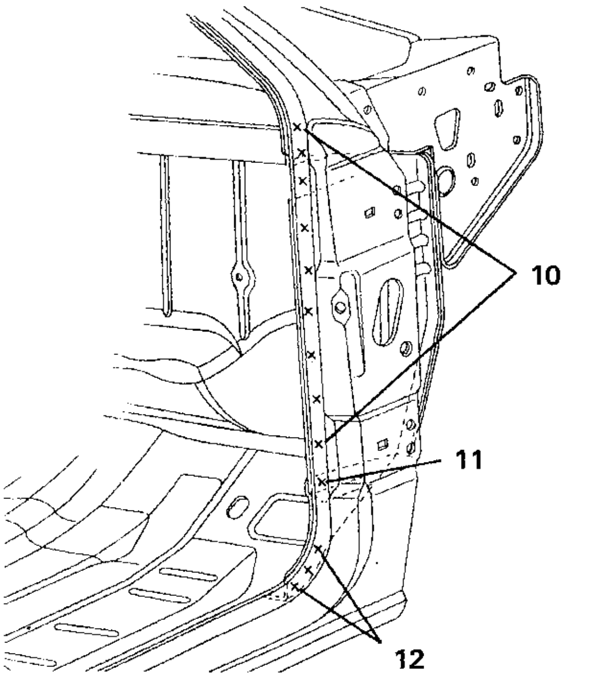
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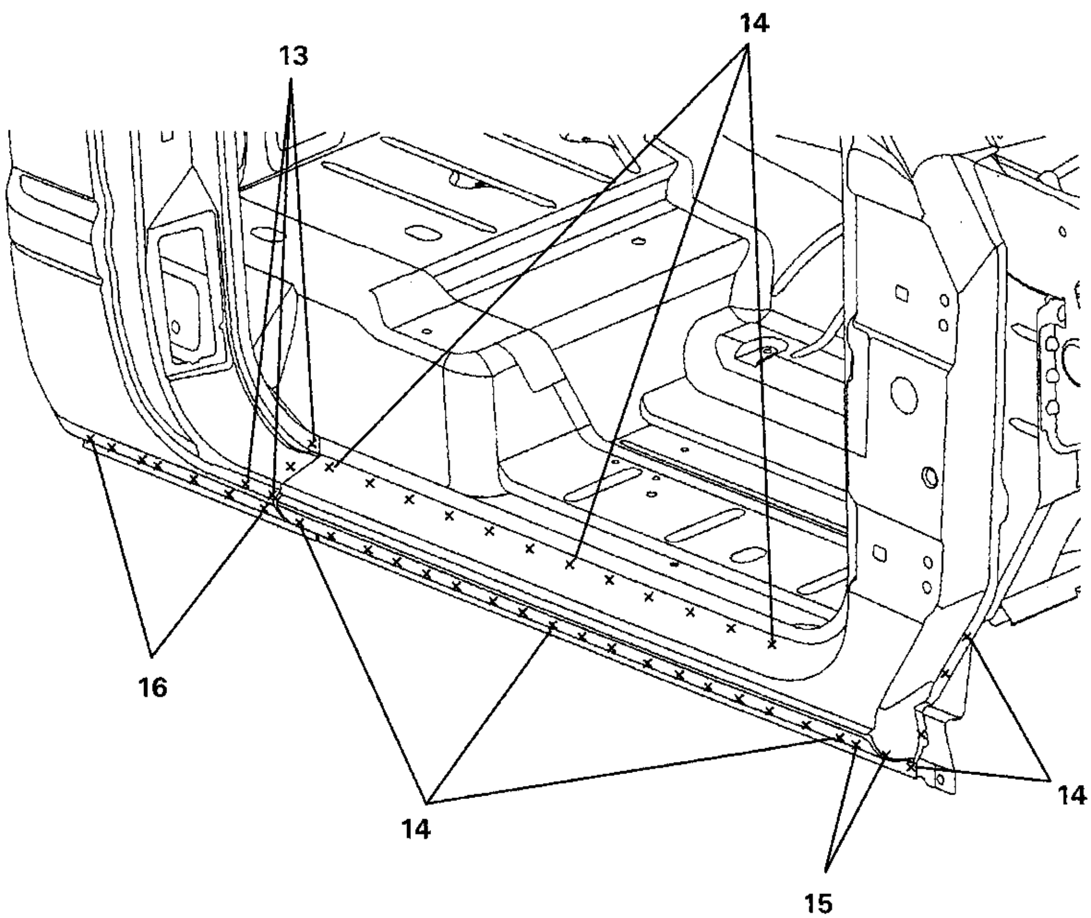
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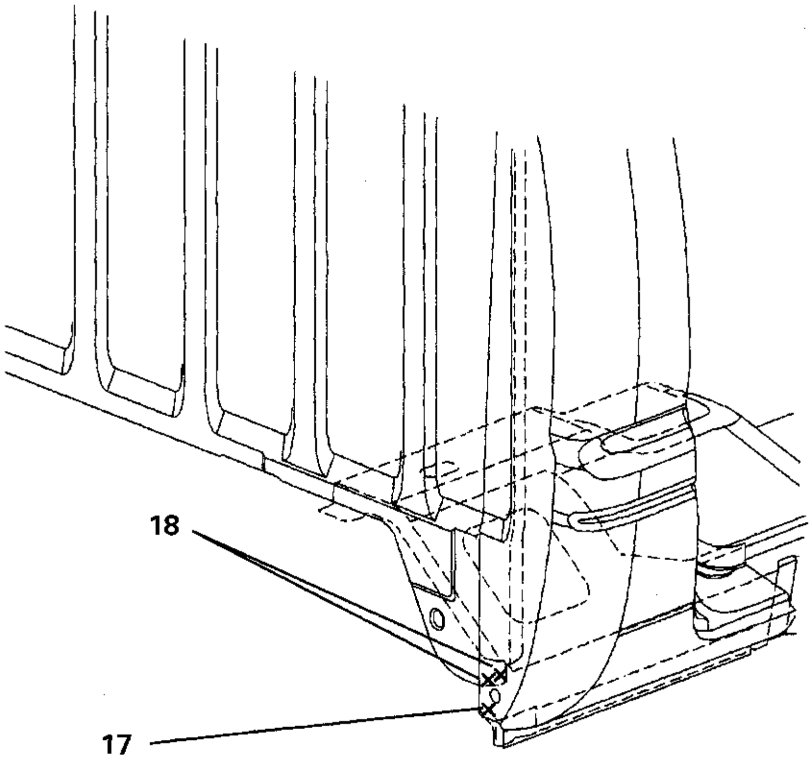
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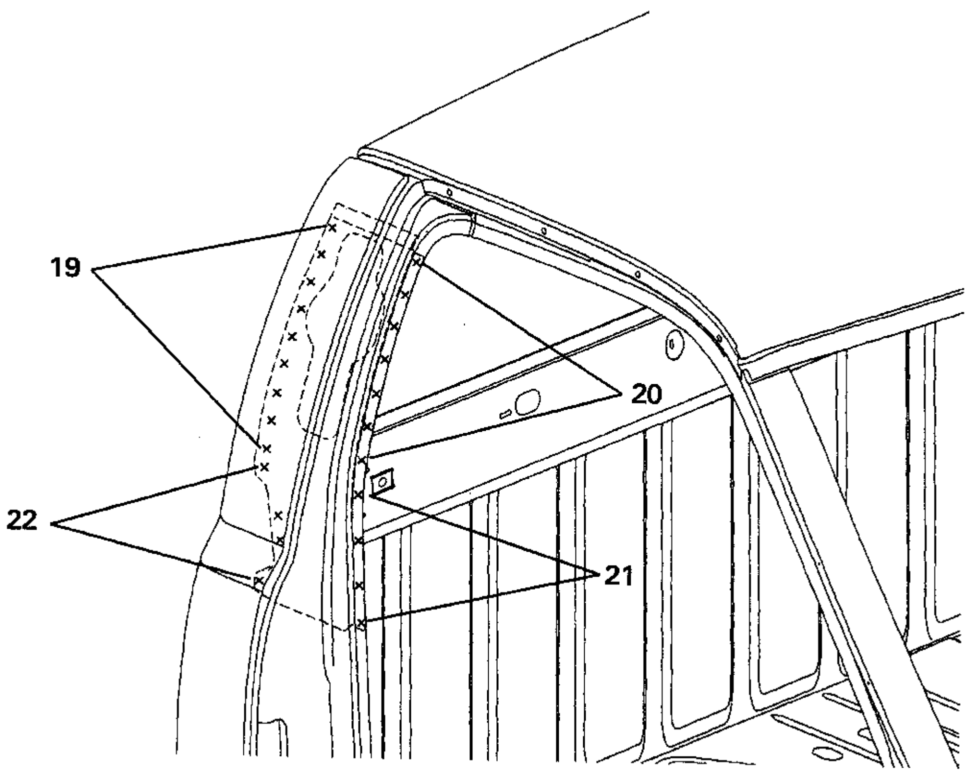
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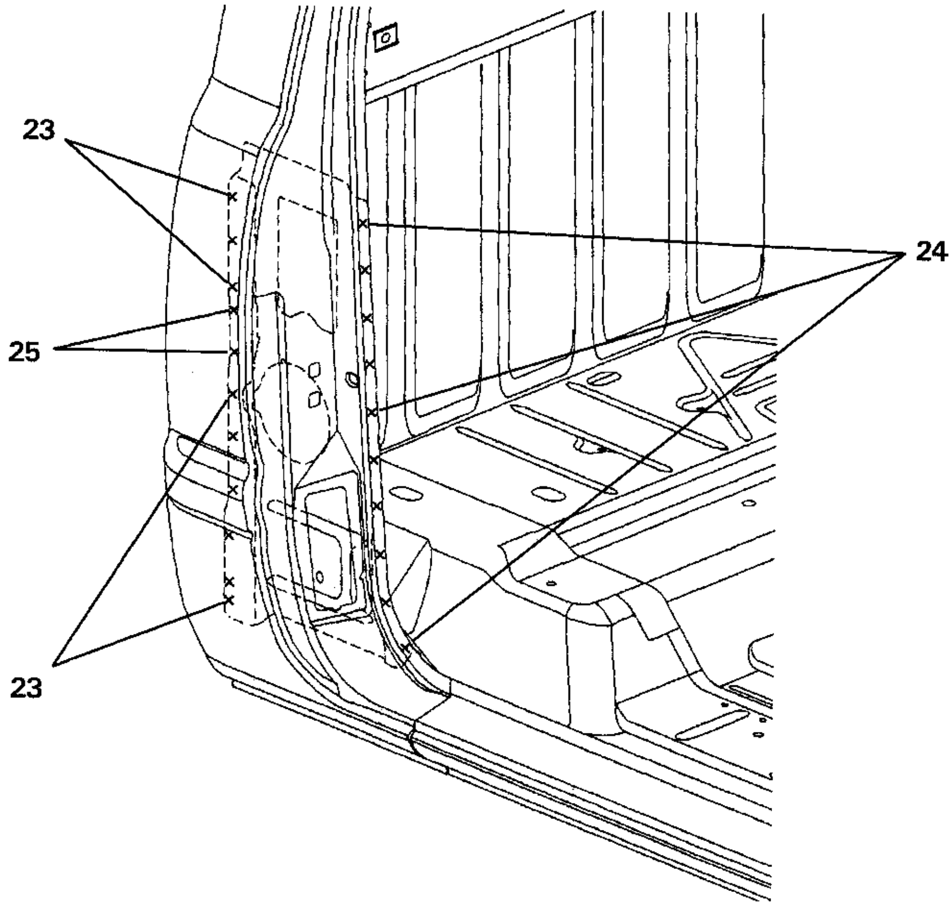
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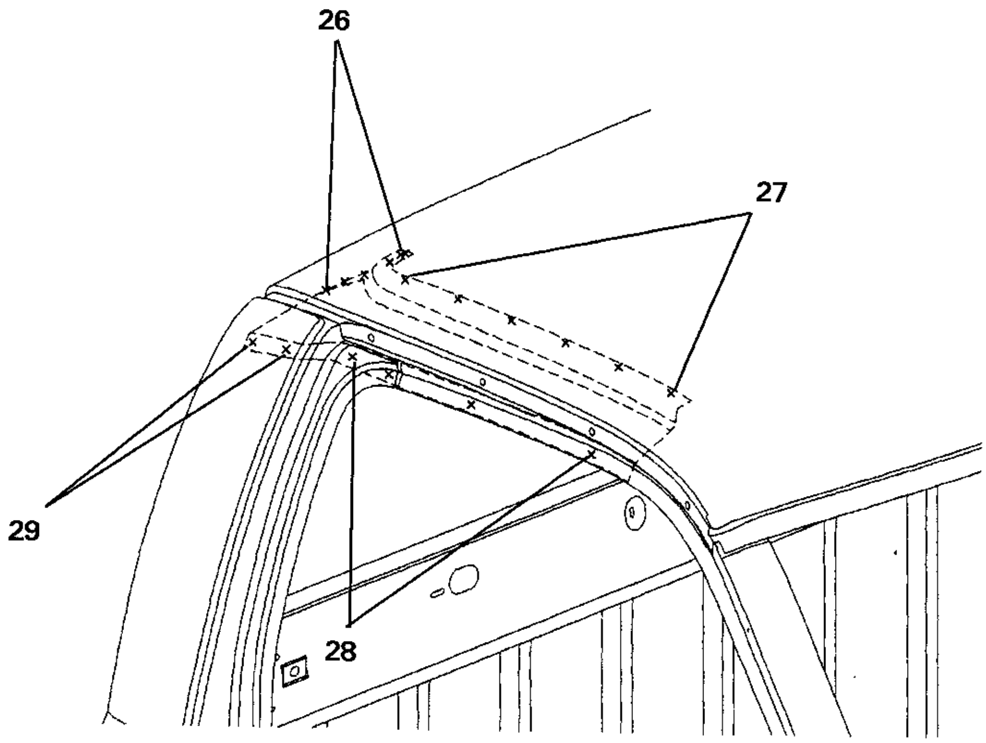
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NOTES WITH REGARD TO REPAIR WORK

- The side aperture is a multilayer assembly. Use care when separating panels to avoid unnecessary damage.
- The side aperture may be sectioned using the proper non-structural repair procedures.

REMOVAL

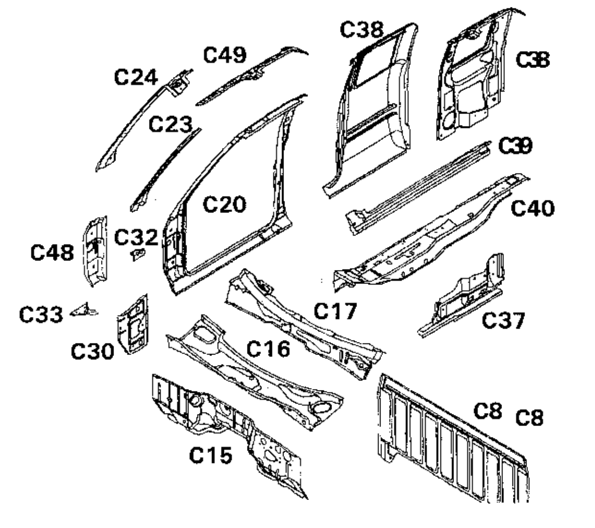
1. Using a spot weld cutter or hole saw, carefully cut all spot welds at indicated locations.
2. Using an air chisel, separate damaged panels and remove.
3. It may be necessary to remove undamaged panels to gain access to panel being replaced.

PREPARATION

1. Clean and remove old adhesive and sealers from panels.
2. Grind and prep all panel flanges.
3. Using old panels, transfer weld locations to new panel.

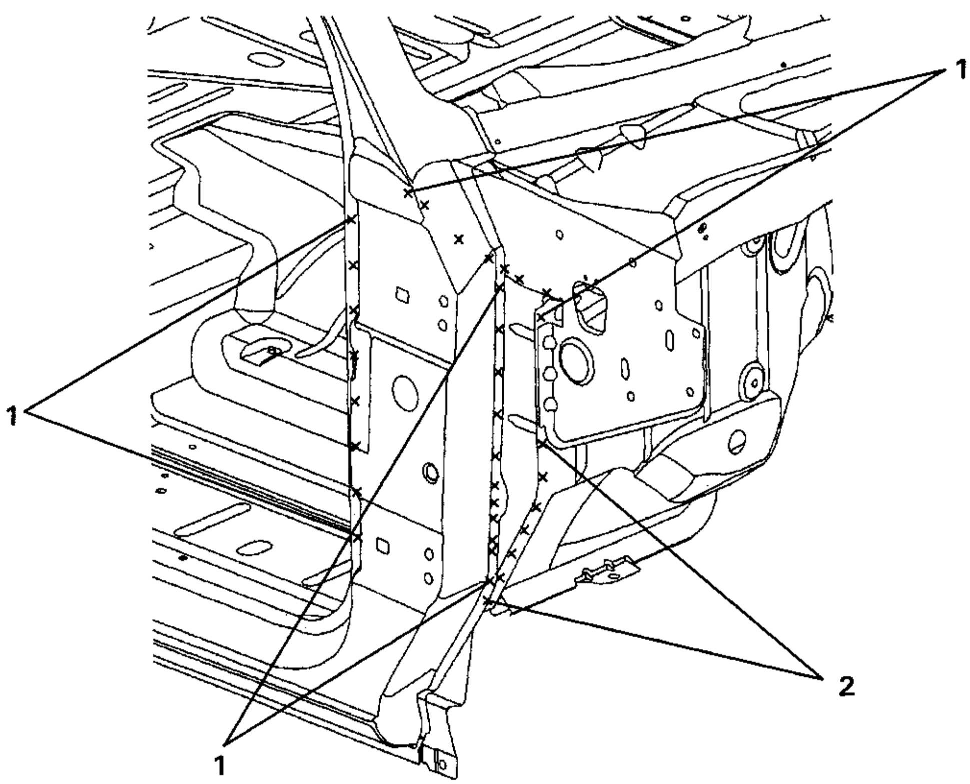
INSTALLATION

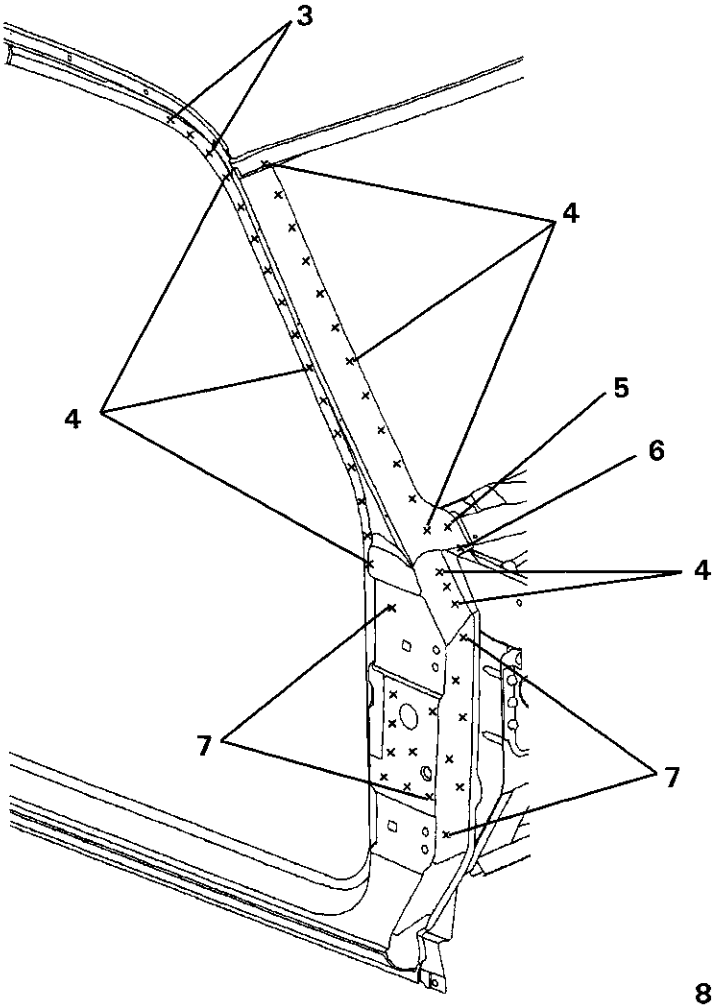
1. Install new panel, fit and align, then clamp in place.
2. Recheck alignment and fit, tack weld.
3. Complete all plug weld as required.
4. Treat all welds and panels with anti-corrosion materials as required.
5. Apply sealers as required.



No.	Welded Parts	F	R
1	C20 + C30	27 each side	P27
2	C15 + C30	7 each side	P7
3	C20 + C24	3 each side	P3
4	C20 + C23 + C24	28 each side	P28
5	C17 +C23 + C24	1 each side	P1
6	C17 + C24	1 each side	P1
7	C20 + C48	15 each side	P15
8	C23 + C48	4 each side	P4

No.	Welded Parts	F	R
9	C20 + C32	6 each side	P6
10	C3 + C20 + C30	9 each side	P9
11	C20 + C30 + C33	1 each side	P1
12	C20 + C33	3 each side	P3
13	C6 + C38	4 each side	P4
14	C20 + C49	6 each side	P6
15	C36 + C38	32 each side	P32
16	C20 + C36	2 each side	P2
17	C20 + C36 + C38	19 each side	P19
18	C38 + C39 + C40	3 each side	P3
19	C20 + C39 + C40	49 each side	P49
20	C20 + C38 + C40	6 each side	P6
21	C20 + C38	3 each side	P3
22	C27 + C37	3 each side	P3
23	C36 + C37	13 each side	P13
24	C20 + C37 + C38	4 each side	P4
25	C37 + C40	7 each side	P7
26	C37 + Tapping Plate Seat Belt O/B Anchor	4 each side	P4
27	C37 + C40	7 each side	P7
28	C8 + C37 + C38	6 each side	P6

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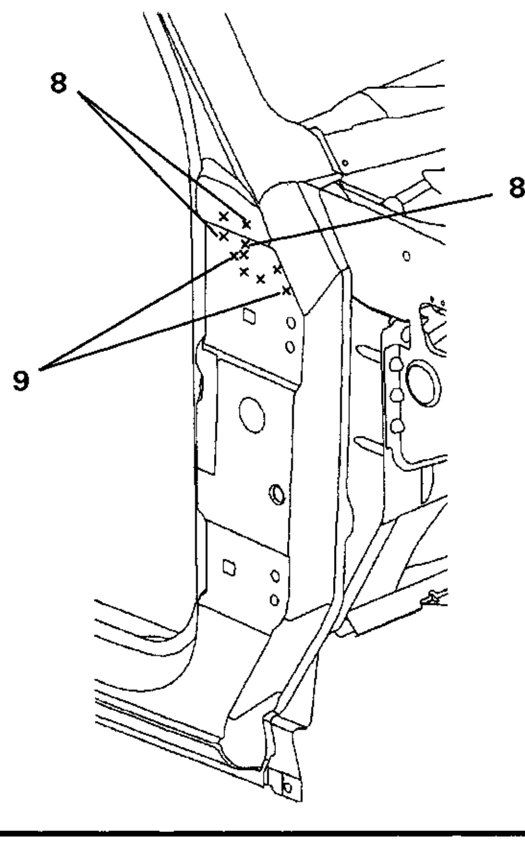
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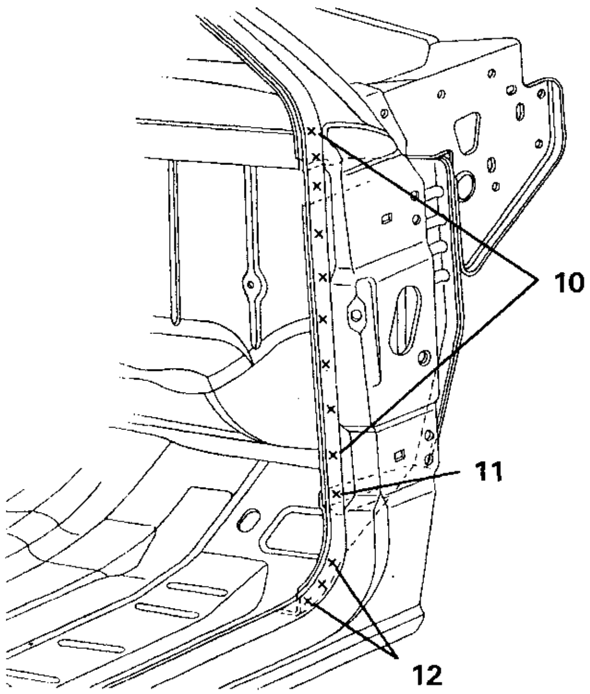
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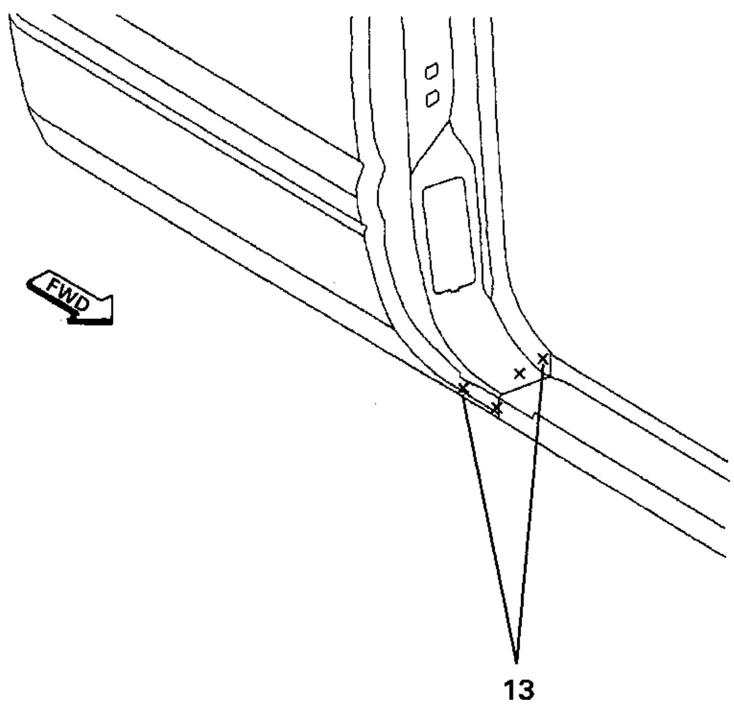
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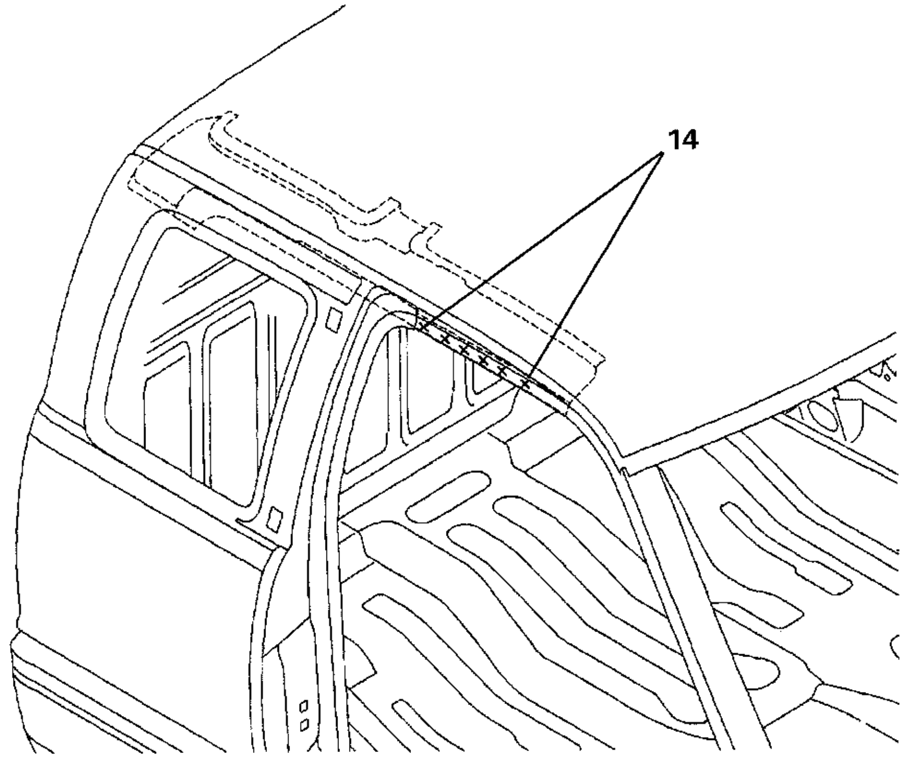
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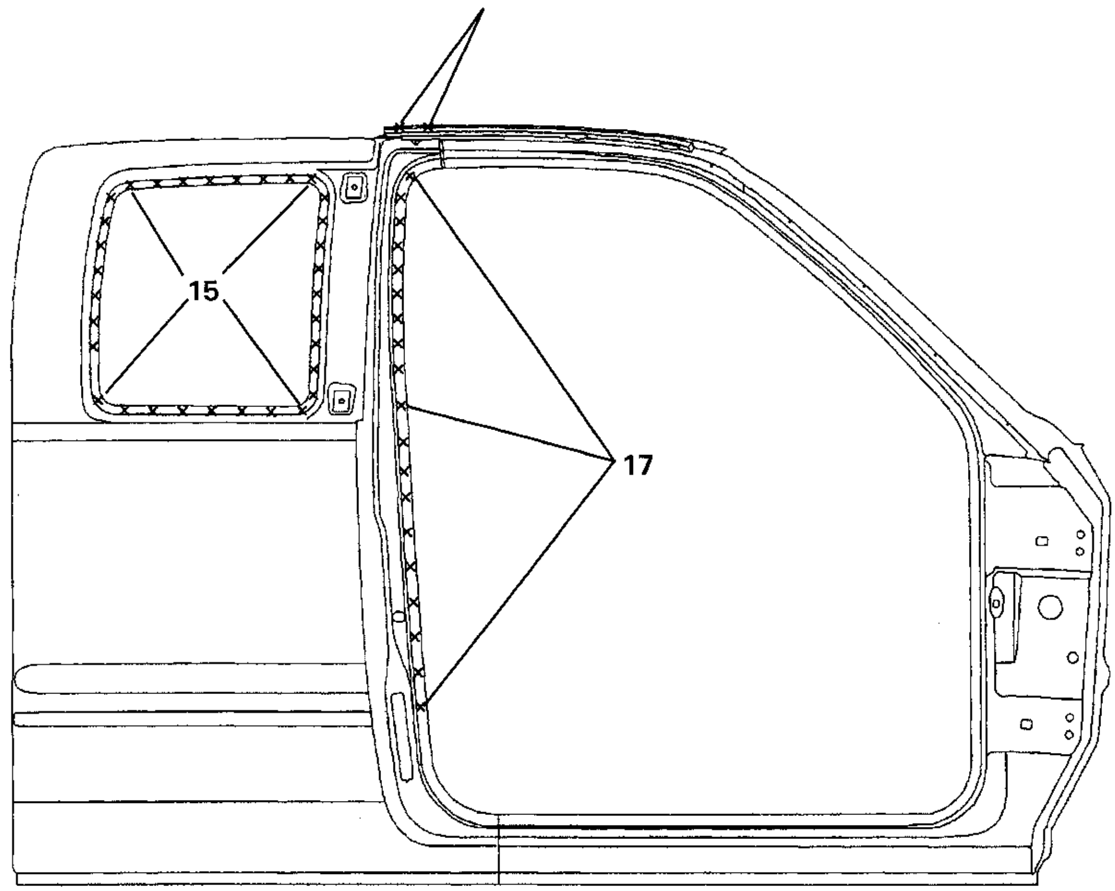
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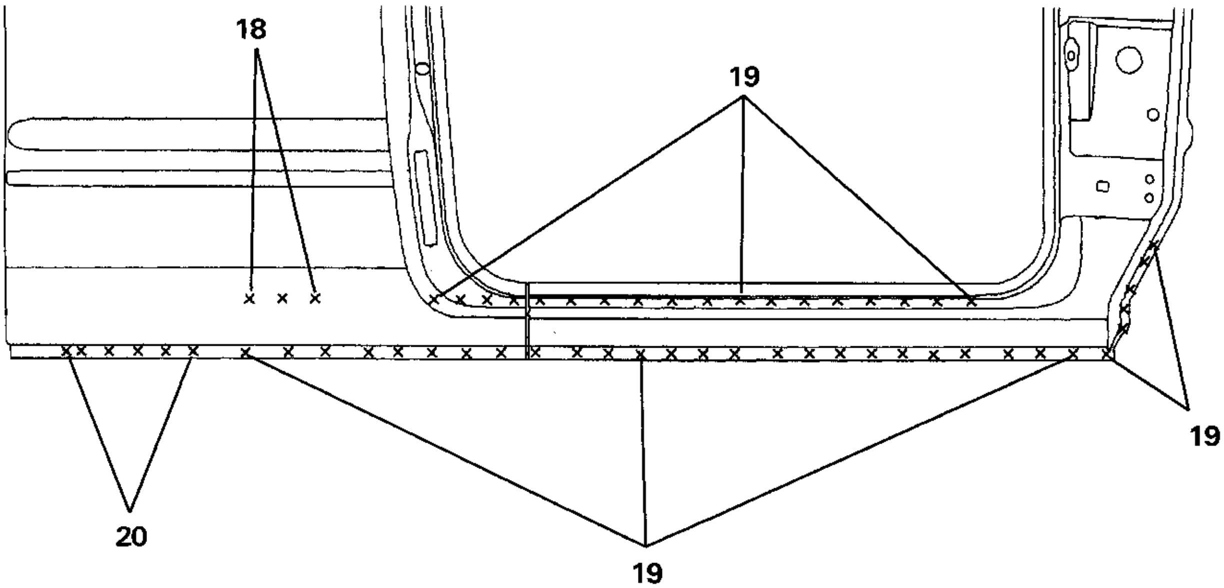
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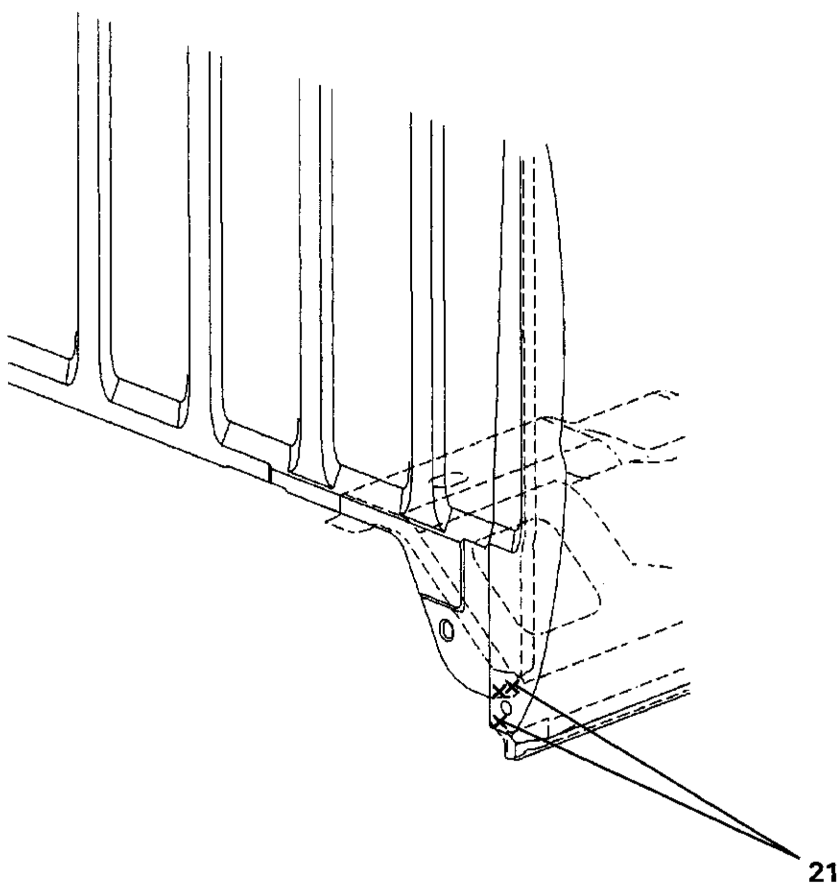

21

NOTES WITH REGARD TO REPAIR WORK

- The side aperture is a multilayer assembly. Use care when separating panels to avoid unnecessary damage.
- The side aperture may be sectioned using the proper non-structural repair procedures.

REMOVAL

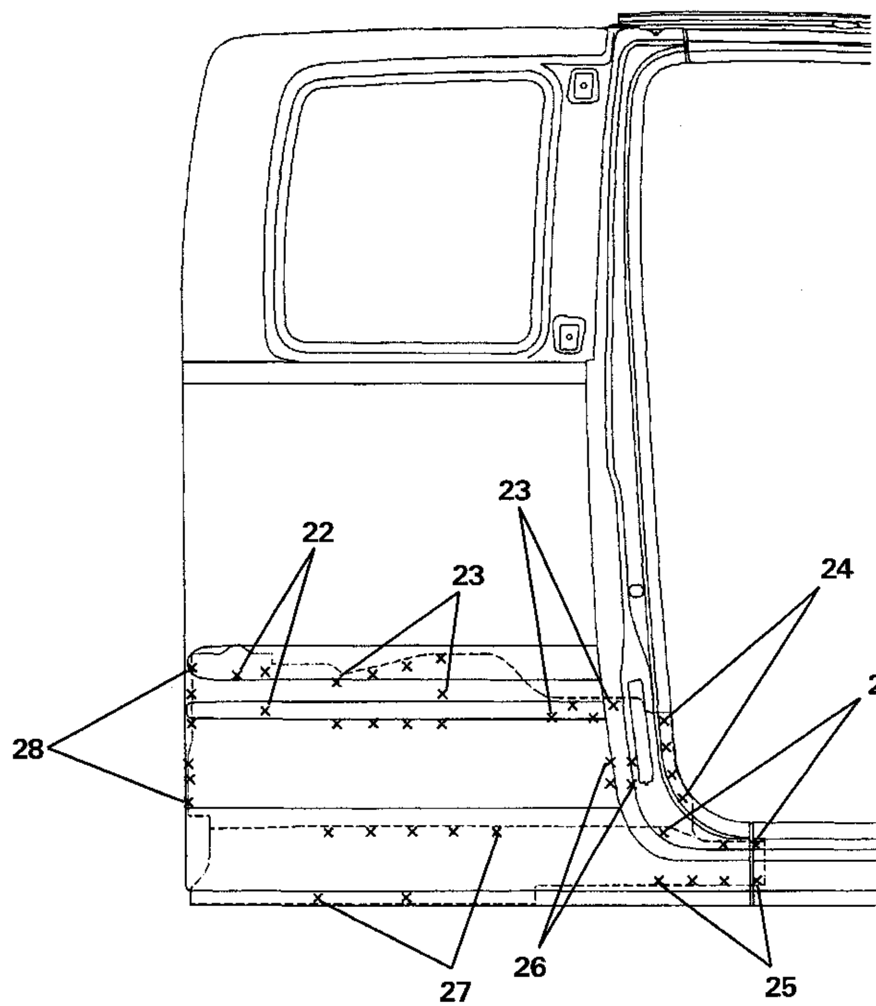
1. Using a spot weld cutter or hole saw, carefully cut all spot welds at indicated locations.
2. Using an air chisel, separate damaged panels and remove.
3. It may be necessary to remove undamaged panels to gain access to panel being replaced.

PREPARATION

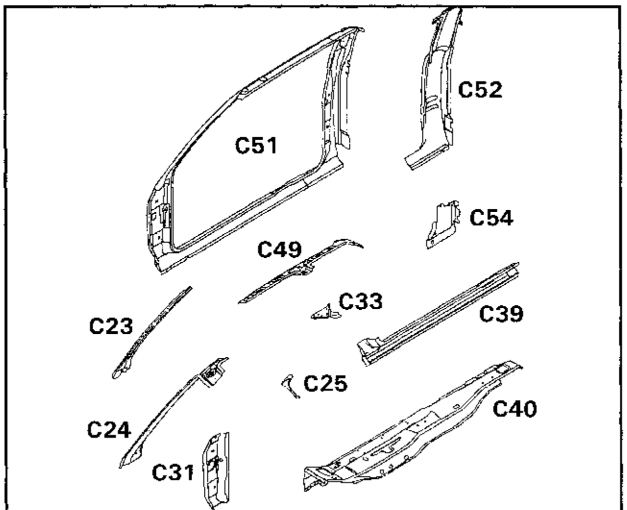
1. Clean and remove old adhesive and sealers from panels.
2. Grind and prep all panel flanges.
3. Using old panels, transfer weld locations to new panel.

INSTALLATION

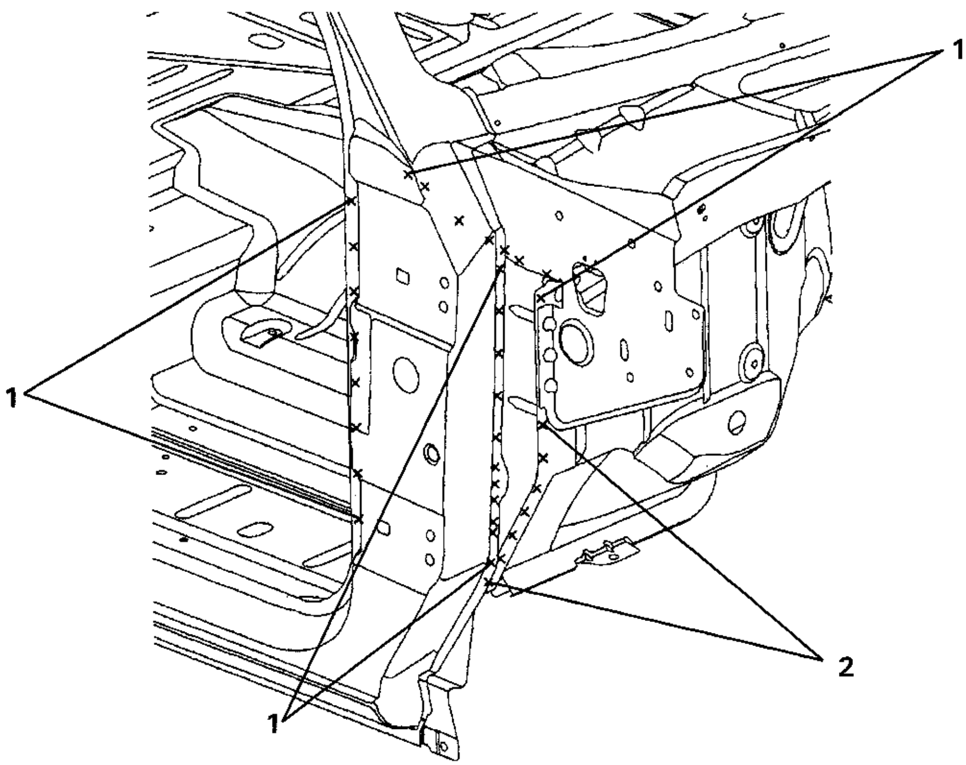
1. Install new panel, fit and align, then clamp in place.
2. Recheck alignment and fit, tack weld.
3. Complete all plug weld as required.
4. Treat all welds and panels with anti-corrosion materials as required.
5. Apply sealers as required.

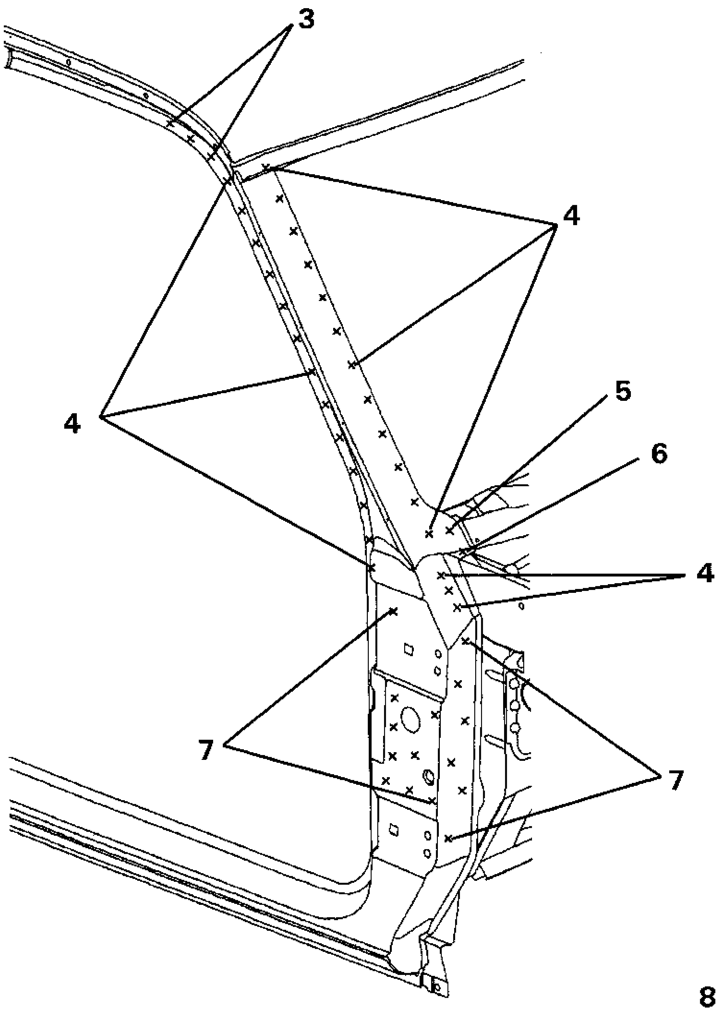


Body Side Aperture (Quad Cab)



No.	Welded Parts	F	R
1	C30 + C51	8 each side	P8
2	C15 + C30	7 each side	P7
3	C24 + C51	3 each side	P3
4	C23 + C24 + C51	28 each side	P28
5	C17 +C23 + C24	1 each side	P1
6	C17 + C24	1 each side	P1
7	C48 + C51	14 each side	P14
8	C23 + C48	3 each side	P3
9	C32 + C51	6 each side	P6
10	C3 + C30 + C51	9 each side	P9
11	C30 + C33 + C51	1 each side	P1
12	C33 + C51	3 each side	P3
13	C39 + C40 + C51	51 each side	P51
14	C40 + C51 + C57	5 each side	P5
15	C39 + C51	17 each side	P17
16	C39 + C51 + C52	2 each side	P2
17	C31 + C39 + C51	6 each side	P6
18	C9 + C40	5 each side	P5
19	C8 + C40 + C52	2 each side	P2
20	C40 + C52	2 each side	P2
21	C52 + C55	16 each side	P16
22	C51 + C53 + C55	10 each side	P10
23	C51 + C54 + C55	2 each side	P2
24	C39 + C51 + C55	2 each side	P2
25	C51 + C52	5 each side	P5
26	C1 + Tapping Plate RR Seat Belt Anchor	4 each side	P4
27	C51 + C52 + C53	22 each side	P22
28	C51 + C53	4 each side	P4
29	C51 + C52	38 each side	P38
30	C27 + C54	1 each side	P1
31	C27 + C53 + C54	4 each side	P4
32	C8 + C51 + C54	3 each side	P3
33	C27 + C54	5 each side	P5
34	C40 + C45	5 each side	P5

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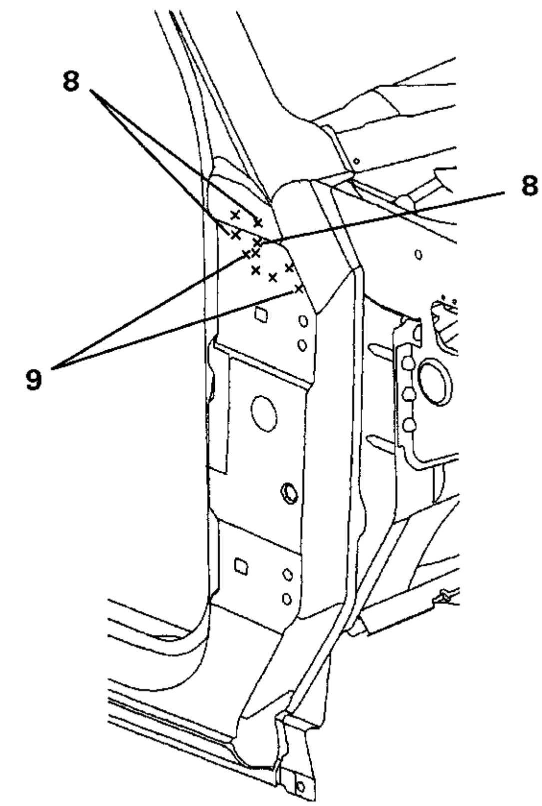
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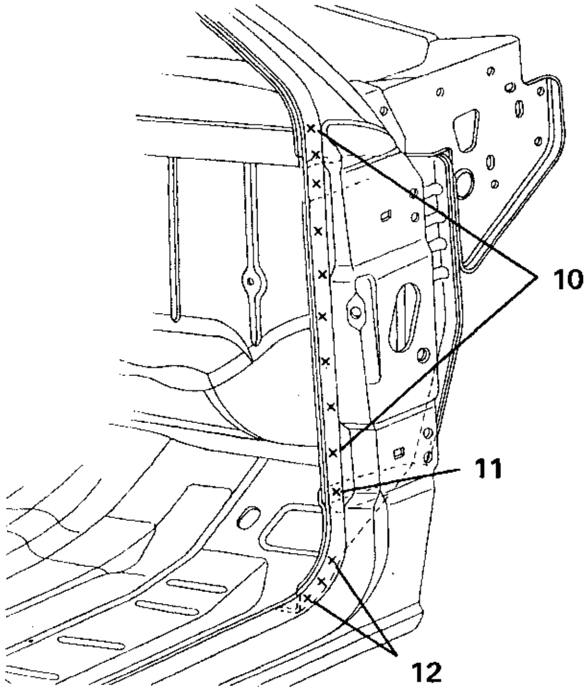
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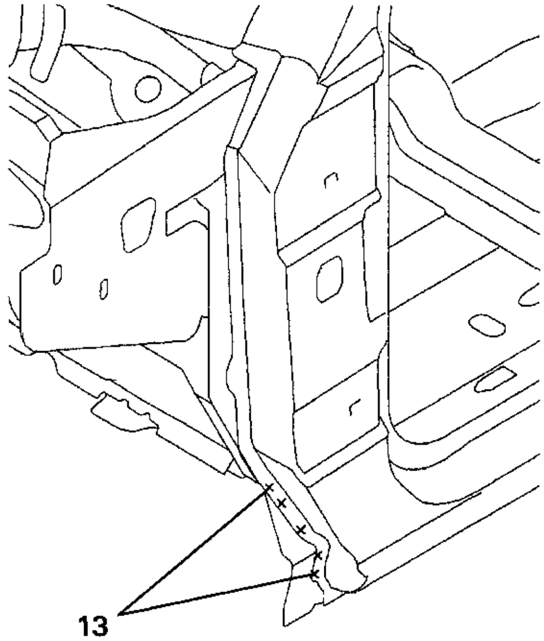
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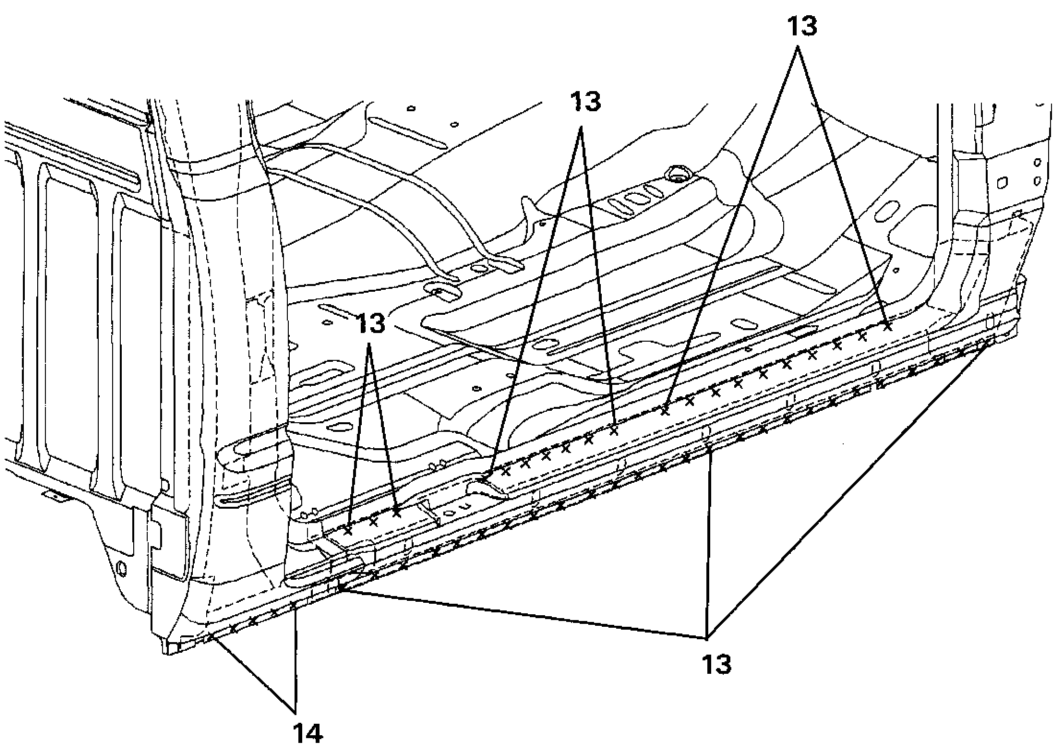
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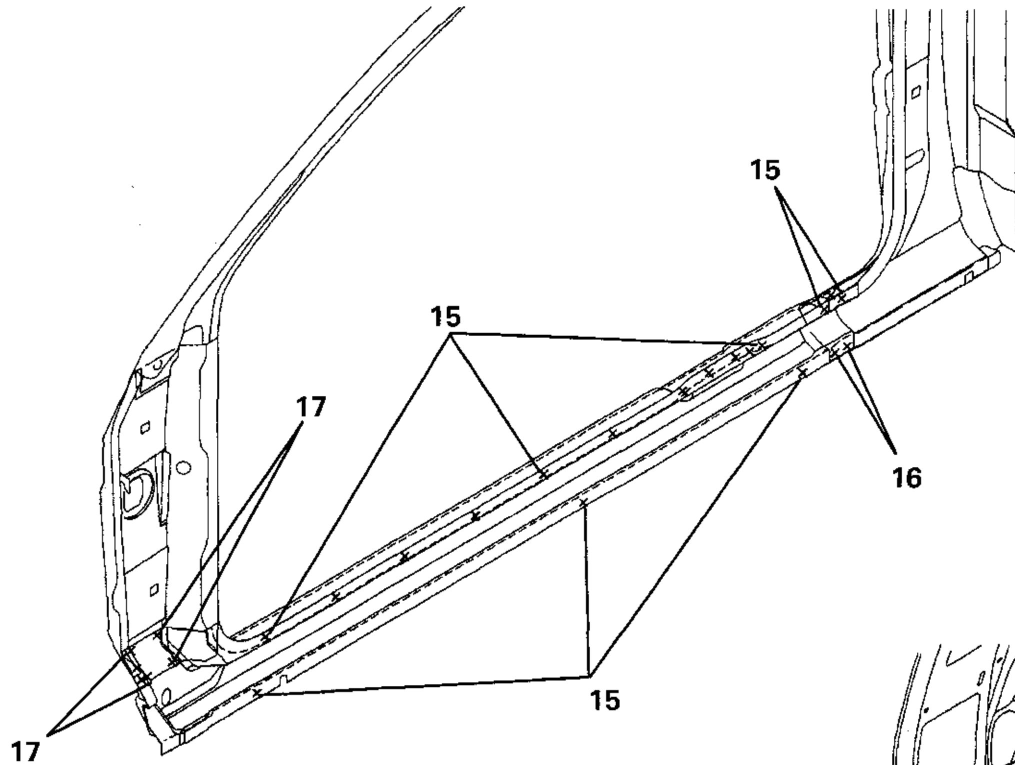
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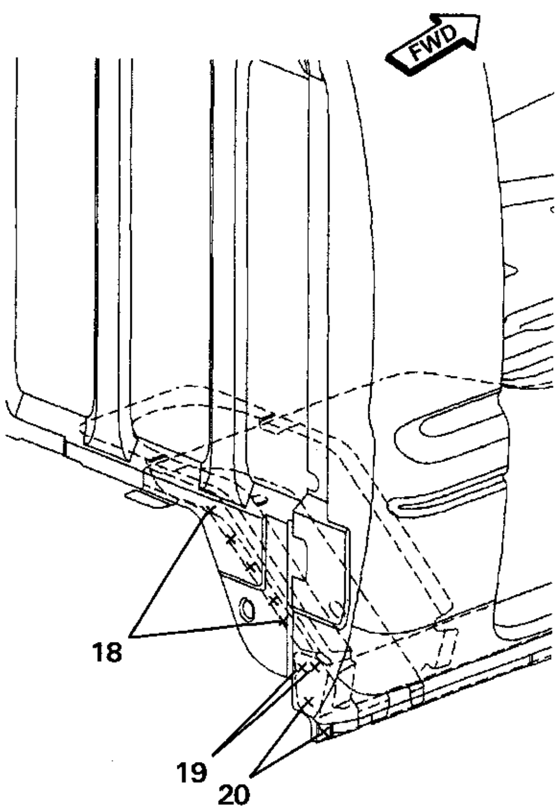
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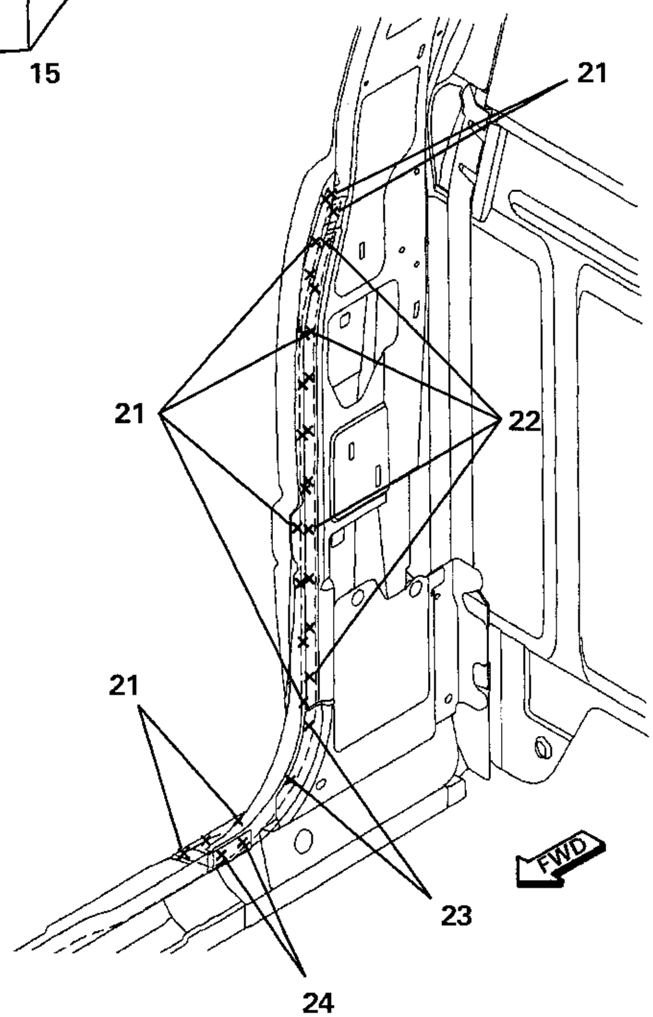
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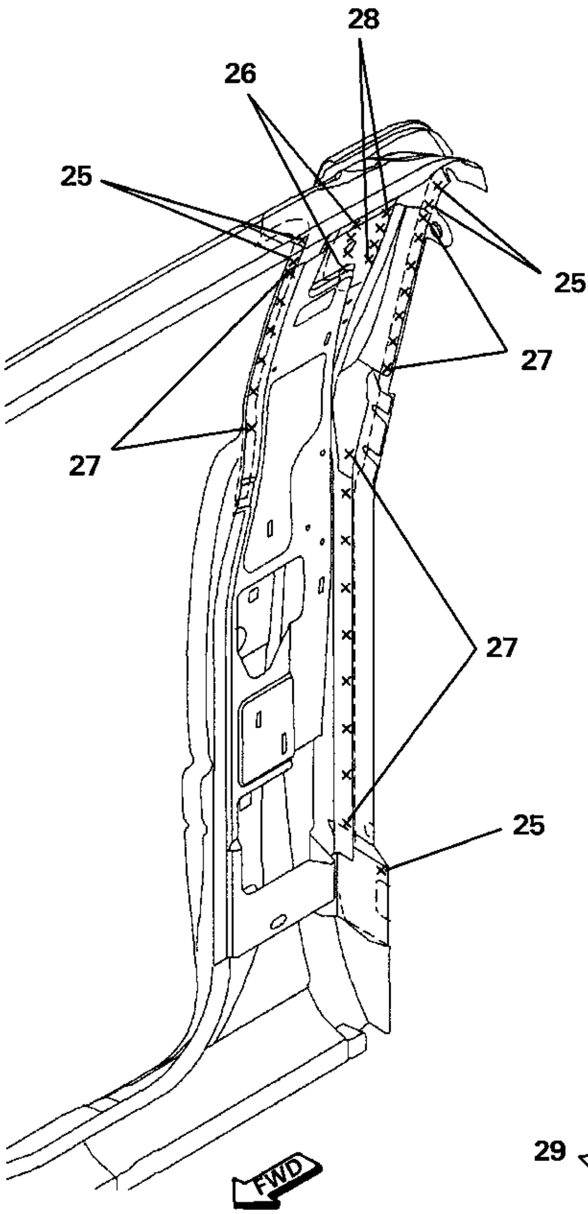
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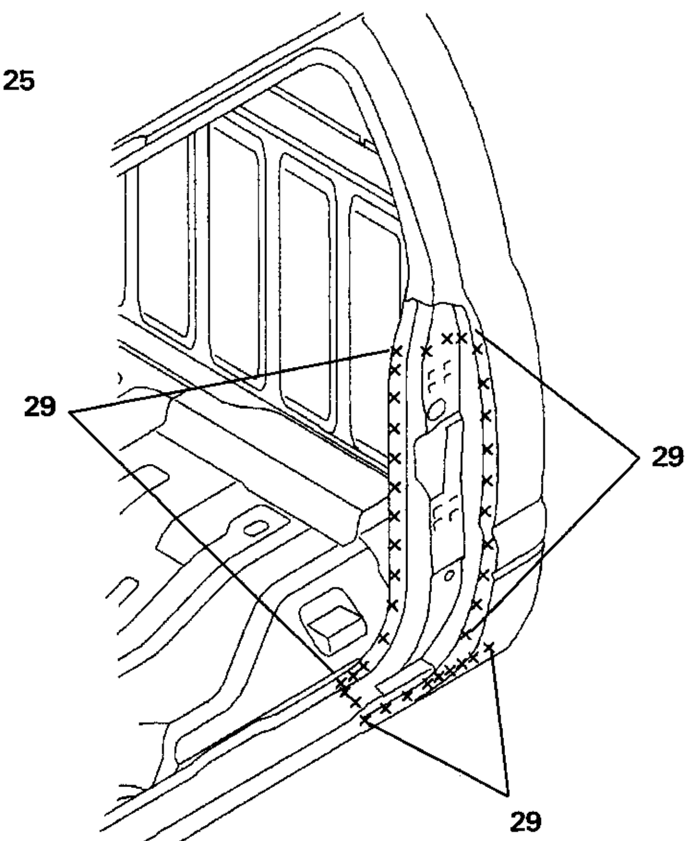
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NOTES WITH REGARD TO REPAIR WORK

- The side aperture is a multilayer assembly. Use care when separating panels to avoid unnecessary damage.
- The side aperture may be sectioned using the proper non-structural repair procedures.

REMOVAL

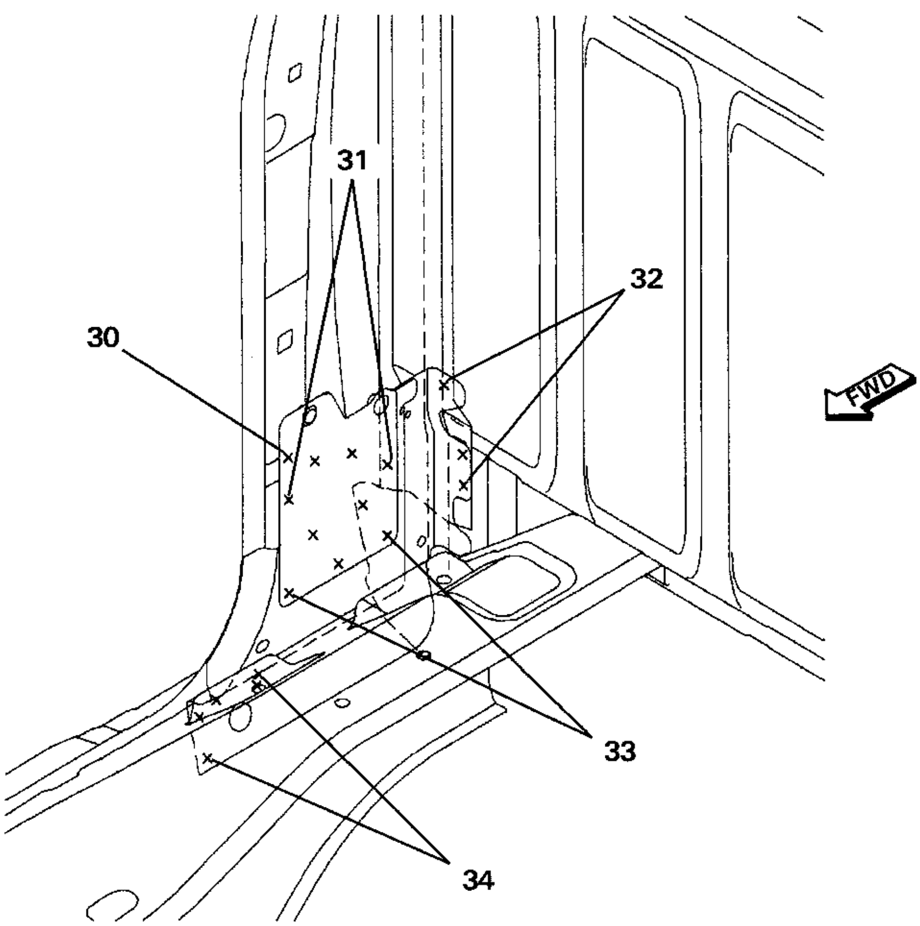
1. Using a spot weld cutter or hole saw, carefully cut all spot welds at indicated locations.
2. Using an air chisel, separate damaged panels and remove.
3. It may be necessary to remove undamaged panels to gain access to panel being replaced.

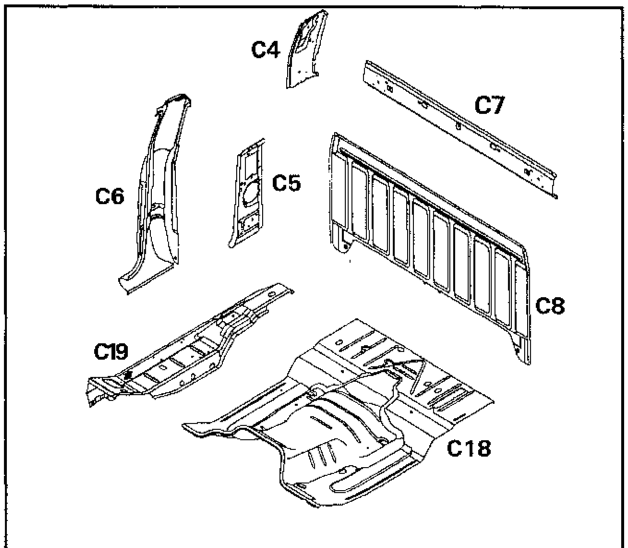
PREPARATION

1. Clean and remove old adhesive and sealers from panels.
2. Grind and prep all panel flanges.
3. Using old panels, transfer weld locations to new panel.

INSTALLATION

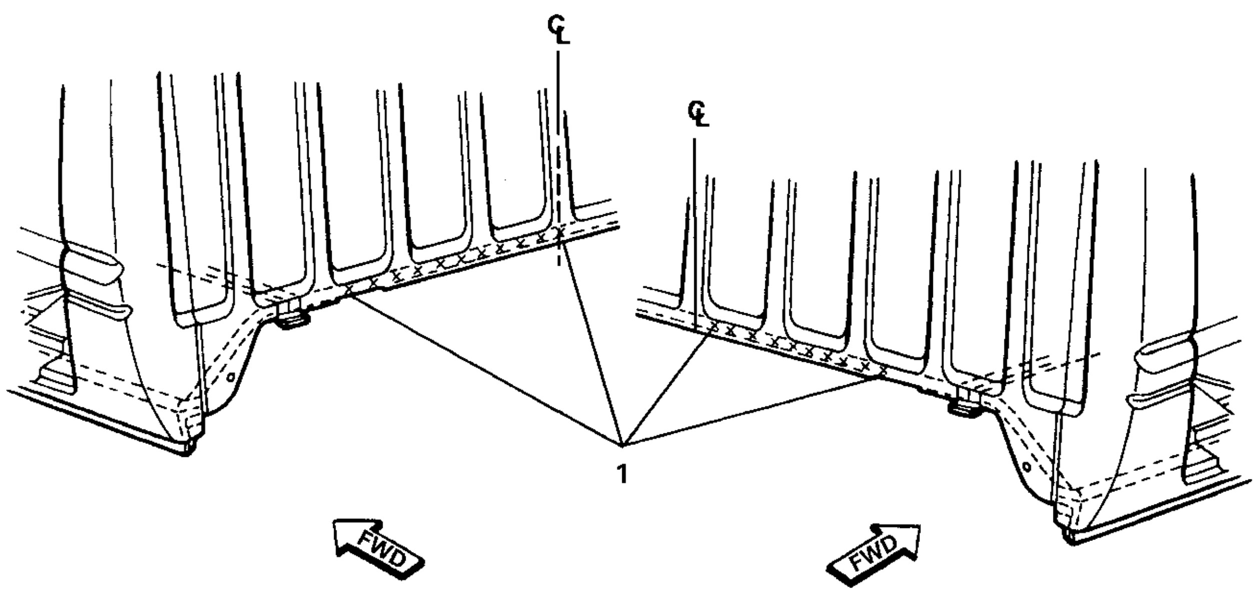
1. Install new panel, fit and align, then clamp in place.
2. Recheck alignment and fit, tack weld.
3. Complete all spot or plug weld as required.
4. Treat all welds and panels with anti-corrosion materials as required.
5. Apply sealers as required.





No.	Welded Parts	F	R
1	C8 + C18	21	P21
2	C8 + C18	1 each side	P1
3	C8 + C18 + C19	1 each side	P1
4	C8 + C19	7 each side	P7
5	C6 +C8 + C19	1 each side	P1

No.	Welded Parts	F	R
6	C6 + C8	12 each side	P12
7	C6 + C8	3 each side	P3
8	C6 + C7 + C8	1 each side	P1
9	C7 + C8	11 each side	P11
10	C7 + C8	9 each side	P9



NOTES WITH REGARD TO REPAIR WORK

- To replace this panel, it will be necessary to remove the inner trim around the rear window area.
- The rear window will need to be removed as well as the cargo box.
- Use caution when welding or grinding; cover, remove or protect all flammable materials from sparks.

REMOVAL

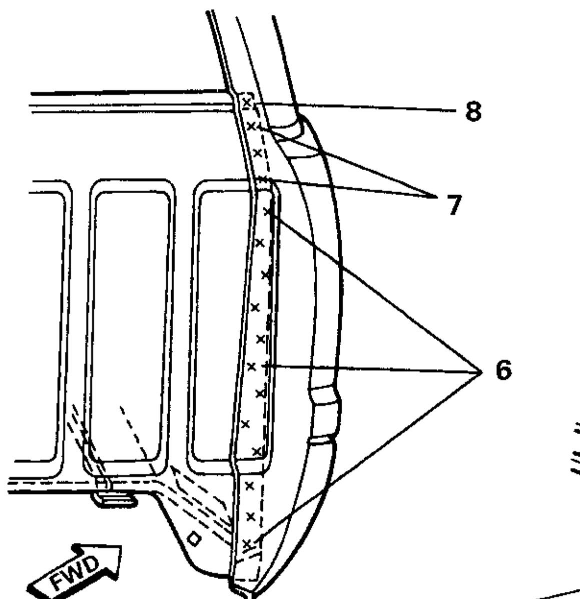
1. Using a spot weld cutter or hole saw, carefully cut all spot welds where indicated. It will be necessary to remove the rear cab panel reinforcement and extensions first to gain access to hidden welds.
2. If replacing rear cab panel, it may be cut into smaller sections to aid in removal.

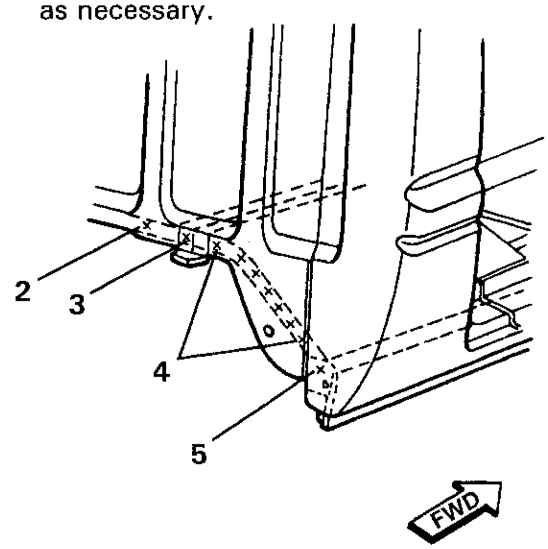
PREPARATION

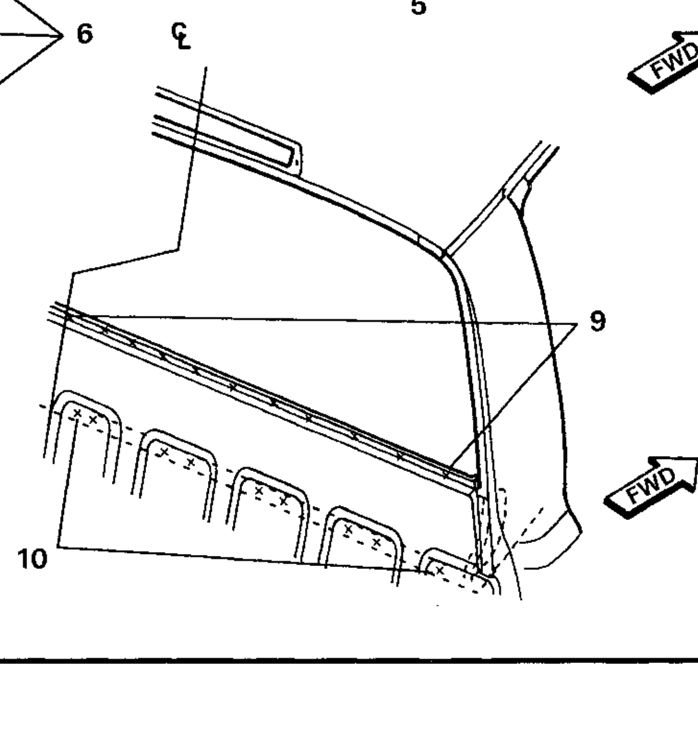
1. Clean all weld surfaces and remove old sealers.
2. Transfer weld location points to new panels using damaged panel as a guide/template if possible.

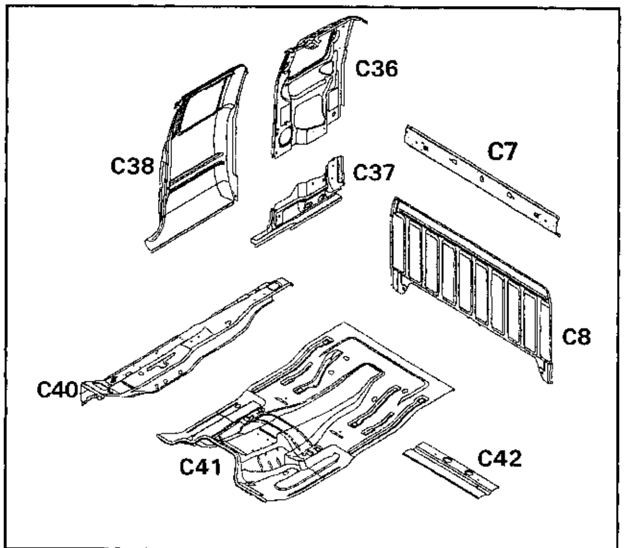
INSTALLATION

1. The new panel will have to be installed from inside the cab and worked into place.
2. Clamp or tack weld into place.
3. Recheck fit and alignment.
4. Complete all plug welds.
5. Finish exterior surfaces at weld locations.
6. Apply anti-corrosion and sealing materials as necessary.



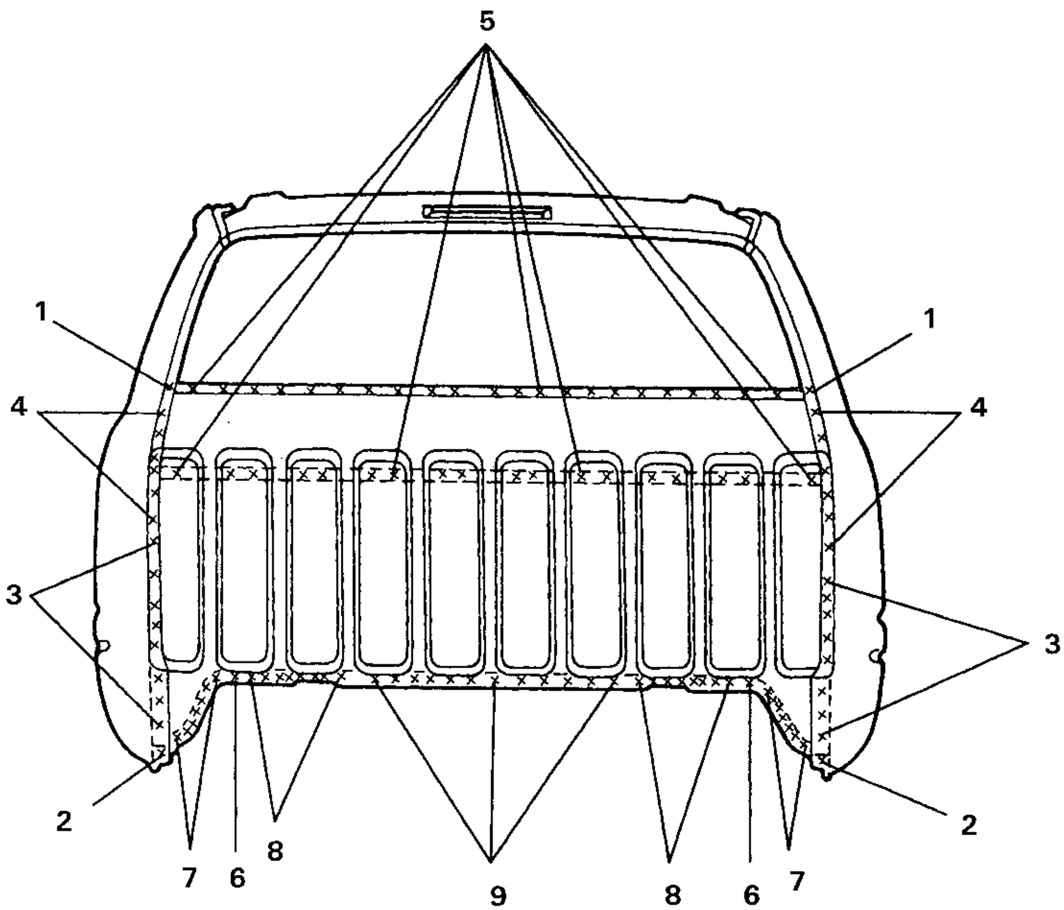






No.	Welded Parts	F	R
1	C6 + C7 +C8	1 each side	P1
2	C6 + C8 + C19	1 each side	P1
3	C5 + C6 + C8	8 each side	P8
4	C4 + C6 + C8	6 each side	P6
5	C7 +C8	40	P40

No.	Welded Parts	F	R
6	C8 + C18	1 each side	P1
7	C8 + C19	7 each side	P7
8	C8 + C18	8 each side	P8
9	C8 + C18 + Seat Belt Reinforcement	12	P12
10	C4 + C6 +C8	3 each side	P3
11	C7 + C8 + Reinforce-ment Extension	4 each side	P4
12	C4 + C6 + Reinforce-ment Extension	2 each side	P2
13	C4 + C6 + Reinforce-ment Extension	3 each side	P3
14	C4 + Reinforcement Extension	3 each side	P3
15	C5 + C8	11	P11

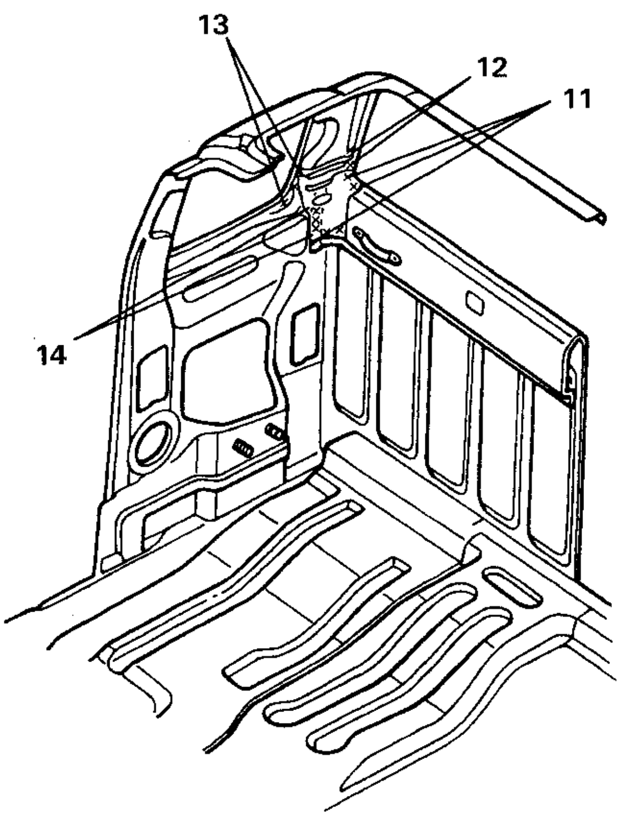


NOTES WITH REGARD TO REPAIR WORK

- To replace this panel, it will be necessary to remove the inner trim around the rear window area.
- The rear window will need to be removed as well as the cargo box.
- Use caution when welding or grinding; cover, remove or protect all flammable materials from sparks.

REMOVAL

1. Using a spot weld cutter or hole saw, carefully cut all spot welds at indicated. It will be necessary to remove the rear cab panel reinforcement and extensions first to gain access to hidden welds.
2. If replacing rear cab panel, it may be cut into smaller sections to aid in removal.

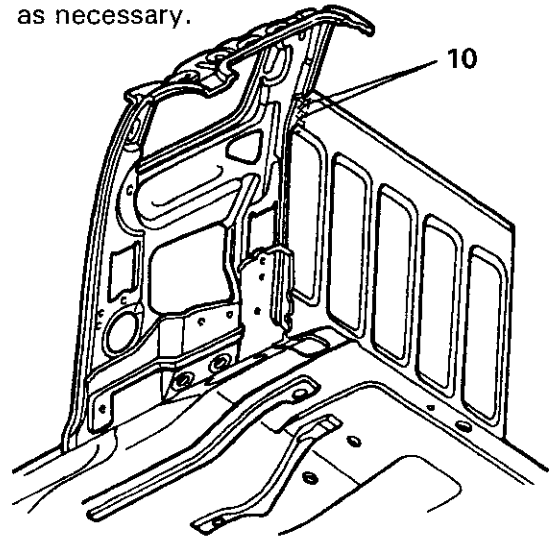


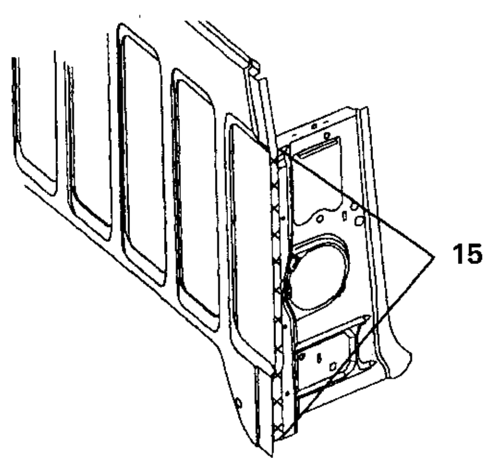
PREPARATION

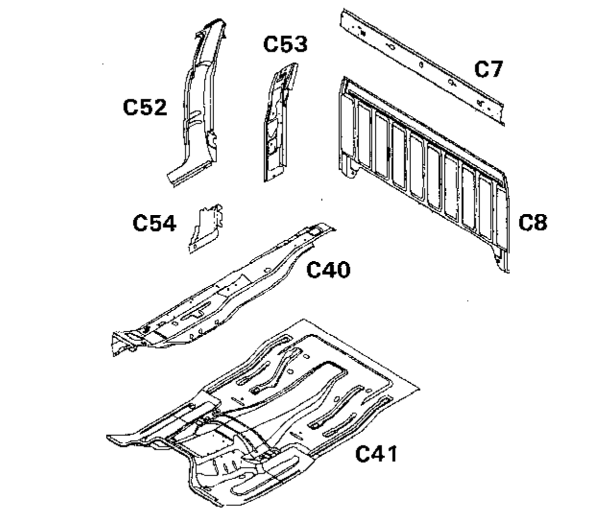
1. Clean all weld surfaces and remove old sealers.
2. Transfer weld location points to new panels using damaged panel as a guide/template if possible.

INSTALLATION

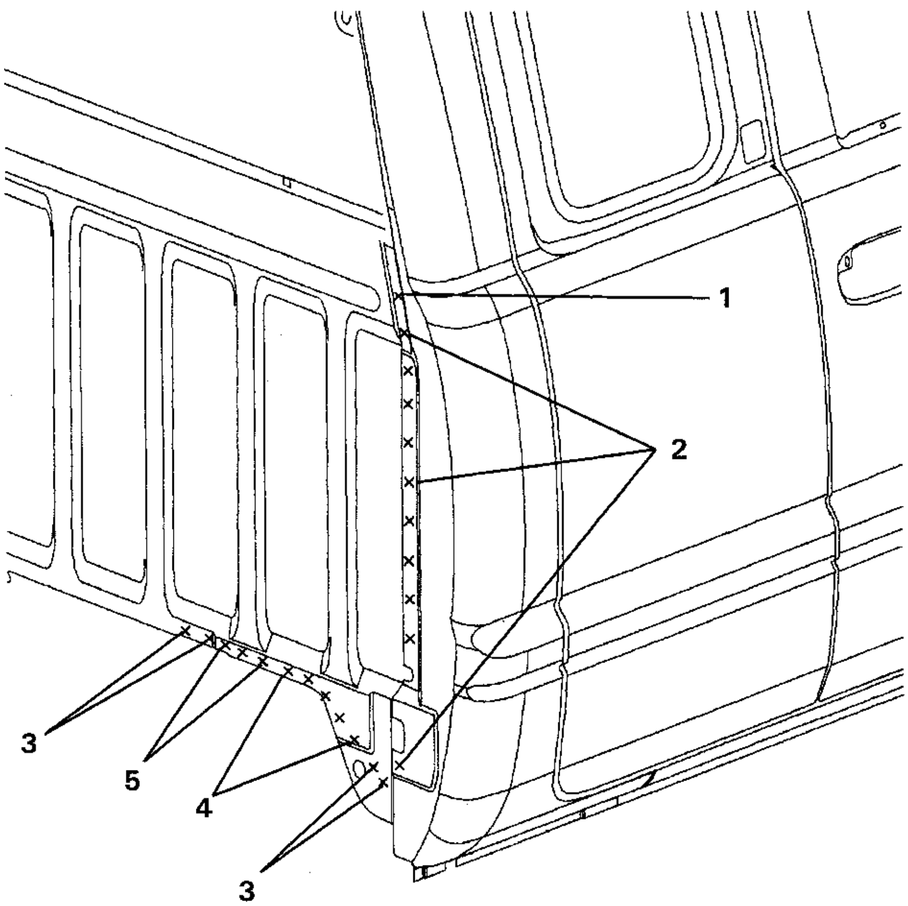
1. The new panel will have to be installed from inside the cab and worked into place.
2. Clamp or tack weld into place.
3. Recheck fit and alignment.
4. Complete all plug welds.
5. Finish exterior surfaces at weld locations.
6. Apply anti-corrosion and sealing materials as necessary.







No.	Welded Parts	F	R
1	C8 + C52	1 each side	P1
2	C8 + C51 + C52	1 each side	P1
3	C8 + C40	8 each side	P8
4	C8 + C40 + Reinforcement Cab Back Lower	5 each side	P5
5	C8 + C41 + Reinforcement Cab Back Lower	3 each side	P3
6	C34 + C52	20 each side	P20



NOTES WITH REGARD TO REPAIR WORK

- To replace this panel, it will be necessary to remove the inner trim around the rear window area.
- The rear window will need to be removed as well as the cargo box.
- Use caution when welding or grinding; cover, remove or protect all flammable materials from sparks.

REMOVAL

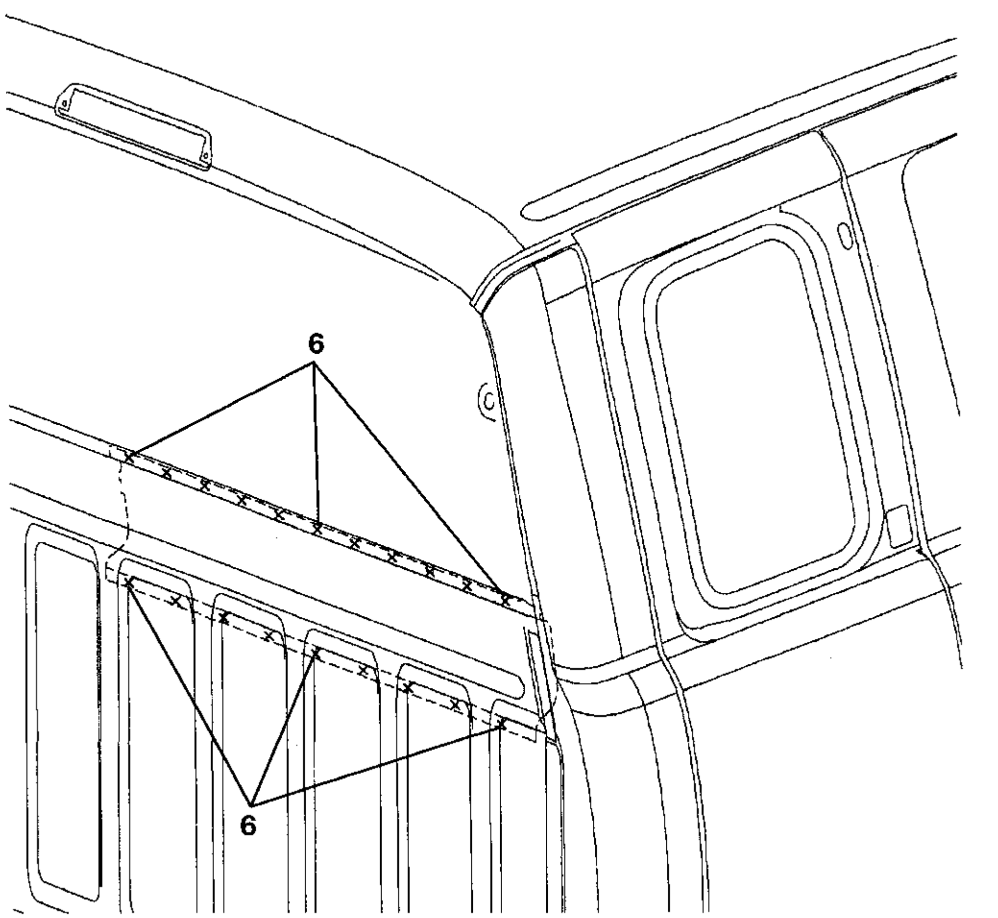
1. Using a spot weld cutter or hole saw, carefully cut all spot welds where indicated. It will be necessary to remove the rear cab panel reinforcement and extensions first to gain access to hidden welds.
2. If replacing rear cab panel, it may be cut into smaller sections to aid in removal.

PREPARATION

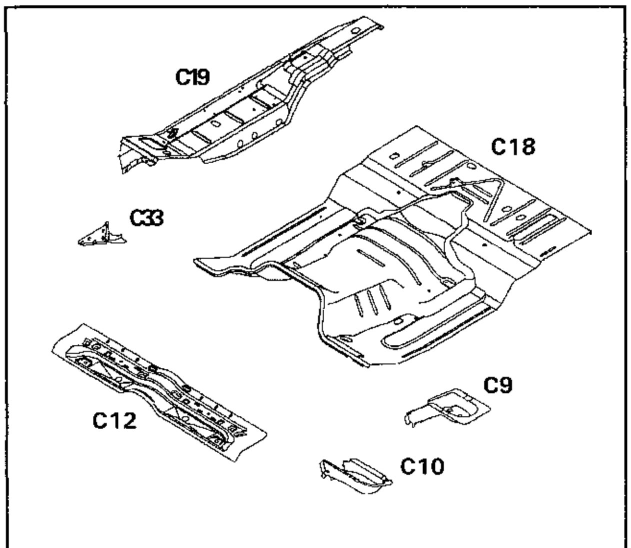
1. Clean all weld surfaces and remove old sealers.
2. Transfer weld location points to new panels using damaged panel as a guide/template if possible.

INSTALLATION

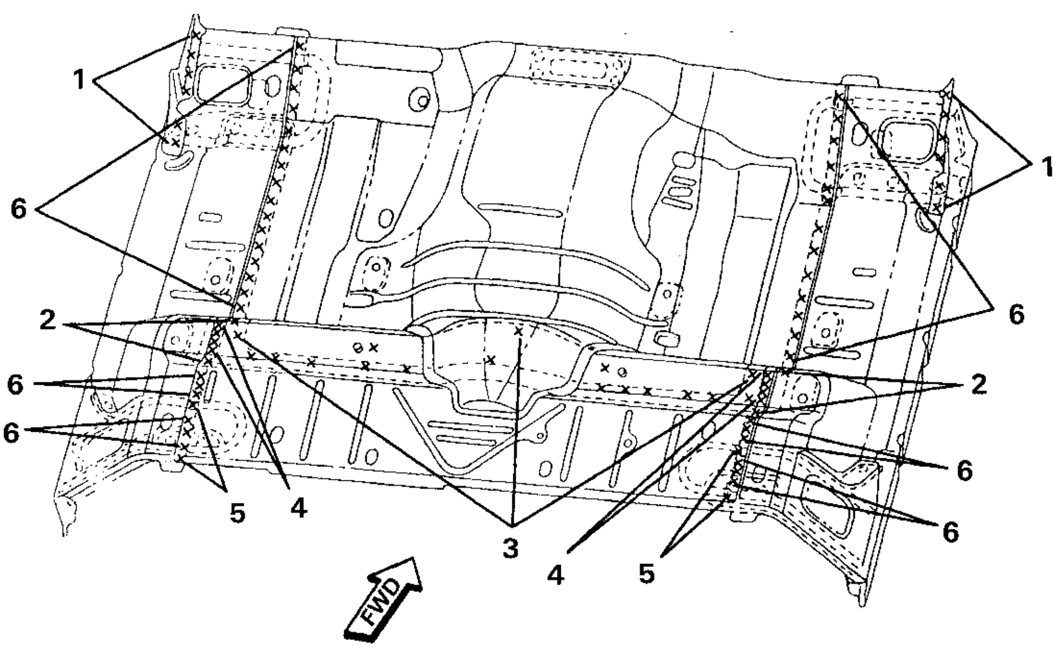
1. The new panel will have to be installed from inside the cab and worked into place.
2. Clamp or tack weld into place.
3. Recheck fit and alignment.
4. Complete all plug welds.
5. Finish exterior surfaces at weld locations.
6. Apply anti-corrosion and sealing materials as necessary.



Floor Pan (Regular Cab)



No.	Welded Parts	F	R
1	C19 + C23	6 each side	P6
2	C12 + C18 + C19	2 each side	P2
3	C12 + C18	17	P17
4	C12 + C18 + C19	4 each side	P4
5	C9 + C18 + C19	2 each side	P2
6	C18+ C19	22 each side	P22
7	C9 + C18	8 each side	P8
8	C9 + C19	14 each side	P14
9	C9 + C19	7 each side	P7
10	C10 + C18	4 each side	P4
11	C10 + C19	8 each side	P8
12	C12 + C18	5 each side	P5
13	C18 + C19	2 each side	P2
14	C10 + C19 + C33	7 each side	P14



NOTES WITH REGARD TO REPAIR WORK

- The floor pan is made up of three separate panels. Each panel can be replaced individually.
- Replacing any of these panels is difficult. Many other panels and components have to be removed to gain access to the damaged panel. Use care not to damage other panels.

REMOVAL

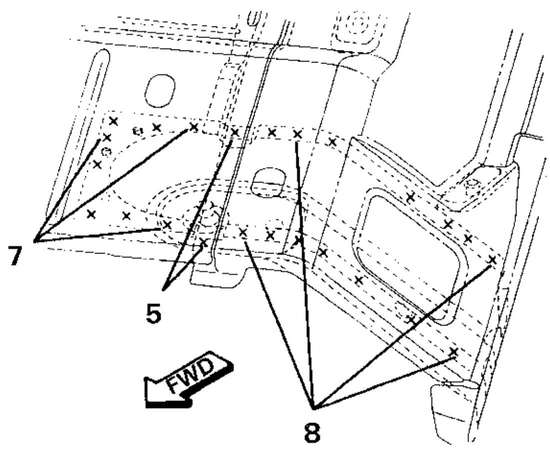
1. Refer to cowl, side aperture and cab back panel sections for additional weld location information.
2. Carefully cut all spot welds and remove undamaged panels.
3. Cut all remaining spot welds and remove damaged panel.

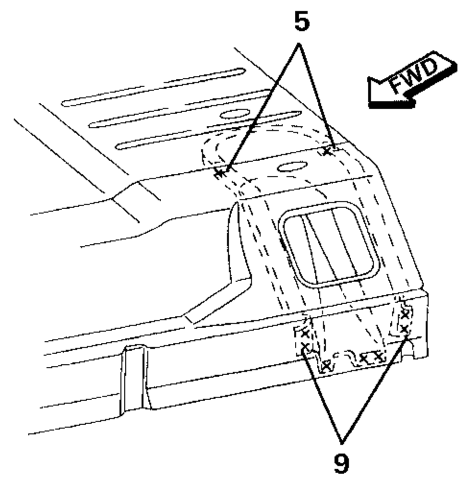
PREPARATION

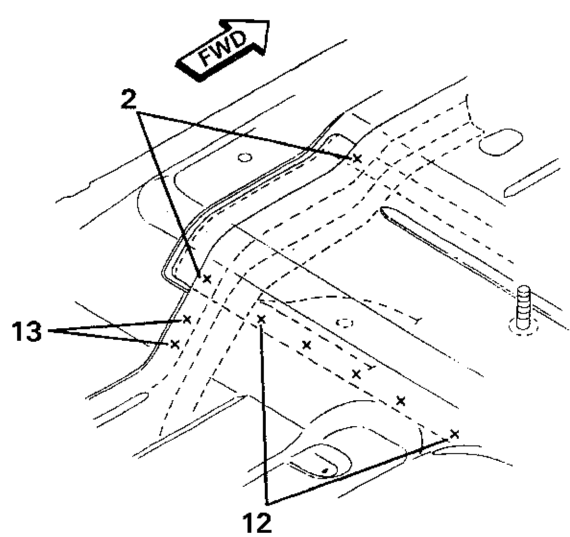
1. Using damaged panel, transfer weld locations to new panel.
2. Clean and prep all panel attaching surfaces.

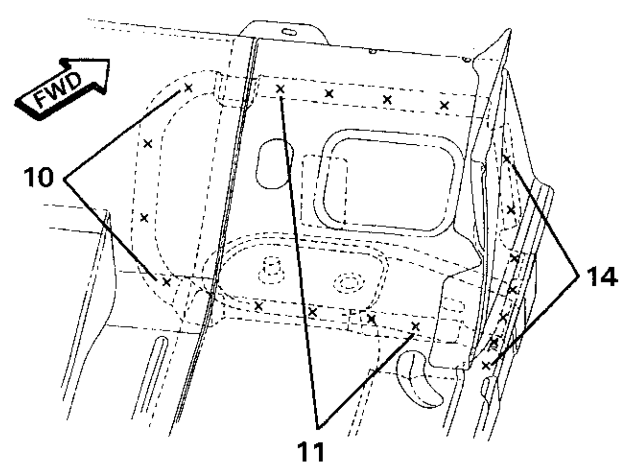
INSTALLATION

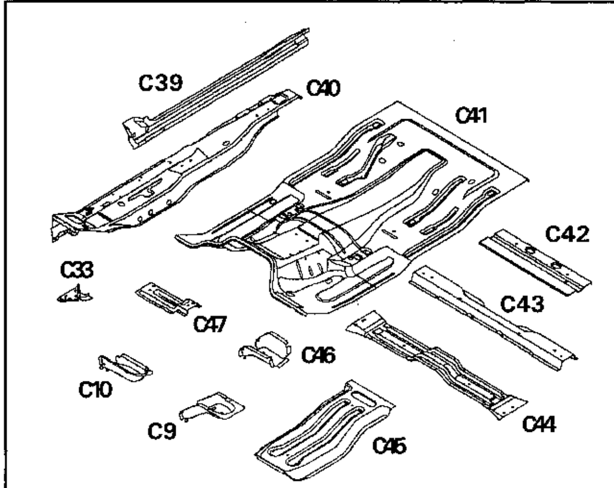
1. Align and temporarily tack weld new panel into place.
2. Recheck for fit and alignment.
3. Complete all spot or plug welds.
4. Reinstall all remaining panels.
5. Apply sealer and anti-corrosion materials as required.





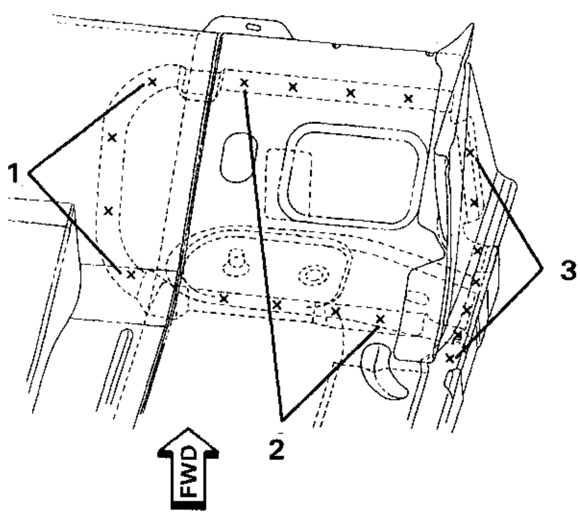


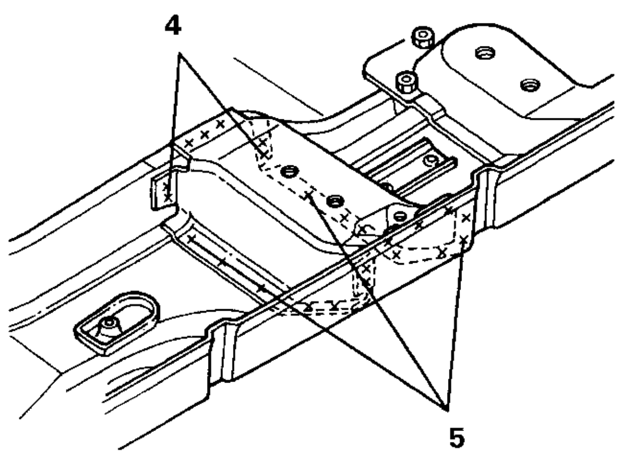


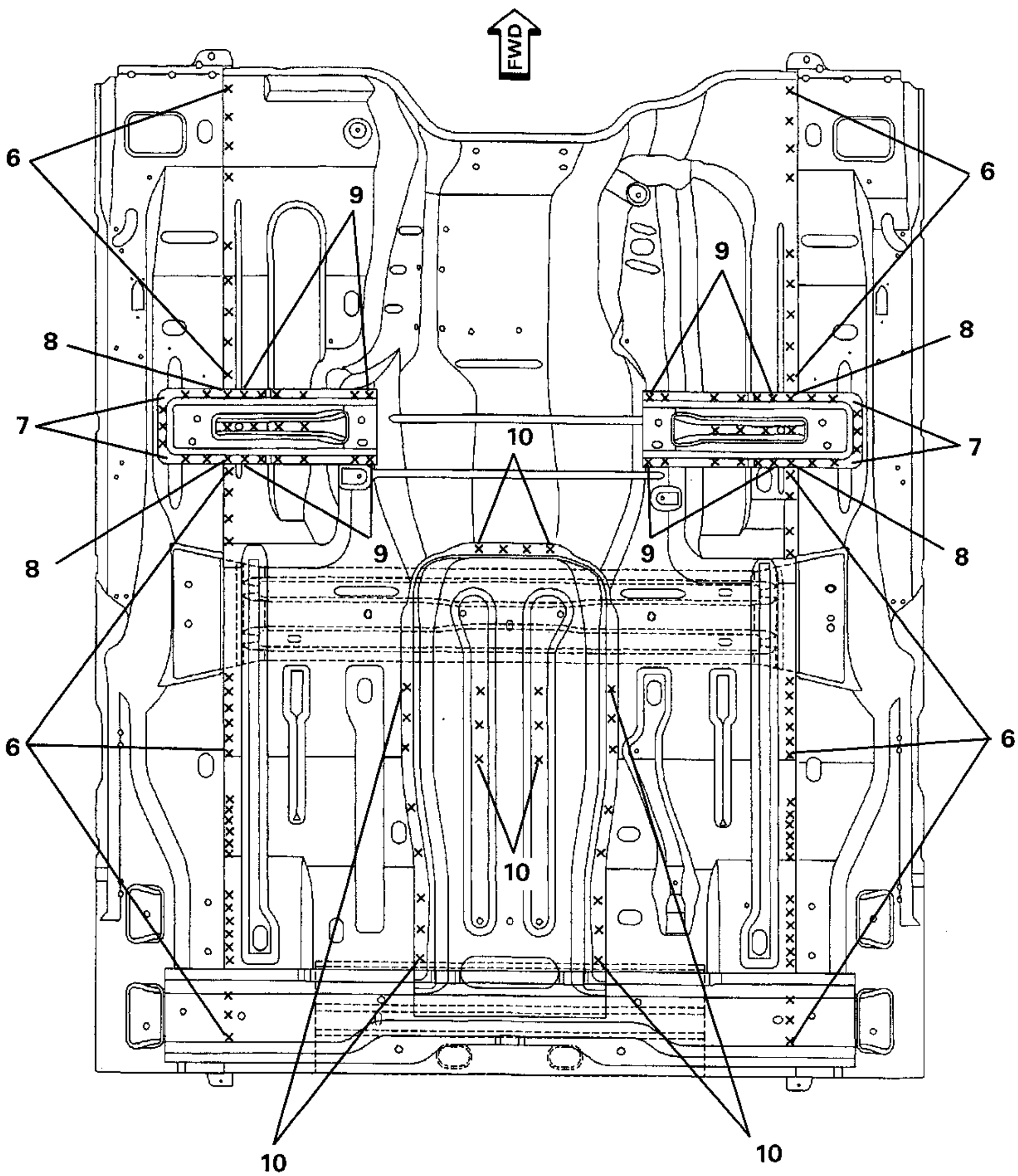


No.	Welded Parts	F	R
1	C10 + C41	4 each side	P4
2	C10 + C40	8 each side	P8
3	C10 + C33 + C40	7 each side	P7
4	C40 + U/B Mid Support	17 each side	P17
5	C40 + U/B Mid Support	7 each side	P7

No.	Welded Parts	F	R
6	C40+ C41	68	P68
7	C40 + C47	14	P14
8	C40 + C41 +C47	6	P6
9	C41 + C47	30	P30
10	C41 + C45	26	P26
11	C40 + C44 + Front Seat Rear O/B Supt.	12	P12
12	C40 + C41 + C44	12	P12
13	C41 + C44	51	P51
14	C41 + C44 + C45	4	P4
15	C40 + Tapping Plate - Support Mtg.	30	P30
16	C41 + C45	12	P12
17	C9 + C41 + C43	8	P8
18	C41 + C43	22	P22
19	C9 + C40 + C41	2 each side	P2
20	C9 + C40	7 each side	P7
21	C9 + C41	8 each side	P8
22	C9 + C40	14 each side	P14







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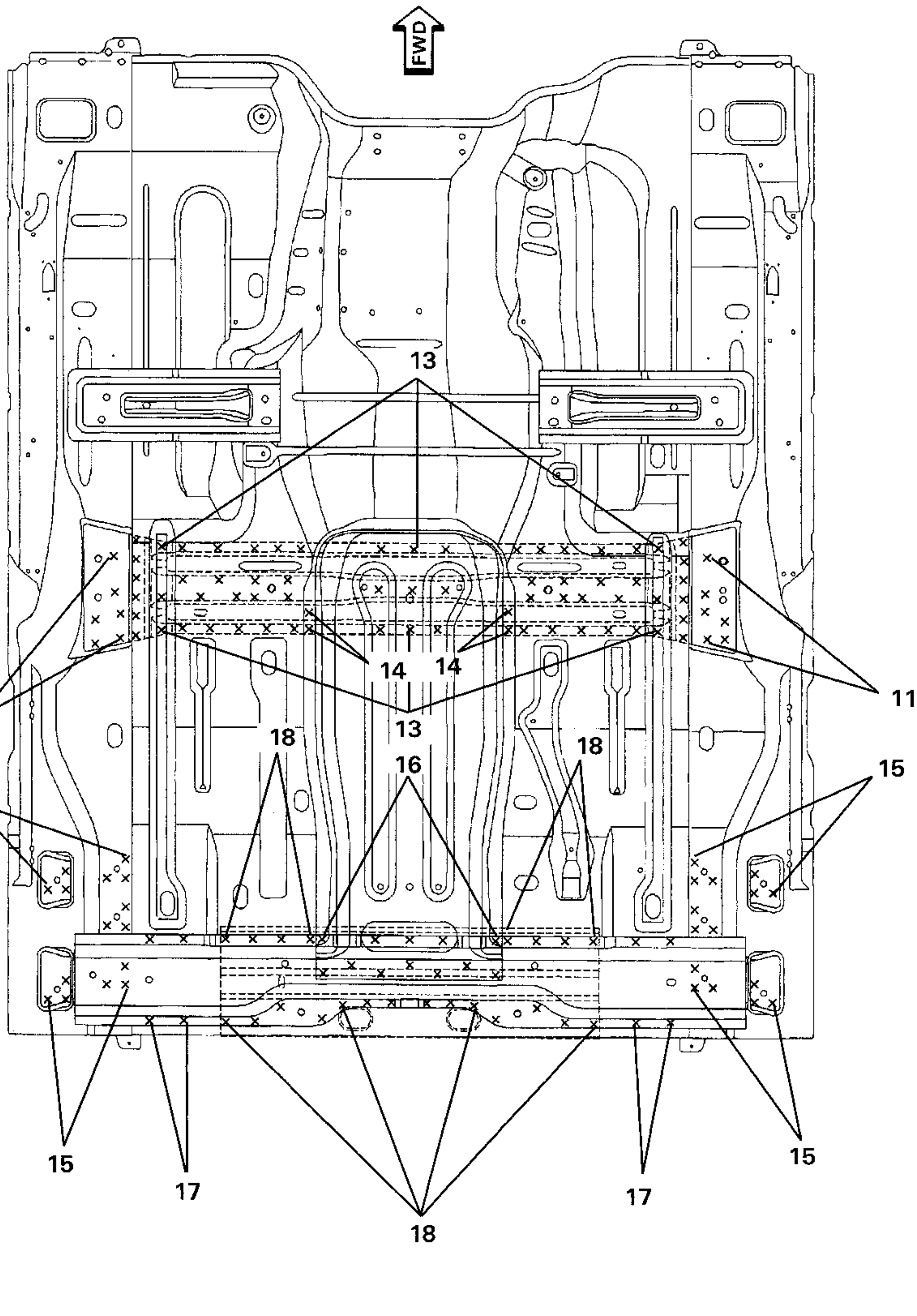
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NOTES WITH REGARD TO REPAIR WORK

- The floor pan is made up of three separate panels. Each panel can be replaced individually.
- Replacing any of these panels is difficult. Many other panels and components have to be removed to gain access to the damaged panel. Use care not to damage other panels.

REMOVAL

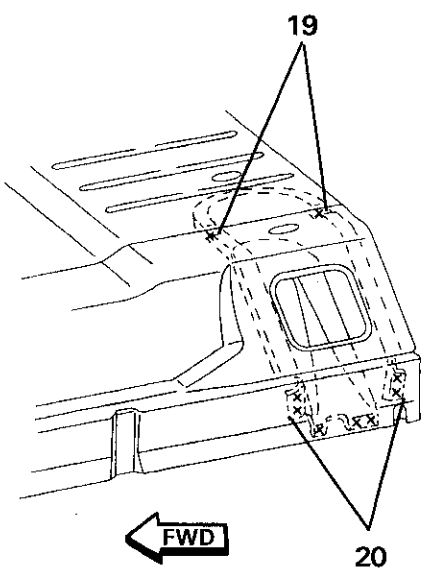
1. Refer to cowl, side aperture and cab back panel sections for additional weld location information.
2. Carefully cut all spot welds and remove undamaged panels.

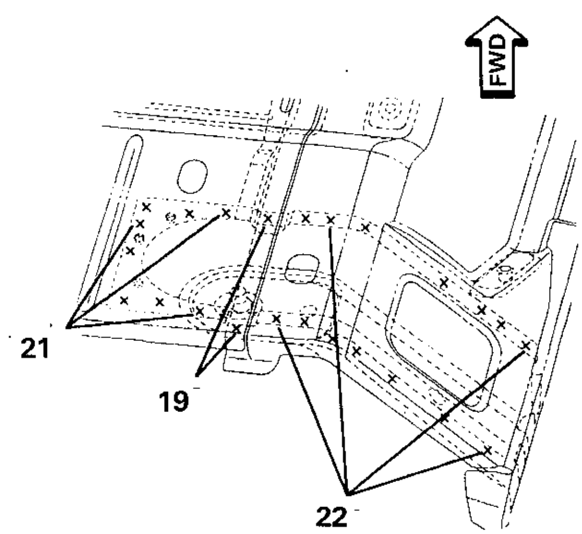
PREPARATION

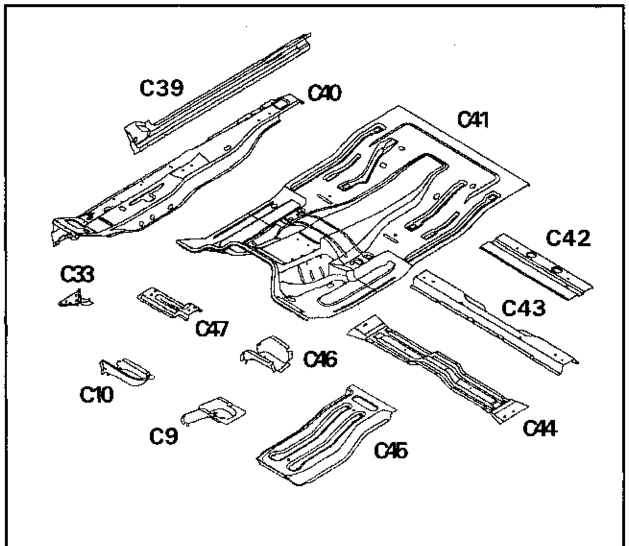
1. Using damaged panel, transfer weld locations to new panel.
2. Clean and prep all panel attaching surfaces.

INSTALLATION

1. Align and temporarily tack weld new panel into place.
2. Recheck for fit and alignment.
3. Complete all plug welds.
4. Reinstall all remaining panels.
5. Apply sealer and anti-corrosion materials as required.

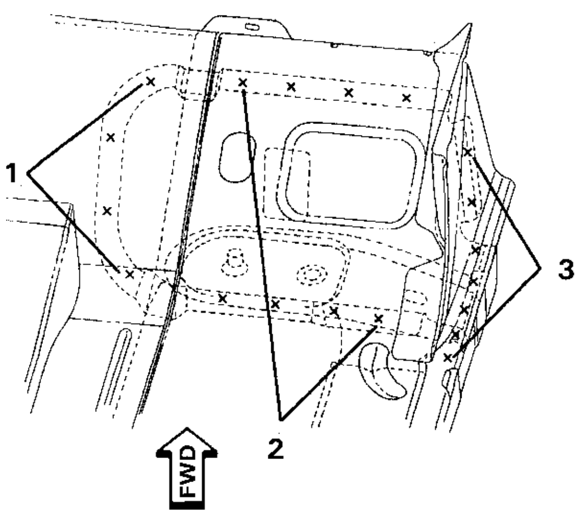


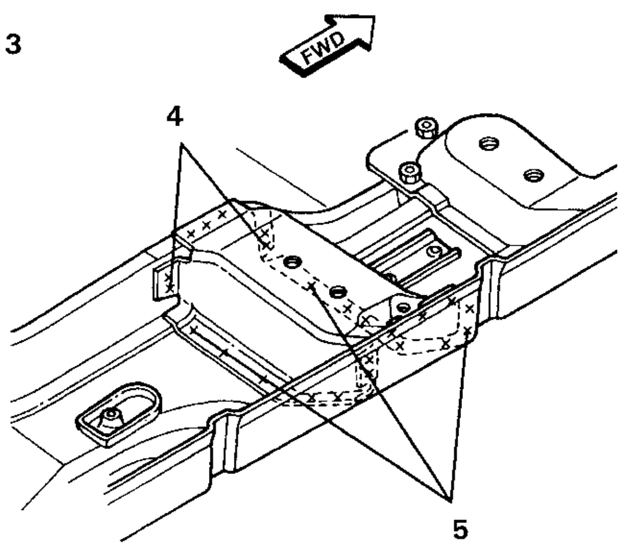


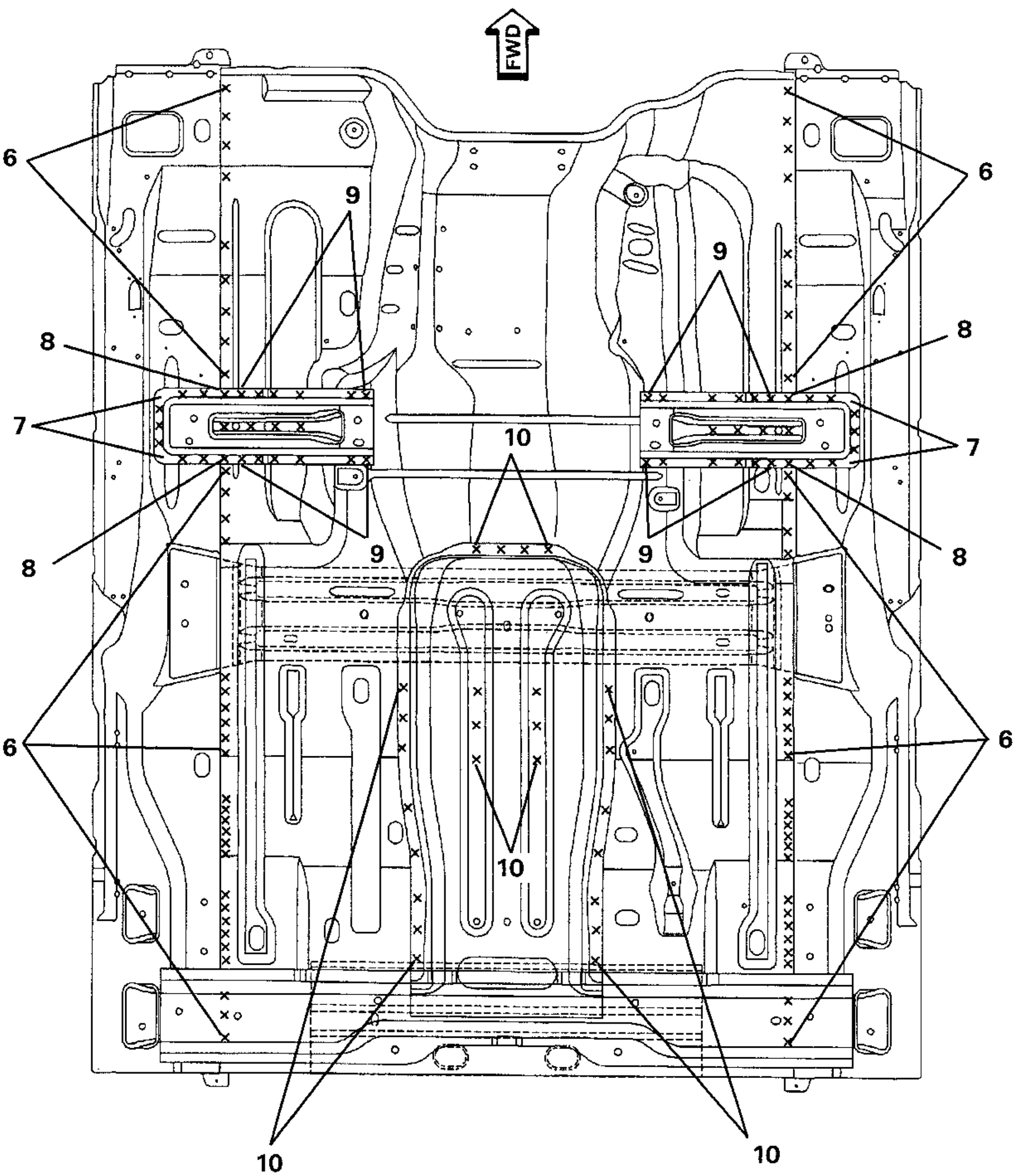


No.	Welded Parts	F	R
1	C10 + C41	4 each side	P6
2	C10 + C40	8 each side	P2
3	C10 + C33 + C40	7 each side	P17
4	C40 + U/B Mid Support	17 each side	P4
5	C40 + U/B Mid Support	7 each side	P2

No.	Welded Parts	F	R
6	C40+ C41	68	P68
7	C40 + C47	14	P14
8	C40 + C41 +C47	6	P6
9	C41 + C47	30	P30
10	C41 + C45	26	P26
11	C40 + C44 + Front Seat Rear O/B Supt.	12	P12
12	C40 + C41 + C44	12	P12
13	C41 + C44	51	P51
14	C41 + C44 + C45	4	P4
15	C40 + Tapping Plate - Support Mtg.	30	P30
16	C41 + C45	12	P12
17	C9 + C41 + C43	8	P8
18	C41 + C43	22	P22
19	C9 + C40 + C41	2 each side	P2
20	C9 + C40	7 each side	P7
21	C9 + C41	8 each side	P8
22	C9 + C40	14 each side	P14






FWD
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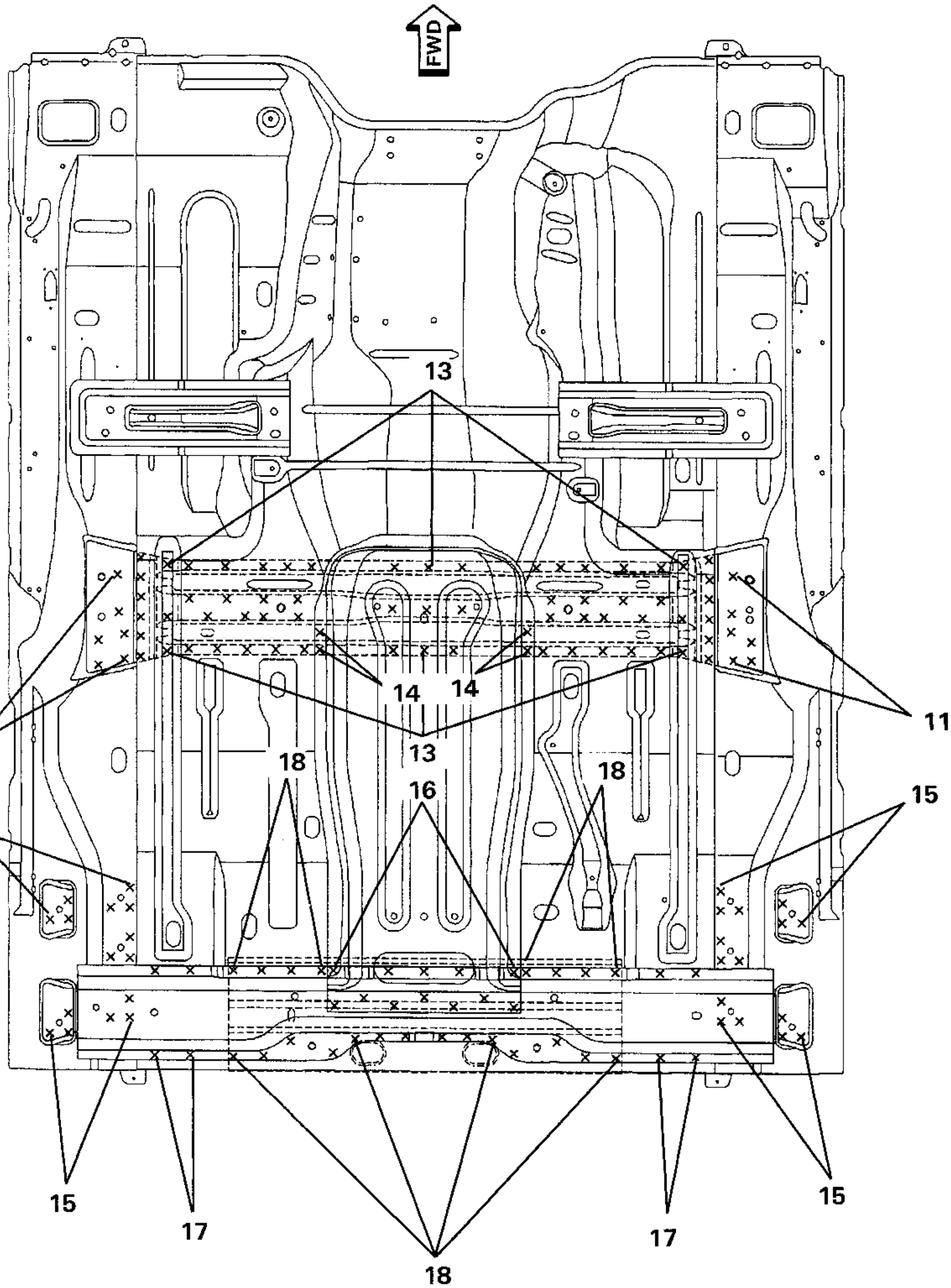
FWD
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18

NOTES WITH REGARD TO REPAIR WORK

- The floor pan is made up of three separate panels. Each panel can be replaced individually.
- Replacing any of these panels is difficult. Many other panels and components have to be removed to gain access to the damaged panel. Use care not to damage other panels.

REMOVAL

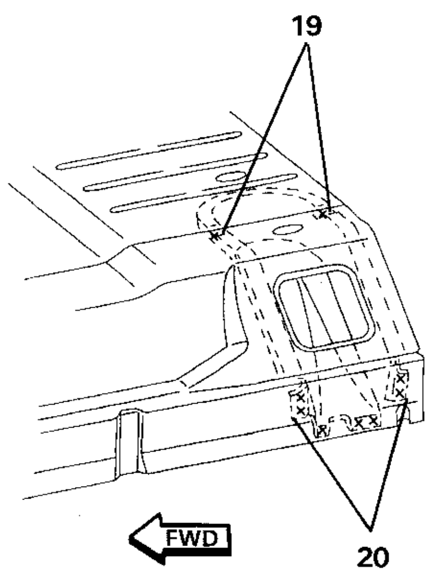
1. Refer to cowl, side aperture and cab back panel sections for additional weld location information.
2. Carefully cut all spot welds and remove undamaged panels.

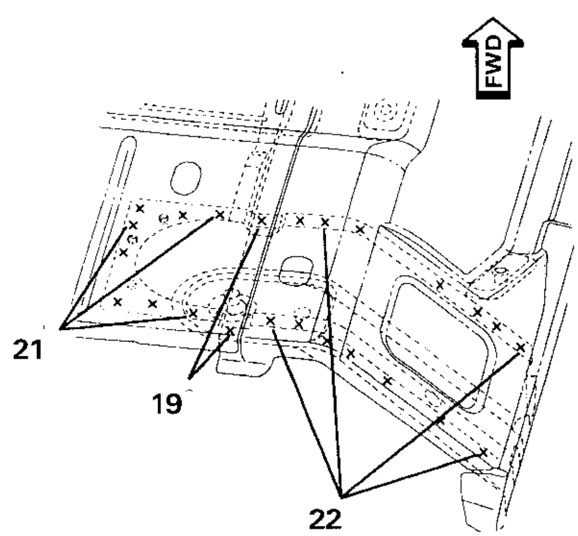
PREPARATION

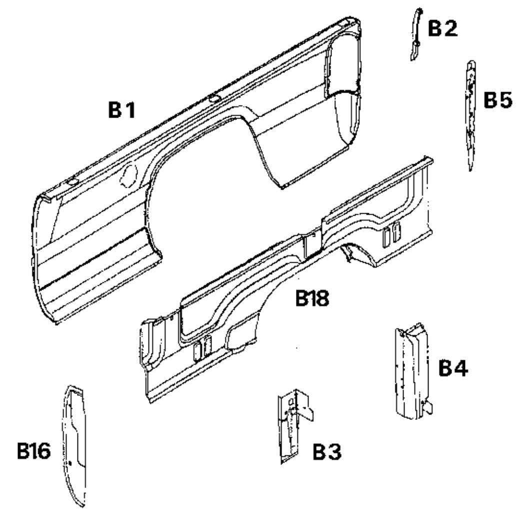
1. Using damaged panel, transfer weld locations to new panel.
2. Clean and prep all panel attaching surfaces.

INSTALLATION

1. Align and temporarily tack weld new panel into place.
2. Recheck for fit and alignment.
3. Complete all plug welds.
4. Reinstall all remaining panels.
5. Apply sealer and anti-corrosion materials as required.

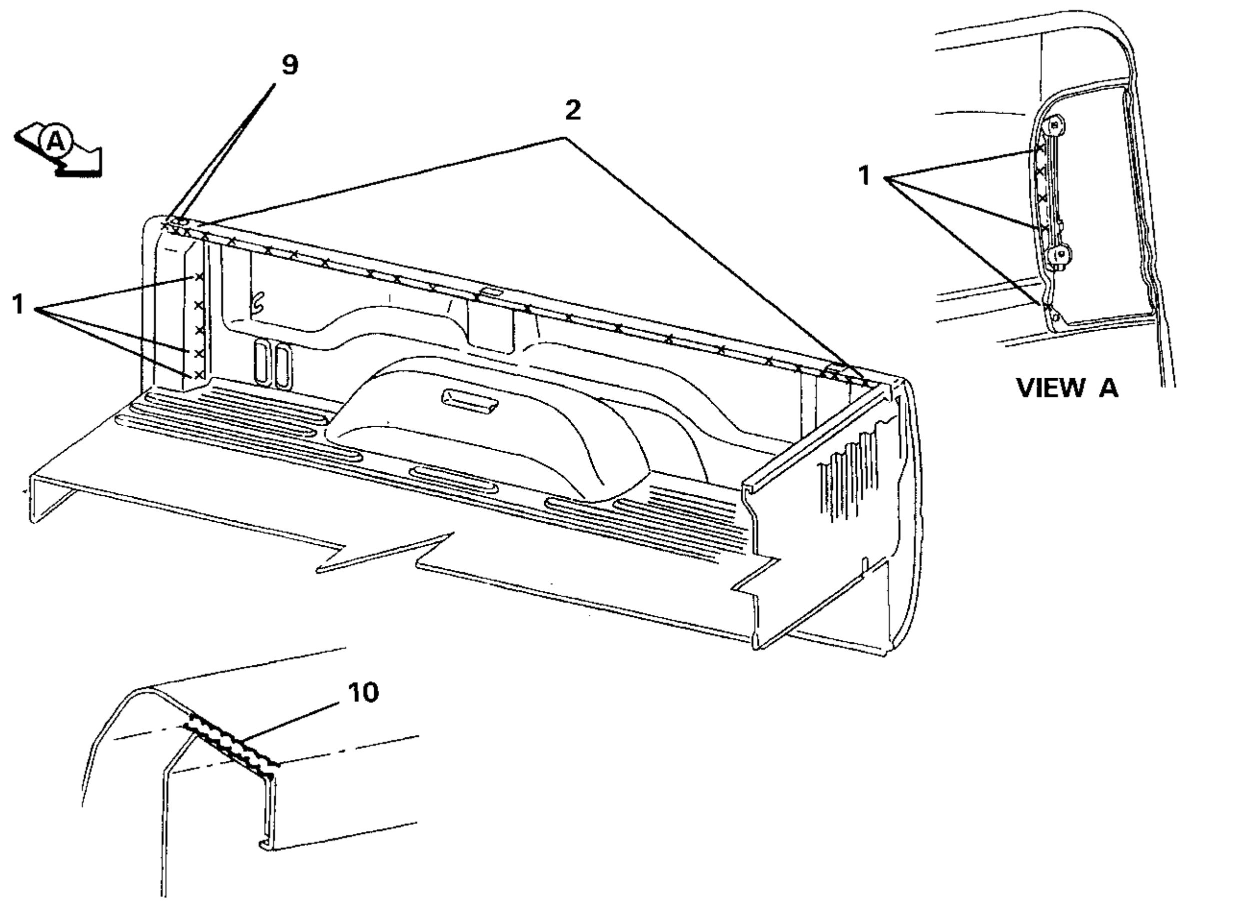






No.	Welded Parts	F	R
1	B1 + B2	5 each side	P5
2	B1 + B18 (6 ft.)	21 each side	P21
2	B1 + B18	24 each side	P24
3	B1 + B5	14 each side	P14
4 LH	B1 + B3	4 each side	P4
4 RH	B1 + B3	3 each side	P3

No.	Welded Parts	F	R
5	B1 + B18	22 each side	P22
6	B1 + B16	16 each side	P16
7	B4 + B5	11 each side	P11
8	B4 + B5 + Rear Stake Pocket Reinforcement	3 each side	P3
9	B1 + B18	2 each side	P2
10	B1 + B18	Expandable Foam Adhesive	



NOTES WITH REGARD TO REPAIR WORK

- Refer to Cargo Box Front Panel section for additional information.
- It will be necessary to remove the cargo box from the vehicle for this repair.
- Use caution when working on left side near fuel filler location.

REMOVAL

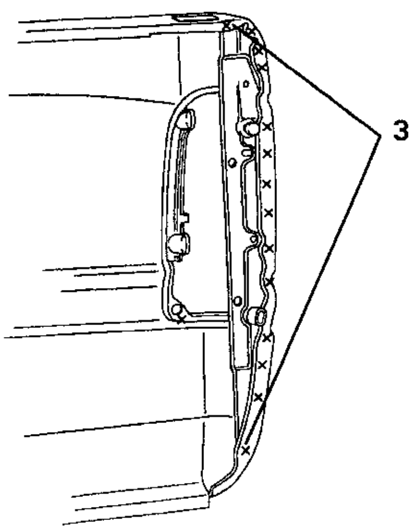
1. With cargo box properly supported, carefully remove all spot welds using weld cutter.
2. Use caution not to damage any adjacent panels.

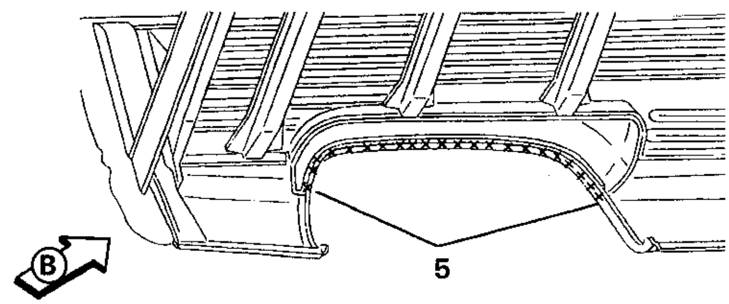
PREPARATION

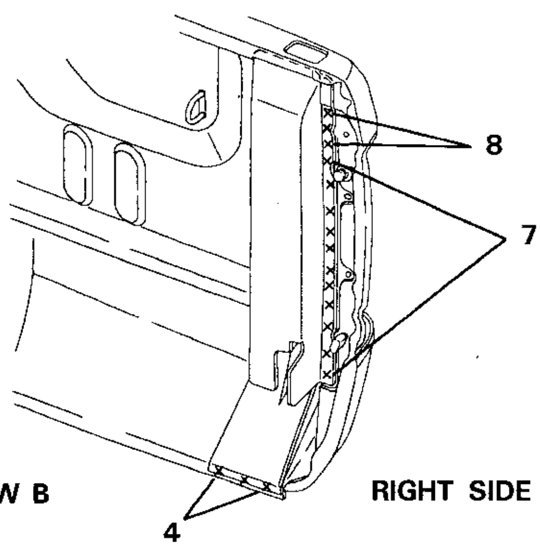
1. Clean and prep all panels not being replaced.
2. Remove primer coating at areas to be welded on new panel(s).
3. The taillamp support bracket (B2) can be welded in place before the panel on the box.

INSTALLATION

1. Install new panel on cargo box; align and clamp in place.
2. Tack weld new panel and recheck alignment and fit.
3. Complete spot and/or plug welding.
4. Treat all welds with anti-corrosion material.
5. Apply sealers as necessary.

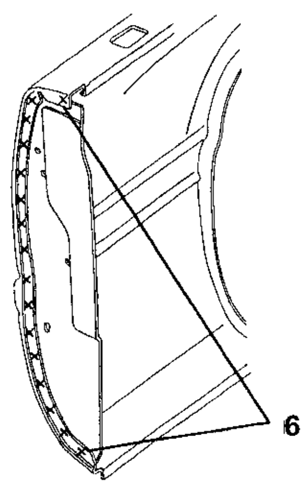




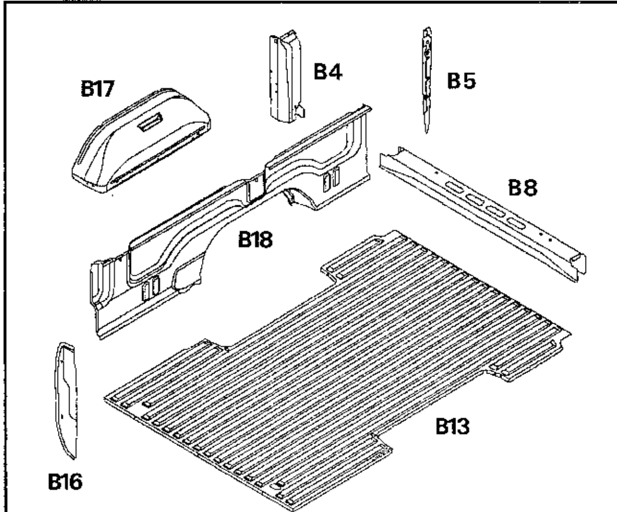


VIEW B

RIGHT SIDE

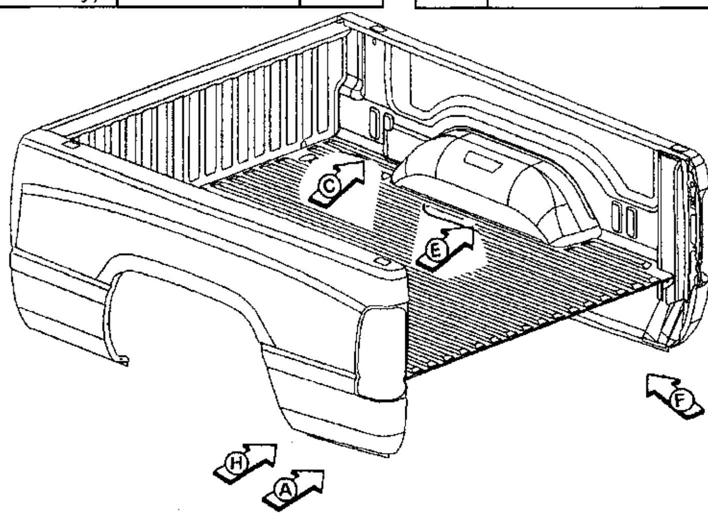


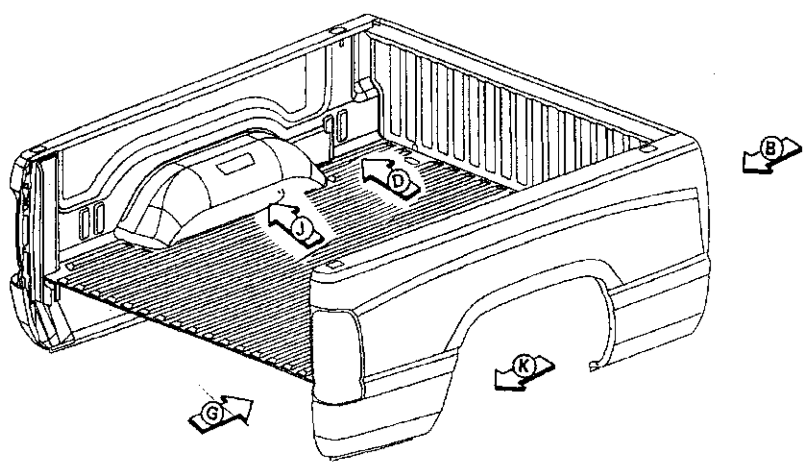
Cargo Box Inner Side Panel

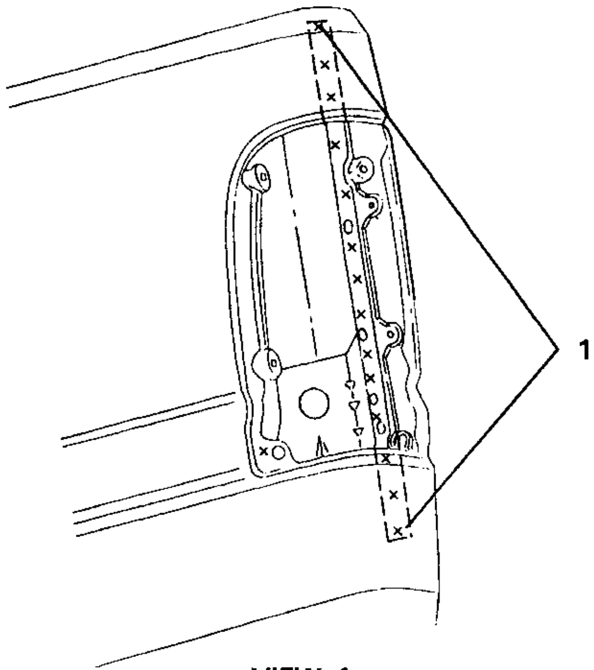


No.	Welded Parts	F	R
1	B4 + B5	14 each side	P14
2	B16 + B18	11 each side	P11
3	B13 + B18	8 each side	P8
4	B13 + B17	3 each side	P3
5	B13 + B18 (8 ft. only)	14 each side	P14

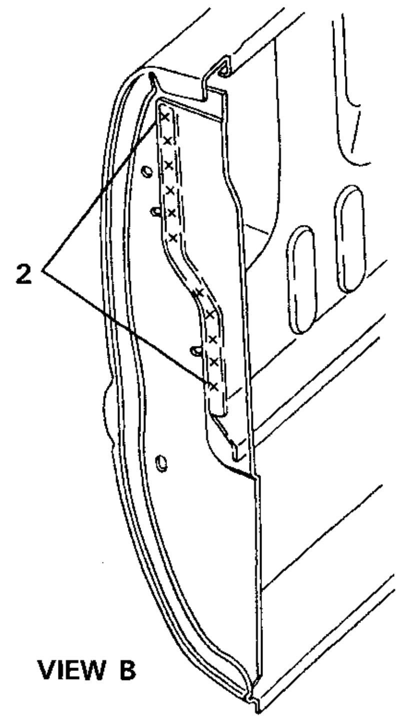
No.	Welded Parts	F	R
6	B13 + B16 (8ft. only)	15 each side	P15
7	B13 + B17	17 each side	P17
8	B4 + B8	7 each side	P7
9	B4 + B8	5 each side	P5
10	B4 + B8 + B13	9 each side	P9
11	B18 + Center Stake Pocket reinforcement	12 each side	P12
12	B18 + Stake Pocket	6 each side	P6
13	B4 + B18	10 each side	P10
14	B10 + Front Stake Pocket	6 each side	P6
15	B17 + B18	24 each side	P24



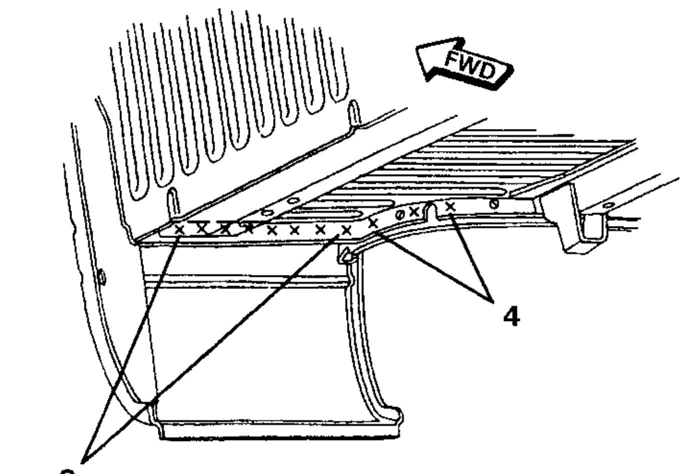




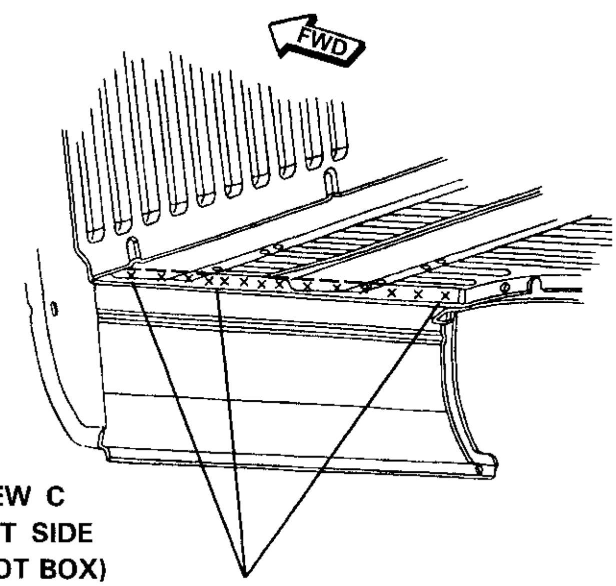
VIEW A



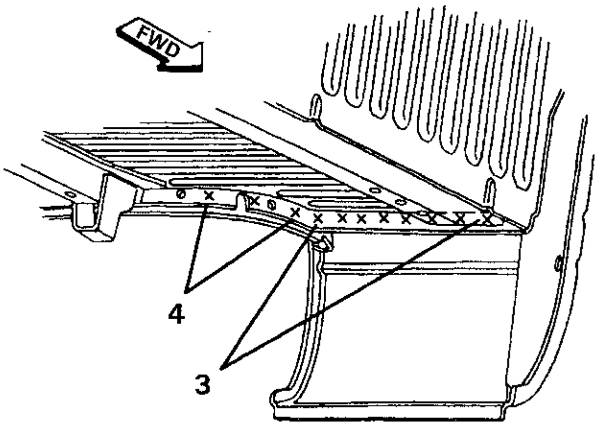
VIEW B



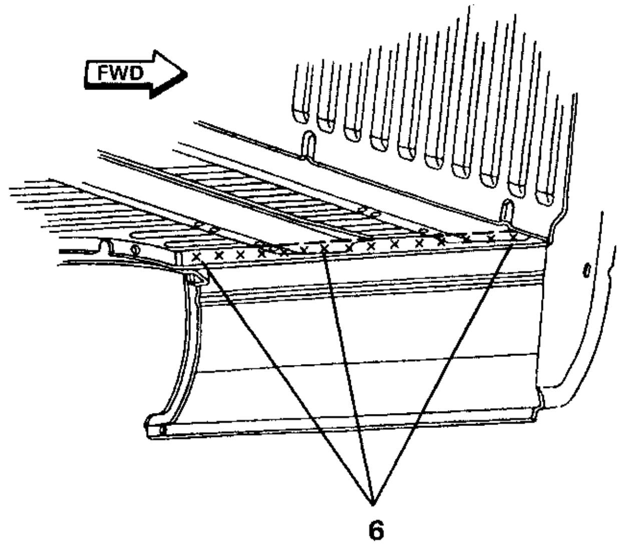
VIEW C
RIGHT SIDE
(6 FOOT BOX)



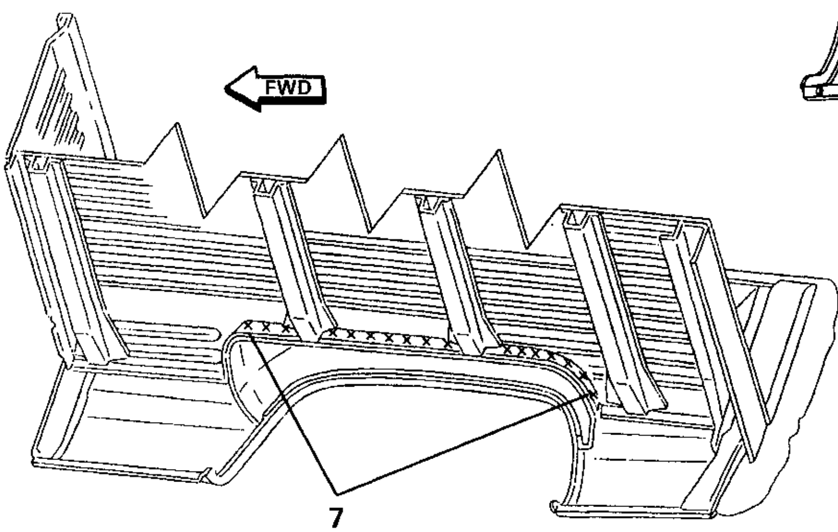
VIEW C
RIGHT SIDE
(8 FOOT BOX)



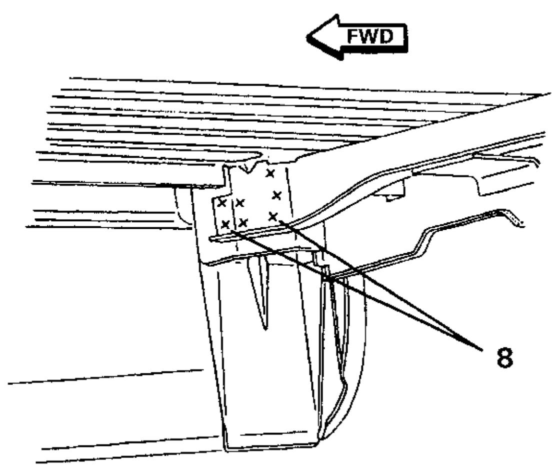
VIEW D
LEFT SIDE
(6 FOOT BOX)



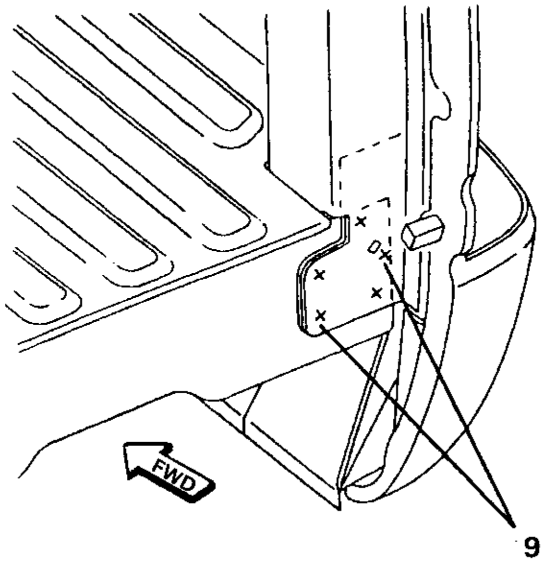
VIEW D
LEFT SIDE
(8 FOOT BOX)



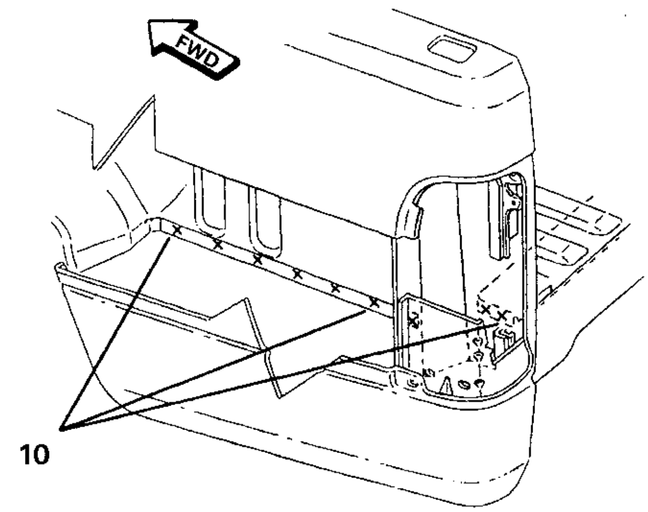
VIEW E



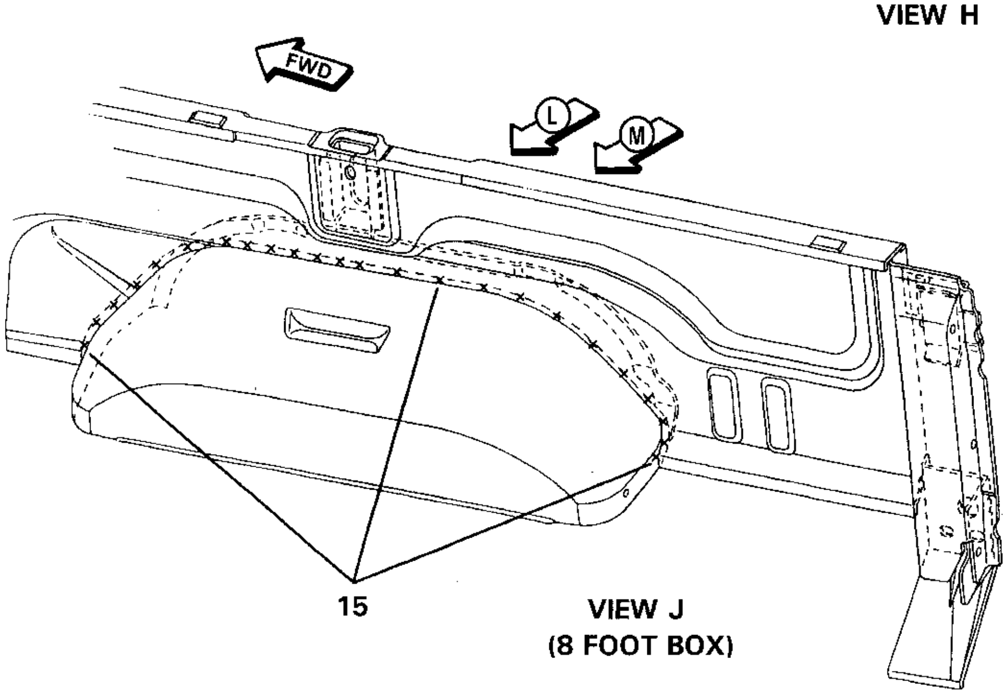
VIEW F



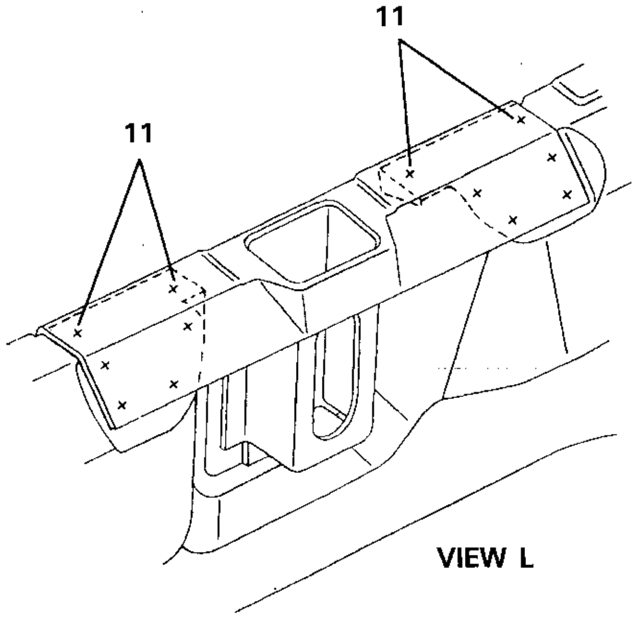
VIEW G



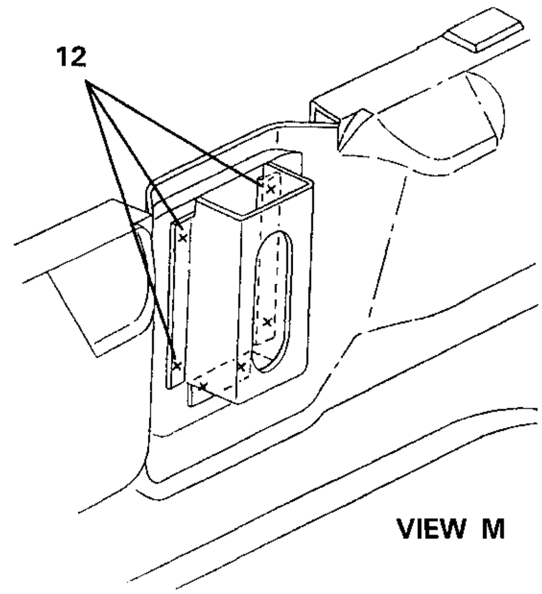
VIEW H



VIEW J
(8 FOOT BOX)

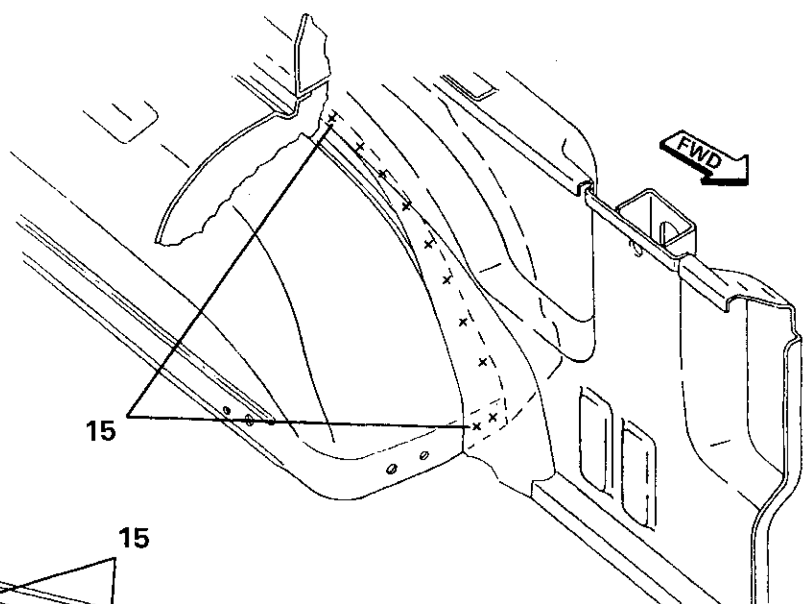


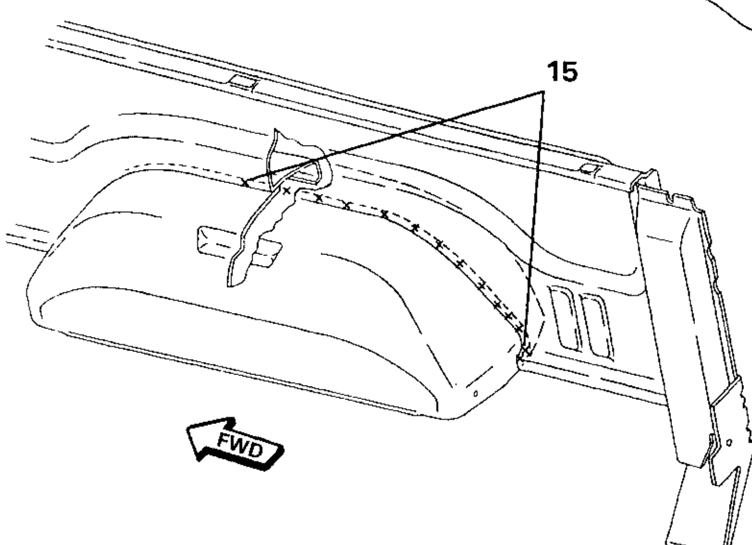
VIEW L



VIEW M

VIEW J
(6 FOOT BOX)





VIEW J
(6 FOOT BOX)

NOTES WITH REGARD TO REPAIR WORK

- Refer to Cargo Box Front Panel and Outer Side Panel sections for additional weld location information.
- If replacing outer panel also, the inner and outer cargo box panels can be removed as an assembly.

REMOVAL

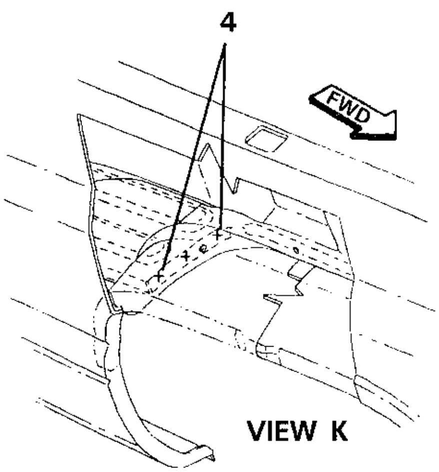
1. Locate and cut all spot welds using a spot weld cutter or 5/16" hole saw.
2. Use care when removing damaged panels not to cause unnecessary damage to panels not being used.

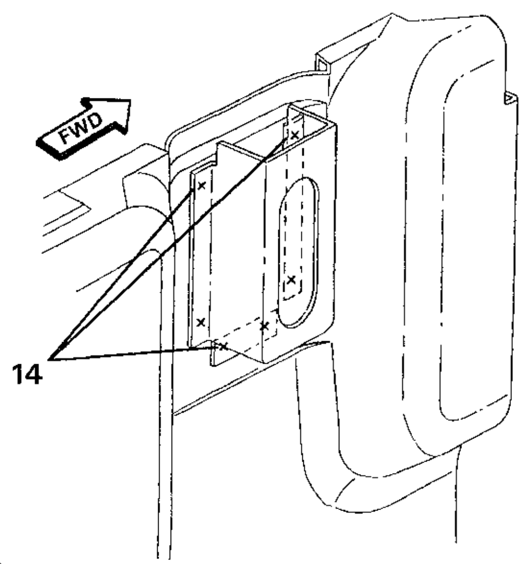
PREPARATION

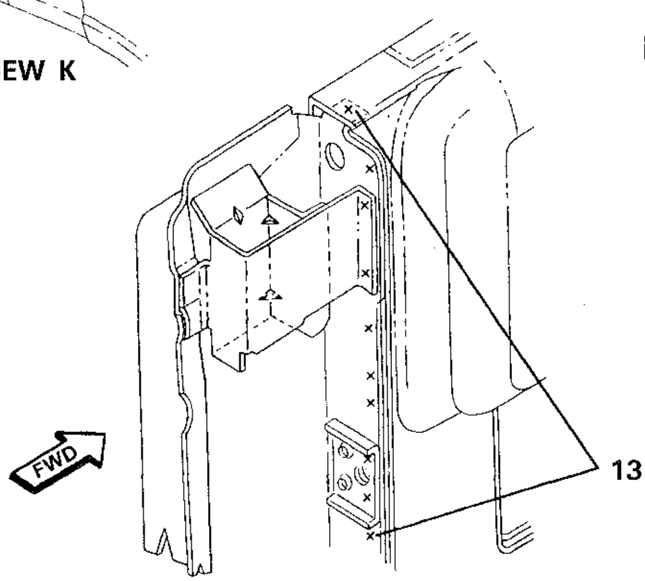
1. Using old panels, measure and locate weld locations onto new panels.
2. Clean and prep all panels for assembly.

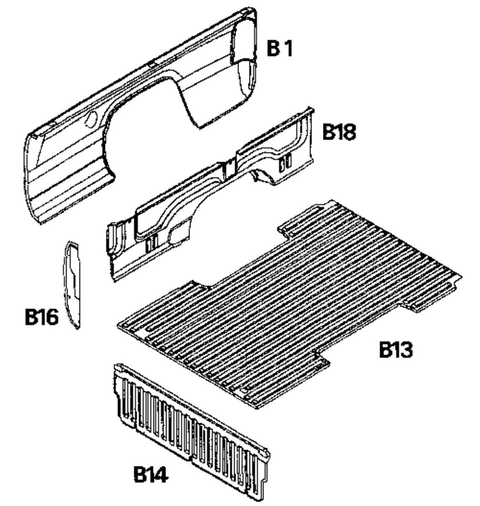
INSTALLATION

1. Temporarily attach all brackets and extensions panels to inner cargo box panel.
2. Recheck measurments, then weld in place.
3. Temporarily secure inner panel assembly to remainder of cargo box.
4. Place outer box panel in place and check for fit and alignment. Adjust inner and outer box panels as necessary.
5. Remove outer box panel and weld inner panel at spot weld locations.
6. Install outer panel as outlined in cargo box outer panel section.
7. Apply sealer and corrosion protection as necessary.



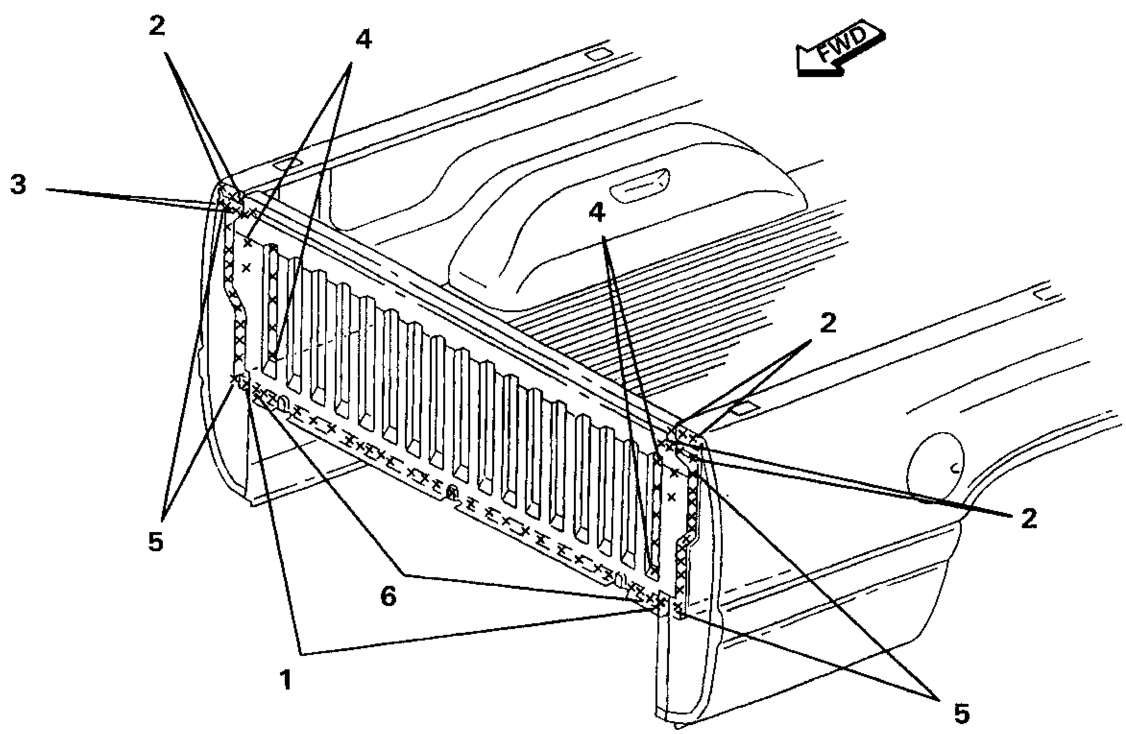






No.	Welded Parts	F	R
1	B14 + B16 + B18	1 each side	P1
2	B1 + B14	3 each side	P3
3	B14 +B16	4 each side	P4
4	B14 + B16	7 each side	P7
5	B14 + B16 + B18	11 each side	P11

No.	Welded Parts	F	R
6	B13 + B14	26	P26
7	B1 + B16	15 each side	P15



NOTES WITH REGARD TO REPAIR WORK

- The front box panel consists of three sections.
- Use care when removing panel to be replaced, so as not to damage surrounding panels that are not being replaced.

REMOVAL

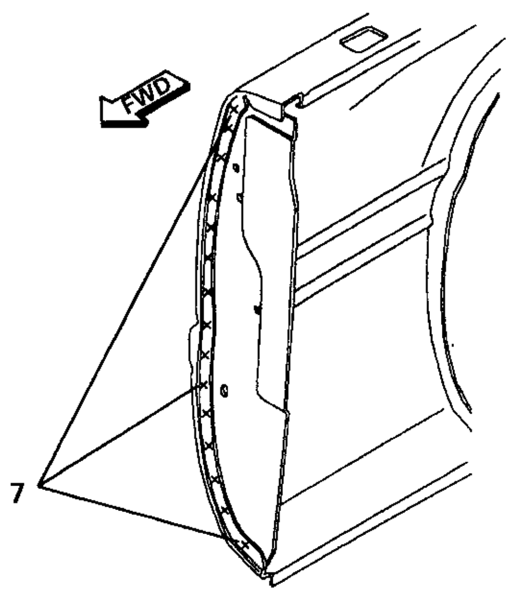
1. Use a spot weld cutter to remove spot welds.
2. Carefully spread box sides to remove front box panel.

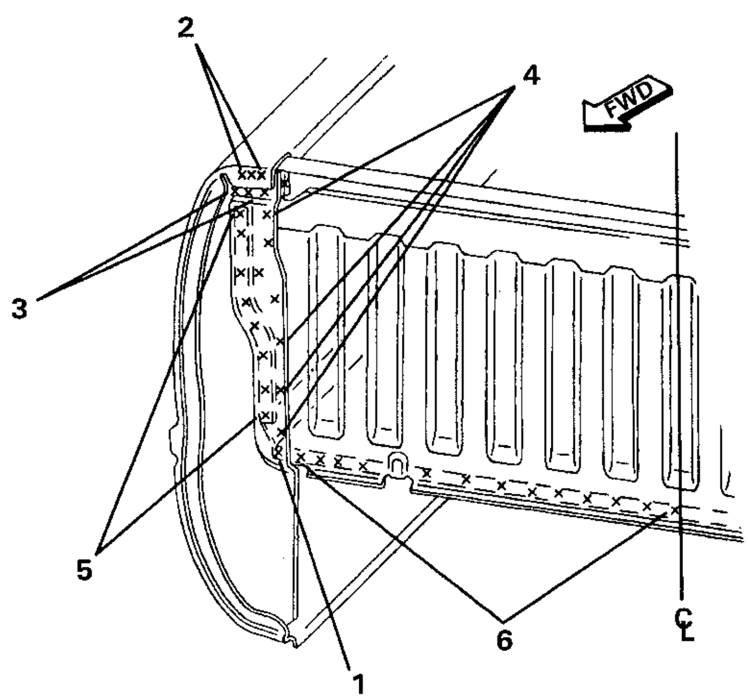
PREPARATION

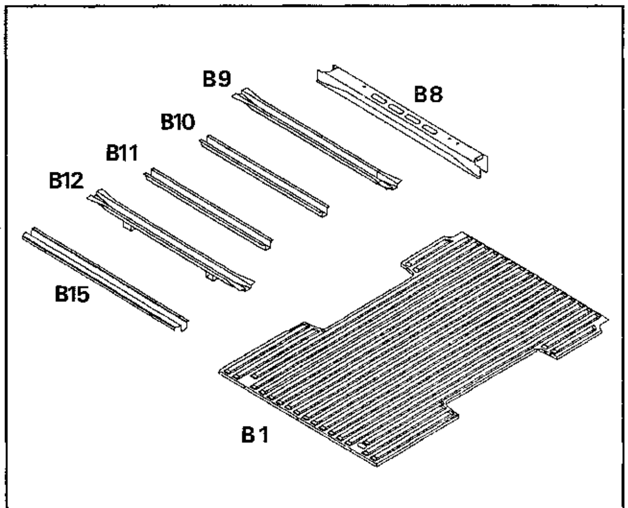
1. Clean and prepare all remaining panels.
2. If possible, use damaged panel as a pattern to locate spot or plug welds on new panel.

INSTALLATION

1. Carefully spread box sides and slip front panel into place.
2. Secure panel in place with clamps.
3. Recheck alignment and fit, and tack weld.
4. Secure panel with plug or spot welds.
5. Apply sealers in specified areas.
6. Treat all welded areas with anti-corrosion material.

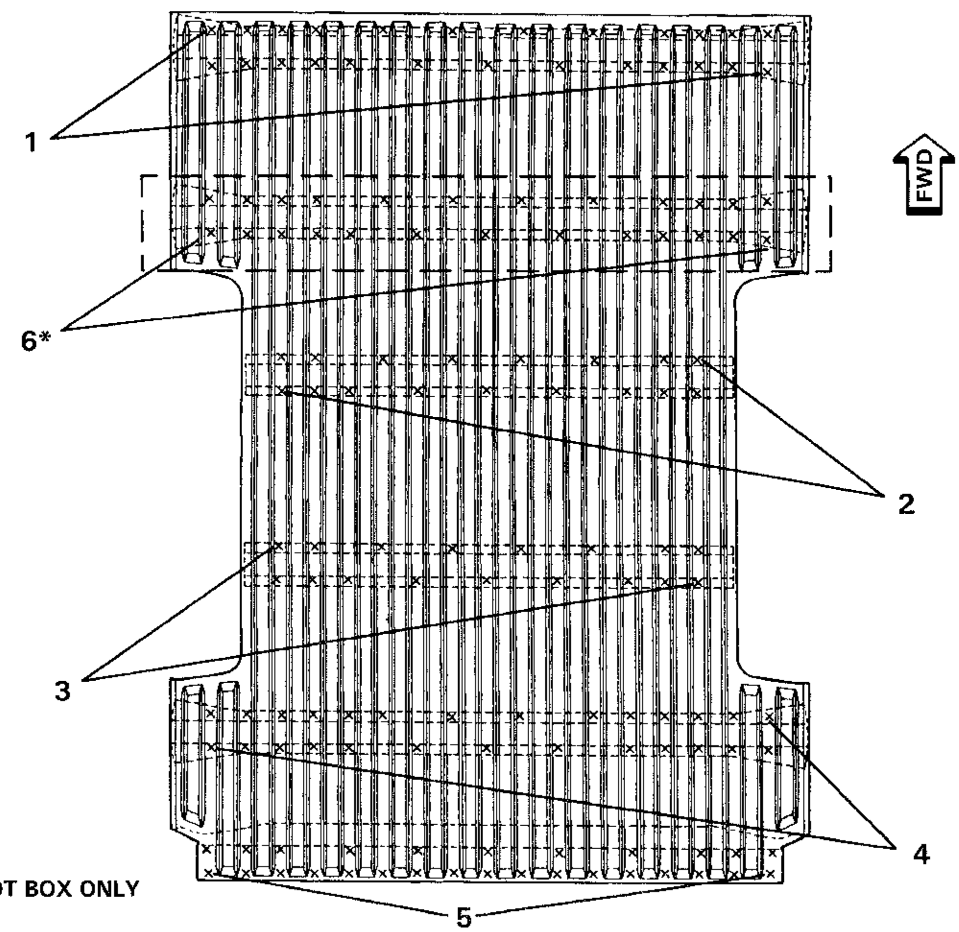






No.	Welded Parts	F	R
1	B13 + B15	25	P25
2	B10 + B13	17	P17
3	B10 +B13	17	P17
4	B9 + B13	27	P27
5	B8 + B13	28	P28

No.	Welded Parts	F	R
6	B12 + B13 *8ft. only)	25	P25



* 8 FOOT BOX ONLY

NOTES WITH REGARD TO REPAIR WORK

- Refer to Inner Box Side and Front Panel replacement sections for additional information.
- ALL replacement crossmembers come as complete assemblies with gussets and top plates already installed.
- If replacing crossmember(s) only, remove welds for that crossmember only.

REMOVAL

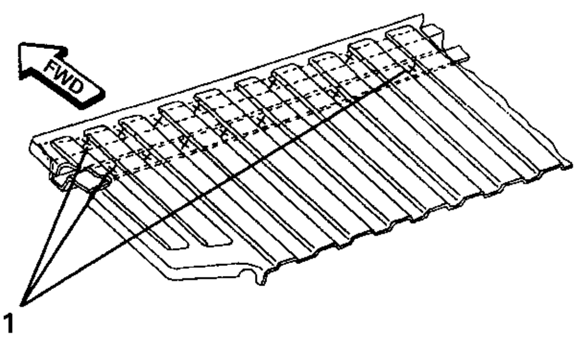
1. Remove cargo box from vehicle. Place box upside down on a suitable stand or on the floor. Support box floor from underside also.
2. Before starting floor panel removal, measure the locations of all crossmembers and transfer measurements to new panel.
3. Carefully cut and separate the spot welds attaching the box floor to the front and side panels using a 5/16" or 3/8" hole saw.
4. It is not necessary to separate the front panel from the box sides if these panels are undamaged.

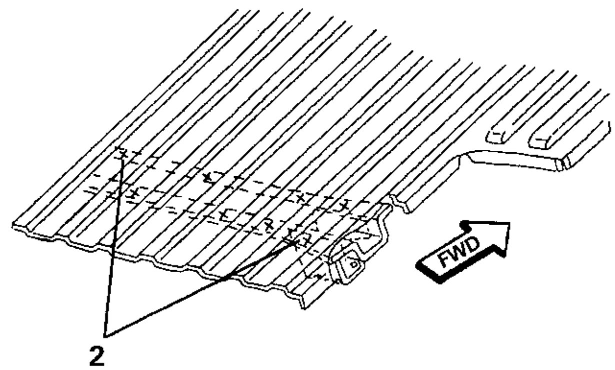
PREPARATION

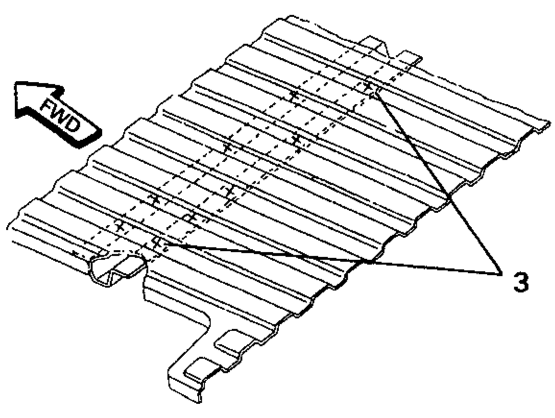
1. Use old floor panels as a guide for locating weld points on new floor panel.
2. Clean and prep all panels.
3. Position and weld crossmembers to new floor panel using measurments from old floor panel as a guide.

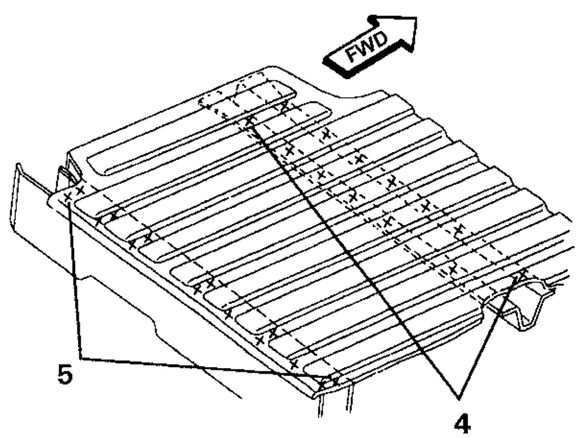
INSTALLATION

1. Place new floor panel into position with box sides and front panel, and clamp in place.
2. Check all measurments and alignments.
3. Tack weld new panel to adjacent panels.
4. Recheck measurments and alignments.
5. Plug weld all panels to factory specifications.
6. Apply seam sealer and anti-corrosion materials as necessary.









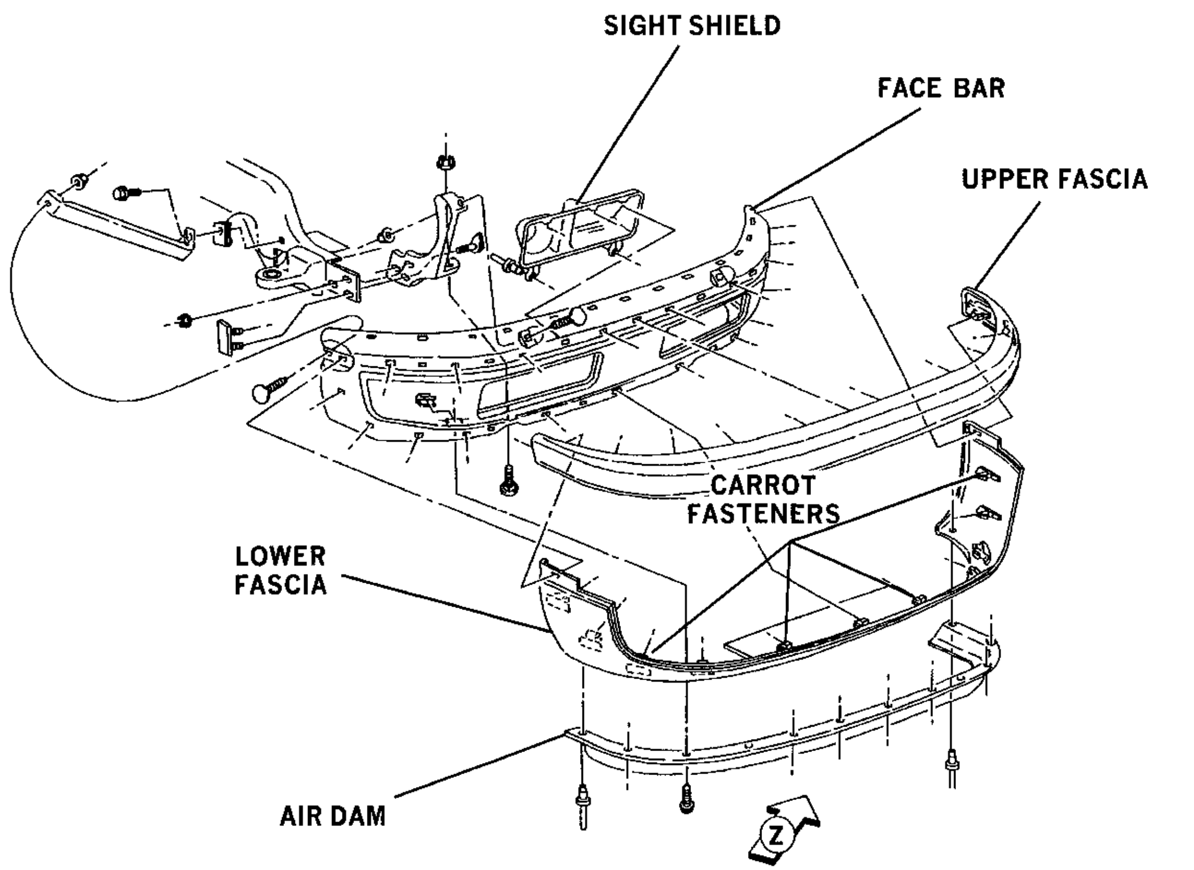
Notes

BUMPER SYSTEMS

Dodge Ram Pickup

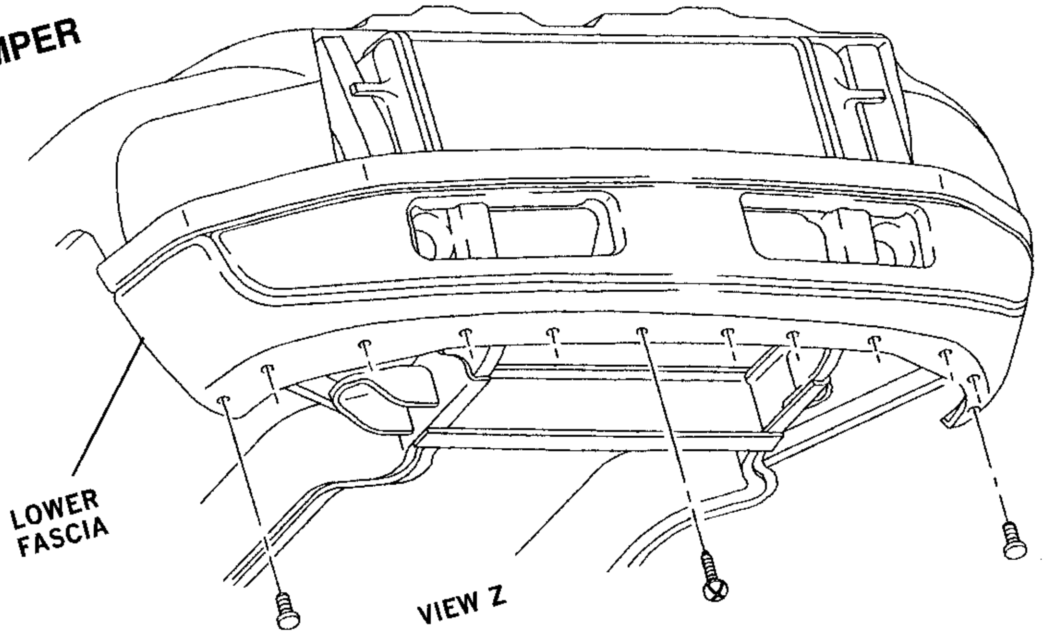
The front bumper consists of a high-strength steel face bar (painted on base vehicles and chromed with the laramie SLT package) with molded upper and lower plastic fascias. The optional rear step bumper is the lightest and strongest in the industry. The bumper has a one-piece stamped steel face coupled with a reinforcement tube for strength. The outer ourface is chrome plated while the inner surface and reinforcement tube are painted to help prevent corrosion. The fascias are attached to the bumper which is then secured to the body via bumper reinforcement brackets. The bumper systems are designed to meet all federal safety standards.

FRONT BUMPER

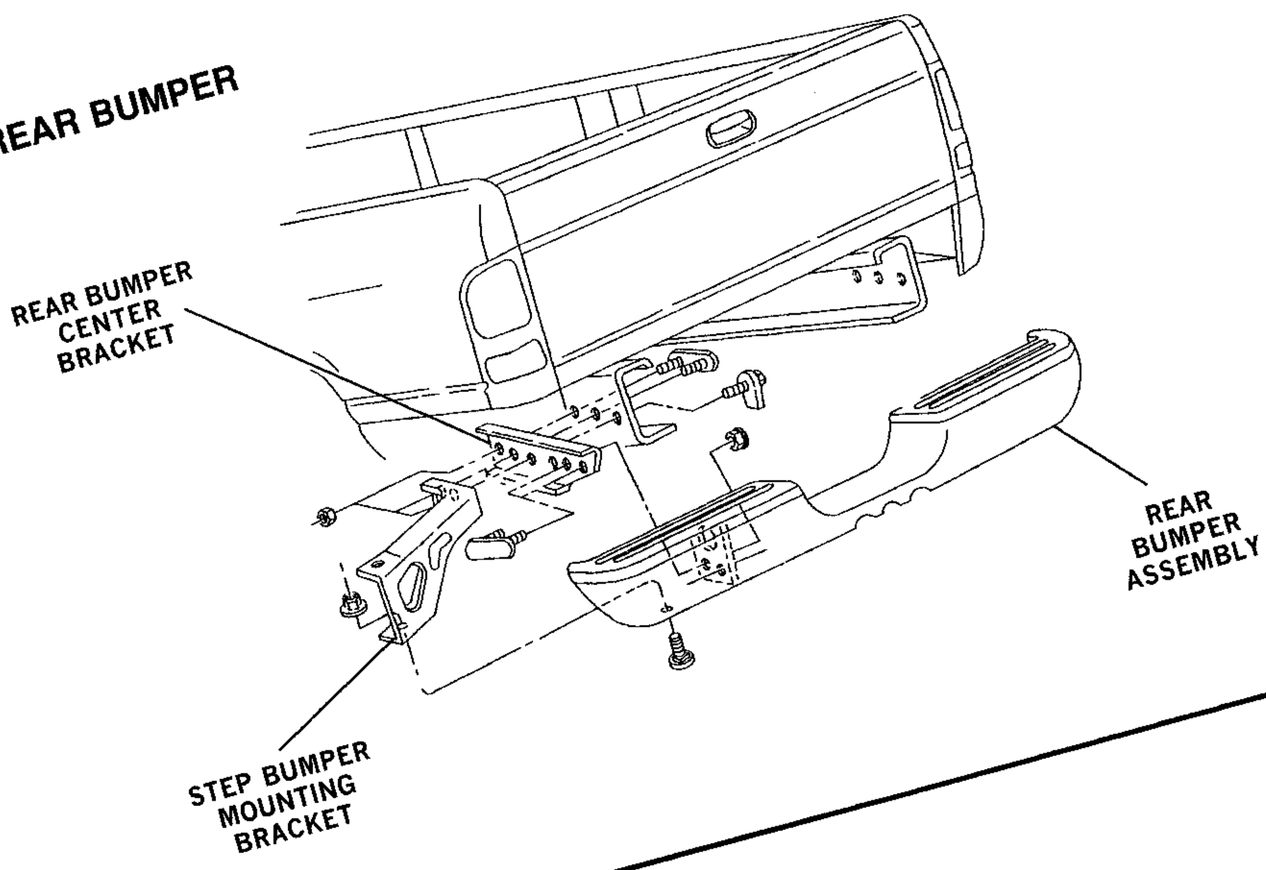


Mopar AUTHENTIC RESTORATION™ PRODUCT

FRONT BUMPER



REAR BUMPER

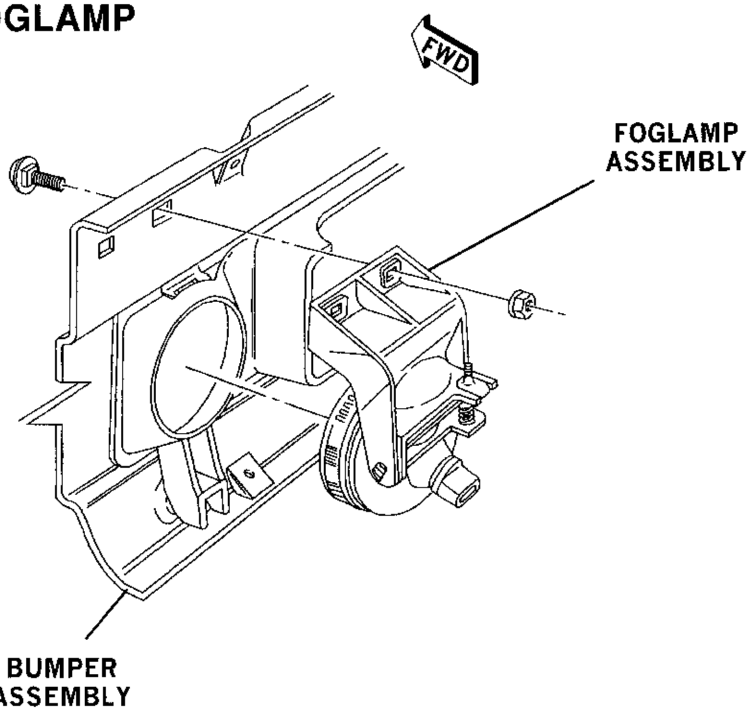


mopar AUTHENTIC RESTORATION™ PRODUCT

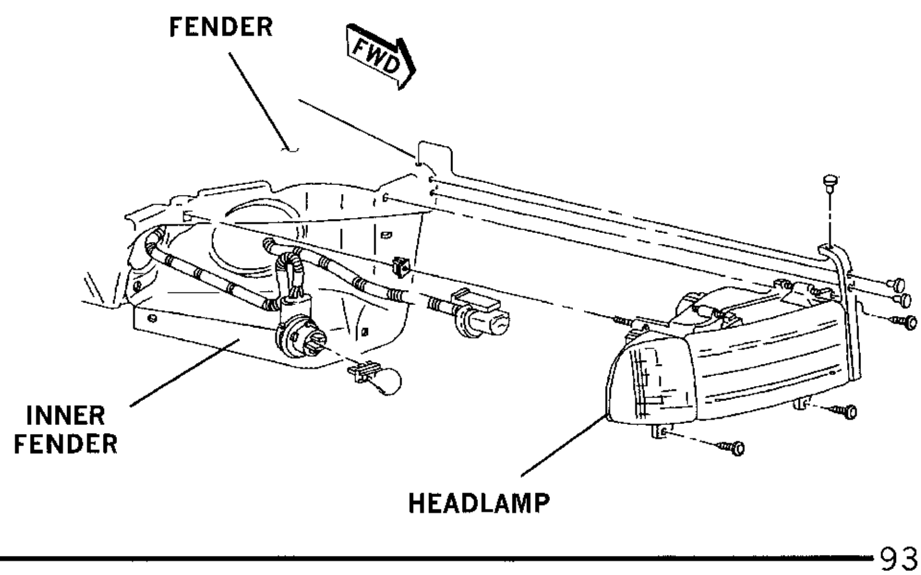
EXTERIOR LIGHTING

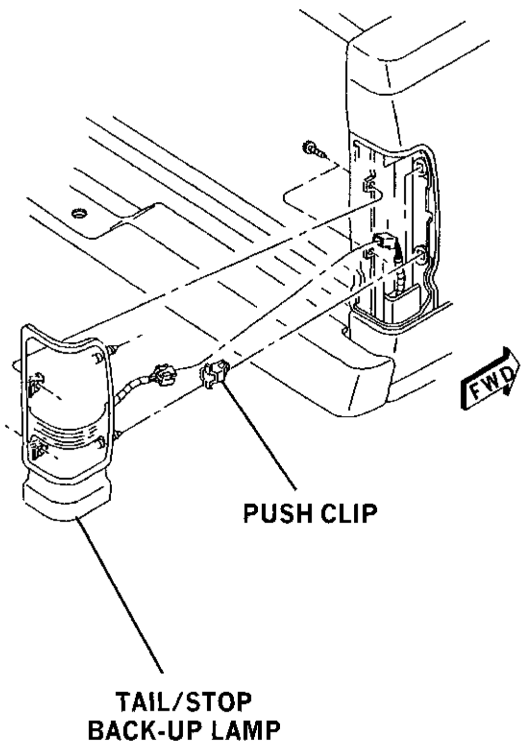
Dodge Ram Pickup

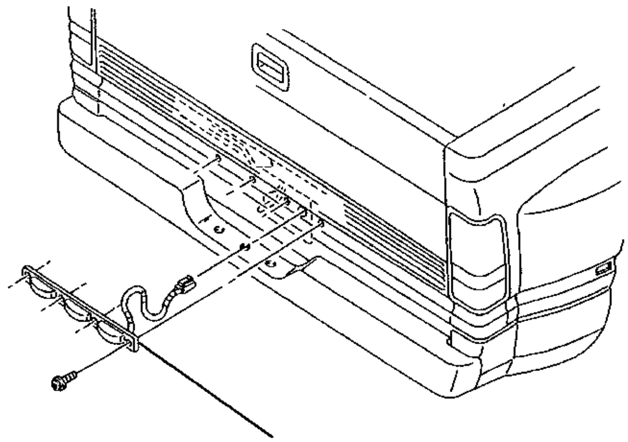
FOGLAMP

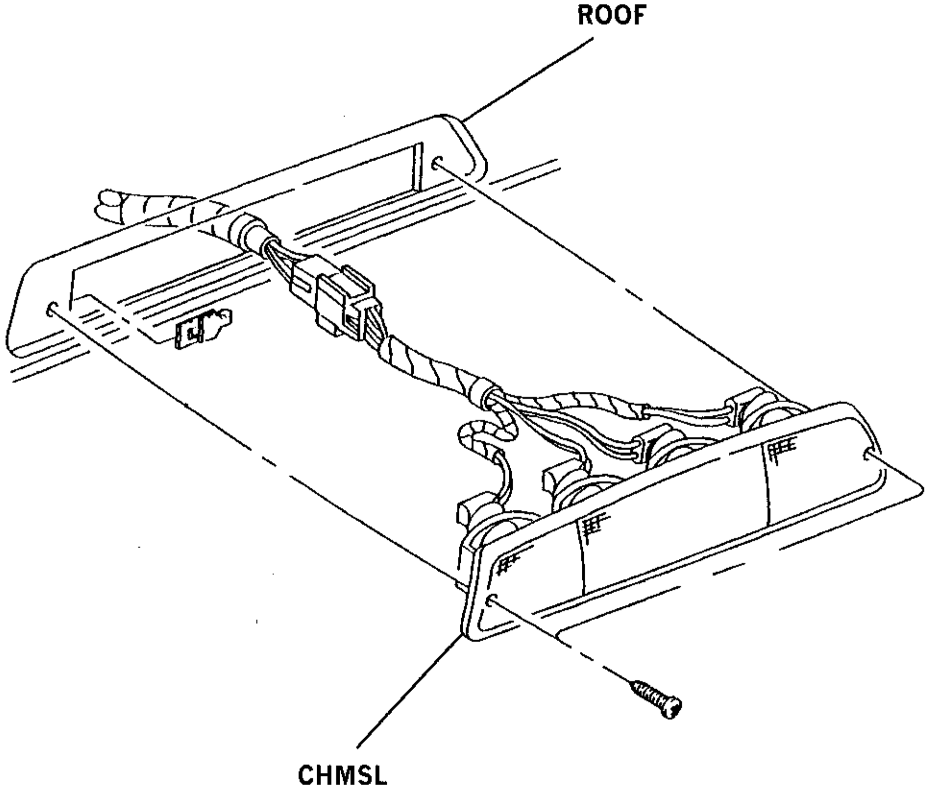


HEADLAMP




FWD
PUSH CLIP
TAIL/STOP
BACK-UP LAMP


TAILGATE I.D.
LAMP ASSY


ROOF
CHMSL

STRUCTURAL ADHESIVES

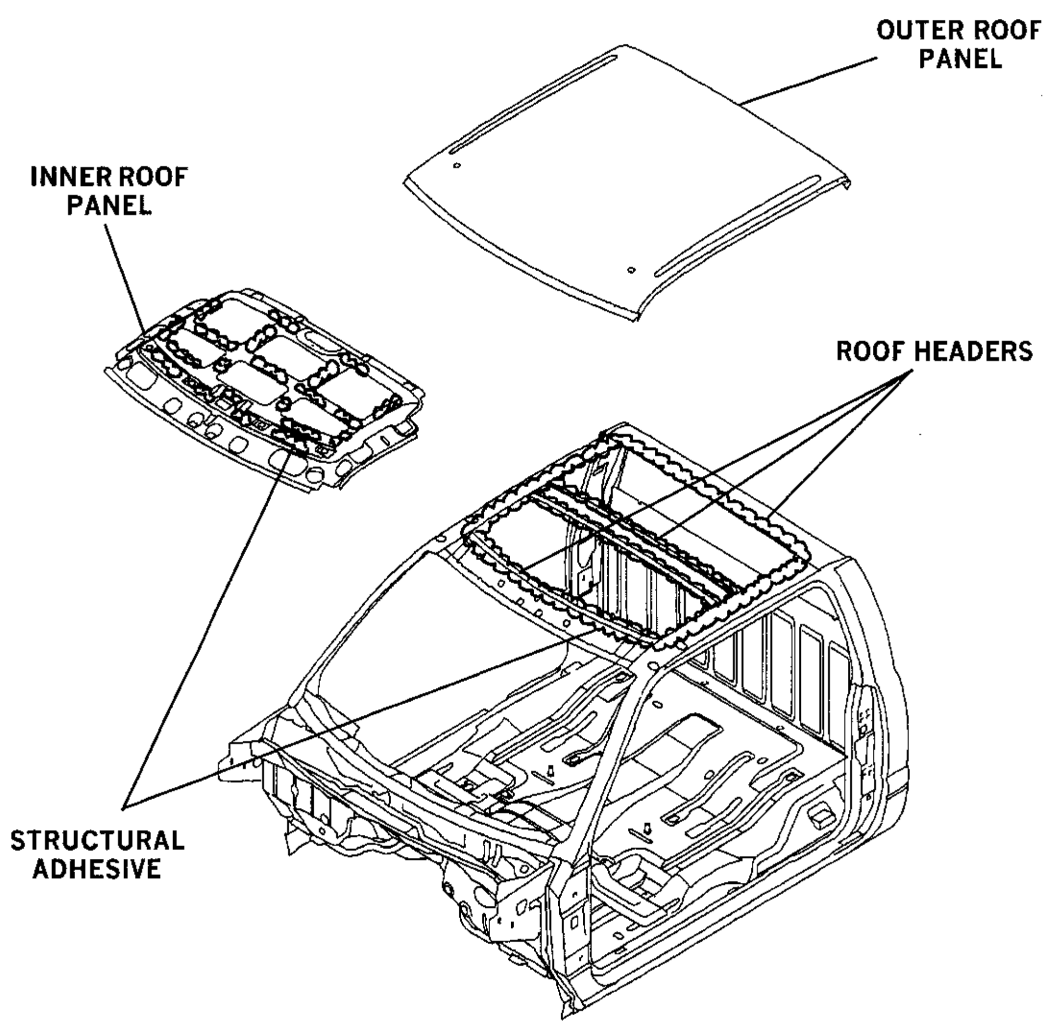
Dodge Ram Pickup

Structural adhesive is used to bond panels for cosmetic or assembly reasons. There are many other benefits to using structural adhesives.

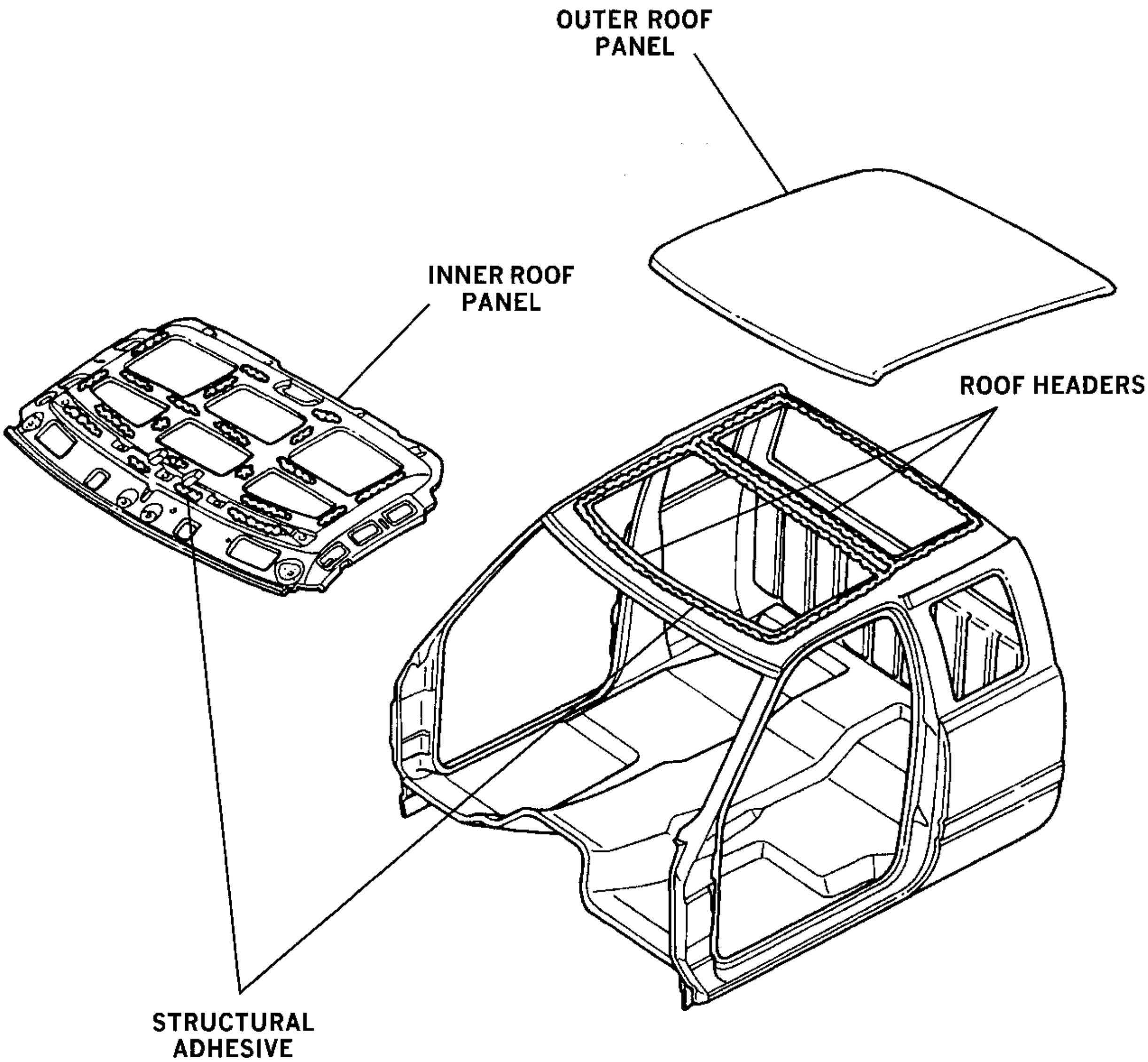
For example:

- Minimal or no welding required
- Added strength
- Reduced panel distortion

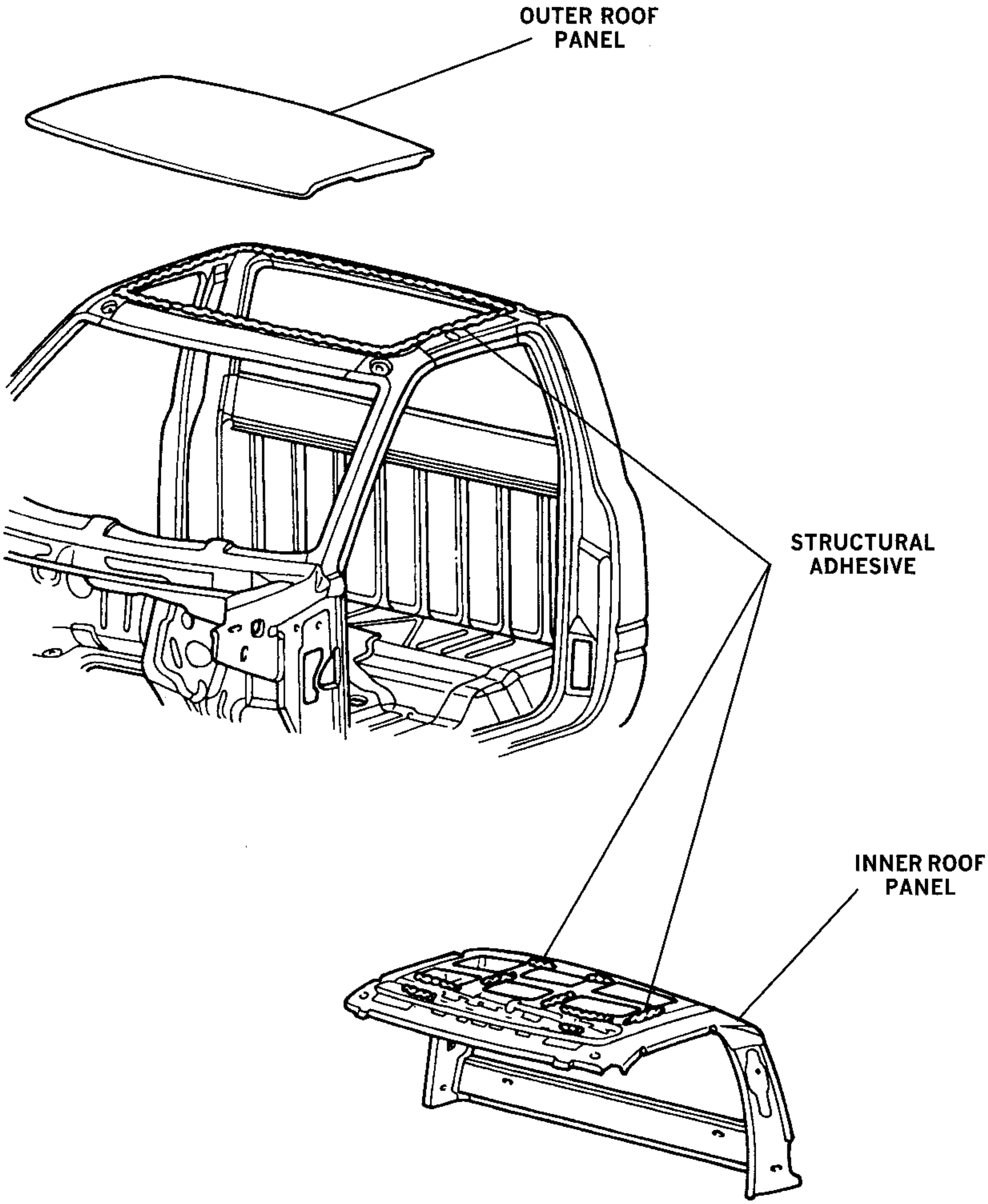
INNER AND OUTER ROOF PANELS (QUAD CAB)



INNER AND OUTER ROOF PANELS (CLUB CAB)



INNER AND OUTER ROOF PANELS (REGULAR CAB)



Notes

AUTHENTIC RESTORATION PRODUCT

BODY SEALING LOCATIONS

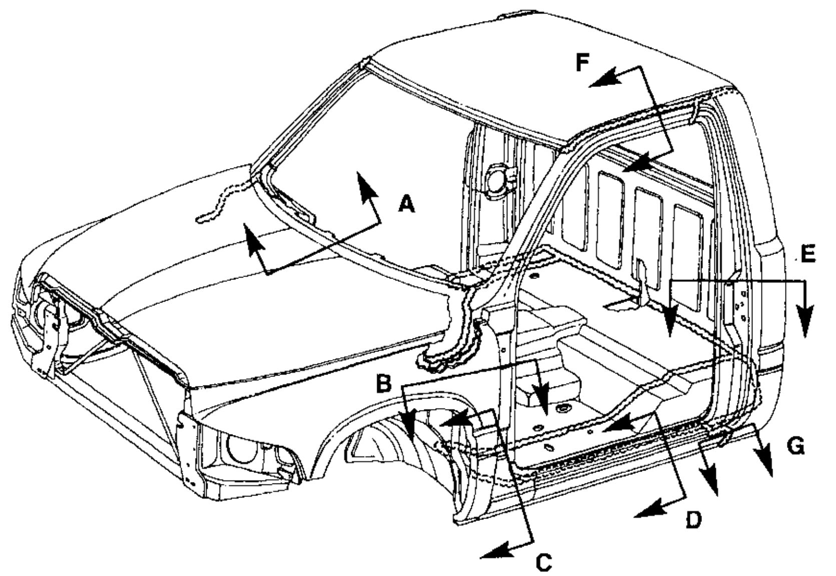
Dodge Ram Pickup

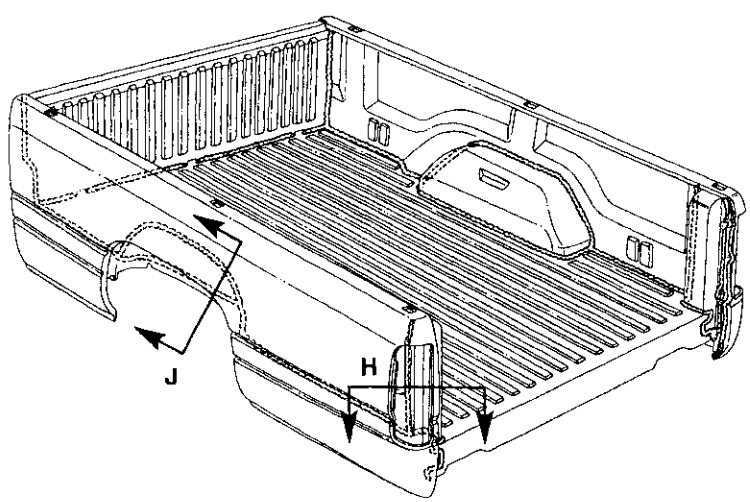
All repairs where panels are replaced may have voids that must be filled with sealant. Sealant also should be applied to sealer skips, pin holes and weld burn-through holes on the interior and exterior of the vehicle that would permit leakage of water, air or exhaust fumes.

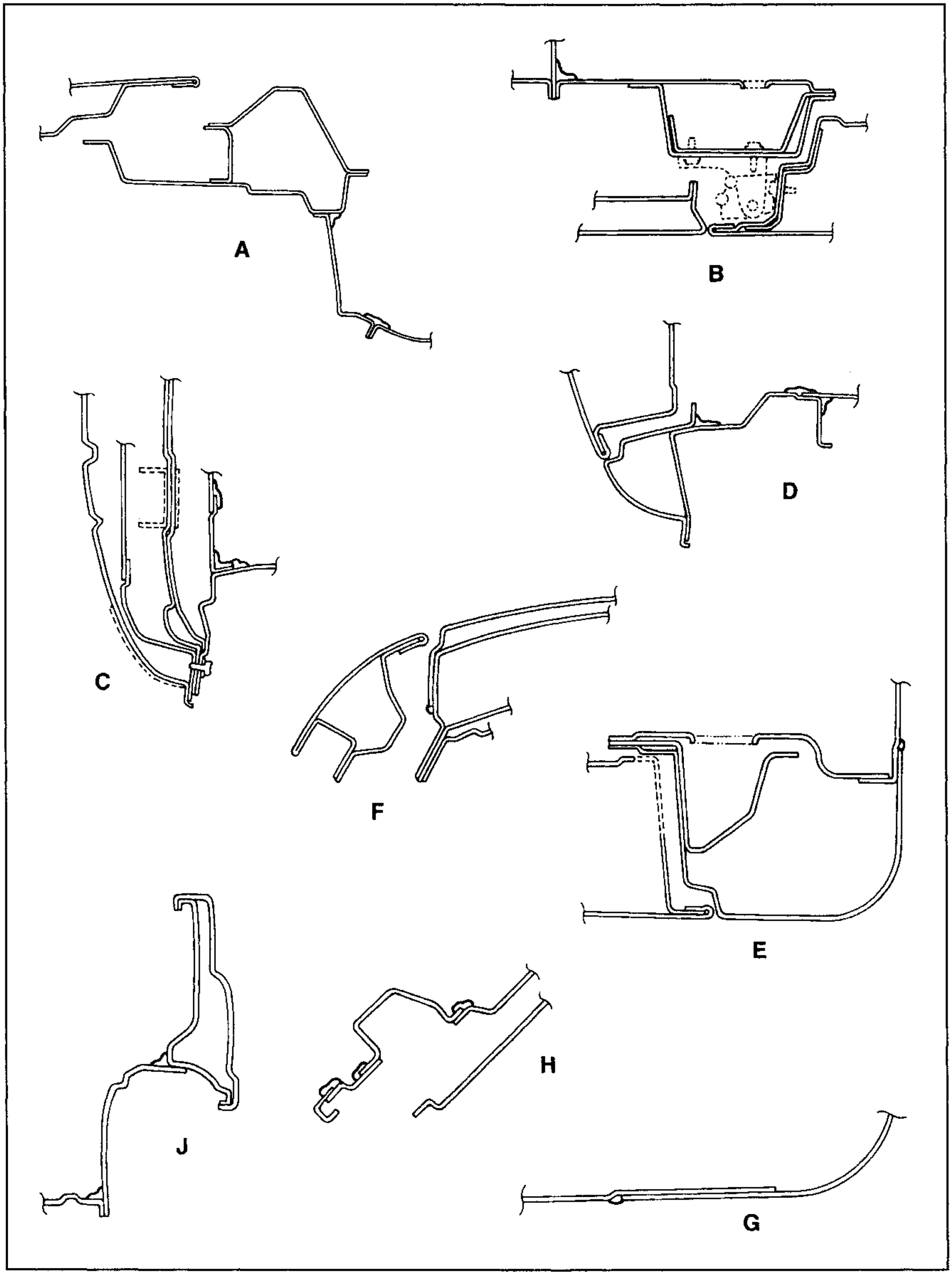
Typical areas of the exterior that must be sealed are listed on this page. Typical areas of the interior that must be sealed are floor pans, wheelhouses, dash panel and cowl sides. Unless noted, all illustrations show the regular cab; sealing locations are similar for the club and quad cab.

AREAS AFFECTED

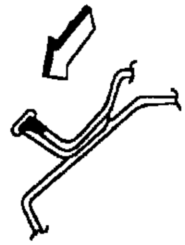
A - COWL AND PLENUM
B - HINGE PILLAR TOP VIEW
C - HINGE PILLAR END VIEW
D - FLOOR AND SIDE SILL
E - B-PILLAR
F - ROOF SIDE RAIL
G - SIDE SILL TO QUARTER PANEL
H - BOX REAR CORNER
J - BOX WHEEL WELL



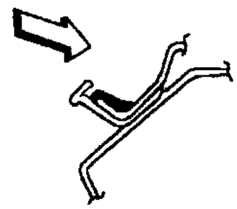



A
B
C
D
F
E
J
H
G

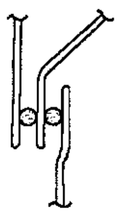
METHODS OF APPLYING AUTO BODY SEALANT



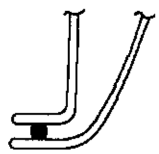
Hold gun nozzle in direction of arrow in order to effectively seal metal joints.



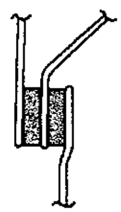
Do not hold gun nozzle in direction of arrow. Sealer applied as shown is ineffective.



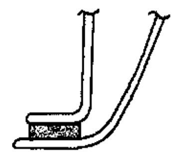
3 metal thickness



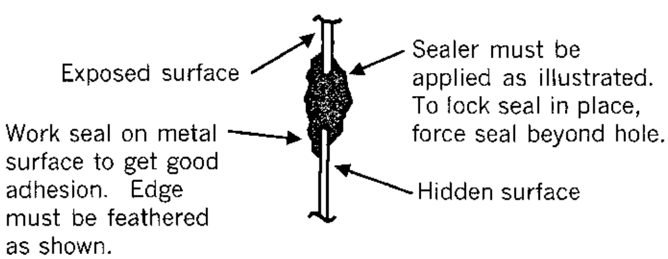
2 metal thickness

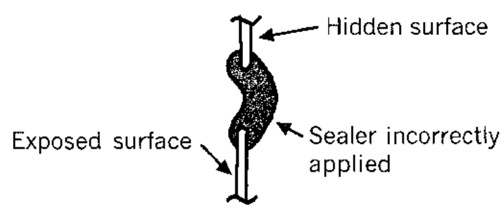


3 metal thickness



2 metal thickness

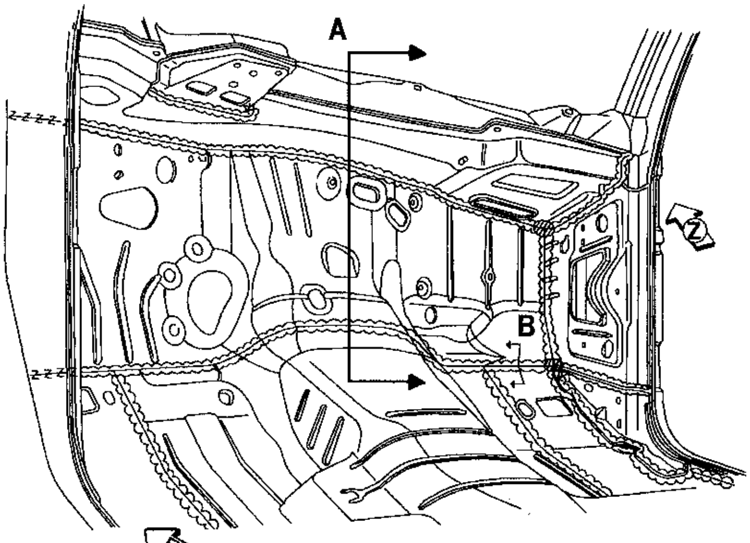


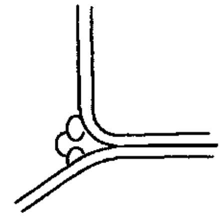


SYMBOLS

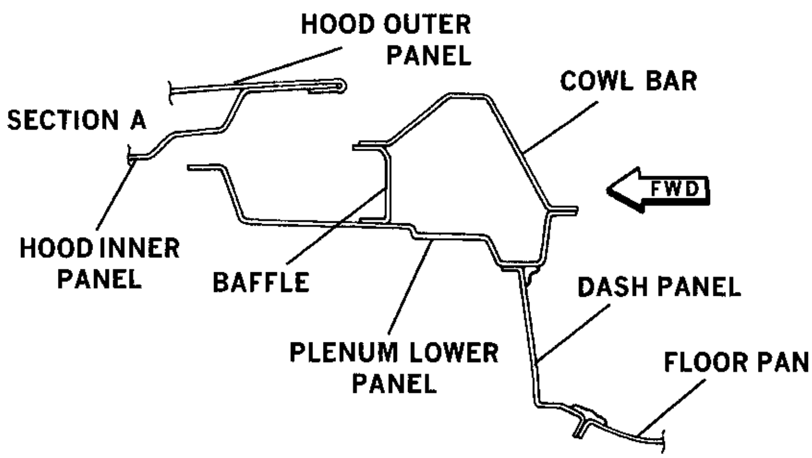
- Thumbgradeable sealer
- Extrudable thermoplastic
- Exposed thermoplastic sealant
- zzzzzzzz Hidden sealant

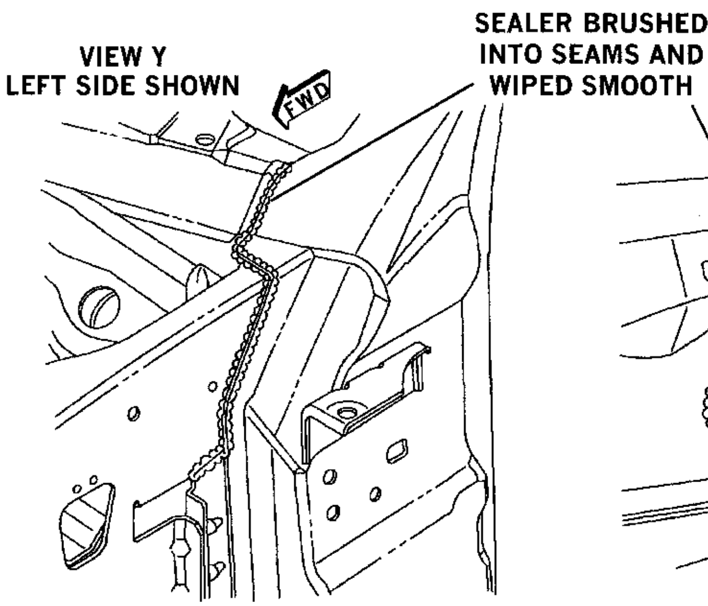
COWL AND DASH PANEL

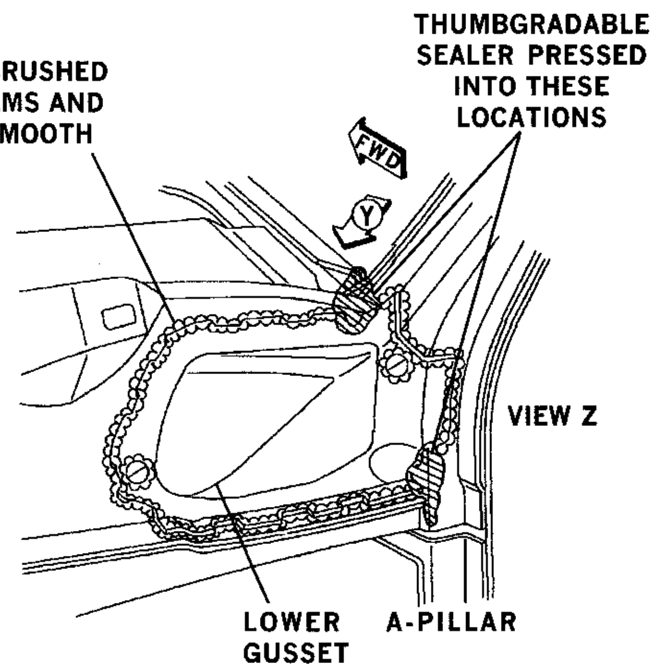




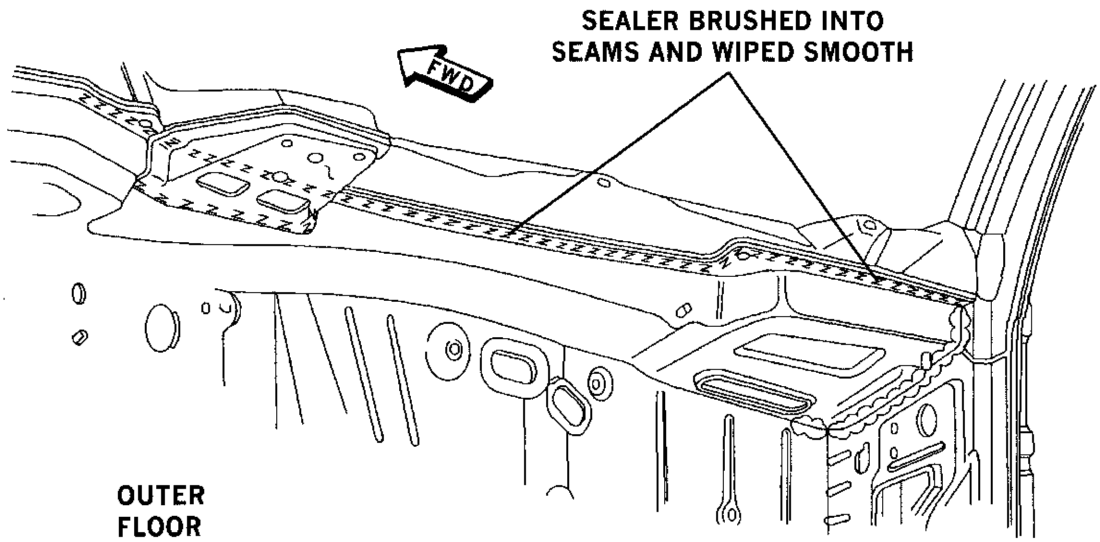
SECTION B

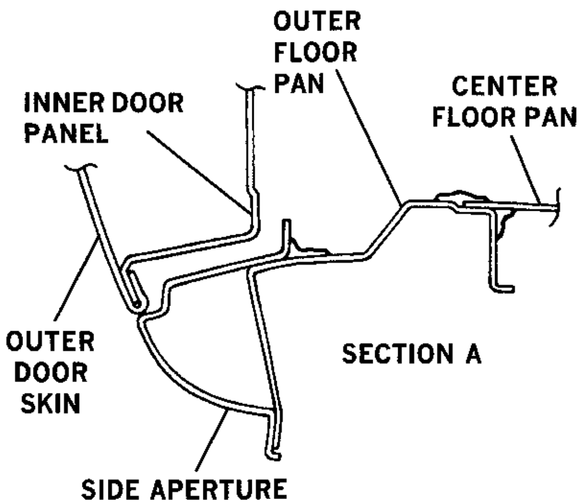




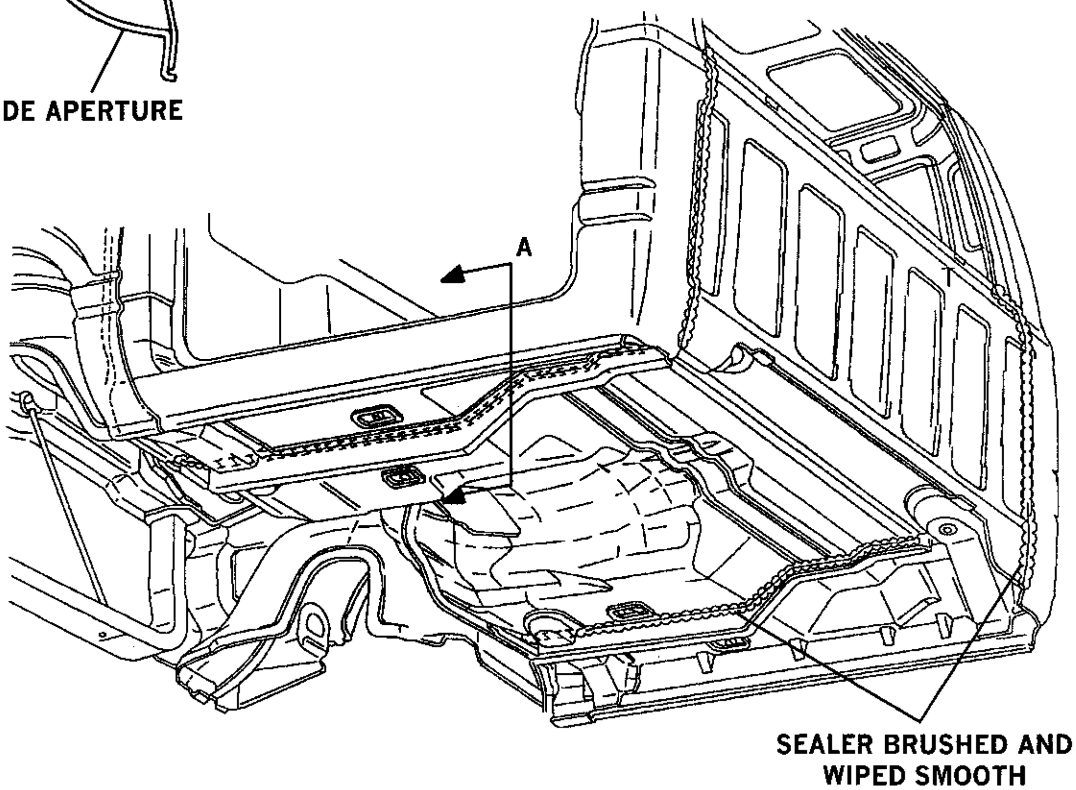


COWL AND DASH PANEL



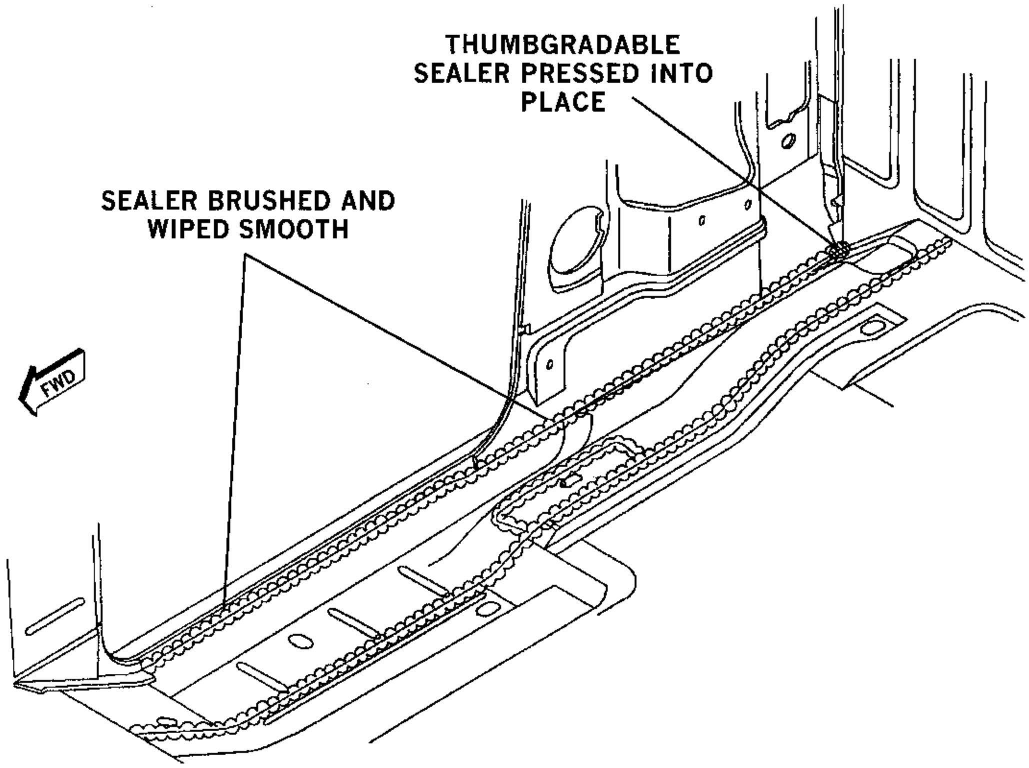


SECTION A

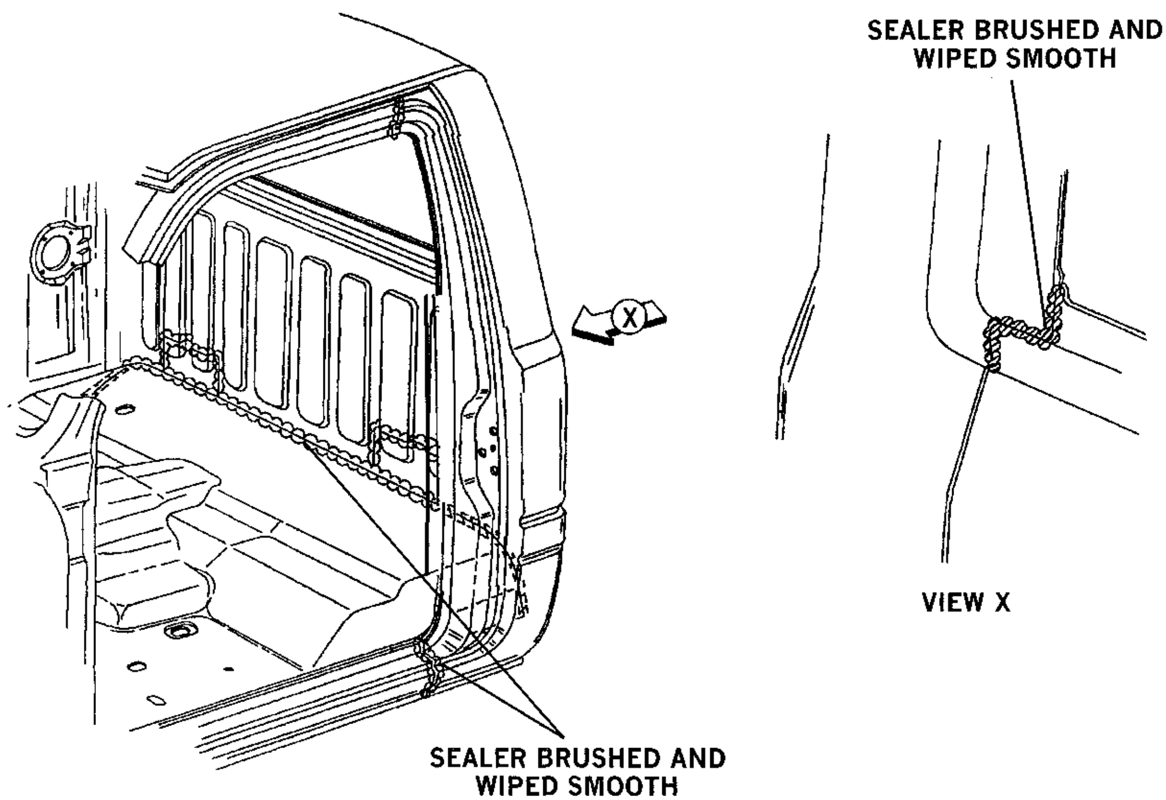


NOTE: SEALER ON UNDERSIDE OF FLOOR PAN IS USED ONLY ON VEHICLES BUILT IN MEXICO.

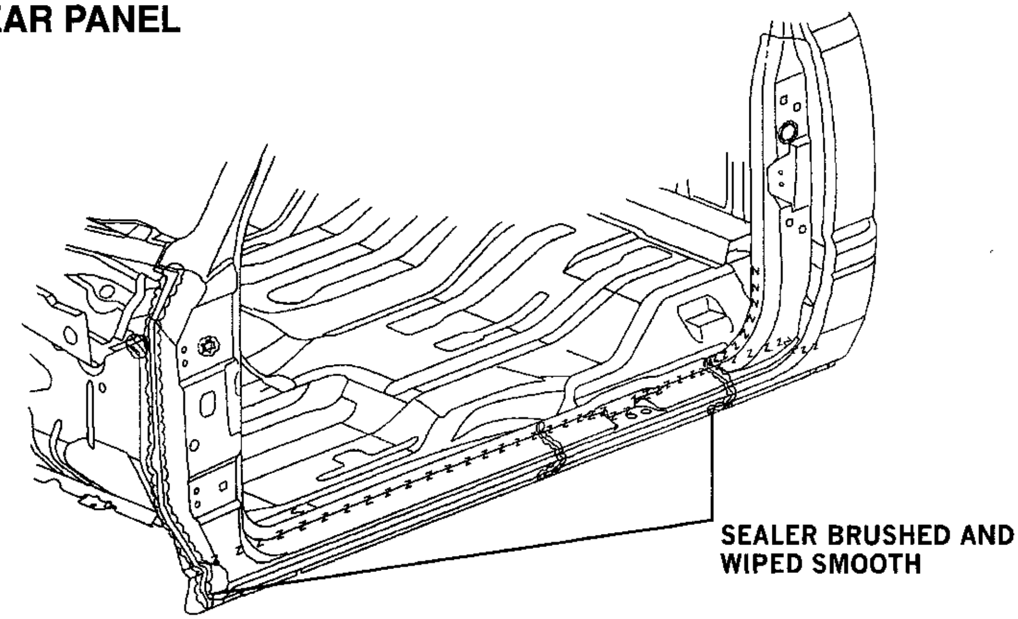
FLOOR PAN



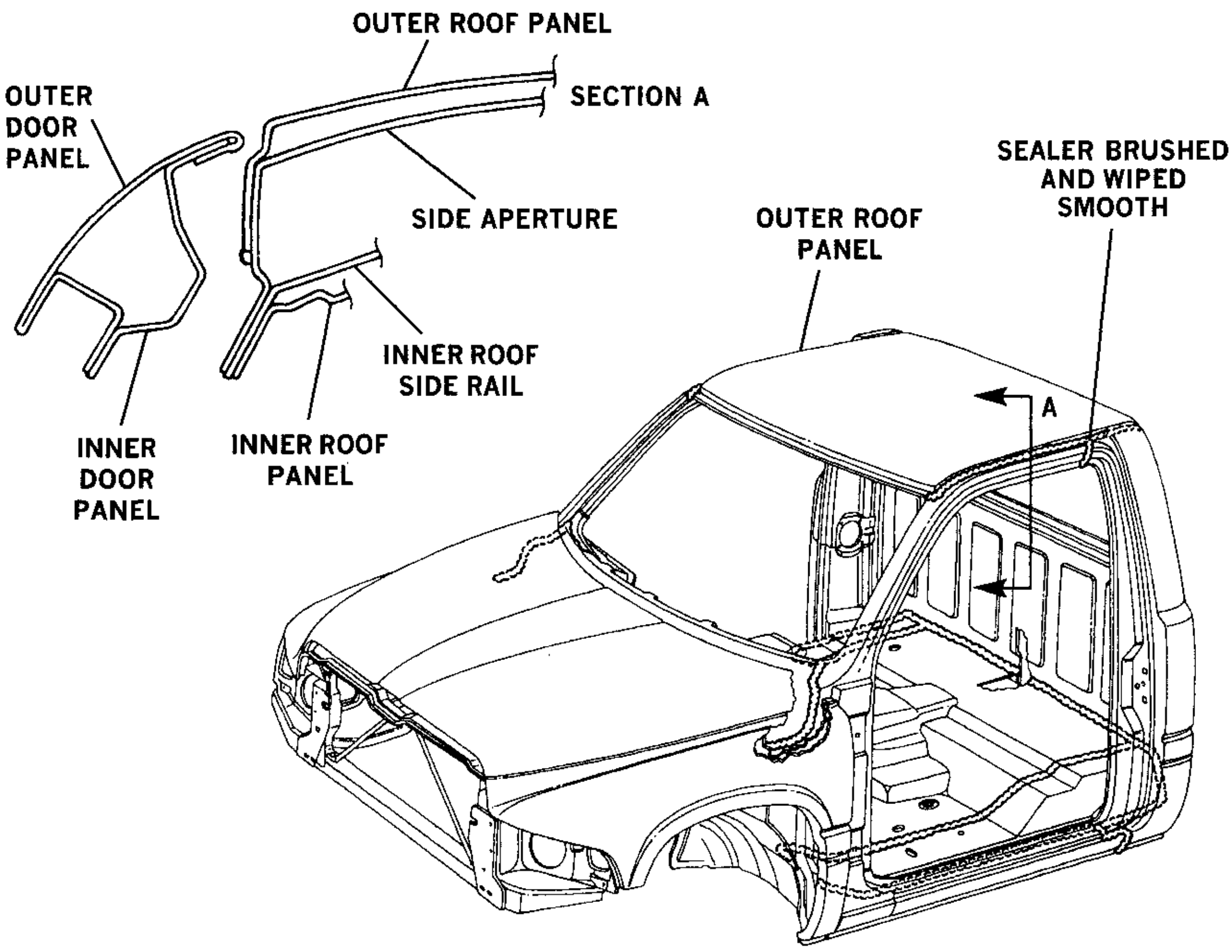
CAB BACK PANEL



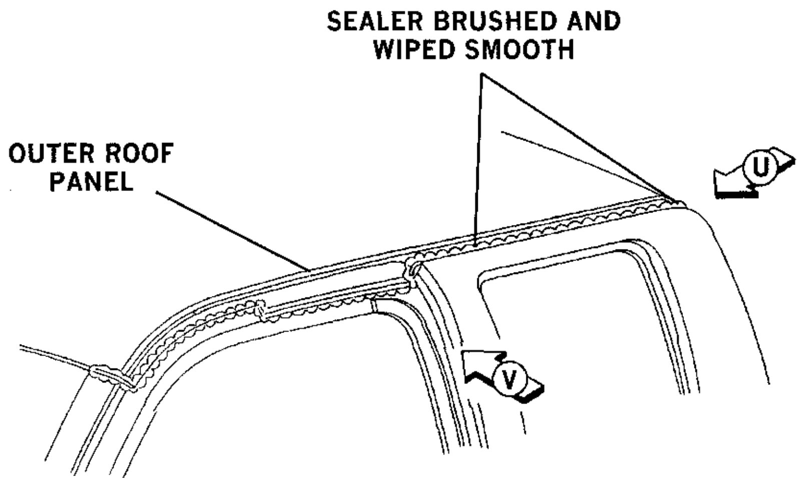
CAB REAR PANEL



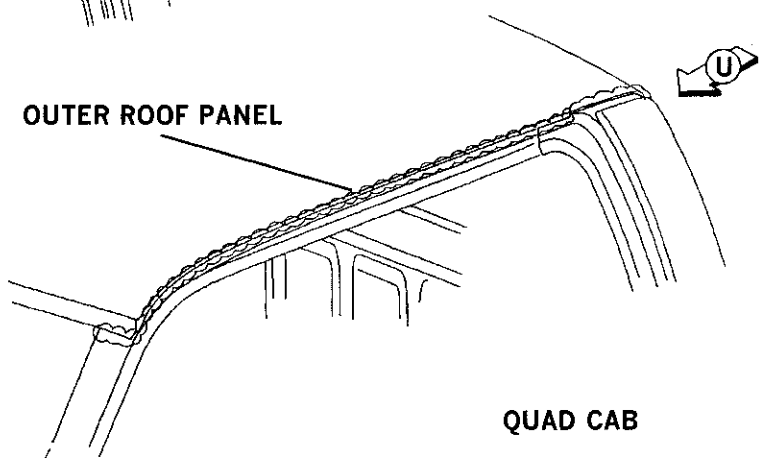
ROOF PANEL



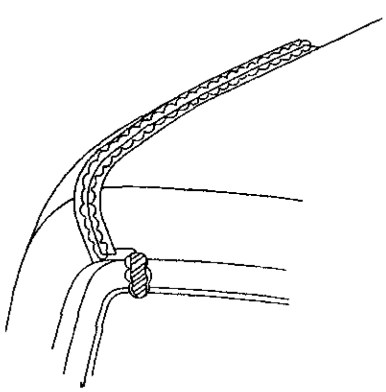
ROOF PANEL



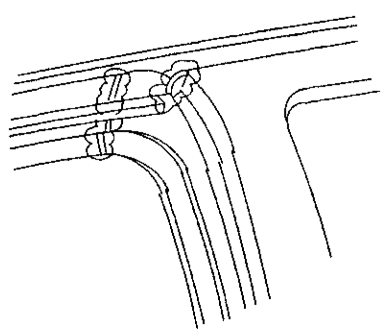
CLUB CAB



QUAD CAB



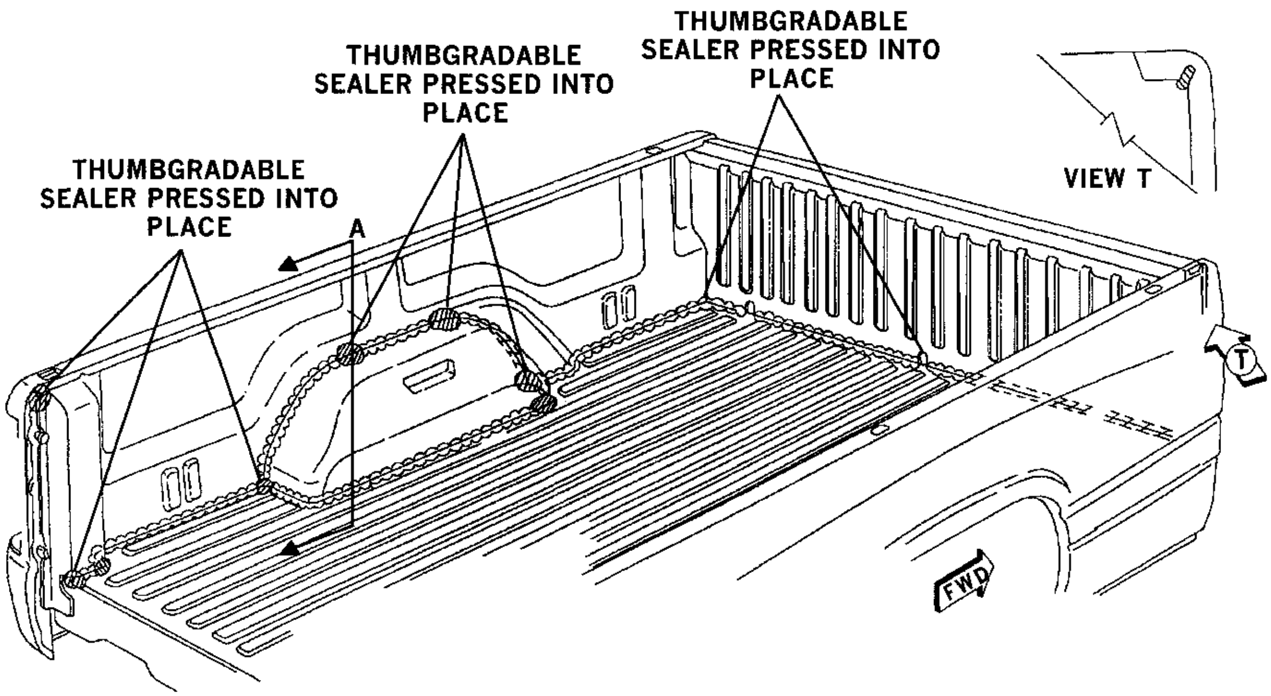
VIEW U

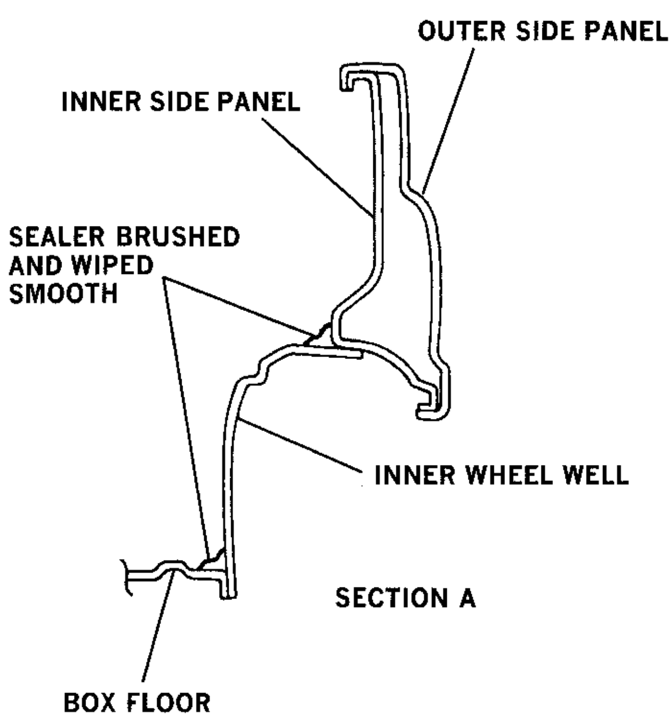


VIEW V

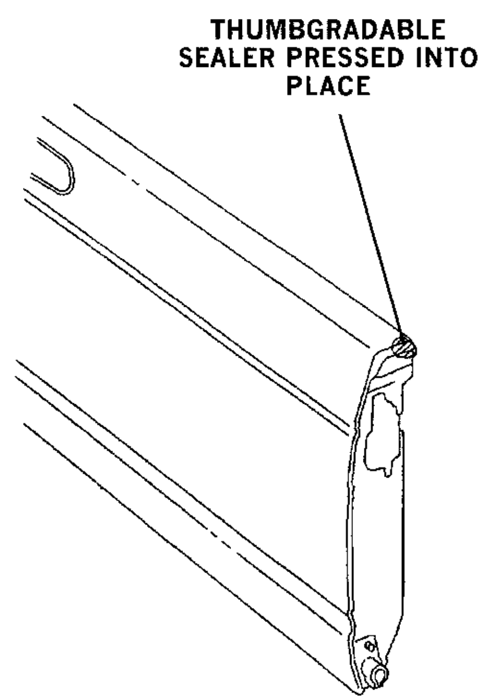
Mopar AUTHENTIC RESTORATION PRODUCT

CARGO BOX

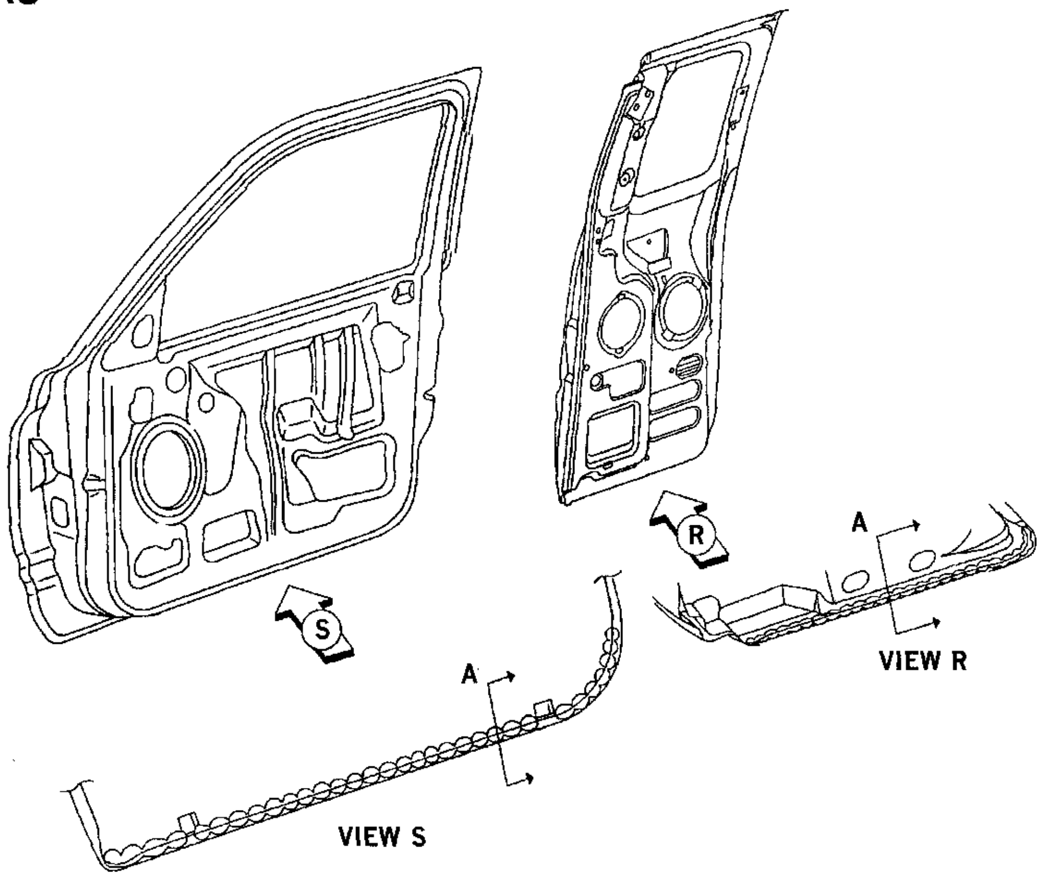


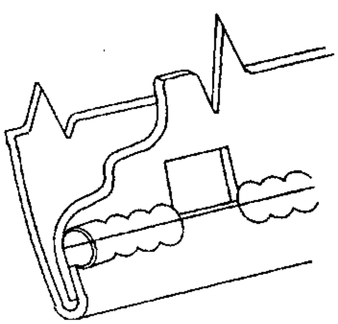


SECTION A

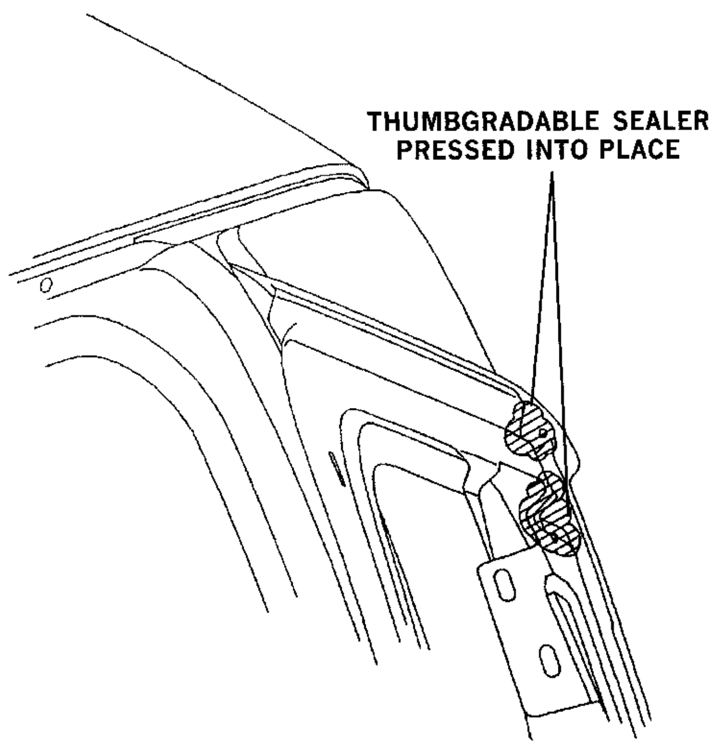


DOORS





SECTION A

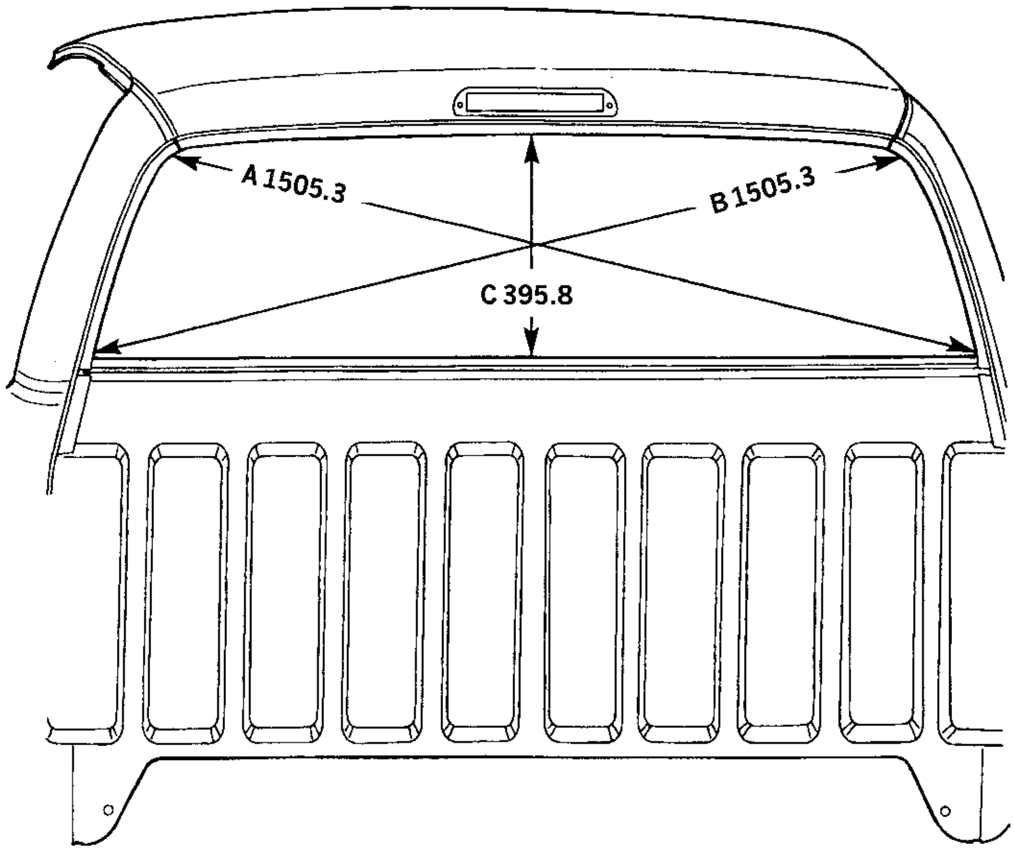


mopar AUTHENTIC RESTORATION™ PRODUCT

BODY DIMENSIONS & SPECIFICATIONS

Dodge Ram Pickup

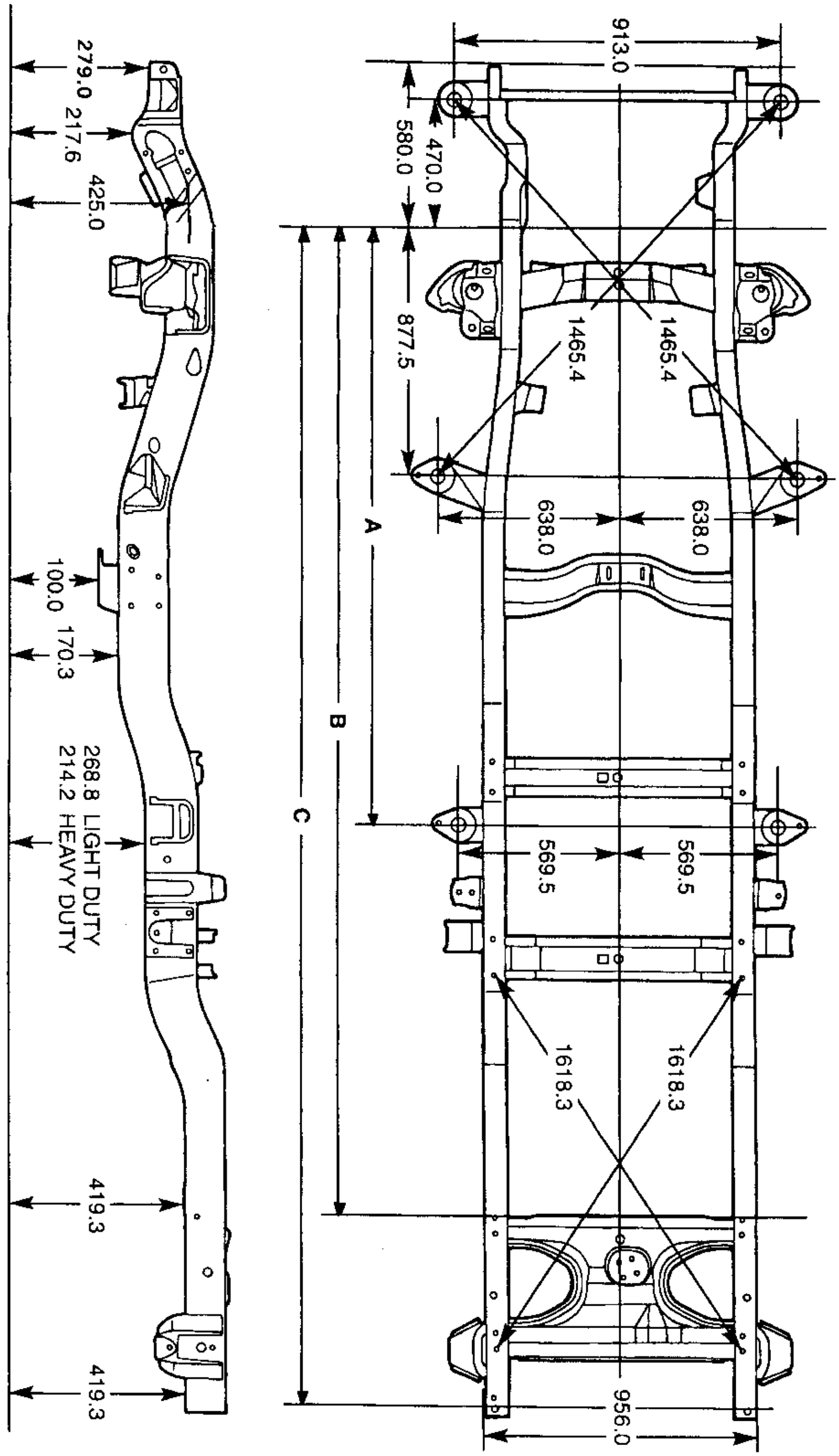
REAR VIEW



A & B. Center of radius at top corner to center of radius at lower corner of glass mounting flange.

C. Lower edge of upper back glass mounting flange to upper edge of lower back glass mounting flange measurement taken at centerline of rear glass opening.

Note: All measurements are in mm. Dimensions referred from PLP holes are from centerline of hole.

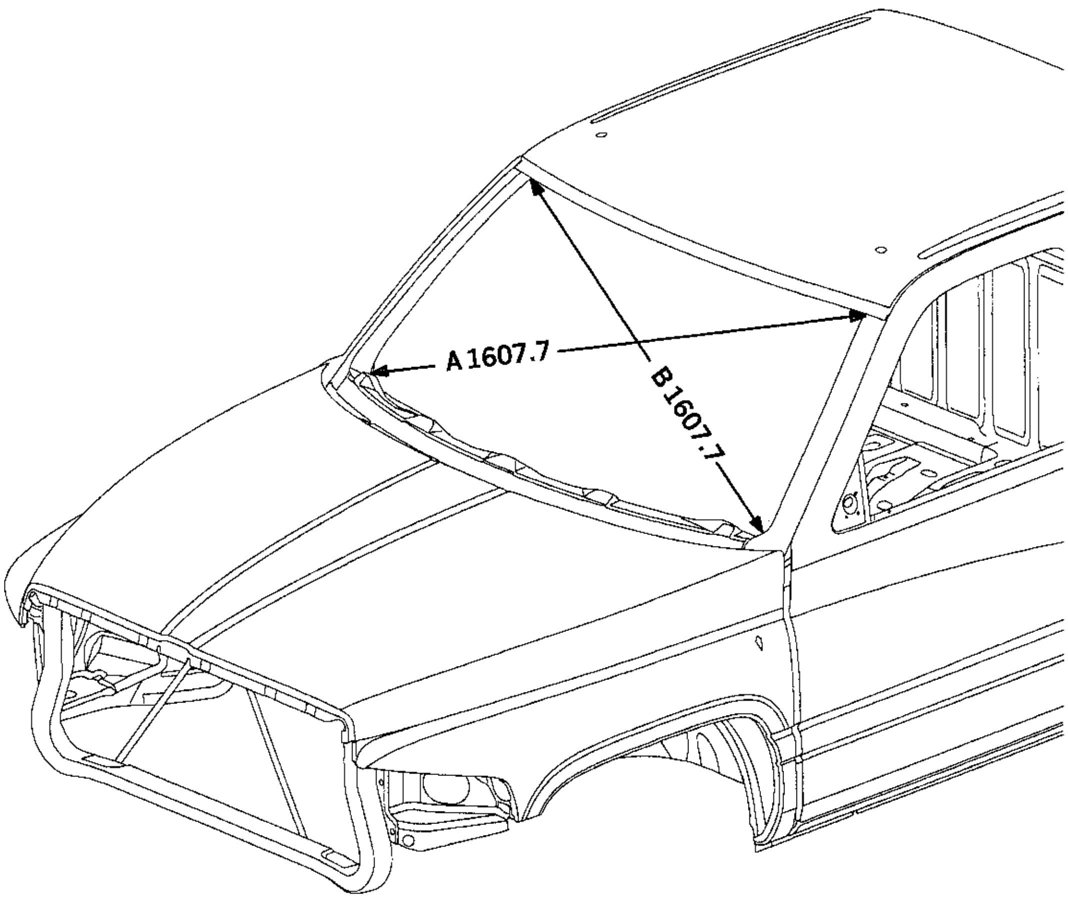


Note: All measurements are in mm. Dimensions referred from PLP holes are from centerline of hole.

LENGTH DIMENSIONS FOR DIFFERING WHEELBASES

WHEELBASE	LENGTH A	LENGTH B	LENGTH C
118	2118.0	3663.6	4185.4
134	2118.0	3994.5	4693.4
138	2626.0	4096.1	4693.4
154	2626.0	4502.5	5201.4
162	2118.0	4705.0	5042.5

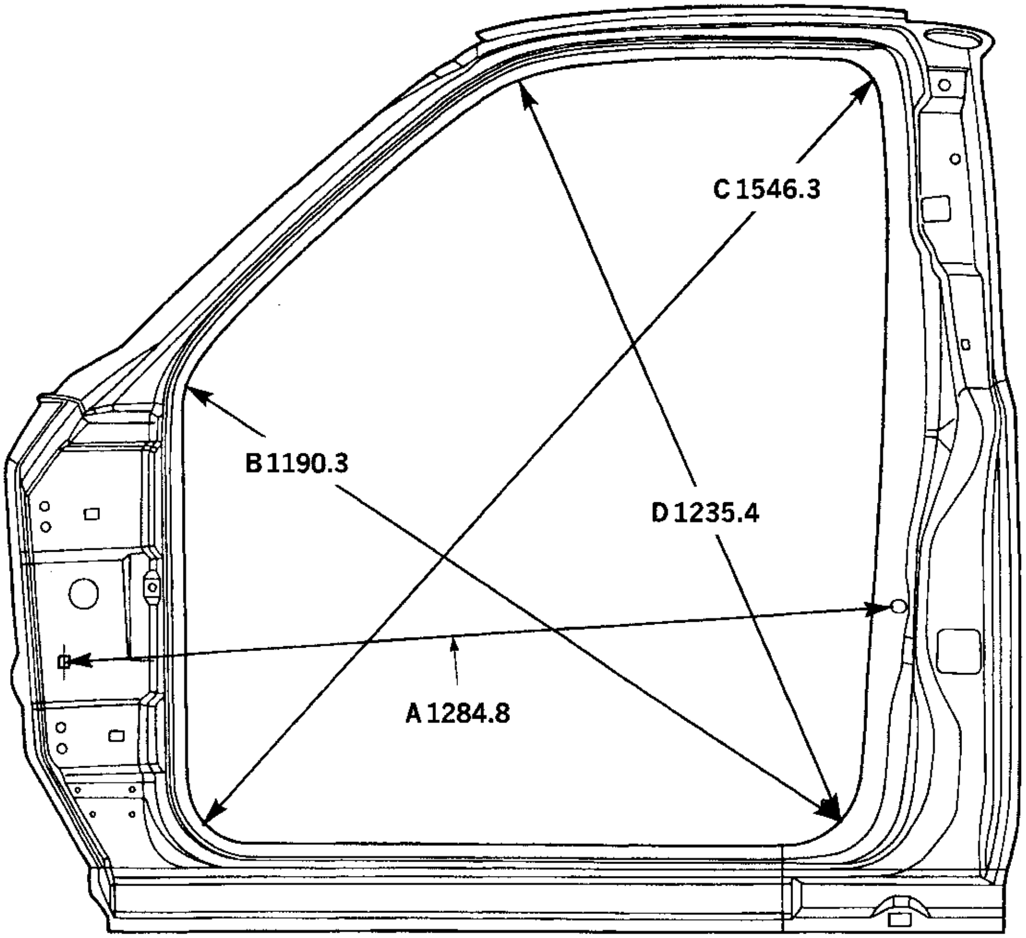
WINDSHIELD



A & B. Upper corner of windshield opening to top of radius at lower corner of opening.

Note: All measurements are in mm. Dimensions referred from PLP holes are from centerline of hole.

REGULAR CAB



A. Centerline of A-Pillar gaging hole to centerline of seat belt retractor hole at B-Pillar.

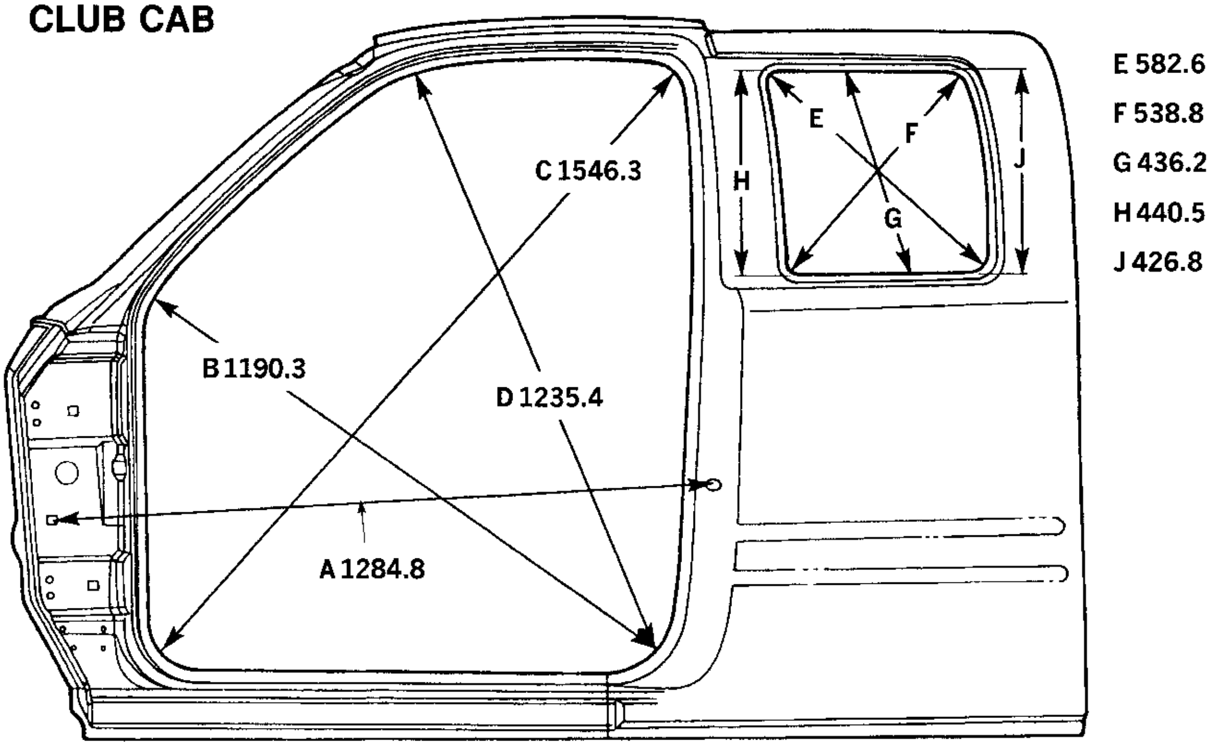
B. Center of radius at rear lower door opening flange inner edge to center of radius at cowl flange edge.

C. Center of radius at front lower door opening flange inner edge to center of radius at upper opening rear flange inner edge.

D. Center of radius at rear lower door opening flange inner edge to center of radius at upper front flange inner edge.

Note: All measurements are in mm. Dimensions referred from PLP holes are from centerline of hole.

CLUB CAB



A. Centerline of A-Pillar gaging hole to centerline of seat belt retractor hole at B-Pillar.

B. Center of radius at rear lower door opening flange inner edge to center of radius at cowl flange edge.

C. Center of radius at front lower door opening flange inner edge to center of radius at upper opening rear flange inner edge.

D. Center of radius at rear lower door opening flange inner edge to center of radius at upper front flange inner edge.

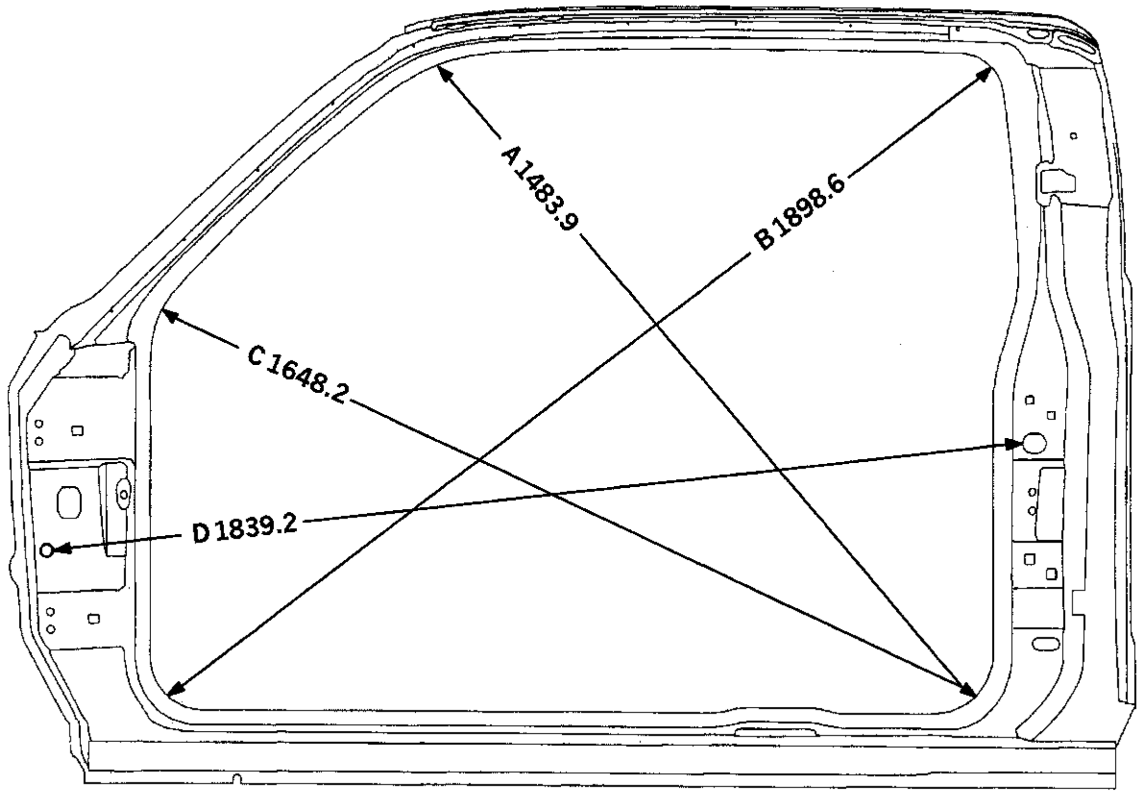
E. Lower rear corner inner flange edge to upper front corner inner flange edge of quarter glass opening.

F. Lower front corner inner flange edge to upper rear corner inner flange edge of quarter glass opening.

G. Upper inner flange lower edge to lower flange upper edge of quarter glass opening.

Note: All measurements are in mm. Dimensions referred from PLP holes are from centerline of hole.

QUAD CAB



A. Centerline of A-Pillar gaging hole to centerline of seat belt retractor hole at B-Pillar.

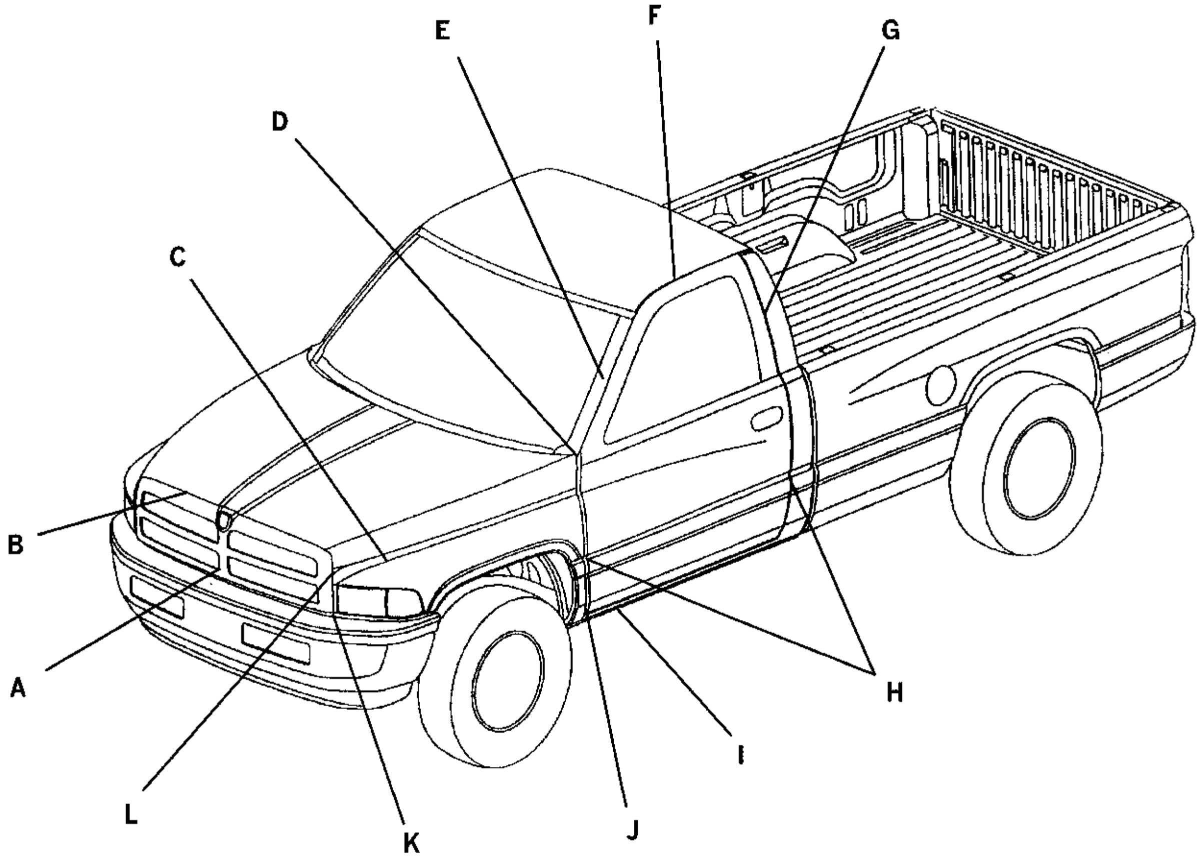
B. Center of radius at rear lower door opening flange inner edge to center of radius at cowl flange edge.

C. Center of radius at front lower door opening flange inner edge to center of radius at upper opening rear flange inner edge.

D. Center of radius at rear lower door opening flange inner edge to center of radius at upper front flange inner edge.

Note: All measurements are in mm. Dimensions referred from PLP holes are from centerline of hole.

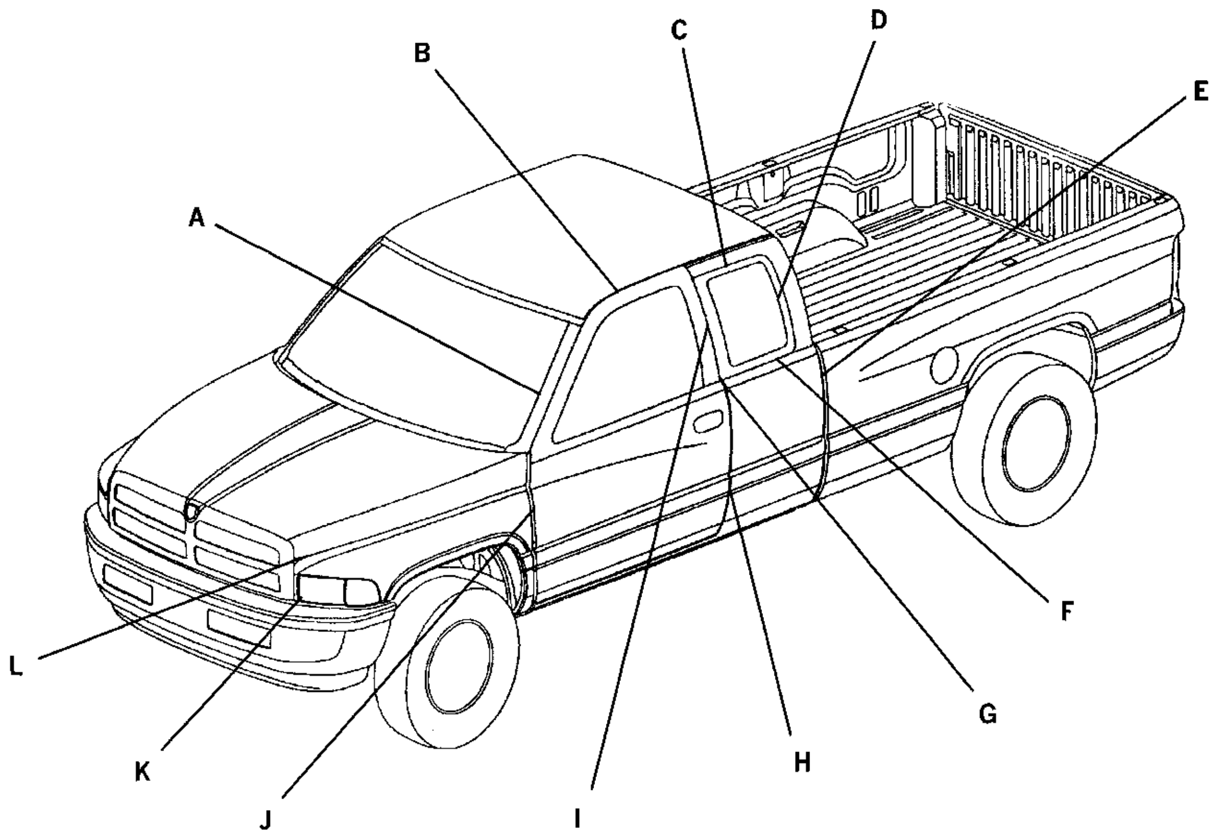
BODY GAP AND FLUSH (REGULAR CAB)



	DESCRIPTION	GAP	FLUSH
A	Grille to Fascia	19.0+/-3.0	N/A
B	Hood to Grille	1.5+/-0.75	0.0+0.0/-1.0
C	Hood to Fender	6.0+/-1.0	3.5+/-1.0
D	Door to Hood / Fender	5.0+/-1.0	0.0+/-1.0
E	Door to Windshield Molding	N/A	2.0+/-2.0
F	Door to Roof	6.0+/-1.5	2.0+/-1.0
G	Door to Quarter	5.0+/-1.0	0.0+/-1.0
H	Fender / Door / Quarter Char Line U/D	N/A	0.0+/-1.0
I	Door to Sill	7.7+/-2.0	0.0+/-1.5
J	Fender to Aperture	5.0+/-1.0	0.0+/-1.0
K	Grille to Headlamp	6.0+/-3.0	N/A
L	Grille to Fender	5.0+/-0.75	1.0+/-0.5

Note: All measurements are in mm.

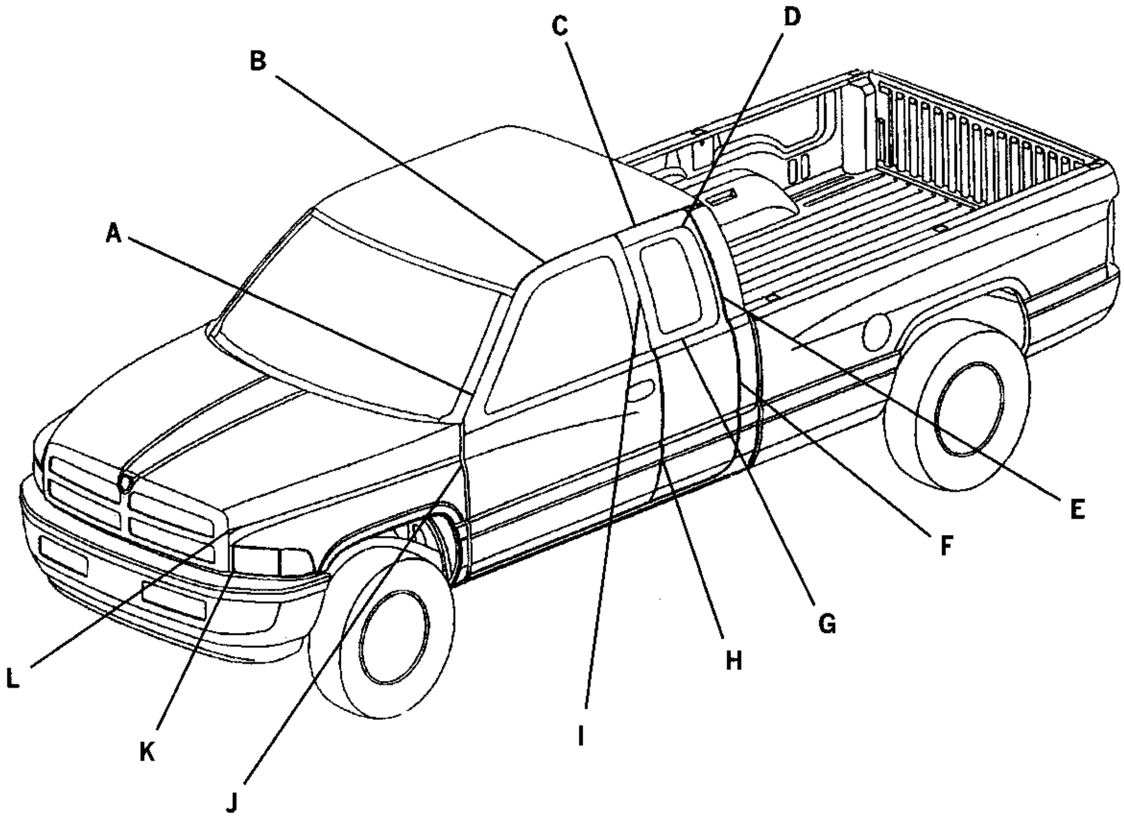
BODY GAP AND FLUSH (CLUB CAB)



	DESCRIPTION	GAP	FLUSH
A	Door to Windshield Molding	N/A	2.0+/-2.0
B	Door to Roof	6.0+/-1.5	2.0+/-1.0
C	Quarter Glass to Quarter (top)	5.0+/-1.0	3.25+/-1.5
D	Quarter Glass to Quarter (rear)	5.0+/-2.0	3.25+/-1.5
E	Cab to Box (side view)	31.0+/-3.0	3.5+/-2.5
F	Quarter Glass to Quarter (bottom)	5.0+/-1.5	N/A
G	Quarter Glass to Quarter (front)	in-line within +/-1.0	
H	Door to Quarter	5.0+/-1.0	0.0+/-1.0
I	Quarter Glass to Door	N/A	2.0+/-1.5
J	Door to Hood / Fender	5.0+/-1.0	0.0+/-1.0
K	Grille to Headlamp	6.0+/-3.0	N/A
L	Grille to Fender	5.0+/-0.75	1.0+/-0.5

Note: All measurements are in mm.

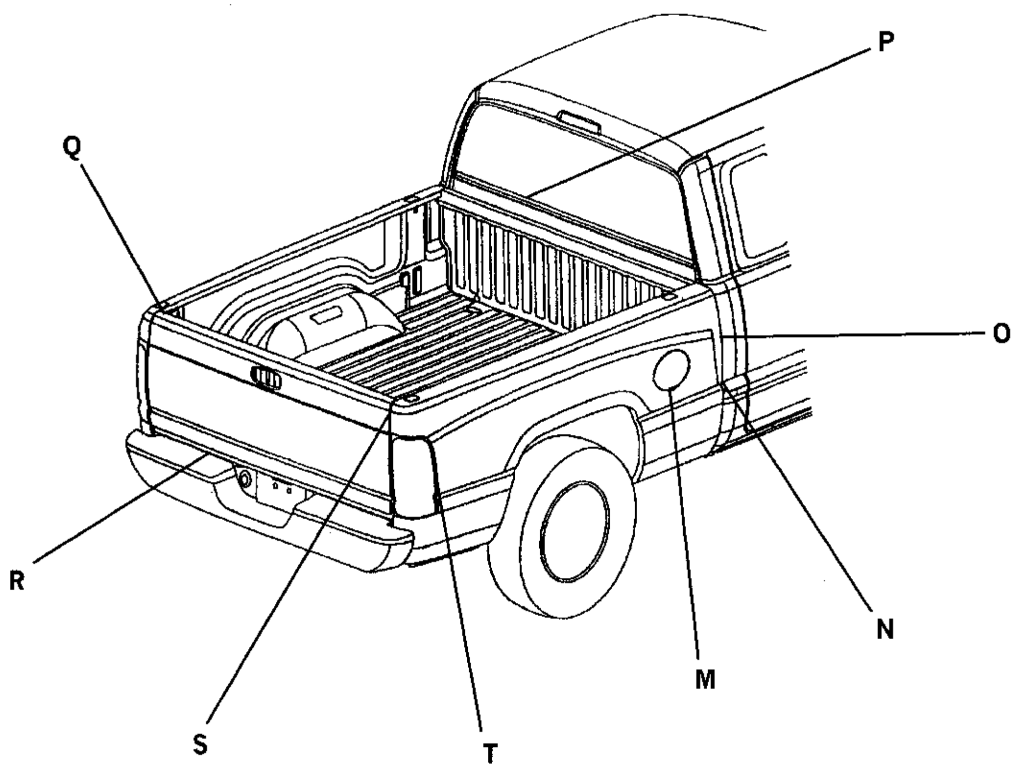
BODY GAP AND FLUSH (QUAD CAB)



	DESCRIPTION	GAP	FLUSH
A	Door to Windshield Molding	N/A	2.0+/-2.0
B	Front Door to Roof	5.0+/-1.5	0.0+/-1.0
C	Rear Door to Roof	5.0+/-1.0	0.0+/-1.0
D	Rear Door Glass to Rear Door (top)	5.0+/-1.0	3.25+/-1.5
E	Rear Door Glass to Rear Door (rear)	5.0+/-2.0	3.25+/-1.5
F	Rear Door to Quarter	5.5+/-1.0	0.0+/-1.0
G	Rear Door Glass to Rear Door (bottom)	5.0+/-1.5	N/A
H	Front Door to Rear Door	5.0+/-1.0	0.0+/-1.0
I	Rear Door Glass to Rear Door (front)	in-line within +/-1.0	
	Rear Door Glass to Front Door	N/A	3.25+/-1.5
J	Door to Hood / Fender	5.0+/-1.0	0.0+/-1.0
K	Grille to Headlamp	6.0+/-3.0	N/A
L	Grille to Fender	5.0+/-0.75	1.0+/-0.5

Note: All measurements are in mm.

BODY GAP AND FLUSH (CARGO BOX)



	DESCRIPTION	GAP	FLUSH
M	Fuel Filler Door to Box	3.0+/-0.75	0.0+/-3.0
N	Cab to Box Character Line U/D	N/A	0.0+/-3.0
O	Cargo to Box (side)	31.0+/-3.0	5.0+/-2.5
P	Cab to Box at Centerline	34.0+/-3.0	N/A
Q	Box to Tailgate U/D	N/A	1.0+/-1.5
R	Tailgate to Bumper	43.0+/-3.0	N/A
S	Box to Tailgate	6.0+/-1.5	1.0+/-1.5
T	Box to Tailgate	1.0+/-1.0	4.0+/-1.5

Note: All measurements are in mm.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
A														
B														
C														
D														
E														
F														
G														
H														
I														
J														
K														
L														
M														
N														
O														
P														
Q														
R														
S														
T														
U														
V														
W														

This is a very easy way to write up your measurement information. You can tell at a glance when a dimension changes, and you can do what is necessary to stay in specification before you proceed.

Here's how to use this sheet or a similar one since each vehicle manufacturer supplies critical measuring point information.

Each time a correction is made to restore the body to its proper dimension, all readings should be taken again, in addition to the dimension you have just corrected.

The A-B-C, etc., are the measuring point dimensions. The 1-2-3, etc., are the readings taken at measurement step 1 , measurement step 2, etc.

This sheet tells you at a glance how you stand in restoring the body to its proper state.

When using the tram and centering gauge system, *always* compile a list of dimensions each time you measure. This provides the information for measurement comparison, especially during the pulling and straightening phase of body collision repair.

The manufacturer of the equipment supplies information, so be sure you constantly review this information and bulletins so you will be up to date on repair techniques.

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